Tikina Naviti Conservation Initiative

Marine habitats broad-scale survey report

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ACKNOWLEDGEMENT

TNCI and LäjeRotuma wish to thank the operators of Botaira, Barefoot and Manta Ray Island Resort for the logistical support in hosting and diving assistance during the period of marine broad-scale surveys for Naviti cluster of islands. A special thank you to the community reps who committed their time and local knowledge to ensure that the profiling of its marine resource base were completed.

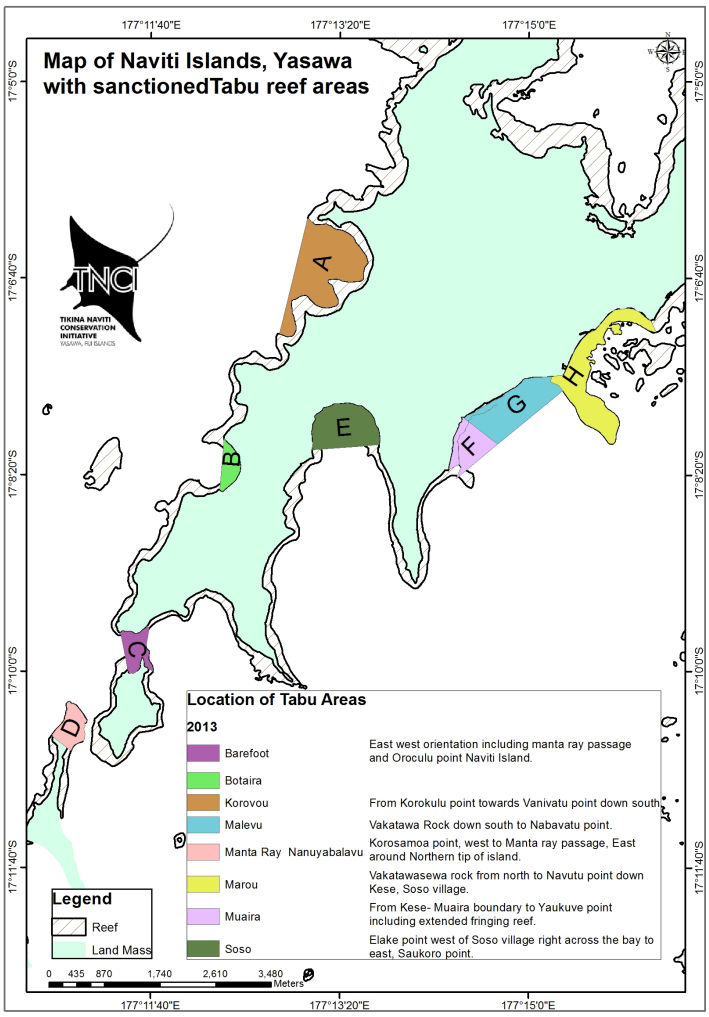
The production of maps were kindly provided by the PAC Secretariat, National Trust of Fiji. The majority of photographs in the report are owned by Mandy, Marine Biologist at Barefoot Island.

Contributions made to this report were by Mandy Carse from Barefoot Island and report drafted by Monifa Fiu of LäjeRotuma.

Soso coastline

LIST OF ABBREVIATIONS

GPS	Global Positioning System
GEF	Global Environment Facility
ID	Identification
LRI	LäjeRotuma Initiative
MPA	Marine Protected Area
PAC	Protected Area Committee
SGP	Small Grants Programme
TNCI	Tikina Naviti Conservation Initiative



The map figure above show listed sanctioned *tabu* areas of mainly fringing or submerged patch reefs situated adjacent to villages, except for the 'house reefs' fringing Botaira, Manta Ray and Barefoot resorts permanently protected from fishing except for snorkeling by its guests.

REPORT AT A GLANCE

This survey activity and report was commissioned under the GEF SGP funded community based project and supported by resort operators Botaira, Manta Ray Island and Barefoot Lodge. The marine ecological broad-scale surveys of surrounding reefs and coastal habitats of Naviti Island exhibited a nursery rich of coral diversity hosting marine life. This baseline report allows for a 'before' idea of management describing the status of these key marine habitat types based on health indicator species of fish, benthic life forms for the varied reef zones and seagrass areas. A healthy marine ecosystem by standard, yet at risk of commercial exploitation with being so close to mainland centres whilst posed to be influenced from land-based effects during extreme flooding events of the western division.

Such ecological baseline information contributes to the knowledge base of resources on Naviti, hence inform ongoing community-led integrative processes to establish protection and management strategies. Such an initiative paves direction for improved resource management amongst village communities and resort operators along the tourism corridor in Yasawa group of islands.

Trained community group and dive team posed for a picture on Botaira.

I. BACKGROUND: NAVITI ISLAND

In this Fijian context, the term "tabu" encapsulates the protection and nurturing values of the reef thus insuring a life-support system for a community, whilst adding value to the Yasawa corridor brand of tourism. This partnership between the two island communities began five years ago when LäjeRotuma (LRI) a community-based environmental Initiative was invited by TNCI, a relative Tikina Naviti Conservation Initiative, to conduct environmental and climate change education awareness outreach with the villagers of Kese and Soso. Content was based on the nexus of a changing climate and how better to adapt to these changes by protective management of island resources as an integral part of culture, inseparable from ethical and aesthetic values or from current socio-economic reality (refer to Figure 1 for a history of project activities). Resort operators of Botaira, Manta Ray and Barefoot were in partnership with the umbrella initiative TNCI established a tabu system with its surrounding reefs crucial to sustaining environmental and local food security.

During the week of 3rd until 9th of March, LäjeRotuma travelled to Naviti to facilitate a basic survey skills training and be engaged in the first community-based broad-scale ecological survey of surrounding reefs and marine notable areas. The 4-day island program was supported by an ongoing TNCI- GEF Small Grants Program in collaboration with resorts Botaira, Barefoot and Manta Ray. This program ensured that 11 villagers were trained in basic reef and seagrass survey skills.

Climate risk profile: Yasawa region, Western Division.

Tropical cyclones are one of the most severe extreme events that have affected Fiji on numerous occasions in the past 4 decades. Cyclone seasons usually affect Fiji from November to April period however, tropical cyclones have also occurred in October and May. On average, 1 to 2 cyclones affect some part of Fiji every season and with the greatest risk during El Niño season. There have been seasons when Fiji has had no cyclones and some seasons with a maximum of 5 tropical cyclones, as in the 1992/93 season and 4 in the 1984/85 season. A decreasing trend in both the number of tropical cyclones and cyclones with hurricane intensity affecting Fiji has been observed in the last 4 decades (Table 1).

Major droughts (meteorological) in Fiji have been associated with El Niño events. During moderate to strong El Nino events, the annual rainfall is reduced to as much as 20-50% over most parts of Fiji as experienced during the 1982/83, 1986/87, 1992/93 and 1997/98 events.

Large-scale flooding in Fiji is mostly associated with prolonged heavy rainfall during the passage of a tropical cyclone, tropical depression and/or enhanced, slow moving convergence zone. Localised flash flooding during the wet season (November to April) is quite common. Sea flooding is usually associated with the passage of tropical cyclones close to the coast. However, heavy swells, generated by deep depressions and/or intense high pressure systems some distance away from Fiji have also caused flooding to low-lying coastal areas. At times, heavy swells coincide with king tides to cause flooding and damage to coastal areas.

