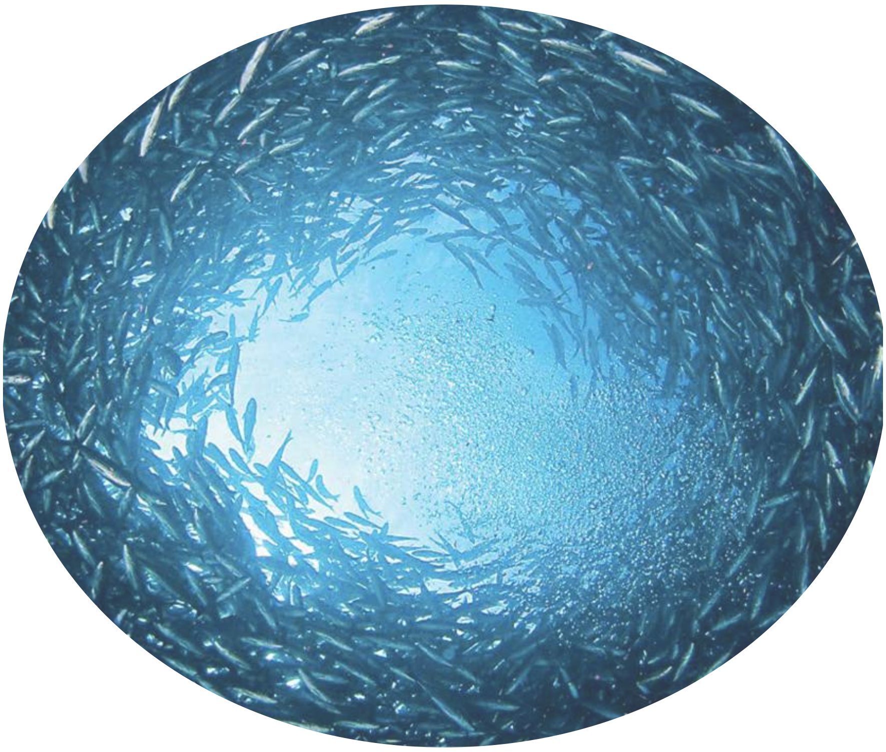
FRONTIER TANZANIA MARINE RESEARCH PROGRAM

Utende Beach, Mafia Island, Tanzania



TZM Phase 172 Science Report
1st April – 30th June 2017

Demi Mills

Contents

Acknowledgements

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Staff Members

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General Summary

All field work carried out by Frontier Tanzania Research Assistants (RAs) in phase 172 was within Mafia Island Marine Park (MIMP) boundaries. This phase began with the implementation of incorporating more fish families to the baseline protocol survey, and removing the commonly used "reef check" method of coral monitoring. Instead of using morphology to identify coral, RAs were taught coral identification to genus level, allowing for a more detailed picture of biodiversity in MIMP.

Introduction

Coral reefs are one of the most productive and highly diverse ecosystems. Providing a number of ecological and economical services which fuel many local, regional and global populations (Moberg & Folke, 1999). At present, approximately 500 million people depend on coral reefs for food, coastal protection, building materials and income from tourism. By 2020 it is estimated that 50% of the world's population will live along the coasts, putting unsustainable pressures on coastal resources (Wilkinson, 2008). Coral reef systems thrive in oligotrophic oceans (Roth, 2014). The major component of coral reef ecosystems is the presence of the scleractinian corals, which "build" the reef. These corals can be referred to as zooxanthellate corals, as they contain the endosymbiotic zooxanthellae within gastrodermal cells of the coral tissue (Smith *et al*., 2005). This symbiotic relationship allows for the host coral to photosynthesise, playing a role in light-enhanced calcification, and the zooxanthellae species gains nitrogenous compounds, CO_2, and phosphates (Davies, 1984).

Over the past few centuries coral reefs have slowed or stopped development repeatedly in periods of climate change (Pandolfi *et al*, 2014). Direct and indirect impacts of climate change have given rise to increased sea surface temperatures, mass bleaching events, ocean acidification and coral decalcification (Reaser *et al*., 2000; Hughes *et al*., 2003; Hughes *et al*., 2010). The most evident decline is in the Caribbean, and the loss of coral and biomass has now been linked to human activity (Mora, 2008). The major anthropogenic risk factors include mortality and reduced growth of the scleractinian corals due to their high sensitivity to rising seawater temperatures (De'ath, 2012). Alongside this there are other direct anthropogenic factors such as over-fishing, destructive fishing methods, pollution and tourism. The combinations of direct and indirect impacts of climate change are limiting the ability of coral reefs to absorb shocks and regenerate after natural and anthropogenic disturbances (Nyström *et al*., 2000). As a result of this, to date there has been a global loss of 19% of the original area of coral reefs; 15% are seriously threatened with loss within the next 10 to 20 years; and 20% are under threat of loss in the next 20 to 40 years (Wilkinson, 2008).

