The Impact of Watamu Marine National Park on Marine Biodiversity & Habitats

A Conservation Research Project

by

A Rocha Kenya

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Executive Summary

The original project vision was "to study the impacts of Watamu Marine National Park (WMNP) on marine biodiversity, habitats, and animal behaviour through high level research and facilitate capacity building for East African marine research and volunteer-led marine conservation at Mwamba Field Study Centre, A Rocha Kenya, Watamu."

From the original proposal the main research goal was to collect baseline data that would provide a basis for identifying key research questions and areas of conservation concern within the National Park environment. During the 2011/2012 field season we were able to conduct three studies identified as important by Kenya Wildlife Service (KWS) who are the government institution managing the marine park: biodiversity of WMNP, Tourism Impacts on Coral Gardens, and Coral Recruitment studies. During these studies our taxonomic identification capacity grew to include fish and coral species found in WMNP and have focussed our attention on IUCN red list priority species for pursuing further data collection. In order to present at conferences and publish results in peer reviewed journals we are using data to produce two papers currently focusing on the results of the tourist study. We are working in a partnership with CORDIO to use our biodiversity data in another paper to be submitted in 2013.

Other goals were to develop relationships with key marine contacts in Kenya. The most important collaboration was with KWS with whom we developed very good relations, have their approval for continuation of the project and worked closely together on research. In Watamu we have begun to work alongside in particular the Watamu Marine Association and the Watamu Association of Boat Operators. Nationally we developed good working relationships with CORDIO and the Wildlife Conservation Society, both international NGOs working extensively in Kenya on marine conservation.

In summary, the project is now recognised within the community and by important partners which provides a good basis for future work. We have purchased basic equipment and developed partnerships which provide capacity for continued marine research and conservation activities. We have utilised existing communication links to educate and garner support for this project within A Rocha internationally. The next stage of the project is to expand research to all sites and habitats within Watamu Marine Park, increase capacity, especially recruiting marine biologists from within Kenya, and work towards a marine laboratory which can better facilitate this programme.

1. Introduction

The first marine protected areas (MPAs) established in Kenya were in Malindi and Watamu in 1968. The purpose of creating marine parks and reserves was to protect biodiversity, manage resources in a sustainable way to protect the livelihoods of coastal communities and manage tourism. The work conducted by A Rocha Kenya in Watamu Marine National Park (WMNP) intends to provide relevant information to these goals through research, capacity building within the local community, partnerships and practical conservation action where necessary.

Flourishing *Acropora* coral in WMNP

September 2011 to March 2012 represented the first period of data collection for A Rocha Kenya involving marine ecology and marine issues. This report documents the progress and successes that have been made over this period and suggests ways forward for work to continue and grow.

Overview of work accomplished

Dr Robert Sluka has been Manager of the project since December 2010. Initial proposal development was accomplished in the Spring of 2011 and fieldwork began in Autumn 2011. From September to March a biology graduate named Benjamin Cowburn was based at Mwamba Field Study Centre in Watamu. Dr. Sluka spent several weeks training and guiding Benjamin towards integrating the marine project within the existing A Rocha Kenya framework. During the first six months of field work Anthony Maingi, an attaché from KWS participated in all areas of fieldwork and related project activities. Benjamin and Anthony were joined in January by an Oceanographer named Joy Smith. Over the six months fieldwork was conducted, community relations were established and several collaborations were forged. Dr Sluka continued to supervise remotely and interfaced with A Rocha Kenya and A Rocha International concerning the development of the marine programme.

In terms of research there were three main themes:

- Investigating tourism and its impacts on Coral Gardens, the main tourist destination in the park
- Baseline ecological and biodiversity data on coral reefs
- Coral recruitment experiment using settlement plates

For a new project, partnership is essential to support it in its infancy, to plug into local movements and prevent duplication of works already going on. The most important organization we collaborated with was Kenya Wildlife Service (KWS), who are the government wildlife protection

agency for the whole of Kenya and who manage WMNP. We also collaborated with Wildlife Conservation Society (WCS), Kenya Marine and Fisheries Research Institute (KMFRI) and Coral Reef Degradation in the Indian Ocean (CORDIO). A Rocha Kenya already has a good network of community relations in the Watamu area, and those relevant to marine work were strengthened. Specifically, we worked with marine stakeholders including; boat operators, tourist operators and other NGOs in the Watamu area.

2. Research

This section intends to give a brief summary of the main scientific research carried out. There were three main strands of this work and below is an explanation of their goals, methods used and some of the main findings.

2.1 Tourist study

Thousands of tourists come every year to see the beauty of Watamu's underwater world, making tourism an important aspect of the Marine Park. Not only does it help to educate an international audience on marine biology within Kenya, but it generates revenue for marine conservation and KWS. Unfortunately, many tourists unknowingly damage the reef through physical contact while they are enjoying the scenery. Whether accidently or out of curiosity, many visitors touch coral and pick it up and occasionally even decide to take their own souvenir home and remove articles from the Marine Park.

A typical day at Coral Gardens

Tourist standing on coral in Coral Gardens

The main **objectives** of the tourist study were to:

- Understand the nature of tourist boat trips and tourist behaviour at Coral Gardens
- Determine whether tourism is causing significant damage to the reef
- Document tourist opinions and perceptions of the reef and reef based tourism and their awareness of marine conservation issues.

Tourist Behaviour

The nature of boat trips was investigated by going out on a tourist boat and collected various data during the trip. The number of boats present was counted along with how long each

boat stayed at Coral Gardens, how many guests were on each boat and how long guests stayed in the water. In order to study the behaviour of tourists in the water, individual visitors were followed for ten minutes per person and the number of times they touched, trampled, held on to, and removed coral was observed.