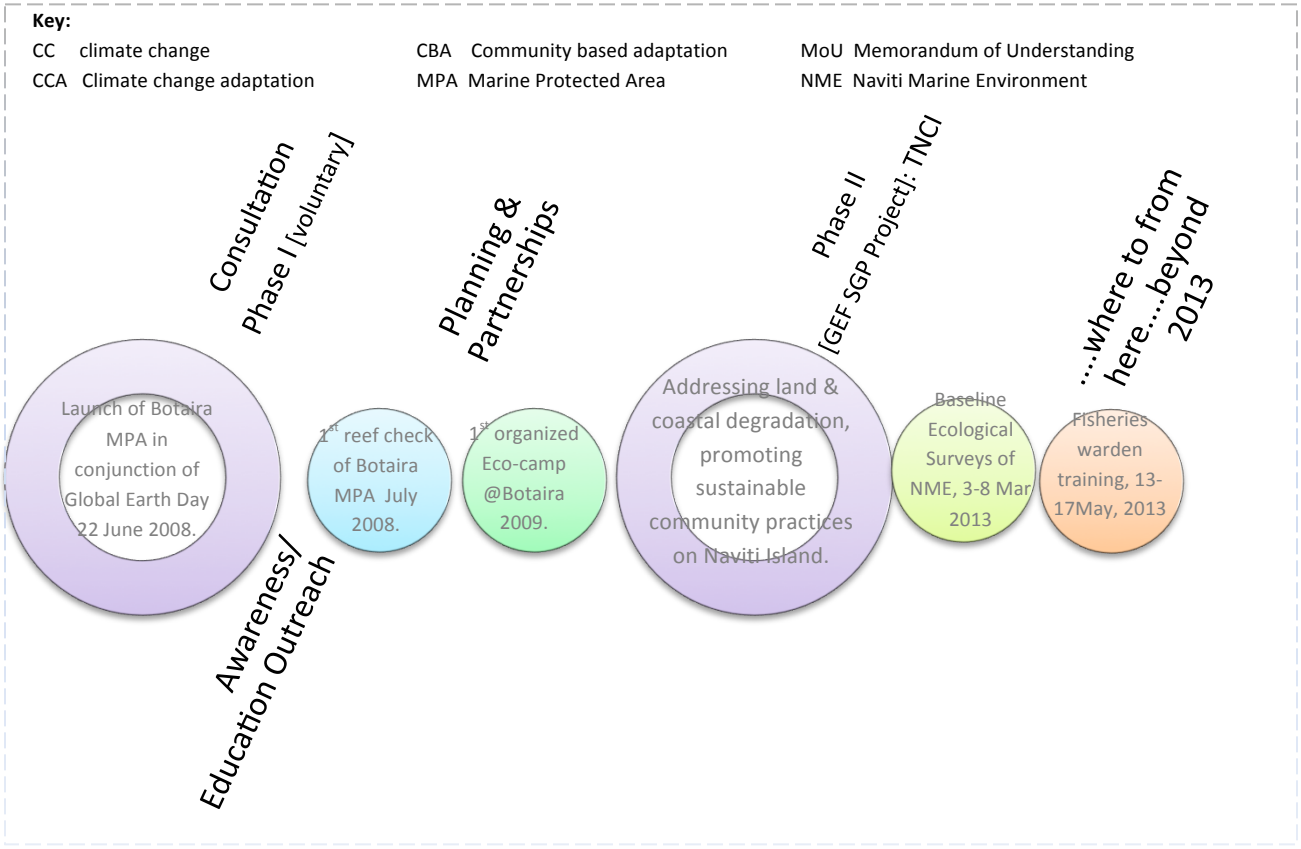


Figure 1. Pathway of TNCI's engagement on Naviti since 2008 to present:

Outputs:

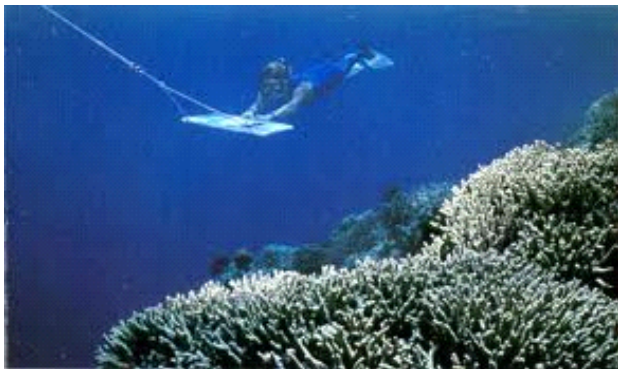
- NME CC Action Plan 2010-2015
- MoU between TNCI and LRI, June 2010
- CC community-MPA awareness & Adaptive Management Planning, 5-6 Nov 2010
- Kese 3-Year Action Plan 2011-2013
- Soso 3-Year Action Plan 2011-2013
- Annual Eco-Camp 2010 at Soso
- Annual Eco-Camp 2011 at Kese
- CBA approaches: mangrove replanting, seagrass watch, nursery, organic gardens for food security.
- Forging partnerships & ownership amongst operators (Botaira, Manta Ray Is. Resort, Korovou, White sandy beach & Barefoot Lodge) and 8 village communities.

Table 1. Climate Trends in Fiji over 1961 to 2010 period (source: Fiji Meteorological Services, 2011)

Climatic Variable	**Observed Trends**
Rainfall	• Very weak positive linear trend in annual rainfall over Fiji. An annual increase of approximately 0.65mm/year (approximately 0.03%/year) is observed from 1961 to 2010 period; • A weak decreasing linear trend in the wet season rainfall with a seasonal decrease of 1.30mm/season (approximately 0.08%/year); • A weak increasing linear trend in dry season rainfall with a seasonal increase of about 0.76mm/season (approximately 0.11%/year).
Maximum Air Temperature	• The average annual maximum air temperature has increased by 1.1˚C in the last 50 years; • The average warm season maximum temperature has increased by 1.2˚C from 1961 to 2010 period; • The average cool season maximum temperature has increased by 1.0˚C over the same period.
Maximum Air Temperature	• Increasing trend in average annual minimum temperature over Fiji. The annual minimum temperature has increased by 0.6˚C over the 1961 to 2010 period; • Increasing trend in average warm season minimum air temperature and has increased by 0.7˚C in the same period; • The cool season minimum air temperature has increased by 0.6˚C over the 1961 to 2010 period.
Sea Surface Temperature	• The sea surface temperature from Lautoka Tidal Gauge indicates a warming trend of 0.05˚C/year over the 1993 to 2010 period (the Tide Gauge data is too short to deduce any conclusive long term trend).
Mean Sea Level	• The mean sea level at the Lautoka Tide Gauge is changing at a rate of 4.6mm/year over the 1993 to 2010 period (the Tide Gauge data is too short to deduce any conclusive long term trend).

A maritime region like the Yasawa group of islands are highly vulnerable to any extreme climate variability effects such as prolonged dry (less rainfall) periods or stormy seas. There is heavy reliance on the surrounding seas for mobility amongst the group of islands, access for fishing for subsistence or its sale of marine products. Most importantly, this sub-region is premier tourist destination and totally reliant on the product of white sand beaches, sun and sea.

II. SURVEY METHODOLOGY


Snorkeler holding onto manta board whilst being tow.

Manta tows were first done during the first three days to provide a quick assessment of the fringing reef system around Naviti Island before the survey dives began at pre-selected sites. Procedures followed standard manta tow protocol detailed in 'Survey Manual for Tropical Marine Resources (English et al., 1997). The trained community team observed and recorded according to three categories i.e hard coral, soft coral or dead coral and cover estimations recorded during the manta tows. Coral cover estimations were converted into a score of five-point scale, 1: 0-10% cover, 2: 11-30% cover, 3: 31- 50% cover, 4: 51-75% cover, 5: 76-100% cover and averaged for each tow area (eg. MT OT1). Start and end position of each tow were recorded using a Garmin GPS unit.

