

- **SCIENCE**

Research programmes

Coral Reef Monitoring

ReefDoctor has been monitoring the status of the Bay of Ranobe's coral reef system since 2003. The well established long term surveying programme monitors various environmental and ecological parameters across the Bay to provide an assessment of the impacts of anthropogenic and natural pressures on coral reef health. In particular, a major threat to the integrity and survival of the bay's coral reef that requires close monitoring, is the shift from coral to algal dominance. This is occurring across many shallow reef areas within the lagoon as a result of sustained nutrient loading and increased fishing pressure.

The surveys are conducted on a biannual basis during the winter and the summer (in order to account for potential seasonal variability) across 12 core sites encompassing a selection of reef zones; patch reefs, barrier reef flats/slope, exterior spur and groove reefs and Marine Protected Areas (MPA's).

Both members of ReefDoctor's science team and trained volunteers take part in SCUBA transect surveys collecting data on the following:

- Reef Fish Community. Underwater Visual Census (UVC) methods are conducted along belt transects to collect data on fish abundance, diversity and biomass.
- Benthic Composition. The Point Line Intercept (PIT) method is used to obtain percentage covers of hard coral, bleached/dead coral, soft coral, macroalgae, rubble, sand etc.
- Indicator Invertebrates. Abundances of invertebrates that have been selected for monitoring on the basis of their ecological and economic significance (e.g. sea cucumbers, sea urchins, crown of thorns starfish, giant triton shells) are recorded along belt transects.
- Environmental Parameters. Data is also collected on several physical / oceanographic variables such as water temperature, air temperature, wind, currents, cloud cover, turbidity etc.

The data collected and analysed over the long term will enable ReefDoctor to monitor changes in the coral reef condition over time and ensure management decisions are scientifically well informed. The impacts of marine protection can be assessed by monitoring deviations from the MPA baseline data already collected and from comparison of unprotected sites. The results of these surveys are also fed back to government departments, relevant regional /

international coral reef organisations and also to the local community to help them better manage their bay's coral reef resource.

Reef Check

Reef Check consists of a global network of teams trained in a specific standardised survey method that regularly monitors and reports on coral reef health. It is the most widely used coral reef monitoring protocol and is in operation in over 80 countries. The protocol is based on the use of high value, easily identified indicator organisms which were selected on the basis of their economic/ ecological value and sensitivity to human impacts.



ReefDoctor decided to adopt the Reef Check methodology in 2009 for the following reasons:

- The techniques involved are relatively simple and quick to learn so it's ideal for volunteers to gain experience in marine surveying, particularly the 4-6 week volunteers.
- To ensure that there will still be an active surveying programme available for volunteers to participate in during periods of the year when biannual surveys are not occurring .
- The data collected from the Bay of Ranobe is included in a global database and published in an annual report, therefore ReefDoctor is actively making a valid contribution to the overall assessment of the status of the world's coral reef's.

Seagrass Surveys

ReefDoctor has been an active participant of the global seagrass monitoring network 'SeagrassNet' since October 2007. Along with other SeagrassNet teams worldwide (in over 20 countries)

ReefDoctor conducts synchronous quarterly sampling of the Bay of Ranobe's seagrass meadows. The monitoring protocol consists of a comprehensive set of surveying and sampling procedures (such as the deployment of temperature /light sensors, specimen collection and processing, quadrat samples, canopy height measurements, photographic analysis, sediment coring, water testing and GPS mapping) which take place across permanently established transects along the seagrass bed.



Seagrass beds are ecological and economically valuable habitats. They act as an important habitat for a large number of organisms, stabilize bottom sediments, act as hydrodynamic barriers reducing wave energy and filter coastal waters of nutrients, contaminants and sediments. Seagrass meadows are also of particular importance to the Vezo communities as they provide the basis of the productivity of numerous subsistence fisheries.

Unfortunately, due to their location on land-sea interface, seagrass beds are subject to many anthropogenic impacts including eutrophication, sedimentation, human development, fishing net trawling and like most other marine ecosystems are also threatened by global climate change. These surveys are carried out in order to be able to document the status of the seagrass resources in the Bay, monitor changes in their health and form the important first steps in understanding and preserving these valuable habitats.

Sedimentation Studies

It is widely accepted that Madagascar's coral reefs systems are under threat from increased terrestrial sediment inputs as a result of extensive deforestation across the country. Research into the dynamics and impacts of sedimentation in the Bay of Ranobe was initiated in 2005 by one of ReefDoctor's Marine Biologists, Emma Gibbons. Alongside a water sampling regime, sediment traps were placed in locations close to ReefDoctor's core survey sites to determine levels of sedimentation and the impacts of this on the health of coral reef habitats.

Emma's current research is focused on establishing a historical baseline record of sedimentation by investigating the input history and spatial extent of terrestrial sediment. This will ultimately lead to an improved understanding of the potential effects of sedimentation in this reef-lagoon complex. Extensive field and laboratory based methodologies include:

- Surface sediment sampling to investigate the present distribution patterns of terrestrial sediments.
- Sediment core sampling to analyse sub-surface sediment to gain a better understanding of the history of sediment input in the bay.
- Photographic quadrats will be used to estimate the cover of the benthic substrate at each sampling station in order to investigate potential ecological impacts of sedimentation.

The above methodologies will take place at 160 pre-selected sampling sites spanning the entire length and width of the bay and taking approximately one year to complete. The impacts and implications of terrestrial inputs in terms of both near-shore benthic ecology and

sub-tidal sedimentology are complex and relatively poorly understood. This research is therefore making a valuable contribution to improving the understanding of lagoon sedimentation dynamics and will help to determine the level of risk to which the Bay of Ranobe's coral reefs are subjected to.