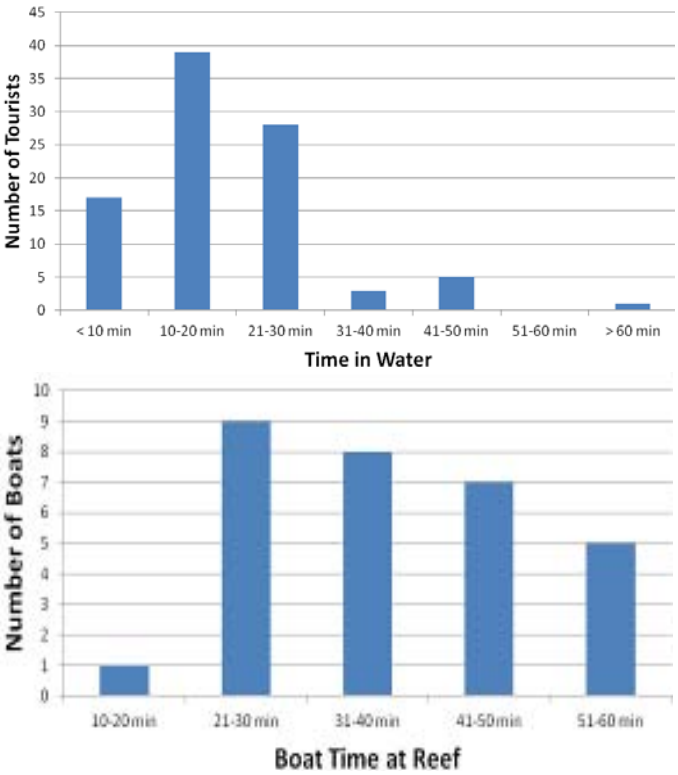


Figure 2.1. (a) Frequency of boats spending different time intervals at the reef and (b) Frequency of tourists spending different time intervals swimming in the sea.

An average of 11 boats visited the reef each day carrying on average 14 passengers meaning that, if these numbers are representative, an estimated 154 people visit the reef daily. However, caution should be taken for this number as these data were collected in high tourist season, and doesn't represent the whole year. Interestingly only three out of four people on boats got in the water, meaning that the actual number of snorkelling is estimated to be 117 per day. Boats stayed at Coral Gardens for on average 40 minutes, but their guests only stayed in the water for the relatively short time of 19 minutes (see fig. 2.1a-b).

A total of 47 people were followed in the water and their interaction with the reef was monitored. 21 (45%) of those people made physical contact with coral in some manner and one person interacted negatively with the reef on eight separate occasions by scraping it four times, trampling on it once, holding onto it once, and stirring up the sediment twice. Furthermore some people chose to sit on the reef to sunbathe and many people stood or sat on the reef to fix their fins or masks.

These results show us that a high number of boats and people visit the reef every day and a significantly high number of these people make potentially damaging contact with the reef. However did this cause significant physical damage to the reef?

Reef damage

Physical damage to the reef was investigated using *Line Intercept Transects* (LIT) of the benthic (bottom-living) flora and fauna. 'Damage quadrats' were used to look for damage and evidence of snapped, scraped, diseased, bleached or overgrown coral found in these quadrats was recorded. Both the Coral Gardens, a "snorkelled site" and areas much less visitation, "unsnorkelled sites" were surveyed with this method so as to compare between them.

Interestingly, results of the Damage quadrats didn't show any significant difference between snorkelled and unsnorkelled areas, suggesting that there is no higher damage in Coral Gardens. Evidence of damage was observed in all locations with snapped and overgrown coral (where coral has died and then been overgrown by algae) being the two types of damage most commonly seen

(Figures 2.1c-d). Coral damage is known to be caused by wave action and disease which kills and thus weakens coral as well as by direct damage by humans. In contrast to similar levels of damage, the benthic community ecology was significantly different between snorkelled and unsnorkelled sites with Coral Gardens having higher levels of turf and coralline algae present and lower levels of hard coral. These results suggest that snorkelling may be interacting with the benthic life of the reef in such a way to change the form, structure and species composition of the reef which may result in the types of coral found in Coral Gardens being less delicate. The study has shown that these methods alone are not sufficient to fully understand the levels and effect of coral damage by either humans or 'natural' causes and more research is required to understand and explain these processes.

Figure 2.1 (c) Snapped coral and (d). Coral head scraped by the bottom of a boat and then overgrown with algae where it has been killed.

Tourist Perception

To understand tourist awareness of environmental issues and perceptions of the reef, questionnaires were issued to 50 tourists over several months where they were asked what they knew about coral and snorkelling and were able to comment on their views of the reef and the service they had received from the boat operators.

Tourists interviewed came from seven different countries (Italy, England, USA, Germany, France, Canada, and Kenya) and had a diverse background in their experiences with coral reefs. Eight people were experiencing snorkelling for the first time while others had snorkelled several times in various locations around the world (Figure 2.1e), with one experienced snorkeler who had been to over 40 different reefs previously. 60% of the tourists interviewed were visiting Watamu for the first time.

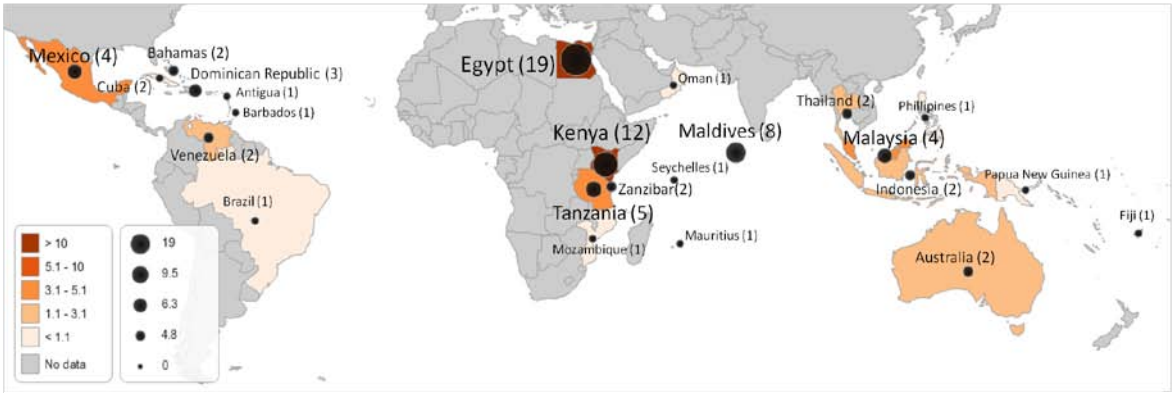


Figure 2.1e. Countries where people visited coral reefs before coming to Watamu

In terms of awareness, of all the people that were interviewed only a quarter knew that the coral reef was protected by law as a national park. This is a worrying statistic and means that information transfer about the national park to visitors is very poor. In general most people could suggest several impacts that humans might have on the reef. The most common response was pollution, although many also responded that you should not touch the coral or take anything away from the snorkelling area. Considering the high levels of contact with the reef mentioned above it appears that this knowledge doesn't translate into responsible action.

