MONACO EXPLORATIONS

Reconnecting Humanity and the Sea

INDIAN OCEAN EXPEDITION 2022

PRELIMINARY REPORT
AUGUST 2023

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2021 2030 United Nations Decade of Ocean Science for Sustainable Development

IIOE-2 2nd International Indian Ocean Expedition 2015-2025

Gouvernement Princier
PRINCIPAUTÉ DE MONACO

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Institut océanographique
Fondation Albert Ier, Prince de Monaco

FONDATION PRINCE ALBERT II DE MONACO

Yacht Club de Monaco

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1. INTRODUCTION

1.1. OBJECTIVE AND SCOPE OF THE REPORT

This report aims at compiling all the preliminary elements about the 2022 Indian Ocean Expedition organized by Monaco Explorations. It provides a summary of the cruise, a summary of the evaluation survey conducted after the expedition, the preliminary results from all the research projects that were implemented during the expedition, a detailed description of all outreach, capacity building, and communication activities that took place both during the expedition and in the following six months, a description of the governance and policy-related actions, and some reflections on next steps and perspectives.

The period covered by the report ends on 31 May 2023. Subsequent activities will be reported in the final report in early 2026.

1.2. OBJECTIVES OF THE EXPEDITION

Monaco Explorations "Indian Ocean Expedition" is the first element of the "Monaco Explorations" project endorsed by the United Nations Decade of Ocean Sciences for Sustainable Development 2021-2030. The expedition itself was endorsed by the 2nd International Indian Ocean Expedition. It took place between Reunion, Mauritius, and Seychelles onboard the South African oceanographic research and supply ship *S.A. Agulhas II*. It involved more than 150 participants, from about 20 different nationalities, including scientists, young researchers and students at the onboard school, filmmakers and photographers, divers, artists, communicators, and the vessel crew.

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The expedition involved a journey of approximately 10,000 nautical miles (18,500 km) from Cape Town and back and four stopovers in Mauritius, Reunion, Mahé (Seychelles), and back to Mauritius. The two months of navigation were dedicated to various research and field operations. The activities took place underway during the transits, around the Aldabra Atoll (Seychelles), on the Saya de Malha Bank, to which 15 days of investigations were devoted, and finally around the island of Saint Brandon (Mauritius).

Guided by an Advisory Committee of fourteen international experts (see list in **Annex A**), the expedition implemented a holistic approach based on a multidisciplinary programme including natural and social sciences.

The scientific programme carried out by international teams was guided by the four main themes of Monaco Explorations: coral protection, megafauna protection, marine protected areas and new exploration techniques.

The expedition's purpose was also to promote the contents, knowledge and resources resulting from the operations by encouraging the exchange and transmission of knowledge to as wide an audience as possible through a varied outreach programme. Its various components were aimed at a broad public: schools, civil society, and decision-makers. The expedition is expected to result in the production of a documentary film for international distribution and other educational and artistic content.

In terms of diplomacy, the expedition was coordinated with an official visit to the region by HSH Prince Albert II of Monaco from 24 to 26 October 2022.

1.3. BACKGROUND

Over the last one hundred and fifty years, Prince Albert Ist (1848-1922) and then Prince Rainier III (1923-2005) have forged a strong link between the Principality of Monaco and the marine environment through their commitment and strong actions in favour of the Ocean. Since His accession to the throne in 2005, HSH Prince Albert II of Monaco has not only strengthened this powerful link but has also increased Monaco's influence and action internationally.

This commitment resulted in the relaunch of the Principality's exploration expeditions, with the creation of Monaco Explorations in 2017. Since then, this collaborative platform serving the commitment of HSH Prince Albert II of Monaco to the knowledge, sustainable management and protection of the Ocean has conducted numerous multidisciplinary expeditions throughout the world.

Following previous discussions with the French Research Institute for Sustainable Development (IRD), the French Institute for Exploitation of the Sea (Ifremer) and the Bertarelli Programme in Marine Sciences, the preparation of the Indian Ocean Expedition was initiated in 2019 through preliminary contacts with the representatives of the Government of Seychelles participating in the 2019 Monaco Ocean Week. A call for proposals was issued in January 2020 on the assumption that the expedition would be conducted on board a research vessel of the French oceanographic fleet operating from Reunion in the first semester of 2021. Following the outbreak of the Covid-19 pandemic, it was decided to postpone the expedition. Due to the lack of prospects for the availability of a French oceanographic research vessel in 2022-2023, alternative solutions were investigated. The possibility of chartering the South African oceanographic research and supply vessel *S.A. Agulhas II* in October and November 2022 was identified, and a letter of intent to charter the vessel was signed on 28 May 2021.

The programme of the expedition was developed in liaison with the authorities of Mauritius and Seychelles, based on the responses to the call for proposals and guided by an Advisory Committee of fourteen international experts, which was established in February 2021.

Authorization was granted by the governments of Mauritius and Seychelles and by the Joint Commission of the Extended Continental Shelf Mascarene Plateau Region to conduct marine scientific research in the maritime zones of Mauritius, Seychelles and in the Joint Management Area respectively.

The Indian Ocean Expedition was presented as the first element of the Decade Action submitted by Monaco Explorations in response to the first Call for Decade Actions of the UN Decade of Ocean Science for Sustainable Development launched on 15 October 2020. The Monaco Explorations programme was endorsed as a Decade Action in June 2021 (action No 202). The expedition itself was endorsed by the 2nd International Indian Ocean Expedition in October 2022 (EP49).

1.4. RESOURCES

The expedition was carried out through a time charter party onboard the supply and oceanographic research vessel *S.A. Agulhas II* owned by the Government of South Africa (Department of Forestry, Fisheries and the Environment DFFE) and operated by African Marine Solutions (Pty) Ltd (AMSOL).

The supply and oceanographic research vessel, S.A. Agulhas II *© Filip Kulisev - Amazing Planet / Monaco Explorations.*

In addition to her standard crew and equipment, the additional resources were mobilized with the vessel (see **Annex B**):

Through the time charter party:

- Two Hydro-Bias 25kg bottom samplers;
- Two C-Worker 880 SRP dive support boats;
- One ABS SL containerized A1500 dive chamber;
- One dive chamber supervisor and two coxswains, one of whom qualified as a dive chamber operator;
- A 24/7 telemedicine service specialized in hyperbaric medicine activated during the diving periods.

Dive support boat © Nicolas Mathys - Zeppelin / Monaco Explorations.

Through a separate service agreement between Monaco Explorations and Marine Solutions (Pty) Ltd:

- One Saab Seaeye Cougar XT ROV;
- the ROV Launch and Recovery System (LARS) with 700 m main lift cable;
- the positioning service based on two Veripos DGPS position systems and one iXblue GAPS MS USBL system with 6 mini beacons;
- One Sound Velocity Profiler (SVP) Valeport MIDAS SVX2;
- One ROV supervisor, two ROV pilot technicians and one surveyor.

Through the partnership agreements with the scientific partners of the expedition:

- Three types of towed gears for bottom sampling: two dredges, one beam trawl and one epibenthic sledge;

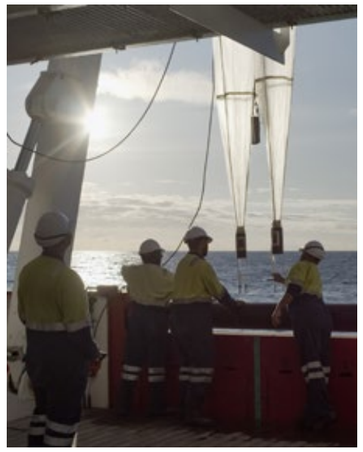
Dredge © Didier Théron - Monaco Explorations.

Beam trawl © Nicolas Mathys - Zeppelin / Monaco Explorations.

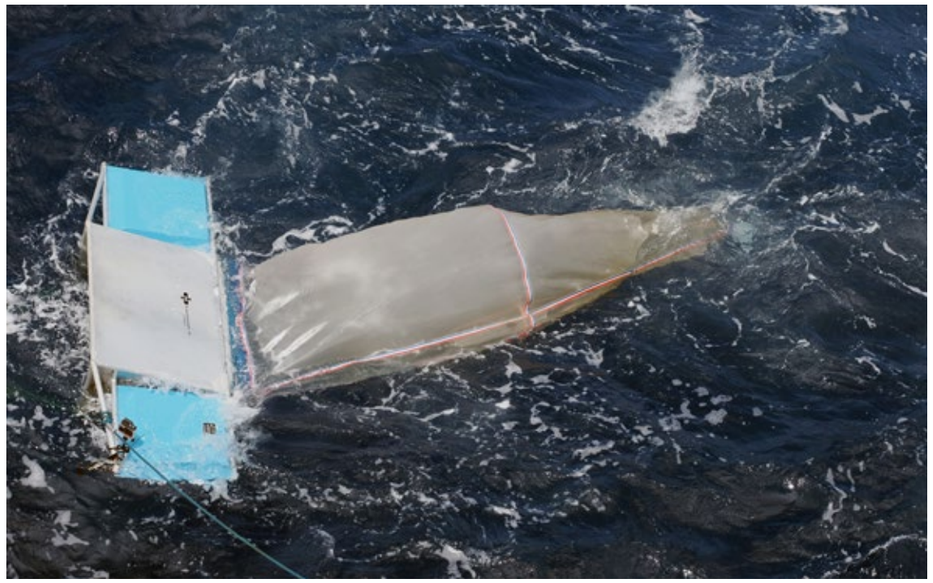
Epibenthic Sledge © Nicolas Mathys - Zeppelin / Monaco Explorations.

- Multinet and Bongo plankton nets;
- Manta trawl;
- Diving tanks and compressor;
- Argo floats, sea surface drifters and buoys;
- XBT probes;
- Tanks and accessories for the conservation of live coral samples;
- Laboratory equipment for the analysis and conditioning of samples.

Multinet © Didier Théron - Monaco Explorations.



Bongo net © Tim Teichmann - Autentic / Monaco Explorations.



Manta trawl © Didier Théron - Monaco Explorations.

1.5. GEOGRAPHY

This section is derived from the Baseline Study prepared by the Advisory Committee (see **section 4.3.1.1**).

1.5.1. INDIAN OCEAN

The Indian Ocean is the third largest of the world's oceanic divisions, covering 70,560,000 km^2 or 19.8% of the water on the Earth's surface. It is bounded by Asia to the north, Africa and the meridian of Cape Agulhas to the west, and Australia and the meridian of South East Cape (Tasmania) to the east. To the south it is bounded by the Southern Ocean or Antarctica, depending on the definition in use. Along its core, the Indian Ocean has some large marginal or regional seas such as the Arabian Sea, the Laccadive Sea, the Gulf of Aden and the Red Sea, the Bay of Bengal, and the Andaman Sea.

Figure 1: *Map of the Indian Ocean.*

1.5.2. MASCARENE PLATEAU

The Mascarene Plateau, also known as the Mascarene Ridge, is a submarine plateau in the Indian Ocean, north and east of Madagascar. The plateau extends approximately 2,000 km from the North Seychelles Bank and the Ritchie Bank in the north, to Reunion in the south. The plateau covers an area of over 115,000 km^2 of shallow water, with depths ranging from 8-150 m, plunging to 4,000 m to the abyssal plain at its edges.

The northern part of the Mascarene Plateau includes Seychelles and the Agalega Islands. The southern part of the Mascarene Plateau includes the Mascarene Islands, Hawkins Bank, Nazareth Bank, the Saya de Malha Bank, and the Soudan Banks. The Mascarene Islands are the mountainous islands of Mauritius, Réunion, Rodrigues, and the Cargados Carajos Shoals, also known as the Cargados Carajos Bank, or Saint Brandon.

It is the most prominent bathymetric feature of the Indian Ocean and extends as a complex submerged seafloor elevation. It is larger than the Great Barrier Reef, longer than the Red Sea and is one of the few submerged features clearly visible from space.

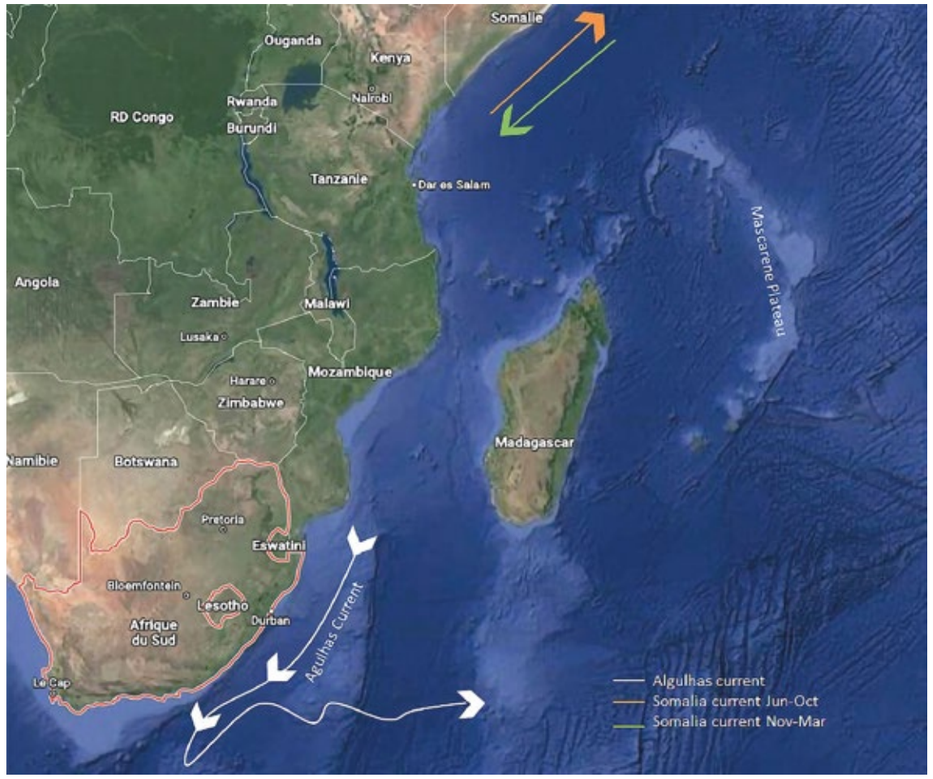


Figure 2: *Map of the Western Indian Ocean region. The region covers approximately 22.3 million km² and includes three Large Marine Ecosystems: The Agulhas Current, the Somali Current and the Mascarene Plateau.*

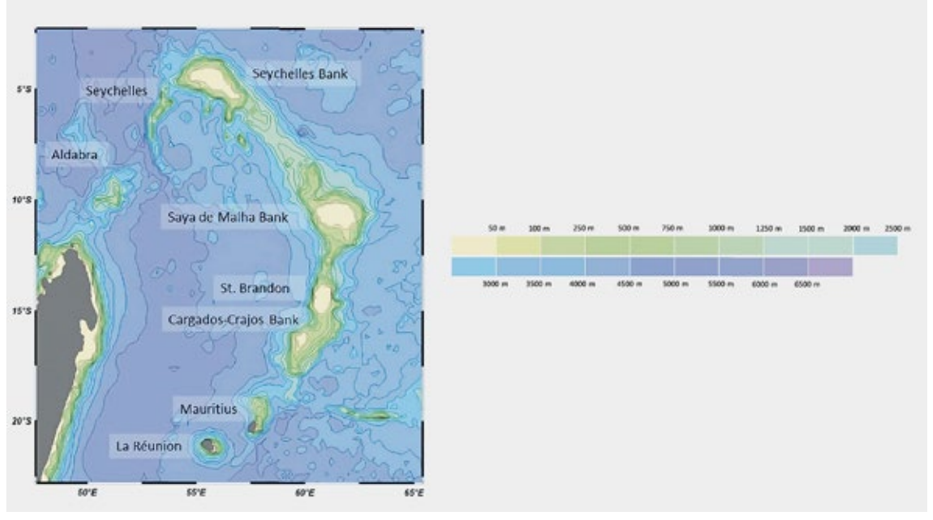
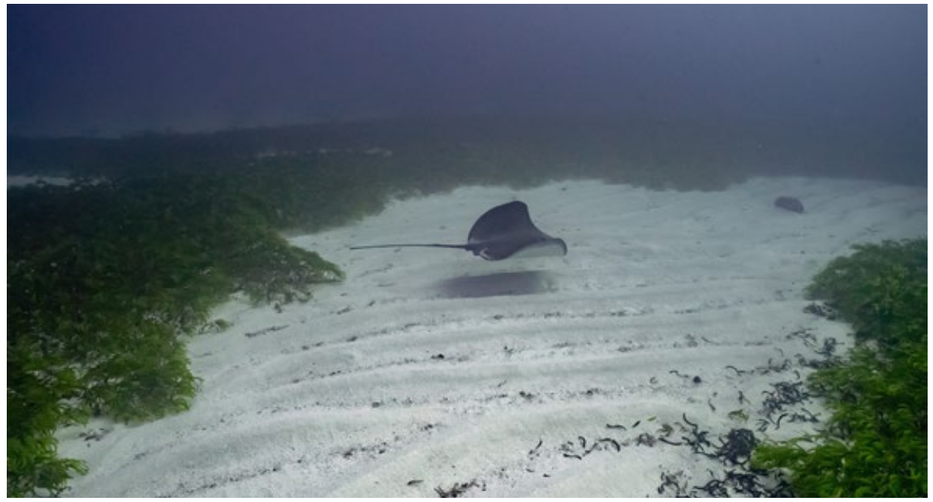


Figure 3: *Map of the Mascarene Plateau. A colour bar highlights isobath values.*

1.5.3. SAYA DE MALHA BANK



Underwater view of the invisible island © Sven Bender - Autentic / Monaco Explorations.

The Saya de Malha Bank is one of the underwater features of the arc-shaped Mascarene Ridge, which stretches over 2,000 km between Seychelles in the North and Mauritius in the South (**Figure 4**). It is also one of the largest submerged banks in the world (40,000 km²) with a surface area equivalent to Switzerland. The Ridge is comprised of elements of very different geological origin and age. The Seychelles Plateau comprises Precambrian granite about 650 MY old. At the other end, Mauritius is only a few million years old and was formed by a crustal hotspot now located under the volcanically active Reunion Island. As for Saya de Malha, the bank was formed 35 MY ago by the Reunion hotspot and is composed of basaltic basal rock overlaid with limestone, a 1,500 m thick cover, the remnants of coral reefs. Millions of years ago, the bank was one or more mountainous volcanic islands, like present-day Mauritius and Reunion, which subsequently sank below the waves. Some of the banks may have been low islands as recently as 18,000-6,000 years ago, when sea levels were up to 130 m lower during the most recent ice age. Saya de Malha includes a small underwater feature, the Ritchie Bank in its northern part. Some features outcrop less than 10 m from the surface and the depth is less than 50 m on the sectors located at the eastern periphery of the bank. Depths generally remain less than 200 m in the central part of the bank; but can reach 350 m in the south-west region of the bank. Current knowledge holds that Saya de Malha supports the largest contiguous phanerogam meadow in the world with 80 to 90% of shallow surfaces being covered by seagrasses dominated almost exclusively by *Thalassodendron ciliatum* from depths up to 30-40m.

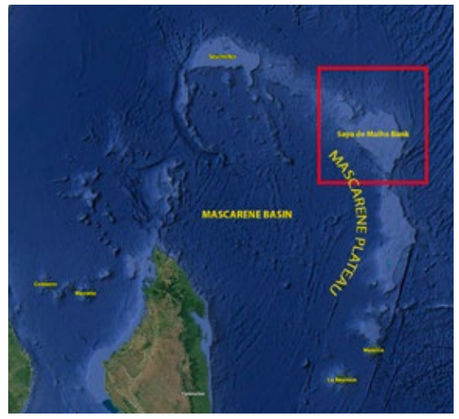


Figure 4: *The regional setting of Saya de Malha Bank (red square) in the Mascarene Ridge.*

The Saya de Malha Bank is located at the northern limb of the South Subtropical Gyre of the Indian Ocean. The South Equatorial Current (SEC) driven by the south-east trade winds carries water of the Indonesian Throughflow in a westerly direction, all the way to Madagascar. It crosses the Mascarene Ridge, and a part of the flow is deflected around the topographic rise. The current increases in

velocity in the pass between Ritchie Bank and Saya de Malha in the North, and in the sill separating Saya de Malha to Nazareth Bank in the South. The current pattern is modified by the monsoon (north-east or south-west), but these seasonal changes do not affect the circulation on the Mascarene Ridge south of 7°S (**Figure 5**).

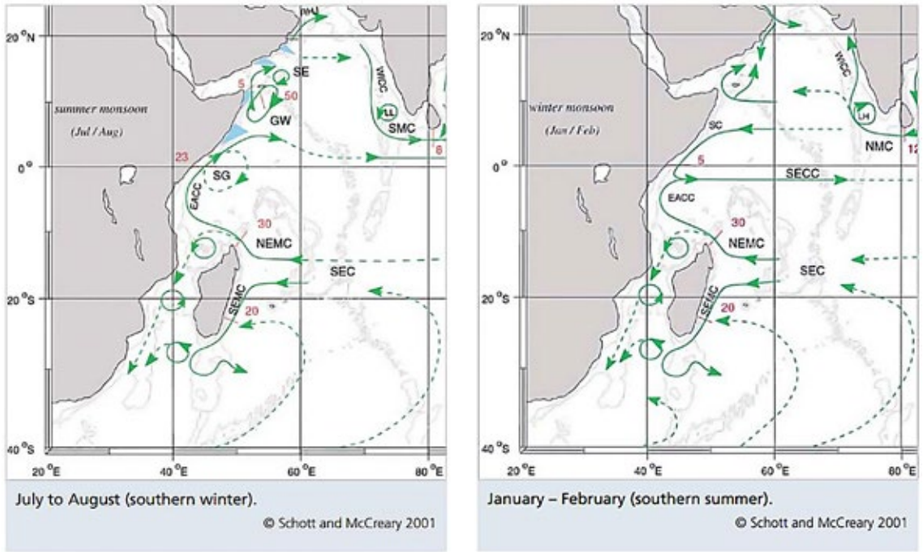


Figure 5: *Circulation pattern in the West Indian Ocean during the winter (or north-east) monsoon (left) and during the summer (or south-east) monsoon (right).*

Beyond its biogeographical and scientific interest, Saya de Malha has a special status in terms of governance. Following a joint request by Seychelles and Mauritius to the United Nations Commission on the Limits of the Continental Shelf for the extension of their continental shelf, these two countries obtained in 2011 the shared sovereignty of Saya de Malha granting them rights to exploit sedentary living resources and mineral resources of the soil (metals) and subsoil (oil, gas). It is then the only Joint Management Area (JMA) in the Indian Ocean, with specific limits beyond the EEZ boundaries of the two island countries (**Figure 6**).

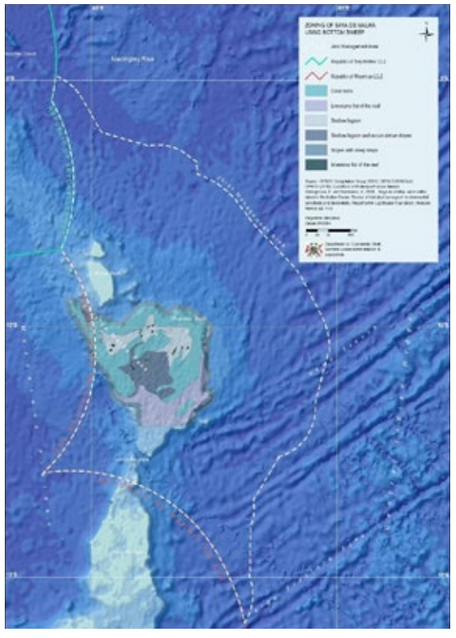


Figure 6: *Delimitation of the Saya de Malha Joint Management Area. The jurisdiction only concerns the seabed and subsoils, whereas the water column remains in the High Seas domain.*

1.5.4. ALDABRA

Aerial view of the Aldabra Atoll © Filip Kulisev - Amazing Planet / Monaco Explorations.

The Aldabra Group is part of the Outer Islands of Seychelles, lying in the south-west of the island nation, 1,000 km from the capital, Victoria, on Mahé Island (**Figure 7**). It comprises four elements:

- Aldabra Atoll: a raised atoll with four main islands and some 40 small islets.
- Assomption Island: a single island on a raised reef.
- Cosmoledo Atoll: a raised atoll with two main islands and about 18 smaller islets.
- Astove Island: a raised atoll with just one island.

Figure 7: *Map of the Outer Islands of Seychelles © Ezilon 2009.*

Aldabra is the world's second-largest coral atoll. Its geographical isolation, rough terrain and scarcity of fresh water have deterred large human populations from settling. As a result, Aldabra is significantly less disturbed than other atolls worldwide. It remains as a universally outstanding example of a coral atoll and, in 1982, was inscribed as a UNESCO Marine World Heritage Site. The atoll is a refuge for many endangered and unique species. It is part of a global biodiversity hotspot and one of the world's natural wonders. It is managed by the Seychelles Islands Foundation (SIF), a non-profit charitable organization that was established as a public trust by the Government of Seychelles in 1979. SIF operates a limited and strictly controlled tourism policy. All visitors to the atoll must receive prior authorization from SIF.

1.5.5. SAINT BRANDON

Aerial view of Saint Brandon © Nicolas Mathys - Zeppelin / Monaco Explorations.

Saint Brandon, also known as the Cargados Carajos Shoals, is an Indian Ocean archipelago about 430 km northeast of Mauritius, consisting of a number of sand banks, shoals, and islets (**Figure 8**). It consists of five island groups, with about 28-40 islands and islets in total, depending on seasonal storms and related sand movements. There are 22 named islands and shoals. Their aggregate land area is estimated variously at 1.3 km^2 and 2.0 km^2. The very extensive shallow bank covers approximately 2,300 km^2 around the islands.

The reef measures more than 50 km from north to south, and is 5 km wide, cut by three passes. The reef area is 190 km^2.

A group of 13 islets are held under a permanent grant by the Raphael Fishing Company which carries out small-scale fishing around them.

The islets are nesting grounds for green turtles, hawksbill turtles and seabirds. It has few inhabitants mostly fishermen and Government of Mauritius officials.

Figure 8: *Map of Saint Brandon.*

1.6. SCIENTIFIC PROGRAMME

1.6.1. OVERVIEW

The scientific programme was initially composed of eight research projects with three different geographic scopes:

- The Saya de Malha Joint Management Area between Mauritius and Seychelles, located beyond the Exclusive Economic Zones of the two States. The expedition aimed to gather scientific elements that could help consolidate the joint governance of a relatively unknown area with potential outstanding universal value. This area was the priority focus of the expedition.
- Two islands: Aldabra (Seychelles) and Saint Brandon (Mauritius). The objective was to characterize the function of refuges for biodiversity and to help preserve it against the impacts of anthropic pressure and climate change.
- The region as a whole: the objective was to improve the understanding of the regional ocean dynamics.

The eight research projects are described hereinafter (see **sections 1.6.2** to **1.6.9**).

The scientific programme was complemented with opportunistic activities such as marine megafauna monitoring (see **section 3.1.4**), routine underway observations (see **section 3.1.5**) and ROV surveys (see **section 3.2.6**). At the request of Mauritius Oceanography Institute (MOI) an additional project devoted to the bioprospection of marine sponges was implemented during the Saya de Malha and Saint Brandon sequences (see **section 1.6.10**).

1.6.2. SAYA DE MALHA ECOSYSTEM PROJECT

This project was designed with the objective of "science for marine governance and planning support" with the following objectives:

- To complement the existing scientific information on the marine environment of the shallow areas of the bank and its slopes;
- To undertake an inventory of the benthic biodiversity, to assess the species richness and possible endemism, in order to map the sensitive habitats that may require specific conservation measures;
- To produce fact sheets on the habitats and communities of the bank;
- To contribute to policy briefs for institutional stakeholders and policy makers in Seychelles and Mauritius;
- To publish the main results in international journals.

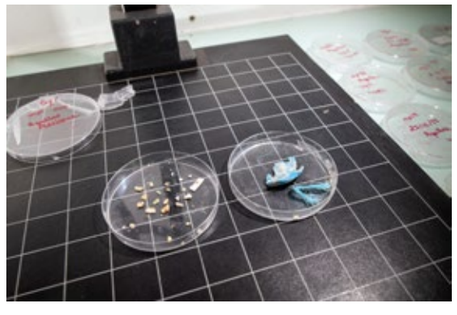
It combined open water and seabed measurements. The water column, both on the bank (ranging in depth from 15 to 120 m) and up to 35 km beyond the slopes, was sampled using vertical CTD profiles with water sampling at various depths to determine physical, chemical, and biological parameters. The project also included a survey of the benthic biodiversity (fauna and flora attached to the seabed) by means of scientific rebreather dives, enabling work to be carried out at depths of over 60 m, and by means of towed gears. Led by IRD in collaboration with the French National Museum of Natural History (MNHN), the project team included representatives from Mauritius (Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office; Ministry of Blue Economy, Marine resources, Fisheries and Shipping; Mauritius Oceanography Institute; University of Mauritius), Seychelles (Ministry of Fisheries and the Blue Economy; Seychelles Fishing Authority; Seychelles Parks and Gardens Authority; University of Seychelles; Talma Consultancy), and other institutions such as the University of Lodz, Poland and Nelson Mandela University, South Africa.

Underwater view of the herbarium of Talassodendron ciliatum, *Saya de Malha Bank © Sven Bender - Autentic / Monaco Explorations.*

1.6.3. MICROPLASTIC AND CORAL PATHOGENS MADCAPS

The MADCAPS (Microplastics AnD CorAls PathogenS) project was developed in 2019 by the BESTRUN Association in collaboration with UMR ENTROPIE, University of Reunion Island.

Plastic pollution is increasing, impacting marine biota. Plastic debris constitute now a new ecosystem called "Plastisphere" with attracts microorganisms and bacteria. In the Indian Ocean, the abundance of plastic debris and their impacts are not well studied. The objectives of MADCAPS were to study the abundance and distribution of floating plastic debris and to determine the characteristics of the microbial flora fixed on microplastics via metabarcoding.



Microplastic samples collected with the Manta trawl © Nicolas Mathys - Zeppelin / Monaco Explorations.

1.6.4. STUDY OF THE GENETIC STRUCTURE AND LEVELS OF CONTAMINATION AND STRESS IN MARINE TURTLES GECOS

The entire Ocean is now affected by human activities, in addition to the strong pressures of climate change. Biodiversity and habitats of coastal ecosystems are the first to be impacted and have decreased by 30 to 60%. The increase in the human population and the growing anthropic and climatic pressures on marine ecosystems raises the question of the sustainability of the exploitation and conservation of these marine ecosystems. This conservation depends above all on our ability to measure these changes on a daily basis, to make this information collection sustainable over the long term and to develop relevant and reliable indicators of these pressures on the ecosystems. Marine megafauna is particularly sensitive to these pressures and there are unfortunately many examples of entire populations disappearing. The case of marine turtles is particularly interesting because, as emblematic species of marine diversity, they have contributed to the development of a species-based approach to the conservation of a habitat, community, or ecosystem.

This project focused on Aldabra and was led by the French Research Institute for Exploitation of the Sea (Ifremer) in partnership with Kelonia, Aalborg University, Denmark and the University of Murcia, Spain. It follows on from the NEXT project led by Ifremer.

Green turtle, Chelonia mydas, *Aldabra © Stéphane Ciccione - Kelonia / Monaco Explorations.*

1.6.5. STUDY OF THE COMBINED IMPACT OF COASTAL HUMAN ACTIVITIES AND CLIMATE CHANGE ON MARINE ECOSYSTEMS 4SEA

The 4Sea project aimed to disentangle the combined impacts of coastal human activities and climate change on marine ecosystems in the Western Indian Ocean. By deploying autonomous observing systems such as autonomous instrumented boards (ASV) and aerial drones (UAV) in pristine and anthropogenically impacted ecosystems this project aims to answer key scientific questions. The project relied on the collection of bathymetry data and images and their analysis using artificial intelligence in order to map habitats and species and changes in their surface area and abundance.

The project was led by Ifremer in collaboration with IRD and CNRS in liaison with Ifremer participatory science project "Seatizen" involving members of French UMR MARBEC. The project focused on Aldabra, in liaison with the GECOS project, and Saint Brandon and contributed also to the investigation of the Saya de Malha Bank.

One of the connected boards used by the 4Sea project team. Aldabra station in the background © Mervyn Ravitchandrane - Ifremer / Monaco Explorations.

1.6.6. REGIONAL IMPLEMENTATION OF THE BGC-ARGO PROGRAMME

This project was a contribution to the international Biogeochemical-Argo (BGC-Argo) programme that aims to establish a global ocean observation system composed of 1,000 profiling floats equipped with autonomous bio-optical sensors. They measure physical, chemical, and biological variables essential to understanding the evolution of the ocean's health and its response to climate change. These variables, measured every 10 days between the surface and 2,000 m depth, are: temperature, salinity, pH, oxygen, nitrate and chlorophyll-a concentration, suspended particles, as well as illumination.

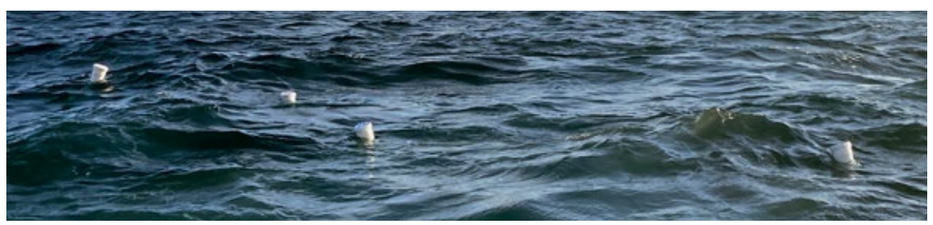
The project objective was to deploy floats in a hitherto poorly equipped area and to contribute to the REFINE[1] programme funded by the European Research Council (ERC) that develops a new generation of highly instrumented jumboized profiling floats required to investigate the various carbon pumps and associated carbon transformation processes within the twilight zone (from around 100 m to 1,000 m depth).

The project was led by the Oceanography Laboratory of Villefranche-sur-Mer, France (LOV) and involved partners from the Mediterranean Institute of Oceanography (MIO Aix-Marseille University, University of Toulon, CNRS, IRD), the Ecce-Terra Observatory (Sorbonne University, CNRS, IRD), as well as the US Universities of Maine and Stanford.

Deployment of a BGC Argo float during the expedition © Tim Teichmann - Autentic / Monaco Explorations.

1.6.7. SURFACE DRIFTERS PROJECT

The University of Western Australia, Oceans Institute (UWA-OI), IRD and Météo-France (French meteorological agency) joined forces to carry out a joint regional project during the expedition. The project was designed to provide new data and biophysical oceanographic information on the hydrodynamics of surface flows within and around the study region in a cost-effective manner. The drifters' speeds are used as a proxy of the movement and related inter-connectivity of biological propagules (incl. coral and fish larvae, nutrients) and anthropogenically introduced substances that have the potential to impact negatively on the ecology of the region (e.g., oil, other toxicants, plastics). The data from the project were expected to be useful transversally to other research projects conducted during the expedition. The project complemented similarly motivated research undertaken recently for the region immediately to the south of the expedition study domain.



Sea surface drifters deployed at Aldabra © Heather Koldewey - Zoological Society of London / Monaco Explorations.

[1] REFINE: Robots Explore plankton-driven Fluxes in the marine twilight zone.

1.6.8. WORLD CORAL CONSERVATORY

Coral reefs are threatened by climate change and in particular by rising water temperatures. In order to counter this disappearance announced by the end of this century, many initiatives are emerging: the World Coral Conservatory is one of them.

A consortium of scientists, aquarium curators and NGOs working on reef restoration are committing to a proposal by the Oceanographic Institute, Prince Albert I[st] of Monaco Foundation, and the Scientific Centre of Monaco, supported by the Prince Albert II of Monaco Foundation, to build a "Noah's Ark" for reef-building corals that will serve as a reservoir for coral reef conservation, research and restoration purposes.

The objective is to create a global reference centre that will house, in a network of public and private aquaria, a unique global collection of the majority of scleractinian (reef-building) coral species and strains described to date, in the form of living colonies. The public aquaria will be reservoirs for conservation, restoration, and research, but also laboratories for the implementation of stress resistant breeding operations. The aim is to preserve as many species as possible and to establish a global platform for the sharing of biological material and for the exchange and production of knowledge.

This conservancy will help protect coral reef biodiversity using solution-based approaches that combine science, conservation, and reef management. It will increase the ability of reef organisms to tolerate stress and facilitate recovery from disturbance, using the "evolutionary-assisted approach" to improve the resilience of coral reefs.

The plan was to initiate the collection process in Aldabra through an agreement with the Seychelles Islands Foundation. For this first collection cycle, coral species with certain characteristics were targeted: endangered corals, resistant corals, species that are easy to cultivate and propagate, endemic species.

Aldabra reef © Katia Quéméré – WCC / Oceanopolis / Monaco Explorations.

1.6.9. CORAL CONNECTIVITY AND ASSOCIATED INVERTEBRATE BIODIVERSITY CORAL CONNECT

This Bertarelli Foundation Marine Programme project was led by the Zoological Society of London and the University of Oxford and supported by the UK diving and underwater research company Tritonia Scientific Ltd.

The project aims to understand whether the Central Indian Ocean atolls and banks (Chagos Archipelago, Aldabra and Saya de Malha) act as a "steppingstone" for invertebrate (particularly coral) recruitment and biodiversity between the Eastern and Western Indian Ocean regions. The project investigates several areas of research, relating to:

- the mechanisms of resilience and recovery of *Acropora* and *Porites* corals in the Central Indian Ocean;
- the population structure and connectivity of *Acropora* and *Porites* corals in the Central and Western Indian Ocean;
- the biodiversity of oceanic cryptic invertebrates; and
- the ecology and biology of the world's rarest coral, *Ctenella chagius*.

The participation in the expedition in Aldabra, Saya de Malha and Saint Brandon aimed to extend and complement the existing dataset from the Chagos Archipelago. Ultimately, collection of these data will allow to understand if these atolls and banks in the Central Indian Ocean) are acting as "steppingstones" for invertebrate (particularly coral) recruitment and biodiversity between the Eastern and Western Indian Ocean regions, as has been surmised due to the prevailing westerly ocean currents connecting the two which reverse halfway through the year. In addition, *Acropora* species recently collected in the Chagos Archipelago were recently revealed to be a new species and the project aimed to investigate whether this new species is also found in Seychelles and Saya de Malha.

The project is also aiming at the conservation of the critically endangered Chagos brain coral, *Ctenella chagius*, which has historically been considered endemic to the Chagos Archipelago; however, archive specimens stored at the Natural History Museum of London were collected from Saya de Malha on the Percy Sladen Linnean Society expedition in 1905 (and subsequently described in 1928), and colonies on reefs there were photographed by David Obura (CORDIO East Africa) in 2010.

Underwater view of Aldabra Reef © Heather Koldewey - Zoological Society of London / Monaco Explorations.

1.6.10. BIOPROSPECTION OF MARINE SPONGES

Marine sponges are sessile organisms that produce an array of chemicals, called secondary metabolites, which they use as a defence mechanism, in response to their environment. These chemicals have been shown to have numerous pharmacological properties, which the Mauritius Oceanography Institute (MOI) is currently investigating for their potential against cancer, Alzheimer and diabetes, in order to find drug leads. Additionally, the same species of sponges can produce different secondary metabolites, depending on the environment they live in, which adds to the diversity of chemicals being produced in various locations and environments.

The MIO was keen to take advantage of the sequences planned in Saya de Malha and Saint Brandon to complete their ongoing inventory of marine sponges and collect specimens in various environments and depths, either by scuba diving, towed gear or ROV and preserved for inventory and onward processing in Mauritius.

The field operations are to be followed by taxonomy and DNA identification of sponges, capacity building and collaboration for work on sponge symbiotic microorganisms and chemotaxonomy, and comparative studies of the bioactivity of same sponge species in different regions.

Sponges collected on the Saya de Malha Bank during the expedition © Nicolas Mathys - Zeppelin / Monaco Explorations.

1.7. CRUISE SUMMARY INFORMATION AND NARRATIVE

Figure 9: *Monaco Explorations Indian Ocean Expedition.*

Expedition Designation		Monaco Explorations Indian Ocean Expedition Monaco Explorations V055
Expedition Leader		Gilles Bessero
Dates		1 October / 1 December 2022
Ship	*Name*	*S.A. Agulhas II*
	Flag	South Africa
	Port of Registry	Cape Town
	IMO Number	9577135
	Call Sign	ZSNO
	MMSI	601986000
	Master	Knowledge Bengu
Ports of Call		Cape Town, South Africa Port Louis, Mauritius Le Port, Reunion, France Port Victoria, Seychelles Port Louis, Mauritius Cape Town, South Africa
Project Leaders		**4SEA:** Sylvain Bonhommeau, Ifremer, France **GECOS:** Jérôme Bourjea, Ifremer, France **BGC-Argo:** Hervé Claustre, IMEV, France **Sea Surface Drifters:** Nick D'Adamo, UWA, Australia **Coral Connect:** Heather Koldewey, ZSL, United Kingdom **Onboard School:** Fabien Lombard, IMEV, France **Saya de Malha:** Francis Marsac, IRD, France **MADCAPS:** Margot Thibault, University of Reunion, France **World Coral Conservatory:** Didier Zoccola, CSM, Monaco **Marine Mammal Observation:** Bernard Rota, GLOBICE Reunion, France
Participants		See **Annex C**

S.A. Agulhas II was mobilized in Cape Town, South Africa, from 26 September to 1 October 2022. She left Cape Town on 3 October.

During the cruise, routine underway observations were recorded through the onboard scientific data system whenever possible, as indicated in **Table 1**.

For the first part of the expedition, *S.A. Agulhas II* called successively in Port Louis, Mauritius (10-12 October) and Le Port, Reunion (13-14 October). The small expedition team that had signed on in Cape Town was completed to 80 participants altogether. The additional scientific equipment from France was loaded on board in Reunion. They included Argo floats transported in a 20-ft container that was returned to the shipping company and diving equipment, towed gears, and tanks transported in a 40-ft container that was stowed on the helicopter deck. A test dive of the ROV had been conducted shortly after leaving Cape Town, and a possible seamount signature was investigated during a few hours between Mauritius and Reunion.

Table 1

PARAMETER	EQUIPMENT	COMMENT
Current	Drop-keel mounted 75 kHz Teledyne RDI Acoustic Doppler Current Profiler (ADCP) system	The recording is stopped when the vessel steams above 14 knots
Sea surface temperature (SST) and conductivity	Seabird SBE45 MicroTSG ThermoSalinoGraph flowthrough system	Several interruptions due to plumbing issues
Depth	Single beam Simrad EK60 scientific echosounder (38, 120 & 200 kHz) Single beam Simrad EA600 hydrographic echosounder (18 kHz)	
Sub-bottom profile	Kongsberg TOPAS PS 18 parametric subbottom profiler (18 kHz)	System failure from 9 to 12 October

Besides routine underway observations, three scientific projects began during the transit from Reunion to Aldabra with the deployment of Argo floats in conjunction with CTD stations (**BGC-Argo Project**), the deployment of sea-surface drifters (**SSD Project**), and Manta trawl transects to collect microplastics (**MADCAPS Project**).

Launch of the CTD Rosette © Filip Kulisev - Amazing Planet / M onaco Explorations.

Deployment of a sea surface drifter © Tim Teichmann - Autentic / Monaco Explorations.

Launch of the Manta trawl © Nicolas Mathys - Zeppelin / Monaco Explorations.

All scientific observations were suspended during the transit in the Exclusive Economic Zone (EEZ) of Tromelin, whose jurisdiction is claimed by France and Mauritius. After entering the EEZ of Seychelles, about 10 hours were devoted to investigating a possible seamount signature during the night from 16 to 17 October.

S.A. Agulhas II reached Aldabra at sunrise on 19 October. The sequence devoted to investigating the area around Aldabra started with an emergency response plan drill to check the arrangements in the event of a dive emergency. Then, three teams composed of nine scientists were transferred ashore to carry out their projects related respectively to:

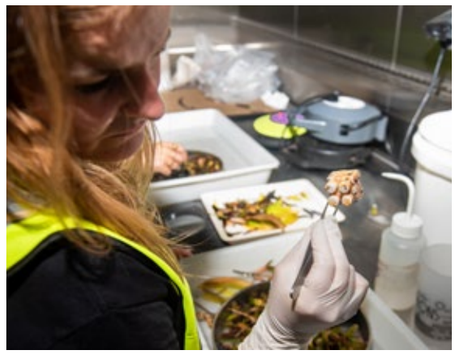
- Monitoring marine turtles (**GECOS Project**);

Measuring the size of the carapace of a green turtle
© Jérôme Bourjea - Ifremer / Monaco Explorations.

- Assessing the coastal environment (**4SEA Project**);

Boards connected before launching
© Sylvain Poulain - Ifremer / Monaco Explorations.

- Monitoring plastic pollution (**MADCAPS Project**).



Sorting plastic waste on board the S.A. Agulhas II *after a Manta transect © Nicolas Mathys - Zeppelin / Monaco Explorations.*

Later that day, the two dive teams operating from the vessel were deployed to start their investigations related to:

- Collecting coral samples (**World Coral Conservatory Project**);

- Assessing the connectivity of coral species and the associated invertebrate biodiversity (**Coral Connect Project**).

Collecting coral colonies in Aldabra
© Katia Quéméré - WCC / Oceanopolis / Monaco Explorations.

This was followed by the first ROV exploration dive off the west coast of Aldabra.

The next morning was disrupted by an accident while launching one of the two dive boats. Unfortunately, one diver was injured and required a medical evacuation. The operations from the vessel were suspended while she transited to Moroni, Comoros. A detailed review of the procedures related to the launch and recovery of the dive boats and to dive operations was conducted, and the associated safety protocols were adapted accordingly.

Operational briefing between the crew and the World Coral Conservatory and Coral Connect teams before departure for a dive session
© Nick D'Adamo - UWA / Monaco Explorations.

Two Argo floats and one SSD were opportunistically deployed during the transit back from Moroni to Aldabra on the evening of 21 October.

The operations off Aldabra resumed on 22 October and continued as planned until 25 October.

One of the species of fish observed by the ROV on the slopes of the Aldabra reef at a depth of 698 m
© Marine Solutions / Monaco Explorations.

In addition to the scientific teams working ashore, day visits on Aldabra were organized for other participants in liaison with the Seychelles Islands Foundation team on the island.

A high-level delegation led by HSH Prince Albert II of Monaco and Mr Jean-François Ferrari, Seychelles' Designated Minister and Minister for Fisheries and the Blue Economy, visited Aldabra from 24 to 25 October and then embarked on *S.A. Agulhas II* in the late afternoon of 25 October. The delegation stayed on board until midday the next day for an intensive programme, including a tour of the ship, meetings with the crew and scientific teams, and a presentation of the investigations carried out during this first part of the expedition.

After disembarking the delegation on Assomption Island, *S.A. Agulhas II* continued the scientific programme on the way to Port Victoria, Seychelles. The call at Port Victoria from 29 to 31 October marked the end of the first part of the expedition with the changeover of many participants.

Participants in the first part of the expedition with HSH Prince Albert II of Monaco, 26 October 2022
© Nicolas Mathys - Zeppelin / Monaco Explorations.

The second part of the expedition was dedicated mainly to the Saya de Malha Ecosystem Project and the continuation of the underway projects.

Samples taken during a dive on the Saya de Malha Bank © Sven Bender - Autentic / Monaco Explorations.

In addition, a marine mammal observer joined the expedition. The Saya de Malha Bank sequence took place from 2 to 17 November.

It was followed by operations around Saint Brandon from 19 to 21 November. In accordance with the prevailing sanitary protocol for Saint Brandon which required a 7-day quarantine in Mauritius before transiting to Saint Brandon no operation could be conducted ashore and no contact with the people living on the island was allowed. Then *S.A. Agulhas II* called again in Port Louis, Mauritius, from 22 to 24 November, where most participants disembarked. An overview of the expedition was presented to HE Mr Eddy Boissezon, Vice-President of the Republic of Mauritius and Mr Sudheer Maudhoo, Minister of Blue Economy, Marine Resources, Fisheries and Shipping and other officials from Mauritius.

Participants in the second part of the expedition
© Nicolas Mathys - Zeppelin / Monaco Explorations.

The small team that remained on board carried out the last three stations of the **BGC-Argo Project** between Port Louis and Cape Town. The scientific equipment to be returned to France and the samples conditioned for further laboratory analysis were stored back in the 40-ft container.

S.A. Agulhas II returned to Cape Town on the night of 30 November to 1 December. 1 and 2 December were devoted to the final demobilization operations, including disembarking the 40-ft container that was stored ashore until it could be loaded onto a container ship bound for Europe. The container waited in Cape Town for a long time and was not delivered to MNHN until 6 April 2023.

1.8. CONNEXION WITH DIDEM

In 2018 IRD approached Monaco Explorations about the development of a project called DiDEM (Dialogue Science-Decision Makers for the Integrated Management of the Coastal and Marine Environment) with the objective to test, validate and deploy innovative scientific outreach tools and methods in the Western Indian Ocean in support of regional initiatives dedicated to ocean governance. Eight countries were concerned: Comoros, Madagascar, Mauritius, Mozambique, Seychelles, Tanzania, Kenya. IRD and Monaco Explorations agreed to coordinate their efforts in the region. A financial endowment protocol in support of DiDEM that set out the relationship between DiDEM and the expedition was developed and signed in January 2021.

Besides the contribution of IRD and Monaco Explorations, DiDEM benefits from the financial support of the International Development Research Center of Canada (IDRC), the French Facility for Global Environment (FFEM), the United Nations Development Program (UNDP), the United Nations Environment Program (UNEP), and Fondation de France. It officially started on 7 January 2021 for a period of 3 years, until 6 January 2024.

The project focuses on three types of ecosystems and deploys its activities in three large Workshop Zones: the islands and archipelagos, the deltas, and the high seas, deep seas and distant seabeds which include international waters, the abyssal plain and seamounts. It is divided in three components:

A/ Tools to bring scientific knowledge to decision-makers;
B/ Capacity building and trainings;
C/ Raising awareness among civil society.

Four DiDEM activities are supported by Monaco Explorations in relation with the Indian Ocean Expedition:

- component A/: contribution to the development of a regional ocean governance strategy covering the high seas, deep seas and distant seabeds, based on marine science.
- component B/: organization of a thematic school on reef geosystems in Seychelles.
- component C/:
  - setting up of an Educational Marine Area (EMA) in Seychelles through the extension to Seychelles of the PAREO project (PAtrimoine RÉcifal de l'Océan Indien entre nos mains) that aims at raising awareness of the need to protect coral reefs.
  - application of the "The Future of®" approach to the development of the blue economy of Seychelles focusing on the management of plastic waste.

Figure 10: *The DiDEM project © IRD.*

2. EVALUATION OF THE EXPEDITION

2.1. OBJECTIVE AND SCOPE OF THE EVALUATION

At its 10th meeting on 19 December 2022 Monaco Explorations Indian Ocean Expedition Advisory Committee agreed to conduct an evaluation of the expedition focusing on the expedition planning and conduct processes. The outreach outcomes and the scientific outcomes will necessitate another evaluation process at a later date.

The main objective of this evaluation was to provide recommendations to Monaco Explorations to inform and improve the scope and conduct of future expeditions.

The scope of the evaluation covers the design, planning, and implementation of the expedition, as well as its overall relevance, financing, and the participation of stakeholders. It includes preliminary comments about the use and management of the data collected during the expedition.

2.2. METHOD

The review was conducted by the Advisory Committee secretary under the guidance of an Evaluation Sub-Committee and with the assistance of Monaco Explorations staff. A questionnaire was sent to all participants of the expedition and complemented by the interviews of a selection of key stakeholders.

The questionnaire covers different aspects of the expedition: design and planning, implementation (research and outreach), passengers' facilities and support, and role of the Advisory Committee. The questionnaire uses a 5-point Likert scale and includes the possibility to "comment" on rating as needed. The online survey was opened first between 24 February and 10 March 2023. In order to improve the return rate, it was re-opened between 2 and 23 May 2023.

The follow up interviews targeted stakeholders who were not on board of the ship, although several of them visited the ship during the stopover in Mauritius or in Seychelles. The questions for the interviews focus on the involvement of the stakeholders in the preparation and planning of the expedition and also consider the fate of the expedition results (availability, uses, etc.). Although the latter aspect was not within the strict scope of the evaluation, it was of great interest to the stakeholders keen to ensure linkages between sciences and policy.

The survey results were first presented at the 12th meeting of the Advisory Committee on 22 March 2023 (preliminary results). The final evaluation was discussed at the Advisory Committee 14th meeting on 20 June. A summary of the evaluation was presented at the meeting of the Board of Monaco Explorations on 22 June.

2.3. RESULTS

The questionnaire was sent to 143 participants. 35 responses were received in March, and 23 more in May, for a total of 58 answers, which represent a return rate of 41%. 49 responses were nominative and 9 were anonymous. Most of the partners institutions were represented.

The majority of the responses came from scientists (26 / 44,8%), followed by students (14 / 24,1%), Committee members (5 / 8,6%), media and artists (4 / 6,9%), Monaco Explorations staff (4 / 6,9%), crew and technicians (2 / 3,4%), stakeholder (1), doctor (1), ROV team (1) (**Figure 11**).

