Blue Ventures Conservation
Andavadoaka, Madagascar
Research update, Sept - Oct 2004

conservation
education
research

Blue Ventures' Madagascar research program is now entering its twelfth month of operations in Andavadoaka.

Coral Reef Monitoring

Utilising data collected on previous expeditions, permanent reef monitoring sites have been selected around Andavadoaka. These sites encompass a range of habitats and benthic assemblages, and include areas both inside and outside of the soon to be established Marine Protected Area (MPA).

Sites are located along the fringing near shore reef, on lagoonal patch reefs, and in the channels along the north and south ends of the Nosy Hao barrier island, and include thirteen sites for monitoring benthic communities and urchin abundance and ten sites for monitoring fish assemblages.

Research volunteers on site between July and August completed baseline surveys for nine of the benthic sites (79 point intercept transects / 76 urchin belts) and 4 of the 10 fish sites (41 fish belts). During the month ahead we intend to establish permanent transects at selected sites and to locate an additional three benthic and fish monitoring sites on patch reefs within the lagoon.

Fig 1. Stake fixed to reef marking location of permanent transect site used for benthic monitoring.

Figure 2 (overleaf) shows the results of benthic sampling at nine sites completed during July and August. Most sites are dominated by turf and macro-algae, but sites with varying levels of coral cover have been selected for monitoring purposes. Lagoonal patch reefs within the Recruitment complex (007, Recruitment, THB (study reefs)) show higher levels of crustose coralline algae than was found on other reefs. Crustose coralline algae (CCA) has been demonstrated to contain metamorphic inducers that promote the settlement of some species of coral larvae, particularly *Acropora* spp.. These three patch reefs are home to the richest species assemblage of *Acropora* that we are aware of in the area, perhaps partly due to the relatively high levels of CCA found there.

Figure 3 shows the results of fish assemblages at the four sites sampled during Expedition 8. Different fish assemblages were found along the sides or edges of reefs than on the tops of reefs. Fish assemblages on reef edges contained less damselfish *Pomocentridae* but relatively more snappers *Lutjanidae* and emperors *Lethrinidae*. Groupers *Serranidae* were found in small numbers across all reef areas and composed < 1% of all the fishes recorded. We are currently assembling lists of the trophic feeding levels of fishes and will be examining the trophic structure of fish assemblages across a range of habitats and reefs.