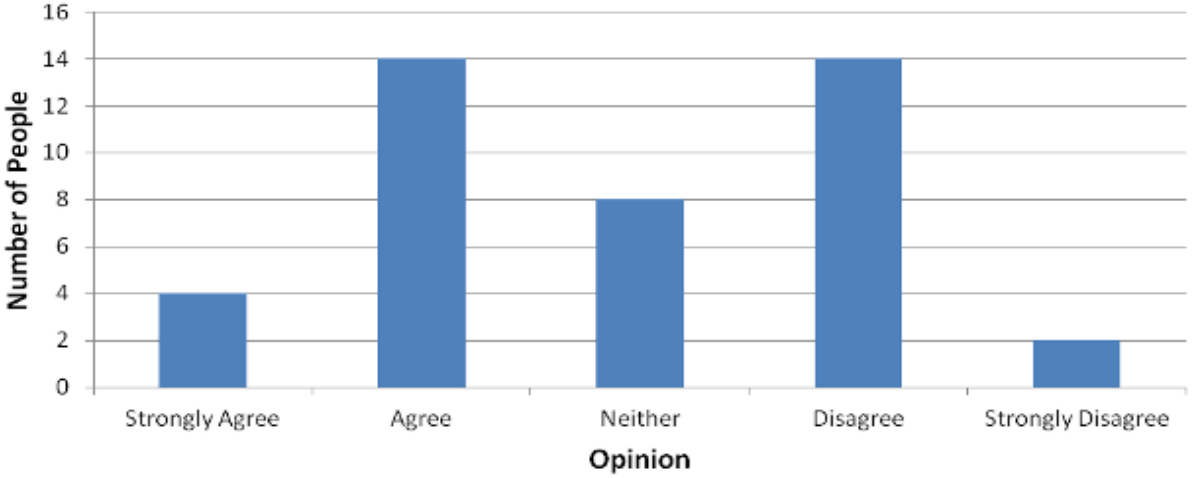


Figure 2.1f. Responses to the question: "Did Coral Gardens meet your expectations?"

Several questions were asked about tourist perceptions of the reef and when asked if they thought the reef was better than expected their answers were almost evenly divided. Fourteen people agreed and four strongly agreed and enjoyed the reef, while 14 disagreed and two strongly disagreed and did not think the reef met their expectations. Eight people were neutral (Figure 2.1f). All of the people who were disappointed with what they saw at the reef have visited reefs in other parts of the world, including the Red Sea, Fiji and Maldives. Even though these people expressed disappointment in the reef they still enjoyed some aspects of the reef because when they were asked to describe the reef using three words, several adjectives included "beautiful", "colourful", and "lively."

2.2 Baseline Biodiversity and Ecological Monitoring

Figure 2.2a. Map of baseline monitoring sites

In order to understand crucial processes and changes in coral reef habitats, which are essential for informed conservation decisions, long-term data sets are required. These data should cover a wide range of taxonomic and ecological factors in

order to establish a 'baseline' upon which comparisons can be made. KWS and other organisations have completed regular monitoring in Coral Gardens and Bennett's Reef since the late 1990's. However, there are many other areas of the park which have received less attention and other methods of data collection which haven't been used. The baseline study aimed to expand the geographical range and scope of baseline ecological data for WMNP.

Different habitats are found throughout WMNP and so research was conducted at three main coral reef sites (figure 2.2a) representing different ecological locations. The sites included: Coral Gardens – Bennett's Reef Site, a site with high tourism pressure located in the inner lagoon north of Mida Creek, Uyombo, a site with low tourism pressure that is unvisited by tourists located south of Mida Creek and Turtle Reef, a site with intermediate tourism pressure that is often visited by divers in deeper water in a gap along the reef crest.

Two types of fish surveys were conducted in the three sites. The first survey measured the **abundance** of the major fish families: surgeonfish, parrotfish, wrasse, triggerfish, angelfish, butterflyfish, sweetlips, goatfish, emperor, snapper, and puffer/box/porcupine fish. For each location fish were counted and separated by family along three transects, each 100 m long. The second survey measured the **diversity** of fish species present. Each species of fish that swam into a given area for five minutes was recorded to get the complete list of species in each site. Twenty of these five-minute observations were conducted for each site to give a complete list.

Abundance Surveys

Abundance surveys at Coral Gardens – Bennett's Reef and Uyombo sites show similar trends: Surgeonfish are the overall most abundant fish followed by wrasse and then parrotfish (Figure 2.2 b-c). Most fish tend to be small with the most frequent size range being from 10-20 cm (Figure 2.2 d-e). The majority of the surgeonfish were found in the 10-20 cm range with more surgeonfish found in Uyombo compared to Coral Gardens. Wrasse were mostly observed in the smallest size classes, <10 cm and 10-20 cm. Also, even though some of the fish families have the capacity of growing to large sizes, such as surgeonfish, snapper and sweetlips, very few in larger size classes were observed and in the case of snapper and sweetlips there were relatively few individuals in any size class.

In terms of fish diversity, 99 species of fish were identified for Coral Gardens – *Bennett's Reef* and 88 species were identified for Uyombo. In addition to these surveys a list of all fish identified for all areas of the park over the entire fieldwork period was compiled and a total of 180 species were identified from 44 families.