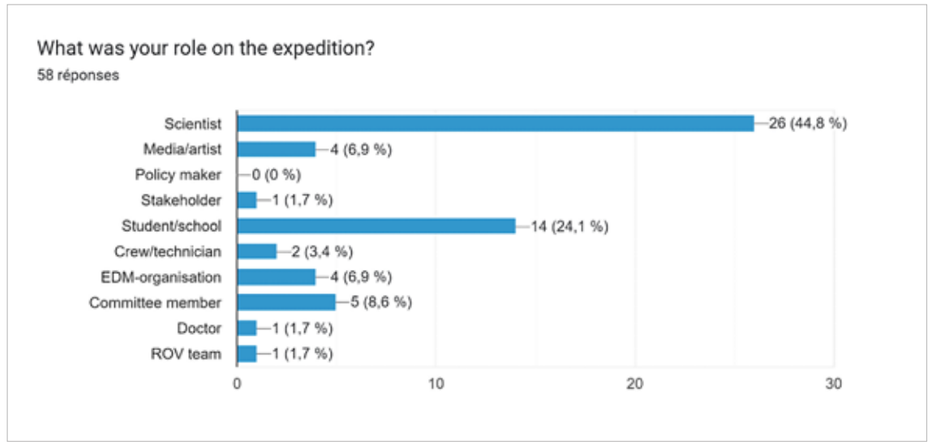


Figure 11: *Respondents by categories.*

The return rates from scientists and students were satisfactory, although a return rate above 50% was expected: 26 answers amongst 55 scientists (47%), 14 answers amongst 35 students (40%). The rate for media and artist is similar at 40%. The best return rate is from the Committee members with 5 answers amongst 7 committee members on board (71% but 35% considering all Committee members), and Monaco Explorations (80%).

OVERALL RATING

Most of the participants were happy with the expeditions with 95% of positive answers when adding the "satisfactory", "good" and "very good" ratings. The "very good" rating came first with almost half of the answers (**Figure 12**).

The main criticisms were about coordination, communication and planning, as well as about the diving conditions. These negative remarks seemed to be based on frustration (*"we could have done much better"*) than on actual impossibility to deliver during the cruise.

The interviews fully confirmed the positive rating of the expedition.

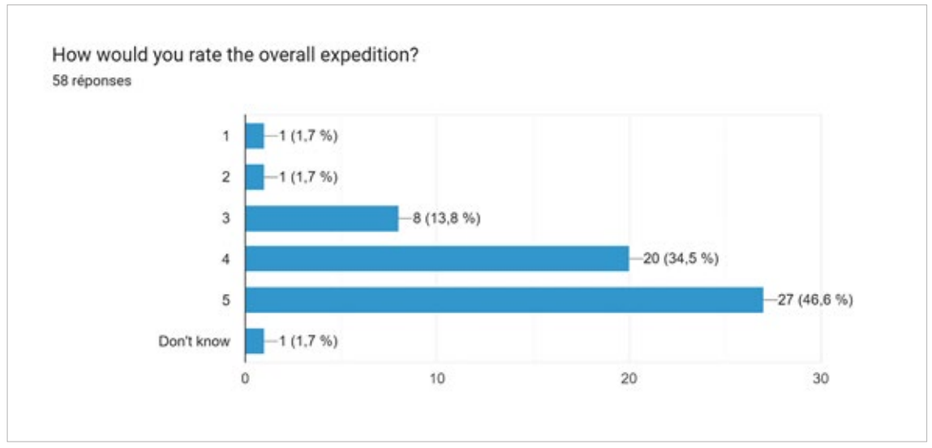


Figure 12: *Overall rating.*

NOTES ON THE USE AND MANAGEMENT OF THE DATA COLLECTED DURING THE EXPEDITION AND RESULTS.

These notes are drafted from the comments collected during the interviews. There was no question about data management and use of results in the questionnaire.

The collected data are important for both Mauritius and Seychelles.

It is complicated but very important to mutualize all data collected during the expedition.

A clear and robust results publication strategy is necessary. A special symposium could be envisaged.

Open access is fundamental but has a cost. Many data and results should be accessible online directly on Monaco Explorations website.

The data collected on Saya de Malha are of particular importance for the management of the Joint Management Area (JMA).

The collected data are important for the development of the Blue Economy at the regional level and at the same time for fostering sustainable fishing activities and the conservation of marine biodiversity.

The information about the seagrass meadows of Saya de Malha is also important for a better understanding of the Blue Carbon in the region.

It is important that the results be formatted so that the policy makers can access the appropriate information. "Science to Policy" is a key process for making sure that collected data are well used by policy makers.

2.4. CONCLUSIONS

Overall, the appraisal of the expedition was good.

All questions received a large majority of "good" and "very good" ratings.

The major positive points were the followings:

- Duration and objectives of the expedition: Aldabra, Saya de Malha, and Saint Brandon were excellent targets for such an expedition.
- Quality of the ship, both in terms of technical and scientific equipment and of onboard hospitality.
- Richness of the multidisciplinary programme and diversity of projects and of scientific teams.
- Richness of the multi-objectives approach with the mix of research, capacity building, education, and outreach, including the artists on board.
- Strong participation of research teams from Mauritius and Seychelles.

The main setbacks are about the planning and some onboard equipment:

- The planning and preparation phases did not consult and involve the ocean research stakeholders enough, or adequately, in particular at the regional level.
- The complexity of the cruise structure (many different projects and approaches) led to some problems in the coordination of onboard activities.
- The structure of the programme did not satisfy some participants who were not much interested in the multidisciplinary approach and were frustrated not to be able to conduct fully their own programme.
- About the onboard tools, although the ship was overall very well appreciated, there were two main hiccups: the lack of multibeam echosounder that hindered bathymetric survey and navigation in shallow unknown areas, and the uneasy diving facilities, especially the auxiliary boats and the access to the sea.

3. SCIENTIFIC OPERATIONS AND RESULTS

3.1. REGIONAL DYNAMICS

3.1.1. BIOGEOCHEMICAL-ARGO

29 floats were deployed at twelve stations (**Figure 13**) where samples were also collected for additional chemical and biological analyses, intended in particular to qualify the sensors installed on the profiling floats.

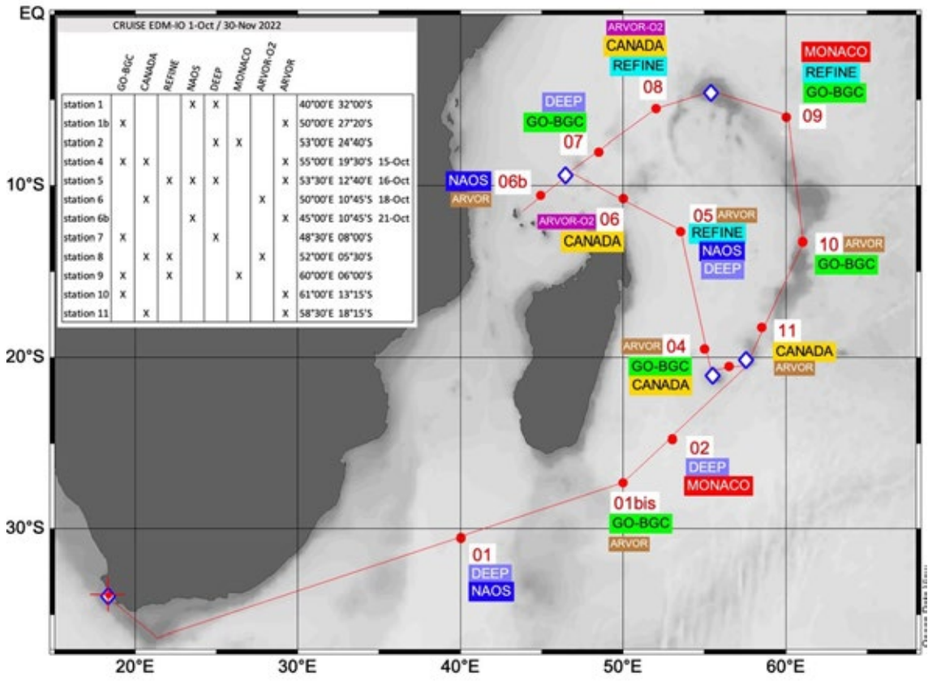


Figure 13: *Oceanographic stations occupied during the expedition and deployments of BGC-Argo floats. At each station, at least one CTD cast recorded hydro-biogeochemical parameters. Water samples were collected for future analysis. Finally, at least two floats from the OneArgo programme were deployed at each of these stations. They are identified either by the country or by the observation programmes that acquired them and made them available for the cruise.*

If the realization of twelve stations may seem little compared to the standards of offshore oceanographic cruises of an equivalent duration, in this case the return in scientific terms is extremely positive. The area studied was among the most under sampled areas of the ocean. Two or three floats were systematically deployed at each station, which was extremely effective. Finally, this is the first time that, at least on a European scale, an oceanographic cruise deployed so many floats of various origins and configurations for the OneArgo programme (**Figure 14**).

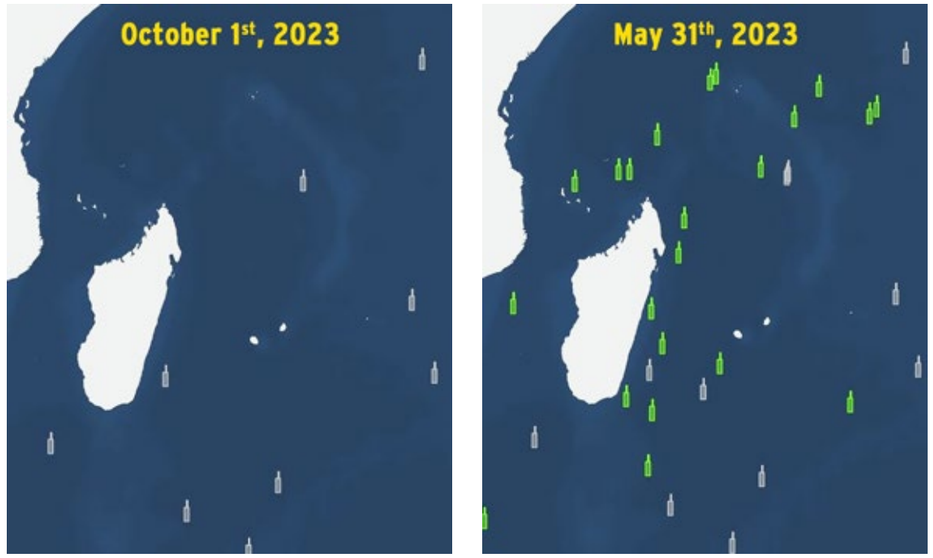


Figure 14: *Status of deployments and observations by BGC-Argo float before and after the expedition.*

Currently, float data are checked automatically in the so-called real-time mode. This quality of control is sufficient for operational oceanography. For scientific purposes, these data must generally be checked by an operator. The so-called deferred time control is generally implemented for certain variables after one year of acquisition by the floats.

The progress of the project is currently in line with expectations and satisfactory for a multi-disciplinary project of this nature.

- Some of the analyses of the samples are completed (pigments by HPLC, particulate organic and inorganic carbon) while others are still in progress (microscopy, flow cytometry, nutrients). All the analyses should be finalized and validated by the end of 2023.

- 27 of the 29 floats deployed are functioning nominally. Each float sends its data every ten days. According to the recommendations of the OneArgo programme, these are accessible in real time to the entire scientific community either from the BGC-Argo website (floats with biogeochemical sensors https://biogeochemical-argo.org/data-access.php), or from the Euro-Argo site (floats measuring temperature and salinity only https://fleetmonitoring.euro-argo.eu/dashboard). These data are currently qualified in real time and the deferred time control procedures will be launched in early 2024.

A summary of the CTD stations and of the data acquired is presented in **Annex D**.

3.1.2. SEA SURFACE DRIFTERS (SSD) AND SURFACE VELOCITY PROGRAMME (SVP) DRIFTERS

Two different types of surface drifters were deployed during the expedition:

- SVP drifters: four surface drifters drogued at 15m below sea surface (**Figure 15**) were provided by the Météo-France unit of Reunion Island, as a contribution to the Global Drifter Programme (GDP), a scientific project of the Data Buoy Cooperation Panel (DBCP), a joint body of the World Meteorological Organization (WMO) and the UNESCO Intergovernmental Oceanographic Commission (IOC). The SVP drifters are equipped with air pressure (P) and sea surface temperature (SST) sensors and tracked via the Iridium service. Data (lon, lat, P and SST) are transmitted hourly. They can be accessed online in nearly real time (https://www.ocean-ops.org/board).

- Sea Surface Drifters (SSD): the Oceans Institute of the University of Western Australia (UWA-OI) provided lightweight (~1.5 kg) drifters (**Figure 16**) meant to move with the current in the upper 50 cm of the sea. They are made of a 60 cm-long plastic casing and contain an internal SPOT Trace satellite tracker powered by small AAA Alkaline batteries. They are tracked via the Globalstar service, with up to 3-4 months of monitoring life if sampling hourly. The initial plan was to deploy 24 SSDs. Unfortunately, only 19 trackers could be procured due to supply chain issues. The data is stored on the UWA system.

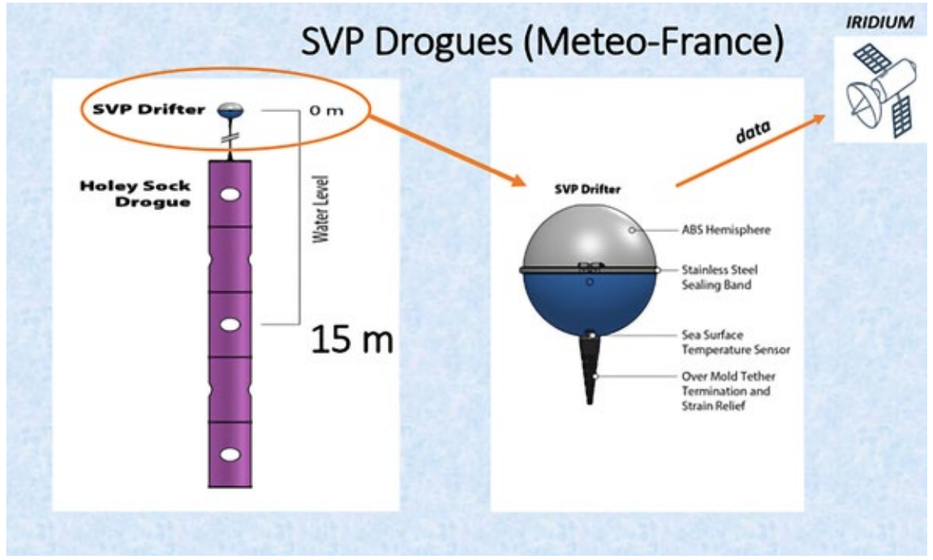


Figure 15: *SVP drifter.*

Figure 16: *Sea Surface Drifter (SSD).*

Nine SSDs were deployed during part one of the expedition between Reunion and Seychelles. Ten SSDs were deployed during part two between Seychelles and Mauritius (**Figure 17** and **Table 2**). The first three units of the first batch had a shorter lifetime as the data acquisition rate was set by default to once per five minutes. The rate was changed to once per hour for the other units, but this was not possible on the last four units of the second batch. The last unit of the second batch did not provide any data.

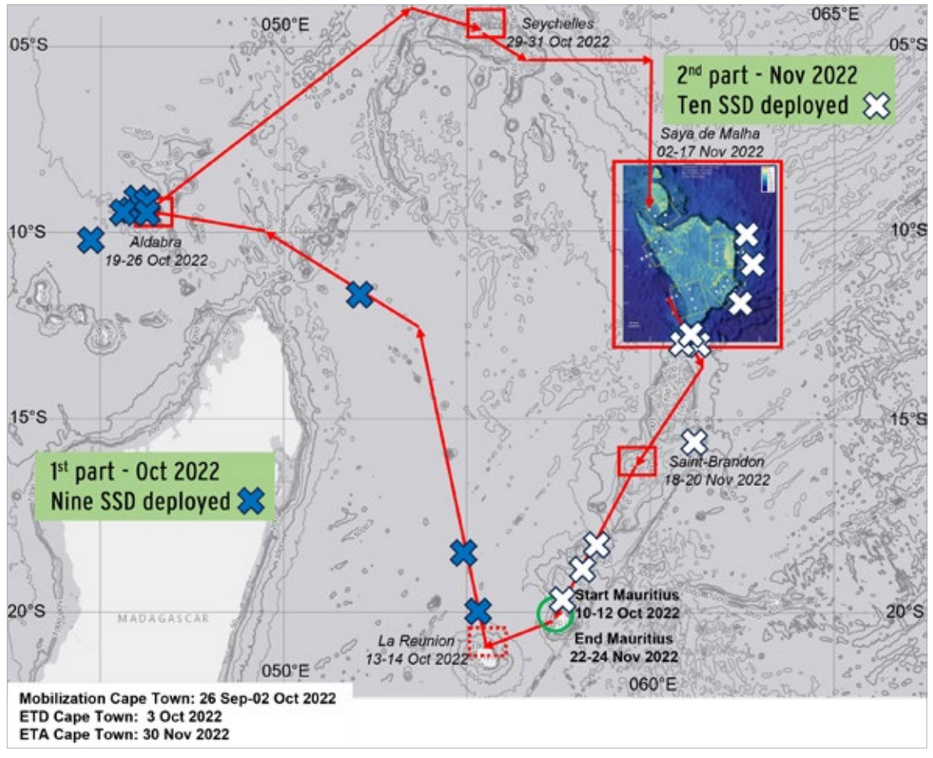


Figure 17: *Map of SSD deployments.*

Table 2
Time and position of SSD deployments

ESN SERIAL NUMBER	ME-IO SSD NUMBER	DATE / TIME (UTC) dd/mm/yyyy hh:mm	POSITION LON (E) LAT (S)	RECORDING INTERVAL (min)	COMMENT
ESN 0-4437514	SSD01	14/10/2022 19:00	055°04.9' 20°00.3'	5	Northward of Reunion Island
ESN 0-4437208	SSD02	15/10/2022 09:50	054°44.8' 18°19.1'	5	
ESN 0-4437206	SSD03	17/10/2022 13:05	051°55.5' 11°47.8'	5	
ESN 0-4437014	SSD6S	21/10/2022 17:45	044°47.8' 10°18.4'	60	Between Comoros and Aldabra
ESN 0-4425407	SSD04	23/10/2022 12:50	046°13.9' 09°22.0'	60	Deployed from a dive boat approx. 2-3 km out (seaward) from the centre of the mouth of Grand Passe, Aldabra
ESN 0-4437201	SSD05	23/10/2022 12:50	046°13.9' 09°22.0'	60	Deployed from a dive boat approx. 2-3 km out (seaward) from the centre of the mouth of Grand Passe, Aldabra
ESN 0-4437508	SSD07	23/10/2022 12:50	046°13.9' 09°22.0'	60	Deployed from a dive boat approx. 2-3 km out (seaward) from the centre of the mouth of Grand Passe, Aldabra
ESN 0-4440776	SSD08	23/10/2022 12:50	046°13.9' 09°22.0'	60	Deployed from a dive boat approx. 2-3 km out (seaward) from the centre of the mouth of Grand Passe, Aldabra
ESN 0-4437203	SSD06	23/10/2022 19:00	045°55.0' 09°25.5'	60	Approx. 30 km west of western end of Aldabra
ESN 0-4437211	SSD09	09/11/2022 15:50	10°12.2' 062°34.9'	60	St 17 - box 3
ESN 0-4441194	SSD10	12/11/2022 00:20	10°54.1' 062°38.8'	60	St 20 - box 3
ESN 0-4436324	SSD11	14/11/2022 14:45	11°53.3' 062°20.1'E	60	St 29R - box 4
ESN 0-4437210	SSD12	18/11/2022 01:20	12°48.6' 061°20.5'	60	East Channel South of Saya de Malha
ESN 0-4440269	SSD13	18/11/2022 01:30	12°49.5' 061°22.5'	60	East Channel South of Saya de Malha
ESN 0-4450210	SSD14	18/11/2022 01:40	12°50.4' 061°24.4'	60	East Channel South of Saya de Malha
ESN 0-4447625	SSD15	18/11/2022 12:55	15°40.7' 061°33.6'	5	East Channel South of Saya de Malha
ESN 0-4450211	SSD16	21/11/2022 18:00	18°13.8' 058°30.8'	5	Between Saint Brandon and Mauritius
ESN 0-4450221	SSD17	22/11/2022 00:10	19°02.9' 058°01.0'	5	Between Saint Brandon and Mauritius
ENS 0-4450215	SSD18	22/11/2022 04:20	20°00.4' 057°26.2'	5	Between Saint Brandon and Mauritius

The four SVP drifters were deployed during part 2: three on the western side of the Saya de Malha Bank to avoid interaction between the drifter's drogue and the shallow bank topography, and one between Saint Brandon and Mauritius (**Figure 18** and **Table 3**).

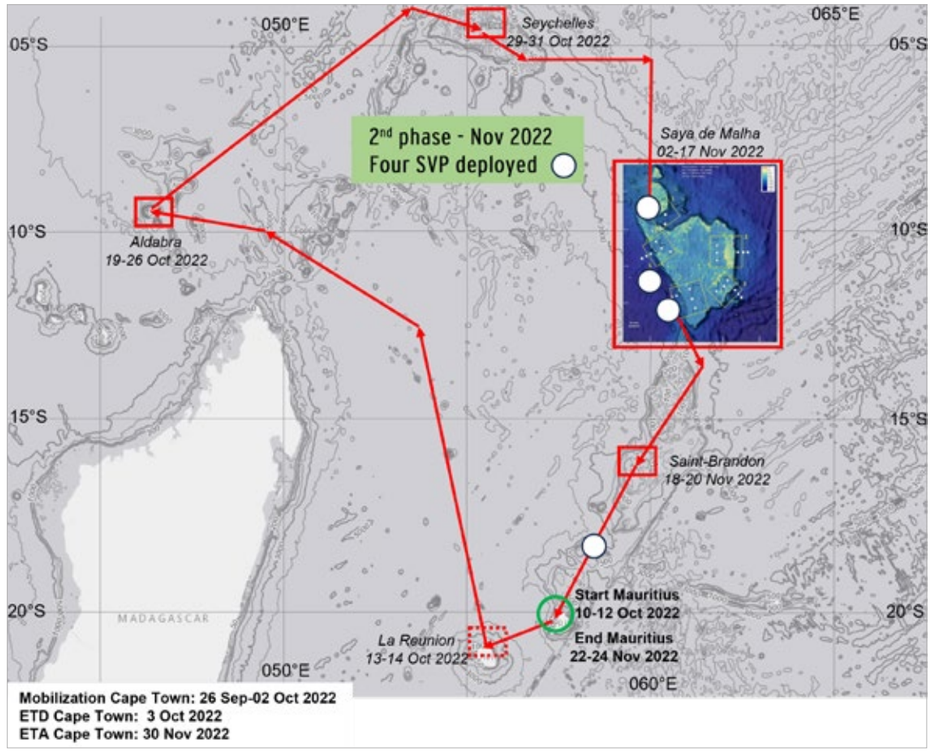


Figure 18: *Map of SVP deployments.*

Table 3
Time and position of SVP deployments

WMO NUMBER[2]	ME-IO SVP NUMBER	DATE / TIME (UTC) dd/mm/yyyy hh:mm	POSITION LON (E) LAT (S)	COMMENT
1601738	SVP1	02/11/2022 15:40	059°57.0' 09°20.3'	West Channel North of Saya de Malha
1601739	SVP2	05/11/2022 20:55	060°00.7' 11°12.3'	St 9 - box 2
1601741	SVP3	16/11/2022 14:30	060°30.2' 12°01.7'	St 37R - box 5
1601740	SVP4	21/11/2022 18:00	058°30.8' 18°13.8'	Between St Brandon and Mauritius

[2] The WMO number provides access to statistical information and graphs of the data collected by the buoy for the past 30 days at http://esurfmar.meteo.fr/qctools/dataplotsurfmar.htm. Status information can also be accessed through the OceanOPS dashboard (https://www.ocean-ops.org/board).

The deployment of SSDs during part 2 was devised to complement the set of drifters released during part 1 and the four SVP drifters. In particular, SSDs were thought to highlight any shift of surface velocity induced by the shallow topography. Consequently, they were mostly deployed east of the Saya de Malha Bank and the Nazareth Bank to the South. The last four of them were deployed between Saint Brandon and Mauritius, at the end of the cruise. One was deployed at the same time and location than the last SVP drifter to test the behaviour of these two distinct lagrangian surface devices.

18 SSDs and the four SVP drifters have provided good quality data. **Figure 19** presents all the drifter tracks up to March 2023. The last tracked SSD drifter stopped emitting on 9 February 2023. One SVP drifter (1601739) stopped emitting on 20 March, while the three others were still emitting on 31 May.

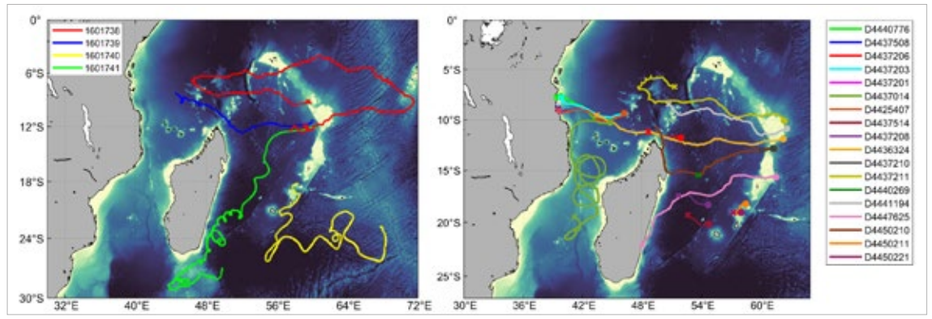


Figure 19: *Left: Trajectories of the SVP drifters (as of 30 March 2023). Right: Trajectories of the SSD drifters (final update: 09 February 2023).*

3.1.3. MADCAPS

Microplastics were collected with a Manta trawl (mouth: rectangular, depth: 0.88 m, length: 0.165 m, mesh size: 500 µm) designed by The Ocean Cleanup. A flowmeter was installed at the entrance of the net to measure the flow and the distance travelled was determined by noting GPS coordinates. At each location, the Manta trawl was deployed at the sea surface for 30 minutes at a speed of 2 knots under good weather condition (wave height < 2 m). Between each transect, the trawl was rinsed with seawater on the outside to remove any missed plastic debris from the cod-end. The cod-end is then detached, placed in a zip lock bag with all information noted (date, cod-end number), stored in a freezer on board and replaced with a new one. Most of the possible environmental parameters were recorded: Beaufort number, wave height, wind speed, atmospheric pressure (**Figure 20**).

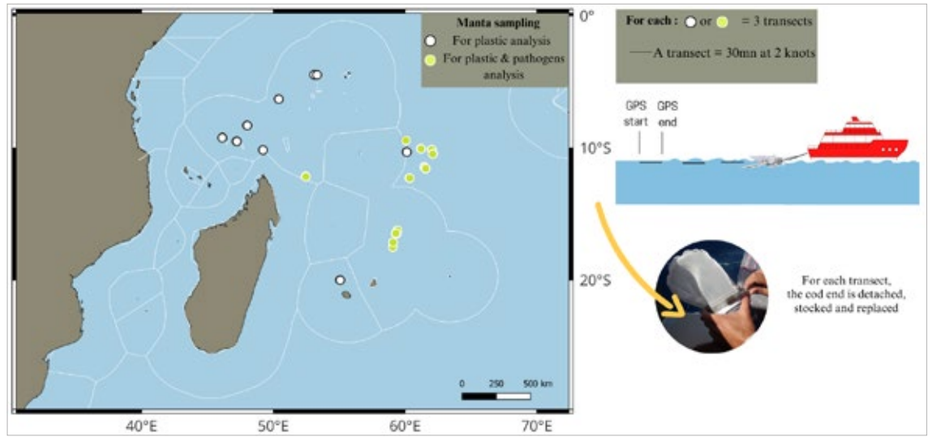


Figure 20: *Sampling methodology.*

Back at the laboratory in the University of Reunion Island, each cod-end was externally rinsed to deposit all plastic debris on a sieve (500µm). Under light and a magnifying glass, all the plastic debris were collected with ultra-fine tweezers (0.3mm diameter) and placed in a Petri dish until analysis and characterization. For each particle collected, we noted: weight (10^{-5} g), category (hard, film, foam, fibre, pellet), polymer type, size class (small microplastics [500 µm-1.5 mm], large microplastics [1.5-5 mm], mesoplastics [5 mm-1.5 cm, small macroplastics [1.5 cm-5.0 cm], colours.

More than 90% of the plastic debris collected are hard type. Other types such as soft plastic, film, pellet, or fibre are found too. This result is consistent with other studies. Hard plastics, in the study, were mostly polyethylene and polypropylene. These types of polymer have a lower density than other types (polystyrene, polyvinylchloride, polyterephtalate). Degradation time of hard plastic can take more time by wind, salt or wave than film or fibre category. As a consequence, they can float across the ocean for a longer period.

Overall, an abundance of (mean +/- sd) 70,859 +/- 173,951 item.km^{-2} was noted (minimum: 0; maximum: 1,176,398 item.km^{-2}) with a size between 500 µm (minimum) and 5 cm (maximum). The distribution by size class is as follows: small microplastics: 21%, large microplastics: 59%, mesoplastics: 17%, and small macroplastics: 3%.

The maximum abundance is observed north-west of Reunion Island at 1,176,398 item.km^{-2} with 53% of small microplastics. For Saya de Malha, we observed an abundance of 7,354 +/- 12,020 item.km^{-2} (maximum: 52,083 item.km^{-2}) with 56% of large microplastics. For Saint Brandon, we observed an abundance of 15,941 +/- 21,466 item.km^{-2} (maximum: 71,285 item.km^{-2}) with 77% of large microplastics.

The analysis of coral pathogens fixed on plastic debris was delayed due to the withdrawal of the partner initially planned. It should be undertaken at the end of 2023.

3.1.4. MARINE MEGAFAUNA MONITORING

A marine mammal observer provided by GLOBICE-Reunion participated in the Seychelles-to-Mauritius leg. The objective was to carry out a survey of cetaceans and marine megafauna in general. This survey represented a unique opportunity to assess the presence of cetaceans on the Mascarene Plateau, and in particular on Saya de Malha Bank and around Saint Brandon shoal, which have been very little surveyed for cetaceans to date.

3.1.4.1. OPERATIONS

The detection of marine mammals was based on both visual an acoustic monitoring. The visual survey consisted in a continuous surveillance of the water surface by an experienced observer to detect the presence of cetaceans. Observations of other marine megafauna, marine birds, marine turtles, and elasmobranchs, were also recorded, as well as marine debris.

The acoustic monitoring consisted in collecting acoustic samples using an autonomous hydrophone, for later analysis.

The equipment used on board to capture megafauna data was composed of:

- A Canon 70D camera with a 150-600 mm zoom lens,
- A Garmin 73 GPS receiver,
- A pair of Swaroski 10x30 binoculars,
- Standardised data sheets for reporting survey effort and sighting data,
- A laptop computer for downloading and saving data,
- An autonomous SoundTrap ST300 STD acoustic recorder (Ocean Instruments).

VISUAL MONITORING

A standard visual survey method was applied along the vessel track. It consisted in continuous monitoring at the front and on each side of the vessel to detect the presence of cetaceans (or other marine megafauna) at the surface. The upper deck of the vessel, above the bridge, located 23 m above the water, provided a 320° field of view on the horizon, allowing a visual detection up to several hundred meters (for dolphins) to a few kilometres (large whales), depending on the species. During transits, the vessel speed was around 14 knots, and the visual survey effort was mainly focused to the front, within an angle of about 120°. This visual field was extended to 320° (160° on each side) when the vessel was stationary or steering at low speed (1.3 knots) to tow gears. Visual monitoring was carried out every day, over a period of time ranging from 8.15 am to 6.15 pm, with some breaks for

lunch and rest (no possibility for shifts since there was only one observer on board).

The vessel track was recorded using a handheld GPS. Visibility conditions were rated on a scale of 1 to 5, based on an assessment of environmental factors that may hinder animal detection, mainly wind speed, swell height and light conditions:

- 1: Null (wind > 4 Beaufort, waves or night),
- 2: Poor (wind >3 Beaufort, many "white horses" or low light),
- 3: Average (wind at 2-3 Beaufort, with some "white horses" or moderate swell),
- 4: Good (wind ≤2 Beaufort, calm sea, no swell),
- 5: Excellent (flat sea).

In case of visibility conditions lower than 3, the visual survey is normally interrupted. During this expedition, however, it was continued in order to detect any opportunistic sighting of marine mammals.

The detection of cetaceans and seabirds was carried out with naked-eyes, binoculars being used only to confirm the detection, identify the species, and collect sighting data. Whenever possible, photographs were systematically taken to confirm the species identification.

When observing cetaceans, or other megafauna, the following sighting data was recorded using a standardised datasheet:

- GPS position (latitude/longitude)
- Species
- Estimated group size
- Group activity (surface resting, foraging, breeding, travelling, undetermined)
- Radial distance between the animals and the vessel
- Bearing angle of the animals in relation to the ship's course.

These last two parameters allow to compute the perpendicular distance of the animals to the vessel's track and therefore to estimate the width of the band being surveyed on either side of the vessel.

Monitoring of other megafauna and avifauna was carried out in conjunction with cetacean monitoring. Because sightings of seabirds are generally more numerous, only the number of individuals and their activity (flight, landing, chasing) were noted. Most identifications were made with binoculars based on morphological (size, colour, wing shape, etc.) and behavioural characteristics (frequency of wing beats, flight altitude, hunting technique, etc.). Photographs were taken when there was a doubt on the species identification.

Observations of marine debris were also recorded. A photograph was systematically taken for further description.

ACOUSTIC MONITORING

The SoundTrap ST300 was deployed from the diving boats, during the dive trips, to get away from the noise generated by the vessel. The acoustic recorder was either attached to a video mooring (IRD team) deployed at the bottom by the divers in depths of 25-30 m or towed behind the boat in deeper waters. The ST300 was set to record continuously, using a sampling rate of 92 kHz. The recordings were analysed at the end of the survey to detect the presence of cetacean's vocalisations, within a radius of a few hundred metres (dolphins) to a few kilometres (large whales and sperm whales).

3.1.4.2. PRELIMINARY RESULTS

VISUAL MONITORING

A total of 148 hours of survey effort (119 hours for Saya de Malha) was carried out by the observer over 21 days, representing an average daily survey effort of 7 hours.

Three sightings of cetaceans (bottlenose dolphins and undetermined baleen whale), 56 sightings of seabirds (nine identified species), two sightings of marine turtles (hawksbill and green turtle) and 52 observations of marine litter were recorded during the survey. Some life was observed on the debris (shell, crabs) or under it (fish).

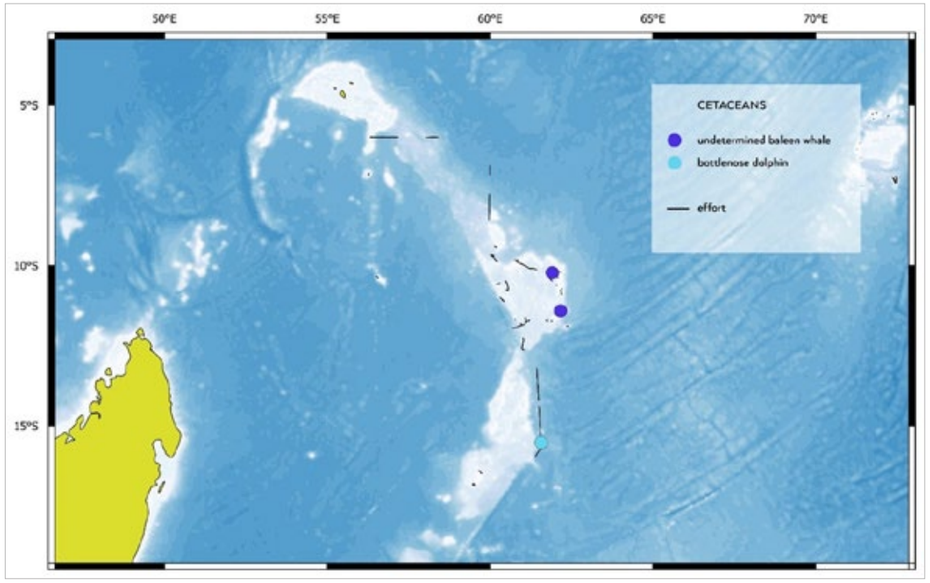


Figure 21: *Maps of cetacean visual sightings.*

Pictures of bottlenose dolphins observed on the Saya de Malha Bank © Bernard Rota - Globice / Monaco Explorations.

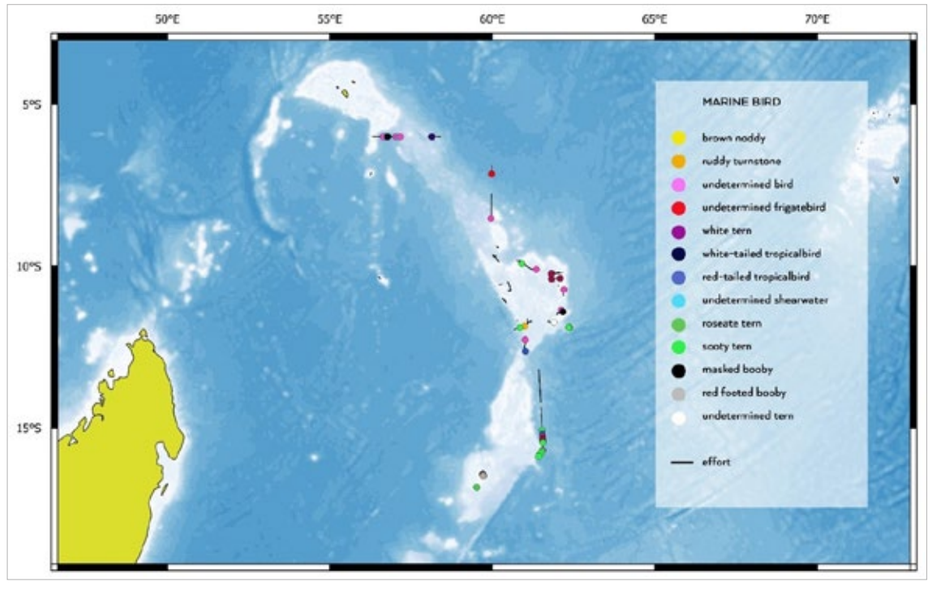
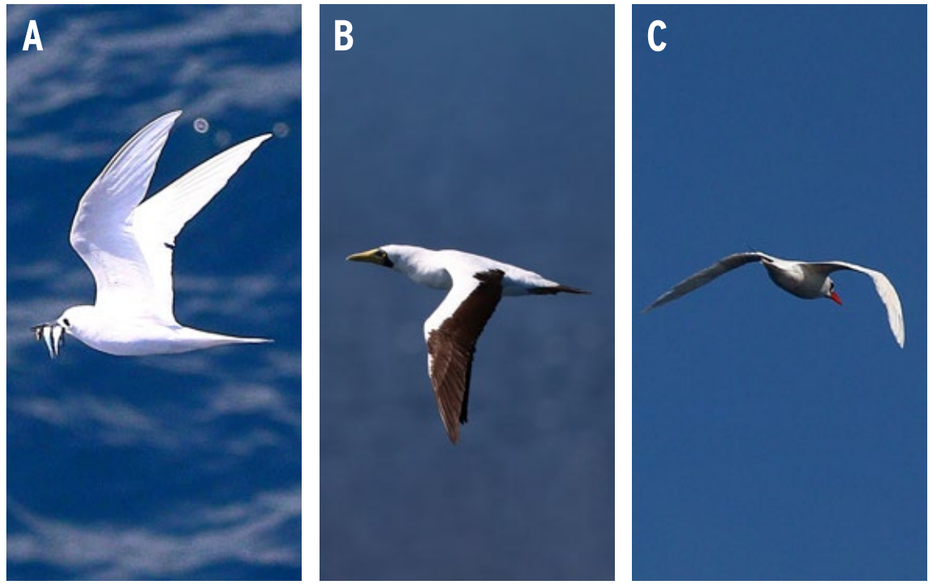


Figure 22: *Maps of sea bird visual sightings.*



Pictures of white tern (A), masked booby (B) and red-tailed tropical bird (C) observed during the survey © Bernard Rota - Globice / Monaco Explorations.

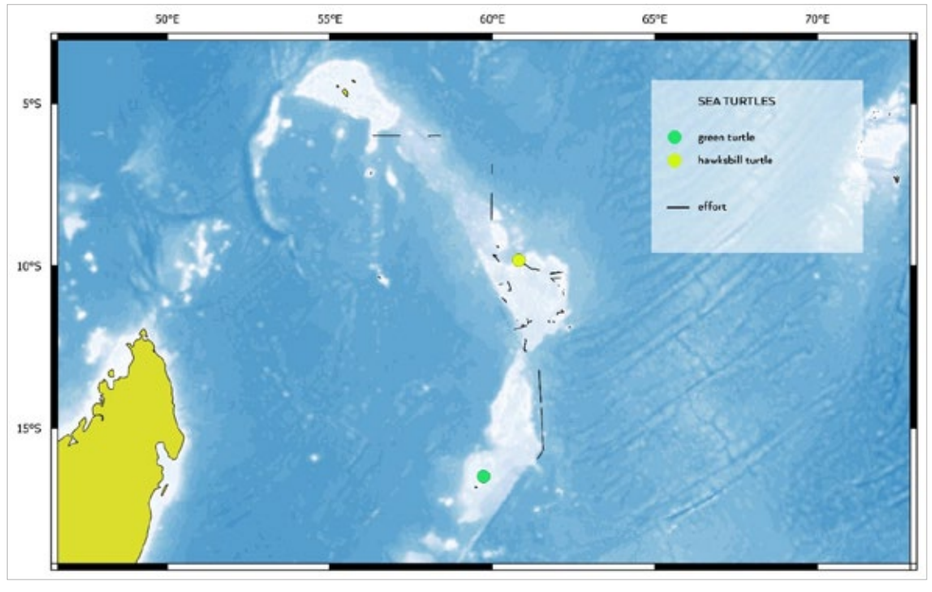


Figure 23: *Maps of marine turtle sightings.*

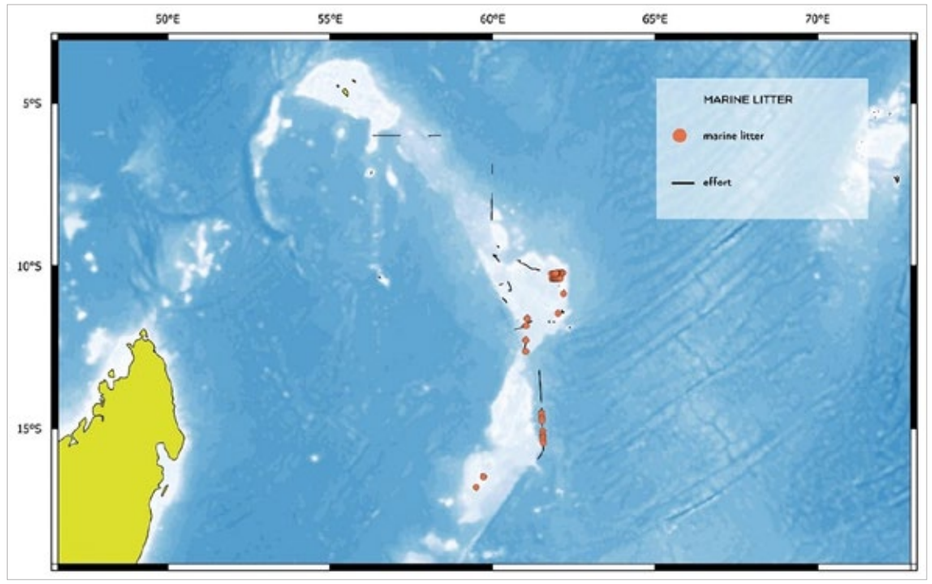


Figure 24: *Maps of marine litter visual observations.*

Pictures of marine litter © Bernard Rota - Globice / Monaco Explorations.

ACOUSTIC MONITORING

11 recordings of approximately one-hour duration each were made on Saya de Malha Bank and around Saint Brandon. The analysis of the recording indicated that no cetacean sound was recorded, while other types of biological sound were present (**Table 4**).

Table 4
Acoustic recordings during the expedition

DATE dd/mm/yyyy	LONG. (E)	LAT. (S)	RECORDING DURATION (hh:mm:ss)	BIOLOGICAL SOUNDS
09/11/2022	062°07.8'	10°22.8'	01:34:12	Fish sounds
10/11/2022	062°07.8'	10°22.8'	01:40:55	Fish sounds
11/11/2022	062°12.0'	10°43.8'	01:10:11	No biological sound
11/11/2022	062°11.4'	10°54.0'	01:25:03	Fish sounds
13/11/2022	062°00.6'	10°54.0'	01:24:04	Fish sounds
19/11/2022	059°39.0'	16°39.0'	02:31:54	Fish sounds and snapping shrimps
19/11/2022	059°39.0'	16°22.8'	00:23:15	Noise
19/11/2022	059°22.8'	16°22.8'	00:49:24	Noise
20/11/2022	059°31.2'	16°50.4'	00:52:22	No biological sound
20/11/2022	059°28.8'	16°48.0'	01:25:36	No biological sound
21/11/2022	059°30.6'	16°36.0'	01:27:48	Snapping shrimps

CONCLUSION

This opportunistic marine megafauna survey along the track of *S.A. Agulhas II*, from Seychelles to Mauritius and on Saya de Malha Bank collected a few sightings of cetacean and megafauna species in general. The low number of sightings is probably due to the poor sea-state and visibility conditions encountered during the survey but also to the fact that this was not a megafauna dedicated survey. A lot of time was spent in shallow waters, on the shelf of Saya de Malha Bank, as opposed to the edge and the slope of the bank usually hosting a high cetacean diversity. The speed of the vessel during transit was also faster than specific cetacean surveys, which also made cetacean detection difficult. These observations however complement the data available for this remote area, which has been only poorly surveyed for cetaceans.

3.1.5. ROUTINE UNDERWAY OPERATIONS

3.1.5.1. SEAFLOOR MAPPING

No Multi Beam Echo Sounder (MBES) is mounted on *S.A. Agulhas II* for undertaking swath bathymetry surveys.

Bathymetry transects were carried out with two single-beam echosounders (SBES): the Simrad EA600 hydrographic echosounder (18 kHz) and the Simrad EK60 scientific echosounder (38, 120 and 200 kHz). Both were used to collect accurate depth data.

The Kongsberg TOPAS PS 18 parametric sub-bottom profiler (18 kHz) was also used for imaging of the sediment layers (sub seafloor imaging) along bathymetry transects.

The passage soundings were conducted by the surveyor contracted by Marine Solutions to provide positioning for the ROV. The three sounders were interfaced to Qinsy for this purpose. No heave or motion compensator was available. All soundings were corrected using GNSS height aiding. Sound velocity was corrected to wherever a profile was available. All soundings were processed onboard. The processing entailed: correction for heights, vessel offsets (heading only as no motion reference unit was available), sound velocity profile (where available) and automated filtering. This was followed by manual de-spiking and suspect data rejection. All data was exported to sounder specific ASCII data files containing the agreed to file header (see **Annex E**).

3.1.5.2. CURRENT

The drop-keel mounted Acoustic Doppler Current Profiler (ADCP) from RDI was operated to measure ocean current velocities and directions. The frequency of the ADCP is 75 kHz with 8 m vertical resolution and a maximum depth of 800 m. The recording was stopped when the drop-keel had to be taken up when the ship's speed exceeded 14 knots.

Some preliminary results related to the analysis of the data collected at 30 m depth during the Saya de Malha sequence are presented in **section 3.3.2.2.2.** Further processing needs to be carried out on the ADCP data including the removal of possible noise/interference caused by other acoustic equipment operating at the same time during the survey.

3.1.5.3. SEA SURFACE TEMPERATURE AND SALINITY

Sea surface temperature and salinity were recorded all along the ship track using the ship's SBE45 thermosalinograph (TSG). Sampling rate was set at 6 s.

The raw data was recorded through the SDS.

3.2. THE VISIBLE ISLANDS: ALDABRA AND SAINT BRANDON

3.2.1. GECOS

The GECOS team operated on Aldabra for six days. The field objective was to capture 30 turtles green (*Chelonia mydas*) juveniles (15 in the Picard station and West Picard areas, and 15 in the Middle Camp East Malabar area), as well as ten hawksbill turtles (*Eretmochelys imbricata*) juveniles (five in the Picard station West Picard area, and five in the Middle Camp Malabar East area), as well as placing an Argos GPS beacons on two juvenile green turtles.

In the Aldabra area, the achievement of the objectives was as follows:

- Total number of individuals per species: 100%
- Spatial distribution of captured individuals:
  - Green turtle: 100%
  - Hawksbill turtle: 50%
- Number of genetic samples: 100%
- Number of blood samples: 100%
- Number of scale samples:
  - Green turtle: 100%
  - Hawksbill turtle: 50%
- Installation of Argos beacons according to the areas initially defined: 100%

For the analytical part:

- Tracking data by satellite telemetry: 100%
  Note that one of the beacons seems to have problems conveying quality positions.
- Genetic analysis: 100%
- Inorganic contamination analysis: 100%
- Physiological analyses: in progress
- Acquisition of geolocations of green turtles from Argos beacons: 80%

As preliminary results:

- The genetic structure is similar to that found in the Northern Indian Ocean but evolves over time.
- As at other sites in the Indian Ocean, juvenile turtles remain faithful to a specific area of the lagoon for several months, even years. Their state of health is therefore a reflection of a specific environment.
- Analyses of inorganic contamination have yielded their first results: there are major differences between Reunion Island and Aldabra.

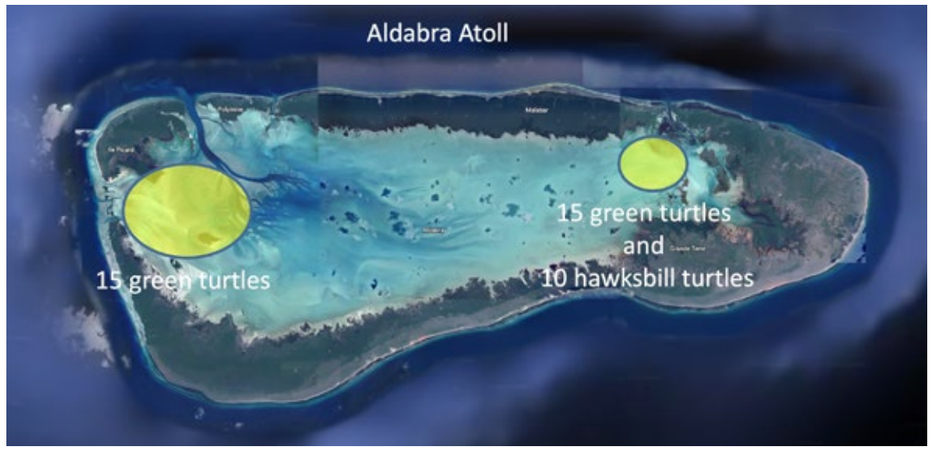


Figure 25: *Summary of skin biopsy (genetic), blood and biopsy (health check) collections from green and hawksbill turtles.*

Turtle Rodeo in Aldabra lagoon © Elise Rigot - Monaco Explorations.

3.2.2. 4SEA

The 4Sea project team was able to carry out acquisitions in areas that are remarkable for their low level of human activity and high level of protection: Aldabra, Saya de Malha Bank and Saint Brandon.

The objectives set for the 6-day sequence in Aldabra were achieved. All the surveys took place in the western part of the atoll, concentrating on four sites with 29 surveys carried out by autonomous board for a total acquisition time of 30 hours and 33 drone overflights representing 8 hours 15 minutes of acquisition (**Figure 26**). A GPS reference base and control points were deployed on land to correct and improve the geolocation of the data acquired (centimetre accuracy). In particular, this enabled to accurately superimpose data from different sources (drone and autonomous board).

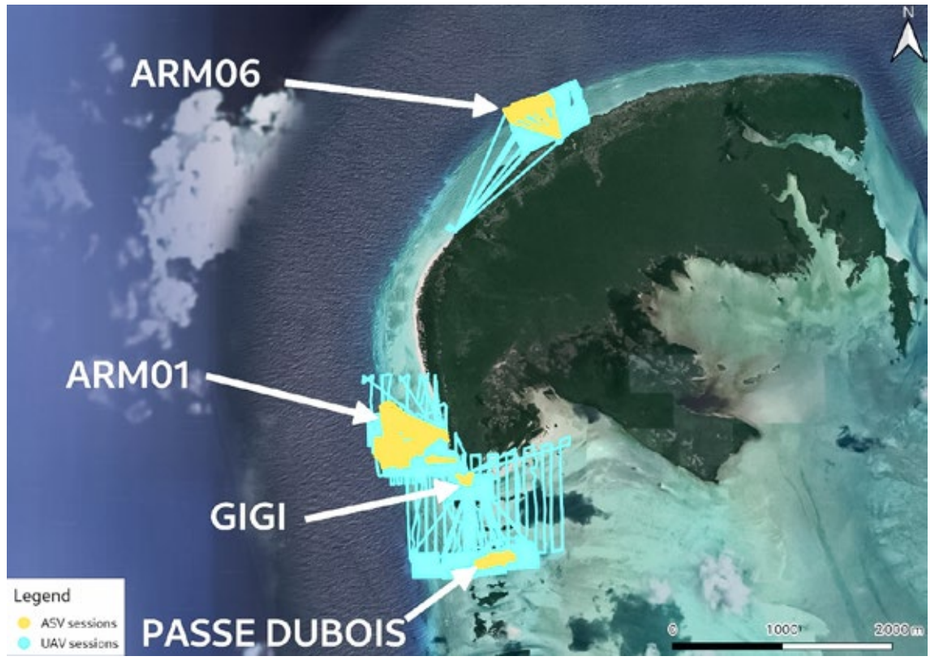


Figure 26: *Transects at Aldabra (UAV / aerial drone in blue, ASV / autonomous board in yellow).*

On the subsequent leg from Seychelles to Mauritius, the aerial drone was no longer on board. The weather conditions and bathymetry meant that only two acquisitions could be recorded on Saya de Malha Bank: one with the autonomous board and one by equipping the ROV with the project cameras. At Saint Brandon, the conditions were favourable and enabled two acquisitions using the autonomous boards, for a total of five hours.