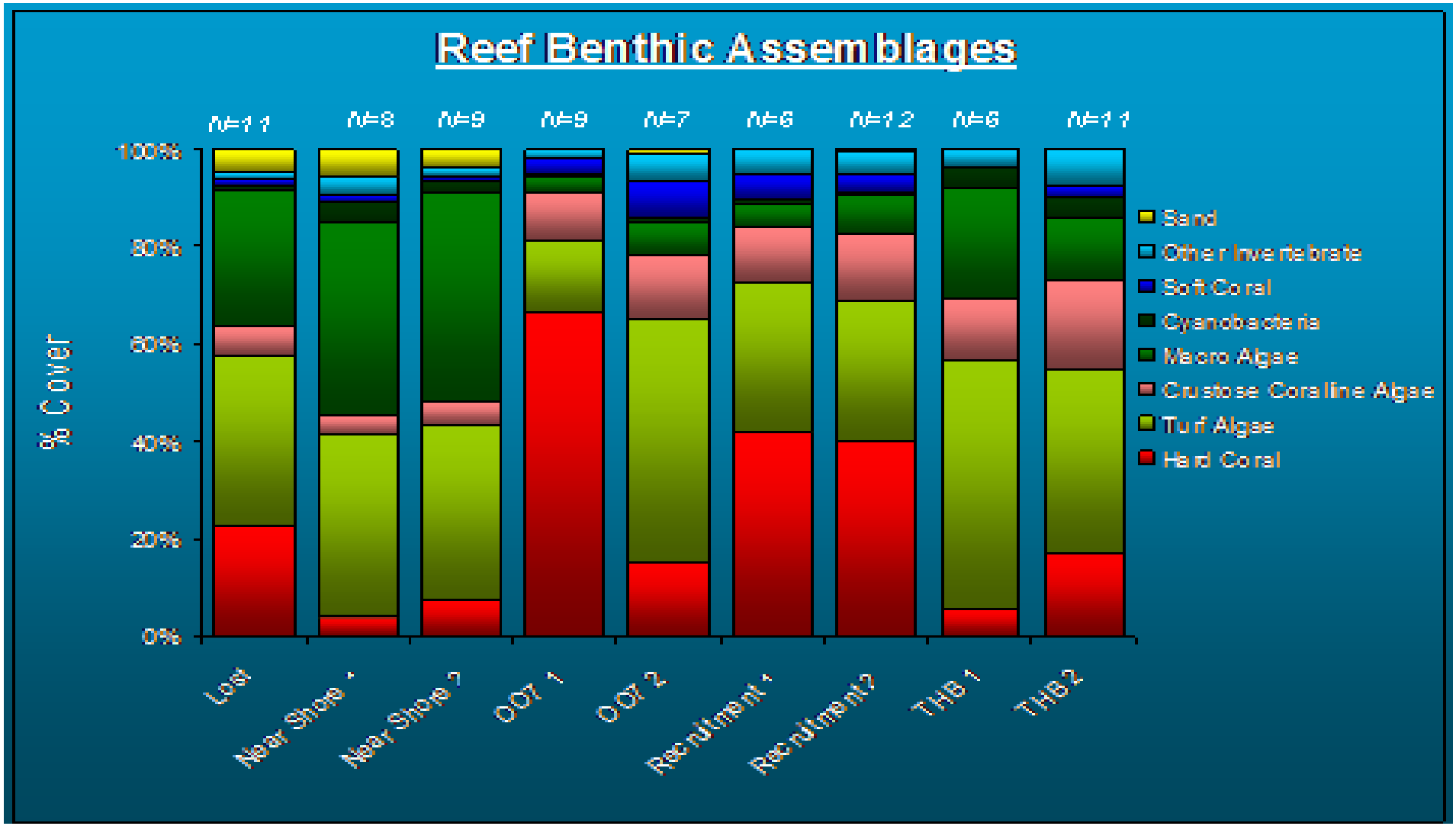

Fig 2. Graph showing reef benthic assemblages

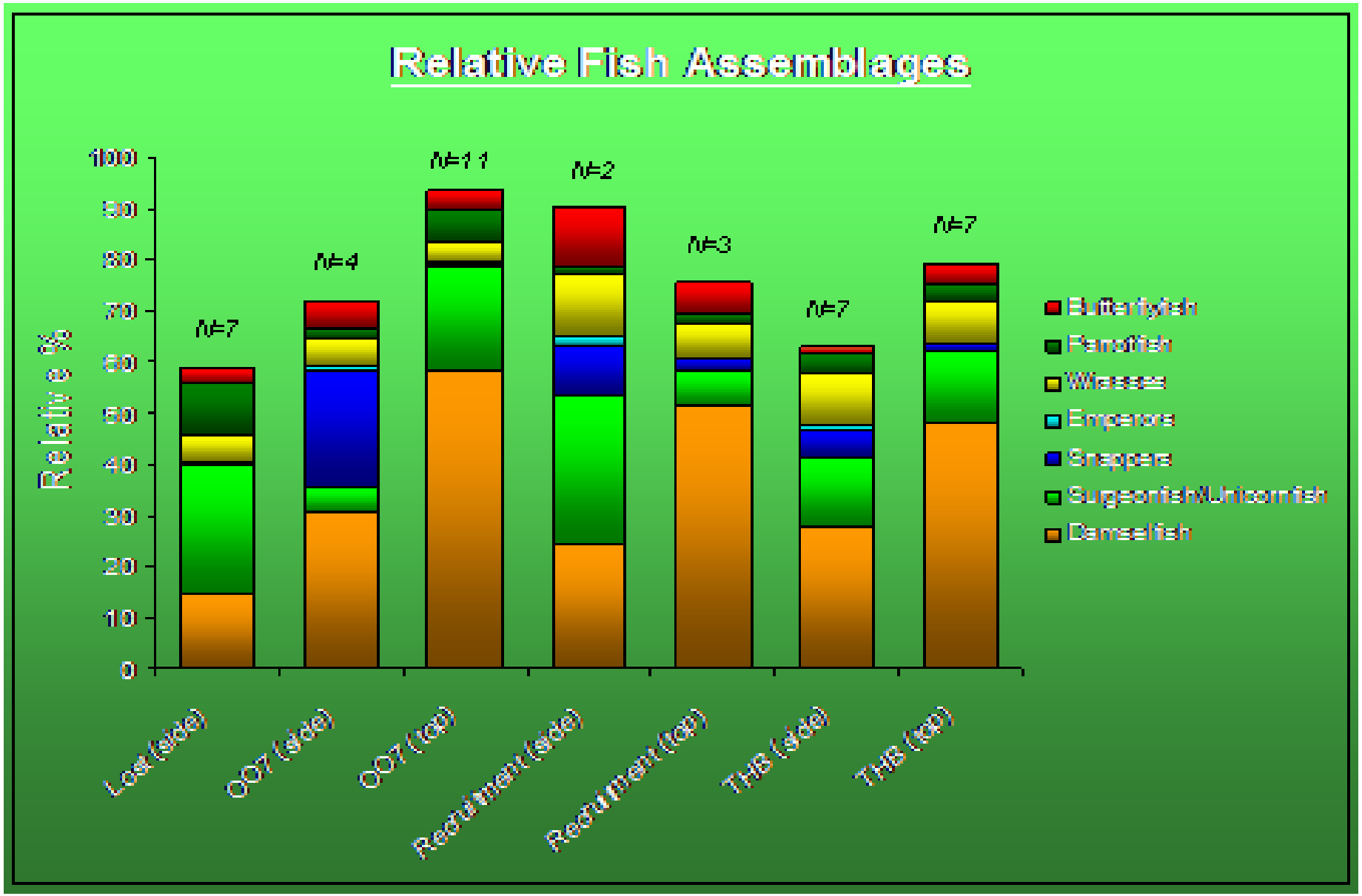

Figure 3. Graph showing relative fish assemblages

Octopus Fishery Monitoring

Roughly every fortnight, the spring tides expose the reef flats around Andavadoaka, creating ideal conditions for octopus gleaning. The reef flats around the village that are most accessible and suitable for gleaning are fished intensively. The fishing method involves the fisher walking the reef flats in search of octopus hiding in their dens. The fisher carries a large spear that is inserted into dens in order to capture the octopus. The physical probing of the reef with spears and the volume of people walking on reef flats are both destructive to the corals and other marine life.

Fig 4. Octopus fishing on the reef flat of Nosy Hao

Octopus gleaning is carried out almost exclusively by women and children and is the main source of income for the family. For this reason, octopus fishing is of immense importance to the village inhabitants. There is no discretion in the size of the octopus that are caught; fishers take whatever can be found. Consequently, a large number of juveniles are collected. A male octopus reaches sexual maturity when it reaches 300g; a female when it reaches 800g. The majority of the octopus caught is sold to a local fishing collection boat, Le Havre, which is owned by and collects fish for Copefrito, a company based out of Tulear. Copefrito buys octopus of all weights.

During Expedition 8, Blue Ventures continued to monitor the size of the octopus collected by Copefrito in order to access the sustainability of this economically important fishery. To date, our study has included data from two collection stations: one in Andavadoaka village, and one on Nosy Hao.

Due to the difficulty in determining the sex of an octopus arriving at the collection station, octopus are divided up into three size classes for analysis. The first size class are octopus weighing 800g or more - these octopus are sexually mature The second is octopus weighing 300g to 800g – these are mature if male and immature if female; the third is octopus weighing less than 300g – these octopus are definitely immature, whether male or female. Of the 2751 octopus sampled to date, 32% were definitely immature (Fig 5) and 79% were less than 800g – possibly immature. Only 21% of the sampled catch were definitely mature. These figures are alarmingly skewed towards the juvenile animals.

Breaking these data into survey periods (with each survey period representing one expedition) no significant changes in catch composition have occurred (Fig 6).

In order to more accurately monitor the octopus fishery in the region, Blue Ventures will be extending sampling of octopus catches. Rather than sampling only the octopus that come into the collection station at Andavadoaka, we intend to collect data from all of the fifteen collection stations in villages in the northern collection district of Le Havre.

Blue Ventures' local staff member Amelie Soambola will be visiting the fifteen stations in coming months to organize data collection with the sous-collectors who manage each station. Volunteers will then begin visiting the different collecting stations to assist in data collection and to experience village life outside of Andavadoaka.