Figure 2.2b. Convict Surgeonfish

Figure 2.2c. Wrasse: Juvenile African Coris

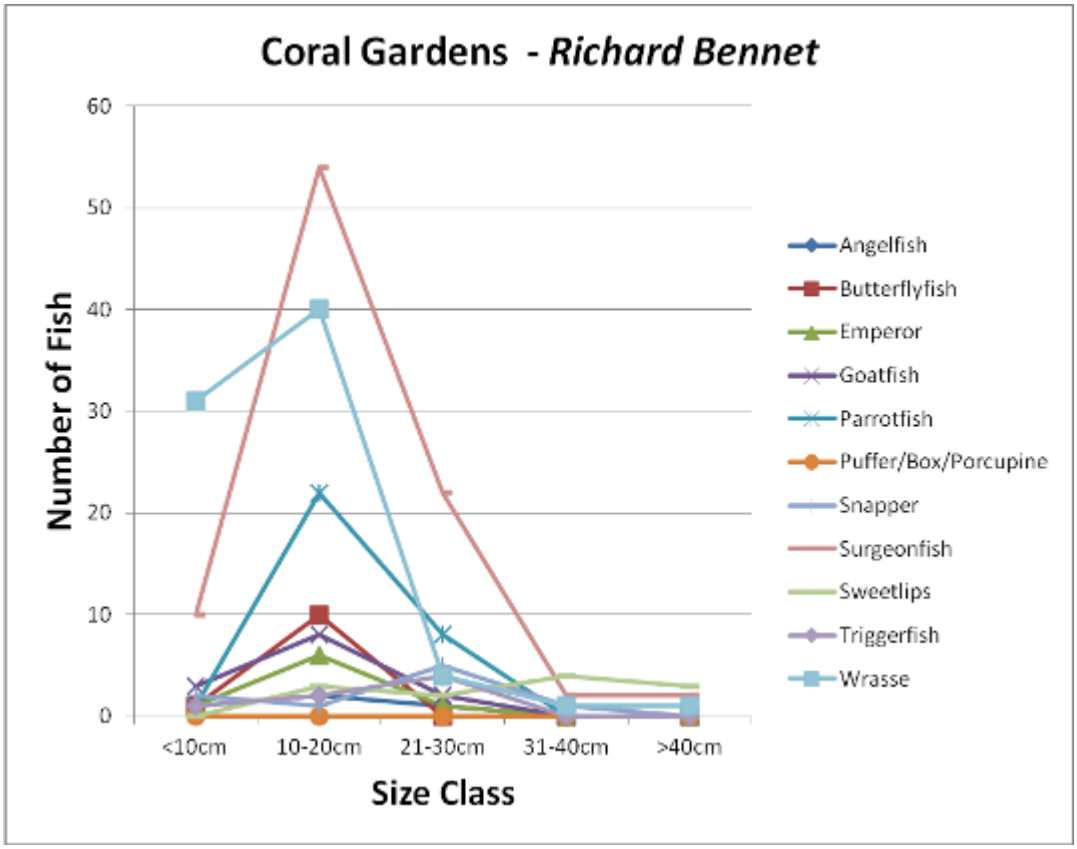


Figure 2.2d. Frequency of size classes for different fish families at Coral Gardens

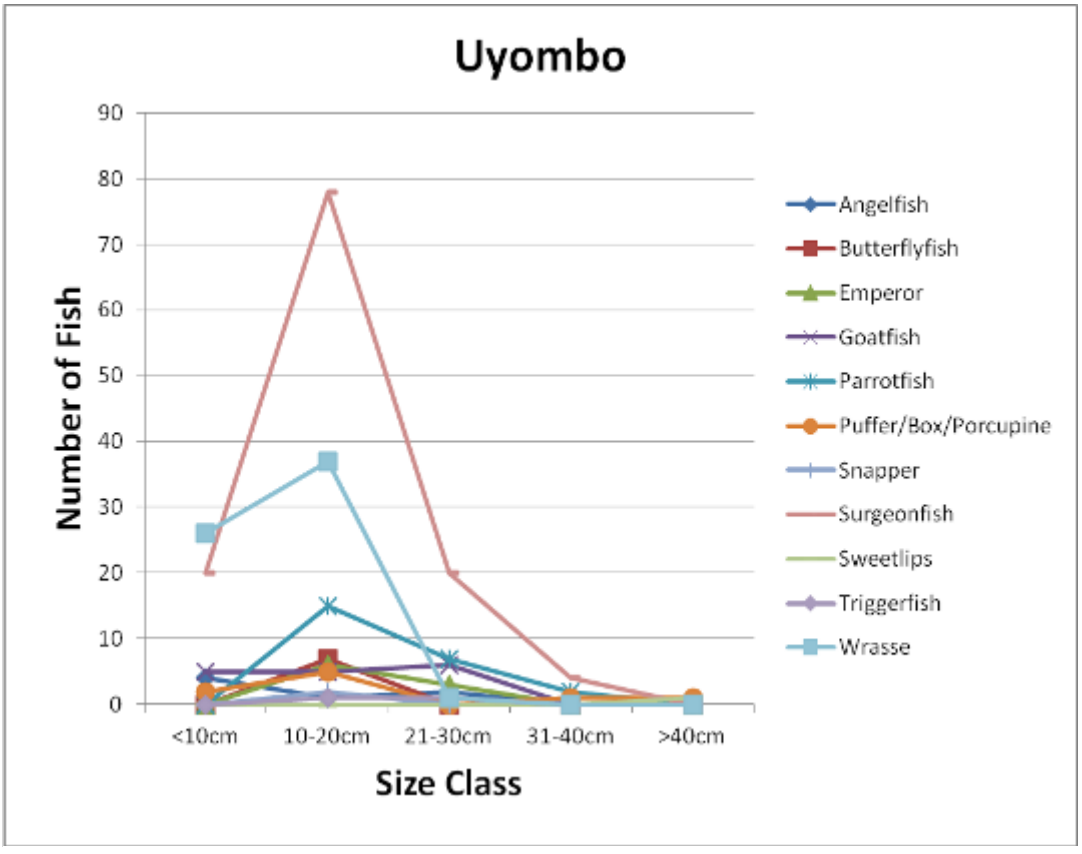


Figure 2.2e. Frequency of size classes for different fish families at Uyombo

Line Intercept Transects compared the dominant benthic coverage on the seafloor for the different study sites (Figure 2.2f). Ten 10m long transects measured how much turf algae, macro-algae, coralline algae, hard coral, soft coral, seagrass, sponge, and sand covered the bottom of the seafloor throughout Coral Gardens, Uyombo, and Turtle Reef. The genera of hard coral and macro-algae were also recorded.

The benthic coverage for Coral Gardens, Turtle Reef, and Uyombo was overall dominated by a combination of turf and macro-algae. Hard coral cover was highest in Uyombo at 31% cover and this is also where the highest diversity of coral was seen (Figure 2.2g). Across all the areas a total of 25 coral genra were recorded.