In the period since the end of the expedition, the main actions have been:

- standardising the data collected and the associated metadata in order to make them available to the community.
- photogrammetric processing of the images collected by the drones and the autonomous boards. This processing uses OpenDroneMap open-source software, a free, commercial-grade software package for structure-from-motion (SfM) photogrammetric processing (software originally developed for aerial images). In particular, it can be used to generate georeferenced orthophotos, point clouds, elevation models and textured 3D models from aerial images.
- processing the data collected by the autonomous boards and drones to produce bathymetry maps and compare them.
- annotating manually the habitats and species identified on the images collected for training a deep learning model.

Underwater and aerial images were collected and then processed using photogrammetry or deep learning to obtain cartographic products (orthophotos, digital elevation models [DEM], maps of habitat distribution or species occurrence, etc.). Echosounder data was processed separately to produce bathymetric maps. The main results concerning photogrammetric processing, analysis of bathymetric data from the echosounder and deep learning processing are as follows:

PHOTOGRAMMETRIC PROCESSING

Photogrammetric processing was completed for UAV images but is still in progress for ASV data.

Orthophotos and digital elevation models (DEMs) were generated from UAV images for the following sites:

- ARM01: 4 orthophotos, 4 DEMs
- ARM06: 1 orthophoto, 1 DEM
- Plage Gigi: 1 orthophoto, 1 DEM
- Passe Dubois: 2 orthophotos, 2 DEMs (examples in **Figures 27.E** and **27.F**)

Bathymetric maps were generated from ASV echosounder data for the following sites:

- ARM01: 13 bathymetric maps (**Figure 27.A**)
- ARM06: 3 bathymetric maps (**Figure 27.B**)
- Plage Gigi: 8 bathymetric charts (**Figure 27.C**)
- Passe Dubois: 5 bathymetric maps (**Figure 27.D**)

For the multiscale part (superimposition of UAV and ASV data over the same area), bathymetric maps were generated for the Passe Dubois area. **Figure 27.E** shows an example of a comparison between the bathymetry generated from UAV data and the more accurate bathymetry generated from ASV echosounder data. The colour palettes are deliberately different to distinguish the data used to generate the two bathymetries.

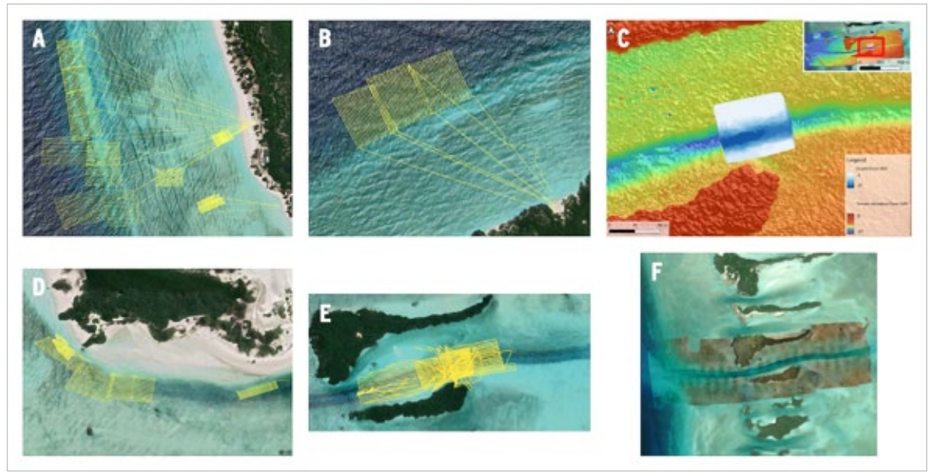


Figure 27: *GPS tracks of ASV acquisitions at ARM01 (A), ARM03 (B), "Gigi" beach (C), Passe Dubois (E), bathymetry produced at Passe Dubois by autonomous boards (blue gradient) and by aerial drones (red to blue gradient) (E) and superposition of an aerial orthophoto with a satellite map at the same site (Passe Dubois) (F).*

Underwater orthophotos were produced from the ASV images. **Figure 28** is representative of those produced on small portions of the areas sampled during each deployment.

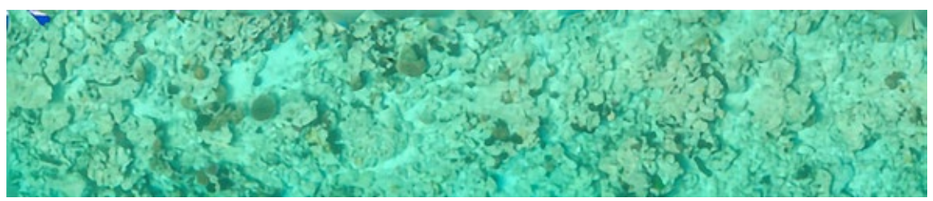


Figure 28: *Example of underwater orthophoto (not georeferenced yet size: 20 m x 5 m).*

DEEP LEARNING PROCESSING FOR HABITAT AND SPECIES IDENTIFICATION

The artificial intelligence (AI) models that have been developed can process images separately (as they are collected) or when they are grouped together in orthophotos (after photogrammetric post-processing).

The presence of new species in the areas studied means that, in order to recognise them automatically, the models need to be trained to recognise these new types of objects. To do this, the main stages of the work involve:

- improving image annotation by increasing the quantity of images available for existing object categories and by creating new object categories to be annotated (manual work with prospects of partial automation),
- train the models to better recognise these categories by training them on manually annotated images,
- predict the presence of these categories on georeferenced images unknown to the models: individual images or orthophotos.

As an example, **Figure 29** shows the result of a prediction by a deep learning model on a georeferenced image processed in isolation. The result shows the contours of the object recognised and indicates that it is dead coral.

Figure 29: *Recognising a dead coral on a georeferenced image.*

By multiplying this type of processing on batches of images collected in the same area, it is possible to map occurrences of species and other categories of objects that deep learning models are trained to recognise. **Figure 30** shows an example of a mapping product that can be automated by AI models for a given category (dead corals in this case) based on predictions made on individual images collected in the same area (Passe Dubois in Aldabra).

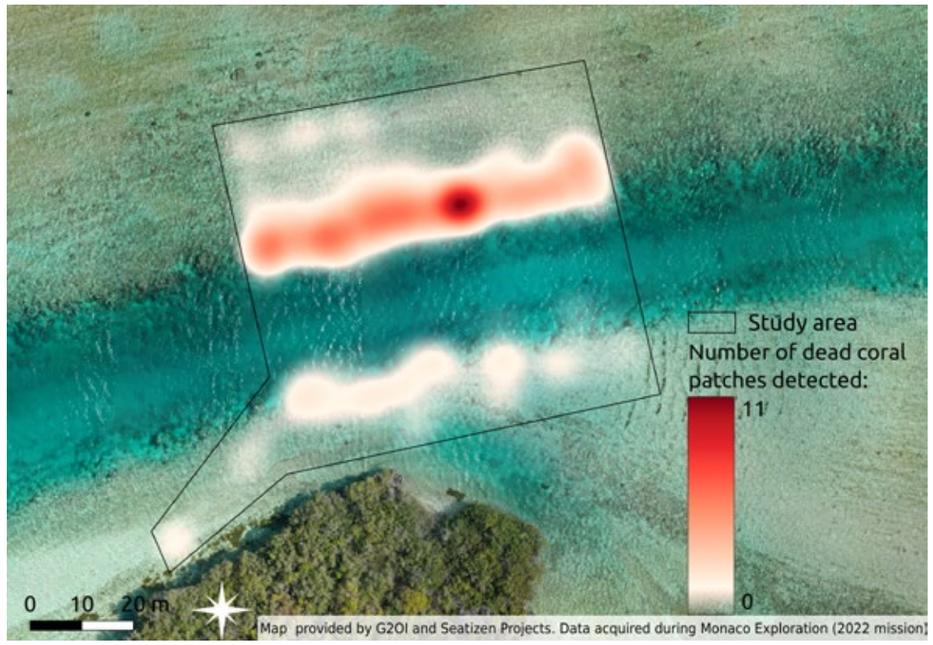


Figure 30: *Density map of dead corals in the Dubois Channel obtained using predictions from deep learning models.*

In addition, similar work is being carried out to enable an orthophoto to be used directly instead of individual images, for both annotation and prediction on these large-scale images. **Figure 31** shows an example of the work in progress, which uses a single image (an orthophoto composed of several images collected separately) to make predictions that return object detections directly in a cartographic format that can be viewed in a Geographic Information System (QGIS in this case).

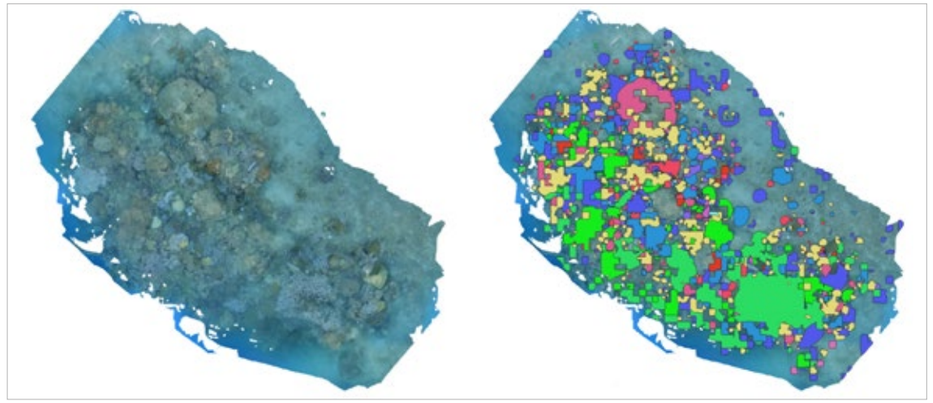


Figure 31: *Automated habitat/species mapping directly on orthophotos. Each colour on the right corresponds to a different coral species.*

3.2.3. MADCAPS

The MADCAPS team took advantage of the Aldabra sequence to characterize the abundance of macro litter beached on the atoll, using Sustainable Seas Trust protocol in partnership with the Seychelles Islands Foundation.

11 transects of 50 m parallel to the shore were completed to collect all size class plastic debris from the vegetation zone to the shoreline (**Figure 32**).

Figure 32: *Transects on Aldabra.*

Among the 828 items collected 71% were plastic debris followed by textile debris, with an average abundance of 1.5 item.m^{-1}, with an average mass of 36.9 g.m^{-1}.

The brand identification from 26 items with legible marking revealed 17 different brands all foreign to Aldabra. Some of the brands analysed originate from a specific region, such as Aqua or Kratingdaeng, which are sold in South-East Asia and are present on 10 of the 26 items of waste displaying a legible brand name. Others are international brands sold worldwide, such as Coca Cola products. In most cases, the area of production and export is not easily identifiable.

The origin of textiles is more complicated to determine and less reliable. Textiles from local Seychelles brands were found.

Comparisons with other islands are always complex, given the many factors that influence them, such as the season or specific events of anthropogenic or natural origin. Aldabra was compared to Sainte Marie Island (Madagascar), considering that on Aldabra, the waste found on the coast is of outside origin, whereas on Sainte Marie Island, the sources of pollution are local and outside. Aldabra has an average of 1.5 items of waste per metre, which is comparable to the 1.1 items of waste per metre found on the least polluted beaches of Sainte Marie.

3.2.4. WORLD CORAL CONSERVATORY

The World Coral Conservatory team collected 58 coral colonies in Aldabra, in collaboration with the Seychelles Islands Foundation. These 58 colonies were dispatched to four European public aquaria: Oceanopolis in Brest, France, Nausicaa in Boulogne-sur-Mer, France, the Oceanographic Museum of Monaco and Burgers' Zoo in Arnhem, Netherlands. The colonies were dispatched as follows: 14 in Nausicaa, 14 in Burgers'Zoo, 15 in Monaco, 15 in Oceanopolis. The precise list of coral species in each aquarium is presented in **Annex F**.

All the colonies collected in Aldabra were in good health conditions on the reef. The project team managed to keep them in good shape on the ship during the transfer from Aldabra to Mahé, thanks to the storage system installed on the poop deck.

Storage system installed on board S.A. Agulhas II *to acclimatise colonies collected in Aldabra © Nicolas Mathys - Zeppelin / Monaco Explorations.*

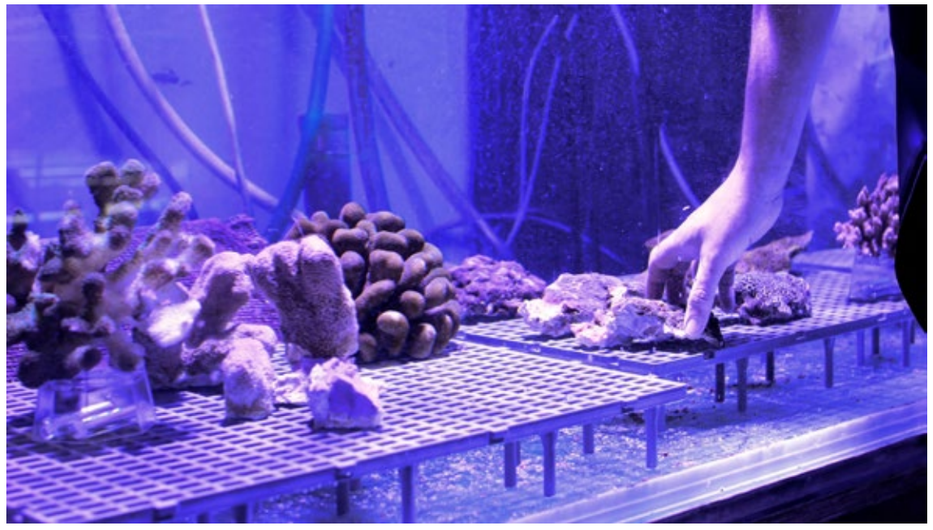
The transfer to the Seychelles Fishing Authority in Mahé and the few days the colonies had to be stored in their facilities also went very well. The preparation for the air transport to Europe, ensured that all the conditions were met to maintain the colonies in good health: the corals were packed following very precise parameters, including the addition of pH buffer, temperature control, etc., to maximize the chances of success. After about 40 hours of transport, the corals arrived in Europe in good condition for almost all of them. Only a few colonies arrived with worrying visual appearance (*Isopora palifera* (977200010159170) in Monaco *Stylophora palmata* (977200010159377) in Nausicaa *Stylophora palmata* (977200010159251) in Oceanopolis). On arrival, the water in the plastic bag used for shipping was brown and smelled a lot. This is usually the sign that the colony

got rid of its zooxanthellae due to a high stress. Despite good care and rapid acclimation, almost all the *Isopora* in Monaco died and the *Stylophora* in Nausicaa totally died. The one in Oceanopolis almost entirely died but a small part was saved. Their size was probably too big to offer optimal conditions during the 40+ hours of transport. The impact of their metabolism on the small amount of water contained in the bag was too important to be buffered.

The rest of the corals acclimated well in the quarantine tanks, but after some weeks, there were the following health issues:

- *Isopora palifera* in Burgers' Zoo started to bleach at the end of March 2023. Despite several treatments and light management changes, the aquarists couldn't stop the phenomenon and the colony finally died on 7 April 2023.
- *Pocillopora eydouxi* in Monaco was really challenging to maintain and it had to be cut several times to remove dying parts. Several frags have been done but they died. The main colony is still alive and pretty big (>20 cm) but maintaining it over a long time period will be a challenge.
- *Leptoseris mycetoseroides* in Monaco started to show some tissue losses a few weeks after arrival. This stopped after it has been moved to a shaded area of the tank. It has been recovering since then but has not yet recovered its initial appearance yet.
- *Goniastrea edwardsi* in Nausicaa died in March 2023 after several intents of treatments and move to different tanks with different light conditions.

All the other colonies are doing really well. Today we have a 95% survival rate which is really high and satisfying, especially considering that some of the species collected are kept in aquarium for the first time. Some colonies are growing fast. The most impressive growth is observed on the *Tubastrea micranthus* hosted in Monaco. The *Acropora valida* in Monaco and Brest also show really nice growth even if it is only a visual appreciation so far.



Some of the coral colonies taken from Aldabra arrive in the Aquarium reserves of the Oceanographic Museum in Monaco. 10 November 2022
© Frédéric Pacorel - Oceanographic Institute.

3.2.5. CORAL CONNECT

3.2.5.1. FIELD OPERATIONS

The operations were conducted by scuba divers.

The sampling in Aldabra was coordinated with the World Coral Conservatory team and broadly followed the same dive times and site plan. A team member stayed on in Aldabra after the ship had left and was able to collect additional samples.

The team also enabled and supported a Mauritian PhD student, University of Mauritius to collect video transect data at three sites in Aldabra to allow comparative work on coral connectivity in collaboration with the Seychelles Islands Foundation.

Figure 33 and **Table 5** provide the details of the sampling sites.

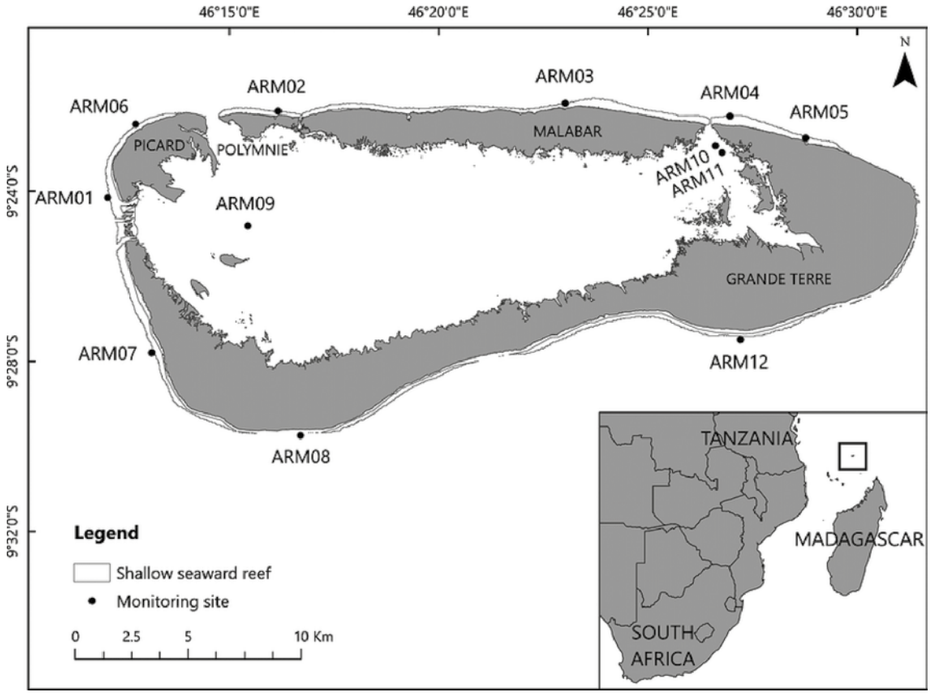


Figure 33: *Location of Aldabra sampling sites.*
Note: the names (ARM01, etc.) refer to the Aldabra Reef Monitoring (ARM) sites detailed in Table 5.

Table 5
Details of Aldabra sampling sites

SITE CODE	SITE NAME	LON (E)	LAT (S)	DEPTH
ARM01	Settlement Reef	046°12.05'	09°24.12'	15 m
ARM01	Settlement Reef	046°12.22'	09°24.12'	5 m
ARM06	Anse Var	046°12.75'	09°22,38'	15 m
ARM06	Anse Var	046°12.76'	09°22,41'	5 m
ARM07	Anse Mais	046°13,24'	09°27.78'	5 m
ARM07	Anse Mais	046°13.13'	09°27.81'	15 m

The sampling in Saint Brandon was coordinated with the researchers from the University of Mauritius, Mauritius Fisheries Training and Extension Centre and the French National Museum of Natural History and included the collection of sponges, giant clams and nudibranchs. **Figure 34** indicates the location of the five sites that were explored.

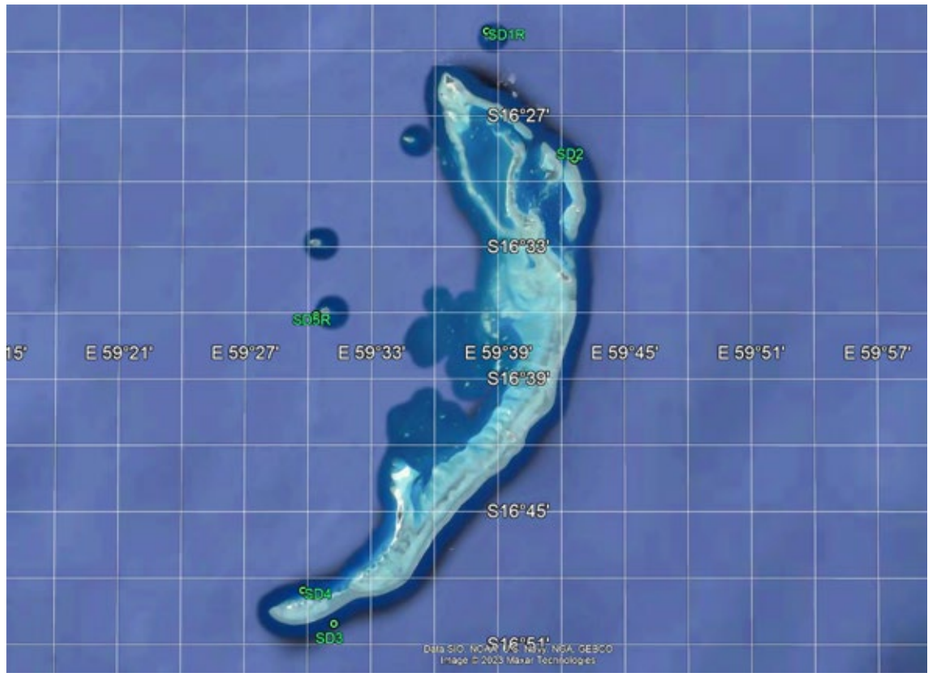


Figure 34: *Location of Saint Brandon sampling sites*.

Whole coral colonies were photographed from approximately 1 m above with a scale bar, as well as in close-up (showing corallites and polyps). Tissues were collected in Ziplock bags with fragments (approximately 2 cm^3) removed underwater using either bone cutters or a small chisel. On the surface, samples were rinsed in filter-sterilised sea water and immersed fully into 99% ethanol/RNAlater, before storage in a chilled cooler box. Upon return to the ship, samples were stored at -20°C.

Triplicate two-litre water samples were collected from a range of reef locations throughout the expedition using sterile Whirl-Pak bags. These water samples were then filtered aboard the ship, using sterile filters and a vacuum pump set-up. The filters were frozen dried aboard the ship and stored at -20°C and transported to the United Kingdom on ice.

To build structure-from-motion (SfM) 3D models from an uncalibrated GoPro™ camera system, a diver filmed slowly over a 25 m section of reef in a straight line (transect). The area for filming was marked out with a measuring tape, and scale bars used for scale calibration. The team aimed to film transects at 8 m and 15 m during each dive. Videos were downloaded after each dive.

3.2.5.2. SCIENTIFIC RESULTS

3.2.5.2.1. CORAL SAMPLING

The target number of species were sampled as listed in **Table 6**.

Table 6
Coral samples (small fragments stored in RNAlater).

CORAL SPECIES	NUMBER OF SPECIMENS
Pocillopora meandrina	14
P. eyedouxi	5
Acropora tenuis	21
A. cytherea	2
Isopora palifera	18
Total number of specimens	**60**

Due to delays in establishing the CITES permits the export of the samples from Seychelles to the United Kingdom where the laboratory analysis will be conducted was postponed. It is expected that the laboratory analysis will start in June.

3.2.5.2.2. EDNA SAMPLING

The target number of water samples was collected from five sites around Aldabra and three sites around Saint Brandon that were filtered and stored for laboratory analysis. The eDNA analysis was completed.

3.2.5.2.3. BENTHIC STRUCTURAL COMPLEXITY SURVEYS

Four reef sites were mapped around Aldabra. A further three sites were mapped around Saint Brandon. The photogrammetry models were completed. Further analysis is in progress on the data to understand the spatial patterns of coral distribution around Aldabra.

3.2.5.2.4. *CTENELLA CHAGIUS*

As recently as 2010, ten to fifteen colonies of *Ctenella chagius* were observed (and in several cases, photographed) by David Obura at Ile du Nord, Saint Brandon in shallow (5-10m) waters, close to the shore. Unfortunately, weather conditions meant that this site was too exposed to safely dive, and so the team instead moored in the lee of the island. The depth at this site (and indeed at most other sites around Saint Brandon) was shallow (<15m) and so bottom (and hence survey) times were long enough. Despite this, no colonies of *Ctenella chagius* were observed.

Expertise and equipment from the World Coral Conservatory team are being applied to a potential rescue mission for the Chagos brain coral due to an imminent El Nino warming event.

3.2.6. ROV SURVEYS

The presence of the ROV installed onboard *S.A. Agulhas II* for the Saya de Malha survey triggered the idea to conduct both video transects and opportunistic sampling using a standard transect and depth methodology that had been used elsewhere in the region (**Figure 35**).

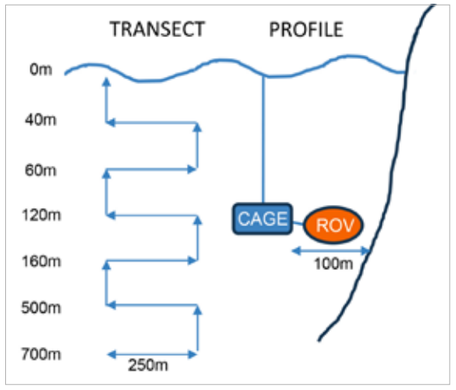


Figure 35: *ROV deployment plan.*
Note: The 700 m transect was replaced with more exploratory surveys due to the cable length and difficulty manoeuvring at that depth.

An operation plan was developed in collaboration between the Coral Connect team and researchers from Seychelles and Mauritius.

Video transects were completed from three sites off Aldabra and two off Saint Brandon. This was the first time that videos were recorded at that depth off both islands. The ROV also collected five water samples for eDNA analysis, three at ~700 m and two at ~120 m off Aldabra, and a further three samples off Saint Brandon.

In addition, two surface transects were conducted with one of the ship's boats towing an underwater camera provided by IRD.

All ROV videos were provided to the Seychelles Islands Foundation (SIF) on hard drives on arrival in Mahé. Based on discussions between the researchers involved in the survey and University of Plymouth researchers who conducted comparable research in the region, a research outline was developed for delivering and resourcing the analysis of ROV data. This analysis is expected to be conducted by a MSc student from Seychelles, subject to appropriate funding.

3.2.7. BIOPROSPECTION OF MARINE SPONGES

55 sponge samples were collected at depths between 10-45 m (five shallow dives), 40-60 m (one ROV dive), and 45-70 m (four deep dives). Same sponge specimens were observed at different sites and depths. Some specimens were unique to one site. A few specimens seem to be the same as the ones collected around Mauritius and Rodrigues.

3.2.8. OCEANOGRAPHIC OBSERVATIONS

One CTD cast and three XBT profiles were recorded (**Figure 36** and **Table 7**).

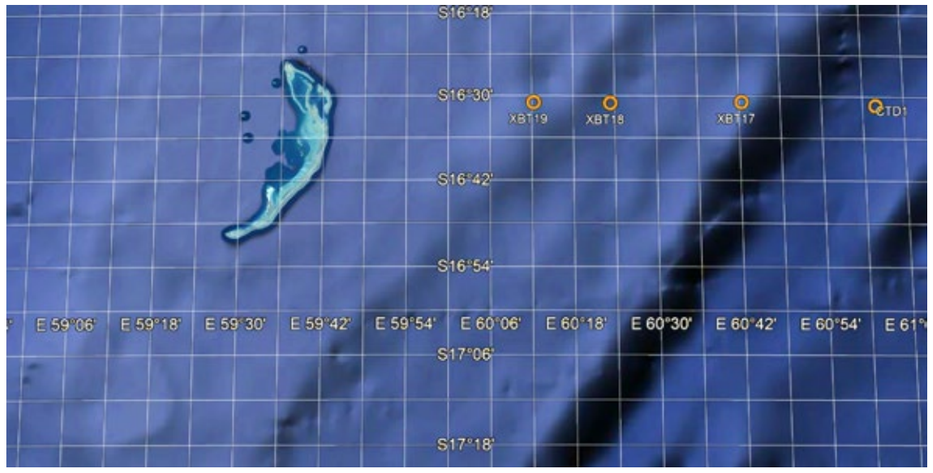


Figure 36: *Location of oceanographic observations ○ off Saint Brandon.*

Table 7
Oceanographic observations off Saint Brandon

NO	DAY (dd/mm/yyyy)	START TIME (UTC) (hh:mm)	LON (E)	LAT (S)	MAX DEPTH (m)	FILE NAME	COMMENT
CTD1	18/11/2022	17:09	061°01.92'	16°31.47'	2000	IO_035	VOY-055-SB-1
XBT17	18/11/2022	20:35	060°43.46'	16°29.83'	900	drop019.nc	Saint Brandon transect
XBT18	18/11/2022	21:52	060°23.22'	16°31.23'	640	drop020.nc	Saint Brandon transect
XBT19	18/11/2022	21:52	060°12.15'	16°31.24'	220	drop021.nc	Saint Brandon transect

3.2.9. BATHYMETRY

Monaco Explorations obtained through the GEBCO-Nippon Foundation Seabed2030 project 30 m resolution satellite derived bathymetry (SDB) for Saint Brandon.

The data provided by TCarta was based on Landsat 8 multispectral imagery (2017-2022).

Single beam echosounder depth data was collected along the ship's track.

3.3. THE INVISIBLE ISLAND: SAYA DE MALHA

A comprehensive provisional report of the Saya de Malha Ecosystem Project, detailing the various work packages and results, was published by the project team in March 2023. The report is available online on the Monaco Explorations website: https://www.monacoexplorations.org/wp-content/uploads/2023/05/MEIO-Leg2-SayaDeMalha-Mar2023_Provisional-Report_FNL.pdf.

3.3.1. WORK PROGRAMME

As the large size of the area (~40,000 km^2) and limited time (2 weeks) did not allow a full coverage of the bank, five areas had been selected during the preparatory phase, based on the diversity of the sediments that were described by previous cruises (**Figure 37**). A small area in the north of the bank was also selected to undertake a short survey of the seagrass meadow. The ship surveyed the areas 1 to 5 sequentially, and the seagrass area was surveyed on the route between areas 2 and 3.

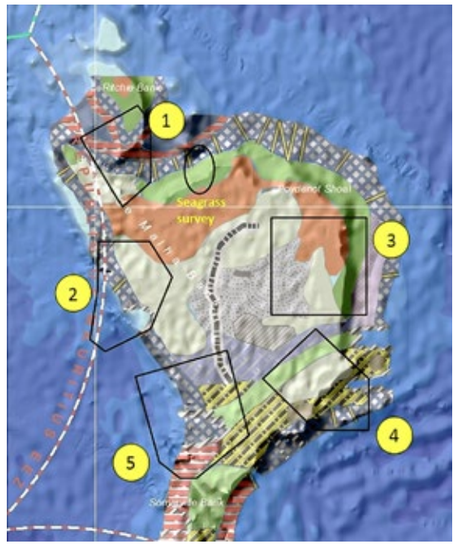


Figure 37: *The five sampling areas (black boxes) and the seagrass meadows area distributed over the sediment landscape of Saya de Malha.*

The work programme was divided into ten work packages (WPs) to cover the diversity of objectives:

- WP1: Seafloor mapping.
- WP2: Physical and chemical oceanography.
- WP3: Phytoplankton.
- WP4: Marine particles and zooplankton.
- WP5: Benthic invertebrates and sponges inventory.
- WP6: Photo-physiological studies of photosynthetic organisms.
- WP7: Scuba diving operations and specimen collection.
- WP8: Video survey and ROV.
- WP9: Megafauna.
- WP10: International Law of the Sea and its relationships with marine science.

Each WP gathered between 4 and 19 members, except WP9 with a single member. The same individual could be assigned to several WPs. There were one or two coordinators by WP.

Five WPs (2, 3, 4, 5 and 8) included day and night operations, with specific teams for each shift, consequently there were two coordinators for each of these day/night WPs.

A variety of operations corresponding to each WP was conducted during the Saya de Malha sequence. The map in **Figure 38** indicates the distribution of operations in the different box areas, on the shelf and in the deep ocean waters (three stations from the slope to a distance of 20 to 25 nautical miles (NM) offshore). Towed gears refer to Warén dredge, beam trawl and epibenthic sledge (WP5). CTD stations (WP2) include the Bongo and Multinet (WP4). The SVP and SSD are the two types of drifters deployed during the cruise (WP2 see **section 3.1.2**).

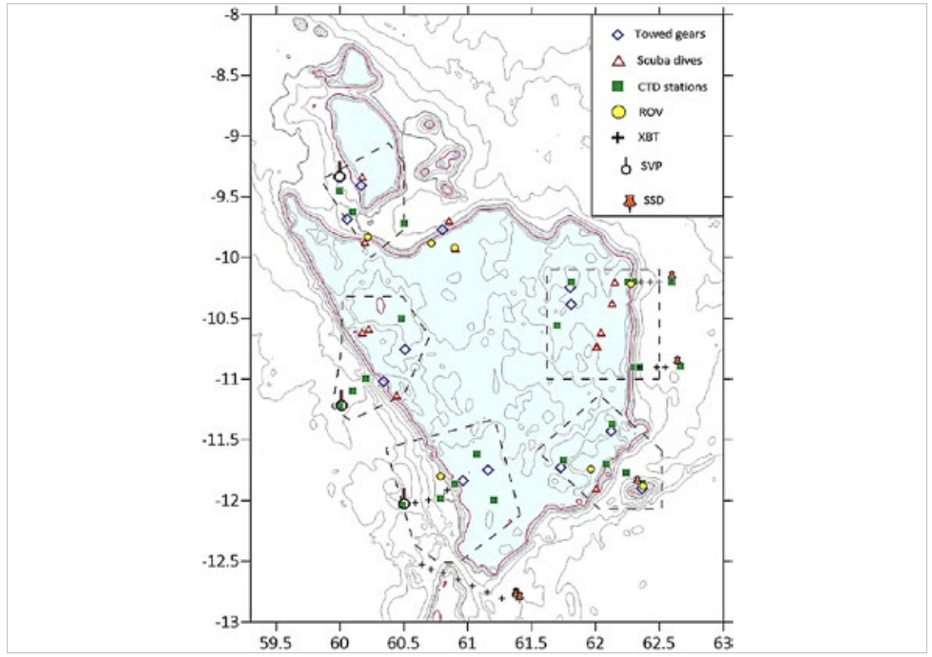


Figure 38: *Location of the operations by category.*

3.3.2. PRELIMINARY RESULTS

3.3.2.1. BATHYMETRY (WP1)

Since no Multi Beam Echo Sounder (MEBS) was available on board *S.A. Agulhas II*, no wide-swath bathymetry maps could be produced along the tracks. The bathymetric data available from previous expeditions (RV *Dr Fridtjof Nansen*, EAF Nansen Programme, 2018; RV *Sonne*, MASCARA project, 2019), was used to navigate safely over and across the shallow areas of the bank.

Monaco Explorations obtained through the GEBCO-Nippon Foundation Seabed2030 project 30 m resolution satellite derived bathymetry (SDB) for the north and east shallow areas. The data provided by TCarta was based on Landsat 18 multispectral imagery (2014). Due to its limited extent and accuracy, it did not help in adjusting the ship's track.

Due to the sea state (2 m swell in general), the 4Sea team could operate its autonomous board from a dive boat only three times. Each session had a duration of about 2 h with a transect spacing range from 1 to 5 m.

The collected Single Beam Echo Sounder (SBES) data provided vertical depth information along the vessel's route (and transits) for the uncovered/unchartered areas. Despite these limitations, these data constitute new information to add to the current database for seafloor mapping of the bank and for navigation purposes. **Figure 39** shows the depth along the tracks followed by the ship. Two of the four frequencies used by the SBES, 38 kHz to cover the deeper areas and 200 kHz for a finer description of the shallow areas are displayed. The information collected by the ship highlighted some discrepancy with the GEBCO bathymetric dataset (2022 version) in a few sectors of the bank. For instance, the deep basin (> 300 m) indicated on the GEBCO map in the north-west part of the bank (**Figure 40**) does not exist. In this area, the *S.A. Agulhas II* measured depths comprised between 80 and 40 m. Similarly, in the north-east corner of the bank, GEBCO indicates larger depths (up to 250 m) than those measured during our survey (< 120 m). Eventually, the GEBCO data of the southern region of the bank indicates depth often deeper than 300 m, whereas the *S.A. Agulhas II* recorded flat bottom not exceeding 300 m.

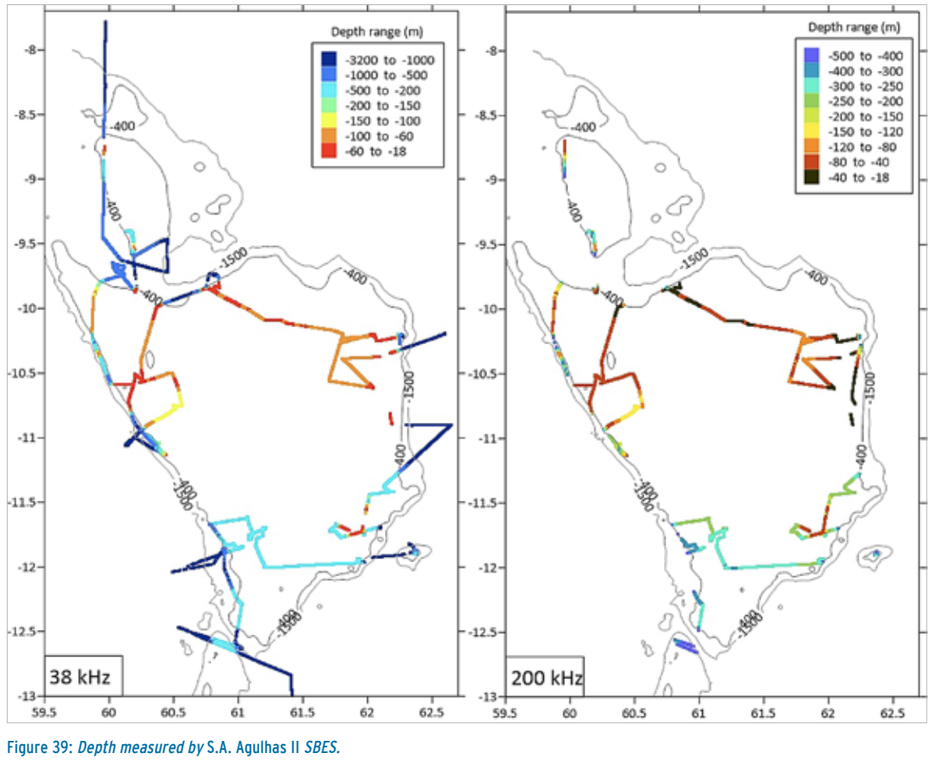


Figure 39: *Depth measured by* S.A. Agulhas II *SBES.*

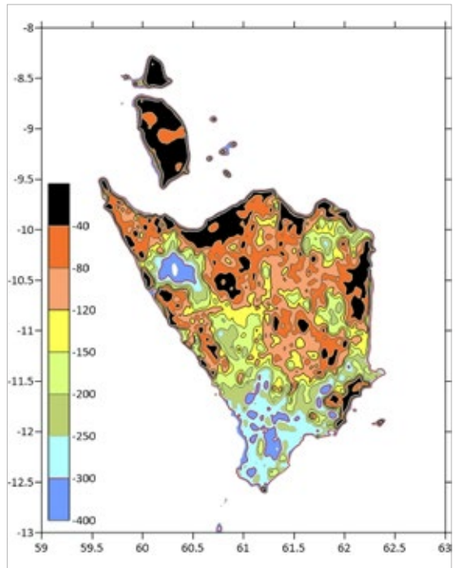


Figure 40: *GEBCO 2022 bathymetric data of the Saya de Malha Bank. The colour scale used here is the same as in the 200 kHz map of Figure 39.*

3.3.2.2. PHYSICAL AND CHEMICAL OCEANOGRAPHY (WP2)

3.3.2.2.1. OPERATIONS

The operations in the WP2 included:

- CTD operations and calibration,
- XBT deployment at selected locations,
- TSG data continuous acquisition along ship track (see **section 3.1.5.3**),
- ADCP data continuous acquisition along ship track (see **section 3.1.5.2**),
- SSD and SVP drifters deployment (see **section 3.1.2**).

CTD OPERATIONS AND CALIBRATION

S.A. Agulhas II Seabird 911+ V2 CTD system was used, coupled with a Seabird 32 Carousel/Rosette fitted with 24 Niskin bottles of 12 l capacity each. The CTD was equipped with sensors for temperature, conductivity, pressure, oxygen, turbidity, fluorescence, transmission. It was associated with an UVP5 (Underwater Vision Profiler voltage 4 on channel 8). The CTD was also equipped with an altimeter. **Table 8** gives detailed information for each sensor.

Table 8
Main characteristics of the CTD sensors

CHANNEL NUMBER	SENSOR TYPE	SENSOR ID	SERIAL NUMBER	CALIBRATION DATE dd/mm/yyyy
1	Temperature	Temperature Sensor SensorID="55"	5646	03/02/2021
2	Conductivity	Conductivity Sensor SensorID="3"	4127	23/03/2021
3	Pressure	Pressure Sensor SensorID="45"	1096	05/03/2021
4	Oxygen	Oxygen Sensor SensorID="38"	1996	05/05/2016
5	OBS, WET Labs, ECO-BB	Turbidity Meter SensorID="70"	BBRTD-385	17/03/2021
6	Fluorometer, WET Labs ECO-AFL/FL	Fluoro WetlabECO_AFL_FL_Sensor SensorID="20"	FLNTURTD-4362	11/11/2019
7	Transmissometer, WET Labs C-Star	WET_Labs CStar SensorID="71"	CST-1775DR	25/11/2019
8	Voltage 4	UVP5		
9	Voltage 5	Free		
10	Altimeter	Altimeter Sensor SensorID="0"	873	15/12/2018
11	Voltage 7	Free		

The CTD/Rosette system was deployed and operated by the crew and DFFE operators.

For CTD calibration purposes, water samples were collected for oxygen and salinity measurements at depths chosen in order to cover the full range of values measured during the cruise and no gradient levels. Water samples were taken at depths depending on the shape of the fluorescence profile in the euphotic layer (surface; upper part of the deep chlorophyll maximum (DCM); DCM; lower part of the DCM, below the DCM). Some depth levels were systematically sampled (surface; 40 m; 100 m) for the plankton physiology study. In the deep layer, samples were taken at regular depths as far as possible (depending on the number of Niskin bottles available).

Salinity measurements (101 samples) were done onboard using a Portasal salinometer, calibrated using OSIL Normal Water standards. Oxygen titrations (using the Winkler method) were used to measure bottle oxygen values on board, within 24h of collection (147 samples). Discrete fluorescence measurements were performed on board (see phytoplankton section **3.3.2.3**). Samples for nutrients analysis (324 samples) were collected at most of the sampled depths and pasteurized (2 hours minimum in an oven at 80°C) for storage and transport back to Brest, France. Measurements (nitrate, nitrite, *phos*phate and silicate) will be done by classical colorimetric method (IMAGO laboratory). Some depth levels were also sampled, filtered and frozen to be analysed in Mauritius (Mauritius Oceanography Institute, MOI). Results obtained by the two methods will be compared.

Of a total of 39 planned grid sampling stations, a total of 25 CTD profiles and rosette samplings were conducted. The stations that were not sampled were largely excluded because more time was needed for dive (SD), towed gears (TG) and ROV operations. In total, all deep stations but one (Sta 28) were sampled, all at night shift (18 deep CTD stations). On the contrary, only seven (out of 20 planned) shallow stations were performed all at day shift. It was decided in the early days of the cruise that repeated day/night shallow stations were not a priority the zooplankton vertical migration could not be characterized (as initially thought) as the towed Bongo nets sampled the whole water column at these shallow stations. More time thus became available for other types of activities.

The CTD profiles reached depths as close to the bottom as possible (10 m above the seafloor thanks to the altimeter of the CTD/Rosette) where depth did not exceed 2,000 m (the maximum depth reached for deeper stations). The station numbering followed the one of the CTD cast (including the 8 CTD profiles achieved during the previous part of the expedition) to facilitate the correspondence in the numbering of all operations done at each station. For Saya de Malha, CTD/Rosette station numbers run from IO_009 to IO_033 (**Figure 41**). The summary of the stations metadata, with time, location, depth, number of sampled levels, plankton net type and station "grid-number" (ship-ID for the operation done at sea) is provided in **Annex G - Table G1**.

Several of the CTD stations were common with the **BGC-Argo project** (see **section 3.1.1**), specifically stations IO_013, IO_018, IO_023 and IO_027. The CTD casts at the BGC-Argo stations were 2,000 m deep and had a specific dense sampling in the upper 120 m (one bottle every 10 m) for calibration purpose. The station IO_034 was a BGC-Argo station close to Saya de Malha but is not considered as a "Saya de Malha station".

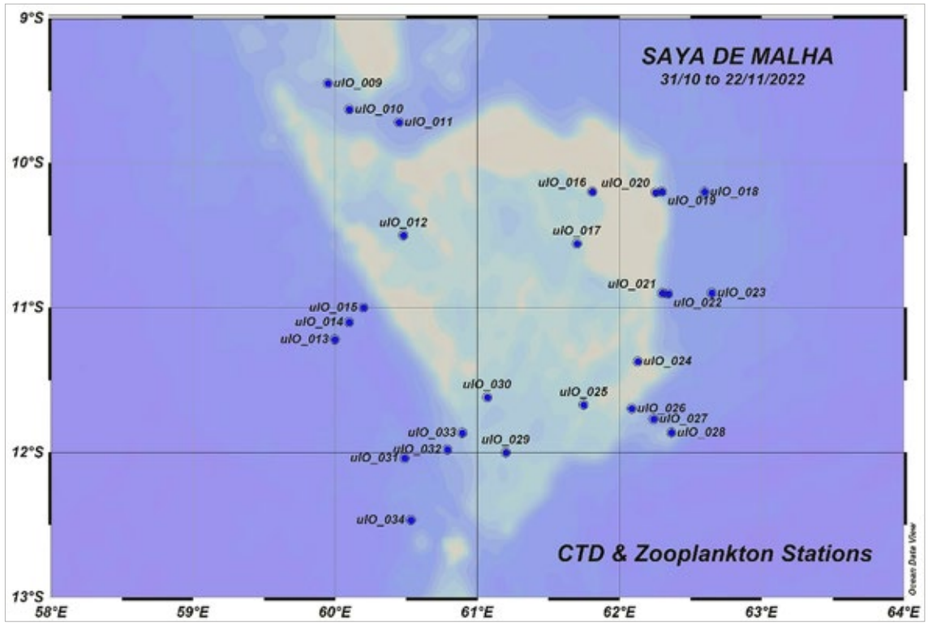


Figure 41: *Map of the CTD stations labelled according to the CTD cast number.*

The CTD raw data were analysed using the Seasoft software SBE Data Processing Win32 Version 7.26.7.1. The process used is the standard one.

The oxygen sensor malfunctioned in the shallow part (~0-50 m) of almost each CTD profile (oxygen concentration much below the expected values). Therefore, the oxygen values are considered incorrect in this surface layer. The oxygen sensor also shifted between downward and upward profiles by almost 20 µmol kg^{-1} at station IO_019 (see **Figure 41**). The sensor's malfunction is probably due to particles caught in the deepest part of the profile (close to the bottom). The oxygen profile looked correct at the subsequent stations, despite small shifts observed at several stations. It was however decided not to replace the sensor to keep the benefice of the calibration by the Winkler titration on water samples done since the beginning of the cruise. Oxygen measurements have thus been more frequent to control a posteriori the validity of the O2 CTD profiles (both upward and downward).

XBT CASTS

Expandable BathyThermograph probes (XBT, T7 type) were launched to provide additional vertical temperature

profiles in between some CTD stations: 16 around Saya de Malha, 3 on the way to Saint Brandon, 4 between Saint Brandon and Mauritius (see **Annex G - Table G2**). This was done during the "offshore" transects on both sides (east and west of the Saya de Malha Bank) in order to highlight possible upwelling signatures. Along each of these transects, three XBTs were launched in order to have temperature profiles every ~5 NM. In addition, an XBT transect (7 XBTs launched at ~6 NM intervals) was achieved across the channel between Saya de Malha and Nazareth Banks at the end of the Saya de Malha cruise when the ship left the study area toward Saint Brandon.

TSG DATA

The TSG data has not been processed so far. Salinity measured from a water sample collected at the upper Niskin bottle (surface samples at around 5 m depth) will be used to adjust the TSG salinity measurements.

ADCP CURRENT DATA

The underway sampling of the hull mounted Acoustic Doppler Current Profiler (ADCP) (see **section 3.1.5.2**) was used to collect ocean current data in the region of the Mascarene Plateau. The ADCP data were pre-processed using the OSSI software developped at GEOMAR, Germany and adapted to the specifics of fishery surveys at IMR, Norway. The preliminary pre-processing involved removing erroneous data, bottom masking and correction of the misalignment between the ship and the ADCP beam axis. The misalignment and amplitude values were -0.5885 and 1.002813 respectively. Only the surface currents at 30 m have been analysed so far.

3.3.2.2.2. PRELIMINARY RESULTS

CHARACTERIZATION OF WATER MASSES

Water masses were first characterized using the Θ-S diagrams at each of the CTD stations (**Figure 42**). These diagrams show a clear distinction between the stations depending on their location relative to the Saya de Malha Bank, both for surface and sub-surface (left) and deep (right) water masses. Less salty waters are present east of the bank compared to the western side, which illustrates the westward transport of fresher Pacific Ocean waters by the South Equatorial Current. Water masses within the channels north and south of Saya de Malha have still distinct characteristics (i.e., origin and mixing). The two easternmost stations (IO-023 and IO-025) also show distinct q-S signature at sub-surface ($26.0 < \sigma < 26.5$). Nutrients concentration (not measured yet) will also be used to characterize the water masses distribution relative to the bank, especially on the slopes of the structure (expected upwelling signature).

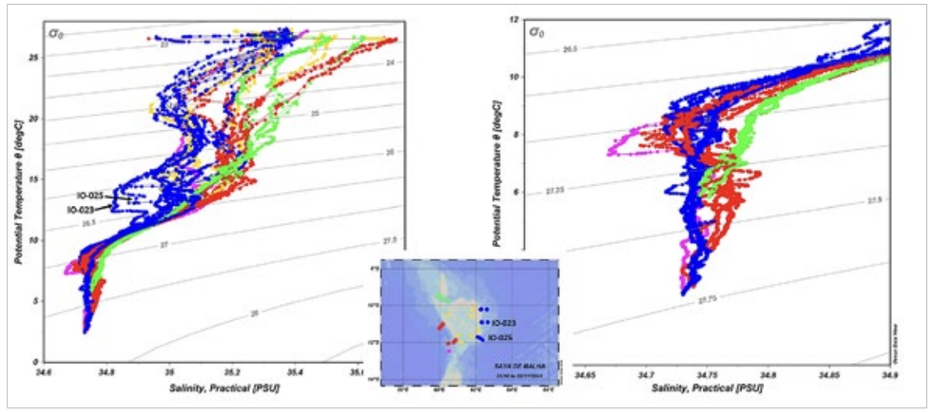


Figure 42: *Left: Θ-S diagram for all CTD stations during the Saya de Malha part. Colour code refers to the station location (blue: east of the bank; red: west of the bank; green: channel between Ritchie and Saya de Malha Banks; yellow: on Saya de Malha Bank; pink: east of the channel between Saya de Malha and Nazareth Banks). Right: zoom on the deepest part of the CTD profiles.*

XBT temperature profiles are plotted in **Figure 43**. The same colour code is used for the two transects (blue for the XBT launched at the seaward position, red for the intermediate XBT and green for the XBT close to the bank slope). XBTs reached the depth of ~800 m but only the first 400 m of profiles are presented here for the sake of readability. The effect of the topography is not straightforward in both figures. The blue profiles (seaward) tend to show lowest temperature, but more detailed analysis is needed. Also, once available, the CTD temperature profiles along the same transects will add valuable information to determine the influence (or not) of the topography on the temperature vertical distribution. The figure highlights however significant differences in the temperature vertical distribution west and east of the bank, with a more pronounced stratification on the eastern flank of the bank. These differences need to be investigated in detail, in relation to the circulation along the slopes. Also, temperature is lower on the east than on the west (e.g., 20°C at 100m in box 3 (east) compared to 22°C to 26°C in box 5 (west) at the same depth).