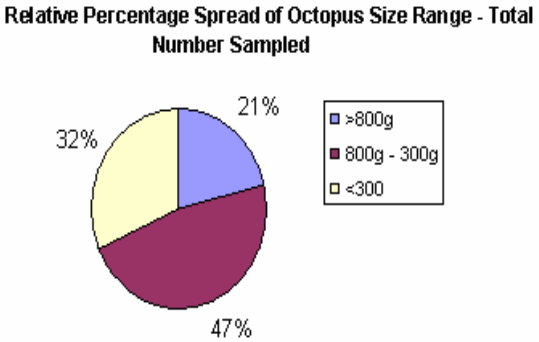

Fig 5. Relative percentage spread of octopus size range

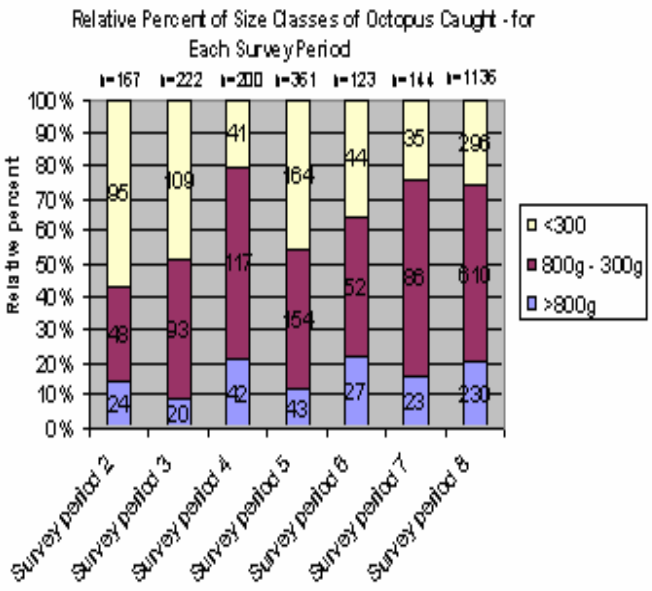

Fig 6. Relative percent of size classes of octopus caught

Fishery surveys

Effective resource management of fish stocks in the Andavadoaka area can only be achieved once the dynamics of the local fishery are understood. This can be achieved through the collection of Catch Per Unit Effort (CPUE) data, identifying the catchment area of the fishery and obtaining the size and weight of species caught and sold. Once this data has been collected, the driving economics behind the fishery must be understood - to know which species sell at the best price, the destination of these fish and the economic benefits.

These studies are conducted through Le Havre, the collection boat for Copefrito. Le Havre collects fish, lobster, crab, squid and octopus to be taken to Tulear. The fishermen of Andavadoaka and surrounding villages bring their catch directly to the boat if they have been fishing from a pirogue. Those who have been gleaning for octopus or netting for squid take their catch to the collection stations in the village.

By stationing surveyors on L'Havre, Blue Ventures is able to monitor the catch from the Andavadoaka area. This study was headed by on of Blue Ventures' local staff members Etienne Bemanaja. Blue Ventures volunteer researchers were on board Le Havre (fish collecting vessel owned by Copefrito) for 1-2 days per week during spring tide periods whilst it was moored in Andavadoaka for fisheries collection.

Here, using questionnaires, volunteers conducted research on several aspects of the fishery – what were the target species for Copefrito, their lengths and weights, prices, and the eventual destinations of the fish. Additional questions posed during these surveys included fishing locations, and catch per unit effort (CPUE) for each fisherman. Volunteers also attempted to measure each fish that came in.

Due to small sample sizes, calculation of accurate and representative CPUE fish catch summaries was not statistically possible. However, observations made by Copefrito staff aboard Le Havre reveal that fishing effort has been considerably less than in the past, with only a recorded 5-15 pirogues (local fishing boats) per day bringing in target species, a considerable decrease. The reason for this new trend is not yet understood, though could relate to the season and the weather.

This decrease in fishing effort is driving Le Havre to new areas of the coast, such as Morombe in the north, where approximately a tonne of target finfish are being collected a day from around 30 - 40 collecting pirogues. It has been suggested that in the future Le Havre will no longer collect from the Andavadoaka area but rather from the Morombe area where catches are larger.