Sites selection was done on the basis of:

- Existing *tabu* reef areas either demarcated by Botaira, Manta Ray resorts and Barefoot lodge or sanctioned by the villages of Kese and Soso;
- Local knowledge of good fishing spots known for fish foraging, spawning aggregations;
- Inner shallow reef areas adjacent to villages, nesting beaches and seagrass growth.

The marine reefal environment is zoned into four reef complexes based on general reef habitat types and assumed environmental conditions.

Table 2. Definition of reef zones:

Fringing reef **-** separated from reef flat by deep lagoon, characterised by terrestrial influence and its proximity to creek mouths/freshwater outlets.

reef *channel/passage* **-** break in the hard matrix of barrier reef allow flushing of water/current or passage of water between two islands eg. Manta ray passage.

Outer barrier reef slope **-** characterised by a gradually sloping reef and exposed to oceanic waves.

Inner barrier reef slope - landward reef slope (IB) is usually a gradual reef slope to a sandy bottom at a depth on the lagoon side.

Reef flat of barrier reef - characterised by a rubble strewn area behind the reef cress to sand dominated flats and patch reefs headed towards shore.

Seagrass meadows - where patches of significant seagrass growth.

Coral reef surveys were conducted using SCUBA diving gear by a team of 4 divers during the week. Methods were adapted from the Reef Check methodology protocol for which five types of data were accounted during each transect survey dive as listed below:

Survey equipment list:

1. Manta tow board + 17m (10mm) rope
2. Harness rope to attach to rear of boat
3. Refractometer & GPS Garmin Unit
4. Slatesx3 to attach recording sheet
5. Pencil per clipboards
6. String for pencil to slate board
7. 4x 50m measure tapes
8. Underwater record sheets : Site description/ fish/ invertebrate/ benthic substrate
9. Reference books: Fish, seashells, marine algae, invertebrates
10. First aid kit + bottles of water.

Dive equipment provided by partners with Manta Ray divers & Reef Safari.

VIII. A site description was completed that had data on anecdotal, observational historical on the location of the reef region/island;

IX. 1st diver placed a 50m line transect on the reef to count fish of commercial value and targeted by the local fishing community. 2nd diver assigned to count fish, swam slowly along the transect tape and stopped every 5m for 3 minutes allowing target fish to come out of hiding before moving to the next 5m stop;

X. 1st diver assigned to lay the tape returns to start of tape to count invertebrates found along a 5m wide belt along the 50m long transects. Invertebrate taxa that was usually collected as food or curios for trade;

XI. Any signs of coral bleaching or disease (discoloration of live coral or white coral skeleton covered with algae);

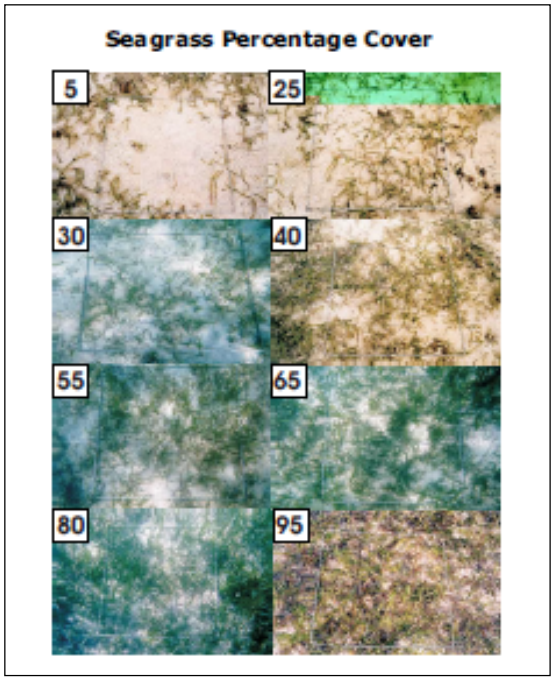
XII. 3rd diver recorded substratum types and benthic community of the reef along the same 50m transect which was point sampled at 0.5m intervals. Standard Reef Check protocol specifies that the categories recorded under each 50cm point are: hard coral, soft coral, recently killed coral, dead coral, fleshy seaweed, sponge, rock, rubble, sand, silt / clay and 'other'. Additional categories recorded hard corals to life form level (along with target species), soft corals and categories of algal cover (mixed assemblage, coralline, *Halimeda*, 'macro' and 'turf ') into non-coral benthos, abiotic categories included the non-living part of the reef surveyed. Finally, the substratum surveyors recorded coral damage from anchors, dynamite, or 'other' factors and trash from fishing nets or 'other'. Divers rated the damage caused by each factor using a 0-3 scale (0 = none, 1 = low, 2 = medium, 3 = high). All data were transferred to specially-designed recording forms (Appendices).

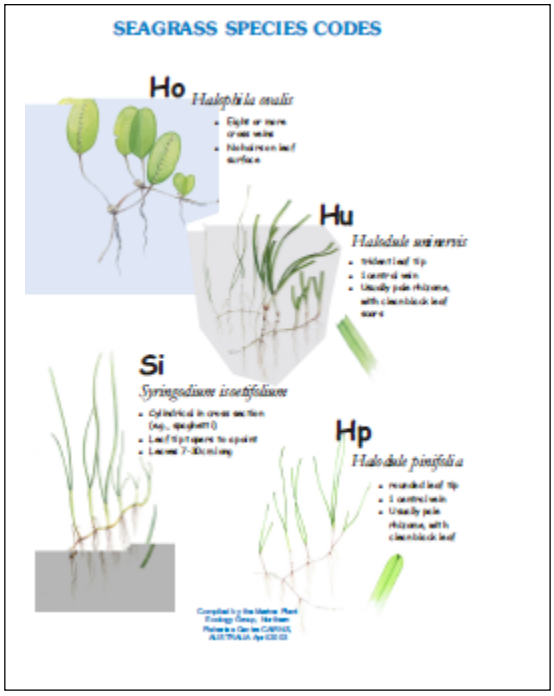
Survey diver in action.

Field equipment: Seagrass watch Kit includes 4x0.25m^2 quadrat
Seagrass ID guide
Data sheets
50m measure tape
30cm ruler to measure seagrass blade length
Magnetic compass

Seagrass watch surveys to characterize the habitat involved visual estimates of above-ground biomass percentage cover using a 0.25m^2 quadrat. Techniques were adopted from Seagrass-Watch: Manual for Mapping & Monitoring Seagrass Resources by Community Volunteers. (2nd Edition. Department of Primary Industries, Queensland, Northern Fisheries Centre. April 2003). Within a seagrass area, 3x50m transects were laid out parallel to each other, at least 25m apart and perpendicular to shore. For every, 5m mark along the 50m tape, a quadrat was placed for sampling according to the following steps:

- ✓ Step 1- describe the sediment composition by feeling the texture of sediment from the top centimeter of the substrate. Note the grain size in order of dominance e.g. sand, fine sand, mud.
- ✓ Step 2-estimate seagrass percent cover within the quadrat-use the percent cover photo standards as a guide (as shown in top key).
- ✓ Step 3-estimate seagrass species composition by identifying each species of seagrass within the quadrat and determine the percent contribution of each species to the cover (must total 100%). Use seagrass species identification keys provided (as shown in bottom key).
- ✓ Step 4- measure canopy height, ignoring the tallest 20% of leaves. A 30cm ruler was used to measure from the sediment to the leaf tip of at least 3-5 shoots.
- ✓ Step 5- Estimate algae percent cover in the quadrat. Algae are seaweeds that may cover or overlie the seagrass blades. Use "Algal percent cover photo guide".
- ✓ Step 6- Estimate epiphyte percent cover. Epiphytes are algae attached to seagrass blades and often give the blade a furry appearance. First estimate how much of the blade surface is covered, and then how many of the blades in the quadrat are covered.
- ✓ Step 7- Describe other features and ID/count of macro-fauna. Note and count any other features of interest eg. number of shellfish, sea cucumbers, sea urchins, evidence of turtle feeding. In this field trip, samples of seagrass and photographs were not taken at each quadrat/transect site. At completion of monitoring, datasheets were checked and filled in completely, i.e. ensure that observers' name, date and site/quadrat details are clearly recorded on the datasheet. Survey equipment





were washed with freshwater and let to dry, ready for the next seagrass survey as according to next schedule.