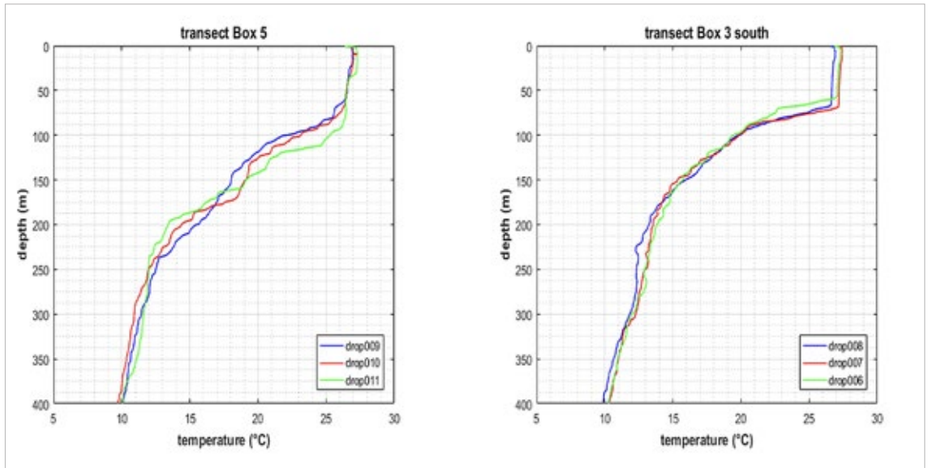


Figure 43: Left: *Temperature profiles measured by 3 XTBs launched on a transect perpendicular to the bank slope west of Saya de Malha (box 5): from the high sea (blue profile) to the bank slope (green profile). Right: same for 3 XBTs on a transect east of Saya de Malha (box 3 south): from the high sea (blue profile) to the bank slope (green profile).*

An XBT transect was performed along the channel between Saya de Malha and Nazareth Banks. Seven XBTs, regularly spaced, were launched from the west (drop012) to the east (drop018) of the channel. **Figure 44** presents XBTs launched in the central part of the channel, with a zoom on the 150 m upper layer on the right panel. To be noted is the presence of a shallow seabed structure (~400 m depth) in the centre of the channel (drop014 and drop015). This topographic structure seems to influence the temperature vertical distribution: the two corresponding profiles are very similar, and they differ significantly for those west and east of the structure. In addition, the surface homogenous layer (from 0 to ~80 m) splits at about 50 m with probably the superposition of two different water masses. This vertical feature is observed all along the transect (7 XBTs) while it has not been identified on profiles both west and east of the Saya de Malha Bank.

XBT launch from the deck of the S.A. Agulhas II
© Jean-François Ternon - IRD / Monaco Explorations.

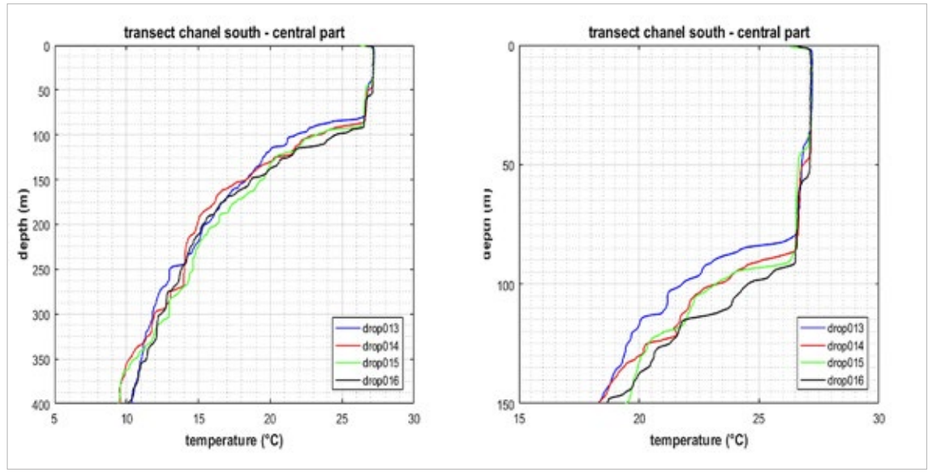


Figure 44: *Left: Temperature profiles measured by 4 XBTs launched on a transect crossing the channel between Saya de Malha and Nazareth Banks, from west (drop013) to east. (drop016). Note that drop014 and drop 015 were above a relatively shallow topographic structure (about 400 m depth). Right: same part of the transect with a zoom on the 0-150 m upper layer.*

CHARACTERIZATION OF THE CURRENTS

During the transit from Seychelles to the Saya de Malha Bank, the westward-flowing South Equatorial Counter Current could be observed at latitudes south of 7°S reaching velocities of about 40 cm/s at 30 m (**Figure 45**).

Along the 6°S transect, the current was northwards in the western part, turning to southwards in the eastern part, under the influence of a cyclonic eddy centred on 4°S. Further south, the SEC intensified on Ritchie Bank (8.6°S) reaching 60 cm/s.

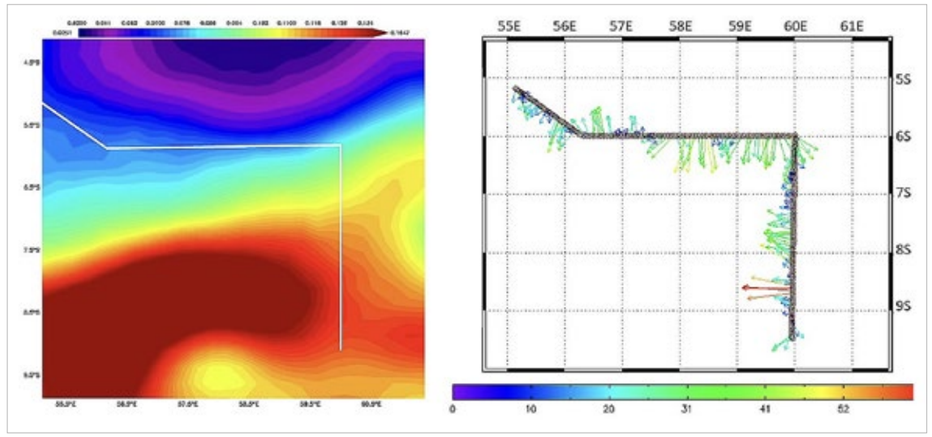


Figure 45: *Left: Sea level anomalies (showing a cyclonic eddy in the north) with the ship track (white line) on 1 November 2022. Right: Current velocity (in cm/s) and direction at 30 m measured by the ADCP during the transit from Seychelles to the Saya de Malha Bank (31 October to 2 November 2022).*

The SEC is also well established over the surveyed region of Saya de Malha (10°S to 12.5°S, 59°E to 62.5°E) at 30 m (**Figure 46**). The current velocities varied between 0 to 30 cm s^{-1} over the bank and up to 63 cm/s along the slopes.

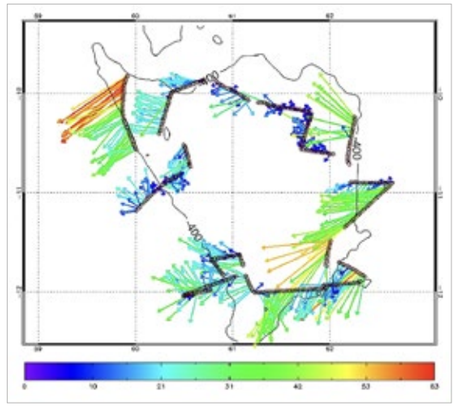


Figure 46: *Current velocity (in cm/s) and direction at 30 m measured by ADCP over Saya de Malha (delimited by isobath -400 m), from 2 to 17 November 2022.*

From Saya de Malha to the eastern slope of the Nazareth Bank (**Figure 47**), the SEC was relatively strong with current velocities reaching 69 cm s^{-1} in the sill region separating Saya de Malha and Nazareth Bank, between latitudes 12°S 13°S.

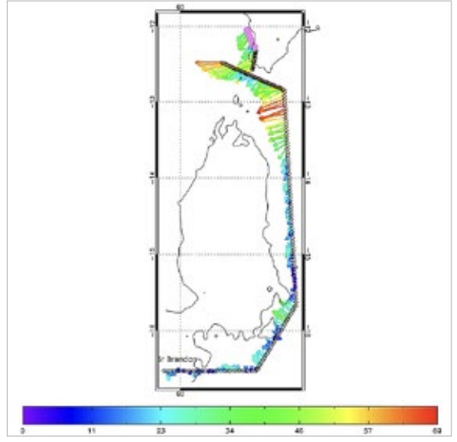


Figure 47: *Current velocity (in cm/s) and direction at 30 m measured by ADCP along the eastern edge of the Nazareth Plateau (delimited by isobath -400 m), from Saya de Malha to Saint Brandon, on 18 and 19 November 2022.*

3.3.2.3. PHYTOPLANKTON (WP3)

3.3.2.3.1. OPERATIONS

PHYTOPLANKTON BIOMASS

Phytoplankton biomass was accessed based on the total chlorophyll-a content of water samples collected with the CTD from the upper 200 m of the water column. Sampling depths were based on the fluorescence maximum (Fmax) depth measured by the CTD fluorescence sensor, and generally included a surface (<5 m), 40 m, 60 m, 80 m, 100 m, and 150 m/200 m depths. From all corresponding Niskin bottles 1 l of water was collected and filtered through Fisherbrand MF300 (GF/C) glass fibre filters (25 mm diameter, 0.7 µm pore) under gentle vacuum. Filters were immediately placed in 6 ml of 90% acetone for chlorophyll-a extraction, and placed at +4°C for 24 hours, whereafter the fluorescence was read on a Turner-Designs Trilogy Laboratory Fluorometer, calibrated prior for the non-acidification measurement of chlorophyll-a. For each batch, both the solid standard and a blank containing only 90% acetone were measured prior to measuring of samples.

For size-fractionated chlorophyll-a, 250 ml of seawater was sequentially gravity filtered through a 20 µm, 2 µm and 0.2 µm 47 mm Nuclepore filters, and all filters placed in 6 ml of 90% acetone for extraction.

Total chlorophyll-a was calculated following the equation of Welschmeyer (1994):

Chl-a (mg.m^{-3}) **=** DF x R-reading x (FRs - FRb) x (Vola - Vols)

where:

- **DF =** Dilution factor
- **R-reading =** R-adjusted reading based on calibrated solid standard and batch solid standard reading
- **FRs =** Fluorometer reading of sample
- **FRb =** Fluorometer reading of blank
- **Vola =** Volume of acetone used for extraction (ml)
- **Vols =** Volume of sample filtered (ml)

The total Chl-a concentration will be used to assess the calibration of the fluorescence sensor of the CTD while the size fractionated Chl-a is an index of the proportion of micro-, nano and picoplankton.

PHYTOPLANKTON SPECIES COMPOSITION

Based on in situ fluorescence data and depth of Fmax obtained by CTD, 5 samples of 1 l of water were collected from the corresponding Niskin bottle at surface, 40 m, 60 m, 80 m and 100 m depth. Samples were immediately concentrated by filtering each 1 l through a 5 µm screen and transferring the concentrated sample to 50 ml sterile centrifuge vials. Samples were preserved with 1% glutaraldehyde and sealed for transportation back to Seychelles.

At the University of Seychelles laboratory, the samples will be stained with Rose Bengal, settled for 24 hours, and transferred to Sedgewick Rafter counting chambers and phytoplankton cells counted using a Zeiss Prima Star light microscope at 400x and 1000x magnification. A minimum of 200 cells will be counted per sample.

Taxa will be identified to species level when possible, using the nomenclature of Taylor et al. (2007), Metzeltin and Lange-Bertalot (2003), Lange-Bertalot (2001), Tomas et al. (1997), Krammer and Lange27 Berlato (1991), Archibald (1983) and Husted (1976); and potential risk assessed using literature and information from the Harmful Algal Event Database (HAEDAT), Ocean Biodiversity Observation System (OBIS), and the IOC-UNESCO Taxonomic Reference List of Harmful Micro Algae (http://marinespecies.org/hab).

3.3.2.3.2. PRELIMINARY RESULTS

PHYTOPLANKTON BIOMASS

The average total chlorophyll-a concentrations ranged from 0.02 ± 0.004 mg.m^{-3} in deeper waters to 0.51 ± 0.04 mg.m^{-3} at the maximum fluorescence level of 60-80 m. Student's t-tests further indicate a significant increase in total chlorophyll-a concentrations in the upper waters towards depths of 60 to 80 m and a significant decrease towards 200m (**Figure 48**). No significant differences were obtained for total chlorophyll-a samples collected at night or during day (p>0.05). However, significant differences were observed between the sampling sites (i.e., box positions) with Box 1 having significantly lower total chlorophyll-a biomass than Boxes 2, 3 and 5 (0.21 mg.m^{-3} vs. 0.33, 0.36 and 0.34 mg.m^{-3}, respectively, p<0.05). Habitat area types within each of the boxes (i.e., Shallow, Ridge & Deep habitats showed only significantly higher total chlorophyll-a in the shallow areas of Boxes 2 and 3 (~0.55 mg Chl-a.m^{-3}, p<0.01), whereas for Boxes 4 and 5 remained low at 0.27 mg.m^{-3} and 0.3 mg.m^{-3}, respectively. These figures were also comparable with the Ridge and Deep phytoplankton biomass within all the boxes (**Table 9**).

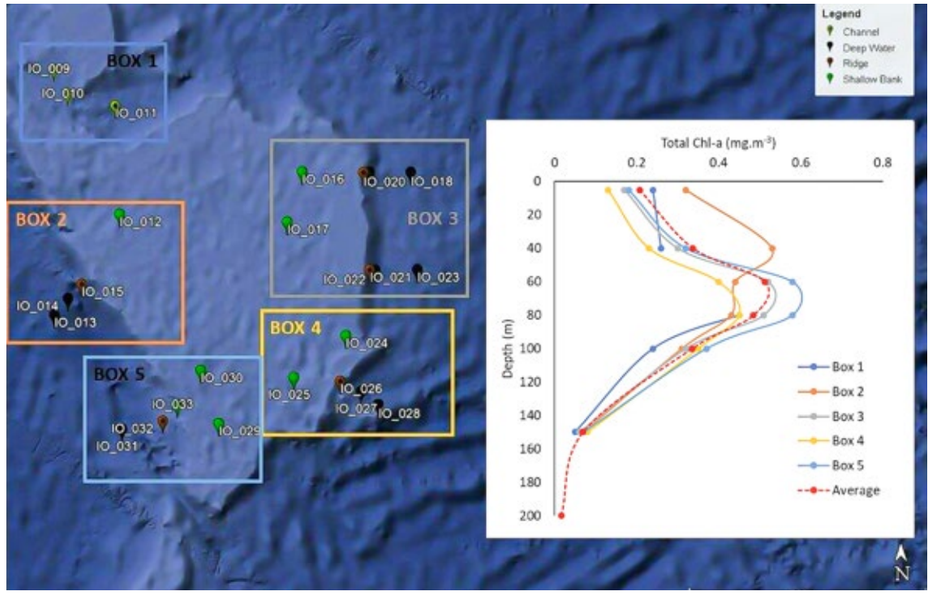


Figure 48: *Box and habitat area map indicating positions of CTD sampling sites, and total chlorophyll-a (mg.m^{-3}) for the five sampling boxes along the Saya de Malha Bank as well as the overall average for the region.*

Size-fractionated chlorophyll-a biomass was dominated by picoplankton (0.2 to 2 µm), followed by nanoplankton (2 to 20 µm) and micro-plankton (<20 µm) (**Table 10**). Picoplankton had highest relative abundance at the surface (~60%) and decreased towards deeper waters (~23%), whereas microplankton increased slightly in deeper waters (~36%) as compared to surface and mid-waters (~13 19%, respectively). Nanoplankton remained almost uniformed throughout the water column ranging from 27 41% (**Table 10**). Comparisons between the size distributions within the various sampling boxes further indicate significant changes in size fractions (**Table 9**).

Although picoplankton dominated all communities, in Boxes 3 and 5, relative abundance was below 50%, compared to the other boxes which remained above 50%. Micro-plankton were also significantly lower in Box 2 (4-9%), while significantly higher in Box 5 (~23%, p<0.05), although both areas were dominated by pico and nano-plankton. The Eastern Bank did show slightly larger sized phytoplankton present, while the Western Bank mainly had pico-plankton present (~54% relative abundance, p20 µm) showed significant differences in relative abundance, with higher abundance in the southern than northern regions (~ 18% vs ~16%, respectively, p = 0.01).

Table 9
Average total chlorophyll-a (mg.m^{-3}) and phytoplankton size distribution (relative abundance, %) for the various sampling sites and habitat areas along the Saya de Malha Bank (mean ± Standard Deviation, BOLD = p<0.05)

AREA	DEPTH	TOTAL Chl-a (mg.m^{-3})	<0.2 µm %	2 µm %	>20 µm %	N
Box 1	Channel	0.21 ± 0.15	47 ± 18	36 ± 12	17 ± 11	18
	Deep	0.29 ± 0.14	64 ± 15	29 ± 13	7 ± 5	12
Box 2	Ridge	0.30 ± 0.13	65 ± 11	26 ± 13	9 ± 11	6
	Shallow	**0.55 ± 0.12**	61 ± 16	**35 ± 15**	**4 ± 2**	3
	Deep	0.30 ± 0.19	43 ± 17	38 ± 12	19 ± 11	24
Box 3	Ridge	0.34 ± 0.19	41 ± 24	30 ± 16	29 ± 14	12
	Shallow	**0.54 ± 0.16**	50 ± 16	**42 ± 18**	**9 ± 9**	10
	Deep	0.26 ± 0.15	59 ± 16	27 ± 17	14 ± 8	12
Box 4	Ridge	0.29 ± 0.17	52 ± 11	39 ± 7	9 ± 7	6
	Shallow	0.27 ± 0.16	54 ± 20	31 ± 17	15 ± 12	12
	Deep	0.37 ± 47 ± 16	29 ± 10	24 ± 17	5	
Box 5	Ridge	0.41 ± 0.25	52 ± 20	24 ± 15	23 ± 18	5
	Shallow	0.30 ± 0.19	45 ± 20	31 ± 16	24 ± 23	15

Table 10
Overall size distribution of phytoplankton (% relative abundance) along depth profile for the Saya de Malha Bank (n = 140).

	RELATIVE ABUNDANCE			TOTAL Chl-a
	0.2µm	2µm	20µm	mg.mg^{-3}
Surface	60%	27%	13%	0.15
40m	57%	33%	10%	0.21
60m	41%	41%	18%	0.32
80m	52%	29%	19%	0.31
100m	53%	29%	18%	0.17
150m	38%	38%	24%	0.052
200m	23%	41%	36%	0.022
Average	**46%**	**34%**	**20%**	

Overall, the phytoplankton communities along the Saya de Malha Bank appear well-mixed with no apparently significant correlation between sizes (i.e., functional groups) and total chlorophyll-a measured (**Figure 49**). Some spatial differences, however, can be observed with higher total chlorophyll-a measured mainly in shallower/shelf areas (i.e., IO_016). Furthermore, some spatial differences in the relative abundance of pico-, nano- and micro-plankton could be observed, especially between shallow and deeper areas of the bank (**Figure 50**). These changes together with differences in chlorophyll-a biomass will be investigated in relation to nutrient data as well as physical ocean data via multivariate and ordination analyses to determine important drivers for primary productivity of the bank, and especially the east vs west spatial patterns observed at the time of the cruise, and often via satellite remote sensing (i.e., **Figure 51**).

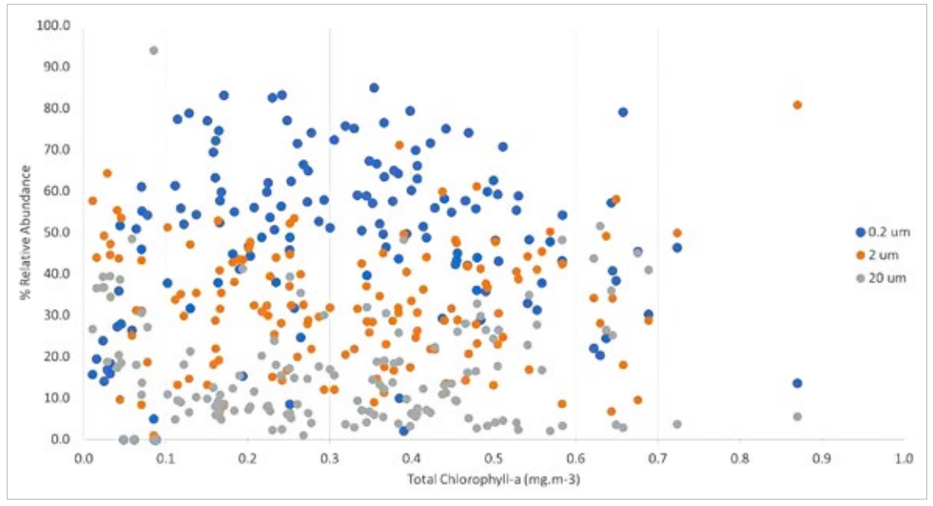


Figure 49: *Overall comparison between total chlorophyll-a (mg.m^{-3}) and phytoplankton size distribution (% relative abundance) for all sites and depths.*

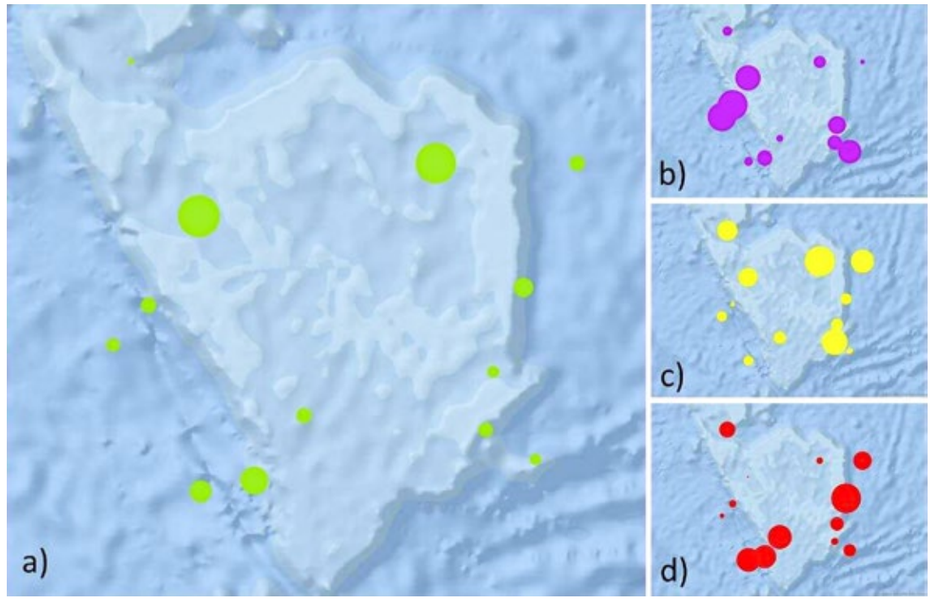


Figure 50: *a) Overall mean total chlorophyll-a (mg.m^{-3}) and relative abundance distribution of b) pico-, c) nano and d) micro-plankton along the habitat areas of the Saya de Malha Bank.*

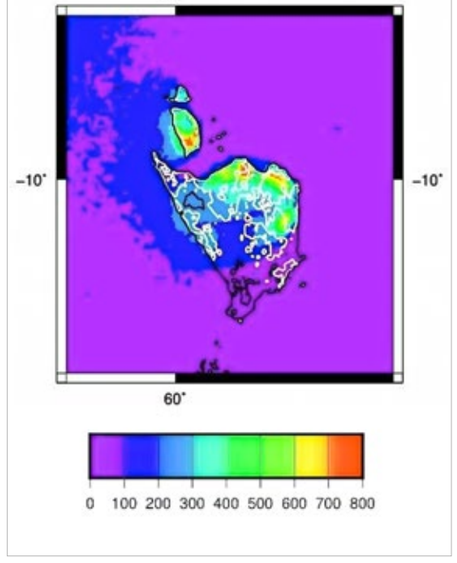


Figure 51: *Frequency of pixels (colour scale) with chlorophyll-a concentration above 0.2 mg m^{-3} to highlight sectors of recurrent primary productivity (source: Dr Fabrizio d'Ortenzio, CNRS, LOV). Phytoplankton enrichment tends to occur more frequently along the western edge of the Ritchie and Saya de Malha Banks, compared to the eastern side that is oligotrophic.*

3.3.2.4. MARINE PARTICLES AND ZOOPLANKTON (WP4)

3.3.2.4.1. OPERATIONS

The investigation of marine particles and meso-zooplankton used three different types of gear: 1) the Underwater Vision Profiler 5 (UVP5) and traditional plankton nets: 2) a Multinet and 3) a Bongo net.

- The CTD rosette was equipped with a UVP5, and data were collected over the whole water column at each CTD stations on the downcast (see **Annex G - Table G3**).
- The Multinet (9 nets of 300 µm mesh size, 0.5 m^2 opening area model Maxi, Hydrobios) was deployed at the most "offshore", or deepest, station of each transect around Saya de Malha, vertically from 900 m to the surface at approx. 0.5 m/s. The Multinet was deployed "offline" and the pre-programmed sampling depths were (in meters): 900, 700, 500, 350, 250, 200, 150, 100, 50, surface.
- At all the other pelagic stations, a Bongo net (200 µm mesh size, 0.25 m^2 opening area) was towed obliquely from 200 m, or to 10 m above the seabed at the stations shallower than 200 m, to the surface.

The net was equipped with a pressure sensor to accurately determine the sampling depth. It was lowered vertically in the water column to the required depth and towed obliquely up with the ship cruising at 1 to 1.5 knots.

Note that the depth sensor had many "bad" data or "noisy" data coming through, especially when more tension was put on the cable. To avoid any issues (e.g., pressure sensor software shutting down entirely), it was agreed to lower the net vertically and only then move forward while hauling the net in. Both nets were equipped with flowmeters to determine the volume of seawater filtered (quantitative samples) and the plankton net samples were preserved in borax buffered formaldehyde (4% final concentration). For the Bongo net samples, the net (without the flowmeter) was used for live observations on board. See **Annex G** (**Table G4**) for the details of each net and volume filtered.

3.3.2.4.2. PRELIMINARY RESULTS

No results have been produced so far. The samples will be analysed at the LOV, France, using a Zooscan to identify the different taxa and to calculate the biovolume and the size spectrum of organisms. We plan to send a Seychellois scientist to be trained to the Zooscan methodology at LOV and to perform the analyses.

3.3.2.5. BENTHIC INVERTEBRATE AND SPONGE INVENTORY (WP5)

3.3.2.5.1. OPERATIONS

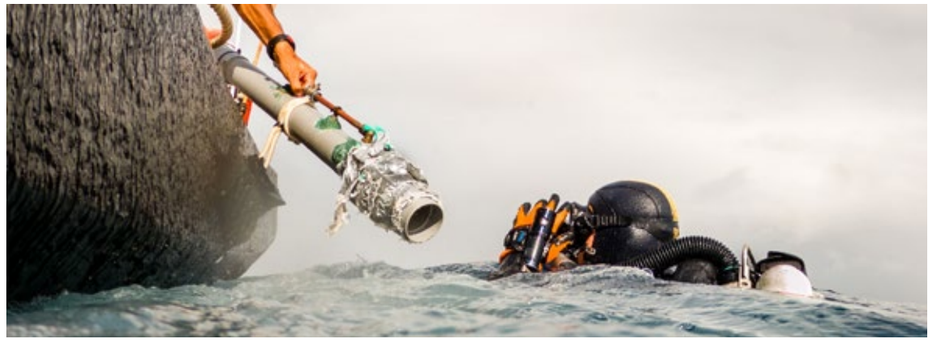
DIVING OPERATIONS (SEE ANNEX G - TABLE G5)

The habitats sampled encompassed all bottom types, from mud, seagrass to coral rubble, and drop-offs, living reefs being just one of the habitat types to be studied. The depth range sampled was from 20 to 50 m. Large-/medium-sized specimens of selected species were visually documented by divers in representative habitats while trying to sample as many habitats as possible. A variety of techniques were used to specifically sample micro-invertebrates.

- Sight harvesting: this technique requires expert divers as most organisms blend into their environment to often achieve perfect mimicry with their hosts. Sight harvesting requires know-how, experience, and intuition: the choice of blocks to be turned, attention to differences in sediment granulometry, camouflaged species or individuals (homochromy or mimicry), etc. Only experienced divers and collectors will be able to spot commensals, parasites and animals living in symbiosis.

- Suction sampling: a suction sampler consists of a 2-meter-long tube connected to a source of compressed air that empties into a 1 mm-mesh net. The suction sampler is operated on soft seafloor sediments, to collect the upper 1-2 cm of material and the thin layer of ooze and microalgae found in rock crevices. A suction sample typically covers 1 to 2 m^2 of seafloor and generates 2-15 l of bottom material.

- Brushing baskets: a brushing basket consists of a 1 mm-mesh net protected inside and outside by sturdy laundry baskets. Loose rocks and coral rubble are placed in the basket and vigorously brushed by hand. The cleaned rock is returned to its place and the residue accumulates in the net. Alternatively, and especially in deeper water (30-50 m) with limited scuba autonomy, the basket can be filled with loose rocks and lifted to the surface where the rocks will be brushed. A brushing sample typically covers 1 to 2 m^2 of seafloor and generates 1-5 l of bottom material.



Suction sampling operation © Nicolas Mathys - Zeppelin / Monaco Explorations.

TOWED GEAR OPERATIONS (SEE ANNEX G - TABLE G6)

- Epibenthic sledge (EBS): the EBS is a gear sliding at the surface of the sediment, sampling vagile small fauna above the bottom called "Suprabenthos". The suprabenthic communities are mainly composed by Peracarid crustaceans (*Amphipoda*, *Isopoda*, *Cumacea*, *Tanaidacea*). The sledge was towed on distances not exceeding 170 m. The EBS was equipped with two nets, i.e., an upper supranet and a lower epinet. The mesh size of the nets was 500 µm. The cod ends were equipped with net-buckets containing a 300 µm mesh window (Brenke 2005). To avoid contamination by planktonic organisms a lever mechanism was attached to the front doors, which were closed while the gear had no contact to the bottom. Metallic grids (about 3 cm mesh size) were attached to the entrance of the nets to avoid collection of big nodules, which may clog or damage the nets.

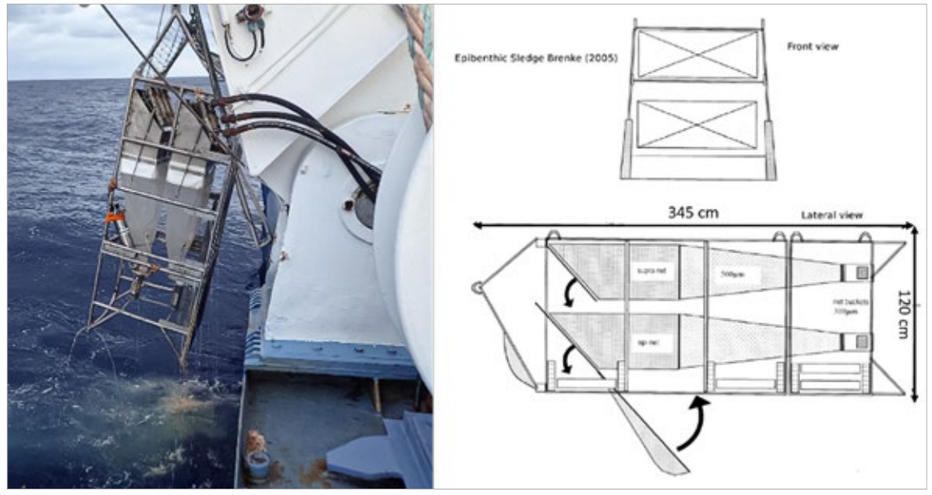


Figure 52: *Characteristics of the epibenthic sledge.*

- Beam trawl: the standard French beam trawl is composed of a 4 m wide wooden beam that is fixed onto heavy iron runners situated at both ends of the bar. These runners serve as skis so that the trawl can glide along the seafloor. The height of the iron side-skis (0.5 m, length 0.45 m, giving an effective height of 0.35 m) defines the vertical opening of the net, the beam determines the horizontal opening of the net. The heavy weight of the runners at the base of the opening of the net settles the trawl and keeps it well on the ground. A fine-mesh net (15 and 12 mm) is attached to this system; the ground rope of the net is strengthened with chain to allow it to dig into the sediment and stir up organisms or substrate on and in the sediment. A tickler chain (4.5 m long, 10 kg) is placed in front of the net. A conical net proper is situated behind the ground rope. This conical shape allows for good filtration of the water and guides the organisms caught in the net towards the cod-end of the trawl. The cod-end is double layered, with an inner finer meshed bag. The trawl is connected to the warp of the ship by two 4 m long wires, forming a triangle with the beam (crowfoot). The trawl is generally deployed at a speed of 2.5-4.5 knots (with pay-out speed about 1 m/sec) and towed at 1-2.5, mostly 1.5 knots ground speed. During the Saya de Malha sequence, the beam trawl was deployed on distances of 800 m.

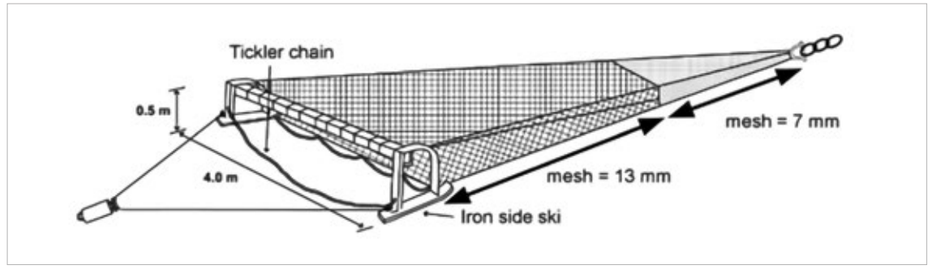


Figure 53: *Characteristics of the beam trawl.*

- Warén dredge: the Warén dredge consists of a strong metallic frame behind which is placed a net to retain sediment and fauna. The frame is connected to a wire and hauled at slow speeds (1-2 knots), sometimes slower depending on seafloor roughness. The bag of the dredge is composed of several layers; an inner bag made of thinner mesh (3-5 mm) is protected by 1 or 2 outer layers with a larger mesh size (20-50 mm) and a stronger weave. In this expedition, the external layer was made of a strong metallic ring net.

PROCESSING OF THE SAMPLES

For each collection operation (diving or towed), the contents of the samples were photographed to document the nature of the substrate. These contents were rinsed with seawater and sieved through a stack of sieves with decreasing mesh size. The organisms were then sorted by main zoological groups (crustaceans, molluscs, echinoderms, cnidarians, polychaetes, fish, others...) on a large table located on the poop deck. The tiny organisms were examined in the lab under stereo microscopes. A series of specimens representative of the diversity of the station were selected and photographed. The organisms were then packaged with a rot-proof label mentioning the station number, depth, date and expedition. The whole set was stored in 80° ethanol or formaldehyde (fish, ascidians).

For molecular studies, procedures were set up in particular for organisms for which tissue samples must be taken before fixation as in the case of fish that are fixed with formaldehyde. Similarly, during fixation, shell molluscs tend to shrink; the tissues are therefore poorly fixed if they are not collected in the field. A procedure was therefore put in place to ensure traceability between the sample, the specimen and possibly the photo taken in the field. This procedure notably involved the use of Matrix tubes identified with a unique 2D bar code.

Sorting on deck 3 © Nicolas Mathys - Zeppelin / Monaco Explorations.

3.3.2.5.2. PRELIMINARY RESULTS

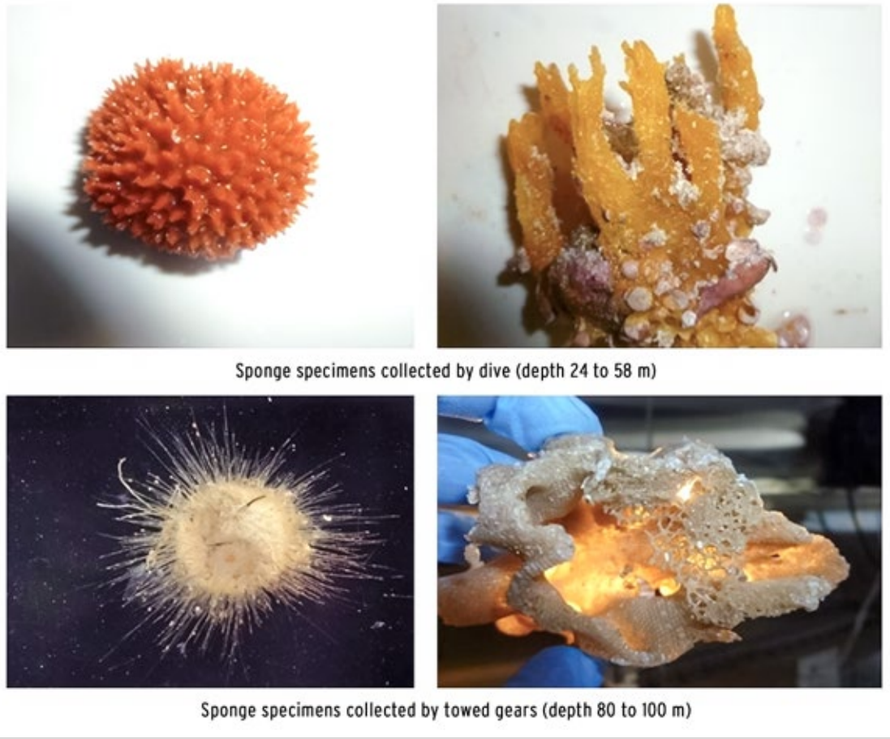
The first in-depth analysis of the collection is expected to start in December 2023 at a taxonomy workshop organized by MNHN with several world taxonomist experts of the different taxa collected. Invitations to participate will be sent to the scientists from Seychelles and Mauritius who are contributing to the research papers.

The descriptions presented here are those resulting from the first sorting and rough classification done on board by the WP5 team. **Tables 11** and **12** display a preliminary inventory of specimens by taxa collected during the cruise.

Table 11
List of sponge specimens collected by dives and towed gears

SPECIMEN COLLECTED BY DIVES	N° OF SPECIMEN	DEPTH (m)
Box 1	6	42
Box 2	5	37-50
North SMB	16	24-58
Box 3	39	24-29
Box 4	14	47
Box 5	6	

SPECIMEN COLLECTED BY TOWED GEARS	N° OF SPECIMEN	DEPTH (m)
Box1	2	286-370
Box 2	6	112-214
North SMB	1	205
Box 3	3	80
Box 4	11	204-321
Box 5	10	



Sponge specimen collected by dive.

Table 12
List of samples by taxa. A batch comprises from 1 to 10 specimens

	TAXA	NUMBER OF BATCHES	DESTINATION
1/ Mollusca		524	MNHN (Paris)
	Polyplacophora	5	
	Bivalvia	102	
	Gastropoda	396	
	Scaphopoda	8	
	Solenogastra	4	
	Cephalopoda	9	
2/ Crustacea		650	MNHN (Paris)
	Decapoda	370	
	Peracarida		
	Amphipoda	100	
	Isopoda	62	
	Mysida	9	
	Lophogastrida	6	
	Tanaidacea	37	
	Cumacea	10	
	unsorted *peracarida*	7	
	Other Crust.	45	
	Decapoda	4	JMA
3/ Algae		358	MNHN (Paris)
	brown	3	
	green	68	
	Rhodophyta	283	
	seagrass	4	
4/Annelida		341	MNHN (Paris)
	Polynoidae	124	
	Fam. Annelida	108	
	Unsorted annelida	109	
5/ Bulk samples		52	MNHN (Paris)
	Sediment	6	
	Sledge samples/ Gandalf	48	
6/ Fish		149	
	tissues + vouchers	139	MNHN (Paris)
	mix	10	JMA
7/ Ascidians		20	MNHN (Paris)
8/ Echinodermata Ophiurids		90	MNHN (Paris)
9/ Echinodermata (except Ophiurids)		168	JMA
	Asteroidea	62	
	Echinoidea	84	
	Holothuroidea	12	
	Crinoidea	10	
10/ Cnidaria		94	JMA
	Hexacorallia	30	
	Octocorallia	64	
11/Porifera		119	JMA

SPONGES

Table 11 lists the specimens that were collected by dives and towed gears:

- 86 sponge specimens were collected by scuba diving, at depths approximately ranging from 24 to 58 m. Some specimens that have not been investigated for their pharmacological properties at the MOI research unit, are shown in the photos below. DNA and taxonomy identification need to be carried out to confirm identity of specimen.

- 33 sponge specimens were collected by towed gears, at depths approximately ranging from 80 to 1,000 m. The majority of sponge specimen were silicious sponges (see photos below).

ANNELIDS

In total, 331 lots of annelids were collected. These lots contain from 1 to about 30 specimens (this latter mostly for small annelids). About a third of these lots remain unsorted and will be part of a dedicated workshop, the remaining ones have been sorted at least to the family level (20 families represented). Some specimens of the family *Polynoidae* (124 lots total) were identified to the genus level but many specimens in the family remain to be identified more precisely (74 lots).

A special attention was also given to associations of polychaetes with other invertebrates: holothurians, starfish, other annelids, stylasterid corals and black corals.

CRUSTACEANS

In total, 650 lots of crustaceans were collected. In terms of relative abundance and relying on the inventory of samples, 56% of the total sampled crustaceans are represented by decapods (shrimp *Caridea*, Crab *Brachyurans* and shrimp *Dendrobranchiatia*. The other main part of sampled crustaceans is represented by Peracarids. *Peracarida* is a superorder of malacostracan crustaceans divided into 12 orders, mainly represented in the marine realm by orders such as *Amphipoda*, *Isopoda*, *Mysida*, *Lophogastrida*, *Cumacea*, *Tanaidacea*. With more than 25,000 known species, *Peracarida* is considered as a hyper-diversified group with many more species yet to be discovered and described. This gap of knowledge results from their small sizes, difficult to sample and their fragile body. In total, 231 lots of peracarids have been sampled and sorted under stereomicroscopes, corresponding at last to more than 1,000 specimens. In terms of diversity, it is quite difficult to provide a species list: first because the time on the field was dedicated to the sampling effort and not to taxonomy and secondly, because this material will be dispatched to a large community of taxonomists, experts of taxonomic groups. Anyway, based on experience on the field and taxonomic knowledge of the crustaceans, it is possible to provide an estimation of the diversity captured during the Saya de Malha sequence.

According to the photos of fresh crustaceans and sorting of macro- and micro-crustaceans performed with stereo microscopes, from 200 to 250 species of crustaceans are expected to have been sampled.

The **figure 54** illustrates the diversity of shape and colours among the crustaceans collected during the cruise. Regarding the decapods, onboard photos (about 150 photos) have already been exchanged with the specialists of the different taxonomic groups. It is noticeable that the crab of the family *Ethusidae* (Station CP5419, 80 m depth) was never seen before and is probably a new species for science. Most of the shallow water decapods from diving operations seem related to the South Madagascar fauna, but specialists provide only general impression and specimens will be carefully studied in order to determine the possible connection with South Madagascar.

Figure 54: *Illustration of the diversity of shape and colours among the crustaceans collected during the cruise © Grégoire Moutardier - MNHN / Monaco Explorations.*

Little is known about peracarids from this area, or even in the whole Indian Ocean. The families *Urothoidae*, *Oedicerotidae*, *Eusiridae*, *Leucothoidae*, *Phliantidae*, *Caprellidae*, *Iphimedidae*, *Dexaminidae*, *Podoceridae*, *Stillipedidae*, *Synopiidae*, *Atylidae* are expected to be represented. The bulk samples from the epibenthic sledge, dedicated to the sampling of the suprabenthic fauna will increase the list of Amphipod families and species as well as Tanaïds, Mysids, Cumaceans and Isopods.

MOLLUSCS

47 species of molluscs had been collected on Saya de Malha by Gardiner's *Sealark* expedition in 1905, and 130 by the Soviet RV *Odyssey* in 1984. A rough estimate is that 300 to 400 species were sampled during this expedition.

There is practically no overlap between the fauna from diving depths (20-50 m) and the fauna from deeper water (70 m and deeper) sampled by the towed gears. Roughly half of the species were sampled during the dives, and the other half by dredging and trawling. Two species-rich families straddle both depths zones, albeit with different species: the *Marginellidae* and the *Columbellidae*, represented by respectively ~20 and 10-15 species. Most are small to minute, with adult sizes in the range of 2-15 mm, and it is remarkable that the *Sealark* expedition of 1905 had collected respectively none and one species, demonstrating the efficiency of the collecting and sorting methods used during this expedition. Likewise, the *Muricidae* and *Fasciolariidae*, with respectively ~15 and 10 species, also occur at all depths and are represented by quite few specimens. By contrast, the families *Triphoridae* and *Cerithiopsidae*, represented respectively by ~15 and ~10 species, are almost entirely confined to the shallow areas. The turrid families, generally extremely diverse in both shallow and deep water, are altogether represented by 20-30 species. Special attention was given during the dives to nudibranchs and other sea slugs, represented by ~40 species, plus another 10 in the dredges and the trawls.

In the summit area, the bivalves are mostly cemented: *Tridacna* (2 species, see below), *Malleus*, 2 species of large oysters; or are byssally attached: *Pteria* (2 or 3 species, byssally attached to hydroids or gorgonians), *Pinctada* (pearl oyster, a single specimen). However, single loose valves of cockles (*Cardiidae*) and *Glycymeridae* indicate that further infaunal bivalves are present in the area. In deeper water, bivalve assemblages with *Bentharca*, *Microcardium*, *Verticordiidae*, *Poromyidae*, and *Cuspidaria* are encountered on soft bottoms.

Just as important, some families are noticeably absent. Among the families of "seashells", the herbivorous family *Strombidae*, characterized by long-distance dispersing larvae, is unexpectedly remarkably scarce, with only 2 juveniles *Strombus* (s.l.) and 3 adult *Lambis* (2 species) found; the predatory miters (family *Mitridae*) are altogether missing; only three species of Terebridae were documented, and the necrophagous *Nassariidae* are also almost completely absent, either in shallow or in deep-water: no *Nassaria*, a couple of species of *Nassarius*, one species of *Phos*. The larger species of the family *Cerithiidae* are almost completely absent, but one *Bittium*-like species is very common in the summit area. The vetigastropods (*Trochidae*, *Fissurellidae*) are remarkably poorly diverse in the summit area. The absence of *Pyramidellidae* is noticeable but may in part be explained by the absence of mud/silt bottoms in shallow water. Overall, the summit area gives an impression of a depauperate fauna, with low biomass and small specimens in species that normally reach a larger size. It is tempting to ask whether this is a result of overfishing and environmental degradation. In this respect, the complete absence of species of the genus *Caecum* is noticeable. These microgastropods, with adult sizes of 2-4 mm, are often abundant in coarse sand and persist in the most overfished situations, as long as the sediment remains unpolluted. We thus believe that the absence of *Caecum* on Saya de Malha is not attributable to pollution or overfishing and is an interesting evidence that many absences are very probably natural and reflect dispersal restrictions. Likewise, the paucity of infaunal bivalves is noticeable and, correlatively, of their predator gastropod family *Naticidae*.

Figure 55: *Examples of mollusc collected during leg2 © Grégoire Moutardier - MNHN / Monaco Explorations.*

BIOLOGICALLY REMARKABLE CATCHES

The lepetelloids are small limpets specialized in feeding on / degrading organic substrates. Species of *Lepetella* feed on empty tubes of the polychaete *Hyalinoecia*, and what may represent a new species was found at CP5412 at 1,420 m. Species of *Bathysciadium* live exclusively on cephalopod beaks decaying on the bottom in deep water. No species was previously known from the tropical Indian Ocean, but one species probably new to science was sampled at DW5445 at 430 m. Species of *Addisonia* live exclusively in spent elasmobranch (rays and sharks) egg-cases. What may be a new species of this genus, or even a new genus, was found in a spent chimaera egg-case at CP5403 at 875 m.

By contrast, the complete absence of sunken wood and its associated fauna is worth noticing. Wood material (whole trees, branches, leaves) is normally carried out at sea by rivers and then dispersed by currents to hundreds if not thousands of kilometres away. Saya de Malha has of course no direct source of trees and the South Equatorial Current is unlikely to bring trees/wood from further East, as there are no island/emerged land to act as source of wood.

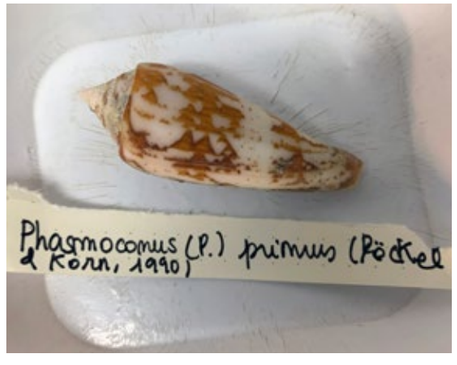
EMBLEMATIC SPECIES

The giant clam *Tridacna rosewateri* was discovered by diving during the Soviet expedition of 1988, and it was again found during this expedition in the shallowest parts of the Saya de Malha Bank. Its distinctiveness

was genetically confirmed. Elsewhere, it is a species known only from Nazareth Bank (Cargados Carajos) and Tromelin and can thus be considered iconic of the coral reef depths on Saya de Malha. A second species of giant clam, T. *squamosa*, is also present on Saya.

The giant clam, Tridacna rosewateri, *rediscovered © Francis Marsac - IRD / Monaco Explorations.*

Conus primus was described based on specimens allegedly collected in 80-98 m, and it is known from a handful (7 or 8) specimens collected during Soviet times, and never seen subsequently. This expedition collected one freshly dead empty shell by diving at 42 m.



Conus primus *© Didier Théron - Monaco Explorations.*

HAS THE SAMPLING OF BENTHIC ORGANISMS ON SAYA DE MALHA BEEN SATURATED?

After an intensive sampling of the nature that was undertaken on Saya de Malha, the questions that naturally arise are: how complete is the inventory of the benthic invertebrates / algae? What has been missed?

Sirenko (1993) recorded many species of "seashells" in the shallowest part of the bank ("12 m") that we did not find. This may reflect the fact that none of our dives were shallower than 20 m, and we would then have missed a segment of the reef fauna. For instance, the *Sealark* expedition of 1905 had recorded the small abalones *Haliotis pustulata* and *H. ovina*, and the Soviet expedition had recorded *Haliotis cf. varia*, whereas we did not get abalones at all. Conversely, we noted the almost absence of strombs, and this is confirmed by earlier expeditions: a single species of stromb and no *Lambis* had been found by the *Sealark* expedition of 1905; one stromb and two *Lambis* were found by the Odyssey expedition of 1984.

Of special concern are various species of "seashells" that were described in the 1990s based on material collected by Russian or Ukrainian vessels, either as a result of the Soviet research expeditions, or as a by-catch of commercial trawlers. We did find *Conus primus*. We possibly found (pending confirmation of the identification of our catches in the lab) *Closia limpida*, *Fusinus malhaensis*, and *Murex surinamensis*. But we did not find *Amalda danilai*, *A. trippneri*, *Conus gordyi*, *Haustellum bondarevi*, *H. danilai*, *Lyria bondarevi*, *L. doutei*, *L. surinamensis*, *Morum vicdani*, *Perotrochus metivieri*, *Phalium vector*, and *Semicassis bondarevi*. In addition, Khromov and co-authors described 4 species of cuttlefish (*Sepia bathyalis*, *S. mascarensis*, *S. saya* and *S. tala*); we probably did not use the right gear to sample Sepia but got *Sepia* (a single specimen) on one occasion, and this may represent one of Khromov's species. In other words, and although our sampling was far more detailed than what had been achieved in the 1980s-1990s, we did not find the majority of the species of seashells known before the Monaco expedition. This may be because we did not hit the right depth range (80-200 m?) in the right sector of the bank; and/or it may be because the Russian/Ukrainian catches were the result of hundreds of commercial otter-trawl hauls that covered a much larger surface of the bottom of the area, unmatched by our beam trawl.

Finally, one cannot avoid noting the occurrence of some remarkable taxa that were found only once and never again, for example we found in abundance of a species of *Turritella* on a bottom of fine calcareous mud in 80 m, which was not found anywhere else. In the same vein, the ROV collected in 300 m a single specimen of a fasciolariid gastropod, which was not collected at all by the towed gears.

To summarize, all this points out to a probably much more diverse fauna of perhaps 1,000 species of molluscs, of which we found between ¼ and 1/3. The explorations carried by our expedition, combining bulk sampling, sieving on a fine mesh, and sorting with stereomicroscopes, has undoubtedly documented hundreds of species for the first time on Saya de Malha. But clearly more dives in the shallowest part of the bank, and more hauls by dredging/trawling would be needed for a full inventory.

ENDEMISM

How much of the mollusc fauna of Saya de Malha can be considered endemic to Saya de Malha? This is a difficult question because declaring a species to be endemic supposes that (i) the species-level taxonomy of the fauna has been worked up and (ii) other locations in this sector of the Indian Ocean have been adequately investigated. This is of course still far from being the case as long as the catches of the *S.A. Agulhas II* expedition have not been worked up. Over 500 specimens/samples of molluscs are specifically ready for DNA sequencing, and the results of this sequencing will also shed light on the possible isolation of Saya de Malha populations of already known species.