This is bringing about a second major change in the local fishery this year, the first being the arrival of Le Havre, which changed the traditional subsistence fishery to a more commercially-driven artisanal fishery.

Now that Le Havre appears to be leaving the area, Copefrito have been constructing a permanent collection station in Andavadoaka, to be run by the "fishing co-operative" (members being the president of the village, the deputy mayor of the region and Copefrito), which when complete will be

open for collection everyday for the whole month, and not just every two weeks.

The cooperative will buy the fish directly from the fishermen and will also sell rice and fishing equipment at a reduced price. It may also sell masks and fins to aid the fishermen in guiding tourists to the snorkelling and MPA sites.

These changes could shift fishing activities for the second time in the village's recent history, from a fishery that fishes in pulses of effort around the spring tides (based on the presence/absence of Le Havre) to a fishery that fishes continually. Blue Ventures will endeavour to follow the activities of the local fishermen over this next period of change, and to refine research methodologies in order to generate more comprehensive data regarding the state of the local fishery in Andavadoaka.

Fig 7. *Copefrito* fisheries collection vessel, Le Havre

Traditional Ecological Knowledge (TEK) - Observations of fishing methods

Local fishermen and villagers in Andavadoaka have amassed decades of knowledge about reefs in the area, the fishing activities that occur at these reefs, and changes in fish stocks. This information, referred to as Traditional Ecological Knowledge (TEK), is of huge value to any project addressing the sustainability of fisheries.

Merging TEK and western knowledge of fisheries management can only improve the success of any resource management plan. For this reason, Blue Ventures aims to better understand the knowledge possessed by local fishermen about the marine environment and fisheries around Andavadoaka. Knowledge of the methods and sites used by fisherman gives us a clearer perception of how local people are using their resources.

Recent volunteers have continued TEK studies and joined local fishermen for a day, travelling out on their pirogues and participating in the day's fishing. Volunteers observed and participated in spear fishing, line fishing (Palangre) and shallow net fishing (referred to as Makarakara and Jahoto in Malagasy).

Volunteers observed line fishing of reef fish, such as emperors *Lethrinidae*, snappers *Lutjanidae*, wrasse *Labridae*, sandperches *Pinguipedidae* and blennies *Belonidae*. A third group of volunteers observed shallow net fishing, which targets smaller, commercially valuable fish such as rabbitfish *Siganidae*, emperors *Lethrinidae*, and goatfish *Mullidae*. Shallow net fishing is carried out on the nearshore fringing reef. The inside of the barrier island is used for line fishing and underwater spear fishing, and the reef flats of both the fringing and barrier reef are routinely gleaned for octopus. GPS points collected on these trips allow the fishing sites to be geographically referenced.

Volunteers also observed octopus fishing and were able to ascertain the precise method used in order to help assess the impacts of the activity on the reef flat. The method observed did not seem as destructive as was previously thought; fisherwomen insert their spear into a suspected octopus den to feel for an inhabitant. They then begin to twist their spear, forcing the octopus to wrap its tentacles around the spear. The women are then able to pull the octopus out and stab it several times. However, even if the women are not destructive with their spears (a few of them were seen to be breaking open coral rocks to get at the octopus) damage is caused by the constant trampling across reef flats.

Fig 8. Volunteers observing octopus fishing on the reef flats of Nosy Hao

Previous TEK studies by Blue Ventures volunteer researchers have included observations of deep nets with complex structure (called Jarifa and ZTZD) that target larger commercial fish, such as jacks *Carangidae* and mackerels *Scombridae*, sharks (*Carcharhinidae* and *Sphyrinidae*), and turtles (*Chelonidae*), and takes place at deeper sites outside the barrier reef.

Blue Ventures' researchers will continue to join fishermen on these excursions to observe fishing methods and collect information. We currently have knowledge of 48 fishing sites in the area, stretching from villages 10-20 km down the coast and 8-10 km out into the ocean. There are eight fishing methods used by fishermen in the area that we know of, six of which have been observed by volunteers first hand. Those not yet observed are two more variations on the net method.