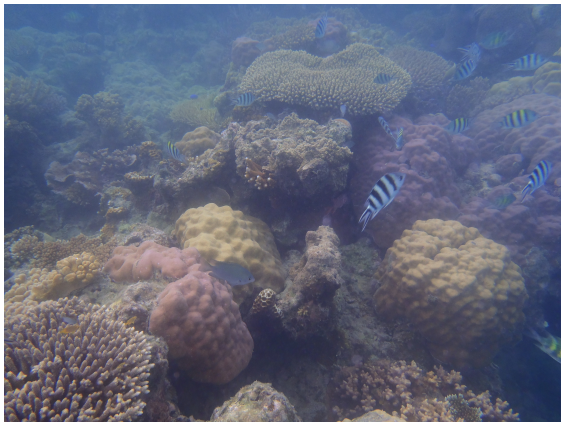
III. BROAD-SCALE SURVEY RESULTS

Manta tows. A total of 71 x 2minute- tow series were conducted with the team spending at most 3 hours of observation in the water (not taking into account travel time between reef sites), conducting a quick preliminary survey of the surrounding fringing reefs.

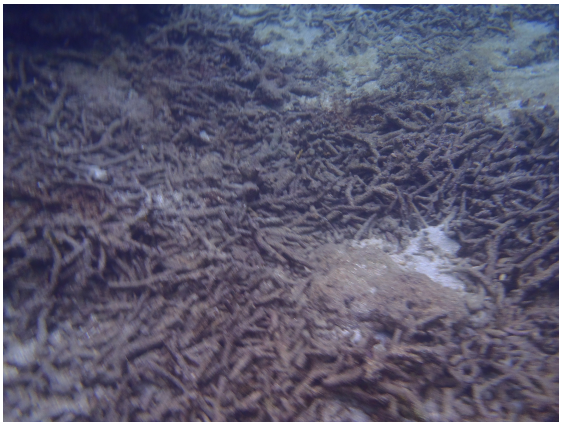
Table 3a.- b. Manta tow summary of results.

	Number of tows	Reef adjacent to	Date of tow
Manta tow (2 min. series)	21	Korovou	5th March
	7	N point to Botaira	5th March
	16	Muaira-Soso village	6th March
	27	Somosomo	7th March

Manta tow site		Live coral cover %	Dead coral cover %	Soft coral cover %	Visibility m	Other observations
A.	Korovou	11-30%	<10%	<10%	7	Rubble field mid-way
B.	N point to Botaira	<10%	11-30%	<10%	12	Macro-algal growth; S end of bay more live coral growth
C.	Muaira-Soso	11-30%	11-30%	<10%	7-10	Macro-algal growth; *Porites* colonies, *Millepora* stands, turbid, warm flushing, signs of coral deaths, crown of thorns
D.	Somosomo	11-30%	<10%	<10%	12	*Porites* heads, crown of thorns, schools of fusiliers



Soso fringing reef. Massive coral lifeforms, *Porites sp.*



Rubble strewn, Kese fringing reef flat

Coral reef health were profiled based on a total of 13 transect surveys at the fringing reef zone, outer barrier reef slope sites, reef flat zone and passage (refer to map for locations). Transect depths ranged only between 5- 12metre depths where coral life form is present. Horizontal visibility was rated at 5-10m and water clarity to at least 10m deep. Survey data were calculated to mean and standard deviation, a basic quantitative analysis of the limited number of transects for replication per reef zone/site.

i. ***Physical and non-living profile of the reefs***

Two distinct reef habitat zones were surveyed i.e. fringing and patch reefs closer to the island and distant barrier reef slopes affected by oceanic influence. Results graphically represented do not provide a comparative analysis of the two reef habitats but profile physical environment, typical of such reefs. There was at least 50% cover of living components consisted of *Acropora,* other coral, marine plants and sponge category at outer barrier reef slopes with 10-13m depth of water as well as shallow fringing or patch reefs. Live coral growth was found to be exceptional in house-reefs managed by Barefoot Lodge (50% coral cover) and Manta Ray Island resorts (average coral cover of 64%). Botaira resort MPA established since 2008 may not have been surveyed during this trip, but have noted its luxuriant coral growth with life-forms of low tabular *Acropora sp.* and more robust massive, encrusting forms of *Porites, Pachyseris, Pocillopora*. Manta Ray island *tabu* is a sandy reef environment. Botaira MPA comprise of the reef fringing shelf due west on the leeward side of Naviti. Barefoot MPA surrounds a coral sandy pit (Drawaqa) which skirts the southern tip of Navit island and Manta Ray Island resort is situated on Nanuya island hugging Drawaqa down south of Naviti. The DCA component is recently dead coral still showing its corallite structures overgrown by encrusting algae and this cover is relatively low with less than 10% at all reef sites surveyed.