Because of the accretionary growth of their shell, the gastropods are uniquely suited to discuss issues of larval dispersal and potential endemism. Several families (*Tonnoidea*, *Architectonicidae*) are well known for their long-distance teleplanic larvae and vast geographical ranges: their occurrence on Saya de Malha would represent an extreme of "non-endemism". Endemism would be expected to occur in species with paucispiral protoconch indicative of non-planktotrophic larval development, an extreme of which is represented by the three narrow-range volutes (which we did not find) with crawl-away juveniles; non-planktotrophy is the rule also in the family *Marginellidae*, which is well represented on Saya de Malha. In between these two extremes, a number of families may exhibit one or the other of the two developmental modes, and a number of species of, e.g., *Columbellidae*, *Fasciolariidae*, Turridae, were noticed with paucispiral protoconchs, and represent putative new species endemic to Saya de Malha.

All in all, perhaps up to 20% of the molluscs living on Saya de Malha are endemic species new to science. The challenge will be to properly describe them in the context of the "taxonomic impediment".

3.3.2.6. PHOTO-PHYSIOLOGICAL STUDIES OF PHOTOSYNTHETIC ORGANISMS (WP6)

3.3.2.6.1. OPERATIONS

Photo-physiological studies of sea plants and symbiotic invertebrates give insights into the functioning and health status of these important marine organisms, which contribute to the food chain and food web. The recent innovative advancement in chlorophyll fluorescence technique has provided rapid study tools to assess photosynthetic functioning from single cell to small organism / colony level imaging scale. In this study, the imaging Pulse-Amplitude-Modulated (PAM) fluorometer was employed to assess the photo-physiology of sea plants and symbiotic marine invertebrates of Saya de Malha. Sea plants included seaweeds and seagrass while marine symbiotic invertebrates included giant clams, hard and soft corals. Phytoplankton diversity, density and estimated productivity were investigated. Additionally, the thermal tolerance of some selected rhodophytes and corals were determined. The main objectives were to:

1. Assess the photo-physiology of sea plants and symbiotic invertebrates collected from Saya de Malha;

2. Assess the density, distribution and estimated productivity of phytoplankton; and

3. Determine the thermal tolerance of selected rhodophytes and scleractinian corals.

SITES FOR SAMPLE COLLECTION

Seawater samples from CTDs and surface samples at respective stations (see **Annex G** - **Table G7**) were collected for later micro-phytoplankton and pico-nanoplankton analyses. Micro-phytoplankton samples were collected by filtering 5 l of seawater from several depths using a 5 µm plankton net while

two 50 ml samples from each depth were collected for pico-nanoplankton analyses. Samples for micro-phytoplankton and pico-nanoplankton were preserved in lugol and formaldehyde, respectively. Seawater samples have been collected for later chlorophyll and nutrient analyses.

THERMAL EXPERIMENTS EXPERIMENTAL DESIGN

Samples such as rhodophytes (red coralline algae and other red algae) and corals were exposed to 26, 29 and 32°C for a duration of 22 h to test the thermal tolerance of these photosynthetic organisms. Rapid light curves (RLCs) were run using the Imaging-PAM and effective quantum yield at photosystem II (ΦPSII) were noted. Other relevant parameters like maximum electron transport rate (ETR_{max}) and non-photochemical quenching (NPQ) will be calculated later. For reliable comparison among species, yield values relative to initial were used.

CHLOROPHYLL FLUORESCENCE MEASUREMENTS

The effective quantum yield at PSII (ΦPSII) was determined as ratio of the difference between the maximum fluorescence (F_m') and base fluorescence (F_o') to F_m'. F_o' and F_m' were measured using a weak light (1 µmol quanta m^{-2} s^{-1}) and a saturating pulse of 4,000 µmol quanta m^{-2} s^{-1}. Rapid light curves (RLCs) were generated using a light range of 0 to 700 µmol quanta m^{-2} s^{-1} increasing at an interval of 20 s. The maximum electron transport rate (ETR_{max}) will be calculated as ΦPSII*PAR, where PAR is photosynthetic active radiation.

3.3.2.6.2. PRELIMINARY RESULTS

OBJECTIVE 1: PHOTO-PHYSIOLOGY OF COLLECTED SPECIMENS

The effective quantum yield values of about 0.600 in both *Lithophyllon sp.* and *Tridacna* indicated that these organisms were photosynthetically healthy (**Figures 56** & **57**).

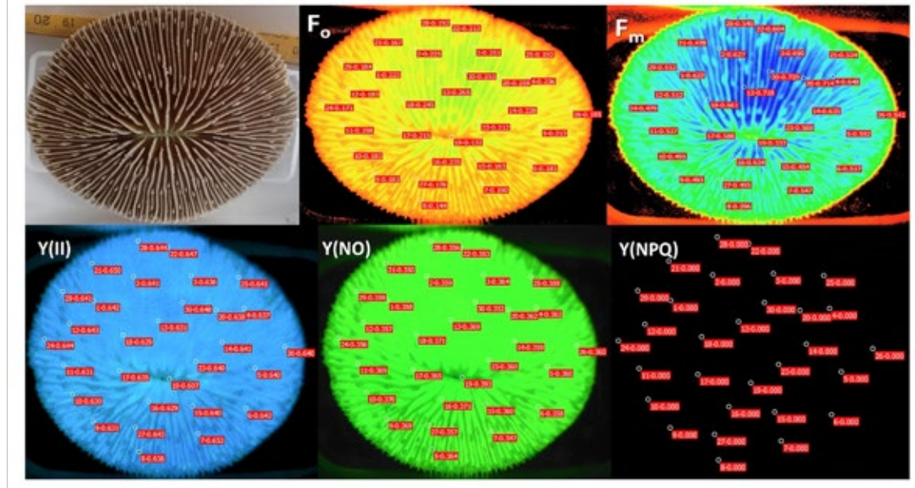


Figure 56: *Yield at photosystem II of coral* Lithophyllon sp.

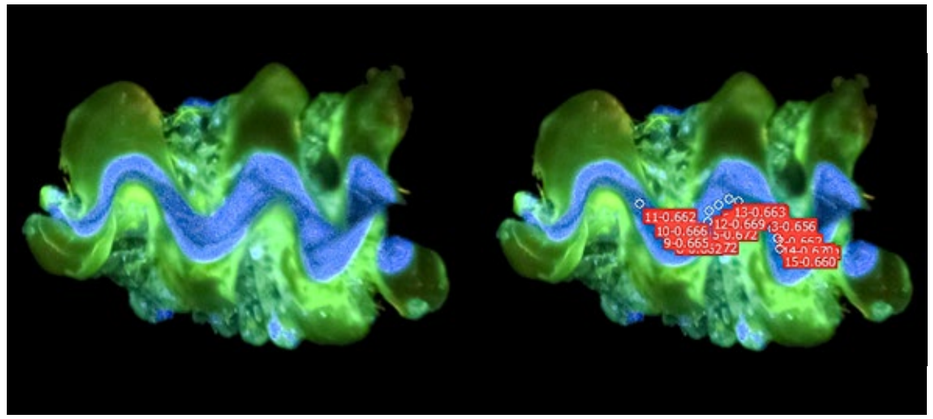


Figure 57: *Yield at photosystem II of giant clam* Tridacna rosewateri.

OBJECTIVE 2: PHYTOPLANKTON

Collected samples will be analysed later.

OBJECTIVE 3: THERMAL EXPERIMENTAL TRIALS

The thermal trials for 26, 29 and 32°C treatments were more or less maintained at respective temperatures during the experimentation period of 22 h (**Table 13**). Temperature was measured using data loggers at intervals of 15 min.

Table 13
Temperature variations during 22 h of exposure

	TEMPERATURE (°C)		
	Red Coralline Alga1	Gorgonian	Branching *Acropora* sp.
Tank - 26°C	25.85±1.07	26.42±0.39	26.51±0.27
Tank - 29°C	29.04±0.90	28.88±0.47	29.14±0.40
Tank - 32°C	31.62±0.85	32.34±0.77	32.37±1.04

The red coralline alga 1 had its ΦPSII reduced at both 29 and 32°C after 22 h of treatment (**Figures 58** & **59**). The gorgonian was mostly affected at 32°C after 22 h of treatment. The ΦPSII of the gorgonian after 22 h at 32°C did show spatial variations within the fragments exposed (**Figure 59B**). The branching *Acropora sp.* had its ΦPSII reduced after 22 h of treatment at 32°C and was visually bleached (**Figures 58C** & **59C**).

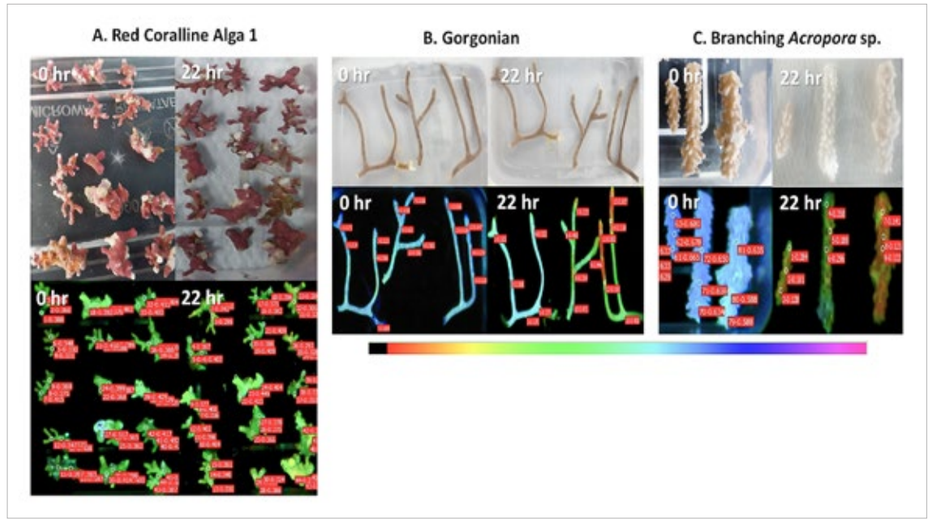


Figure 58: *Natural and IPAM images for yield initially and after 22 h treatment at 32°C for red coralline alga 1 (A), gorgonian (B) and branching* Acropora sp. *(C).*

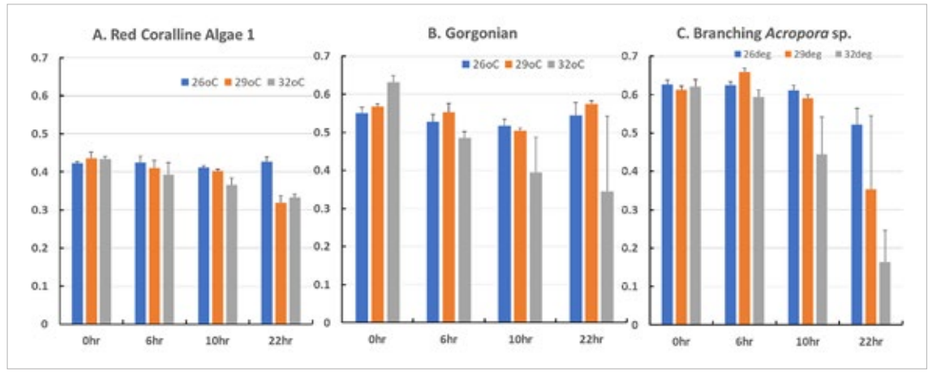


Figure 59: *Effective quantum yield (ΦPSII) of red coralline alga 1, gorgonian, branching* Acropora sp. *exposed to 26, 29 and 32°C for a duration of 22 h.*

In order to compare the ΦPSII responses among the red coralline alga 1, gorgonian and branching *Acropora sp.*, relative ΦPSII to initial, i.e., values prior to the start of the thermal stress, for respective treatments were calculated (**Figure 60**). At 29°C after 22 h, the red coralline alga 1 and branching *Acropora* sp. seemed to be more vulnerable than the gorgonian. However, at 32°C after 22 h treatment, the red coralline alga 1 was more tolerant than the gorgonian and branching *Acropora.*

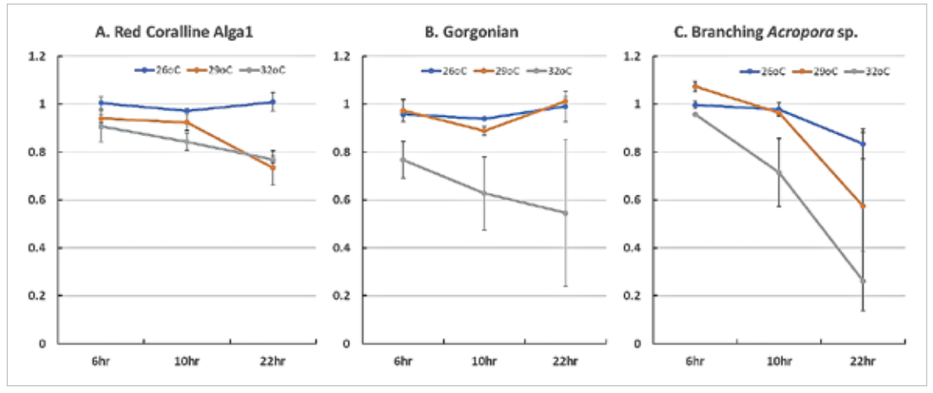


Figure 60: *Relative (to initial) effective quantum yield (ΦPSII) of red coralline alga 1, gorgonian, branching* Acropora sp. *exposed to 26, 29 and 32°C for a duration of 22 h.*

MAIN PRELIMINARY FINDINGS

- Imaging-PAM is a good rapid method for assessing the physiological health of photosynthetic marine organisms tested; and,
- Red coralline alga 1 appears to be most tolerant among the tested species to the exposed thermal conditions. Gorgonian and branching *Acropora* may not survive climate change-driven warming oceans as they are thermally vulnerable.

3.3.2.7. SCUBA DIVING OPERATIONS AND SPECIMEN COLLECTION (WP7)

3.3.2.7.1. OPERATIONS

Two C-Worker 880 SRP dive support boats, chartered for the expedition, were used for the two teams of divers. One team (three divers) operated in shallow depths (20-30 m) with open circuit systems, while the second team (two divers) did deeper dives (to 60 m) using rebreather/recycler system. The two boats remained under close surveillance, within sight of *S.A. Agulhas II*, throughout the dives.

The divers used the different sampling techniques described in **section 3.3.2.5.1**, i.e., sight harvesting ("cherry-picking"), suction sampling and brushing baskets. The positions of the dives are listed in **Annex G - Table G5**.

The specimens were stored in containers or small bags by the divers during the dive. The bags were then hauled on board the support boat. The collections were displayed and sorted in the ship's laboratory after each dive, for everyone to see and to start sorting by large taxonomic group.

This work package contributed to the development of an algae collection for a regional herbarium project funded by the Blue Grants Fund of the Seychelles Conservation and Climate Adaptation Trust (SeyCCAT). A first set composed of 34 algal specimen and 1 seagrass pressed specimens was produced and brought back to Seychelles to be stored and curated at the Seychelles National Herbarium. Aside from the specimen collection, the iNaturalist application was used to digitalise and share the pressed specimens, while they were still fresh to assist in their identification.

Due to the requirements to survey at 8 m and 15 m depths and the lack of shallow sites and challenging conditions in Saya de Malha, no reef photogrammetry surveys could be conducted by the Coral Connect team. The depths of the majority of dives were prohibitively deep for the team. Those few dives where the seafloor was accessible were still at depths that necessitated significantly reduced bottom times for non-decompression diving. As such, whilst no colonies of *Ctenella chagius* were observed during this expedition, the depth and time limits meant that the search at these locations proved inconclusive.

3.3.2.7.2. PRELIMINARY RESULTS

The collection made by the divers are included in the inventory discussed in **section 3.3.2.5.2**.

A community project named "**Indian Ocean Citizen Science Monaco Expedition Seychelles and Mauritius**" was created on the iNaturalist platform for participants to share and comment pictures of specimens they found interesting.

3.3.2.8. ROV AND VIDEO SURVEYS (WP8)

3.3.2.8.1. OPERATIONS

ROV SURVEYS

A total of 7 surveys were undertaken with the ROV to allow for benthic communities to be documented and strategically collected at depths below scuba limits. All surveys were modelled after surveys used by the Nekton project and other collaborators from the region (see **section 3.2.6**). The reasoning was to conduct surveys that could then be compared with other surveys conducted in the region. This protocol has previously been implemented in Seychelles, Comoros, Maldives, seamounts in the Southern Ocean and South Africa. Surveys were conducted at four priority depths of 30, 60, 120 and 250 m with a duration ranging from 1 to 8 h. These surveys were not always possible due to time constraints and topography of the area surveyed. The surveys were conducted over a transect distance of 250 m at a speed of 0.2 knots, each transect was then replicated twice to ensure replications for further statistical analysis.

The ROV was fitted with 4K cameras, an articulated arm to collect samples and four sampling boxes to store the specimen collected. In addition, a low-cost deep-sea prototype camera designed by the Ocean Discovery League was attached to the ROV.

ROV in its cage during deployment © Nicolas Mathys - Zeppelin / Monaco Explorations.

Table 14 provides the details of the seven ROV dives at Saya de Malha.

Table 14
Position, time, and main information on the 7 ROV dives at Saya de Malha

ROV DIVE #	DATE	TIME (UTC+5)	LOCATION	TRANSECT DEPTHS (m)	COMMENTS
SDM_001	03 to 04 November 2022	23h25 - 03h07	Saya de Malha North	30, 60, 120, 250 m and exploratory at 700 m	Only one 250m transect was conducted at each of these depths as time was limited
SDM_002	07 November 2022	10h28 - 15h02	Saya de Malha North	30 m - Grass surveys only	Sea grass survey conducted for Blue Economy Department
SDM_003	08 November 2022	12h17 -13h30	Saya de Malha North	30 m Sea grass survey	Sea grass survey conducted for Blue Economy Department
SDM_004	10 to 11 November 2022	23h10 - 05h21	Saya de Malha East	30, 60m, 120m, 250 m	Three 250m transects collected at each depth
SDM_005	12 November 2022	20h36 - 04h26	Saya de Malha South-East	60m, 120m, 250 m	3 transects at each depth. No 30m bathymetry line - 30m line too far for transit
SDM_006	14 November 2022	06h39 - 14h43	Seamount	Exploratory 200-500 m	No transects conducted here. Seamount was purely exploratory. There was a 2 hour pause between transects.
SDM_007	15 to 16 November	21h33 - 04h45	Saya de Malha South-West	270 m, 500 m, 700 m	Transects were conducted at 270m and 500m

VIDEO SURVEYS

Low-cost cameras, limited to depths less than 100 m, were deployed in different configurations to record marine life above the sea floor and in the water column. Macrofauna, especially fishes, sharks and turtles, were the main targets of this simple-to-deploy visual observation systems.

The mooring illustrated in **Figure 61** was deployed in seven dives. The mooring was equipped with four cameras. Two waterproof boxes deployed at two depth levels (2 m above the seabed, and another 2 m above the lower box) contained 2 cameras each. One camera was set to take photos and the other videos. In addition, the near-bottom box was equipped with a hydrophone in order to record noise as indicator of marine life activity. Batteries enclosed in the boxes powered the instruments. The mooring specification and the containers were designed and provided by IRD (UMR MARBEC, Sète, France) which also provided the cameras. The mooring was recovered at the end of each dive and the data were downloaded on board the ship.

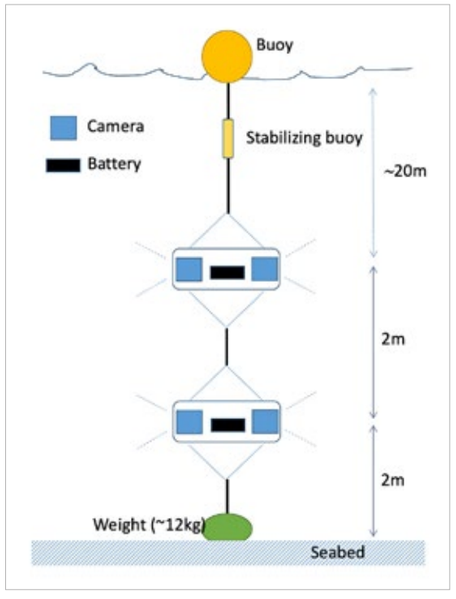


Figure 61: *Design of the camera moorings.*

For the two ROV operations carried out during the seagrass survey, two cameras were attached on the front arms of the ROV, and one camera at the rear of the ROV cage.

During each operation, the ROV was brought back on board twice, in order to carry out three successive transects at different locations.

3.3.2.8.2. PRELIMINARY RESULTS

ROV SURVEYS

ROV pilots in the control room. From left to right: Robert and Egon Laaser, Marine Solutions © Didier Théron - Monaco Explorations.

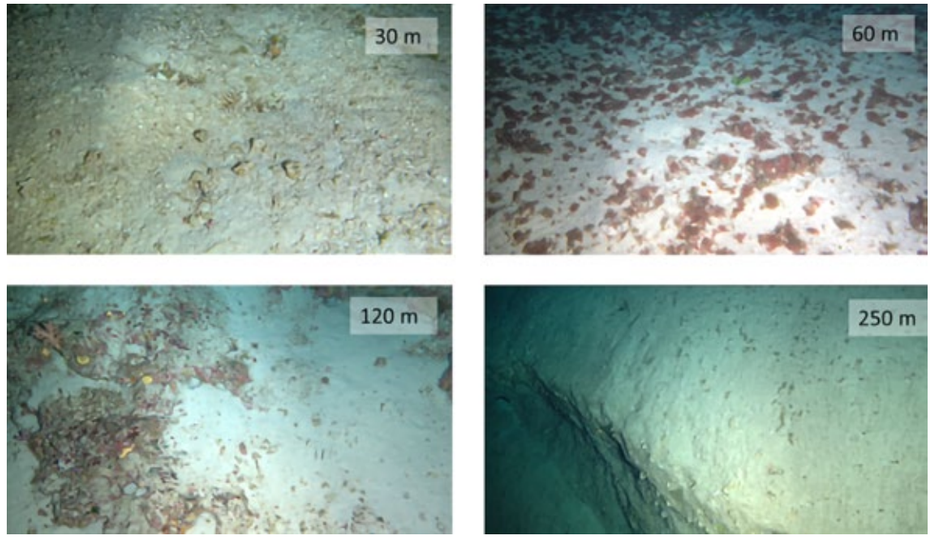
ROV001: SDM_001 Site 1: North-East Saya de Malha Ritchie Bank

30 m: Sandy bottom with coral rubble. Very little structure, presence of some red and green algae. Lacked 3D complex environments or ledges or caves. Lacked large benthic communities or presence of hard or soft coral. Some occasional sections of rhodoliths.

60 m: Substrate dominated by gravel and rubble, prevalence of red algae and leafy green algae, lacked in complex structures or ledges and caves. Gentle slopped bottom.

120 m: Rocky habitat with some sandy patches. Dominance of white whip corals, fleshy corals and encrusting varieties. Some structure such as caves and ledges seen during this transect.

250 m: Flat seabed with gentle slope, intermittent boulders with Stylastrids and sponges. Very little variety of fish and corals seen at this depth.



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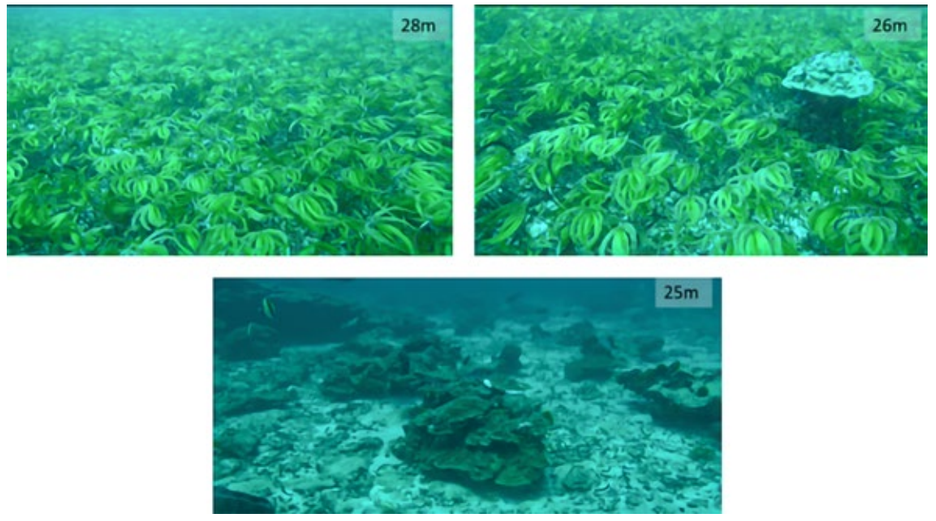
ROV002 and ROV003: SDM_002 Site 1: North-East Saya de Malha Sea Grass Survey

20-30 m: Seagrass meadows covered a large expanse of the transects, the dominant species of seagrass noticed was *Thalassodendron* with some green algae. Sparse distribution of sea cucumbers, a school of rabbitfish was spotted. Patches of coral was seen between the seagrass, these were lively habitats with a mix of triggerfish, rabbitfish and surgeonfish. The transects at two different sites were conducted over two days at a speed of 0.4-0.6 knots. On the last day only one transect of 750-1,000m was conducted due to a mechanical issue with the ROV winch.



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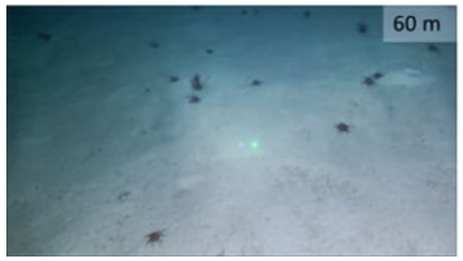
ROV004: SDM_004 West Saya de Malha

30 m: mixture of algae (*Halimeda* and encrusting algae) and coral as well as rhodoliths. These corals included species like *Porites*, *Acropora* and *Turbinaria*. A mixture of different fish species was seen such as; white tip reef shark, Moorish idol, snappers, groupers, surgeonfish, squirrelfish, rabbitfish, parrotfish and unicorn fish.

60 m: sandy bottom with no boulders or complex 3D structures, presence of red algae in high abundance and large aggregations of sea urchins. Limited diversity in seen with regards to corals. Large aggregations of sea urchins were present.

120 m: rocky habitat with some sandy patches. Presence of some 3D structures in comparison to 60 m. Large quantities of coil corals (possibly *Junceella* / *Viminella*) and black corals.



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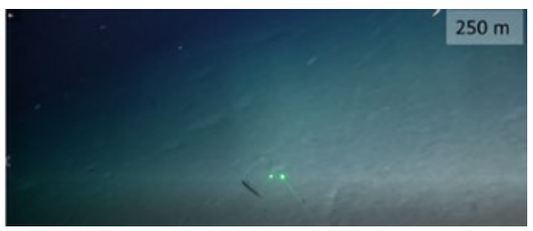
250 m: sandy habitat with what appears to be large boulders at the end of the transects. Sandy bottom mostly consisted of brush black coral and echinoderms (sea urchins and sea stars). Boulders with complex structures had a bit more life, with a sighting of a Darwin slimehead as well as a large aggregation of shrimp, a variety of sponges and bryozoans. As well as stylastrids and a sighting of a Brinsingidae as previously seen in the Nansen cruise in 2018.



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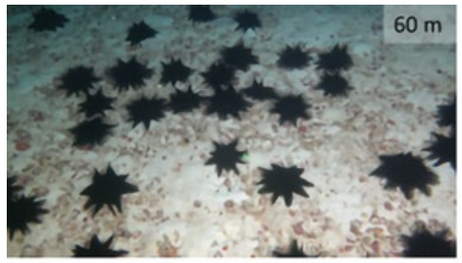
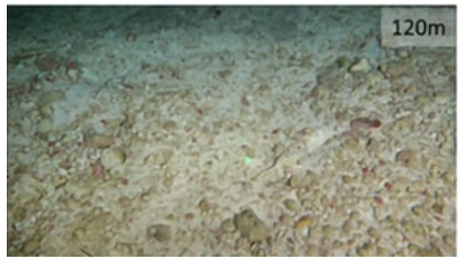
ROV005: SDM_005 South-West Saya de Malha

30 m: Transects conducted at 60 m because the 30 m and shallower depths were too far away for transit.

60 m: Sandy habitat with scattered rubble and large fields of rhodoliths, intermittent presence of black brush coral. Porcupine fish as well as echinoderms were sighted.

120 m: Sandy habitat with outcrops rocks creating complex structures. Some areas covered in rhodoliths. There was a prevalence of whip corals with some fan corals sponges, crinoids and red algae. Present fish include a single sighting of a file fish, nurse shark, several butterfly fish, Moorish idols.





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250 m: Dominantly sandy habitat with some algae and very little sponges or corals. Limited diversity in benthic and pelagic species. Several sightings of sea robins (gurnards), lizard fish and a single sighting of a cray fish.

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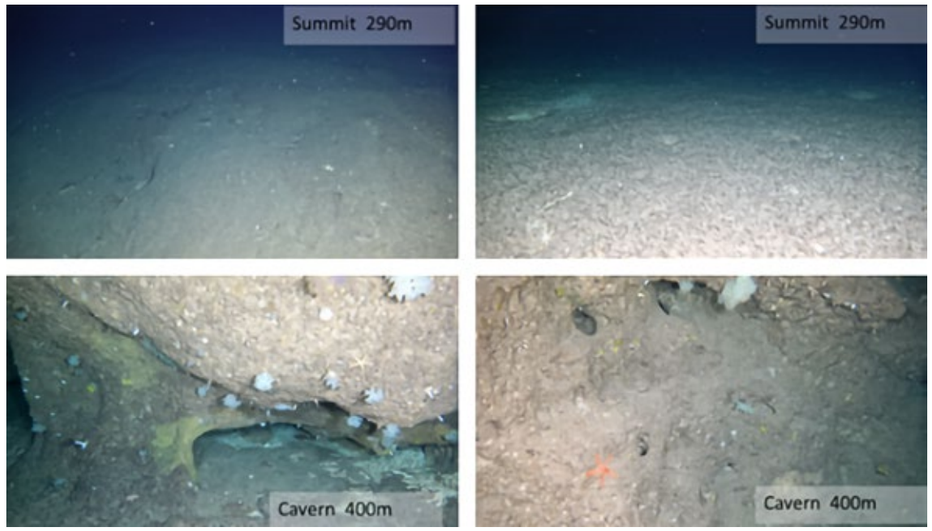
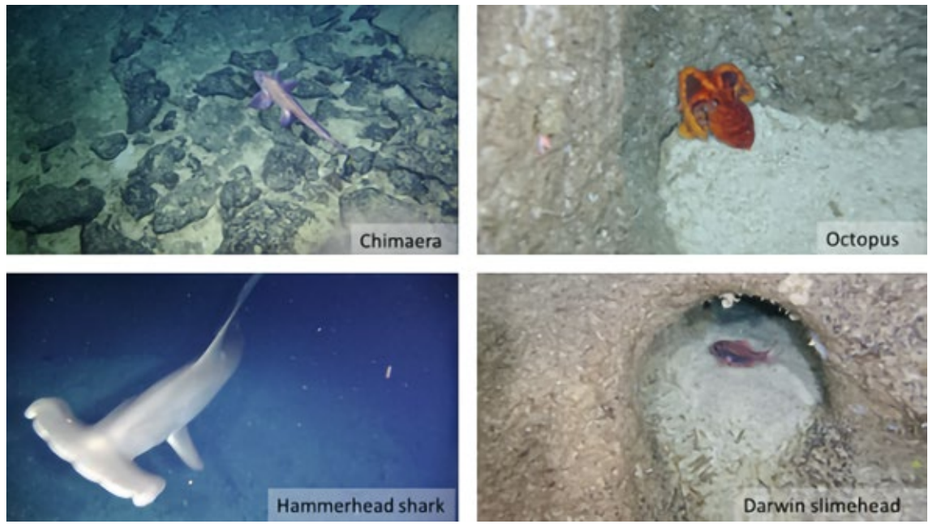
ROV006: SDM_006 Site Seamount South-West Saya de Malha

The seamount summit at 295 m was made up of hard calcareous rock with pots and crevices of sand. Crevices and holes were occupied by bentho-pelagic fishes like sea robins (flying gurnards). Presence of some scattered sponges and solitary corals the dominant species seen were Stylastrids.

The flanks of the seamount constitute a complex system of caves and caverns on an almost vertical ledge dominated by sponges, crinoids, bryozoans and stylastrids. A variety of fish species were seen including single sightings of Darwin slimehead, chimaera and a hammerhead shark.



© Marine Solutions / Monaco Explorations.



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ROV007: SDM_007 South-East Saya de Malha

No transects were conducted at 30,60 or 120 m as the transit distances to these depths were too long for the allocated time. Transects were conducted at 250 and 500 m only.

250 m: This area was similar to the seamount in structure, hard calcareous rock with caverns of sand. These caverns and cave often had the presence of a variety of fish.

The dominant benthic species seen was stylastrids with interdispersed yellow fans. There were a few white fans sighted during the transect covered in sea stars, crinoids and on two occasions large white crabs.

500 m: Transects were conducted along the steep wall of the 500 m line. This area was a mix of hard basalt rock outcrops and sandy slopes. Sandy slopes were quite bare, with some outcrop of whip corals. The basalt rock in most cases were covered in bryozoans, sponges, yellow fan corals and polychaete casings.

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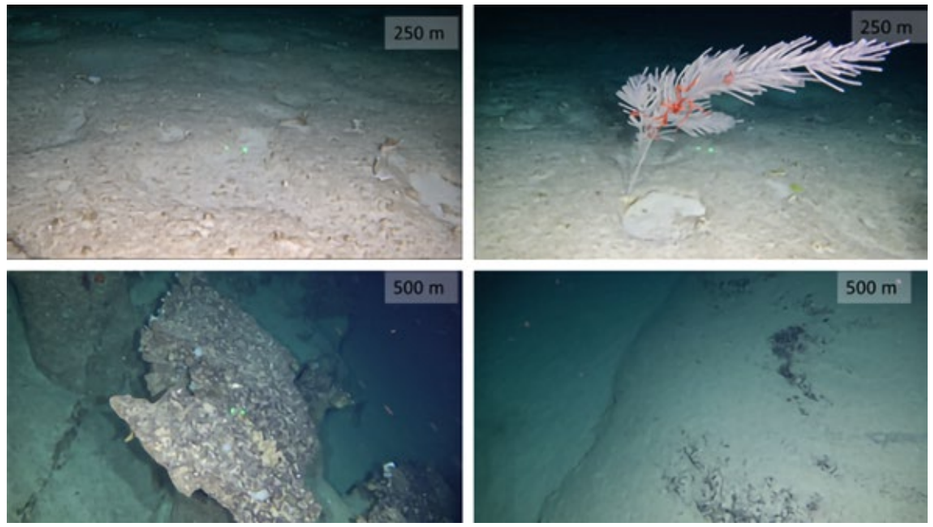

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VIDEO SURVEYS

The moored cameras did not always work properly. **Table 15** summarizes the recorded footages.

Table 15
Video surveys

STATION	DATE (dd/mm/yyyy)	DEPTH (m)	POSITION		UPPER CAMERA		LOWER CAMERA	
			LON (E)	LAT (S)	VIDEO	PHOTO	VIDEO	PHOTO
Mooring#1	07/11/2022	25	060°54.2'	09°55.5'	NO	YES	YES	YES
Mooring#2	08/11/2022	18	060°51.0'	09°49.9'	Partially	NO	YES	YES
Mooring#3	09/11/2022	28	062°02.6'	10°36.9'	YES	YES	YES	YES
Mooring#4	10/11/2022	22	062°07.7'	10°22.8'	YES	YES	YES	YES
Mooring#5	10/11/2022	22	062°09.6'	10°12.6'	YES	YES	YES	YES
Mooring#6	11/11/2022	23	062°12.3'	10°43.8'	YES	YES	YES	YES
Mooring#7	11/11/2022	28	062°11.4'	10°54.0'	YES	YES	YES	NO

A preliminary examination of the images recorded during the moorings was carried on board. Observations includes one turtle, some sharks, some large fish (**Figure 62**).

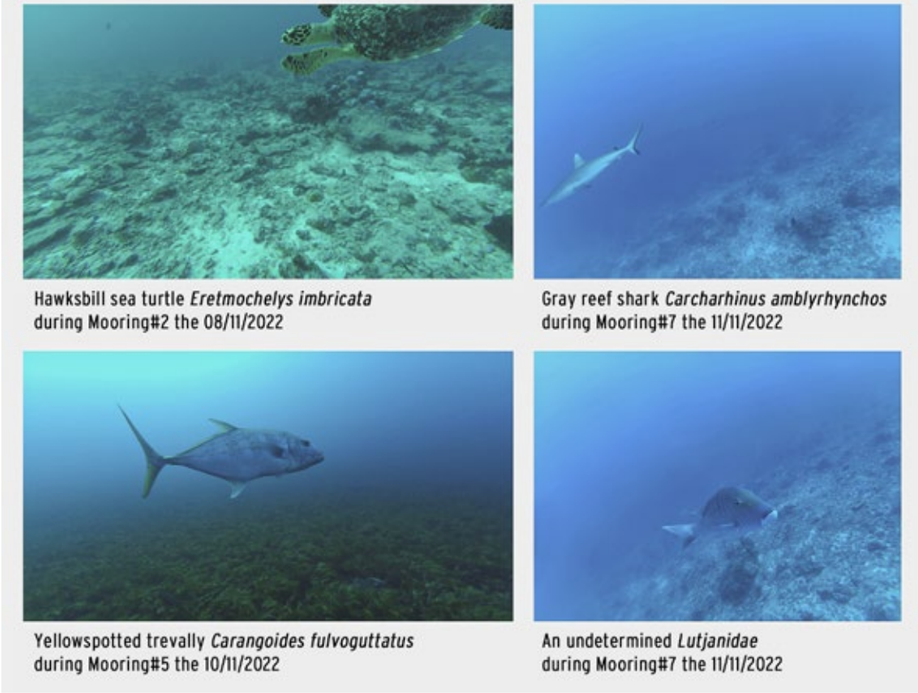

Figure 62: *Photos taken by the moored cameras.*

Carangids and probably one skipjack tuna (*Katsuwonus pelamis*, to be confirmed) were observed but most of the observed fishes were benthopelagic and coral species (e.g., black triggerfish *Melichthys niger*, short-nosed unicornfish *Naso brevirostris*). Several fish schools evolving in the water column were recorded.

Overall, the macrofauna was not abundant in the water column of the observed sites. No large predator was detected by the cameras.

The depth of the two ROV seagrass surveys did not exceed 20 m. The ROV moved close to the bottom.

Because the ROV cage remained hanging in the water column above the ROV, the camera attached to the back of the ROV cage was too high in the water column and did not capture any interesting images. By contrast, the two cameras attached to the front of the ROV and turned to the sides recorded excellent images.

The recordings indicate that the seagrass beds (composed in majority of *Thalassodendron ciliatum*) are in good health. A succession of parcels of seagrass with rhodolith beds and coral areas were observed. This mosaic of habitats structures the seagrass bed ecosystem and shelters a diversity of organisms. However, no abundant colony of organisms was observed, neither fishes of large size, nor large predators.

The information shows that the plateau of Saya de Malha shelters key habitats representing probably a peculiar ecosystem vulnerable to non-regulated exploitation.

Further analyses combining camera recordings with ROV footages and with high-resolution bathymetric mapping performed with autonomous sensor-equipped board, in order to characterize and roughly estimate the distribution of the habitat and associated fauna.

3.3.2.9. MEGAFAUNA (WP9)

See **section 3.1.4**.

3.3.2.10. THE INTERNATIONAL LAW OF THE SEA AND ITS RELATIONSHIPS WITH MARINE SCIENCE (WP10)

This work package relates to the component of the DiDEM project devoted to the high seas, deep seas and distant seabeds (see **section 1.8**). The training sessions organized on board *S.A. Agulhas II* under this work package are described in **section 4.5.3**. Related DiDEM activities are reported in **section 5.3**.

3.4. DATA AVAILABILITY

3.4.1. PRINCIPLES

As a principle, all data produced during the expedition are deemed to be in open access, according to the arrangements agreed between Monaco Explorations and the scientific partners of the expedition. However, scientific data collecting and sharing are regulated by international agreements such as the UN Convention on the Law of the Sea (UNCLOS) and the provisions of the UNESCO Intergovernmental Oceanographic Commission (IOC). In this context, the sharing of data collected in the areas under national jurisdiction (territorial waters and economic exclusive zones) of France, Mauritius, and Seychelles, or related to the seabed of Mauritius and Seychelles Joint Management Area of the Extended Continental is subject to the authorization of the relevant coastal States.

In any case, the issue of open access to the expedition results is key. This applies to the scientific papers that will be published in open access and for the data sets. Monaco Explorations requests that each publication and data set be identified by a DOI that will be shared through their website and the IIOE-2 metadata portal.

In accordance with its terms of reference, the Expedition Advisory Committee oversees the expedition's reporting work and the dissemination of the outcomes. A Publication Group composed of members of the Advisory Committee and project leaders was established to develop the publication plan of a special issue to be published in 2025 in a scientific journal. This special issue will encompass the whole expedition.

3.4.2. SAYA DE MALHA

The utilization, the publication and the dissemination of the data collected in the Saya de Malha JMA, jointly managed by Mauritius and Seychelles, are regulated by the Marine Scientific Research (MSR) Code established by the JMA Commission. The approval granted to conduct the research survey in the JMA requires compliance with the provisions relevant to Intellectual Property Rights (IPR) for data and biological samples which are the property of the Designated Authority. It is understood that these provisions apply to living and non-living resources attached/associated to the seabed. They do not apply to data of the water column which belong to the high-sea domain. Provisions regarding the use and sharing of water column data from the survey were made in a supplementary agreement between the Department for Continental Shelf, Maritime Zones Administration and Exploration (CSMZAE) of the Republic of Mauritius, the Department of Blue Economy of the Republic of Seychelles and IRD.

It is therefore necessary to consider separately the different types of data collected during the survey:

- **Bathymetry**. Bathymetric data of the Saya de Malha Bank have a high strategic and economic value for the two States. The MSR Code stipulates that the submission of the bathymetric data to international databases such as GOOS and GEBCO are subject to prior written authorization from the Designated Authority of the JMA. The data are now stored on the JMA servers in Mauritius and Seychelles and are not in open access.

- **Physical and chemical oceanography**. The seawater samples (nutrients of the water column) collected by the bottles of the rosette at each hydrological station were analysed by the IMAGO Laboratory, IRD, Brest. The results will be produced in June 2023. Other data such as salinity and dissolved oxygen were analysed on board during the survey. This set

of information will be used to calibrate the raw CTD profiles. The calibration process will be achieved by September 2023. The calibrated profiles and the biogeochemical data analysed by IMAGO and on board will be transferred to SISMER (Scientific Information Systems for the Sea) and access will be restricted during a moratorium period. Other physical data such as current data will also be submitted to SISMER under the same conditions. During the moratorium period, only the scientists participating in the survey and their associated teams will be able to use the data to write scientific papers. The data will be set in open access on 1st March 2025. A digital copy of the raw CTD profiles, current data at the surface and in the water column, were given to the chief scientists of Mauritius and Seychelles at the end of the survey.

- **Plankton data**. The phytoplankton pigments data are being analysed at the IMAGO Laboratory, IRD, Brest. The chlorophyll biomass data were produced on board during the survey. These data will remain for use by the participating research teams and will be released in open access at the end of the moratorium period. Other chlorophyll data were collected by BGC Argo floats deployed during the cruise, and such data are already in open access as per the BGC-Argo programme data policy. The mesozooplankton samples will be analysed by Zooscan in the LOV in France in October-November 2023 and will become available for the participating research teams. Finally, UVP data, which are images of plankton particles along vertical profiles, have been uploaded on the open-access databases Ecopart and Ecotaxa (http://ecotaxa.obs-vlfr.fr). They complement the other plankton data. Likewise, phytoplankton, mesozooplankton data will be in open access at the end of the moratorium period.

- **Benthic specimen**. The supplementary agreement concerning the terms and conditions for sharing biological materials and benefits from the Saya de Malha Project was signed between MNHN and JMA focal points from Mauritius and Seychelles (MNHN-JMA_Conv. 1176-22). It defines the procedure for sharing the benthic specimens collected during the expedition. The sharing was made by main zoological groups (taxa). At the end of the expedition, Porifera, Fish (subsamples), Echinoderms (except Ophiurids), Corals and Crustaceans (subsample) were delivered to JMA authorities. The others taxonomic groups such as Algae, Molluscs, Crustaceans, Annelids, Fish, Echinoderms (only Ophiurids), Ascidians and bulk samples collected by the epibenthic sledge were shipped to MNHN (Paris) and received in April 2023.

- Specimen metadata are available at: https://expeditions.mnhn.fr/campaign/saya. As per the supplementary agreement, the benthic specimen database is in open access in the MNHN collection of expeditions. It compiles the references of all the sampling data of benthic specimens (station coordinates, types of gears etc.). The web page is about to be completed with all the information on the cruise and the data from the stations can be downloaded.

- The biological material conserved by the MNHN as a long-term scientific loan has begun to be sorted and identified from a taxonomic point of view. A total of 600 batches of specimens have already been deposited in the open-access database of the MNHN collections. Photos and primary identifications are available at: https://science.mnhn.fr/all/list?country=JMA%20Maurice/Seychelles

- The biological materials have been started to be examined by several experts of the MNHN network. The first publication is in progress with the description of a new species of shrimp belonging to the family *Stenopodidae*, subject to revision by the JMA Commission:

Chen & Chan (In Press). The use of three-dimensional ↔CT imaging technique in the description of a new species of *Stenopus* Latreille, 1819 (*Decapoda*: *Stenopodidea*: *Stenopodidae*), with a revised key to the species of *Stenopus*. Journal of Crustacean Biology.

- **ROV data**. The video footages taken by the ROV along the slopes of Saya de Malha were shared among the concerned scientists of the expedition in Mauritius and Seychelles, in the three weeks following the end of the survey. These data are submitted to the approval of the Designated Authority for utilization, publication, and dissemination.

Contact points that can assist the coastal State(s) concerned in evaluating or interpreting the data, samples and results upon request:

- Bathymetric data:
  Dass Bissessur:
  dpbissessur@govmu.org (CSMZAE, Mauritius)

- Physical data:
  Jean-François Ternon: jean-francois.ternon@ird.fr,
  Arshad Rawat: arawat@govmu.org &
  Priscilla Coopen: pcoopen@govmu.org

- Biogeochemical data:
  Hervé Claustre: herve.claustre@imev-mer.fr
  Vincent Taillandier: vincent.taillandier@imev-mer.fr
  Jean-François Ternon (IRD, France):
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  Hervé Claustre: herve.claustre@imev-mer.fr

- Sponges:
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- Corals:
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  Philippe Bouchet: pbouchet@mnhn.fr

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  Mariette Dine: mariette22dine@gmail.com

- Fish:
  Francis Marsac: francis.marsac@ird.fr
  Sundy Ramah: sundy.ramah@gmail.com
  Vikash Munbodhe: vmunbodhe@gmail.com

- ROV data:
  Sheena Talma: sheenatalma@gmail.com

3.4.3. MADCAPS

The raw data per methodology (beach cleanup, Manta trawl, visual survey, pathogens characterization) will be made available directly to the main partners (Seychelles Islands Foundation, GLOBICE, IRD) and to Monaco Explorations.

- Characterization of the plastic debris collected with the Manta trawl: 2024;

- Pathogens analysis: 2024;

- Characterization of plastic debris collected on Aldabra: done;

- Samples collected (plastic debris and pathogens) will stay at UMR ENTROPIE, University of Reunion Island, but the results and the raw data will be shared with the partners.

The published data and associated metadata will be included in the final report.

Contact points that can assist the coastal State(s) concerned in evaluating or interpreting the data, samples and results upon request:

- General information:
  Margot Thibault: margotthibault@orange.fr

- Genetic pathogens:
  Philippe Jourand: philippe.jourand@ird.fr

3.4.4. GECOS

The raw data per analysis will be made available directly to the main partner (Seychelles Islands Foundation) and to Monaco Explorations on an ongoing basis via computer files:

- Field metadata file: individual sampling summary table sent to the partners after the expedition.

- Satellite tracking: the data was made available to all partners a few days after the beacons were deployed via a web interface:

https://my.wildlifecomputers.com/data/map/?id=6368a76831af5915db3b48a3

- Genetic results: sent to the partners in January 2023.
- Inorganic contamination results: sent to the partners in January 2023.
- Physiological results: analysis of the sampling data in progress.

The published data and associated metadata will be made available via dedicated servers. The project's final data and associated metadata will be shared in accordance with the procedures currently being defined by the Expedition Advisory Committee.

Once the beacons have stopped transmitting, a file containing all the raw data and a final map will be sent to the partners.

Contact points that can assist the coastal State(s) concerned in evaluating or interpreting the data, samples and results upon request:

- General information:
  Jérôme Bourjea: jbourjea@ifremer.fr
- Satellite tracking and genetic data:
  Jérôme Bourjea: jbourjea@ifremer.fr
- Physiological and inorganic contamination data:
  Quentin Schull: qschull@ifremer.fr

3.4.5. 4SEA

The metadata and data will be stored in archives in which the file structure and naming conventions are standardised to enable automated publication of these archives in reference data infrastructures. This work on data sharing will be developed as part of a data paper that is currently being drafted.

The data is first inventoried and described in a simple spreadsheet (Dublin Core metadata format) which then feeds a workflow managed through the R geoflow library in order to automate the publication of the metadata and data in data warehouses such as Zenodo, thereby obtaining a DOI (Digital Object Identifier). This work is currently being verified, and the first publications will be supplemented as and when new results are obtained. Publication will be subject to the authorization of the local partners and coastal States concerned.

A processing chain has also been developed to facilitate the production of maps from separate georeferenced images or from orthophotos. It will be presented in a paper to be published with a DOI. The code will be shared on GitHub and made available with a dedicated DOI.

Contact points that can assist the coastal State(s) concerned in evaluating or interpreting the data, samples and results upon request:

- Sylvain Bonhommeau:
  sylvain.bonhommeau@ifremer.fr
- Julien Barde:
  julien.barde@ird.fr
- Serge Bernard:
  serge.bernard@lirmm.fr

3.4.6. BGC-ARGO

The calibration data will be made available once the water samples are analysed and the results are validated. A number of results files have been produced already. A mechanism remains to be identified to make these files available.

According to the recommendations of the OneArgo programme, the float data are accessible in real time either from the BGC-Argo website (floats with biogeochemical sensors https://biogeochemical-argo.org/data-access.php), or from the Euro-Argo site (floats measuring temperature and salinity only https://fleetmonitoring.euro-argo.eu/dashboard). These interfaces allow data to be viewed in profile mode (generally 0-2,000m) or in time series mode (generally one profile every 10 days).

Contact points that can assist the coastal State(s) concerned in evaluating or interpreting the data, samples and results upon request:

- Hervé Claustre:
  herve.claustre@imev-mer.fr
- Vincent Taillandier:
  vincent.taillandier@imev-mer.fr
- Fabrizio d'Ortenzio:
  fabrizio.dortenzio@imev-mer.fr

3.4.7. SSD-SVP

The UWA SSD data curation and management system is available to all who may wish this project's data. The data were already provided to Mauritius.

The SVP data can be accessed online in nearly real time through OceanOPS dashboard (https://www.ocean-ops.org/board).

Contact points that can assist the coastal State(s) concerned in evaluating or interpreting the data, samples and results upon request:

- Nick D'Adamo:
  nick.dadamo@uwa.edu.au
- Charitha Pattiaratchi:
  chari.pattiaratchi@uwa.edu.au
- Jean-François Ternon:
  jean-francois.ternon@ird.fr
- Olivier Desprez de Gesincourt:
  olivier.desprez.de.gesincourt@shom.fr
- Priscilla Coopen:
  pcoopen@govmu.org

3.4.8. WORLD CORAL CONSERVATORY

At present, the data is collected but not yet put to any real use. Only project partners have access to the data. It is expected that the protocols for storage, packaging and air transport and the results of the molecular and taxonomic analyses will be published.

Contact points that can assist the coastal State(s) concerned in evaluating or interpreting the data, samples and results upon request:

- Olivier Brunel:
  o.brunel@oceano.org
- Didier Zoccola:
  zoccola@centrescientifique.mc

3.4.9. CORAL CONNECT

Data from Aldabra are owned and held by the Seychelles Islands Foundation (SIF), with other data being used by UK researchers under the terms of the permits and in collaboration with SIF.

Contact point that can assist the coastal State(s) concerned in evaluating or interpreting the data, samples and results upon request:

- Heather Koldewey:
  heather.koldewey@zsl.org

3.4.10. MARINE MEGAFAUNA OBSERVATION

Data collection occurred in the Mauritian EEZ and in international waters. Regarding data collected in Mauritius waters, GLOBICE collaborate with local partners (Marine Megafauna Conservation Organization and Green Attitude Foundation), facilitating the sharing and use of data collected in Mauritius waters.

The data is standardised and centralized in a regional IndoCet database maintained by GLOBICE. The data collected is explicitly referenced as belonging to both GLOBICE and Monaco Explorations, with a contact referring to each of the entities and the need to cite the owners of the data when making any use of it.

Contact point that can assist the coastal State(s) concerned in evaluating or interpreting the data, samples and results upon request:

- Violaine Dulau:
  violaine.dulau@globice.org

3.4.11. ROUTINE UNDERWAY OBSERVATIONS

The SDS files containing the depth and TSG data are available. The TSG remains to be calibrated against the CDT data (see **section 3.3.2.2.1**).

Subject to the agreement of the coastal States and JMA Commission as appropriate, the depth data will be made available to the Data Centre for Digital Bathymetry of the International Hydrographic Organization in support of GEBCO and the TSG data will be made available to OceanOPS.