Artificial Habitat Programme

ReefDoctor has an ongoing research programme that aims to enhance fish biodiversity and biomass by the introduction of artificial habitats. In this way ReefDoctor hopes help the local community manage their fishing resources by providing habitats that are a viable alternative to the over exploited, traditional Vezo fishing. Since 2001 ReefDoctor has conducted a number of experiments looking at different types of artificial reef structures and how these may help both the local fishing community and the marine environment:

- IARCs (Indigenous Artificial Reef Complexes). These are small experimental structures created from reef rubble placed into cement bases thus creating structure from an unstructured habitat. The more complex and stable habitat promotes greater diversity of fish and coral life.
- Pelagic FADS (Fish Aggregation Devices) are method of improving artisanal fisheries. They are artificial structures placed in the water to act as a means of concentrating fish from a large area, into a smaller one, thereby making them easier to catch. FAD experiments were conducted between 2004-2006 and with advice from Ifaty's fishing community, ReefDoctor designed, constructed and deployed a low cost FAD from locally sourced materials. There are currently plans underway to begin installing a series of these functional FADs to improve the bay's fisheries yields, sustaining a good nutritional and economic income for Vezo communities.

At present members of ReefDoctor's science team are conducting further research into other forms of artificial habitats such as 'ReefBalls' and conducting feasibility studies across the bay to determine suitable sites for future initiatives.

Fisheries Assessment

Coral reef health is intricately linked to fisheries therefore in order to achieve a sustainable marine management programme for the Bay of Ranobe, a socio-economic perspective must be taken alongside consideration of the ecological and biological factors. Fisheries assessments to monitor fishing effort, popular fishing areas and commonly



caught species have been completed with local fishermen since January 2005.

Fisheries surveys take place at three locations across the bay, Ifaty, Mangily and Beravy covering a 10km stretch of coast. Our local staff meet with fishermen on the beach after they return from their morning fishing trip to identify and measure their catches.

The results of these surveys are recorded in ReefDoctor's database and analysed to assist local communities in the management of their marine resources. The data collected will improve our understanding of the artisanal fishery in the Bay of Ranobe which is essential for its successful management and the protection of fish stocks for future generations.

Coral Studies

Coral is the foundation of any reef system, providing food and a structured habitat for many marine organisms. Without the continued health of coral, reef degradation will occur resulting in the loss of an extremely productive and diverse ecosystem, impacts to subsistence reef fisheries, loss of diving tourism related revenue and an increasing threat of coastal erosion as a result of the reef's reduced ability to dissipate wave energy.

There numerous threats to coral health including sedimentation, bleaching, disease, algal overgrowth, ocean acidification and destructive fishing practices. ReefDoctor has an ongoing coral research programme dedicated to improving the understanding of coral biology, ecology, responses to stress and the impacts of the highlighted threats. Past, current and future research includes:



- Coral Reproduction. Past field experiments have been focused on quantifying the larval supply of coral in the lagoon through the use of settlement plates and microscopic analysis. Very little is known about coral spawning in the bay so there are continual efforts being made by the science team to monitor and document annual spawning events.
- Coral Recruitment. Investigations into coral recruitment will take place across ReefDoctor's 12 core survey sites through quadrat based methodologies requiring the identification, measuring and recording of juvenile corals by SCUBA. Identifying patterns in and levels of coral recruitment across the bay will provide an insight into how the reefs will develop in the future and indicate levels of reef resilience.

- Coral Tagging. At the start of 2009 a coral tagging project was implemented to permit the accurate assessment and long term monitoring of the health of specific coral colonies. Various aspects of coral health will be monitored over time including growth rates, bleaching intensity, evidence of disease and algal overgrowth.
- Coral Bleaching. As it is readily accepted to be the most widespread and significant threat to coral reefs, ReefDoctor has begun a coral bleaching monitoring programme. Key physical and biological aspects of coral bleaching events will be monitored and there will be a particular focus on studying the bleaching susceptibilities of different coral genera. The ultimate goal of this research is to determine the resiliency of the Bay of Ranobe's coral reefs under the threat of global climate change and develop effective resilience based management strategies.

Turtle Fishery Research and Conservation

A serious decline of marine turtles has been documented across Madagascar. The exploitation of turtles across their foraging grounds, including the Grand Recif de Tulear (a 32km long reef system encompassing the Bay of Ranobe), has been suggested to be the cause for seriously impacting the sea turtle resources of the wider Western Indian Ocean.



The Vezo tribal leaders of Ifaty have asked ReefDoctor for assistance in the protection of their sea turtle, as a result the group 'Miamby Fano' was created to establish a permanent monitoring and education program in the Bay of Ranobe. Miamby Fano taps into traditional knowledge and engages local populations, it is therefore central to the implementation of a stakeholder participatory approach to turtle resource management. The organisation has several goals:

MIAMBY FANO
Guardian of the turtle



- Collect data on the distribution, abundance and threats to marine turtles.
- Improve the scientific understanding and economic implications of the subsistence turtle fishery.
- Assess the local harvesting of turtle eggs.
- Establish community participation programs and education development strategies

Research recently undertaken has involved monitoring the sea turtles captured by subsistence hunters or as

by-catch in the village of Ifaty. A Vezo representative of Miamby Fano collects various data at the time of the specimen landing such as carapace measurements, sex, species, area of capture, purchase price and occurrence of eggs. The data collected is essential to the management of the sea turtle resource and will be shared with regional organisations to enable institutional integration.