Fig 9. A research volunteer participating in line fishing

Investigations into the intended destination of fish caught by fishermen of the Andavadoaka area have revealed that large fish belonging to the families *Lethrinidae, Lutjanidae, Haemulidae, Serranidae, Scombridae* and *Carangidae* are sold to the fish collection company Copefrito for export into international markets. Smaller members of the above families, as well as species in the families *Siganidae, Mullidae, Sphyraenidae, Belonidae* and some *Labridae*, are bought by Copefrito for sale in local markets. Reef fish such as *Scaridae, Acanthuridae, Pomacanthidae*, and *Chaetodontidae* are not purchased by Copefrito, so instead are sold to collectors within the village who dry the fish and resell it to villages further inland.

Open Day

A second Open Day was held at the Blue Ventures site in August, the theme of which was "Friendship". Volunteers and camp staff organised an event that was educational, musical and fun as well, building further on the good relationship between the Andavadoaka community and Blue Ventures.

Our first open day focused on demonstrating the research Blue Ventures is carrying out in Andavadoaka and the methods used. This one focused on the importance of working together and sharing knowledge and skills, to ultimately achieve sustainable resource management in the region as well as a long lasting friendship with the people of Andavadoaka village.

Fig 10. Exchanging knowledge on coral structures - and laughs!

The morning began with an exchange of knowledge - Blue Ventures researchers

hosted open tables, each table having a different selection of marine fauna, for everyone to discuss and label with both the English and Malagasy names for each organism. An extensive list was compiled to be shared by the village and Blue Ventures.

Next, a presentation was held where the village chiefs, Mr Roger and Mr Bist, introduced Blue Ventures, and Blue Ventures staff introduced themselves in semi-fluent Malagasy, much to the amusement of the villagers! After the presentation, two songs were performed by the volunteer researchers and children from the village, one in English – a reworked version of "500 miles" by the Proclaimers - and the other in Malagasy.

Fig 11. Blue Ventures research staff introducing themselves to the villagers

To round off the day, a pirogue race was held from the Blue Ventures' Half Moon" beach to the middle of the Andavadoaka village beach, with mixed teams of volunteers and local fishermen competing.

A fast and furious race soon began, with most of the pirogues neck and neck right until the end. Along the way boats collided, sank, and some ended up a bit wet, but it was clear that the clear that the event was enjoyed by all. After a short award ceremony and prize distribution the open day drew to a close in the village, with celebrations heard until the early hours of the next day, in true Vezo style!

The event demonstrated that despite the differing backgrounds between the village and Blue Ventures, differences in education, language and culture can be overcome through sharing knowledge and by working together.

Many thanks to Mike, Caz, Yaz, Carina, Anju, Jess, Charlie, Martin, Rob, Hannah, Cat, Ali, Bic John and to all the children who participated in making the day a success.....

"I will see 500 fish,
and I will see 500 more.
Just to be the one who sees 1000 fish before we eat them all!"

Language lessons

Students from Andavadoaka continued their English lessons during Expedition 8. Since school was not in session, Blue Ventures volunteer researchers gave weekly English lessons in the Blue Ventures classroom, Nosy Kao. Approximately 12-15 students participated in group lessons, and 3-4 students received individual tutoring. Blue Ventures expedition manager Richard Nimmo also began one-on-one tutoring with the chief of Andavadoaka village, Mr Roger.

Fig 12. Teaching English in the local school

The school year in Andavadoaka began on the last day of Expedition 8 and students in all classes expressed a strong desire to continue with their English lessons. Blue Ventures volunteers on Expedition 9 will visit village schools to give English lessons at least once a week.

In order to enrich their experience in Andavadoaka and expand their cultural understanding of the Vezo people, volunteer researchers during Expedition 8 received bi-weekly Malagasy lessons from Malagasy staff

scientists Amelie and Etienne. Students learned Malagasy greetings, numbers and money, body parts, family structure, and how to ask and respond to some basic questions. We are planning for Malagasy lessons to become a weekly feature on Expedition 9.

Mangrove mapping

Volunteer Researcher Carina Kalke completed a mapping project of the mangroves near Andavadoaka and began examining the species composition and distribution across the mangroves.

With the data she has collected, Carina is creating a geo-referenced map of the mangroves that delineates mangrove boundaries, high and low tide marks, and interesting topographical features. Carina found five species of mangroves in the forest and discovered that one species is being harvested for use by villagers.