4. COMMUNICATION AND OUTREACH

Communication and outreach are essential to the expedition's objective to share the issues and knowledge with as wide an audience as possible: decision-makers, scientific networks, civil society, general public, schools, teachers and young generations...

4.1. COMMUNICATION TOOLS AND RESOURCES

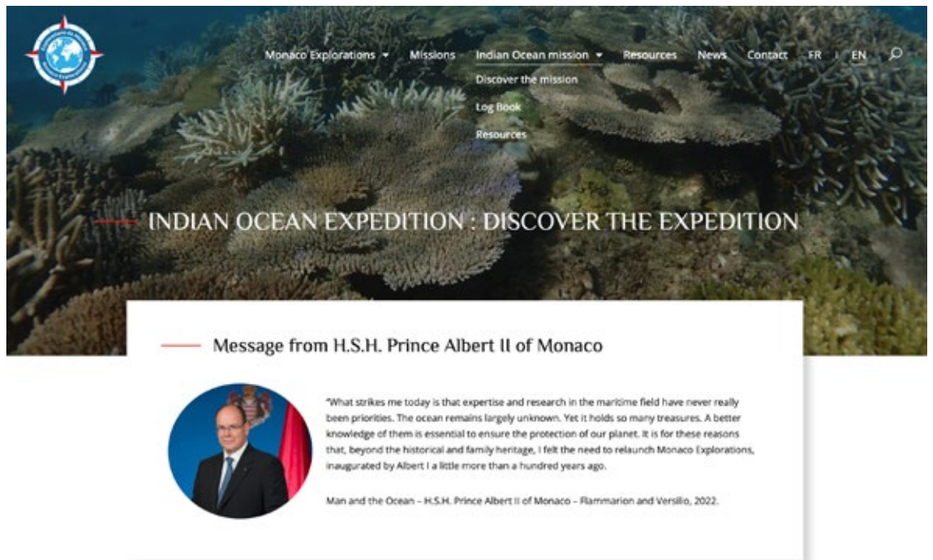
4.1.1. COMMUNICATION AND OUTREACH PLAN

Based on the outline approved by Monaco Explorations Board in April 2022, the expedition communication and outreach plan was developed in liaison with the partners' communication manager with the support of the Oceanographic Institute.

4.1.2. MONACO EXPLORATIONS WEBSITE

The page dedicated to the expedition was launched on Monaco Explorations website just before the expedition began. It was structured in three sections:

- Discover the expedition,
- Logbook,
- Resources.



Home page dedicated to the Indian Ocean Expedition on Monaco Explorations website: www.monacoexplorations.org © Didier Théron - Monaco Explorations.

4.1.3. INFORMATION OF THE PARTICIPANTS

An information videoconference open to all participants in the expedition was organized on 22 September 2022.

The expedition programme was presented to the crew of *S.A. Agulhas II* on 8 October. A general briefing with all the participants on board was organized on 14 October after the stopover at Reunion Island and on 31 October after the stopover at Port Victoria.

General briefing with Knowledge Bengu, Master of S.A. Agulhas II *© Didier Théron - Monaco Explorations.*

4.2. GENERAL COMMUNICATION

4.2.1. PRESS AND OTHER MEDIA

The expedition received extensive media coverage, with over 150 articles or reports in the press, on television or online, starting with the press kit distributed in September 2022, on the occasion of the visit of HSH Prince Albert II of Monaco and following the press visits organized during the stopovers. In particular, the expedition was covered by the following national media:

- **France:**
  - France Inter
  - RFI
  - Le Journal du Dimanche
  - Le Marin
  - Point de vue
  - Mer et marine
- **Mauritius:**
  - MBC
  - Télé Plus
  - Le Mauricien
  - Lexpress.mu
- **Seychelles:**
  - SBC
  - Seychelles Nation
  - Seychelles News Agency
  - Today in Seychelles

Press review: over 150 articles © Monaco Explorations.

4.2.2. ISSUE OF A STAMP ON THE EXPEDITION

A stamp dedicated to the expedition was issued on 24 November 2022 by Monaco Postage Stamp Office to mark the MonacoPhil 2022 event. Print run: 40,000 copies. This stamp with a face value of €2.32 was designed by Marie-Christine Lemayeur and Bernard Alunni and was issued in a print run of 40,000 copies.

Stamp of the Indian Ocean Expedition
© Monaco Postage Stamp Office.

4.2.3. MONACO EXPLORATIONS

Regular updates on the expedition were published on social networks (240 posts and stories) and on Monaco Explorations website (11 news).

4.2.4. BGC-ARGO

The "Adopt a float" website was initiated and enhanced by the media material collected during the expedition.

During the expedition, the story of the floats and the research programme related to the float were disseminated by the "Adopt a float" team on board to the "Ocean Culture" community through the social networks:

- Twitter (@adoptafloat, @ERC_REFINE): posts on the start of the expedition, deployments of the profiling floats, presentation of the adopted floats and the adopting classes, summary of the sessions in the "Adopt a float" classes.
- Instagram (@adoptafloat): posts and stories on the expedition and its sequences, people and life on board, oceanographic tools, the ship, the places.

Adopt a float website: https://adoptafloat.com © IMEV.

4.2.5. MARINE MEGAFAUNA

The targets of GLOBICE's communications via the social media are the people generally interested in marine mammals and their protection, mainly on Reunion Island, in France and in the South-West Indian Ocean. Communication elements are often picked up by local media in Reunion. GLOBICE website also reaches a large community of people at the local, national and international levels.

GLOBICE also use different education tool to reach a large public, especially local communities in Reunion, schools and students.

GLOBICE communication aims also at scientists from the South-West Indian Ocean, via the social media and other communication tools of the IndoCet network (website, newsletter, etc.)

The social media platforms, and in particular Facebook and Instagram GLOBICE pages, reaching respectively 22 k and 5 k followers, were the two different media used to communicate about the activities conducted during the expedition.

The GLOBICE observer shared the picture of his observation of bottlenose dolphins with Monaco Explorations, for communication on the YouTube channel:

https://www.youtube.com/watch?v=-AOmHIw25jA

4.2.6. WORLD CORAL CONSERVATORY

The project in Aldabra received extensive media coverage in both the local and national press. Articles were published in the following journals:

- Monaco Observer
- Nice Matin
- Lemauricien.com
- Today in Seychelles
- BFM Nice Côte d'Azur
- Les Echos Planète
- Emission "Grand Format" sur Monaco Info

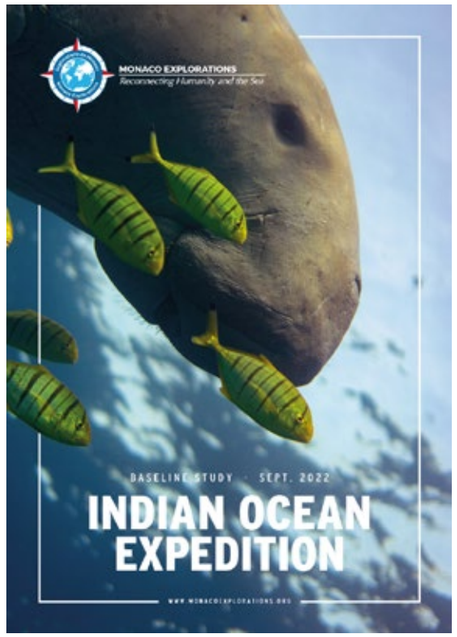
As for social networks, there were 106 publications (Twitter, Facebook, and Instagram) reaching 214 people and 7,500 likes.

4.3. RESULTS DISSEMINATION / PRESENTATIONS / SCIENTIFIC PAPERS

4.3.1. GENERAL PUBLICATIONS AND PRESENTATIONS

4.3.1.1. BASELINE STUDY

In accordance with its terms of reference, the Advisory Committee developed a Baseline Study to support and guide the preparation and refinement of the Expedition programme. It was drafted from existing data and information and from communications provided by the Committee members to provide an assessment combining different perspectives: geography, oceanography, ecology, and policy and governance. A chapter about threats to biodiversity and associated measures was also included. The final document was published in September 2022 and is available on Monaco Explorations website at: EDM_Baseline-Study-2022_final.



© Monaco Explorations.

4.3.1.2. MONACO: EXPEDITION FEEDBACK DAY, 21 MARCH 2023

The first results and perspectives of the expedition were discussed at a hybrid event organized on 21 March 2023 during the annual Monaco Ocean Week at the Oceanographic Museum of Monaco. About 150 participants attended on site and more than 2,500 connections to the live feed were registered.

The event was moderated by Carl Gustav Lundin, Advisor, Mission Blue, and Chair of the Expedition Advisory Committee. It began with a 20-min video summary of the expedition produced by Sylvain Peroumal (https://youtu.be/Be-QsW4y2w4) followed by a review of the importance of regional knowledge and cooperation in the South-West Indian Ocean complex geostrategic and socio-economic context and an overview of the expedition itself. Next, a high-level sequence in the presence of HSH Prince Albert II of Monaco included the views from Mauritius, by Dr M Rezah Badal, Director General of the Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office and from Seychelles, by Mr Jean François Ferrari, Designated Minister, Minister of Fisheries and the Blue Economy, and the visit of an artistic and photographic exhibition displayed around the Conference Hall to evoke the key moments, places and atmospheres that characterized the expedition (see **section 4.8.3**).

An overview of the UN Ocean Decade and of the IIOE-2 under which the expedition was conducted followed. Then, the teacher and the pupils of a Monaco primary school that had participated in a live session with the artists and the scientists during the expedition shared their experience in their own touching words.

A roundtable devoted to the "The Invisible Island - Saya de Malha" discussed the first results of the investigation of this area in terms of physical, chemical and biological oceanography, bottom characteristics and benthic biodiversity. It concluded the morning session.

The first roundtable of the afternoon session discussed the benefit of the onboard school on oceanographic instrumentation and data processing that had taken place during the first part of the expedition between Reunion and Seychelles. The second roundtable considered the preliminary results of the different investigations that were conducted around the "Visible Islands" of Aldabra and Saint Brandon.

The observations of the surface currents and the distribution of microplastics were discussed next.

Finally, the presentation of the "Adopt a float" outreach programme associated with the deployment of Argo floats and of the artistic activities hosted by the expedition concluded the event.

A video summary of the event is available here: https://youtu.be/D4KKJWgsDk0.

Expedition Feedback Day, 21 March 2023. Top left: Carl Gustav Lundin, Chair of the Expedition Advisory Committee; top right: Dr Rezah Badal, Director General of the Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office; bottom left: the audience around HSH Prince Albert II of Monaco; bottom right: from right to left: Mr Jean-François Ferrari, Seychelles' Designated Minister and Minister for Fisheries and the Blue Economy, Dr Rezah Badal, Dr Frauke Fleischer-Dogley, CEO of the Seychelles Islands Foundation © Fondation Prince Albert II de Monaco.

4.3.1.3. SPECIAL ISSUE OF A SCIENTIFIC JOURNAL

At its 12th meeting on 22 March 2023, the Advisory Committee agreed to plan a special issue of a scientific journal that will encompass the whole expedition and add value to separate publications based on the different projects. A publication group composed of members of the Committee and project leaders was established to carry out this project. A tentative summary is being developed to approach different journals, discuss their conditions, and select the most attractive solution in terms of accessibility, readership, impact factor, and cost. The objective is to publish the special issue in late 2024 or early 2025.

4.3.2. SAYA DE MALHA

The project team is looking for every opportunity to showcase disciplinary results at regional or international conferences.

The team has proposed 11 papers related to the project for the expedition special issue.

4.3.3. MADCAPS

Three research publications are planned for 2023 and 2026:

- Is there a garbage patch in the Southern Indian Ocean subtropical gyre?
- Coral pathogens fixed on plastic debris floating in the South-West Indian Ocean.
- Marine litter beached on remote islands and Madagascar: What are they and where do they come from?

The first two papers are being considered for publication in the expedition special issue.

4.3.4. GECOS

An overview of the project on was presented during the 12th WIOMSA Scientific Symposium, 10-15 October 2022, at a workshop dedicated to the Marine Turtle Task Force of the Western Indian Ocean (WIO-MTTF), bringing together marine turtle specialists from this region of the Indian Ocean. The aim here was not to promote the project, but to indicate the type of research being carried out on marine turtles in the region. To date, and in the absence of the final results, no other communication has been made about the GECOS project.

4.3.5. 4SEA

The data collected during the Indian Ocean Expedition was used to generate analyses (bathymetric maps, digital elevation models, orthophotographs) of the Aldabra site. These analyses were promoted through a popularisation video, a methodological description article, and presentations at international and national events:

- SEAS-OI Station (Reunion, France, November 2022): workshop on photogrammetry tools.
- GEOHAB 2023 Conference (Reunion, France, May 2023): oral presentation available with a DOI at https://doi.org/10.5281/zenodo.7923093.
- IHSM Workshop (Toliara, Madagascar, May 2023): oral presentations on data acquisition and image processing techniques using photogrammetry and deep learning available with a DOI at https://doi.org/10.5281/zenodo.7928814.

4.3.6. BGC-ARGO

News about the project were posted during the expedition on Twitter (@adoptafloat, @ERC_REFINE) and Instagram (@adoptafloat) (see **section 4.2.4**).

Annex D provides the links to display and download the data collected by the floats that were deployed during the Expedition.

The BGC-Argo project and resulting observations are rather unique for two main reasons:

(1) the profiling floats are expected to provide long-term time-series of data over at least ~ 4 years, and

(2) the data are in open access. In this context, the outcomes of the BGC-Argo project are potentially diverse and will occur over a rather long timeframe.

Three categories of publications are foreseen:

- A general descriptive manuscript that establishes the oceanographic conditions of the investigated area is expected to be prepared by the end of 2023.
- The specific in-depth analysis of data acquired by floats, in particular the REFINE floats equipped with new additional sensors, should provide the basis for several articles over the coming years.
- Finally, the data will likely be used by other scientists for addressing different scientific aspects.

Some of the results acquired during the expedition or later by profiling floats will be presented at relevant meetings (see **section 6**, **Table 16**).

4.3.7. SSD-SVP

- Reporting at IIOE-2 Meeting No 6, Perth, Australia, February 2023.
- Special Highlights article in UWA-OI Newsletter, May 2023.
- Presentation planned in 'IIOE-2' Session of the IAPSO Symposium at IUGG 2023 Berlin, July 2023.
- "Drifters" paper for a scientific journal in preparation.

4.3.8. WORLD CORAL CONSERVATORY

An oral presentation of the project was given by Olivier BRUNEL at the 11th International Aquarium Congress (IAC), held in Nausicaa, Boulogne-sur-Mer, France in November 2022.

4.4. EDUCATIONAL ACTIVITIES WITH SCHOOLS, TEACHERS AND THE GENERAL PUBLIC

4.4.1. INFORMATION FOR TEACHERS PRIOR TO THE EXPEDITION

In collaboration with the Monegasque National Education Centre for Teacher Training, the expedition was presented as an educational tool and resource to interested teachers in the Principality on two occasions prior to its launch: on 14 September 2022 to a group of primary school teachers and on 21 September 2022 to a group of secondary school teachers.

Also in September 2022, the expedition was included in the "Explorer and Citizen of the Seas" scheme coordinated by the Academic Delegation for Cultural and Artistic Action of Nice Education Authority in Alpes-Maritimes and Var. The expedition was also presented at the teachers' information day organized in Monaco by the Oceanographic Institute Outreach and Education Department on 3 October.

Lastly, the announcement was relayed in September at the national level in France to the academic inspectors for science and technology, through the French Ministry of Education and Youth.

4.4.2. VISITS, EVENTS AND EDUCATIONAL ACTIVITIES DURING THE EXPEDITION

During each port of call, in addition to visits from the press and officials to whom the challenges and objectives of the expedition were presented, around 500 people were welcomed on board for tours of the ship and activities for schoolchildren. These outreach activities were coordinated by the Monaco Explorations team with the scientists and the artists involved, who were asked to take part in the activities and visits, specially BGC-Argo, MADCAPS, World Coral Conservatory, Saya de Malha team... The crew of the ship was a precious and important partner for the organization of the visits of the ship The contacts established on this occasion with the authorities and representatives from the education sector also helped to raise awareness among teachers of the educational actions carried out by the expedition's partners.

The stopovers were great opportunities to meet new people, interact, and pass on knowledge © Nicolas Mathys - Zeppelin / Monaco Explorations & Didier Théron - Monaco Explorations.

"OCEANO FOR ALL" CONTEST

The "Oceano for All" outreach contest organized by the Oceanographic Institute, Prince Albert I[st] of Monaco Foundation was presented to the educational representatives of each country (France / Reunion, Mauritius, Seychelles) during the stopovers for further development of this programme in the region. Two classes of Reunion, involved in this contest, were welcomed on board during the stop over at Le Port.

Visiting S.A. Agulhas II *on 13 October 2022 in Le Port, pupils from Quartier Français Lucet Langenier and Chemin Morin de la Réunion Secondary Schools and their teachers, Cécile and Stéphane Delebarre, took part in the "Oceano for All" contest during the 2022-23 school year © Didier Théron - Monaco Explorations.*

"ADOPT A FLOAT" PROGRAMME

As part of the "Adopt a float" programme lead by the BGC-Argo team, which offers classes of all levels to "adopt" an Argo float, follow its trajectory and study the data it collects, three floats have been adopted by respectively one class in Reunion, a group of seven classes in Mauritius and one class in Seychelles.

Meetings and activities were organized on board *S.A. Agulhas II* with the adopting classes: signing of the floats and scientific presentations of the floats and by the BGC-Argo team.

Hervé Claustre, co-manager of the BGC Argo international programme, presents the "Adopt a float" educational programme and how a buoy works to representatives of Mauritian school classes, 31 October 2022 © Nicolas Mathys - Zeppelin / Monaco Explorations.

LIVE SESSIONS

Despite the sometimes-capricious satellite communication coverage, several live interactive sessions were organized between the scientists and artists on board and the rest of the world. In all, eight sessions enabled the various actors involved to share the expedition with listeners thousands of kilometres away:

- **16 October 2022:** Science Festival, Paris, France: exchange between Hervé Claustre, co-leader of the International BGC-Argo Programme and the public present at Sorbonne University.
- **28 October 2022:** the children of the "Oceano for All" Club at the Oceanographic Museum in Monaco exchanged with the teams of the BGC-Argo, MADCAPS and World Coral Conservatory projects.
- **7 November 2022:** the 6[th] grade class from the Quartier Français Lucet Langenier Secondary School in Reunion interacted with the MADCAPS team.
- **11 November 2022:** Ms Gaëla Huet's cycle 3 class, from the Cours St-Maur in Monaco, exchanged views with the BGC-Argo team on floats, the MADCAPS team on plastic and artists Rémi Leroy and Elise Rigot who presented their work and their approach.
- **16 November 2022:** interaction between the students of the Master of Science "Conservation and enhancement of marine resources" (MARRES) of the University of Nice, during a workshop visit to the Oceanographic Museum of Monaco, and the following scientists involved in the study of the Saya de Malha Bank: Line Le Gall and Philippe Bouchet (MNHN), Francis Marsac (IRD).
- **17 November 2022:** interaction in English between Ms Julie Wilson's 1[st] B class of the Le Rebours Secondary School in Paris and Damaris Landers and Bryan Wilson, two Coral Connect scientists.

- **21 November 2022: two sessions:**
  - Interaction between Ms Wilson's 1st C class and artists Rémi Leroy and Elise Rigot;
  - Live recording of three lectures by the team of Seychellois researchers on board (Mariette Dine, Teena Shalma, Camilla Labonte, Rosabella Mangroo) for the National Education of Seychelles represented that day by Ms Lynndina Essack in Port Victoria.

Live session with the Expedition, 28 October 2022 © Michel Dagnino - Institut océanographique.

4.4.3. EDUCATIONAL ACTIVITIES AFTER THE EXPEDITION

The educational activities initiated during the expedition continued throughout the school year 2022-2023.

"OCEANO FOR ALL" OUTREACH CONTEST

Two of the classes received on board during *S.A. Agulhas II* stopover in Reunion took part in the "Ocean for All" contest run by the Oceanographic Institute Outreach and Education Department in the "France: over 1,100 km from the Museum" category. Pupils from the Quartier Français Lucet Langenier secondary school produced a logbook on the MADCAPS project and took part in a workshop on planting endemic species to revegetate the beach and encourage marine turtle nesting. The students from Chemin Morin secondary school in Reunion produced a video to raise awareness of the need to protect coral reefs. Both classes are in the running to win the competition in their category.

For the next school year (2023-2024), it was decided, during a meeting on the occasion of the Monaco Ocean Week in March between Mr Robert Calcagno, Managing Director of the Oceanographic Institute and Minister Jean-François Ferrari and their respective teams, that an "Ocean for All" contest will be held in Seychelles next year. The classes involved in the contest will used results and resources of the expedition to participate.

"ADOPT A FLOAT" PROGRAMME

After the expedition and throughout the school year, meetings and training sessions were organized for teachers and pupils by the "Adopt a float" team with local adopting classes (Reunion 6th class, Mauritius, Seychelles high school classes).

Three "Adopt a float" sessions with classes that adopted a float deployed during the expedition: presentation of the oceanographic expedition (scientific and societal issues): face-to-face & online videoconferencing, slideshow support and voyage sheet have been provided.

One "Adopt a float" teachers' meeting: sharing of scientific concepts and teaching resources relating to oceanography and the expedition.

This monitoring was made possible thanks to contacts initiated during the expedition with education officials by Monaco Explorations team. In Mauritius, two researchers who were on board during the expedition, Priscilla Coopens and Yuneeda Oozeeraully, then got involved to liaise with the classes on site and facilitate the implementation of the programme with the remote "Adopt a float" team.

4.5. ONBOARD TRAINING

4.5.1. ONBOARD SCHOOL

With a few adjustments to the sequence of lessons, it proved possible to organize during the leg between Reunion and Seychelles a practical module of the course on instrumentation and acquisition of oceanographic data, which is part of the Master's degree in Marine Sciences at Sorbonne University (SU). In addition to twelve students from this Master's programme as well as eight students from the European International Master of Science in Marine Biological Resources (IMBRSea), five students or young researchers from Mauritius and five students or young researchers from Seychelles were invited to take part in this onboard school. The onboard school was run by three teachers from IMEV (*Institut de la Mer* in Villefranche-sur-Mer, France).

The onboard school: immersing students in field research © Didier Théron - Monaco Explorations.

EDUCATIONAL OBJECTIVES

Two teaching units in the second year of the master's programme are based on time at sea: MU5MRM31 Instrumentation and Acquisition of Data in Oceanography and MU5MRM32 Methods for the Exploitation of Data in Oceanography. They were scheduled within the master's programme from 26 September to 4 November 2022.

The teaching programme began on 26 September with classes given by IMEV lecturers (six lecturers involved in addition to the three onboard lecturers).

These lectures were broadcast and recorded by Zoom so that they could be accessed in real time by the 10 non-SU participants. These lectures provided students the essential basics on the hydrological and chemical

context of the Indian Ocean, as well as on digital processing of large datasets.

This was followed by the onboard phase, which offered students the opportunity to discover and experience a large-scale oceanographic expedition in a relatively unknown ocean, as well as acquire a large amount of oceanographic data. The final week back at IMEV was devoted to finalising the study report and preparing a poster presentation.

The teaching objectives of MU5MRM31 are to give students the experience of a research cruise at sea, from the planning to the implementation phase, while MU5MRM32 focuses specifically on the processing and analysis of oceanographic data.

From the start of the expedition, the students were immersed in the operation of an oceanographic vessel, with dedicated workstations and shift work. During the first part of the expedition, the students collected oceanographic samples (nets, rosette, etc.), analysed these samples (planktoscope, dissolved oxygen measurement, chlorophyll measurement) and carried out in pairs a prospective project (30% of the final score). The projects consisted of preparing a research cruise file: scientific question, state of the art, sampling plan, data processing. These projects were presented at seminars (40% of the final score) attended by the scientists on board. A few examples of the topics proposed:

- Effect of sediment collection in Rivière des Remparts, Reunion;
- Effects of eddy dynamics on phytoplankton community distribution in the Mozambique Channel;
- Multi-perspective assessment of particulate organic carbon export on the Mahé Shelf.

In a second phase, the students took ownership of the various analyses, of which the planktoscope was at the centre, and carried out extensive work to identify and sort thumbnails of organisms in order to start organizing the workflow, i.e., data formatting, processing and analysing. The objective was to answer a scientific question as part of a personal project based on direct use of the cruise data. This work was the subject of an oral presentation (40% of the final score) and a poster (20% of the final score. Some examples of projects:

- Zooplankton vertical distribution on the Mascarene Plateau, Western Indian Ocean;
- Variation of plankton composition around Aldabra atoll;
- How do different sampling gears describe the sampled phytoplankton communities?
- Spatial characterization of water mass properties in the South-West Indian Ocean by BGC-Argo floats.

From these two master units and the work carried out at sea, students are expected to acquire the following skills and knowledge:

- Define the framework of an oceanography study according to practical constraints: objects and scales to be described, vessels and sensors available, nature of the systems to be analysed, budget;
- Draw up and justify a cruise plan;
- Implement a set of oceanographic instruments;
- Use pre-existing databases (cruise data, satellite data, etc.) to contextualise scientific questions;
- Carry out chemical measurements classically associated with a research cruise;
- Process biological plankton samples (counts, imaging, classification);
- Format all the data collected during the cruise (CTD profiles, BGC-Argo data, GPS coordinates, station sheets, chemical measurements, etc.);
- Analyse oceanographic data sets;
- Design a personal project on a scientific question requiring the direct use of cruise data.

TYPE AND QUANTITY OF COLLECTED DATA

Two sampling strategies were deployed during the expedition.

- Mesoscale strategy: seven stations were set up to deploy BGC-Argo floats. At these stations rosette profiles were carried out to collect water samples for chemical analyses (chlorophyll and dissolved oxygen at eight depths) and a plankton net was deployed.
- High-frequency strategy: when the vessel was stationed off Aldabra atoll high-frequency sampling was carried out with plankton nets (17 casts).

For each net cast, the data was counted and stored on EcoTaxa. All the metadata and chemical analysis data were saved on the onboard teaching server for later use by the students.

In terms of the scientific use of the data, the image database will be made public on the EcoTaxa site (UVP and planktoscope) and may be the subject of a scientific publication. The final exploitation has been delayed due to the late return of the container.

4.5.2. DATA PROCESSING TRAINING SESSIONS

Two technical training sessions were delivered on board the ship, during the transit from Saya de Malha to Saint Brandon.

TRAINING 1 DECODING AND ANALYSIS OF CTD CASTS USING THE SEASOFT PACKAGE
(16 November 2022, Jean-François Ternon, IRD)

After a review of the main physical properties of the water masses in the ocean, and their description in the Western Indian Ocean, a detailed description of the Seasoft software SBEDataProcessing_Win32_V7.26.7-b40, and the way to use it on CTD casts was delivered. The software had been installed beforehand on the trainees' laptops. The practical exercises used the CTD casts files collected during the expedition. The session was attended by 18 participants from the different project teams and some members of the Advisory Committee.

TRAINING 2 MAPPING NETCDF DATA WITH R
(17 and 18 November 2022, Francis Marsac, IRD)

This technical training was to familiarize scientists with the use of the R package to create a map, taking three case study: mapping the GEBCO 2020 bathymetry of the Saya de Malha Bank, mapping temperature and dissolved oxygen at a given depth (4-dimension files), and mapping currents (requiring two 4-dimension files, i.e., zonal and meridional components). The session was run under RStudio. On 17 November, R with all its necessary packages and scripts were installed on the laptops, as well as the datasets used in the exercises. This pre-session was to ensure that the system was operating correctly before starting the exercises the next day. The exercise session started with a very basic description of R and a brief description of the properties of a NetCDF (nc) file. Then, a series of simple R scripts were run, from the very basic ones to open and read a 'nc' file and gradually adding instructions to display the map, then customizing the isobaths to be represented on the map and the associated colour scale (in the case of the bathymetric map). For the temperature/oxygen and current maps, the participants learned how to perform a selection of data in a 4-dimension grid (longitude, latitude, time, depth) and display the map. This training session was attended by 19 participants.

4.5.3. WORKSHOP ON THE INTERNATIONAL LAW OF THE SEA AND ITS RELATIONSHIPS WITH MARINE SCIENCE

A choice of three training workshop was proposed to scientists, members of public bodies, university lecturers, students, civil society representatives or stakeholders presents on board, and *S.A. Agulhas II* crew members. Up to 31 participants attended the three training sessions. These sessions were closely related to the "high seas" component of the DiDEM programme and highlighted the importance of the development of a regional ocean governance strategy covering the high seas, deep seas and distant seabeds, based on marine science.

A training session with Florence Galletti in the vessel Auditorium, 18 November-2022 © Didier Théron - Monaco Explorations.

TRAINING 1: BASIC CONCEPTS AND DIVISIONS OF OCEAN AREAS, GENERAL ASPECTS AND INDIAN OCEAN ASPECTS
(18 November 2022, Florence Galletti, IRD)

The "new" Law of the Sea originates from the United Nations Convention on the Law of the Sea (UNCLOS) of 10 December 1982, which came into force on 16 November 1994. Its application in the Western Indian Ocean resulted in mapping maritime zones in accordance with UNCLOS, customary law, or international court judgments. On the one hand, spaces are mostly delimited by scientific approaches, such as internal waters, territorial seas, contiguous zones, exclusive economic zones (EEZ), single or extended continental shelves, the high seas, and the international seabed area. On the other hand, sub-divisions are formed by fisheries zones, or specific marine spaces like archipelagic waters and baselines claims (the Republic of Seychelles is an example of a user of both normal and archipelagic baselines for four separate groups of islands) and their legal regimes.

This training addresses this fragmented governance, boundaries, delineation, and evolving maritime areas and claims, the 21st century legacy, to facilitate access to the second training more focused on ecological descriptions and the legal means to exploit or conserve several habitats and resources (**Figure 63**).

Figure 63 A

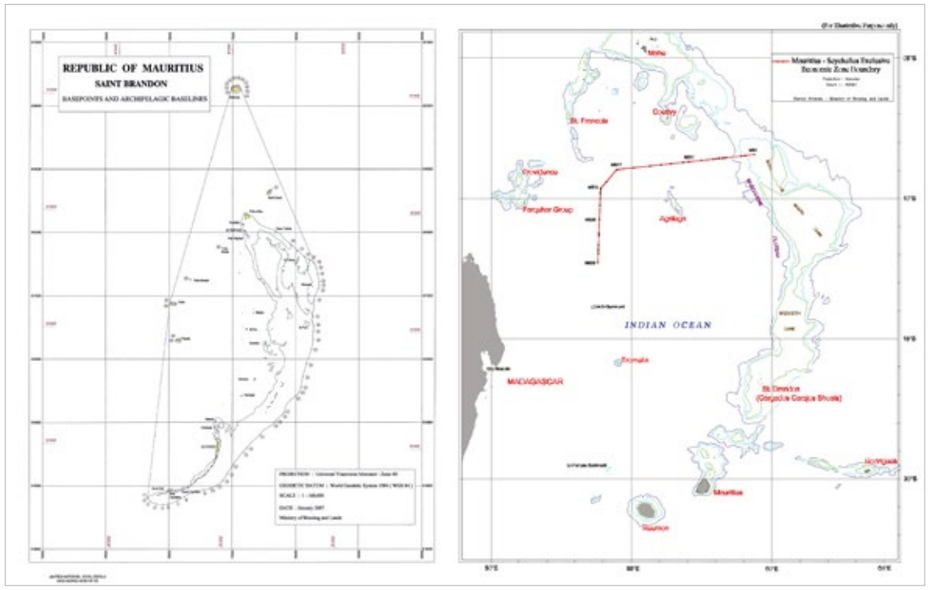


Figure 63 B and C
Figures A, B and C: *Marine delimitation examples. Retrieved from https://www.un.org/Depts/los/LEGISLATIONANDTREATIES/index.htm - Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs, United Nations.*

TRAINING 2: REMOTE MARINE ENVIRONMENTAL HERITAGE

(19 November 2022, Florence Galletti, IRD)

After a short introduction to the definition of Marine Heritage, this training focuses on where Remote Marine Environmental Heritage is located and what is being made in a context of large progress in marine sciences. It also explains why we deal with such distant areas in the Western Indian Ocean and the needs that justify it (precautionary approach, economy of nations, well-being, others...). A second part shows how to act on the Remote Marine Environmental Heritage, both with support given by biogeographical and ecological divisions and support given by the legal regimes available. Two hypotheses are presented: 1) act on the Remote Marine Environmental Heritage inside a 200 NM marker; and 2) act on the Remote Marine Environmental Heritage beyond a 200 NM marker (Areas Beyond National Jurisdiction [ABNJ]). An overview of two sectors of ABNJ governance (fishery law & governance/ mining regime & governance) is given, with examples relating to non-living remote marine heritage (minerals) and to living marine heritage.

TRAINING 3: MARINE SCIENTIFIC RESEARCH AND LAW OF THE SEA OVERVIEW OF SOME MODERN INTERACTIONS AND DIFFICULTIES
(20 November 2022, Florence Galletti, IRD)

This session aims at defining what marine scientific research (MSR) is according to UNCLOS, what is part of MSR and what is not, and several related issues. It recalls the current situation where more inputs are required (from marine sciences) to strengthen decision-making capacity for the conservation of marine heritage, and the position of scientists confronted to this evolving situation.

Two specific cases were presented:

- identification of Vulnerable Marine Ecosystems (VMEs) and change in the legal regime when encountered (difficulty of the task, complementary or concurrency of real data sampling and modelling, deep-fishing sector supremacy over scientific advice);

- new issues and claims related to objects drifting at the ocean surface (floats from international Argo program, fishing aggregating devices [FADS] operated by the tuna industry, Illegal, unreported and unregulated [IUU] fishing...).

4.6. MEDIA PRODUCTION

4.6.1. OVERVIEW

Throughout the two months of the expedition, various creations and content were added to the resources on Monaco Explorations website: 26 resources including podcasts, newsletters and videos, as well as 16 mood notes and several portraits of the people involved in the expedition. This production will continue in various forms in 2023.

4.6.2. SAYA DE MALHA DAILY

Dominique Benzaken and François Simard, both members of the expedition's Advisory Committee, embarked on the leg from Seychelles to Mauritius. Through their daily newsletter, 20 issues in all, they took an original and offbeat look at the progress of the expedition.

SAYA DE MALHA DAILY

A Newsletter by Dominique and François

N°19, 21st November 2022

Where are we ?

Saint Brandon

16°50 South 59.31° East

Sunny some Clouds, Calme Seas, Wind 11.27 Knots

Air Temperature 24°5, Water Temperature 25°7

©Tim_Teichmann_ExplorationsMonaco

Reef of Saint Brandon

Saint Brandon has three main lagoons up to 7 m deep, separated by reef crest walls. The lagoons have sandy floors either heavily bioturbated by worms, crustaceans, bivalves and gastropods, or covered by blue-green algal mats and seagrasses. Patches of reefs grow to 3 m in diameter in the lagoons, often having dead or rubble tops, around which larger fish aggregate.

Saya de Malha Daily, n°19 © Monaco Explorations.

4.6.3. L'ÉCHO DES LABOS (ECHO FROM THE LABS)

Journalist and author Stéphane Dugast, who was also present during the leg from Seychelles to Mauritius, turned his microphone to those involved in the expedition. In the laboratories, on the deck, while samples were being sorted or on board the dive boats with the divers, he captured the reactions, initial analyses and feelings. Four podcasts were produced on board.

4.6.4. PHOTOGRAPHS AND VIDEOS

Additional video coverage of the leg between Reunion and Aldabra, as well as the visit of HSH the Sovereign Prince was entrusted to Sylvain Peroumal (Terre M'Air Production).

For photographic coverage of the expedition and the production of reports, two other teams were mobilised. Photographic coverage of the leg between Reunion and Seychelles was provided by photographers Filip Kulisev and Zuzana Matejbusova (Amazing Planet), while the Zeppelin Agency covered the trip of HSH the Sovereign Prince as well as the leg between Seychelles and Mauritius with Stéphane Dugast and photographer Nicolas Mathys.

The initial content from the audio and video recordings and the photographs and shots taken during the expedition were posted on Monaco Explorations, Amazing Planet and Zeppelin Agency websites, as well as stored in Oceanographic Institute of Oceanography online digital asset library. They also fed into various press articles and reports.

Several terabytes of images were produced and generated during the expedition. They will feed into a number of projects, including a documentary to be co-produced with TV Monaco and Autentic.

4.6.5. DOCUMENTARY PROJECT

The future Monegasque public television channel TV Monaco teamed up with the production company Autentic, a subsidiary of the German film and television group Beta specialized in international factual productions, to produce a documentary on the expedition. Autentic mobilised a film director with a solid filmography, Harald Pokieser, and a small production team including an assistant and a diver cameraman.

4.7. ARTISTIC PRODUCTION

4.7.1. CALL FOR ONBOARD ARTISTIC RESIDENCY

56 applications had been received in 2021 in response to the call for expressions of interest for an onboard artistic residency. A selection committee was established. It shortlisted six candidates who were auditioned on 6 May 2022. Two artists were selected:

- Elise Rigot, 3D artist, for her project to tell the stories of the Saya de Malha Bank through an artistic installation and audiovisual support;
- Rémi Leroy, notebook artist, for his project to create a dialogue between art and science through illustrated stories.

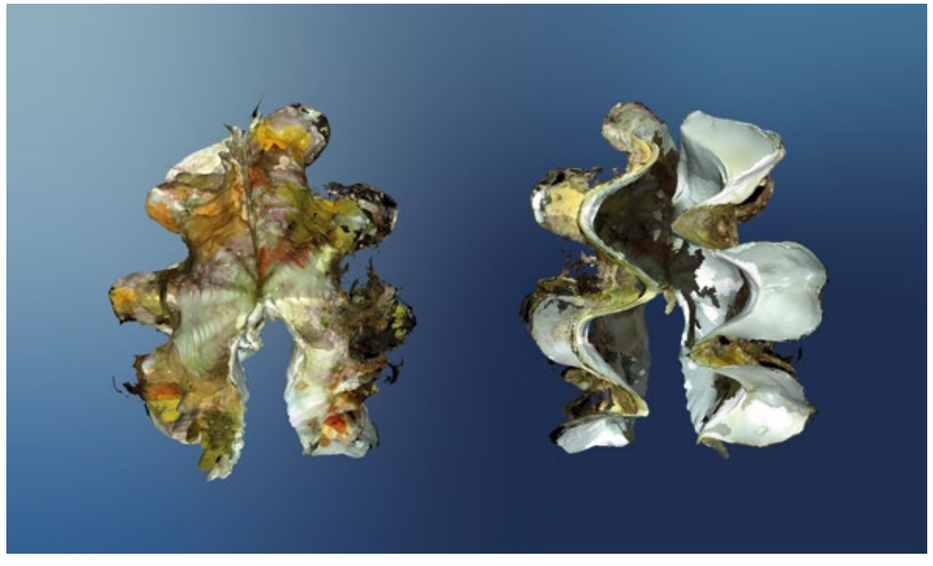
4.7.2. ON BOARD ACTIVITIES

On board, Rémi Leroy produced a number of drawings and watercolours that documented the progress of the expedition. Some of them were published on Monaco Explorations website. These creations are accompanied by texts and insights which will later be compiled in a logbook with the Arts-Science dialogue as the story line.

The Gangway, *2022 © Rémi Leroy - Monaco Explorations.*

Throughout the expedition, Elise Rigot used sound to document the progress of the expedition: scientists in action, sounds of animals or natural environments, stories. Through each character, the voices of the Indian Ocean bear witness to a culture, a heritage, but also to the quest for discovery, knowledge and truth.

Five podcasts were produced during the expedition and the series will be completed in 2023. Elise Rigot also produced watercolours and 3D scans of specimens collected during the investigations on the Saya de Malha Bank. They will be incorporated in a series entitled "Artist's view", which will be completed in 2023.



The Clam, *2023. Graphic composition and photogrammetric scans © Elise Rigot - Monaco Explorations.*

The two artists in residence were joined on the leg between Seychelles and Mauritius by Chloé Thibault, a cartoonist commissioned by the MADCAPS team to illustrate their work. The three artists presented some of their work on board.

The Manta Protocol, *2022 © Chloé Thibault - MADCAPS / Monaco Explorations.*

4.8. EVENTS / EXHIBITIONS

4.8.1. ONBOARD EVENTS

CAPE TOWN, SOUTH AFRICA: VIP VISIT, 1 OCTOBER 2022

Several representatives of partners of the expedition were welcomed on board for a visit of the ship. Among them: Mr Laurent Alberti, Consul General of France in Cape Town, Mr Robert Yearham, Honorary Consul of Monaco, Mr Mukthar Joonas, Honorary Consul of Mauritius, Mr Dawie Crous, President of the Princess Charlene Foundation in South Africa and his wife, Ms Chuma Phamoli, Acting Director, Southern Oceans and Antarctic Support, DFFE.

PORT LOUIS, MAURITIUS: MEETING AND EXCHANGES, 11 OCTOBER 2022

Several representatives of Mauritian partners of the expedition were welcomed on board for a visit of the ship. Among them: Mr Lloyd Richard Coombes, Consul of Monaco in Mauritius, Dr Rezah Badal, Director General of the Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office and Mr Maubarakahmad Boodhun, Acting Chief Executive, Ministry of Blue Economy, Marine resources, Fisheries and Shipping.

LE PORT, REUNION: VIP VISIT, 13 OCTOBER 2022

An official reception took place at the end of the afternoon in the presence of some thirty personalities from Reunion involved in the management of the maritime environment, conservation, awareness-raising or education. Among them, Mr Charles Giusti, Prefect, Administrator of the French Southern and Antarctic Territories, Ms Béatrice Sigismeau, Vice-President of the Departmental Council, Mr Eric Mévélec, Director of the Sea, Ms Chantal Manès-Bonisseau, Rector of the Reunion Academy, Mr Thierry Clot, Executive Secretary of the Southern Indian Ocean Fisheries Agreement (SIOFA).

ALDABRA: HSH PRINCE ALBERT II OF MONACO ON BOARD, 25-26 OCTOBER 2022

After a day devoted to exploring the island and discussing joint actions to be implemented with the Seychelles Government and the Seychelles Island Foundations, HSH Prince Albert II of Monaco was hosted on board *S.A. Agulhas II* where he spent the night of 25 to 26 October. On the schedule: visit of the installations and laboratories, meeting with the crew and the various scientific teams and participants in the expedition, presentation of the scientific and artistic projects linked to the expedition.

On board the S.A. Agulhas II, *in front of the buoy provided to Seychelles by the Principality of Monaco, HSH Prince Albert II surrounded by the following people: on His right, Mr Jean-François Ferrari, Designated Minister and Minister for Fisheries and the Blue Economy of Seychelles, Mr Gilles Bessero, Expedition Leader and Director of Monaco Explorations and the artist Rémi Leroy. On His left, Mr Hervé Claustre, co-leader of the international BGC Argo programme, Mr Flavien Joubert, Seychelles Minister for Agriculture, Climate Change and the Environment. Behind the Prince, Mr Robert Calcagno, Managing Director of Monaco Explorations and CEO of the Oceanographic Institute, with on his left Dr Fabrizio d'Ortenzio, member of the BGC Argo team © Filip Kulisev - Amazing Planet / Monaco Explorations.*

PORT VICTORIA, MAHÉ, SEYCHELLES: VIP VISIT, 29 OCTOBER 2022

The ship's facilities, as well as the scientific projects carried out during the expedition were presented to the visitors. Mr Jean-François Ferrari, Designated Minister and Minister for Fisheries and the Blue Economy and Mr Flavien Joubert, Minister for Agriculture, Climate Change and the Environment, were accompanied by the French Ambassador to Seychelles, HE Ms Olivia Berkeley-Christmann, the Honorary Consul of Seychelles in Monaco, Mr Jean-François Noaro and his wife, and Mr Bernard Georges, Chairman of the Board of the Seychelles Islands Foundation, Dr Frauke Fleischer-Dogley, Chief Executive Officer of the Seychelles Islands Foundation, Ms Katrin Perchat, Coordinator of the DiDEM TFOPW project and Ms Pascale Chabanet, Coordinator of the PAREO project, were also present. A group of students from the University of Seychelles, accompanied by Mr Jérôme Harlay, teacher-researcher, also visited the ship.

PORT-LOUIS, MAURITIUS: VIP VISIT, 22 NOVEMBER 2022

After the arrival of the *S.A. Agulhas II* on her second stopover in Mauritius on 22 November, Monaco Explorations hosted a reception in the early evening which brought together HE Mr Marie Cyril Eddy Boissezon, Vice-President of the Republic, Acting President, and Mr Sudheer Maudhoo, Minister for the Blue Economy, Marine Resources, Fisheries and Maritime Transport, Dr Rezah Badal, Director General, Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office, Mr Nadeem Nazurally, Chairman of the Board of the Mauritius Institute of Oceanography, and Ms Aneeta Ghoorah, Director, Primary Education, UNESCO and Curriculum Development and Evaluation, Ministry of Education, Tertiary Education, Science and Technology. An initial assessment of the operations conducted on the Saya de Malha Bank was presented.

Gilles Bessero, Expedition Leader, presents the initial results of the expedition to the Mauritian authorities on board S.A. Agulhas II. *Seated in the front row, from left to right: Mr Sudheer Maudhoo, Minister for the Blue Economy, Marine Resources, Fisheries and Maritime Transport, HE Mr Marie Cyril Eddy Boissezon, Vice-President of the Republic, Acting President, and Dr Rezah Badal, Director General, Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office © Nicolas Mathys - Zeppelin / Monaco Explorations.*

CAPE TOWN, SOUTH AFRICA, FINAL EVENT ON BOARD, 1 DECEMBER 2022

The initial results of the expedition were presented to officials and the staff of the companies involved in the expedition.

4.8.2. FEEDBACK EVENTS

PORT VICTORIA, MAHÉ, SEYCHELLES: ALDABRA SEMINAR, 2 NOVEMBER 2022

On 2 November, researchers, environmentalists, local stakeholders, SIF staff and members of the media attended a seminar dedicated to the preliminary results of the expedition visit to Aldabra. Guest speakers from the Seychelles Islands Foundation, Ifremer, Oceanographic Institute - Prince Albert Ist of Monaco Foundation, University of Reunion and others, conducted in-person and virtual presentations on the expedition. Some of the participants: Carl Lundin, Chair of the Advisory Committee, Dr Frauke Fleischer-Dogley, SIF CEO, some projects leaders of the expedition or their representatives: Jérôme Bourjea (GECOS), Gwennaïs Furstemberg (MADCAPS), Didier Zoccola (World Coral Conservatory), Veronique Banane, SIF Senior Officer, Corianna Julie, SIF Science Officer.

PORT VICTORIA, MAHÉ, SEYCHELLES: PRESENTATION OF THE MONACO EXPEDITION AND LAUNCHING OF THE SEYCHELLOIS SCIENTISTS SOCIETY, 2 FEBRUARY 2023

In order to promote the outcomes of the Indian Ocean Expedition and to expose young Seychellois scientists to presenting their research carried out during the cruise, the Ministry of Fisheries and Blue Economy organized a public session on 2 February 2023. In the presence of Minister Jean-François Ferrari and Principal Secretary Kenneth Racombo, the event was introduced by M. Robert Calcagno, CEO of Monaco Explorations. The research program was briefly presented by Dr Francis Marsac (IRD), before showing the video teaser of the expedition and a slide show. Then five young Seychellois scientists presented their research project for the leg between Seychelles and Mauritius. The last session of the event was the presentation of Certificates of Participation jointly signed by Monaco Explorations and the Ministry of Fisheries and Blue Economy, to the Seychellois participants in the expedition.

Presentation of the Indian Ocean Expedition at the Seychelles Institute of Teacher Education (SITE) auditorium , Mahé, Seychelles on 2 February 2023. First row, from left to right : Mr Robert Calcagno, Managing Director of Monaco Explorations and CEO of the Oceanographic Institute, HE Ms Olivia Berkeley-Christmann, Ambassador of France, Mr Justin Valentin, Minister of Education, Mr Jean-François Ferrari, Designated Minister and Minister for Fisheries and the Blue Economy, Mr Kenneth Racombo, Principal Secretary for the Blue Economy, Mr Vincent Meriton, former Vice-President, Ms Béatrice Calcagno, Mr Francis Marsac, IRD © Ministry of Fisheries and Blue Economy.

4.8.3. EXHIBITION: "MULTIPLE PERSPECTIVES"

The "Multiple perspectives" exhibition, on display in the Oceanographic Museum in Monaco from 17 March to 27 June 2023, looks at the expedition through the eyes of the artists, photographers, journalists and filmmakers who took part in the expedition: Chloé Thibault, Rémi Leroy, Elise Rigot, Stephane Dugast, Nicolas Mathys, Sylvain Peroumal. Narrative, drawing, watercolour, sound, video and photography are the media used on the 25 panels of the exhibition to bear witness to the characters, situations, key moments, places and atmospheres that gave this expedition its identity.

The exhibition was inaugurated on 21 March 2023 during the expedition's feedback day, in the presence of the artists and personalities present (see **section 4.3.1.2**).

The exhibition is expected to continue during the summer of 2023 on the gates of Saint Martin's Gardens. The content will also be showcased on the Monaco Explorations website. There are also plans to duplicate the content for use in educational programmes in Reunion, Mauritius and Seychelles.

Exhibition poster © Monaco Explorations.

4.8.4. MADCAPS EXHIBITIONS

An exhibition of the work of Chloé Thibault called "Ziska Kan Torti I manz plastik" will be displayed at Kelonia Sea Turtle Rehabilitation Centre from 1 June 2023. Another exhibition is expected to be displayed at the University of Reunion Island during the academic year 2023-2024.

4.9. DIDEM RELATED ACTIVITIES

4.9.1. COMPONENT B: CAPACITY BUILDING AND TRAININGS

The organization in Seychelles of a thematic school on reef geosystems is still on the agenda. Initially scheduled for April/May 2023, it was postponed in order to refine the programme and exploit the results of some of the research work carried out during the expedition, particularly in Aldabra. It should take place in October 2023 or during the first half of 2024.

4.9.2. COMPONENT C: RAISING AWARENESS IN CIVIL SOCIETY IN SEYCHELLES

4.9.2.1. PAREO: MARINE EDUCATIONAL AREA

The restitution of PAREO activities undertaken in 2020 with three primary schools in Seychelles was organized on 24 and 25 August 2021. It ensued a consultation with local partners for the implementation of a marine educational area (MEA) project.

The MEA project started in mid-January 2022 as planned. However, the children's activities did not begin until May 2022 due to administrative difficulties. Thirty or so sessions to raise awareness and pass on scientific knowledge were held in schools and in the field for children from the Baie Sainte-Anne public primary school on the island of Praslin.

The MEA was demarcated within the Curieuse Island Marine Park. The inauguration took place on 28 October2022 in the presence of representatives from the Baie Sainte-Anne district, the Seychelles Ministries of Environment and Education, Seychelles Parks and Gardens Authority, the school principal and parents. Francis Marsac represented Monaco Explorations, as *S.A. Agulhas II* was not due to arrive in Seychelles until the following day.

The children involved in the project and their parents were also welcomed on board *S.A. Agulhas II* on 31 October for a guided tour of the ship, followed by a workshop with artists Elise Rigot and Rémi Leroy. During the workshop, they made recordings of their stories and were introduced to a new illustration technique.

The period from July to December 2022 saw the finalisation of the application for European INTERREG funding for the PAREO 2 project, which will run until December 2023 in Reunion, Mauritius and will enable AME to resume its activities in Seychelles with new students and more classes.

Inauguration of the Curieuse Marine Education Area, 28 October 2022 © Nicolas Mathys - Zeppelin / Monaco Explorations.

Children from Baie St-Anne school in Praslin discover the Ile Curieuse Marine Park. June 2022 © Lola Massé - IRD / Monaco Explorations.

4.9.2.2. THE FUTURE OF® PLASTIC WASTE (TFOPW)

Initiated in 2020 with training actions for partners and stakeholders and the launch of a call for projects, the TFOPW program organized two partnership days that took place online on 27 and 28 May 2020. As a result, six project proposals were shortlisted on four themes: understanding and mapping sources of plastic pollution (one proposal), physical collection of plastic (one proposal), processing of collected plastics (three proposals), environmental education and awareness-raising (one proposal). The selection committee met on 30 November 2021 and selected three projects to benefit from 6 months of follow-up and a start-up budget to accompany and build solid partnerships (project management, network and funding opportunities):

- Recycling Machine: promote simple, inexpensive and easy-to-use technologies to treat and transform waste.
- Connect-Collect: promote a more transparent, efficient and sustainable recyclable waste management system.
- Awareness Campaign: raise awareness of the problem of plastic pollution and educate the population to adopt good practices.

The first two projects started in March-April 2022 while the third one was delayed due to the temporary unavailability of the project manager. They are progressing slowly, hindered by limited expertise and funding. Potential additional fundings are being investigated.

A shredder is being built by students at the Seychelles Institute of Technology for the Recycling Machine project.

5. POLICY AND GOVERNANCE

5.1. DIPLOMATIC ARRANGEMENTS

Following a round of discussions with the focal points designated by the Governments of Mauritius and Seychelles, the outline of the expedition and a preliminary plan were submitted to both Governments in November 2021. Requests for consent to conduct marine scientific research in maritime areas under the jurisdiction of France, Mauritius Seychelles and the joint management area (JMA) authority for the extension of the Saya de Malha continental shelf, were prepared with the scientific partners and finalised with the focal points designated by Mauritius and Seychelles. They were submitted through diplomatic channels in March 2022.