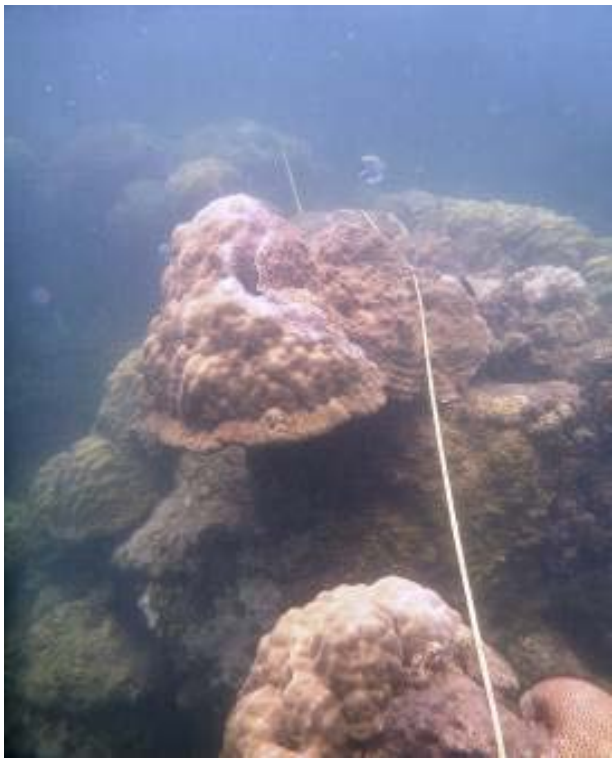


Figure 2.2f. Line intercept transect across a section of reef

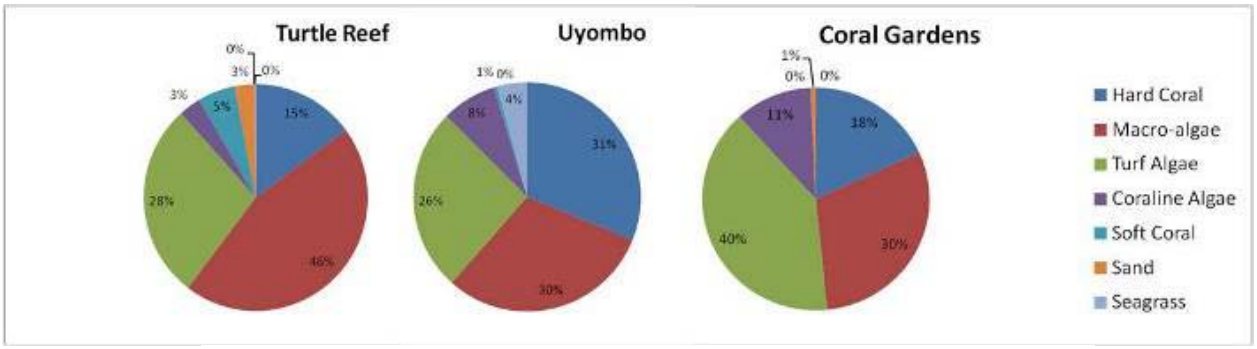


Figure 2.2g. Benthic community composition in the three sites

2.3 Coral Recruitment Experiment

The results above and general observations around the park showed that there was quite a large variation in coral cover. In order to start understanding the processes which control coral growth, coral settlement plates were placed throughout the park. Settlement plates are used to encourage juvenile corals and other benthic life to settle on the plates in order understand the process of recruitment (forming new colonies). An understanding of recruitment will allow us to understand how coral regrows after human disturbance and hopefully point to ways in which conservationists can better sustain healthy coral.

Plate 2.3a: Settlement plate on the reef

Coral settlement plates consisted of a c.20x20cm square tile of dead coral inside a plastic cage which was weighted to the reef with a concrete base (plate 2.3a). Thirty-six plates were placed in total with 12 plates in three separate locations: Coral Gardens, Uyombo, and Kanani. Coral Gardens and Uyombo represent two distinct habitats within the Marine Park while Kanani is also a unique habitat north of the Marine Park but still in the Reserve. Every plate was placed into a cage to prevent fish and other marine life from feeding on anything that settled on the plate. The plates were put in to their location in December 2011 and removed March 2012. The objective of the study was to evaluate the amount of coral recruits in each area.

After the plates were removed from the sea, the percent coverage of macro-algae, turf algae, sediment, coralline algae and coral recruits was estimated for each plate. Then the plates were later placed in bleach water so that the coral recruits can be counted and identified under a microscope.

Plate 2.3b: Plates removed from their cages after 3 months.

Thirty-five of the 36 plates were successfully collected with one plate being lost from Kanani. Sediment and turf algae were the dominant substances covering the plates and coralline algae was also noticeably present on the edges of the plates. Although microscope work is yet to be done, a casual look at the Uyombo plates showed more coral recruits compared to the plates from the other sites.

3. Collaboration

One of the core committments of A Rocha worldwide is *Cooperation*. A Rocha seeks to work closely with the local community and often in a cross-cultural setting. This project is a collaboration between A Rocha Kenya and Kenya Wildlife Service (KWS). KWS manages WMNP and provided invaluable help towards the completion of our marine studies. With every step there has been close collaboration between the two organisations, whether it's data collection or the sharing of resources and skills. Members of KWS and A Rocha Kenya worked together over the course of several months to have a successful field season and we look forward to many more.

Plate 3a: Fieldwork on KWS boat

Plate 3b: Anthony, Joy and Benjamin

As managers of the park and the arm of the government charged with administration of the park, KWS support was a legal requirement in order to complete work. From the start Assistant Director, Research – Coast, Dr. Mohamed Omar and WMNP Warden, Dickson Korir, senior management figures in Kenya's Marine Parks, approved the project as a part of their own research programme. Not only did they offer the legal support required, but they went above and beyond to accommodate us and provide support we needed throughout the fieldwork period (see more in capacity section).

An important part of the collaboration was working with a KWS intern through all aspects of the project. Anthony Maingi is a student from Moi University in Eldoret and assisted with the project for the entire six months. He became one of the team at A Rocha Kenya and an integral part of organising and completing work. Another key collaboration with KWS was assisting with the regular monitoring carried out by their research branch based in Mombasa. This aided their research with more man power and really helped A Rocha's work to see the field methods already being used, so that we could adopt these methods and contribute to national efforts.

We also worked with other national organisations including Wildlife Conservation Society (WCS) and Kenya Marine and Fisheries Research Institute (KMFRI) on their regular monitoring programmes and on the coral recruitment experiment. WCS initially gave advice and provided some of the equipment to make settlement plates. After this, 'Coral Reef Degradation in the Indian Ocean' (CORDIO), an organisation based in Mombasa but working across the entire Indian Ocean, helped with this same study by providing expertise and advice for removing plates from the water. Finally KMFRI helped us remove the plates from the water and their researcher Juliet Furaha helped with the initial analysis of the plates. The interest in this particular area of research was very encouraging and advice from many sources ensured that we had the best methods and analysis possible with limited capacity from our side.

In summary, we have endeavoured to collaborate with partners in order to assist them and aid their efforts. However, on balance we have received enormous benefits and assistance from collaborators, which have pushed the work we achieved to levels which would have been impossible alone. Not only this but great relationships and friendships were made, which provides the project with a sustainable network for future work.

4. Capacity

Capacity refers to both the physical and human resources that have been established in order to create a sustainable long-term research and conservation project that can serve Watamu and East African marine conservation efforts as a whole. Capacity can take a long time to set up, but reaps rewards for years to come.

Plate 4a: Benjamin in the improvised dive store/wet lab

In terms of physical resources we have begun to build a library of marine taxonomy and conservation books, materials, and electronic papers, which can provide basic information for any volunteers and scientists working or visiting A Rocha Kenya's centre, Mwamba. We also converted the garage into a space to properly store snorkelling equipment and research tools, such as wetsuits, snorkels and tape measures and also a place to carry out some lab work involved with research (plate 4a). However our physical capacity at this stage is quite limited and we were very grateful to KWS for their assistance with using a boat especially and other equipment, such as the loan of wetsuits and SCUBA equipment.

