



maRHE

MaRHE Center – Marine Research and Higher Education Center



Nestled within the Maldives archipelago, the Marine Research and Higher Education Center (MaRHE), in collaboration with the Government of Maldives, represents a vital scientific hub dedicated to the comprehensive study of marine ecosystems in one of the world's most biodiverse regions. With an interdisciplinary approach, MaRHE Center stands at the forefront of marine science, leveraging advanced technology to address pressing environmental challenges facing our oceans.

At the core of the MaRHE Center's mission is the systematic exploration of the Maldivian marine environment. Through extensive fieldwork, underwater surveys, and molecular analysis, researchers meticulously study the region's diverse flora and fauna, researching species distributions, ecological interactions, and evolutionary patterns. By integrating data from remote sensing, acoustic telemetry, and satellite tracking, the center provides critical insights into the dynamic processes shaping marine ecosystems, from ocean circulation patterns to the movement of marine megafauna.

A key focus of research at the MaRHE Center is the impact of climate change on coral reef resilience and adaptation. Scientists investigate the responses of coral communities to rising sea temperatures, ocean acidification, and extreme weather events. By studying the molecular mechanisms underpinning coral stress tolerance and bleaching susceptibility, researchers aim to inform targeted conservation strategies and facilitate the restoration of degraded reef habitats.

Moreover, MaRHE Center conducts pioneering studies on the ecological dynamics of pelagic environments surrounding the Maldives. Employing hydroacoustic surveys, biogeochemical profiling, and autonomous underwater vehicles (AUVs), scientists unravel the complexities of marine food webs, nutrient cycling, and carbon sequestration in open-ocean ecosystems. Through collaborative partnerships with international research institutions and governmental agencies, the center contributes to global efforts to monitor and mitigate the impacts of

anthropogenic activities on ocean health and biodiversity.

Beyond research, the MaRHE Center plays a pivotal role in fostering scientific literacy and capacity building in the Maldives and beyond. Through immersive field courses, workshops, and academic exchanges, the center empowers students, educators, and local communities to engage with marine science and conservation practices. By nurturing a culture of environmental stewardship and interdisciplinary collaboration, the MaRHE Center seeks to inspire a new generation of scientists and decision-makers committed to safeguarding our oceans for future generations.

As a center of scientific excellence and environmental advocacy, the MaRHE Center embodies the spirit of discovery and resilience in the face of unprecedented environmental change. Through its steadfast commitment to advancing knowledge and fostering sustainable solutions, the center stands as a beacon of hope for the preservation of our planet's most precious marine ecosystems.

ECOSYSTEM ACCESS

SCUBA DIVING FACILITIES AND VESSEL

Our facility service for Scientific Diving at MaRHE Center provides our guests with SCUBA equipment (air tanks, BCDs, regulators, wet suits 3mm, masks and snorkels, foot-pocket fins), training and scientific/technical support that underpins a wide range of high-class interdisciplinary research in the underwater environment. It also provides equipment for different sampling activities and visual census techniques.



The Scientific Diving team delivers practical support for diving-related underwater scientific projects by providing additional manpower for groups with limited diving experience, total project management for scientists with no diving experience and/or specialist equipment loans for groups with diving experience but limited resources.

MaRHE Center has agreements with several Resort spread in the Maldives to conduct sampling collections, access at several uninhabited islands and local islands.

Through a local vessel (Dhoni) it is possible to reach several reefs in Faafu Atoll, the furthest being 2 hours away, for sampling and collection of marine organisms or for physical and geological data collection from 0 to 120 meters of depth.



The dhoni can host 40 people, complete with crew, and diving equipment for 20 people. A first AID kit and oxygen tanks are available.

Specifically, the equipment available is:

- Niskin bottles, phytoplankton net, zooplankton net;
- Two Canon PowerShot G7 X Mark II cameras equipped with Fantasea Underwater Housing with a dive rated to a maximum depth of 60 meters.
- 20 and 50 m underwater measurements tapes, and 1 x 1 m quadrats;
- Diving slates;
- Hammers and chisels
- ROV Seamore Steel Head portable with a 150m cable, Depth-rated to 300 m.
- Emlid Reach RS+ Single-Band RTK GNSS Receiver and Base with centimeter precision.
- Acoustic underwater programmable digital recorder.
- Ricoh Theta V, 360° camera shooting video in 4K equipped with an underwater case with a dive rated to a maximum depth of 40 m.
- Temperature and Light Data logger HOBO Pendant.

TECHNOLOGY PLATFORMS

MaRHE Center researchers can provide support for testing and experimentation of advanced technologies for experimental field and laboratory activities.

The center provides the following tools for research uses:

- Microscopes: 1 Olympus BX51 Fluorescence Microscope, 1 Olympus SZ61 Stereomicroscope, 3 Zeiss Microscope, 1 Leica EZ4D Microscope
- Weather station: temperature sensor and humidity control, wind direction and speed sensors, pyranometer, rain gauge, barometer
- Laboratory equipment and chemicals: Bench space, cabinets, sinks, Laminar flow hood, Chemical fume hood, Tissue, and sample preparation appliances, Micro-oven forced air. The center can provide plastic tubes of various capacities and sizes, Refrigerator and Freezer, Petri plates, Ethanol 99%, Formalin, different chemicals upon request, Micropipettes, and Basic equipment to preserve and analyze biological samples.
- 2 DJI Mavic 3 Enterprise

In addition, for molecular analysis and eDNA analysis, the lab provides:

- Instruments for extraction of proteins and nucleic acids from samples, specifically: Immersion cooler Julabo FT902, Centrifuge HETTICH – MOD. MIKRO 120, Heating plate M520-PR, Vortex, Phmeter Mettler Toledo FiveEasy, Thermostatic bath M418-BASIC, Mortar and pestle, Micropipettes
- Instruments to collect and filter water for eDNA Analysis



BIOLOGICAL RESOURCES

Due to the location of the Center, with direct access to the reef or through a diving vessel, researchers can access biological resources, specifically, but not limited to benthic and nektonic organisms (molluscs, echinoderms, crustaceans, fish, benthic organisms), scleractinian corals, and seagrass species.