Biodiversity surveys

Madagascar's coral reefs are home to an extremely diverse array of coral reef organisms. Although studied quite intensively in the late 1960's and early 1970's, the marine fauna of Madagascar remains poorly known and few specimens exist that are preserved for use in scientific studies involving molecular techniques. During Expedition 8, Blue Ventures began a more comprehensive species inventory of the marine fauna around Andavadoaka. Species lists are being generated and specimens of select taxa from reef and soft bottom habitats have been collected by hand while wading, snorkelling, or diving. The focus recently has been on fish, corals, echinoderms, and molluscs. All specimens collected are photographed *in situ* or back at our field station and then preserved for morphological and genetic analyses.

Fig 13. Research volunteers conducting P.I.T.s

Specimens will be sent to our project partner, the Florida Museum of Natural History (FLMNH), from where they will be distributed to taxonomic experts for identification and then catalogued into the museum collection for use by the scientific community. Some specimens, mainly corals, molluscs, crustaceans, and echinoderms will be used by FLMNH in ongoing research that addresses evolutionary questions such as species boundaries, broader taxonomic relationships, and gene flow around the Indo-Pacific. Results from these projects have wide-ranging applications for resource management and conservation efforts.

A voucher collection of specimens collected will be sent to L'Institut Halieutique et des Sciences Marines (IHSM) where they will be displayed in the marine museum and used for educational purposes. IHSM is the only marine institute in country and houses the most complete collection of local marine fauna in Madagascar. Among its prize possessions is one of few coelacanths (A fish only known from 65 million year old fossils yet found in 1938 alive and well) that have ever been caught in the world. While the museum collection has many interesting specimens, its collections are far from complete. Additionally, most of the collections at IHSM are dry or in formalin and thus can not be used in genetic studies.

The teaching collection of mollusc shells and corals used in Blue Ventures educational projects continues to be expanded. This collection is used to help volunteers learn some of the most commonly sited marine fauna and will be used in ecological lectures given in to local fisherman and in Andavadoaka's schools.

Fig 14. Research volunteers having a close look at the teaching collection of corals

To date our mollusc shell collection numbers over 70 species and our coral collection includes more than 86 species in 44 genera, including endemic species such as *Horastrea indica* and *Stylophora madagascarensis*. Currently, our species inventories from the area include 319 species of fish, 153 species of coral, and 65 species of other invertebrates identified from our reef and soft bottom survey sites.

Over 130 species of corals have already been documented from a series of lagoonal patch reefs in the recruitment reef complex, with many more yet to be identified. The recruitment reef complex is a unique series of reefs that are included in the newly designed Marine Protected Area initiated by Blue Ventures in Andavadoaka. As we have just begun this project, we expect our inventory of invertebrates and fishes to grow rapidly as we continue to thoroughly survey more habitat types.

Megafauna sightings

Megafauna including Cetaceans, Chelonidae, Carcharhinidae and Sphyrinidae are commercially valuable as tourist attractions as well as in international markets. Presence of these animals is, therefore, a potential source of income for coastal villages. However, these species and others, such as the Triton shell *Charonia tritonis*, are listed on the CITES endangered species list, therefore, the presence of these species is of conservation concern. Blue Ventures routinely records megafauna and CITES listed species spotted by research volunteers and staff.

This expedition has seen the first sightings of white tip reef sharks in the deep channel along the south end of Nosy Hao, the largest barrier island in the area, and at 007 reef. Both of these areas are contained within the boundaries of the soon to be established Andavadoaka Marine Protected Area (MPA). Two turtle species *Eretmochlelys imbricate* and *Chelonia mydas* have also been spotted in that same channel, along with several large *Charonia tritonis* individuals. Two more *C. tritonis* individuals were spotted at two of our other sites. Blue Ventures' volunteers and staff continue to see the Napoleon fish, *Cheilinus undulates*, with at least five individuals spotted on Expedition 8.

Marine Protected Area

In order to protect marine resources and offer opportunities for sustainable economic development through eco-tourism, Blue Ventures has initiated a collaborative effort to establish a marine protected area (MPA) in Andavadoaka. Implementation of this MPA is planned for sometime in October. Collaborators in this project include the Wildlife Conservation Society (WCS), World Wildlife Foundation (WWF), L'Institut Halieutique et des Sciences Marines (IHSM), L'Institut de Researche et Development (IRD), Coco Beach Resort (CBR), and Fonds de Solidarite Prioritaire (FSP).