In terms of internal human capacity, Benjamin Cowburn is now able to carry out basic coral reef field methods independently and has a good working knowledge of the ecology of reefs. In particular he can now identify most fish groups down to species and coral down to genus level. He has also started to get to grips with speaking Swahili which is an important tool to aid with community relations and general independence to work in a range of settings from community meetings to important scientific and government liaisons. Dr Sluka has over 20 years experience working in coral reef habitats, the last 15 in the Indian Ocean. His relationships with WCS and CORDIO were helpful and he was able to help the project utilize the appropriate methodologies for the objectives. He furthermore is working with A Rocha International to develop a global marine conservation programme using the Kenyan project as a flagship project that can inspire other A Rocha National Organisations in developing their own marine projects. He is also a member of the Scientific Advisory Committee of A Rocha International.

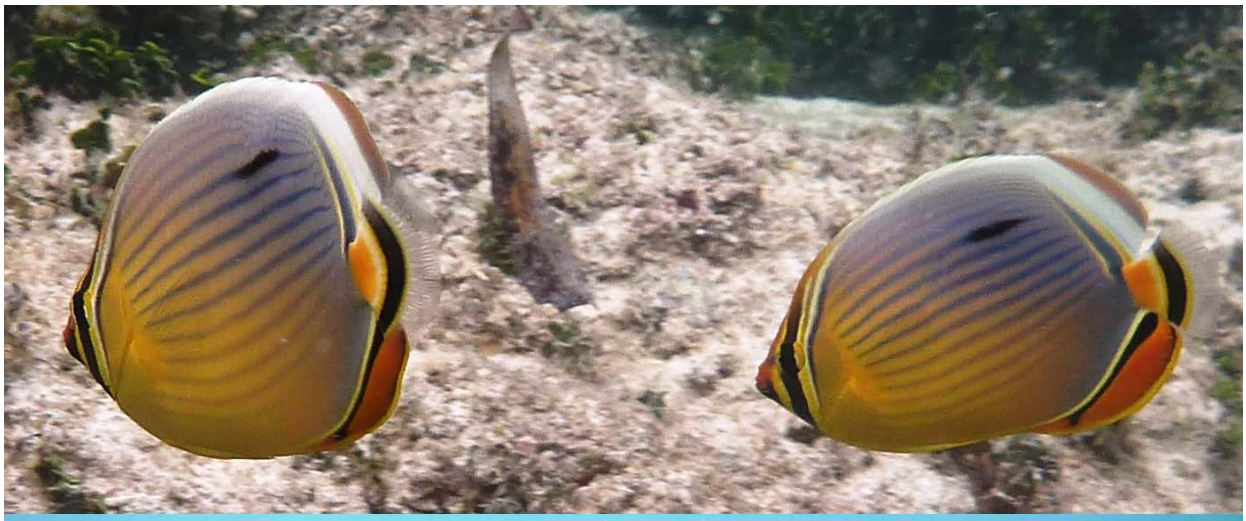
We have also been able to utilise the existing communication mechanisms within A Rocha Kenya including blogs, websites and Facebook to educate about marine conservation in general and this project in particular. This has attracted the attention of many qualified volunteers who are now applying to A Rocha Kenya's volunteer programme with a desire to join the marine project.

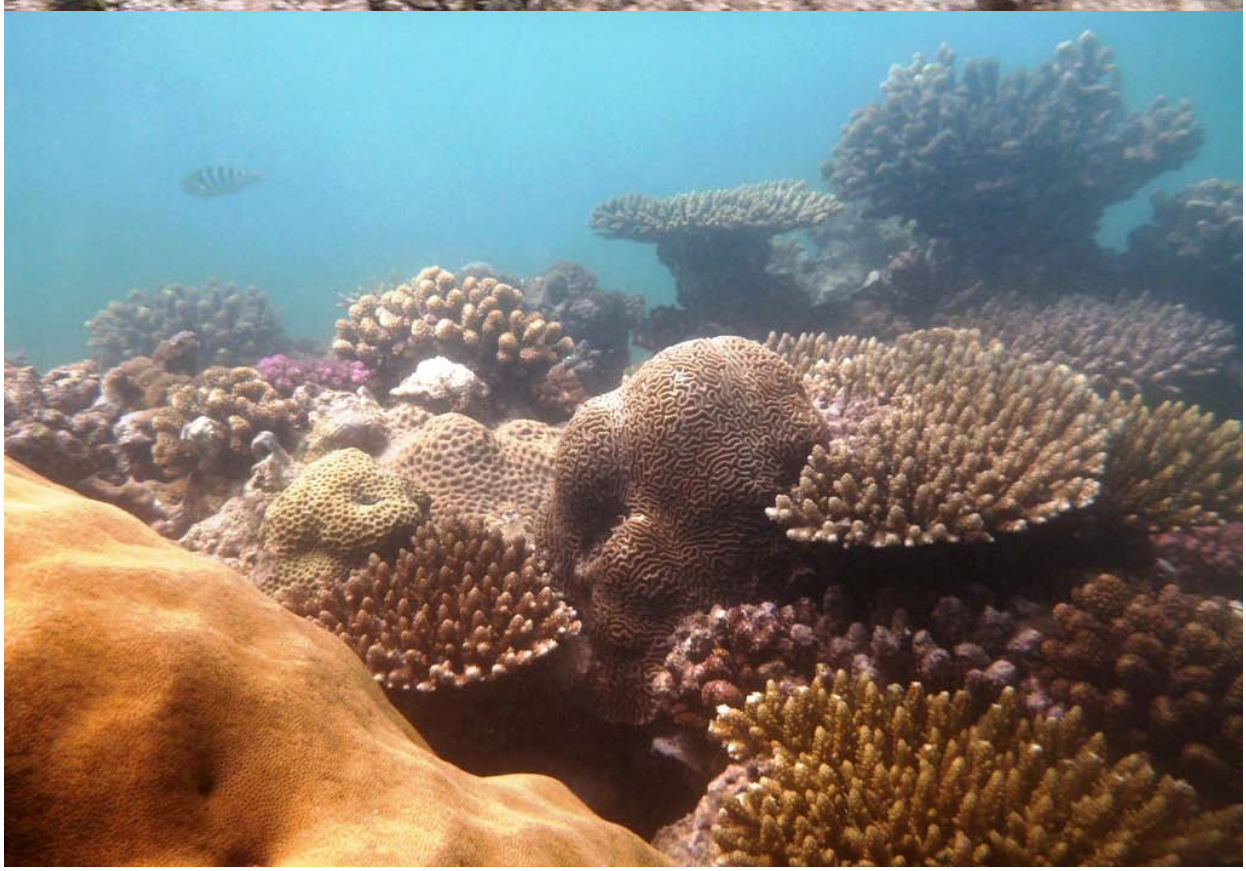
Plate 4b: KWS and community representatives at a Goat Roast organised to say thank you to all our collaborators at the end of the field season