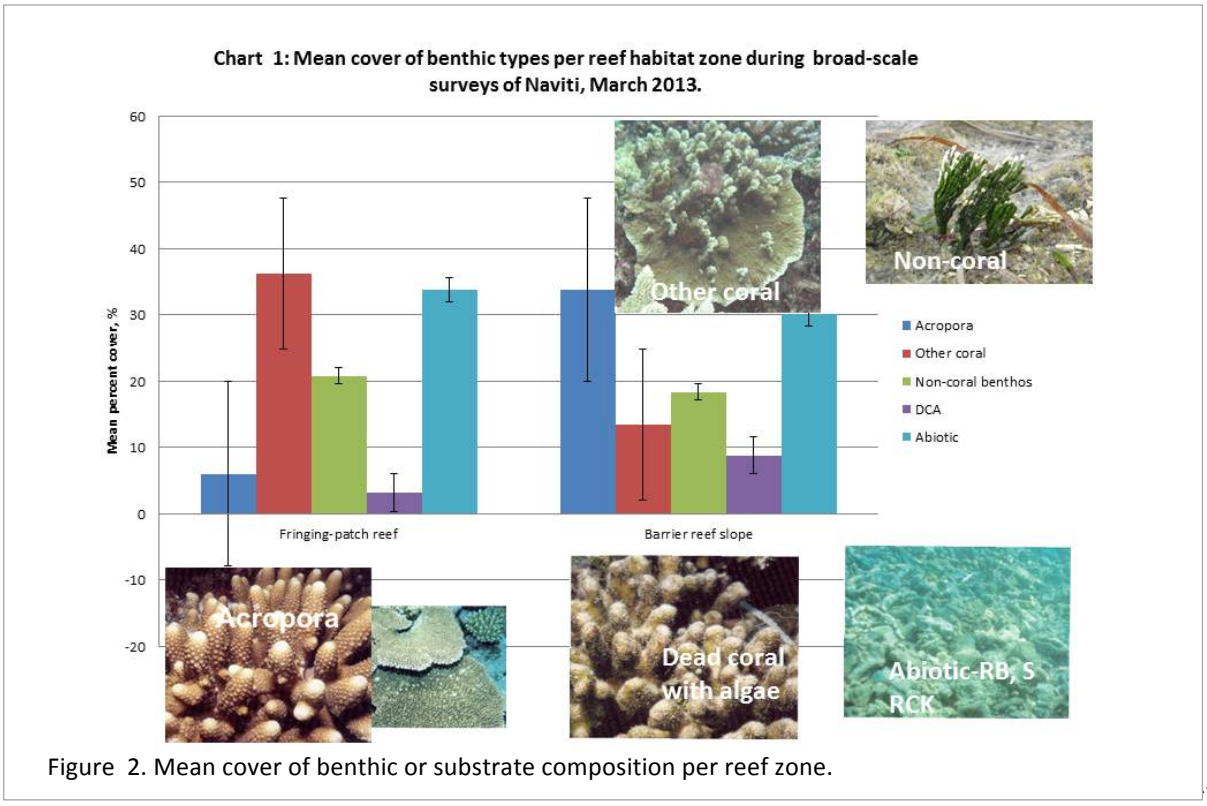


Figure 2. Mean cover of benthic or substrate composition per reef zone.

ii. ***Living components of surveyed reefs***

Observed fish data was summarized into reef habitat zone type instead of per transect site due to lack of replication. On average, fish abundance was noted to be higher at barrier reef slope transects with despite no fish size estimations, bigger and more fish species were observed at the deeper transects. Figure below illustrated that pattern of fish count, however, obligate coral feeder fish groups like butterfly fish and fish types that function as detrivores feeding on dead material off the reef bottom were noted to be relatively common on fringing reef transects. Fish species with diets feeding on plant material (herbivores) , coral feeders and planktivores, fish feeding on drifting mass of tiny plants and animals found naturally in the water were found to be the common type observed along barrier reef transects.

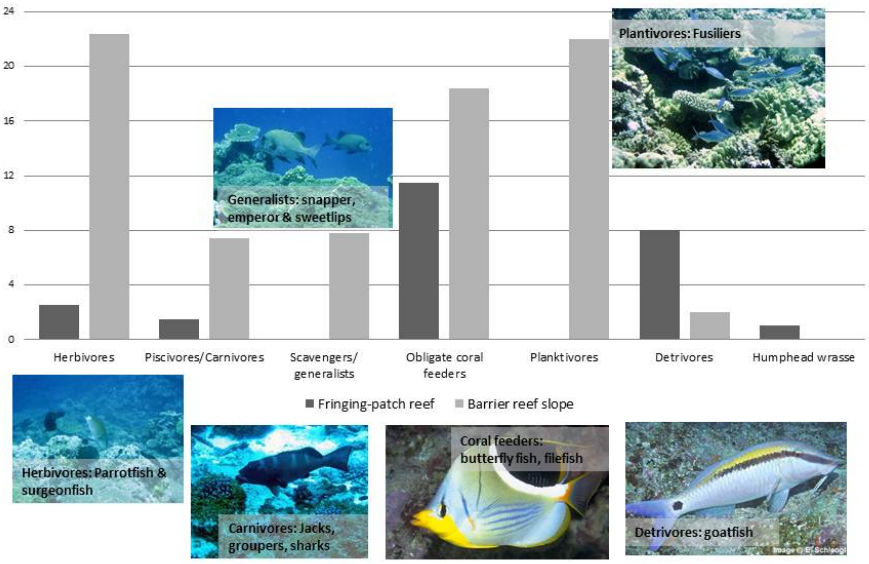


Figure 3. Average fish count per reef habitat.

Naviti –Drawaqa Manta Ray channel

Interestingly, the marine ecosystem of Naviti Island hosts the infamous manta ray channel popularly visited by tourists during cooler months. Manta rays are the largest rays that are close relatives to sharks. These graceful swimmers can be on average about 22 ft wide which feed on plankton, small fish and tiny crustaceans. Manta's funnel the food into their mouth while they swim, using two large, flap-like cephalic lobes which extend forward from the eyes. Mantas are solitary creatures and females give birth to one or two pups at a time. Ongoing research about manta behavior at this channel revealed that there are on average 2 mantas per trip with at least 14 individual mantas recognized to revisit the hannel. Preliminary earnings recorded during a period of 56 days (between 15th September- 7th November and 29th December -1st January) was estimated at over $12,680 (pers. comms Barefoot).

Chart 3: Average count and composition of *sasalu* observed along per 250m^2 strip of reef surveyed during broad-scale surveys of Naviti, March 2013.

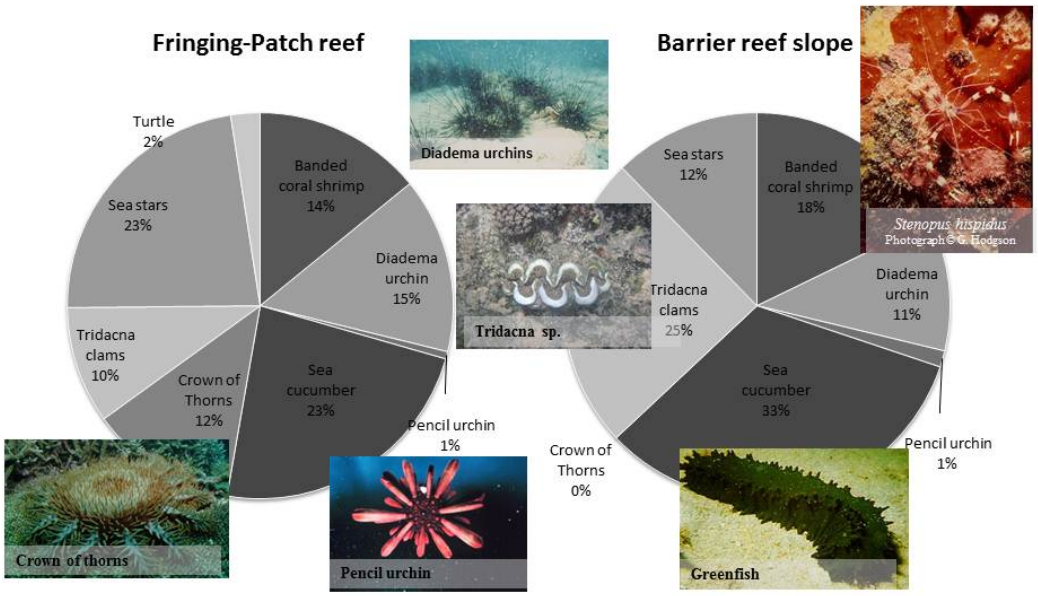


Figure 4. Average count and composition of invertebrate, *sasalu* observed per reef habitat.

Common reef creatures found on reef flats or slope were reported to indicate reef health and fishing pressure mainly, as shown in pie charts above. The distribution of invertebrates were relatively diverse on the fringing reef flat and included sighting of turtle plus crown of thorns. Evidently from the transect surveys and manta tows, there was a noticeable low count of commercial sea cucumber species on the shallow reef flats and or the barrier reef slopes. The most common invertebrate found along the shallow transects of fringing reef flat were sea stars namely *Linckia sp.* and concerning presence of crown of thorns, a killer of coral reefs found at the Barefoot fringing and Kese-Marou fringing reefs. Operator-managed MPA sites of Botaira, Barefoot and Manta ray island resort have clam farm set-ups with a primary aim to re-stock and seed giant clam populations at the local reefs.