In accordance with the guidance of the Prince Cabinet, an initial framework for the visit of HSH the Sovereign Prince to Seychelles during the expedition was set during Monaco Ocean Week 2022 (21 to 25 March) with the delegation representing Seychelles led by Mr Jean-François Ferrari, Designated Minister, Minister for Fisheries and the Blue Economy.

HSH the Sovereign Prince was officially invited to visit Seychelles on 7 April by the President of the Republic of Seychelles and Mauritius on 1 June by the Prime Minister of the Republic of Mauritius. Only the first invitation could be accepted within the timeframe of the expedition, considering the busy schedule of the Prince.

The diplomatic approach initiated in 2021 to include the chartering of *S.A. Agulhas II* in the scope of the cooperation between South Africa and Monaco was not successful. It was not possible to obtain the participation of the South African Navy Hydrographic Office in the expedition.

After discussions with the executive secretariat of the Southern Indian Ocean Fisheries Agreement (SIOFA) and via the Seychelles delegation, the expedition was presented on 23 March at the 7th meeting of the Scientific Committee of the Agreement. On the recommendation Committee, the 9th Meeting of the Parties held in July expressed its support for the project.

Discussions on the requests for consent to conduct marine scientific research led to three memorandums of understanding aimed at developing develop cooperation in the field of fundamental and basic and applied marine research, which were signed respectively with:

- the Department for Continental Shelf, Maritime Zones Administration and Exploration (CSMZAE), Prime Minister's Office of the Republic of Mauritius;
- the Government of the Republic of Seychelles, represented by the Department of Blue Economy;
- the Saya de Malha Management Authority.

Within this framework, Monaco Explorations took charge of the acquisition of two Argo floats for donation to Mauritius and Seychelles with a view to deployment to contribute to the BGC-Argo project during the expedition.

5.2. VISIT OF HSH PRINCE ALBERT II OF MONACO

The diplomatic highlight of the expedition was the visit to the region by HSH Prince Albert II of Monaco from 24 to 26 October. The Prince and His delegation were welcomed in Seychelles on the morning of 24 October by Mr Sylvestre Radegonde, Minister of Foreign Affairs and Tourism. Together with a Seychelles delegation led by Mr Jean-François Ferrari, Designated Minister and Minister for Fisheries and the Blue Economy, accompanied by Mr Flavien Joubert, Minister for Agriculture, Climate Change and the Environment, they visited the island of Aldabra. Their stay on the island, until late afternoon of 25 October was devoted to exploring the island and discussing possible actions with the Seychelles Islands Foundation and the Government of Seychelles. The visit ended with the signing of a scientific collaboration agreement between the Seychelles Islands Foundation, the Scientific Centre of Monaco and the Oceanographic Institute related to the World Coral Conservatory project.

After their visit on board *S.A. Agulhas II* (see **section 4.8.1**), the two delegations were transferred to Assomption Island and then flew back to Mahé. The official segment of the visit continued with a meeting at the State Residence between HE Mr Wavel Ramkalawan, President of the Republic of Seychelles and the Prince, followed by a working meeting co-chaired by the two Heads of State. The Prince left Seychelles in the evening.

Official visit: HSH Prince Albert II of Monaco welcomed by HE Mr Wavel Ramkalawan, President of the Republic of Seychelles, at State House, Mahé © Nicolas Mathys - Zeppelin / Monaco Explorations.

Working meeting co-chaired by the two Heads of State, Mahé, Seychelles © Nicolas Mathys - Zeppelin / Monaco Explorations.

5.3. DIDEM RELATED ACTIVITY

As part of the "high seas" component of the DiDEM programme, the expedition in the Indian Ocean was presented on 11 October 2022 at the mini-symposium on "The contribution of marine sciences in areas of the Western Indian Ocean beyond national jurisdiction to the development of a regional ocean governance strategy", held during the 12th Scientific Symposium of the Western Indian Ocean Marine Science Association (WIOMSA). On this occasion, the establishment of a network of researchers working on WIO National Or International SEamounts, banks and submarine structures (WIO NOISE), was announced.

Members of the WIO NOISE network at the 12th WIOMSA Scientific Symposium, 12 October 2022. From left to right: Jean-François Ternon, IRD, Deepeeka Kaullysing, University of Mauritius (UOM), Ranjeet Bhagooli, UOM, Florence Galletti, IRD, Francis Marsac, IRD, Sundy Ramah, Mauritius' Ministry of Blue Economy, Marine Resources, Fisheries and Shipping, Arshad Rawat, Department for Continental Shelf, Maritime Zones Administration and Exploration, Mauritius' Prime Minister's Office © IRD.

A large number of WIO seamounts are concentrated along the South-West Indian Ridge, on the Mozambique Plateau and on the plateau that extends over 1,100 km south of Madagascar (Madagascar Ridge, Walters Shoal...), to the north of Madagascar and to the north of Mauritius, and as far as Seychelles, the Mascarene Ridge (from south to north, Saint Brandon, Nazareth and Saya de Malha Banks...). Many of them are probably remarkable in many ways: abundant biodiversity, concentration of preys for predators, waypoints in the displacement of migratory species, VMEs. Because of their supposed biological abundance and richness (fishing operations are common), sometimes because of their mineral resources, these structures are of interest for many operators, and this can threaten their specific ecosystems. The legal protection in the form of a governance framework to regulate exploitation of these features is lacking or at least insufficient in the WIO, except for recent regulations related to some benthic fisheries (SIOFA conservation and management measures [CMM]), the JMA and marine spatial planning exercises.

Advanced ecological knowledge based on data collected during this expedition is expected to inform science-based conservation and encourage the coastal States (action within EEZ and continental shelf, possibly bilateral agreements, and multilateral strategies/actions) to engage any form of network protections on sites only partially documented by the Western Indian Ocean Large Marine Ecosystems Strategic Action Programme Policy Harmonisation and Institutional Reforms (WIO LME SAPPHIRE), the identification of Ecologically or Biologically Significant Marine Areas (EBSA), or previous WIO research cruises. The objective of the network is to bring together oceanographic and legal sciences and characterize the ecological features and legal status of these areas in order to inform a responsible public decision-making process.

The WIO NOISE initiative was strengthened during Monaco Explorations Expedition, specifically during the second part of the cruise on the Saya de Malha Bank. To keep the momentum, a follow-up workshop was organized in Mauritius from 3 to 5 May to gather the main parties from the expedition and consolidate their collaborations.

The workshop was hosted and strongly supported by the Department for Continental Shelf, Maritime Zones Administration and Exploration (CSMZAE) of the Prime Minister's Office and by the University of Mauritius (UOM).

The first two days at CSMZAE gathered about 40 participants from France (mainland, Reunion Island), Mauritius, Seychelles, and Madagascar. With more than 30 presentations, the meeting, covered four themes: (1) marine and legal sciences interaction, (2) science support to Marine Spatial Planning, (3) importance of physical and biological in situ data for public and conservation actions, (4) marine and coastal connectivity.

The second part of the workshop on the third day was hosted at the UOM. Forty students and scientists, specialized in marine science, economics, coastal law, and law of the sea attended the presentations and shared their experiences of sea cruises and research projects, in the context of future management and conservation issues faced by policy makers, and as an introduction to science-to-policy dialogue.

WIO NOISE working group in Mauritius, May 2023 © Sundy Ramah.

6. PERSPECTIVES / CONCLUSIONS

The processing and the analysis of the samples and data collected during the expedition will continue in the coming months up to the publication of scientific articles in peer-reviewed journals. We'll have to wait for these outcomes to assess the full impact of the expedition. Meanwhile the most immediately obvious impact results from the links that were forged between the participants during the expedition: links between young students or researchers and senior scientists, between scientists from different fields, between artists and scientists, between Mauritian and Seychellois scientists. The latter did not know each other very well, but thanks to the expedition they are now keen to continue working together for the common good, particularly in the Saya de Malha area, which is jointly managed by Mauritius and Seychelles.

In accordance with the partnership agreements between Monaco Explorations and the different projects, each project is expected to provide a final report not later than 18 months after the end of the expedition, i.e., in May 2024.

As indicated in **section 4.3.1.3**, a special issue of a scientific journal that will encompass the whole expedition is being prepared for publication in late 2024 or early 2025.

All projects are encouraged to disseminate their research through additional individual publications and to promote the outcomes in general purpose media targeting a wider public.

Project leaders are invited to ensure that all papers are collaborative and whenever possible, include authors from Mauritius and Seychelles.

All publications will be referenced on Monaco Explorations website. An inventory of the publications will be provided in the final expedition report that will be produced by the end of 2025.

Monaco Explorations, in liaison with the Expedition Advisory Committee, maintains a schedule of meetings and events that may be conducive to promoting the outcomes of the expedition. They include the opportunities listed in **Table 16** for the consideration of all participants.

Liaison was established with the US-based ocean exploration initiative OceanX that is discussing with the Government of Seychelles a 4-to-5-week research cruise with RV *OceanXplorer* in January 2024. In the longer term, the ten-year programme published by the US-based Schmidt Ocean Institute indicates that their RV *Falkor(too)* is expected to operate in the Western Indian Ocean in 2029-2030. The stakeholders of Monaco Explorations Indian Ocean Expedition are invited to consider submitting expressions of interests for follow-on surveys in due course[3].

[3] https://schmidtocean.org/expression-of-interest-2023/

Table 16
Upcoming opportunities to promote the Indian Ocean Expedition in 2023-2024

DATE (dd/mm/yyyy)	CITY	COUNTRY	EVENT
22/06/2023	Paris	France	Ocean Science Day, 32nd IOC Assembly
22/06/2023	Villefranche-sur-Mer	France	"Adopt a float" event
02-05/07/2023	Penang	Malaysia	6th World Conference on Marine Biodiversity
11-20/07/2023	Berlin	Germany	28th IUGG General Assembly
21-23/08/2023	Boston	USA	GO-BGC/BGC-Argo Science Workshop
August 2023	Nairobi	Kenya	Nairobi Convention Science to Policy Dialogue Platform (to be confirmed)
13-20/09/2023	Woods Hole	USA	Ocean Twilight Zone Symposium 2023
Autumn 2023	Paris	France	Sorbonne University Master Graduation Ceremony (to be confirmed)
07-09/11/2023	Dar es Salaam	Tanzania	Marine Regions Forum 2023: "Navigating Ocean Sustainability in the Western Indian Ocean and Beyond"
30/11-12/12/2023	Dubai	United Arab Emirates	COP28 United Nations Framework Convention on Climate Change (UNFCCC)
18-23/02/2024	New Orleans	USA	Ocean Science Meeting
11-13/03/2024	Lisbon	Portugal	11th World Ocean Summit and Expo
18/03/2024	Monaco	Monaco	14th Monaco Blue Initiative
18-22/03/2024	Monaco	Monaco	Monaco Ocean Week
18-22/03/2024	Southampton	United Kingdom	25th Argo Steering Team Meeting
March 2024	To be decided	To be decided	9th SIOFA Scientific Committee Meeting
10-12/04/2024	Barcelona	Spain	2nd Ocean Decade Conference
14-19/04/2024	Vienna	Austria	General Assembly of the European Geosciences Union
17-19/04/2024	Athens	Greece	9th Our Ocean Conference
April 2024	To be decided	To be decided	COP11 Nairobi Convention
29/06/2024	Monaco	Monaco	Seychelles Event
21/10-01/11/2024	To be decided	Turkey	COP16 UN Conference on Biological Diversity
11-22/11/2024	To be decided	To be decided	COP29 UNFCCC
2024	To be decided	Seychelles	DiDEM thematic course on coral reef
2024?	To be decided	To be decided	13th WIOMSA Scientific Symposium

7. ACKNOWLEDGEMENTS

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Monaco Explorations would like to thank all those who made the 2022 Indian Ocean Expedition possible:

- HSH Prince Albert II of Monaco;
- The Government of the Principality of Monaco;
- The Government of the French Republic;
- The Government of the Republic of Mauritius;
- The Government of the Republic of Seychelles;
- The partner scientific institutions and their teams, the vessel's operator and crew, the teachers and students of the on-board school, the artists, videographers, photographers, journalists and all the people and organizations involved in this project.

8. ANNEXES

- **Annex A:**
  Membership of the Advisory Committee
- **Annex B:**
  Specifications of *S.A. Agulhas II*
- **Annex C:**
  List of participants
- **Annex D:**
  Summary of BGC-Argo data acquisition
- **Annex E:**
  Metadata of the survey equipment
- **Annex F:**
  Distribution of the coral colonies collected in Aldabra

  Note: several colonies were better identified after the collection trip. The annex indicates the correspondence between the name of the species used in the research agreement, and the names used since the second identification.
- **Annex G:**
  Inventory of Saya de Malha operations

ANNEX A

MONACO EXPLORATIONS INDIAN OCEAN EXPEDITION MEMBERSHIP OF THE ADVISORY COMMITTEE

CARL GUSTAF LUNDIN	Chair	Mission Blue, USA (formerly Director, Global Marine and Polar Programme, IUCN)
DOMINIQUE BENZAKEN		Australian National Centre for Ocean Resources and Security, University of Wollongong, Australia - World Bank (consultant)
NICK D'ADAMO		University of Western Australia - Oceans Institute (formerly Head, UNESCO IOC Perth Programme Office)
SYLVIA EARLE		Mission Blue, USA
TESSA HEMPSON		Mission Blue, USA (formerly at Oceans without Borders)
HEATHER KOLDEWEY		Zoological Society of London & Bertarelli Foundation, UK
OLIVIER LAROUSSINIE		CEREMA, France
MARGARET LEINEN		Scripps Institution of Oceanography, USA
NADINE MARSHALL		formerly at CSIRO
DAVID OBURA		CORDIO East Africa
ALEX ROGERS		REV Ocean, Norway
ANWAR RUMJAUN		Mauritius Institute of Education
NIRMAL JIVAN SHAH		Nature Seychelles
FRANÇOIS SIMARD	Secretary	formerly Deputy Director, Global Marine and Polar Programme and Advisor for Fisheries, IUCN

ANNEX B

SPECIFICATIONS OF *S.A. AGULHAS II*

'S.A. AGULHAS II'
Steel Hulled, Ice strengthened
Antarctic Supply /
Oceanographic
Research Vessel

SPECIFICATIONS

Classification	1A1 Passenger ship BIS Clean (Design) COMF (C-2, V-2) DAT (-35°C) C DEICE DYNPOS(AUT) E0 HELDK (S, H, F) LFL (*) NAUT(AW) PC (5) RP TMON Winterized (Basic)
Built	2011 STX Finland Oy, Rauma, Finland
Flag	South Africa
Port of Registry	Cape Town
IMO Number	9577135
Call Sign	ZSNO
MMSI	601986000

MAIN DIMENSIONS

Length OA	134.0m
Breadth	22.0m
Maximum Draft	7.70m
GRT	12,897T
NRT	3,870T
Main Engines	4 x 3,000kW
Power	9,000kW shafts
Prop. Motors	2 x 4,500kW

Cruising speed	14.0 knots
Maximum speed	18.0 knots
Range	15,000 nautical miles
Endurance	90 days
Complement	144 comprising 44 crew and 100 scientific/other staff
Affiliation	Manned and managed by African Marine Solutions (AMSOL) on behalf of Department of Forestry, Fisheries & the Environment (DFFE) Directorate Antarctica and Islands Republic of South Africa

PROPULSION

- Four uni-directional Wartsila 6L32 turbo-charged and intercooled 6 cylinder 4 stroke diesel engines directly coupled to four Converteam B128P8 Generators.
- Total power MCR 12,000kW, service power at 85% MCR 10,200kW
- Two Converteam N3HXCH2LL8CH Propulsion motors, Total power 9,000kW
- Two 750kW Rolls-Royce TT2000 DPN FP Bow thrusters, Total power 1,500kW
- One 1,200kW Rolls-Royce TT2400 DPN FP Stern thruster, Total power 1,200kW
- Bunker oil capacity: Maximum 3,009 tonnes, at 95% 2,858 tonnes.

ELECTRICAL POWER

- Generated for propulsion at 3.3kVA, 3 phases, 50Hz, by the Wartsila/Converteam combination mentioned above. From the above Hotel Services are supplied at 3 phases, 50 Hz, 400V
- Harbour Generator: Mitsubishi S12R-Z3MPTAW-4 diesel engine, developing 1351kVA, 3 phases, 50Hz, 400 v. Generator Stamford PM734CZ
- Emergency Generator: Volvo-Penta D 16MG diesel engine, developing 490kVA, 3 phases, 50Hz, 400V. Generator Stamford HCM534E-1
- 220v AC, 50Hz domestic supply
- 220v AC, 50Hz stabilized domestic supply.

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NAVIGATION EQUIPMENT

- Integrated Navigation System by Raytheon Anschutz, GMBH, Kiel, Germany
- Gyrocompass 2 x Anschutz Type 22 Digital
- Autopilot Anschutz NautoPilot 2025
- Radars 1 x Raytheon Anschutz S-Band 30kW ARPA Chartradar Blackbox System
  2 x Raytheon Anschutz X-Band 25kW ARPA Chartradar Blackbox Systems.
  One fitted with a high-speed scanner.
  1 x Sigma S6 Integrated Radar Processing System, for ice navigation
- GPS 2 x Saab R4 DGPS Receivers
- ECDIS 2 x (Main + Secondary) Raytheon Anschutz ECDIS Blackbox Version with overlay
- Speed log Skipper DL850 2 Axis Doppler Log
- Echo Sounder Raytheon Anschutz GDS101 50/200kHz
- Conning Screen The ship's operating parameters such as position, speed, propeller pitch, rudder angle, wind direction, wind speed, etc. are displayed either in graphic or alpha numeric form on the bridge and in the Captain's cabin.

METEOROLOGICAL EQUIPMENT

- 2 x Lambrecht Weather Sensors, indicating wind speed and direction, air temperature, barometric pressure andrelative humidity.
- Sea temperature given by the Skipper Log

DYNAMIC POSITIONING SYSTEM (LEVEL 1)

- 1 x Navis 4001 DP System
- 1 x Navis 4011 Joystick Control System
- 1 x Model LID3-G1 DGPS Receiver for the DP system
- FMEA trials not conducted
- Vessel not classed as a DP vessel

COMMUNICATIONS

- Radio and Satellite Equipment, to GMDSS Sea Area 4

BRIDGE Communication Console

- 2 x Raytheon Anschutz MF/HF DSC Radio Controllers CU 5100
- 1 x Raytheon Anschutz VHF DSC Controller RT 5022
- 1 x Sailor Inmarsat C Message Terminal TT3606E
- 3 x Raytheon Anschutz printers H1252B/TT-3608A for above
- 1 x Raytheon Anschutz GMDSS Alarm Panel AP 5042
- 3 x Sailor GMDSS VHF Portable Radios, SP 3520
- 1 x ICOM Air band Portable VHF Radio (with headset and microphone)

Bridge Main Console

- 1 x Raytheon Anschutz VHF DSC Duplex Controller RT 5020
- 1 x Motorola GM 360 UHF radio
- 1 x Raytheon Anschutz GMDSS Alarm Panel AP 5065

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Bridge Helicopter Console
- 1 x Raytheon Anschutz VHF Radio Controller CU 5000
- 1 x Becker Air band VHF Radio
- 1 x Motorola VHF Radio DM 3600

Bridge Starboard Console
- 1 x Sailor VHF Radio 6210

Bridge Port Console
- 1 x Sailor VHF Radio 6210

Bridge, After Bulkhead
- 1 x SARTs, Sailor 6913A-SART (1 Port, 1 Starboard)
- 1 x EPIRB, TRON 40S Mk II 406 MHz

Monkey Island (Deck 10)
- 1 x EPIRB (Float Free), TRON 40S Mk II 406 MHz
- 1 x VDR Capsule

Bridge, Office
- 22 x UHF Radios, Motorola
- Navtex Receiver, NCR-333
- Weather Facsimile Receiver, Raytheon Anschutz Blackbox FAX-30

SCIENTIFIC WINCHES
- 1 x Rapp Hydema HW 2300 E CTD Winch, 6,000m x 11.73mm conductor cable (usable cable 5,850m)
- 1 x Rapp Hydema HW 2300 E CTD Winch, 6,000m x 12mm Kevlar cable (usable cable 5,190m)
- 1 x Rapp Hydema HW 200 E Vertical Plankton Winch, 1,650m x 6.35mm conductor cable (usable cable 538m)
- 1 x Rapp Hydema DSW-4006 E Deep-water Coring Winch, 5,000m x 14mm SWR (usable cable 4,100m)
- 1 x Rapp Hydema HW 500 E Plankton Towing Winch, 2,500m x 11.73mm SWR (usable cable 1,980m)
- 1 x Rapp Hydema HW 500 E General Purpose Towing Winch, 2,500m x 12mm SWR (usable cable 1,900m)
- 1 x Rapp Hydema HW 500 E Undulating Vehicle Winch, 760m x 8.41mm SWR (100m faired) (usable cable 580m)

MOORING WINCHES
- 1 x Hatlapa Electric Windlass with 2 x 160kN @ 5/15m/min.
  Cable Lifters and 2 x 150kN @ 15/30m/min.Warping Drums
- 2 x Hatlapa Electric Capstans, 100kN @ 15/30m/min
- 1 x Rapp Hydema CF 600 E General Purpose Capstan, 3.0T @ 12m/min

LABORATORIES
- Meteorological Laboratory
- Operations Room
- Underway Sampling Laboratory
- Wet Biological Laboratory
- Dry Biological Laboratory
- Wet Geological Laboratory
- Liquid Scintillation Counter Laboratory
- General Chemistry Laboratory.
- Provision made for 6 “Own-User” Container Laboratories on deck aft.

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SCIENTIFIC WORKING AREAS
- Helicopter flight deck and hangar, when available
- Enclosed poop deck space of 400m² with a 50m² wooden working deck served by a hydraulic A-frame with 6 loading points and a vertical sliding stern gate.
- AFT deck 4T SWL Deep Corer Davit by Triplex, with a 1T SWL Deep Corer handling Frame attached.
- The Environmental Hangar boasts a Triplex A-Frame for CTD deployment, with a SWL of 7T

ON BOARD SCIENTIFIC SYSTEMS
A Network Data System acquires data from selected navigational, meteorological and scientific instrumentation. The data is sent to a dedicated server once per second and mean values logged once per minute. The real time data is transmitted continuously over the LAN and the logged data is made available in a shared folder on the network.

- Seabird 911 CTD and Rosette Sampling System
- Seabird S38 Remote Temperature Probe
- Seabird SBE 45 Thermosalinograph and De-Bubbler
- Kongsberg Topaz P18 Sub-bottom Profiler
- A Moon Pool, dimensions 2.4 x 2.4m, for CTD deployment in ice covered waters

A Drop Keel, extending to a depth of 3.0m, containing:
- Scientific Echo Sounder, Simrad EK 60, 38/120/200kHz
- Scientific Deep-Water Echo Sounder, Simrad EA 600
- Acoustic Doppler Current Profiler, RDI Instruments Ocean Surveyor II, 75kHz

ADDITIONAL SCIENTIFIC & LABORATORY EQUIPMENT
- Grab Sampler + Backup unit
- Seabird 911 CTD and Rosette Sampling System (Back up unit)
- Milli-Q water generator
- Microbiological Safety cabinet with vertical laminar flow hood

Available to Charterer
- Cold storage
  - Blast Freezer (-20) – scientific store. 1.85 m3
  - Freezer (-20) – scientific store. 7.14 m3
  - Scientific cold store (+5) DK3 aft 19.15 m3
  - Cargo freezer (-20) DK 3 fwd 21.71 m3
  - Cargo freezer (-20) DK 3 fwd 26.32 m3
  - Mini freezers (-20) Port aft lab 0.12 m3 x 3 units

- 2 x -80c Freezers (one for chemistry + one for biological samples)
  - Upright freezer (-80) Port lab aft 0.83 m3 x 3 draws
  - Chest freezer(-80) Port aft lab 0.29m3

Not Available to Charterer
- Cargo fridge (+5) DK 3 fwd 10.84m3 (used for ship stores)

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NOTICE: The data contained herein is provided for convenience of reference to allow users to determine the suitability of the Company’s equipment. The data may vary from the current condition of equipment which can only be determined by physical inspection. Company has exercised due diligence to ensure that the data contained herein is reasonably accurate. However, Company does not warrant the accuracy or completeness of the data. In no event shall Company be liable for any damages whatsoever arising out of the use or inability to use the data contained herein.

HABITABILITY - ACCOMMODATION

All officers and crew are housed in single quarters. Vessel is air conditioned as well as heated for Antarctic conditions.

Passenger accommodation:

- 2 VIP suites
- 16 single berth cabins
- 15 two berth cabins
- 13 four berth cabins
- Upper and lower passenger lounges
- Library
- Live TV, via satellite, streamed to all cabins
- Full laundry facilities
- Fresh water capacity is 290T supplemented by a 28T/day fresh water generation capability when at sea
- Hospital with surgery facilities
- Doctor
- Small gymnasium, with sauna, shower and change room facilities
- Baggage Room

LIFE SAVING APPLIANCES

- 2 x FRC's
- 254 x Life Jackets
- 150 x immersion Suites
- 19 x Lifebuoys
- 6 x (25 Man) Life Rafts
- 2 x (75 Man) Life Boats

CARGO CAPACITIES AND CARGO HANDLING EQUIPMENT

- Three cargo hatches, all with tween deck and lower hold.
  Total dry cargo capacity:

Bale	3,801m³
Grain	4,602m³
Refrigerated space	79.4m³
Cargo oil capacity	510m³/408T

- 1 x TTS 35T @ 27.5m at 17m knuckle boom cargo crane on forecastle head
- 2 x TTS 10T @ 10m knuckle boom cargo cranes forward
- 1 x TTS 5T @ 18m knuckle boom stores crane aft
- Two large 10m inflatable rafts with a working capacity of 15T per paired rafts
- One 2-ton Electric Forklift Truck.

HELICOPTER SUPPORT AND FACILITIES

- Enclosed hangar facilities for two PUMA size helicopters. Manual sprinkler system for hangar
- 113T JetA1 bunker capacity
- Helicopters fitted with flotation gear, winches and cargo slings. Long range tanks available
- Skid fittings
- Radar and GPS receivers fitted

RADIOS

- 1 HF SSB transceiver
- 2 VHF (AM) aeronautical transceiver, and
- 1 VHF (FM) marine band transceiver

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OTHER FEATURES

- Roll damping tank
- Ice breaking heeling tank/pump system
- Closed circuit television available to points around the ship
- 2 x 200hp 10-man SOLAS Fast Rescue Craft
- 1 x 230hp Weedo 710 Tug/Workboat, Bollard Pull 2.2T
- 1 x 40hp 4-man inflatable dinghy for inshore scientific work
- CO2 flooding system for machinery spaces and cargo holds
- Automatic water sprinkler system for accommodation spaces
- Inert gas system for JetA1 pump room/tank space
- Foam monitor cannons for flight deck and cargo deck helicopter operations
- Remote control fire retarding doors for accommodation space
- Cross flooding system for damage stability
- CATHELCO impressed current, cathodic protection, system

VSAT FACILITIES

- Bandwidth Speed: 16 384/4096 (MIR)– 8192/2048 (CIR) (2:1 ratio) specifically enhanced for this charter only. Unlimited data, but this is subject to the number of users on the system, location strength, and the controls put in place.

OFFICE & WORKSHOP FACILITIES

- Office spaces – Business Center with 8 Computer desks, incl Meeting room for 6 persons.
- Conference Room – 1 by 120 Person possible to split into 2 rooms.
- Video Conferencing System - Blackmagic Atem Mini pro video mixer with Rode dual wireless microphone & transmitter kit, Canon XA 11 video cameras, Rode Interview Go video handle & POP filter handheld audience microphone, Sirui K-10II Ball Head for roof mount & wall mount, streaming PC and 2 x video monitors.
- Workshops – DFFE Electronics workshop, Operations Room in Environmental hangar
- Various lab areas
- Helicopter Briefing room

MEDICAL EQUIPMENT

- Anesthetic Machine
- Ventilator
- Mobile X-Ray unit
- ECG & blood pressure function of LifePak defibrillator
- Infusion pump for IV fluid infusion
- Monitor in ward: Blood pressure, saturations, pulse
- Hyfercator
- Theatre Light

The supplies, consumables and other items as required.

DIVING EQUIPMENT

- Diving Chamber
- DMAC Medical Kit
- Medical Oxygen
- 2 x RIB

NOTE : This specification sheet is EXCLUSIVE to the Monaco Expedition Charter Oct – Nov 2022

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ANNEX C

MONACO EXPLORATIONS INDIAN OCEAN EXPEDITION
LIST OF PARTICIPANTS

PROJECT	LAST NAME	FIRST NAME	AFFILIATION	UNIT	NATIONALITY	FUNCTION	CATEGORY	EMBARKATION PORT	DISEMBARKATION PORT
Saya de Malha	Theresine	Patsy	Seychelles Parks and Gardens Authority (SPGA)		Seychelles	Marine Biologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Bonne	Rodney	Seychelles Parks and Gardens Authority (SPGA)		Seychelles	Marine Biologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Mangroo	Rosabella	Seychelles Fishing Authority (SFA)	Research Section	Seychelles	Environmental Scientist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Vidot	Annie	Seychelles Fishing Authority (SFA)	Research Section	Seychelles	Marine Biologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Barreau	Estelle	Seychelles Fishing Authority (SFA)	Research Section	Seychelles	Marine Biologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Dine	Mariette	Ministry of Fisheries and the Blue Economy		Seychelles	Entrepreneur	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Gordon	Nuette	University of Seychelles	Blue Economy Research Institute	South Africa	Marine Biologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Sorry	Abel	Ministry of Fisheries and the Blue Economy	Department of the Blue Economy	Seychelles	Environmental Scientist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Talma	Sheena	Talma Consultancy		Seychelles	Marine Biologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Maria	Joshua	University of Seychelles		Seychelles	Student	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Marzocchi	Bianca	University of Seychelles		Seychelles	Student	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Labonte	Camilla	University of Seychelles		Seychelles	Student	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Jeanne	Terry	Fisherman		Seychelles	Observer	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Sauba	Keshav	Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office		Mauritius	Geoscientist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Oozeeraully	Yuneeda	Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office		Mauritius	Physical Oceanographer	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Bissessur	Dass	Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office		Mauritius	Geoscientist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Rawat	Arshad	Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office		Mauritius	Physical Oceanographer	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Roy	Prerna	Mauritius Oceanography Institute (MOI)		Mauritius	Chemical Oceanographer	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Oogarah	Preeti Nitisha	Mauritius Oceanography Institute (MOI)		Mauritius	Chemical Oceanographer	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Bhagooli	Ranjeet	University of Mauritius	Department of Biosciences and Ocean Studies	Mauritius	Marine Biologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Kaullysing	Deepeeka	University of Mauritius	Department of Biosciences and Ocean Studies	Mauritius	Taxonomist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Ramah	Sundy	Ministry of Blue Economy, Marine resources, Fisheries and Shipping	Fisheries Training & Extension Centre	Mauritius	Marine Ecophysiologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Munbodhe	Vikash	Ministry of Blue Economy, Marine resources, Fisheries and Shipping		Mauritius	Chemical Oceanographer	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Marsac	Francis	French Research Institute for Sustainable Development (IRD)	IRD Sète / UMR Marbec	France	Oceanographer/Project Leader	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Ménard	Frédéric	French Research Institute for Sustainable Development (IRD)	IRD Marseille / UMR MOI	France	Marine Ecologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Ternon	Jean-François	French Research Institute for Sustainable Development (IRD)	IRD Sète / UMR Marbec	France	Physical Oceanographer	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Galletti	Florence	French Research Institute for Sustainable Development (IRD)	IRD Sète / UMR Marbec	France	Marine Lawyer and Biologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius

PROJECT	LAST NAME	FIRST NAME	AFFILIATION	UNIT	NATIONALITY	FUNCTION	CATEGORY	EMBARKATION PORT	DISEMBARKATION PORT
Saya de Malha	Noyon	Margaux	Nelson Mandela University	Ocean Science Campus	France	Marine Biologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Corbari	Laure	French National Museum of Natural History (MNHN)	UMR ISYEB	France	Marine Biologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Bouchet	Philippe	French National Museum of Natural History (MNHN)	UMR ISYEB	France	Marine Biologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Frutos	Inmaculada	University of Lodz	Department of Zoology and Marine Invertebrates	Spain	Biologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Le Gall	Line	French National Museum of Natural History (MNHN)	UMR ISYEB	France	Taxonomist/Diver	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Vassard	Emmanuel	French National Museum of Natural History (MNHN)		France	Diver	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Moutardier	Grégoire	French National Museum of Natural History (MNHN)		France	Diver	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Gouillieux	Benoit	University of Bordeaux	UMR EPOC	France	Diver	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Saya de Malha	Hourdez	Stéphane	French National Centre for Scientific Research	UMR LECOB / Oceanology Observatory of Banyuls-sur-Mer	France	Diver	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Advisory Committee / Coral Connect	Koldewey	Heather	Zoological Society of London		United Kingdom	Marine Biologist/Project Leader	Science	Le Port, Reunion	Port Victoria, Seychelles
Coral Connect	Burt	April	Seychelles Islands Foundation		United Kingdom	Marine Biologist	Science	Le Port, Reunion	Aldabra, Seychelles
Coral Connect	Wilson	Bryan	University of Oxford	Department of Zoology - John Krebs Field Station	Ireland	Marine Biologist	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Coral Connect	Landers	Damaris	University of Oxford		United Kingdom	PhD Student/Diver	Science	Le Port, Reunion	Port Louis, Mauritius
Coral Connect	Mogg	Andy	Tritonia Scientific Ltd		United Kingdom	Diver	Science	Le Port, Reunion	Moroni, Comoros
MADCAPS	Fustemberg	Gwennais	University of Reunion	UMR Entropy-BEST RUN	France	Marine Biologist	Science	Le Port, Reunion	Port Louis, Mauritius
MADCAPS	Fernandes Da Costa	Vyctoria Marillac	University of Reunion	UMR Entropy-BEST RUN	Brazil	Marine Biologist	Science	Le Port, Reunion	Port Louis, Mauritius
MADCAPS	Vanderlynden / Thibault	Chloé	BEST RUN	BEST RUN	France	Artist	Artist	Port Victoria, Seychelles	Port Louis, Mauritius
GECOS	Bourjea	Jérôme	French Institute for Exploitation of the Sea (Ifremer)	Ifremer Sète / UMR MARBEC	France	Marine Biologist/Project Leader	Science	Le Port, Reunion	Port Victoria, Seychelles
GECOS	Schull	Quentin	French Institute for Exploitation of the Sea (Ifremer)	Ifremer Sète / UMR MARBEC	France	Marine Biologist	Science	Le Port, Reunion	Port Victoria, Seychelles
GECOS	Ciccione	Stéphane	Kelonia		France	Outreach Specialist	Communication	Le Port, Reunion	Port Victoria, Seychelles
4SEA	Contini	Matteo	French Institute for Exploitation of the Sea (Ifremer)	Ifremer/Indian Ocean Delegation	Italie	Drone Operator/Data Manager	Science	Le Port, Reunion	Port Louis, Mauritius
4SEA	Ravitchandirane	Mervyn	French Institute for Exploitation of the Sea (Ifremer)	Ifremer/Indian Ocean Delegation	France	Drone Operator	Science	Le Port, Reunion	Port Louis, Mauritius
4SEA	Julien	Mohan	French National Centre for Scientific Research	CNRS/LIRMM	France	Drone Operator/Data Manager	Science	Le Port, Reunion	Port Victoria, Seychelles
4SEA	Poulain	Sylvain	French Research Institute for Sustainable Development (IRD)	IRD Sète / UMR Marbec	France	Drone Operator/Data Manager	Science	Le Port, Reunion	Port Victoria, Seychelles
BGC Argo	Claustre	Hervé	Sea Institute of Villefranche-sur-Mer (IMEV)	Oceanography Laboratory of Villefranche-sur-Mer (LOV)	France	Oceanographer/Project Leader	Science	Le Port, Reunion	Port Louis, Mauritius
BGC Argo	d'Ortenzio	Fabrizio	Sea Institute of Villefranche-sur-Mer (IMEV)	Oceanography Laboratory of Villefranche-sur-Mer (LOV)	Italy	Physical Oceanographer	Science	Le Port, Reunion	Port Louis, Mauritius
BGC Argo	Dimier	Céline	Sea Institute of Villefranche-sur-Mer (IMEV)	Oceanography Laboratory of Villefranche-sur-Mer (LOV)	France	Engineer	Science	Cape Town, South Africa	Cape Town, South Africa
BGC Argo	Jessin	Thomas	Sea Institute of Villefranche-sur-Mer (IMEV)	Oceanography Laboratory of Villefranche-sur-Mer (LOV)	France	Webdesigner	Science	Le Port, Reunion	Port Louis, Mauritius
BGC Argo / Saya de Malha	Taillandier	Vincent	Sea Institute of Villefranche-sur-Mer (IMEV)	Oceanography Laboratory of Villefranche-sur-Mer (LOV)	France	CTD Specialist	Science	Le Port, Reunion	Cape Town, South Africa
World Coral Conservatory	Vimercati	Silvia	King Abdullah University of Science and Technology		Italy	Taxonomist/Diver	Science	Le Port, Reunion	Port Victoria, Seychelles
World Coral Conservatory	Zoccola	Didier	Monaco Scientific Centre (CSM)		France	Biologist/Diver/Project Leader	Science	Le Port, Reunion	Port Victoria, Seychelles
World Coral Conservatory	Piguet	Bruno	Monaco Oceanographic Institute	Oceanographic Museum	France	Aquariologist/Diver	Science	Le Port, Reunion	Port Victoria, Seychelles
World Coral Conservatory	Midol	Maureen	Oceanopolis		France	Aquariologist/Diver	Science	Le Port, Reunion	Port Victoria, Seychelles
World Coral Conservatory	Quéméré	Katia	Oceanopolis		France	Cameraman/Diver	Communication	Le Port, Reunion	Port Victoria, Seychelles

PROJECT	LAST NAME	FIRST NAME	AFFILIATION	UNIT	NATIONALITY	FUNCTION	CATEGORY	EMBARKATION PORT	DISEMBARKATION PORT
Marine Mammal Observation	Rota	Bernard	GLOBICE Reunion		France	Marine Mammal Observer	Science	Port Victoria, Seychelles	Port Louis, Mauritius
Onboard School	Lombard	Fabien	Sea Institute of Villefranche-sur-Mer (IMEV)	Oceanography Laboratory of Villefranche-sur-Mer (LOV)	France	Teacher/Project Leader	Science	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Irisson	Jean Olivier	Sea Institute of Villefranche-sur-Mer (IMEV)	Oceanography Laboratory of Villefranche-sur-Mer (LOV)	France	Teacher	Science	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Mousseau	Laure	Sea Institute of Villefranche-sur-Mer (IMEV)	Oceanography Laboratory of Villefranche-sur-Mer (LOV)	France	Teacher	Science	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Oh	Jun	IMBRSea		Belgium	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Quevedo Zabala	Juliana	IMBRSea		Colombia	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Bates	Elliott	IMBRSea		USA	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	van Langen Rosón	Andrea	IMBRSea		Netherlands	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Chung	Wing Yi	IMBRSea		China (Hong Kong)	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Pohl	Lotte	IMBRSea		Germany	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Tupper	Emiliana	IMBRSea		Chile	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Dukan	Nergiz	IMBRSea		Turkey	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Finet	Thomas	Sorbonne University		France	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Monjol-Delphine	Axel	Sorbonne University		France	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Accardo	Alexandre	Sorbonne University		France	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Patier	Laura	Sorbonne University		France	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Garmirian	Zoé	Sorbonne University		France	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Lemoine	Julie	Sorbonne University		France	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Ringard	Antoine	Sorbonne University		France	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Zaccomer	Hugo	Sorbonne University		France	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Vigneron	Mathilde	Sorbonne University		France	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Ozanam	Baptiste	Sorbonne University		France	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Campos	Rebeca	Sorbonne University		Peru	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Barale	Ilaria	Sorbonne University		Italy	Student	Student	Le Port, Reunion	Port Victoria, Seychelles
Onboard School	Munnaroo	Sivanee	Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office		Mauritius	Student	ECOP	Port Louis, Mauritius	Port Victoria, Seychelles
Onboard School	Bhunjun	Devin	Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office		Mauritius	Student	ECOP	Port Louis, Mauritius	Port Victoria, Seychelles
Onboard School/ Saya de Malha	Coopen	Priscilla	Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office		Mauritius	Student	ECOP	Port Louis, Mauritius	Port Louis, Mauritius
Onboard School	Jeetun	Sruti	Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office		Mauritius	Student	ECOP	Port Louis, Mauritius	Port Victoria, Seychelles
Onboard School	Sadien	Murughen	Department for Continental Shelf, Maritime Zones Administration and Exploration, Prime Minister's Office		Mauritius	Student	ECOP	Port Louis, Mauritius	Port Victoria, Seychelles
Onboard School	Banane	Véronique Mireille	Seychelles Islands Foundation		Seychelles	Student	ECOP	Port Louis, Mauritius	Port Victoria, Seychelles
Onboard School	Naiken	Saratha	University of Seychelles		Seychelles	Student	Student	Port Louis, Mauritius	Port Victoria, Seychelles
Onboard School	Rocamora Solé	Magali	Consultant		Seychelles	Student	ECOP	Port Louis, Mauritius	Port Victoria, Seychelles
Onboard School	Nancy	Ella	University of Seychelles		Seychelles	Student	Student	Port Louis, Mauritius	Port Victoria, Seychelles
Onboard School	Julie	Corianna Lauren	Seychelles Islands Foundation		Seychelles	Student	ECOP	Port Louis, Mauritius	Port Victoria, Seychelles
Communication	Bender	Sven	Autentic		Germany	Cameraman/Diver	Communication	Port Louis, Mauritius	Port Louis, Mauritius
Communication	Teichmann	Tim	Autentic		Germany	Film Assistant	Communication	Port Louis, Mauritius	Port Louis, Mauritius
Communication	Pokieser	Harald	Autentic		Austria	Film Director	Communication	Port Louis, Mauritius	Port Louis, Mauritius
ROV	Laaser	Egon	Marine Solutions		Namibia	ROV Supervisor	Support	Cape Town, South Africa	Cape Town, South Africa

PROJECT	LAST NAME	FIRST NAME	AFFILIATION	UNIT	NATIONALITY	FUNCTION	CATEGORY	EMBARKATION PORT	DISEMBARKATION PORT
ROV	Laaser	Robert	Marine Solutions		Namibia	ROV Pilot	Support	Port Victoria, Seychelles	Port Louis, Mauritius
ROV	Arlove	Dominique	Marine Solutions		Namibia	ROV Pilot	Support	Cape Town, South Africa	Port Victoria, Seychelles
ROV	Karreman	Jeandre	Marine Solutions		South Africa	ROV Pilot	Support	Port Victoria, Seychelles	Port Louis, Mauritius
ROV	Matthew	Andrew	Underwater Surveys		South Africa	Senior Surveyor	Support	Cape Town, South Africa	Cape Town, South Africa
Dive support	Jacobs	Mervyn	AMSOL		South Africa	Hyperbaric Chamber Operator/Dive Support Boat Coxswain	Support	Cape Town, South Africa	Port Louis, Mauritius
Dive support	Frankland	Derek	AMSOL		South Africa	Dive Control	Support	Cape Town, South Africa	Cape Town, South Africa
Dive support	Miadorp	Travis	AMSOL		South Africa	Dive Support Boat Coxswain	Support	Cape Town, South Africa	Port Louis, Mauritius
Equipment support	Jacobs	Leon	Department of Forestry, Fisheries and the Environment (DFFE)		South Africa	Scientific Technician	Support	Cape Town, South Africa	Cape Town, South Africa
Equipment support	Lombi	Mfundo	Department of Forestry, Fisheries and the Environment (DFFE)		South Africa	Engineer Technician	Support	Cape Town, South Africa	Port Louis, Mauritius
Equipment support	Anders	Darrell	Department of Forestry, Fisheries and the Environment (DFFE)		South Africa	Scientific Technician	Support	Port Victoria, Seychelles	Cape Town, South Africa
Medical support	Quinn	Brendan	AMSOL		South Africa	Doctor	Support	Cape Town, South Africa	Cape Town, South Africa
Organization	Bessero	Gilles	Monaco Explorations		France	Expedition Leader	Organization	Cape Town, South Africa	Cape Town, South Africa
Organization	Théron	Didier	Monaco Explorations		France	Outreach Manager	Organization	Cape Town, South Africa	Cape Town, South Africa
Organization	Gasquy	Océane	Monaco Explorations		France	Communication Officer	Organization	Port Louis, Mauritius	Cape Town, South Africa
Organization	Habbas	Mélissa	Monaco Explorations		France	Coordination Assistant	Organization	Cape Town, South Africa	Cape Town, South Africa
Organization	Ginocchio	Flora	Monaco Explorations		Monaco	Administration Manager	Organization	Port Louis, Mauritius	Le Port, Reunion
Communication	Péroumal	Sylvain	Terre M'air Production		France	Cameraman	Communication	Le Port, Reunion	Assomption, Seychelles
Communication	Dugast	Stéphane	Agence Zeppelin		France	Reporter	Communication	Port Victoria, Seychelles	Port Louis, Mauritius
Communication	Mathys	Nicolas	Agence Zeppelin		France	Photographer	Communication	Port Victoria, Seychelles	Port Louis, Mauritius
Communication	Kulisev	Filip	Amazing Planet		Slovakia	Photographer	Communication	Le Port, Reunion	Port Victoria, Seychelles
Communication	Matejbusová	Zuzana	Amazing Planet		Slovakia	Photographer	Communication	Le Port, Reunion	Port Victoria, Seychelles
Artist in residence	Rigot	Elise	Monaco Explorations		France	Artist	Communication	Port Louis, Mauritius	Port Louis, Mauritius
Artist in residence	Leroy	Rémi	Monaco Explorations		France	Artist	Communication	Le Port, Reunion	Port Louis, Mauritius
Advisory Committee	Hempson	Tessa	&Beyond	Oceans without Borders	South Africa	Observer	Organization	Port Louis, Mauritius	Port Victoria, Seychelles
Advisory Committee	Lundin	Carl Gustaf	Mission Blue		Sweden	Observer	Organization	Port Louis, Mauritius	Port Victoria, Seychelles
Advisory Committee/ SSD	D'Adamo	Nick	University of Western Australia (UWA)		Australia	Observer/Project Leader	Organization	Port Louis, Mauritius	Port Victoria, Seychelles
Advisory Committee	Laroussinie	Olivier	French Centre for Studies on Risks, the Environment, Mobility and Urban Planning (CEREMA)		France	Observer	Organization	Cape Town, South Africa	Port Louis, Mauritius (1st stop)
Advisory Committee	Simard	François	Consultant		France	Observer	Organization	Port Victoria, Seychelles	Port Louis, Mauritius
Advisory Committee	Benzaken	Dominique	Consultant		Australia	Observer	Organization	Port Victoria, Seychelles	Port Louis, Mauritius
Observer	Fleischer-Dogley	Frauke	Seychelles Islands Foundation		Seychelles	Observer	Science	Aldabra	Port Victoria, Seychelles
Observer	Appoo	Jennifer	Seychelles Islands Foundation		Seychelles	PhD Student	Student	Le Port, Reunion	Aldabra, Seychelles
Observer	Jeremie	Shemilla	Ministry of Agriculture, Climate Change and Environment		Seychelles	Observer	Science	Port Louis, Mauritius	Port Victoria, Seychelles
Observer	Ricot	Mélanie	University of Mauritius		Mauritius	Observer	Science	Port Louis, Mauritius	Le Port, Reunion
Observer	Jogee	Shakeel	University of Mauritius		Mauritius	Student	Student	Port Louis, Mauritius	Le Port, Reunion
Observer	Soobugh	Ritesh	University of Mauritius		Mauritius	Student	Student	Port Louis, Mauritius	Le Port, Reunion

ANNEX D

MONACO EXPLORATIONS INDIAN OCEAN EXPEDITION SUMMARY OF BGC-ARGO DATA ACQUISITION

Table D1
Links for viewing and downloading data
Programme or nation that provided the floats
Station and date of deployment

WMO NUMBER EURO-ARGO ACCESS[1]	BGC-ARGO ACCESS	PROG.	STATION	DEPLOYMENT DATE (dd/mm/yyyy)
5906971	https://maps.biogeochemical-argo.com/bgcargo/?&txt=5906971	NAOS	1	27/11/2022
6903084	https://maps.biogeochemical-argo.com/bgcargo/?&txt=6903084	DEEP	1	27/11/2022
1902573		ARVOR	1 bis	26/11/2022
5906538	https://maps.biogeochemical-argo.com/bgcargo/?&txt=5906538	GO-BGC	1 bis	26/11/2022
3902472	https://maps.biogeochemical-argo.com/bgcargo/?&txt=3902472	MONACO	2	25/11/2022
6903033		DEEP	2	25/11/2022
4902620	https://maps.biogeochemical-argo.com/bgcargo/?&txt=4902620	CANADA	4	15/10/2022
5906536	https://maps.biogeochemical-argo.com/bgcargo/?&txt=5906536	GO-BGC	4	15/10/2022
6903149		ARVOR	4	15/10/2022
5906970	https://maps.biogeochemical-argo.com/bgcargo/?&txt=5906970	REFINE	5	16/10/2022
6903088	https://maps.biogeochemical-argo.com/bgcargo/?&txt=6903088	DEEP	5	16/10/2022
6903148	https://maps.biogeochemical-argo.com/bgcargo/?&txt=6903148	ARVOR	5	16/10/2022
6990505	https://maps.biogeochemical-argo.com/bgcargo/?&txt=6990505	NAOS	5	16/10/2022
4902626	https://maps.biogeochemical-argo.com/bgcargo/?&txt=5906970	CANADA	6	18/10/2022
7901013	https://maps.biogeochemical-argo.com/bgcargo/?&txt=7901013	ARVOR-O2	6	18/10/2022
5906972	https://maps.biogeochemical-argo.com/bgcargo/?&txt=5906972	NAOS	6 bis	21/10/2022
6903150		ARVOR	6 bis	21/10/2022
6903031	https://maps.biogeochemical-argo.com/bgcargo/?&txt=6903031	DEEP	7	27/10/2022
5906540	https://maps.biogeochemical-argo.com/bgcargo/?&txt=5906540	GO-BGC	7	27/10/2022
4902623	https://maps.biogeochemical-argo.com/bgcargo/?&txt=4902623	CANADA	8	28/10/2022
5906969	https://maps.biogeochemical-argo.com/bgcargo/?&txt=5906969	ARVOR-O2	8	28/10/2022
6990503	https://maps.biogeochemical-argo.com/bgcargo/?&txt=6990503	REFINE	8	28/10/2022
3902471	https://maps.biogeochemical-argo.com/bgcargo/?&txt=3902471	REFINE	9	01/11/2022
5906539	https://maps.biogeochemical-argo.com/bgcargo/?&txt=5906539	GO-BGC	9	01/11/2022
6990504	https://maps.biogeochemical-argo.com/bgcargo/?&txt=6990504	MONACO	9	01/11/2022
1902572		ARVOR	10	17/11/2022
5906537	https://maps.biogeochemical-argo.com/bgcargo/?&txt=5906537	GO-BGC	10	17/11/2022
7901003		ARVOR	11	21/11/2022
4902628	https://maps.biogeochemical-argo.com/bgcargo/?&txt=4902628	CANADA	11	22/11/2022

[1]Link format: https://fleetmonitoring.euro-argo.eu/float/WMO Number

Table D2
Assessment of sensor performance for each float and measured variables

- Green: nominal operation
- Yellow: non-optimal operation, but measures can be corrected
- Red: sensor not working

P: pressure; T: temperature, S: salinity; Chla: chlorophyll-a concentration; bb: particle backscattering; NO3: dissolved nitrate concentration; pH: acidity; O2: oxygen concentration; Mu_Irr: multispectral irradiance; Tra: optical transmission of water; UVP: underwater imager; Hy_Irr: hyperspectral irradiance; Hy-Rad: hyperspectral radiance.