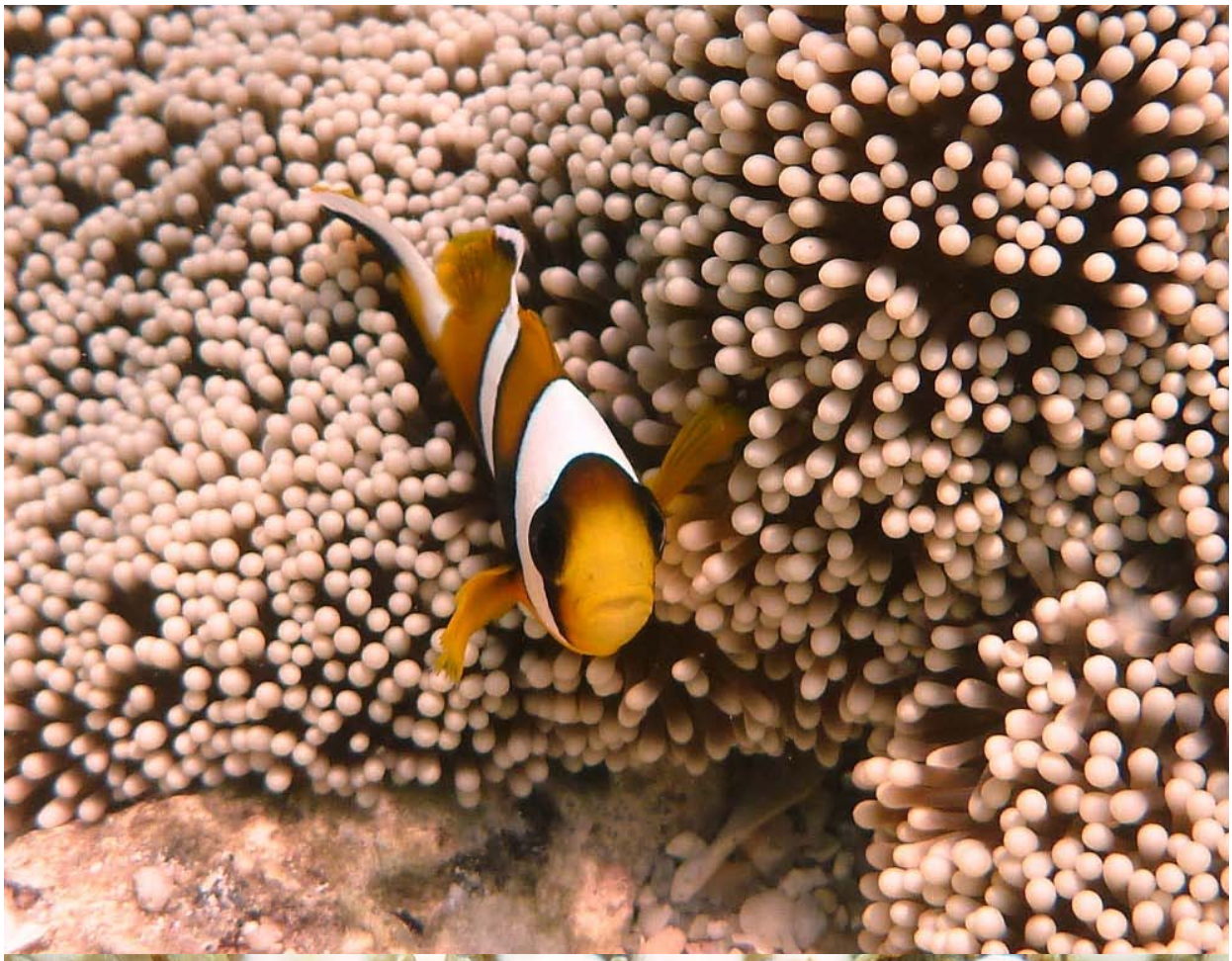
Relationships with the immediate Watamu community provide the capacity of the marine project to get approval and assistance for our work in the local setting. A key part of this was strengthening A Rocha Kenya's existing relationship with Watamu Marine Association (WMA), an umbrella organisation for all stakeholders of the marine park and reserve. Attending their regular community meetings allowed us to support existing local initiatives and build links with a wide range of people from Watamu. During this field study period the relationship with tourist boat operators as members of the Watamu Association of Boat Operators (WABO) was key for conducting questionnaires on the tourist study. Several boat captains gladly allowed us to conduct questionnaires with guests on their boats for no charge and even assisted with the translation of some questionnaires with Italian guests (who are the dominant tourist nationality in Watamu). Other friendships have been made through WMA, which have yet to reap direct benefits, but firmly place A Rocha Kenya's marine programme as an integral part of the work going on in Watamu.