Marine Protect Areas (MPA) are sanctuaries for coral reefs that can attempt to mitigate the effects of anthropogenic exploitation and climate change. Successful MPAs have increased abundance and biomass of target species (Lester, 2009), raised fish recruitment rates (Evans *et al*., 2008) and increased migration of adults into neighbouring areas (Jupiter and Egli, 2010). Mafia island, located in the Zanzibar archipelago off the coast of Dar es Salaam, Tanzania is home to 822 km^2 of protected area. The marine park is a multi-user MPA consisting of three different zonation tiers. Core, specified and general, with the overall aim of the marine park to conserve and protect the biodiversity of Mafia islands reefs (MIMP GMP, 2011).

Training

All Research Assistants (RAs) were given a series of lectures and tests to ensure quality of data collected was accurate and efficient. Below is a list of the lectures provided. The specific coral genus, fish families and invertebrate species can be found in Appendix 1.

To ensure accuracy of data collection RAs had a pass mark of 95% in all three areas of data collection (Coral identification, Fish identification and Invertebrate identification) before beginning surveys.

Table 1: Briefing Sessions and Science lectures given in Phase 171.

Lecture	Description	Lecturer
Welcome to Mafia	General Introduction to Mafia Island, Utende Village and Frontiers role in MIMP	DM
Hazards of the reef	Health and safety lecture on the potential dangers and hazards of marine life	DM
Medical	Awareness of Malaria, Tropical ulcers ect	DM
Benthic Identification	Methodology 40 Coral genus taught	DM
Fish Identification	Methodology 42 Fish families	DM
Invertebrate Identification	Methodology 20 invertebrates	DM
Introduction to Coral Biology	Brief introduction to coral reefs and their importance	DM
Coral evolution and reproduction	History of coral reefs and reproductive methods	DM
Seagrass	Introduction to types of seagrass, distribution and economic and ecological importance	DM
Mangroves	Introduction to types of Mangroves, distribution, ecological and economical importance	DM
Coral reef ecology	Formation of corals, distribution patters	DM
Coral Reef Management	MPA and their uses	DM
Turtle Biology	General biology of all species, nesting behavior and ecology	DM
Turtle Conservation	Threats to turtle population globally and locally. Conservation efforts to date	DM
Whale Shark Biology and Conservation	General biology of whale sharks, their threats and conservation efforts to date	DM

Research assistants were exposed to a wide variety of lectures on marine conservation and management. Continuing the efforts in assisting MIMP staff with their monthly beach cleans and surveys on Utende beach. RAs were also able to go into a local men’s class three times a week to help teach English and spread environmental awareness.