Clam farm set up, Manta Ray Island resort 'house reef'.

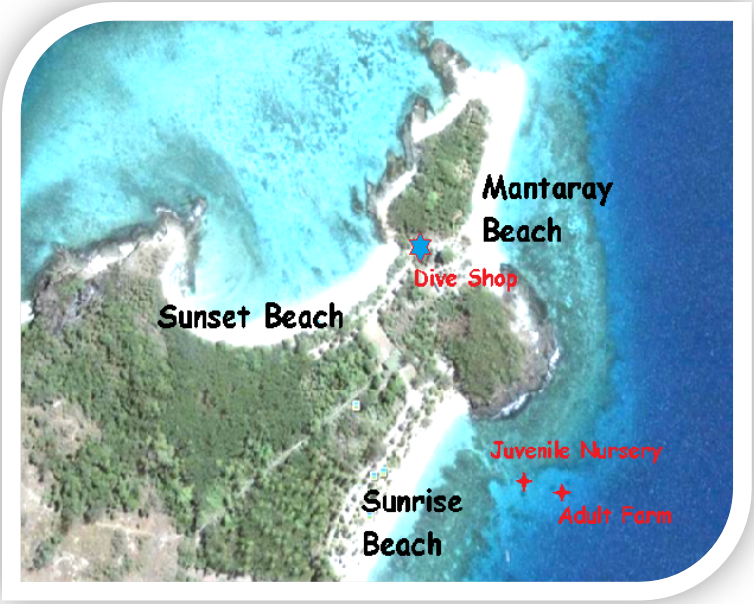
Case study: Giant clam farming at Barefoot, Drawaqa Island, Naviti, Yasawa Group.

Barefoot resort started a clam farm with hopes to repopulate the surrounding reefs around Drawaqa island, with spill-over effects to neighboring Naviti marine areas. Supported by Fiji Fisheries initiative on the aquaculture of local giant clam species sourced from Makogai Research Station.

Methodology:

Cages 50cm x 40cm are placed in 3.5m of water off our sunrise beach. Weekly and monthly monitoring is required. We began this nursery in October 2012, and plan to extend again this year with Fisheries.

Currently in nursery:
40 x Tridacna gigas between 10-20cm
60 x Tridacna derasa – between 6cm and 10cm.



Seagrass health was assessed on the basis of growth, extent of its growth from shoreline, length of seagrass blades measured and a count of marine creatures found in the meadow. Seagrasses are flowering plants of the sea which live and complete its entire life cycle under the sea. These under-water plants have adapted to survive in the world's coastal oceans with different species found growing in a range of marine environmental conditions. Its seagrass roots, leaves, rhizome (rootstalk) and reproductive organs for flowering, water-borne pollination and seed production set them apart from other plants in the ocean. Seagrasses also multiply (propagate) by elongating its rhizome, an underground horizontal plant stem which has roots and shoots from its nodes. Many seagrass meadows consist only of one seagrass type but there are also mixed stands of two to four species found. However, five seagrass species and one subspecies are reported from Fiji Islands listed as *Halodule pinifolia, Halodule uninervis, Halophila ovalis, Halophila ovalis* ssp. *bullosa, Halophila decipiens* and *Syringodium isoetifolium* (Spalding *et al.* 2003; Skelton and South 2006). The shapes of seagrass shoots vary from long, thin or strap-like leaf blades to small rounded paddle-shaped leaves. The vegetative growth patterns of lateral branching and new shoot production often create dense meadows that form a canopy over the sandy bottom.

Table 4 describes seagrass cover and fauna distribution along the 50m transect where seagrass areas surveyed. Mean canopy height describes the length of seagrass blades measured. Highest seagrass cover was observed at shores adjacent to Kese village. Diversity of organisms observed in the seagrass areas

were generally non-existent, mainly rubble, the occasional lone starfish and yet highlighting the important food links of the seagrass to the surrounding coral reefs.

Table 4. Description of seagrass cover and fauna distribution at the surveyed sites, Naviti during March 2013 surveys.

Seagrass site (no. 50m transects)	Dominant species (Mean canopy height)	Ave. seagrass cover	Mean count, organisms
Adj. to Marou village (3)	mainly *Hu* (8cm)	25.7%	None counted
Adj. to Kese village (1)	*Hu, Hp* present (8.8cm)	35%	Small fish observed
Botaira MPA (6)	*Hu, Hp* (6.1cm)	20.6%	Linckia star-fish, rubble
Adj. Korovou Resort (4)	*Hu, Hp, Si found further ashore* (8.2cm)	21.7%	Noted algal abundance
Manta Ray Resort, Nanuya Balavu Is.	*Ho, Hu* (3.3cm). *Si* in deeper transect	27.5%	Too deep to sample, stormy

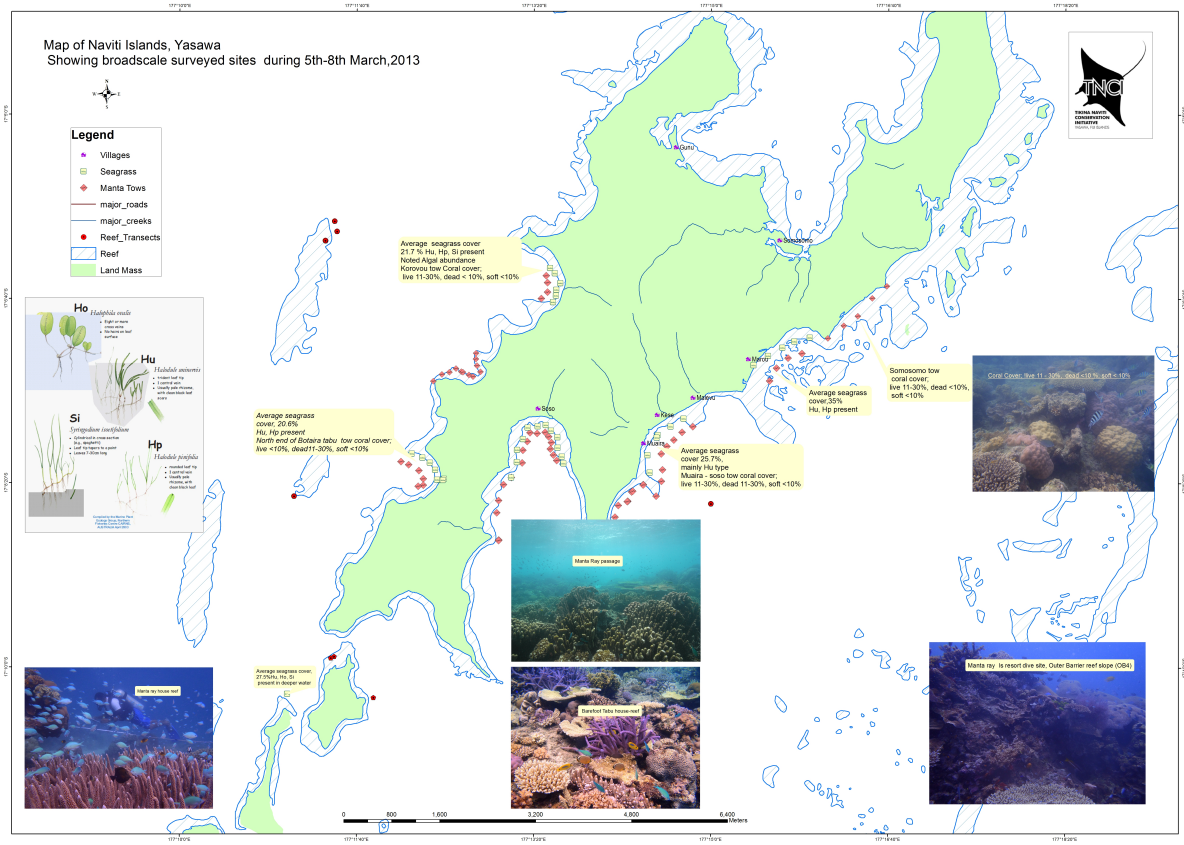


Figure 5. Map showing location where surveys were conducted with a summary of manta tow and seagrass results.