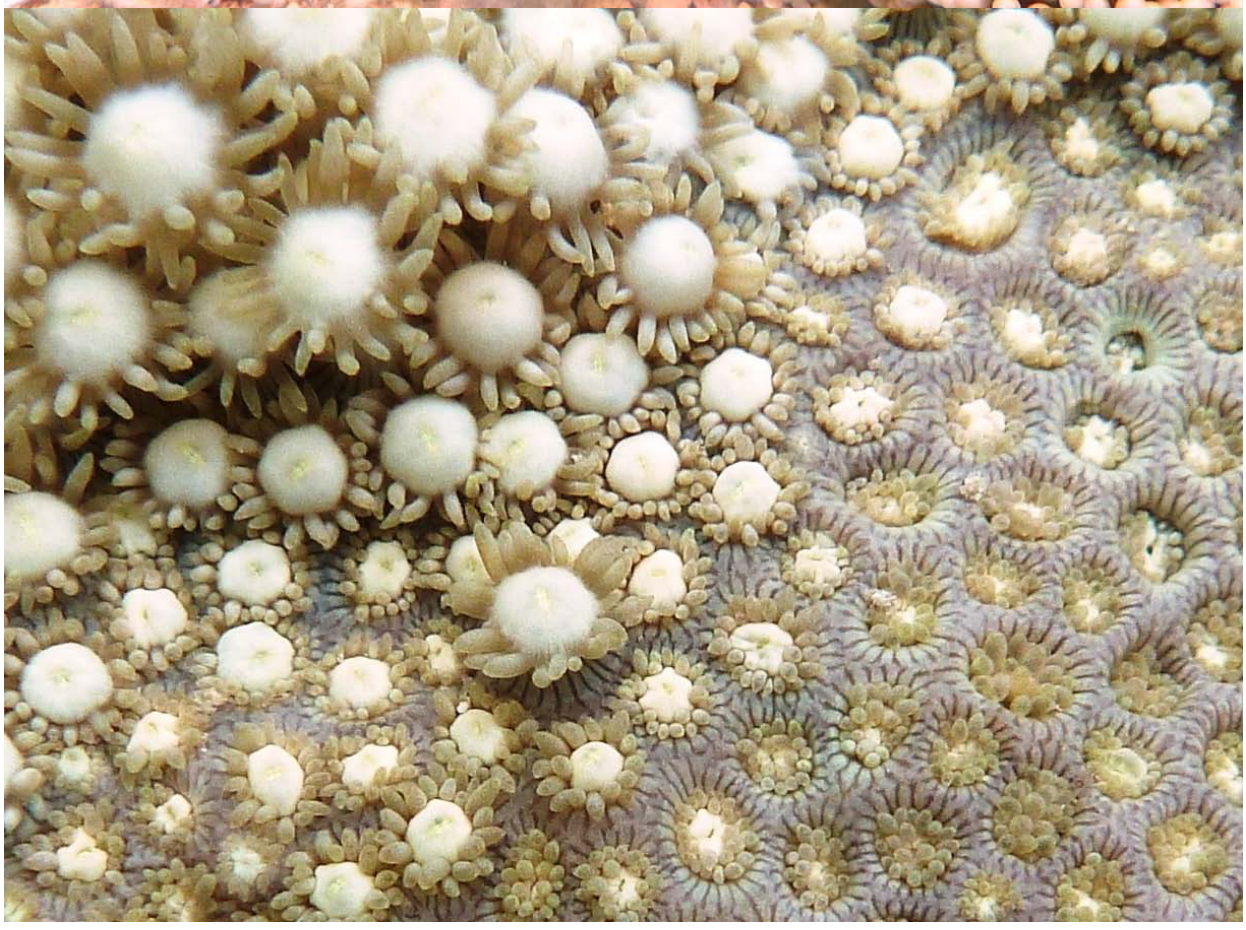
5. Photography

At the start of the project a small underwater camera was purchased for use in shallow water less than 10m, which yielded some fantastic results. Most of the photos in this report were taken using the camera and it proved to be an irreplaceable tool for photographing organisms for later identification in the office. Not only this, but the quality of the photos was such that A Rocha International have used some of the images, KWS coast department wants to produce a photo book using mostly our images and even the Warden has had the best images printed and created a 'wallpaper' on his office wall with pictures taken on the reef by our project camera! Below are a few examples of the great photography we were able to achieve.









6. The future

The most exciting part of the project to date is the opportunities for potential future work that are available. While we have achieved some good scientific research, which will help conservation efforts in the area and wider scientific community, the most important achievement is that we have built a foundation on which a range of future work can be based.

Plate 5: How will Watamu look in 10 years time?

In terms of research we would like to see the three current projects continue and expand. Baseline biodiversity studies will be expanded to more areas and more habitats as well as the current areas, including seagrass, beach, rockpool habitats and, with diving capacity, deeper coral areas as well. As well as gaining a comprehensive picture of what is in the park, we would also like to understand the main drivers of environmental damage through researching ecosystem health, human usage patterns and the processes which link these factors. The tourist study and coral recruitment study will feed into this goal and we will continue researching these factors, but there are many other areas to consider as well, including fishing pressure, sedimentation and water quality issues and the links between forest, mangrove and the reef.

In terms of future collaboration our involvement with KWS is a given, and for the next stage we want to set up a formal Memorandum of Understanding to formally cement the relationship for future years. We hope they will continue to provide us with an intern and we will have close communication about all work to ensure it is beneficial to their goals and role as park managers. We also intend to continue communication with other national marine science bodies including WCS, KMFRI and CORDIO and specifically submitting work for publication in CORDIO's regular Indian Ocean Marine reports.

For the long term sustainability of the project we need to increase our physical capacity with key resources including wetsuits, a more versatile and higher quality underwater camera for all depths and conditions, and more books in the short term future, and a boat together with the construction of a permanent wet-lab in the medium to long term future. These resources will allow A Rocha Kenya's marine programme to become a hub for visiting scientists and the first permanent marine research facility north of Mombasa in Kenya, as well as serving our own research and conservation goals. We will increase human capacity through recruiting and training a Kenyan marine biologist who will eventually lead the marine project and also by advertising for volunteers from Kenya and abroad to get work experience on the programme.

Community involvement

A final branch of the marine project's work will be community involvement. A Rocha already has a well established Community Conservation programme, with the Arabuko-Sokoke Schools and Ecotourism Scheme (ASSETS: www.assets-kenya.org) at the centre. The marine project will consider spreading this and other community initiatives into fishing villages and those areas heavily reliant on the marine ecosystem, the first stage of which will means meeting and building relationships with

elders and stakeholders in these communities. Community involvement is the only way to make lasting conservation impact and so involvement with these marine stakeholders is crucial.

7. Conclusions

The first year of data collection and collaboration has been a great success. It has highlighted the real need for marine research in the Watamu Marine National Park which can contribute directly and effectively to the management of the park by KWS. It has also strongly shown the desire from partners, both local and international, for this work to happen and that there is much room for A Rocha Kenya to play a role in this area. The results of the study to date have been confirmed by KWS to contribute to management of the park resulting in a strong, positive partnership with them and other key marine conservation players in Kenya. The project has enabled the start of capacity building at the ARK centre with key equipment obtained and raising awareness with staff with regards to what it means to do marine research.

The actual research results have clearly shown the need for change of behaviour of tourists and boat operators in the marine park, pointing the way towards implementing training and capacity building for boat operators with lower impact on the park as the goal. The biodiversity surveys have taken good steps towards understanding the place of Coral Gardens within the park ecologically and in so doing new sites have been discovered that are of real importance for coral reef conservation. These sites have not previously been studied and need proper assessment.

Overall it has highlighted the huge amount that we do not know about the marine park, and indeed the overall marine ecosystem in Watamu – and that there is a lot more to learn. With the knowledge gathered through fieldwork and collaboration with diverse stakeholders in the community, A Rocha Kenya's marine programme has firm foundations for future continuation and expansion.

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