Working together, IRD and Blue Ventures have developed tourist questionnaires in French and English that will be distributed at local resorts and are designed to help gain a better understanding of the types of tourists that come to Andavadoaka and their particular interests. Distribution of these questionnaires began at CBR during Expedition 8 and volunteer researchers began compiling the data into a spreadsheet for later analyses. Distribution of these questionnaires will continue at CBR and will soon begin at Laguna Blue resort and at tourist accommodations in Andavadoaka village.

Blue Ventures Malagasy scientists Etienne and Amelie have recently completed a census of Andavadoaka village. Information

they collected include: the location of all homes, shops, and other structures; the number of people in each household, their method of gaining income, their approximate age and relationship, and the type and amount of fishing equipment they own. Preliminary maps have been drawn to visually display the information, however, our ultimate aim is to have the data entered into ArcView and displayed on a GIS map. These maps will serve as a baseline for future socio-economic studies in the village.

Blue Ventures staff and volunteer Researchers continue to explore the reefs near Andavadoaka not only to gain a better understanding of the reef system and reef fauna, but also to locate an assortment of interesting diving and snorkelling sites included inside the MPA boundaries that could be used for eco-tourism activities.

Fig 15. Aerial photo of Nosy Hao showing extent of fringing reefs, which will form part of the MPA

Exploratory dives during Expedition 8 led to the discovery of two magnificent sites in the channel south of Nosy Hao that have been named Shark Alley and Yellow Brick Road. Shark Alley is a dive that follows the sloping channel edge of the reef and was rightly named such as the first volunteer dive at the sight resulted in a sighting of a white-tip shark *Triaenodon obesus*, the first seen by Blue Ventures divers in Andavadoaka.
Yellow Brick Road is a dive that explores the well-developed spur-and-groove system off the south-west side of the Nosy Hao reef flat. Sand-lined channels begin around 16 m depth on a flatter terrace area and continue up into narrow spur-and-groove formations that are 6-8m in height and covered in a wide diversity of hard and soft corals as well as gorgonians. Several sightings of the turtles *Eretmochlelys imbricate* and *Chelonia mydas* have occurred on exploratory dives at these two sites.

Aquaculture

Blue Ventures is continually looking to create alternative opportunities for sustainable economic development in local villages. One such potential opportunity is aquaculture, specifically the cultivation of red algae in the genus *Eucheuma*. *Eucheuma* spp. These algae have commercial value because of the high amounts of carrageen they produce and are currently “farmed” at many locations in the Pacific Islands, Eastern Africa, and Madagascar. Its cultivation is simple and requires few materials - mainly just rope, floats, and seed stock.

In collaboration with the local fisherman’s cooperative, Blue Ventures has begun designing a pilot project in Andavadoaka to determine the feasibility of cultivation in the immediate area. The site for the pilot project has been located and the necessary start-up materials have been purchased by the local fishing cooperative.

A meeting will be held with village elders and cooperative members this month to, among other things, locate up to five families in the village who would be ideal candidates for the trial project. The pilot project is set to commence at the beginning of October.

Blue Ventures staff and volunteers will be involved in monitoring the daily growth rates of the algae and will also collect temperature data from the test site to better determine during which months of the year algal cultivation is feasible and most productive.

Pirogue guide training

One of Blue Ventures’ objectives in establishing a MPA in Andavadoaka is to create opportunities for sustainable economic development through eco-tourism. By creating opportunities to gain income apart from fishing, Blue Ventures hopes to promote the conservation of marine fauna by

reducing fishing pressure in the immediate area; a reduction in fishing pressure is likely to cause a cascade of positive effects on the ecosystem.

An obvious and feasible economic opportunity is for villagers to accompany tourists as guides as they discover the natural world around Andavadoaka and in the MPA. Considering the resources currently available in the village, one of the easiest and most logical starting points is to train and organise local fisherman to serve as pirogue guides.

Fig 16. A traditional pirogue used by fishermen in Andavadoaka

Blue Ventures Vazaha and Malagasy staff are starting to organize a series of training sessions geared at helping interested fisherman understand the desires and demands of tourists and how to best cater to the clientele they are likely to receive.

We hope that training sessions for pirogue guides will begin by early October and lead to an interest in villagers desiring to be trained as guides for snorkelling and nature excursions.