Research Work Programme

Seagrass mapping, the importance of seagrass inside Chole Bay

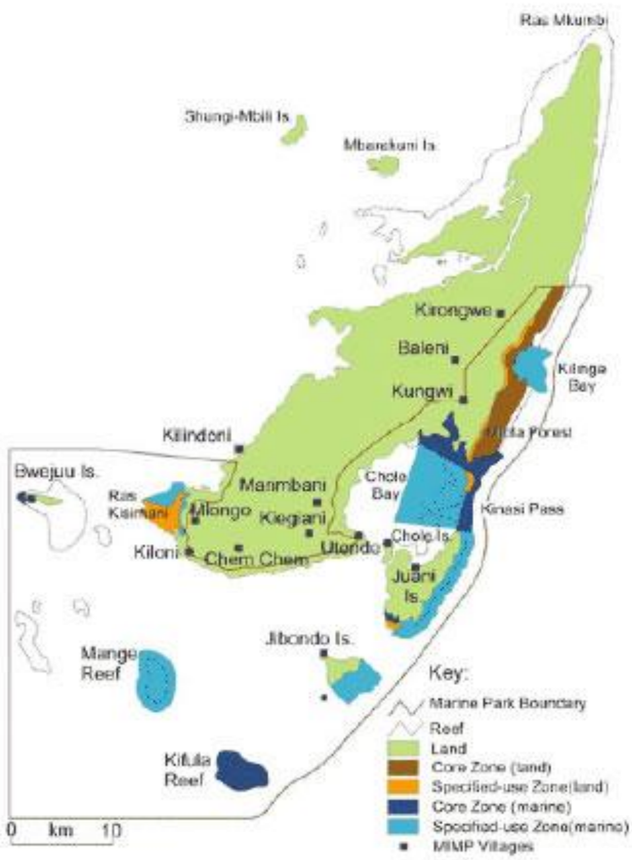
<u>Introduction</u>

Seagrass is the only true marine angiosperm, growing in soft sediments in shallow coastal waters. There, underground network of rhizomes and roots provide stabilisation of the sediment (Kaiser *et al.*,2011; Amesbury and Francis 1988). Seagrass meadows provide important ecosystem services, including an estimated $1.9 trillion per year in the form of nutrient cycling (Waycott *et al.,* 2008). Seagrasses trap sediment and slow water movement, causing suspended sediment to fall out of the water column. This trapping of sediment benefits coral by reducing sediment loads in the water (Mckenzie *et al.*, 2003). Seagrass beds also prevent coastal erosion thereby offering natural shoreline protection (Manikandan *et al.,* 2011). Other ecological benefits include; habitat sanctuaries for invertebrates, epiphytes and juvenile reef fish (Morris and Greening, 2006). Seagrass beds are also an important feeding ground for the Green Turtle (*Chelonia mydas*). To understand the ecosystem connectivity inside Chole Bay, the data collected during the quarter 172 begins to provide the baseline for continued monitoring to ensure the seagrass remains healthy and therefore continue their provision of ecosystem services. Thus, to determine the importance of seagrass ecosystems and to detect changes that occur through perturbations it is necessary to first map the distribution and density of existing seagrass meadows.

<u>Methods</u>

This report was written based on data collected between April and June 2017 on the Seagrass bed based inside the bay of Mafia Island Marine Park. The marine park covers 822 km^2 (Figure 1), located between S 07° 45' 07", E 39° 54' 01" and S 08° 09' 40", E 39° 30' 00".

Figure 1: Management zon*es* of Mafia Island Marine Park (MIMP) legend showing the different areas of zonation. (MIMP GMP, 2011)



Surveys were conducted on slack low tide via snorkeling. Teams of two measured their distance from the shore and using a 50 m transect tape measured species composition. At 5 m intervals a 50 cm x 50 cm quadrat was laid to the right of the transect. The surveyors estimated the overall percentage of seagrass cover and identified the seagrass species present within the quadrat. The surveyors then estimated the percentage composition of these species within each quadrat. A total of 11 samples were taken per transect tape and a total of 6 transects were laid during phase 172.

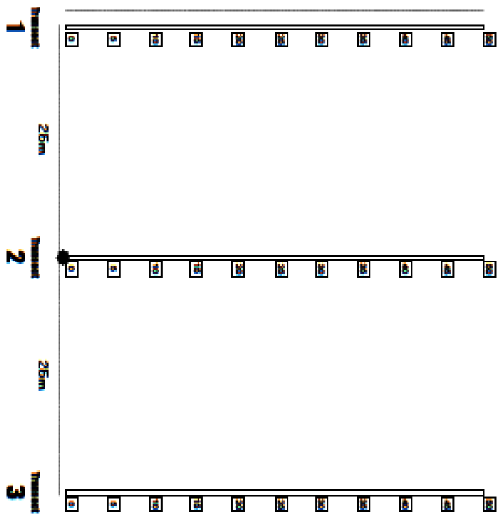
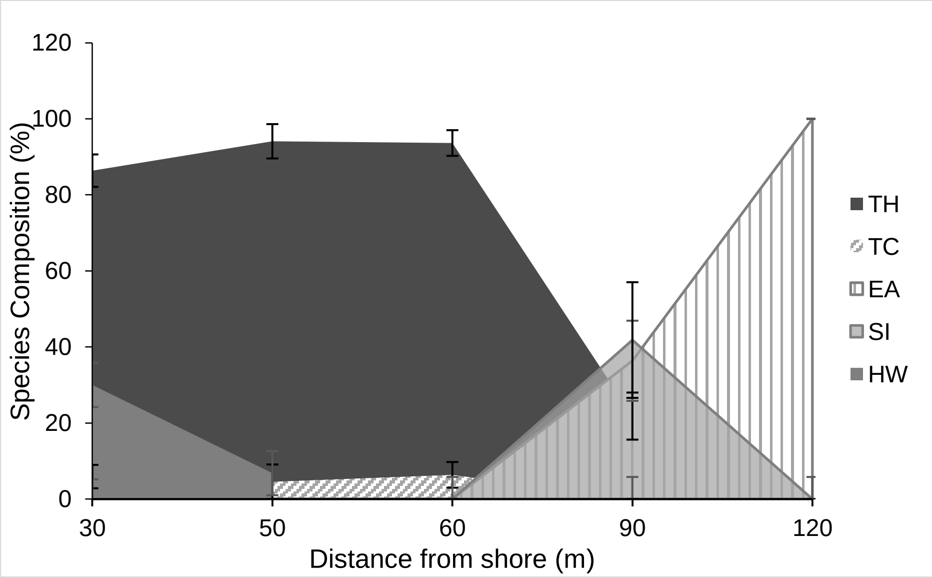