WMO NUMBER EURO-ARGO ACCESS	P	T	S	Chla	bb	NO3	pH	O2	Mu_Irr	Tra	UVP	Hy_Irr	Hy_Rad
5906971	●	●	●	●	●	●		●	●				
6903084	●	●	●					●					
1902573	●	●	●										
5906538	●	●	●	●	●	●	●	●					
3902472	●	●	●	●	●			●	●				
6903033													
4902620	●	●	●	●	●			●					
5906536	●	●	●	●	●	●	●	●					
6903149	●	●	●										
5906970	●	●	●	●	●	●	●	●	●	●	●		
6903088	●	●	●					●					
6903148	●	●	●										
6990505	●	●	●	●	●	●		●	●				
4902626	●	●	●	●	●		●	●					
7901013	●	●	●					●					
5906972	●	●	●	●	●	●		●	●				
6903150	●	●	●										
6903031	●	●	●					●					
5906540	●	●	●	●	●	●	●	●					
4902623	●	●	●	●	●			●					
5906969	●	●	●					●					
6990503	●	●	●	●	●		●	●			●	●	●
3902471	●	●	●	●	●		●	●	●	●	●		
5906539	●	●	●	●	●	●	●	●					
6990504	●	●	●	●	●			●					
1902572	●	●	●										
5906537	●	●	●	●	●	●	●	●					
7901003	●	●	●										
4902628	●	●	●	●	●		●	●					

Table D3
List of CTD stations

OP REF	DATE (dd/mm/yyyy)	START TIME UTC (hh:mm)	LON (E)	LAT (S)	DEPTH (m)	MAX CTD DEPTH (m)	CTD FILE	CRUISE ID	AMSOL STAT REF
B5-4	15/10/2022	00:23	054°59,9'	19°30,1'	4873	1000	IO_001	VOY-055-B5-	AM01327
B5-5	16/10/2022	10:36	053°29,9'	12°40,1'	4227	2000	IO_002	VOY-055-B5-	AM01328
B5-6	17/10/2022	22:09	050°00,2'	10°45,0'	3600	1000	IO_003	VOY-055-B5-	AM01330
B5-6b	21/10/2022	16:06	044°47,78'	10°18,40'	3633	1000	IO_004	VOY-055-B5-	AM01333
S/N	23/10/2022	19:03	045°54,96'	09°25,53'	4062	1000	IO_005	VOY-055-B5-	AM01334
B5-7	26/10/2022	22:47	048°29,90'	07°59,93'	4629	2000	IO_006	VOY-055-B5-	AM01336
B5-8	28/10/2022	02:48	052°00,08'	05°30,03'	4200	2000	IO_007	VOY-055-B5-	AM01338
B5-9	01/11/2022	22:30	060°01,15'	05°59,44'	3360	2000	IO_008	VOY-055-B5-	AM01339
B5-10	17/11/2022	17:58	060°32,04'	12°27,99'		2000	IO_034	VOY-055-BOX	AM01414
B5-11	21/11/2022	18:18	058°30,01'	18°15,00'		1000	IO_036	VOY-055-B5-	AM01420
B5-2	25/11/2022	12:36	053°00,55'	24°59,57'		1000	IO_037	VOY-055-B5-2A	AM01421
B5-1b	26/11/2022	04:51	049°59,94'	27°20,02'		1000	IO_038	VOY-055-B5-	AM01422
B5-1	27/11/2022	19:18	039°59,78'	32°00,14'		1000	IO_039	VOY-055-B5-	AM01423

ANNEX E

MONACO EXPLORATIONS INDIAN OCEAN EXPEDITION METADATA OF THE SURVEY EQUIPMENT

Project parameters

Survey Type: Passage
Technique: Single Beam Echo Sounders - Details below
Order of Survey: Classified according to the S-44 Matrix as Ba7; Bb3; Bc7; Bd4 International Hydrographic Organization Standards for Hydrographic Surveys, S-44 - Edition 6.1.0 - Oct 2022
Geodetics: Coordinate System: ITRF2014 (WGS84)
Vertical Reference: EGM2008
Feature Detection Ability: N/A
Feature Search: N/A
Bathymetric Coverage: N/A
Survey Date Range: Start Date: 03/10/2022
End date: 30/11/2022
Survey undertaken by: Survey Contractor: Underwater Surveys (Pty) Ltd
Senior Project Surveyor: Andrew Matthew
Tel: +27 21 709 6000
Email: info@underwatersurveys.com
Project Reference: 22/116
Data Ownership: Client: Monaco Explorations
Project: Indian Ocean Expedition of Monaco Explorations
Grid Attributes: N/A
Data Density: N/A
Usage Constraints: N/A

Survey Equipment:

Recording/Processing System:
QPS Qinsy: 9.4.6.781 (B 2002.04.16.1)
Geodetic Resources: 3.0.3
QPS Geoid Height Models: 2.0.2

Single Beam Echo Sounders:
TOPAS PS18:
TOPAS MMI: 3.2
Tx Ch Athwart/Along: 16/8
Element spacing Athwart/Along: 65.0/142.0
Analog sampling rate: 600 kHz
Rx Channels: 1
Primary Frequency: 18.0kHz
Offsets (set in device): None
VRU: Not operational
Sound velocity set: 1500 m/s

EA600:
Transceiver: GPT-S18(2)-H 1.0 009072067462
Program Version: 2.4.0.0
Heave compensation: None
Draft set in device: 5.0m
Offsets (set in device): None
Sound velocity set: 1500 m/s

EK60:
- Program Version: Simrad ER60 V 2.2.1 (10/06/2009)
- Transceiver: GPT-38 kHz 009072060466 ES38B
  - Angular parameters set in sounder: Along/Athwartship
  - Angle sensitivity (el.deg/mec.deg): 21.90/21.90
- 3dB beam width (deg): 7.15/7.13
- Angle Offset (deg): 0.23/-0.05
- Transceiver: GPT-120 kHz 0090720674c2 ES120-7C
  - Angular parameters set in sounder: Along/Athwartship
  - Angle sensitivity (el.deg/mec.deg): 23.00/23.00
  - 3dB beam width (deg): 6.59/6.37
  - Angle Offset (deg): 0.02/-0.03
- Transceiver: GPT-200 kHz 0090720674e7 ES200-7C
  - Angular parameters set in sounder: Along/Athwartship
  - Angle sensitivity (el.deg/mec.deg): 23.00/23.00
  - 3dB beam width (deg): 6.61/6.54
  - Angle Offset (deg): 0.01/-0.06
- Heave compensation: None
- Draft set in device: 0.0m
- Offsets (set in device): None
- Sound velocity set: 1500 m/s

GNSS System (Primary / Secondary):
- Receiver: Veripos LD7/Veripos LD7
- Antenna: AD491/AD491
- Differential Method: PPP/PPP
- Correction Service: APEX2/APEX2
- L-Band Beam: 25E/10R
- Horizontal accuracy: <5 cm at 95%
- Vertical accuracy: <12 cm at 95%

Heading Sensor (Primary / Secondary):
- GNSS Heading: Veripos LD7/Veripos LD7

Vertical Reference Unit: None
Heave sensor: None

Offsets in meters [X (Stbd+)/Y (Bow +)/Z (Up +)]

GAPS Deployed:	0.00/0.00/0.00
LD7 GNSS - Green:	-7.00/-9.90/29.90
LD7 GNSS - Blue:	-10.93/-4.82/29.86
TOPAS:	0.00/39.17/2.50
EA600 18kHz:	0.00/30.44/2.46
EK60 38 kHz - UP:	-0.15/29.59/2.46
EK60 120 kHz - UP:	0.33/29.90/2.46
EK60 200 kHz - UP:	0.30/29.30/2.46
EK60 38 kHz - DOWN:	-0.15/29.59/-0.423
EK60 120 kHz - DOWN:	0.33/29.90/-0.423
EK60 200 kHz - DOWN:	0.30/29.30/-0.423

ANNEX F

MONACO EXPLORATIONS INDIAN OCEAN EXPEDITION DISTRIBUTION OF THE CORAL COLONIES COLLECTED IN ALDABRA

LOCATION	RFID TAG	SPECIES NAMES IN THE RESEARCH AGREEMENT	SPECIES NAMES AFTER BETTER IDENTIFICATION	BREEDING TANK
Burgers' Zoo	977200010158962	*Leptoseris mycetoseroides*	*Leptoseris mycetoseroides*	Q04
Burgers' Zoo	977200010158964	*Gardineroseris planulata*	*Gardineroseris planulata*	Glas
Burgers' Zoo	977200010158974	*Echinopora gemmacea*	*Echinopora gemmacea*	Q04
Burgers' Zoo	977200010158975	*Tubinaria reniformis*	*Turbinaria mesenterina*	Q04
Burgers' Zoo	977200010158990	*Galaxea fascicularis*	*Galaxea fascicularis*	Q04
Burgers' Zoo	977200010158991	*Favites flexuosa*	*Favites abdita*	Q04
Burgers' Zoo	977200010159012	*Pavona varians*	*Pavona varians*	Glas
Burgers' Zoo	977200010159041	*Acropora hemprichii*	*Acropora valida*	Glas
Burgers' Zoo	977200010159061	*Cyphastrea microphthalma*	*Cyphastrea microphthalma*	Q04
Burgers' Zoo	977200010159131	*Isopora palmata*	*Isopora palifera*	Glas
Burgers' Zoo	977200010159177	*Leptastrea purpurea*	*Leptastrea purpurea*	Glas
Burgers' Zoo	977200010159184	*Goniastrea retiformis*	*Goniastrea edwardsi*	Glas
Burgers' Zoo	977200010159230	*Acanthastrea echinata*	*Acanthastrea hemprichii*	Q04
Burgers' Zoo	977200010159293	*Dipsastrea favus*	*Dipsastrea cf favus*	Q04
Monaco	977200010158951	*Pavona varians*	*Pavona varians*	K4
Monaco	977200010158977	*Lobactis scutaria*	*Lobactis scutaria*	K4
Monaco	977200010158979	*Turbinaria reniformis*	*Turbinaria reniformis*	K4
Monaco	977200010158988	*Stylophora palmata*	*Stylophora palmata*	K4
Monaco	977200010159014	*Stylocoeniella armata*	*Stylocoeniella armata*	K4
Monaco	977200010159022	*Galaxea fascicularis*	*Galaxea fascicularis*	K4
Monaco	977200010159094	*Leptoseris mycetoseroides*	*Leptoseris mycetoseroides*	K4
Monaco	977200010159154	*Acropora hemprichii*	*Acropora valida*	K4
Monaco	977200010159170	*Isopora palmata*	*Isopora palifera*	K4
Monaco	977200010159208	*Tubastrea micranthus*	*Tubastrea micranthus*	Tubastrea
Monaco	977200010159248	*Leptastrea purpurea*	*Leptastrea purpurea*	K4
Monaco	977200010159303	*Pocillopora sp.*	*Pocillopora eydouxi*	K4
Monaco	977200010159306	*Echinopora gemmacea*	*Echinopora gemmacea*	K4
Monaco	977200010159376	*Echinophyllia aspera*	*Echinophyllia aspera*	K4
Monaco	977200010159403	*Coscinarea monile*	*Coscinaraea monile*	K4

LOCATION	RFID TAG	SPECIES NAMES IN THE RESEARCH AGREEMENT	SPECIES NAMES AFTER BETTER IDENTIFICATION	BREEDING TANK
Nausicaa	977200010158972	*Pavona varians*	*Pavona varians*	
Nausicaa	977200010158976	*Turbinaria reniformis*	*Turbinaria mesenterina*	
Nausicaa	977200010158982	*Favites flexuosa*	*Favites abdita*	
Nausicaa	977200010158998	*Coscinarea monile*	*Coscinaraea monile*	
Nausicaa	977200010159036	*Galaxea fascicularis*	*Galaxea fascicularis*	
Nausicaa	977200010159072	*Lobactis scutaria*	*Lobactis scutaria*	
Nausicaa	977200010159079	*Goniastrea retiformis*	*Goniastrea edwardsi*	
Nausicaa	977200010159080	*Pocillopora eydouxi*	*Pocillopora eydouxi*	
Nausicaa	977200010159097	*Gardineroseris planulata*	*Gardineroseris planulata*	
Nausicaa	977200010159169	*Leptastrea purpurea*	*Leptastrea cf bottae*	
Nausicaa	977200010159420	*Acanthastrea echinata*	*Acanthastrea hemprichii*	
Nausicaa	977200010159236	*Dipsastrea favus*	*Dipsastrea cf favus*	
Nausicaa	977200010159288	*Cyphastrea microphthalma*	*Cyphastrea microphthalma*	
Nausicaa	977200010159377	*Stylophora palmata*	*Stylophora palmata*	
Oceanopolis	977200010158981	*Acropora hemprichii*	*Acropora valida*	
Oceanopolis	977200010158987	*Echinopora gemmacea*	*Echinopora gemmacea*	
Oceanopolis	977200010159009	*Coscinarea monile*	*Coscinaraea monile*	
Oceanopolis	977200010159117	*Goniastrea retiformis*	*Goniastrea edwardsi*	
Oceanopolis	977200010159144	*Lobactis scutaria*	*Lobactis scutaria*	
Oceanopolis	977200010159148	*Isopora palmata*	*Isopora palifera*	
Oceanopolis	977200010159182	*Pocillopora sp.*	*Pocillopora eydouxi*	
Oceanopolis	977200010159251	*Stylophora palmata*	*Stylophora palmata*	
Oceanopolis	977200010159259	*Leptoseris mycetoseroides*	*Leptoseris mycetoseroides*	
Oceanopolis	977200010159287	*Favites flexuosa*	*Favites abdita*	
Oceanopolis	977200010159314	*Echinophyllia aspera*	*Echinophyllia aspera*	
Oceanopolis	977200010159333	*Leptastrea purpurea*	*Leptastrea cf bottae*	
Oceanopolis	977200010159370	*Stylocoeniella armata*	*Stylocoeniella armata*	
Oceanopolis	977200010159408	*Dipsastrea favus*	*Dipsastrea cf favus*	
Oceanopolis	977200010159213	*Acanthastrea echinata*	*Acanthastrea hemprichii*	

ANNEX G

MONACO EXPLORATIONS INDIAN OCEAN EXPEDITION INVENTORY OF SAYA DE MALHA OPERATIONS

- **Table G1:**
  List of CTD stations
- **Table G2:**
  List of XBT casts
- **Table G3:**
  List of UVP casts
- **Table G4:**
  List of meso-zooplankton nets
- **Table G5:**
  List of diving operations
- **Table G6:**
  List of towed operations
- **Table G7:**
  List of samples collected

Table G1
List of the CTD stations including start date/time, lat/lon, bottom depth and maximum sampled depth, number of sampled depths, station IDs and the type of zooplankton net deployed.
The stations highlighted in light blue are the deep stations performed outside the Saya de Malha Bank

NO	STATION ID	DATE (dd/mm/yyyy)	START TIME UTC (hh:mm)	LON (E)	LAT (S)	CTD FILE	DEPTH (m)	MAXIMUM CTD DEPTH (m)	NUMBER OF BOTTLES CLOSED	SAMPLING DEPTHS	ZOOPLANKTON NET	CRUISE ID
1	ST 1	02/11/2022	16:39	059°57.00'	09°27.04'	IO_009	722	700	16	12	Bongo	VOY-55-B1-1
2	ST 2	02/11/2022	20:03	060°05.95'	09°37.80'	IO_010	970	950	23	14	Bongo	VOY-55-B1-2
3	ST 3	03/11/2022	00:13	060°26.96'	09°43.19'	IO_011	1614	1000	23	15	Bongo	VOY-55-B1-3
4	ST 4	05/11/2022	09:56	060°28.79'	10°30.00'	IO_012	60	60	9	3	Bongo	VOY-55-B2-1
5	ST 6	05/11/2022	17:41	059°59.90'	11°13.12'	IO_013	2855	1500	24	16	Multinet	VOY-55-B2-2
6	ST 7	05/11/2022	21:45	060°05.96'	11°06.01'	IO_014	2740	1500	24	16	Bongo	VOY-55-B2-3
7	ST 8	06/11/2022	01:18	060°11.94'	10°59.97'	IO_015	1598	1000	23	13	Bongo	VOY-55-B2-4
8	ST 16R	08/11/2022	15:30	061°48.58'	10°11.98'	IO_016	71	76	12	7	Bongo	VOY-55-B3-1
9	ST 15R	08/11/2022	18:12	061°42.00'	10°33.53'	IO_017	70	76	17	8	Bongo	VOY-55-B3-2
10	ST 17	09/11/2022	16:13	062°36.02'	10°12.06'	IO_018	2196	2000	24	19	Multinet	VOY-55-B3-3
11	ST 18R	09/11/2022	21:00	062°17.97'	10°11.96'	IO_019	1545	1500	24	17	Bongo	VOY-55-B3-4
12	ST 19R	09/11/2022	23:56	062°15.28'	10°12.24'	IO_020	930	900	24	17	Bongo	VOY-55-B3-5
13	ST 22R	11/11/2022	14:10	062°18.06'	10°54.03'	IO_021	897	850	23	17	Bongo	VOY-55-B3-6
14	ST 21R	11/11/2022	17:20	062°20.53'	10°54.29'	IO_022	1830	1500	24	18	Bongo	VOY-55-B3-7
15	ST 20R	11/11/2022	20:35	062°38.94'	10°53.96'	IO_023	2252	2000	24	19	Multinet	VOY-55-B3-8
16	ST 23	12/11/2022	03:25	062°07.71'	11°22.25'	IO_024	225	200	15	9	Bongo	VOY-55-B4-1
17	ST 24R	13/11/2022	06:50	061°44.96'	11°40.24'	IO_025	227	200	15	9	Bongo	VOY-55-B4-2
18	ST 31	13/11/2022	16:48	062°06.60'	11°41.83'	IO_026	870	880	22	15	Bongo	VOY-55-B4-3
19	ST 30	13/11/2022	19:20	062°14.39'	11°46.21'	IO_027	2274	2000	24	18	Multinet	VOY-55-B4-4
20	ST 29R	14/11/2022	00:12	062°21.99'	11°51.70'	IO_028	667	650	19	13	Bongo	VOY-55-B4-5
21	ST 32	14/11/2022	22:18	061°11.99'	12°00.03'	IO_029	284	287	18	12	Bongo	VOY-55-BOX5-1
22	ST 33	15/11/2022	11:50	061°04.16'	11°37.11'	IO_030	209	200	16	10	Bongo	VOY-55-BOX5-2
23	ST 37R	16/11/2022	14:59	060°29.40'	12°02.32'	IO_031	2640	2000	24	18	Multinet	VOY-55-BOX5-3
24	ST 38R	16/11/2022	20:03	060°47.37'	11°58.85'	IO_032	1685	1500	22	16	Bongo	VOY-55-BOX5-4
25	ST 39R	16/11/2022	23:45	060°53.72'	11°51.80'	IO_033	765	755	23	14	Bongo	VOY-55-BOX5-5

Table G2
List of XBT casts

XBT NO	DAY (dd/mm/yyyy)	START TIME (UTC) (hh:mm)	LON (E)	LAT (S)	MAX DEPTH (m)	FILE NAME	COMMENT
1	09/11/2022	20:04	062°29.92'	10°12.00'	820	drop003.nc	North transect box 3
2	09/11/2022	20:19	062°25.72'	10°12.00'	820	drop004.nc	North transect box 3
3	09/11/2022	20:31	062°21.55'	10°12.00'	840	drop005.nc	North transect box 3
4	11/11/2022	19:21	062°24.60'	10°54.00'	880	drop006.nc	South transect box 3
5	11/11/2022	19:39	062°28.80'	10°54.00'	760	drop007.nc	South transect box 3
6	11/11/2022	19:59	062°33.00'	10°54.00'	840	drop008.nc	South transect box 3
7	16/11/2022	18:49	060°35.40'	12°01.20'	900	drop009.nc	Transect box 5
8	16/11/2022	19:16	060°41.40'	12°00.00'	805	drop010.nc	Transect box 5
9	16/11/2022	22:29	060°50.40'	11°55.20'	820	drop011.nc	Transect box 5
10	17/11/2022	22:32	060°38.35'	12°31.85'	880	drop012.nc	Channel south of Saya de Malha
11	17/11/2022	22:49	060°42.87'	12°33.84'	920	drop013.nc	Channel south of Saya de Malha
12	17/11/2022	23:08	060°48.35'	12°35.78'	380	drop014.nc	Channel south of Saya de Malha
13	17/11/2022	23:40	060°55.50'	12°39.02'	420	drop015.nc	Channel south of Saya de Malha
14	18/11/2022	00:06	061°02.17'	12°42.15'	920	drop016.nc	Channel south of Saya de Malha
15	18/11/2022	00:35	061°09.01'	12°45.31'	880	drop017.nc	Channel south of Saya de Malha
16	18/11/2022	01:06	061°16.25'	12°48.52'	780	drop018.nc	Channel south of Saya de Malha
17	18/11/2022	20:35	060°43.46'	16°29.83'	900	drop019.nc	Saint Brandon transect
18	18/11/2022	21:52	060°23.22'	16°31.23'	640	drop020.nc	Saint Brandon transect
19	18/11/2022	21:52	060°12.15'	16°31.24'	220	drop021.nc	Saint Brandon transect
20	21/11/2022	11:08	059°11.42'	17°08'	260	drop022.nc	Transect from Saint Brandon to Mauritius
21	21/11/2022	12:34	059°08.98'	17°14.86'	290	drop023.nc	Transect from Saint Brandon to Mauritius
22	21/11/2022	15:17	058°56.08'	17°35.31'	900	drop024.nc	Transect from Saint Brandon to Mauritius
23	22/11/2022	00:10	58°02.50'	19°01.00'	850	drop025.nc	Transect from Saint Brandon to Mauritius

Table G3
List of UVP casts

PROFILE_ID	BOTTOM DEPTH (m)	CTD FILENAME	LON (E)	LAT (S)	STATION (OR GRID #)	PHASE
io_station_001	4873	io_001	054°36.0'	19°18.1'	io_station_001	1
io_station_002	4227	io_002	053°17.9'	12°24.0'	io_station_002	1
io_station_003	3600	io_003	050°00.1'	10°27.0'	io_station_003	1
io_station_004	3633	io_004	044°28.7'	10°11.0'	io_station_004	1
io_station_005	4062	io_005	045°33.0'	09°15.3'	io_station_005	1
io_station_006	4629	io_006	048°17.9'	07°36.0'	io_station_006	1
io_station_007	4200	io_007	052°00.0'	05°18.1'	io_station_007	1
io_station_008	3360	io_008	060°00.7'	05°35.7'	io_station_008	1
io_station_009	726	io_009	059°34.1'	09°16.2'	VOY-055-B1-1	2
io_station_010	970	io_010	060°03.6'	09°22.7'	VOY-055-B1-2	2
io_station_011	1614	io_011	060°16.2'	09°25.9'	VOY-055-B1-3	2
io_station_012	62	io_012	060°17.3'	10°18.0'	VOY-055-B2-1	2
io_station_013	2855	io_013	059°35.9'	11°07.9'	VOY-055-B2-2	2
io_station_014	2740	io_014	060°03.6'	11°03.6'	VOY-055-B2-3	2
io_station_015	1598	io_015	060°07.2'	10°36.0'	VOY-055-B2-4	2
io_station_016	71	io_016	061°29.1'	10°07.2'	VOY-055-B3-1	2
io_station_017	70	io_017	061°25.2'	10°20.1'	VOY-055-B3-2	2
io_station_018	2196	io_018	062°21.6'	10°07.2'	VOY-055-B3-3	2
io_station_019	1545	io_019	062°10.8'	10°07.2'	VOY-055-B3-4	2
io_station_020	930	io_020	062°09.2'	10°07.3'	VOY-055-B3-5	2
io_station_021	897	io_021	062°10.8'	10°32.4'	VOY-055-B3-6	2
io_station_022	1830	io_022	062°12.3'	10°32.6'	VOY-055-B3-7	2
io_station_023	2252	io_023	062°23.4'	10°32.4'	VOY-055-B3-8	2
io_station_024	225	io_024	062°04.6'	11°13.4'	VOY-055-B4-1	2
io_station_025	227	io_025	061°27.0'	11°24.1'	VOY-055-B4-2	2
io_station_026	870	io_026	062°03.1'	11°25.1'	VOY-055-B4-3	2
io_station_027	2274	io_027	062°08.6'	11°27.7'	VOY-055-B4-4	2
io_station_028	667	io_028	062°13.2'	11°31.0'	VOY-055-B4-5	2
io_station_029	289	io_029	061°07.2'	12°00.0'	VOY-055-BOX5-1	2
io_station_030	209	io_030	061°02.5'	11°22.3'	VOY-055-BOX5-2	2
io_station_031	2497	io_031	060°17.6'	12°01.4'	VOY-055-BOX5-3	2
io_station_032	1740	io_032	060°28.4'	11°35.3'	VOY-055-BOX5-4	2
io_station_033	760	io_033	060°32.0'	11°31.0'	VOY-055-BOX5-5	2

Table G4
List of mesozooplankton nets

SAMPLE_NAME	LONGITUDE (E)	LATITUDE (S)	DATE (dd/mm/yyyy)	TIME (UTC)	LOCAL TIME	DAY / NIGHT	BOTTOM DEPTH (m)	STATION_ID	CTD FILENAME	GRID #	NET TYPE & NUMBER	MAX. DEPTH (m)	MIN. DEPTH (m)	VOLUME FILTERED (m^3)	BARCODE
EDM_station_009	059°59.914'	09°27.036'	02/11/2022	18:06	22:06	N	726	EDM_station_009	io_009	VOY-055-B1-1	Bongo	180	0	96	EDM000000218
EDM_station_010	060°05.948'	09°37.803'	02/11/2022	21:23	01:23	N	970	EDM_station_010	io_010	VOY-055-B1-2	Bongo	200	0	177	EDM000000222
EDM_station_011	060°26.956'	09°43.191'	03/11/2022	0:20	04:20	N	1614	EDM_station_011	io_011	VOY-055-B1-3	Bongo	200	0	139	EDM000000213
EDM_station_012	060°28.786'	10°30.00'	05/11/2022	0:20	04:20	D	62	EDM_station_012	io_012	VOY-055-B2-1	Bongo	50	0	61	EDM000000214
EDM_station_013_9	059°59.896'	11°13.119'	05/11/2022	21:30	01:30	N	2855	EDM_station_013	io_013	VOY-055-B2-2	Multinet_9	899	699	137	EDM000000205
EDM_station_013_8	059°59.896'	11°13.119'	05/11/2022	21:30	01:30	N	2855	EDM_station_013	io_013	VOY-055-B2-2	Multinet_8	699	497	148	EDM000000207
EDM_station_013_7	059°59.896'	11°13.119'	05/11/2022	21:30	01:30	N	2855	EDM_station_013	io_013	VOY-055-B2-2	Multinet_7	497	349	87	EDM000000208
EDM_station_013_6	059°59.896'	11°13.119'	05/11/2022	21:30	01:30	N	2855	EDM_station_013	io_013	VOY-055-B2-2	Multinet_6	349	248	60	EDM000000209
EDM_station_013_5	059°59.896'	11°13.119'	05/11/2022	21:30	01:30	N	2855	EDM_station_013	io_013	VOY-055-B2-2	Multinet_5	247	200	29	EDM000000210
EDM_station_013_4	059°59.896'	11°13.119'	05/11/2022	21:30	01:30	N	2855	EDM_station_013	io_013	VOY-055-B2-2	Multinet_4	199	149	33	EDM000000211
EDM_station_013_3	059°59.896'	11°13.119'	05/11/2022	21:30	01:30	N	2855	EDM_station_013	io_013	VOY-055-B2-2	Multinet_3	149	97	33	EDM000000217
EDM_station_013_2	059°59.896'	11°13.119'	05/11/2022	21:30	01:30	N	2855	EDM_station_013	io_013	VOY-055-B2-2	Multinet_2	97	50	27	EDM000000215
EDM_station_013_1	059°59.896'	11°13.119'	05/11/2022	21:30	01:30	N	2855	EDM_station_013	io_013	VOY-055-B2-2	Multinet_1	50	0	47	EDM000000221
EDM_station_014	060°05.962'	11°06.007'	05/11/2022	23:30	03:30	N	2740	EDM_station_014	io_014	VOY-055-B2-3	Bongo	200	0	111	EDM000000206
EDM_station_015	060°11.944'	10°59.967'	06/11/2022	0:52	04:52	dawn	1598	EDM_station_015	io_015	VOY-055-B2-4	Bongo	200	0	135	EDM000000204
EDM_station_016	061°48.576'	10°11.979'	08/11/2022	17:58	22:58	N	71	EDM_station_016	io_016	VOY-055-B3-1	Bongo	200	0	18	EDM000000203
EDM_station_017	061°41.999'	10°33.532'	08/11/2022	20:36	01:36	N	70	EDM_station_017	io_017	VOY-055-B3-2	Bongo	200	0	2	EDM000000201
EDM_station_018_9	062°36.025'	10°12.061'	09/11/2022	18:10	23:10	N	2196	EDM_station_018	io_018	VOY-055-B3-3	Multinet_9	89ç	698	139	EDM000000190
EDM_station_018_8	062°36.025'	10°12.061'	09/11/2022	18:10	23:10	N	2196	EDM_station_018	io_018	VOY-055-B3-3	Multinet_8	697	496	136	EDM000000191
EDM_station_018_7	062°36.025'	10°12.061'	09/11/2022	18:10	23:10	N	2196	EDM_station_018	io_018	VOY-055-B3-3	Multinet_7	496	348	111	EDM000000195
EDM_station_018_6	062°36.025'	10°12.061'	09/11/2022	18:10	23:10	N	2196	EDM_station_018	io_018	VOY-055-B3-3	Multinet_6	348	248	66	EDM000000196
EDM_station_018_5	062°36.025'	10°12.061'	09/11/2022	18:10	23:10	N	2196	EDM_station_018	io_018	VOY-055-B3-3	Multinet_5	248	98	29	EDM000000198
EDM_station_018_4	062°36.025'	10°12.061'	09/11/2022	18:10	23:10	N	2196	EDM_station_018	io_018	VOY-055-B3-3	Multinet_4	198	147	31	EDM000000179
EDM_station_018_3	062°36.025'	10°12.061'	09/11/2022	18:10	23:10	N	2196	EDM_station_018	io_018	VOY-055-B3-3	Multinet_3	147	97	28	EDM000000199
EDM_station_018_2	062°36.025'	10°12.061'	09/11/2022	18:10	23:10	N	2196	EDM_station_018	io_018	VOY-055-B3-3	Multinet_2	96	48	38	EDM000000197
EDM_station_018_1	062°36.025'	10°12.061'	09/11/2022	18:10	23:10	N	2196	EDM_station_018	io_018	VOY-055-B3-3	Multinet_1	48	1	36	EDM000000200
EDM_station_019	062°17.968'	10°11.964'	09/11/2022	22:33	03:33	N	1545	EDM_station_019	io_019	VOY-055-B3-4	Bongo	200	0	171	EDM000000189
EDM_station_020	062°15.278'	10°12.243'	09/11/2022	23:20	04:20	N	930	EDM_station_020	io_020	VOY-055-B3-5	Bongo	200	0	267	EDM000000188
EDM_station_021	062°18.056'	10°54.028'	11/11/2022	03:58	08:58	N	897	EDM_station_021	io_021	VOY-055-B3-6	Bongo	200	0	123	EDM000000187
EDM_station_022	062°20.527'	10°54.290'	11/11/2022	16:52	21:52	N	1830	EDM_station_022	io_022	VOY-055-B3-7	Bongo	200	0	136	EDM000000192
EDM_station_023_9	062°38.944'	10°53.965'	11/11/2022	22:52	03:52	N	2252	EDM_station_023	io_023	VOY-055-B3-8	Multinet_9	899	698	139	EDM000000160

SAMPLE_NAME	LONGITUDE (E)	LATITUDE (S)	DATE (dd/mm/yyyy)	TIME (UTC)	LOCAL TIME	DAY / NIGHT	BOTTOM DEPTH (m)	STATION_ID	CTD FILENAME	GRID #	NET TYPE & NUMBER	MAX. DEPTH (m)	MIN. DEPTH (m)	VOLUME FILTERED (m^3)	BARCODE
EDM_station_023_8	062°38.944'	10°53.965'	11/11/2022	22:52	03:52	N	2252	EDM_station_023	io_023	VOY-055-B3-8	Multinet_8	697	496	136	EDM000000163
EDM_station_023_7	062°38.944'	10°53.965'	11/11/2022	22:52	03:52	N	2252	EDM_station_023	io_023	VOY-055-B3-8	Multinet_7	496	348	111	EDM000000164
EDM_station_023_6	062°38.944'	10°53.965'	11/11/2022	22:52	03:52	N	2252	EDM_station_023	io_023	VOY-055-B3-8	Multinet_6	348	248	66	EDM000000168
EDM_station_023_5	062°38.944'	10°53.965'	11/11/2022	22:52	03:52	N	2252	EDM_station_023	io_023	VOY-055-B3-8	Multinet_5	248	198	29	EDM000000171
EDM_station_023_4	062°38.944'	10°53.965'	11/11/2022	22:52	03:52	N	2252	EDM_station_023	io_023	VOY-055-B3-8	Multinet_4	198	147	31	EDM000000172
EDM_station_023_3	062°38.944'	10°53.965'	11/11/2022	22:52	03:52	N	2252	EDM_station_023	io_023	VOY-055-B3-8	Multinet_3	148	97	28	EDM000000175
EDM_station_023_2	062°38.944'	10°53.965'	11/11/2022	22:52	03:52	N	2252	EDM_station_023	io_023	VOY-055-B3-8	Multinet_2	96	48	38	EDM000000182
EDM_station_023_1	062°38.944'	10°53.965'	11/11/2022	22:52	03:52	N	2252	EDM_station_023	io_023	VOY-055-B3-8	Multinet_1	48	1	36	EDM000000193
EDM_station_024	062°07.707'	11°22.248'	12/11/2022	04:19	09:19	D	225	EDM_station_024	io_024	VOY-055-B4-1	Bongo	200	0	148	EDM000000156
EDM_station_025	061°44.957'	11°40.241'	13/11/2022	07:25	12:25	D	227	EDM_station_025	io_025	VOY-055-B4-2	Bongo	200	0	205	EDM000000153
EDM_station_026	062°05.229'	11°41.826'	13/11/2022	16:49	21:49	N	870	EDM_station_026	io_026	VOY-055-B4-3	Bongo	200	0	118	EDM000000155
EDM_station_027_9	062°14.387'	11°46.213'	13/11/2022	21:20	02:20	N	2274	EDM_station_027	io_027	VOY-055-B4-4	Multinet_9	898	697	119	EDM000000159
EDM_station_027_8	062°14.387'	11°46.213'	13/11/2022	21:20	02:20	N	2274	EDM_station_027	io_027	VOY-055-B4-4	Multinet_8	697	498	124	EDM000000165
EDM_station_027_7	062°14.387'	11°46.213'	13/11/2022	21:20	02:20	N	2274	EDM_station_027	io_027	VOY-055-B4-4	Multinet_7	497	348	91	EDM000000166
EDM_station_027_6	062°14.387'	11°46.213'	13/11/2022	21:20	02:20	N	2274	EDM_station_027	io_027	VOY-055-B4-4	Multinet_6	348	249	60	EDM000000167
EDM_station_027_5	062°14.387'	11°46.213'	13/11/2022	21:20	02:20	N	2274	EDM_station_027	io_027	VOY-055-B4-4	Multinet_5	249	198	30	EDM000000161
EDM_station_027_4	062°14.387'	11°46.213'	13/11/2022	21:20	02:20	N	2274	EDM_station_027	io_027	VOY-055-B4-4	Multinet_4	198	148	29	EDM000000162
EDM_station_027_3	062°14.387'	11°46.213'	13/11/2022	21:20	02:20	N	2274	EDM_station_027	io_027	VOY-055-B4-4	Multinet_3	148	98	29	EDM000000144
EDM_station_027_2	062°14.387'	11°46.213'	13/11/2022	21:20	02:20	N	2274	EDM_station_027	io_027	VOY-055-B4-4	Multinet_2	98	49	35	EDM000000158
EDM_station_027_1	062°14.387'	11°46.213'	13/11/2022	21:20	02:20	N	2274	EDM_station_027	io_027	VOY-055-B4-4	Multinet_1	48	0	37	EDM000000152
EDM_station_028	062°21.988'	11°51.700'	14/11/2022	23:30	04:30	N	667	EDM_station_028	io_028	VOY-055-B4-5	Bongo	200	0	108	EDM000000157
EDM_station_029	061°11.988'	12°00.027'	14/11/2022	23:00	04:00	N	289	EDM_station_029	io_029	VOY-055-BOX5-1	Bongo	200	0	137	EDM000000154
EDM_station_030	061°04.163'	11°37.114'	15/11/2022	12:53	17:53	D	209	EDM_station_030	io_030	VOY-055-BOX5-2	Bongo	200	0	126	EDM000000139
EDM_station_031_9	060°29.399'	12°02.318'	16/11/2022	17:00	22:00	N	2497	EDM_station_031	io_031	VOY-055-BOX5-3	Multinet_9	899	697	134	EDM000000127
EDM_station_031_8	060°29.399'	12°02.318'	17/11/2022	17:00	22:00	N	2497	EDM_station_031	io_031	VOY-055-BOX5-3	Multinet_8	697	500	127	EDM000000180
EDM_station_031_7	060°29.399'	12°02.318'	18/11/2022	17:00	22:00	N	2497	EDM_station_031	io_031	VOY-055-BOX5-3	Multinet_7	499	350	100	EDM000000151
EDM_station_031_6	060°29.399'	12°02.318'	19/11/2022	17:00	22:00	N	2497	EDM_station_031	io_031	VOY-055-BOX5-3	Multinet_6	350	248	63	EDM000000150
EDM_station_031_5	060°29.399'	12°02.318'	20/11/2022	17:00	22:00	N	2497	EDM_station_031	io_031	VOY-055-BOX5-3	Multinet_5	247	198	28	EDM000000129
EDM_station_031_4	060°29.399'	12°02.318'	21/11/2022	17:00	22:00	N	2497	EDM_station_031	io_031	VOY-055-BOX5-3	Multinet_4	198	146	33	EDM000000130
EDM_station_031_3	060°29.399'	12°02.318'	22/11/2022	17:00	22:00	N	2497	EDM_station_031	io_031	VOY-055-BOX5-3	Multinet_3	146	98	32	EDM000000132
EDM_station_031_2	060°29.399'	12°02.318'	23/11/2022	17:00	22:00	N	2497	EDM_station_031	io_031	VOY-055-BOX5-3	Multinet_2	98	48	32	EDM000000137
EDM_station_031_1	060°29.399'	12°02.318'	24/11/2022	17:00	22:00	N	2497	EDM_station_031	io_031	VOY-055-BOX5-3	Multinet_1	48	0	35	EDM000000138
EDM_station_032	060°47.371'	11°58.848'	16/11/2022	20:35	01:35	N	1740	EDM_station_032	io_032	VOY-055-BOX5-4	Bongo	200	0	164	EDM000000126
EDM_station_033	060°53.723'	11°51.802'	16/11/2022	23:00	04:00	N	760	EDM_station_033	io_033	VOY-055-BOX5-5	Bongo	200	0	159	EDM000000125

Table G5
List of diving operations

DATE (dd/mm/yyyy)	AREA	SITE	TIME APPROX. (UTC)	LON (E)	LAT (S)	TEAM	DEPTH (m)	BOTTOM TIME (min)	TOTAL TIME (min)	SAMPLING*	COMMENT
03/11/2022	Box 1	SD1	03:30	060°10.2'	09°34.0'	All	NO	NO	NO	/	Diving cancelled due to bad weather
04/11/2022	Box 1	SD2	05:10	060°11.8'	09°52.3'	Open circuit	42	25	70	YR01	
04/11/2022	Box 1	SD2	04:10	060°11.8'	09°52.3'	Rebreather	42	40	93	YR02	Suction lost, swell 2 meters, wind
05/11/2022	Box 2	SD3	04:45	060°13.5'	10°35.6'	Open circuit	43	15	31	YR03	
05/11/2022	Box 2	SD3	04:40	060°10.3'	10°37.2'	Rebreather	50	35	134	YS02-YR04	Swell 2 meters, wind
06/11/2022	Box 2	SD4	05:15	060°26.8'	11°08.2'	Open circuit	39	23	53	YR05	
06/11/2022	Box 2	SD4	04:55	060°26.8'	11°08.2'	Rebreather	37	45	106	YS04-YR06	
07/11/2022	North SMB	SD5	11:00	060°54.2'	09°55.5'	Open circuit	25	38	58	YR07-N01-YS01	
07/11/2022	North SMB	SD5	11:00	060°54.0'	09°55.3'	Rebreather	58	55	113	YS06-YR08	
08/11/2022	North SMB	SD6	03:20	060°51.0'	09°41.9'	Open circuit	19	58	79	YR09	
08/11/2022	North SMB	SD6	03:20	060°51.0'	09°41.9'	Rebreather	26	90	107	YS08-YR10	
09/11/2022	Box 3	SD7	03:30	062°02.8'	10°37.2'	Open circuit	27	40	60	YR11	
09/11/2022	Box 3	SD7	03:30	062°02.8'	10°37.2'	Rebreather	27	83	103	YS10-YR12	
09/11/2022	Box 3	SD8	10:40	062°07.8'	10°22.8'	Open circuit	24	37	54	YR13	
09/11/2022	Box 3	SD8	10:40	062°07.8'	10°22.8'	Rebreather	26	69	94	YS12-YR14	
10/11/2022	Box 3	SD9	03:05	062°09.1'	10°12.1'	Open circuit	24	45	80	YR15-N02-YB01	
10/11/2022	Box 3	SD9	03:00	062°09.1'	10°12.1'	Rebreather	24	104	129	YS14-YR16	
11/11/2022	Box 3	SD10	04:00	062°10.5'	10°44.0'	Open circuit	27	40	50	YR17-N03-YB03	
11/11/2022	Box 3	SD10	04:00	062°10.5'	10°44.0'	Rebreather	27	72	105	YS16-YR18	
11/11/2022	Box 3	SD11	11:00	062°00.8'	10°54.0'	Open circuit	30	31	58	YR19	
11/11/2022	Box 3	SD11	11:00	062°00.8'	10°54.0'	Rebreather	30	65	108	YS18-YR20	
13/11/2022	Box 4	SD12	03:00	061°54.0'	11°44.0'	Open circuit	47	21	68	YR21	
13/11/2022	Box 4	SD12	03:00	061°54.0'	11°44.0'	Rebreather	47	58	118	YS20-YR22	

*** Sampling techniques: YS: suction; YB: brushing basket; YR: sight picking; N: net**

Table G6
List of towed operations (DW: dredge / CP: beam trawl / EB: epibenthic sledge)

DATE (dd/mm/yyyy)	BOX	OP REF	NUMBER MNHN	GEAR TYPE	START POSITION			END POSITION			DURATION (h:mm)	DISTANCE (m)	DEPTH (m)	AMSOL STAT REF
					TIME UTC	LON (E)	LAT (S)	TIME UTC	LON (E)	LAT (S)				
03/11/2022	1	TG1	5400	DW	11:18	060°10,13'	09°24,54'	11:39	060°10,53'	09°24,83'	0:21	924	286	AM01343
03/11/2022	1	TG1	5401	DW	12:57	060°09,03'	09°24,17'	13:09	060°09,34'	09°24,34'	0:12	664	244	AM01343
03/11/2022	1	TG1	5402	DW	14:19	060°10,49'	09°25,08'	14:28	060°10,62'	09°25,22'	0:09	367	317	AM01344
04/11/2022	1	TG2	5403	CP	11:36	060°02,77'	09°40,21'	11:46	060°02,94'	09°40,40'	0:10	472	873	AM01345
04/11/2022	1	TG2	5404	CP	13:54	060°03,83'	09°41,47'	14:12	060°04,03'	09°41,70'	0:18	572	862	AM01346
05/11/2022	2	TG3	5405	DW	13:00	060°30,33'	10°45,50'	13:13	060°30,52'	10°45,60'	0:13	394	112	AM01349
05/11/2022	2	TG3	5406	DW	13:41	060°30,87'	10°45,69'	13:58	060°31,14'	10°45,76'	0:17	512	110	AM01349
06/11/2022	2	TG4	5407	DW	09:27	060°18,91'	10°59,36'	09:47	060°19,10'	10°59,65'	0:20	644	196	AM01353
06/11/2022	2	TG4	5408	DW	10:34	060°19,32'	10°59,95'	10:50	060°19,51'	11°00,19'	0:16	572	205	AM01353
06/11/2022	2	TG4	5409	DW	12:32	060°20,99'	11°02,05'	12:52	060°21,24'	11°02,29'	0:20	646	214	AM01354
06/11/2022	2	TG4	5410	CP	13:50	060°21,61'	11°02,63'	14:06	060°21,83'	11°02,83'	0:16	540	201	AM01355
07/11/2022	North SMB	TG5a	5411	DW	02:53	060°45,46'	09°49,81'	03:03	060°45,57'	09°49,76'	0:10	233	204	AM01357
07/11/2022	North SMB	TG5b	5412	CP	07:16	060°48,05'	09°44,19'	07:46	060°48,44'	09°44,56'	0:30	988	1419	AM01358
07/11/2022	North SMB	TG5b	5413	DW	04:32	060°50,22'	09°44,81'	04:42	060°50,13'	09°44,92'	0:10	261	1158	AM01359
09/11/2022	3	TG6	5414	CP	07:08	061°48,50'	10°23,28'	07:19	061°48,72'	10°23,30'	0:11	408	76	AM01363
09/11/2022	3	TG6	5415	EB	08:23	061°48,89'	10°23,30'	08:28	061°48,96'	10°23,30'	0:05	130	73	AM01364
10/11/2022	3	TG7	5416	CP	07:27	061°48,60'	10°14,02'	07:47	061°48,61'	10°14,37'	0:20	643	76	AM01368
10/11/2022	3	TG7	5417	EB	08:38	061°48,61'	10°14,52'	08:43	061°48,61'	10°14,60'	0:05	156	73	AM01369
10/11/2022	3	TG7	5418	EB	09:12	061°48,61'	10°14,68'	09:18	061°48,62'	10°14,76'	0:06	159	73	AM01370
10/11/2022	3	TG7	5419	CP	10:59	061°47,51'	10°15,42'	11:29	061°47,37'	10°15,96'	0:30	1021	80	AM01371
12/11/2022	4	TG8	5420	DW	05:56	062°10,33'	11°25,00'	06:16	062°10,70'	11°25,04'	0:20	684	215	AM01378
12/11/2022	4	TG8	5421	CP	07:24	062°11,44'	11°25,12'	07:54	062°11,93'	11°25,17'	0:30	907	215	AM01379
12/11/2022	4	TG8	5422	EB	08:52	062°12,33'	11°25,15'	08:57	062°12,42'	11°25,15'	0:05	156	214	AM01380
12/11/2022	4	TG8	5423	DW	11:12	062°00,86'	11°26,78'	11:32	062°00,77'	11°27,12'	0:20	651	204	AM01381
12/11/2022	4	TG8	5424	DW	12:23	062°00,60'	11°27,68'	12:33	062°00,55'	11°28,02'	0:10	631	161	AM01382

DATE (dd/mm/yyyy)	BOX	OP REF	NUMBER MNHN	GEAR TYPE	START POSITION			END POSITION			DURATION (h:mm)	DISTANCE (m)	DEPTH (m)	AMSOL STAT REF
					TIME UTC	LON (E)	LAT (S)	TIME UTC	LON (E)	LAT (S)				
13/11/2022	4	TG9	5425	DW	09:09	061°42,71'	11°43,53'	09:29	061°43,04'	11°43,63'	0:20	630	230	AM01384
13/11/2022	4	TG9	5426	CP	10:39	061°43,64'	11°43,63'	11:09	061°44,16'	11°43,63'	0:30	956	219	AM01385
13/11/2022	4	TG9	5427	EB	12:02	061°44,54'	11°43,63'	12:07	061°44,62'	11°43,63'	0:05	146	321	AM01386
14/11/2022	4	TG10	5428	DW	10:54	062°21,62'	11°53,93'	11:17	062°21,74'	11°54,10'	0:23	372	307	AM01391
14/11/2022	4	TG10	5429	DW	13:06	062°22,83'	11°52,33'		entangled in rock		300	554	AM01392	
15/11/2022	5	TG11	5430	DW	02:06	061°09,25'	11°46,52'	02:26	061°09,56'	11°46,36'	0:20	638	266	AM01395
15/11/2022	5	TG11	5431	CP	03:28	061°10,19'	11°46,09'	04:08	061°10,90'	11°45,81'	0:40	1405	262	AM01396
15/11/2022	5	TG11	5432	EB	05:07	061°11,30'	11°45,64'	05:12	061°11,37'	11°45,59'	0:05	168	263	AM01397
15/11/2022	5	TG11	5433	CP	07:01	061°11,85'	11°41,95'	07:21	061°12,33'	11°42,00'	0:20	883	235	AM01398
15/11/2022	5	TG11	5434	DW	09:45	061°05,36'	11°47,44'	09:56	061°05,44'	11°47,44'	0:11	137	269	AM01399
16/11/2022	5	TG12	5435	DW	01:58	060°55,07'	11°49,87'	02:15	060°55,30'	11°49,82'	0:17	450	318	AM01401
16/11/2022	5	TG12	5436	CP	03:54	060°55,63'	11°49,97'	04:24	060°56,28'	11°49,80'	0:30	1232	306	AM01402
16/11/2022	5	TG12	5437	DW	05:48	060°56,91'	11°49,57'	06:13	060°57,37'	11°49,44'	0:25	880	292	AM01403
16/11/2022	5	TG12	5438	DW	08:08	061°00,03'	11°51,75'	08:28	061°00,37'	11°51,56'	0:20	707	267	AM01404
16/11/2022	5	TG12	5439	CP	09:50	061°01,05'	11°51,18'	10:10	061°01,42'	11°50,96'	0:20	786	260	AM01405
16/11/2022	5	TG12	5440	DW	11:15	061°01,82'	11°50,73'	11:30	061°02,06'	11°50,59'	0:15	527	303	AM01406
17/11/2022	5	TG13	5441	DW	03:38	061°00,60'	12°16,27'	03:58	061°00,86'	12°16,58'	0:20	753	303	AM01409
17/11/2022	5	TG13	5442	CP	05:24	061°01,39'	12°17,21'	05:39	061°01,50'	12°17,34'	0:15	312	286	AM01410
17/11/2022	5	TG13	5443	CP	09:44	061°00,29'	12°36,82'	10:24	061°00,72'	12°37,08'	0:40	936	1067	AM01411
17/11/2022	5	TG13	5444	EB	12:54	061°01,56'	12°37,95'	13:04	061°01,67'	12°38,06'	0:10	288	1086	AM01412
17/11/2022	5	TG13	5445	DW	15:09	060°55,85'	12°36,05'	15:28	060°55,55'	12°35,91'	0:19	615	431	AM01413

Table G7
List of samples collected

DATE	STATION NO	SAMPLES	DEPTH (m)
Microplankton and Pico-nanoplankton			
2 Nov 22	IO-009	Water from surface + CTD	0, 3, 40, 80, 100
2 Nov 22	IO-010	Water from surface + CTD	0, 3, 40, 75, 100
3 Nov 22	IO-011	Water from surface + CTD	0, 3, 40, 80, 100
5 Nov 22	IO-012	Water from surface + CTD	0, 5, 80, 100
5 Nov 22	IO-013	Water from surface + CTD	0, 5, 65, 80, 100
6 Nov 22	IO-014	Water from surface + CTD	0, 5, 40, 60, 80, 100
6 Nov 22	IO-015	Water from surface + CTD	
8 Nov 22	IO-017	Water from surface + CTD	0, 5, 30, 50, 70
8 Nov 22	IO-016	Water from surface + CTD	0, 5, 50
9 Nov 22	IO-018	Water from surface + CTD	0, 5, 40, 100
9 Nov 22	IO-020	Water from surface + CTD	5, 40, 60, 100
11 Nov 22	IO-022	Water from surface + CTD	0, 5, 40
11 Nov 22	IO-021	Water from surface + CTD	0, 5, 40, 80, 100
12 Nov 22	IO-024	Water from surface + CTD	
13 Nov 22	IO-025	Water from surface + CTD	0, 5, 40, 100
13 Nov 22	IO-026	Water from surface + CTD	0, 5, 40, 90, 100
14 Nov 22	IO-028	Water from surface + CTD	0, 5, 40, 100
14 Nov 22	IO-029	Water from surface + CTD	0, 5, 25, 40, 100
16 Nov 22	IO-031	Water from surface + CTD	0, 5, 40, 90, 100
16 Nov 22	IO-033	Water from surface + CTD	5, 40, 100
Trawl / Towed gears			
4 Nov 22	TG2 / CP	Surface water	0

DATE	STATION NO	SAMPLES	DEPTH (m)
Diving sites / Collections			
4 Nov 22	SD 2 / YR02	Surface water	0
5 Nov 22	SD 3 / YR03	Surface water	0
6 Nov 22	SD 4 / YS04	Red Coralline Alga 1 (RCA 1) maerl	38.7
6 Nov 22	SD 4/ YR05	Fleshy Red Algae (Ceramiales)	37
7 Nov 22	SD 5/ YS06	Red Coralline Alga (RCA 2) (ball type)	58
8 Nov 22	SD 6 / YR09	*Acropora Branching Colony*	19.2
8 Nov 22	SD 6 / YR09	*Danafungia sp. 1*	19.2
8 Nov 22	SD 6 / YR09	*Danafungia sp. 2*	19.2
8 Nov 22	SD 6 / YR09	*Herpolitha sp.*	19.2
9 Nov 22	SD 8 / YR13	*Tridacna rosewateri (Adult)*	23.5
9 Nov 22	SD 8 / YR14	*Tridacna rosewateri (Adult)*	26
10 Nov 22	SD 9 / YR16	*Acropora robusta*	24
10 Nov 22	SD 9 / YR16	*Tridacna rosewateri (Juvenile)*	24
10 Nov 22	SD 9 / YR15	*Tridacna squamosa*	24
10 Nov 22	SD 9 / YR15	*Galaxaura rugosa*	24
11 Nov 22	SD 10 / YS16	*Heliopora coerulea*	27
11 Nov 22	SD 10 / YR17	*Acropora tabular*	29
11 Nov 22	SD 10 / YR17	*Sinuopta sp.*	26.5
11 Nov 22	SD 10 / YR18	*Pocillopora sp.*	27
13 Nov 22	SD 11 / YR18	*Gardineroseris sp.*	27
13 Nov 22	SD 11 / YR18	*Cyphastrea sp.*	27
13 Nov 22	SD 11 / YR22	*Soft Coral*	47
13 Nov 22	SD 11 / YR22	*Gorgonian*	47
13 Nov 22	SD 11 / YR22	*Favia sp.*	47

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PRELIMINARY REPORT
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