IV. DISCUSSION

The value of reefs are priceless. The crux of observing the fish, the type of reef surface and the kind of organisms found living on the reef were to determine how the reefs looked like and functioned, as baseline to sanctioned marine areas' measure for protection. This statement "structure without function is a corpse and function without structure is a ghost" formed the basis of learning amongst the community trainees group about coral reef ecology and life interactions on the reef.

Case study: How healthy is the beche-de-mer fishery?

Sea cucumbers as 'earthworms' of our lagoons help vacuum sediment off corals from blockage where polyps (small animals that live in the coral skeleton) need the sunlight for food to build our coral reefs. Sea cucumbers feed off detritus found on the reef bottom by engulfing sediment, grounding it as the sand bits pass through its gut and excreted, leaving a trail of finer sand than before. The sea cucumbers' feeding process contributes to the breakdown of larger sediment types and aeration of reef sediment, crucial for all bottom dwelling organisms which feed and live within the reef substrate on the floor of the lagoon.

The issuance of license to collect beche-de-mer for its commercial sale is primarily intended to regulate collection. However, the current state of the sea cucumber fishery in Naviti is unknown. It is important to keep check on the fishery in considering the elements of safety in diving to collect beche-de-mer plus the conservation value of this important species. Six key ecosystem health indicators frame management concerns of this fishery as outlined below:

- Take some, leave some for breeding
- How to fish for sea cucumber
- How many sea cucumbers
- Types of sea cucumbers
- Sizes of sea cucumbers
- Profit to the fishers

This can be the first step to consider island-level management of this fishery in conjunction to the role of Fish wardens sanctioned by the Department of Fisheries.

Why survey seagrass?

The plant's structure and height of the seagrass canopy, the extent of the meadow is influenced by a number of ecological factors such as water motion caused by currents and waves. Usually the leaves are wider and weaker in areas with slow water motion, and narrower and more flexible where water movement is higher. Where present, seagrasses form the basis of many ecologically important marine habitats supporting far reaching biotic, living communities. It has been suggested that 400 square meters of seagrass (10metres long and 40 metres wide) can support 2000 tonnes of fish a year. Fiji's coastal fisheries productivity depends greatly on seagrass habitats. For example, juvenile emperor fish (*sabutu, cabutu, kabatia, kabatiko*) live in the shallow inshore areas where seagrass and mangroves before they move to deeper waters as adults (Richards et al. 1994). Seagrasses are a known resource for

green turtles in the central south Pacific region. The seagrass areas in Fiji may well be providing foraging areas where turtle search for food by over half of the adult green turtles in the central South Pacific (McKenzie et al. 2007). This could be a result of lower availability of turtle food east of Fiji, where most islands are small and steep with limited areas suitable for seagrass growth.

There has been not much careful attention given to seagrasses however, contributions from field observations with community groups to map local seagrass areas as part of own resource planning, should be applauded. Such initiatives of keeping watch over local seagrass areas also contributes to global insight on how seagrasses could be a major local influence on seawater that could alleviate the problems of ocean acidification. It has been discovered that varieties of seagrass could help reduce the acidity of water surrounding coral reefs. This is a potential solution to endangered coral reefs vital to providing natural fishing and sea defenses for most of us living on small islands in the South Pacific. Due to increased carbon dioxide in the atmosphere, the survival of these calcium carbonate forming corals raises the acidity of the oceans. Scientists made the analogy about the risks of ocean acidification rotting our reefs, the same way that fruit and fizzy drinks can erode tooth enamel. Past studies indicate that there are varieties of seagrass which can photosynthesis (complex process by plants converting carbon dioxide, water and inorganic salts into carbohydrates) quickly and efficiently that they actually turn the surrounding water more alkaline. (http://www.bbc.co.uk/news/uk-wales-south-west-wales-18558155)

We will be at a loss without our healthy seagrasses either it be due to neglect from pollution, over-fishing and climate change. So unless we as individuals or community living along a coast where seagrass thrives take local action towards a global phenomenon to protect and manage risks posed with changing seas. [For more information on seagrass, please visit www.seagrasswatch.org]

V. GUIDING PRINCIPLES: "*MANAGING OUR TABU"*

A take-home message for the community trained group inspired by the guiding principles of tabu management was to think about 'to limit your catch, not catching your limit' and promoting the assessment, monitoring and protection of seagrass areas though its 'local eyes global wise' volunteers network. Reef areas surveyed in the vicinity of Naviti islands are in varying states, however, healthy live coral cover and positive commitment by both operators and messages of the *tabu* may design the level of protection and access for fishing. Seagrass beds and shores adjacent to the villages is recommended for protection with set up measures to maintain the beach vegetation and mitigate beach erosion, household dumping, zoning areas for boat anchors.

In consideration of the existing resource use challenges for such a dynamic tourism region within a setting of climatic change, such partnerships with tourism operators and resource custodians is inspiring. What is lasting with this partnership is that ten of the trainees will have the opportunity to be certified in the use of SCUBA (Self-Contained Unit Breathing Apparatus) ensuring dive safety in an area where diving accidents become prevalent due to lack of awareness. This chapter ends here yet brings the next step closer for the community of Naviti district in its quest for an integrated resources management framework. A fish wardens training supported by the Department of Fisheries is scheduled

for May, TNCI's next steps to recognizing the listed sanctioned *tabu* reef areas for compliance and surveillance.

VI. REFERENCES

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Gosliner, T., Behrens, D.W., and Williams, G.C. 1996. Coral reef animals of the Indo-Pacific. A Sea Challengers Publication.

List of websites visited:

http://www.bbc.co.uk/news/uk-wales-south-west-wales-18558155

www.seagrasswatch.org

www.reefcheck.org

VII. APPENDICES

NAVITI Island Marine Biological Baseline Survey Objectives/Strategy and Personnel Responsibilities

2nd – 8th March, 2013

GOAL: To conduct the marine ecological baseline surveys of surrounding reefs and inform the planning process of marine resource management framework for Tikina Naviti.

TNCI Broad Objectives

To strengthen community capacity to sustain initiated project activities independently long-term with the goal to ensure that the natural resources and biodiversity available on Naviti Island is not diminished but enhances through better resources management.

Specific Objectives & Expected Outputs

1. To train community divers & resort staff in low-tech locally adapted coral reef /coastal habitat monitoring based on global standard coral reef survey techniques and participate in the assessment of local reef conditions. Output: A baseline assessment report.
2. Visioning exercise. Plan of Action for monitoring of coral reef health [linked to the Climate Change Action Plan for Naviti drafted in 2010].

Survey strategy:

- 5 days of coral reef surveying which will utilize SCUBA diving, reef snorkeling and manta tow techniques**.**
- At least 8 *tabu* sites to be marked for mapping profile and a pre-selection of barrier reef sites to include tourist dive sites, special sites i.e. grounding of vessel, collection of marine aquarium species considered for both the leeward and windward side of Naviti Island.