Figure 2 Schematic of sampling method used

<u>Results</u>

The results showed that the total mean seagrass cover in the sites sampled equated to 44.4 %. The maximum mean seagrass cover seen in one replicate was 57.7 %, with the minimum being 31.4 %.

Thalassia hemprichii was the most common species of seagrass (74 % mean cover) and had a higher percentage cover close to the shore with no less than 80 % cover within 60m of the shore (Figure 1). *Halodule wrightii*, covered 6.8% and 1.4 % of the substrate 30m and 50m away from the shore respectively (Figure 1). *Syringodium isoetifolium* was recorded at greater depths having 41.8 % coverage 90m from shore (Figure 1). *Enhalus acroides* dominated further out at sea, with 100 % cover 120m from shore (Figure 1). The final species sampled, *Thalassodendron ciliatum*, was seen in small amounts with 5.9%, 4.5% and 6.4 % cover at distances of 30m, 50m and 60 m from shore respectively.



Discussion

Seagrass zonation in Chole Bay followed usual patterns of seagrass intertidal ecology (Bos et al., 2007). Seagrass morphology is directly related to its position on the seabed as species adapt to their environment accordingly. Competition for light, and tolerance to salinity and air exposure are the major factors that affect seagrass zonation globally (Shafer, Sherman & Wyllie-Echeverria, 2007). This is the same for Chole Bay, as the results from this research support that of previous studies (Dahdouh-Guebas, Coppejans & Van Speybroeck, 1999; De Troch et al., 2001; Shafer, Sherman & Wyllie-Echeverria, 2007).

Halodule wrightii, a pioneer species, was found in the shallowest waters and is often uncovered during low tides. Similar studies have found the same results (De Troch et al., 2001). It has a higher tolerance than other seagrass species to air exposure and high salinities, and as such it faces little competition close to shore. This is represented by its morphology, as it receives plenty of light being in shallow water and is exposed during low tides it does not need a large surface area for gas exchange so has thin, needle like leaf blades (Nobel, Zaragoza & Smith, 1975). This also prevents a loss of water through transpiration when it is uncovered (Miller & Gates, 1967). At very similar, but slightly greater depths *Thalassia hemprichii* dominated. This species of seagrass has broader leaf blades than *Halodule wrightii* as it is not always uncovered at low tides, so excessive transpiration is not always a danger. Being slightly deeper, it needs broader blades to increase its surface area to photosynthesise more efficiently. Both species, *H. wrightii* and *T. hemprichii* do not exceed 30cm in length which further illustrates how their morphology is adapted to shallower waters.

Thalassodendron ciliatum was seen in small percentages within 30m to 60m from shore, but is a very common species in Chole Bay. However, it is generally seen further out from shore, so the data shown here represents a few patch colonies. The broad leaves and elongated stem of *Thalassadendron ciliatum* suggest it is adapted to deeper waters, having to continually compete for light with larger species such as *Enhalus acroides* and *Syringodium isoetifolium*. The former of these dominated at greater depths, as a result of its broad leaf blades and size, being able to reach lengths of over 1m. *S. isoetifolium* was also prevalent at greater depths (not to the same extent as *E. acroides*), being able to reach lengths close to half a meter it can compete for light further out from shore. Its cylindrical leaf blades prevent transpiration as it is uncovered at low tides in other regions of the world and means it loses out to the broader *E. acroides* with regards to light absorption (Skelton & South, 2006).

A low number of replicates was the main limitation faced during this study. There were no long term research assistants this phase, which meant that by the time they were capable of species identification they soon left Mafia Island. Added to this was the fact that Mafia has just experienced its rainy season and extremely adverse weather has restricted the number of possible surveys.

The research supports that of previous studies, where seagrass zonation is related to intertidal ecology and species have morphological adaptations to tolerate specific environments.

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