Species can be collected upon request and preserved for molecular or zoological analyses through ethanol and formalin.

Due to years of experiments, in the lagoon in the proximity of the center are present different types of coral nurseries for coral restoration activities: rope nurseries, table nurseries, reef stars, and coral tree nurseries. These can be used for experimental setup for different restoration experiments.

The equipment in possession of the center allows for morphological analysis on mixed samples or target organisms through preparation, observation, and imaging of phytoplankton, zooplankton, benthos samples in microscopy (stereomicroscope and microscopes), and molecular characterization of marine organisms.

TRAINING



On a regular basis, the center organizes several specialized training and courses. Specifically, on:

- **Tropical Marine Ecology** covers topics such as: Geomorphology of coral reef; Zoobenthos of coral reef; Sampling Techniques; Fishes of coral reef; Problems and conservation of coral reef; Symbioses in coral reef; Realisation of a scientific project: planning, sampling and data return
- **Coral Reef Restoration:** techniques to build coral nurseries (mid-water, trees); populate coral nurseries; use structures to stabilize the substrate (reef stars); out-plantation techniques onto a degraded reef site; coral identification; coral health conditions; how to plan and carry out a coral reef restoration project.
- **Tropical marine fishes:** identification of the main tropical fish families associated with the reef habitat; identification at genus or species level of the most important fish of the Indian Ocean; description of a fish community based on the trophic groups that compose it; description of the temporal and spatial variations (nictimeral rhythms, reef zoning) of fish communities; main patterns and processes that influence the structure of a fish community; visual census techniques, for the study and monitoring of fish communities (theoretical and practical); detection of signs of overfishing, which can damage entire biological communities; use of photography as data collection or as visual documentation.
- **Coral Health and Disease Assessment** focusing on: coral reef health assessment in the field with activities aimed at understanding the importance of health monitoring in coral reef ecosystems, threats to coral reefs, field and laboratory methods used to assess coral reef health, their advantages and limitations, and management practices that can help reefs become more resilient.
- **Mapping Technologies for Coral Reef Environments** teaching how to: plan a geomorphological survey in coral reef environments; collect, process and interpret terrestrial and submarine; topographic data using a wide range of technologies and software; packages (UAV, multibeam echosounder, ROV, bionomic transects and sediment sampling); integrate multi-scale terrestrial and marine data in a GIS environment and generate DEMs; identify the main carbonate producers in coral reef environments.
- **Marine Spatial Planning** aimed at providing a basic knowledge on the biology of the

coral reef surrounding the Maldivian islands and its ecological role; defining the vision and main objectives of the area, initial assessment of the area, data collection and mapping, analysis of the needs and critical issues of the area (use vs use; use vs environment); mapping and assessing environmental information through the use of Unmanned Aerial Vehicles (UAV) for high-resolution photos and topographic surveys, field and snorkelling activities and through a habitat mapping exercise.

- **Sustainable Tourism in Fragile Environment** that focuses on: tourism and insularity; the Maldivian tourism system; tourism in small island developing states; sustainable tourism in the Maldives; pro-poor tourism and local empowerment; the “Maldivian resort”: brand construction and site inspection; some key environmental issues: climate change, waste management and energy production; introduction to the main families of coral reef bony fishes, ecology and identification on field; coral reef conservation: introduction to the ecology of tropical coral reef systems.
- **Places and Local Communities** with topics covering: local communities’ adaptation and resilience; The human geography of small islands; symbolic places and landmarks; islands’ mapping; political ecologies of islands; anthropology of Indian Ocean; some key environmental issues: climate change, waste management and energy production; coral reef conservation: introduction to the ecology of tropical coral reef systems.



SUPPORTING MATERIAL AND ACTIVITIES

MRHE Center provides **diving support** for guest scientists who need specific biota from the Maldivian underwater area. Amongst the staff we have:

6 Dive Instructors (PADI, FIPSAS, RAID), Dive Master, Advanced Scientific Divers.

The staff assists with Business VISA documents and application, and **sampling permission** (Research Permit, Permit for studies within MPAs or with protected species, Export permits, Nagoya Agreement)

The **library** at the center gives access to the following books, some in multiple copies:

- Fishes of the Maldives;
- Corals of the Indo-Pacific Field Guide;
- Corals of the World (Vol. 1, 2, 3);
- World Atlas of Marine Fauna;
- World Atlas of Marine Fishes;
- World Atlas of Seagrasses;
- Nudibranchs of the World;
- Mar Rosso;
- Fisheries Science Vol.2;
- Field Guide of Hard Corals;
- Maldives Trees and Flowers;
- La Comunicazione interculturale nell'Era Digitale;
- Field Guide of Hard Corals – Yemen;
- Sharks and Rays;
- Sharks of the Maldives;
- The Maldivian Islanders;
- Island World of the Maldives;
- Acropora Staghorn Corals;
- Mysticism in the Maldives

At the center is present a **coral collection** of the most important scleractinian genera and some gorgonians present in the Maldives.