Site selection

- Initial efforts will concentrate (weather/currents permitting) on the profiling of listed *tabu* sites. Surveys according to reef zones will include:

1. Fringing reef areas
2. Reef flats including the seagrass areas
3. Oceanic/submerged patch reefs and potential spawning areas
4. Manta ray passage & possibly one other channel
5. Barrier reef (inner and outer reef slopes)

♦ Other resource materials include bathymetric map/image of Naviti Island, identification books of fish, invertebrates and marine plants for the survey divers.

Target group: potentially 10 PADI divers + 10 snorkel surveyors

Provision of dive gear: Barefoot & Manta to outfit full kit for 5 divers each. In addition to consider the supply of at least 5 pairs of snorkeling gear at least to cater for a buddy team. Please consider for a plan on how tanks efficiently be ready for use.

Daily Program Outline (draft): 5 days

It is anticipated that the daily program – starts at 6am and evening sessions to conclude by 10pm!

Part 1: Marine awareness coral reef ecology & interactions

Content for theory and evening sessions:

- Ecology in theory "how to recognise your reef! "

* Colors and forms

* How are our reefs doing? REEF CHECK methodology

*What are the key threats ? eg. *Marine Aquarium Trade= live coral and fish collection by Walt Smith Int'l*

**Beche-de-mer Fishery, Overfishing, Increased traffic of boats* eg. beaching of M.V. Reef Endeavor

Q& A session

* Video screening 'the health of our coral reefs"

* Visioning Exercise i.e. what are our roles in making/getting to realise our goals & vision

Part 2: Survey diving experience

Survey team roles and responsibilities:

- Document total diversity of fishes to species level at each site – delineated 20 meter zigzag deep to shallow dives recording as many species as possible
  – fish abundance/biomass
- ***D***ocument abundance (density) and biomass (TBC) of a localized indicator fish species list. 50 x 5 meter transects at deep (12-15 m) and shallow (3 -6 m) depths.

- diversity of seagrasses

- Document species of macroalgae and sea grasses at each site and estimate of percentage cover for each seagrass species

Diver #1a: Diver which lays the tape and

- Record reef profile at each site by drawing the topography of the reef area where tape was laid to be surveyed
- Record the amount and type of lost/discarded fishing gear at each site

Diver #2: who observes the <u>fish abundance</u> and size

- Fish abundance and size class estimations per survey depth and site

Diver #1b: who counts and records the <u>Sessile Invertebrates</u>

- Record the diversity and abundance of indicator groups of sessile invertebrates. Reef Check methodology. Species level if possible.

Diver #3: who records the <u>Benthic cover</u> per 0.5m along a 50m transect

- Records benthic cover using point intercept transect method at each site. 1x50 transects at deep (12-15 m) and shallow (3 -6 m) depths. Special notes on percent bleached corals and crown of thorns cover and damage. Benthic data recording will include resilience variables for coral bleaching monitoring.

DRAFT PLAN FOR LOGISTICS:

Daily schedule of boat runs during March 4-8 survey period:

	Mon, 4th	Tue, 5th	Wed, 6th	Thur, 7th	Fri, 8th
Tides:	*L- :H*	*L : H*	*L : H*	*L :H*	*L :H*
Morning		Boat MT	Boat MT Boat DT	Boat MT Boat DT	Boat MT Boat DT
Midday	Boat MT	Boat DT	Boat MT Boat DT	Boat MT Boat DT	Boat MT Boat DT
Afternoon	Boat DT	Boat MT	Boat MT Boat DT	Boat DT	
Evening	Boats needed for transfer of trainees to theory sessions for those not camping at Barefoot				

Operators offering boat support- Barefoot/ Botaira/ Manta Ray resort

Key codes:

Boat for dive team = Boat DT

Boat for manta tow = Boat MT

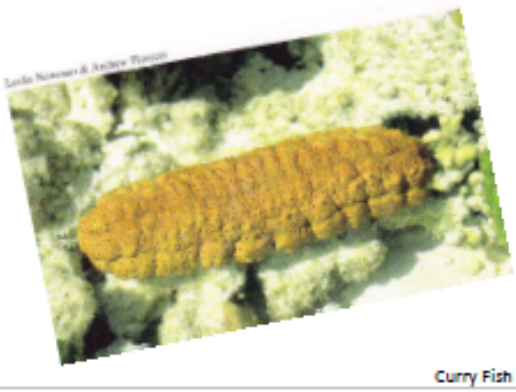
Diving highlighted in blue

Listing of pre-selected survey sites by priority:

1. Korovou
2. Botaira
3. Barefoot
4. Manta Ray passage
5. Kese
6. Malevu
7. Marou
8. Soso
9. Muaira

Somosomo & Gunu village yet to be consulted

BECHE DE MER SPECIES OF FIJI IN THE EXPORT MARKET

COMMON NAME	DESCRIPTION
 Amber fish	**Common name:** Amber fish **Scientific Name:** *Thelenota anax* **Fijian Name :** Dri volevola **Wet Length :** 80cm **Export Length : 7.62cm** **Value :** Low **Features –Wet color:** Upper surface cream grey with brown patches.
 Black Fish	**Common Name :** Black fish **Scientific Name :** *Actinopyga miliaris* **Fijian Name :** Dri Loa **Wet Length:** 20-30cm **Export Length:** 7.62cm **Value:** Low **Features- Wet color:** Black sometimes brown underside.
 Brown sand fish	**Common Name :** Brown sand fish **Scientific Name:** *Bohadschia marmorata* **Fijian Name:** Vula **Wet Length:** 15-35 cm **Export Length:** 7.62cm **Value:** Low. Islanders trade for $2/animal **Features- Wet color :** Small brown dots with golden brown color.
 Curry Fish	**Common Name :** Curry Fish **Scientific Name:** *Stichopus variegatus* **Fijian Name:** Lokoloko **Wet Length:** 20-25cm **Export Length:** 7.62cm **Value:** Low **Features- Wet color :** Typically dark yellow with brown patches

Deep water red fish

Common Name : Deep water red fish
Scientific Name: *Actinopyga echinitus*
Fijian Name: Dritabua
Wet Length: 15-30cm
Export Length: 7.62 cm
Value: Low
Features- Wet color : Surface red orange underside.

Elephants Trunk Fish

Common Name : Elephant trunk fish
Scientific Name: *Microthele fuscopunctata*
Fijian Name: Daliro ni cakau
Wet Length:40-60cm
Export Length: 7.62cm
Value: Low
Features- Wet color : Dark orange or rust brown

Green Fish

Common Name : Green Fish
Scientific Name: *Stichopus chloronotus*
Fijian Name: Dri votovoto
Wet Length: 40-60cm
Export Length: 7.62cm
Value: Low. Islanders trade at estimated price of $4/kg (wet) on Rotuma.
Features- Wet color : Very dark green almost black

Lolly Fish

Common Name : Lolly fish
Scientific Name: *Holothuria atra*
Fijian Name: *Lolioli*
Wet Length: 10-30cm
Export Length: 7.62cm
Value: Low. Islanders trade@ $1.20/kg (approx. 60 dried pieces).
Features- Wet color : Black with sand cover

Pink Fish

Common Name : Pink Fish
Scientific Name: *Holothuria edulis*
Fijian Name: Dri damu
Wet Length: 20-30cm
Export Length: 7.62cm
Value: Low
Features- Wet color : Dark brown upper surface & pink under

White teat fish

Common Name : white teat fish
Scientific Name : *Holothuria fuscogilva*
Fijian Name: Sucuwalu
Wet Length: 30-40cm
Export Length: 7.62cm
Value: High
Features- Wet color: Yellowish white to grey-brown.

Tiger Fish

Common Name : Tiger fish
Scientific Name : *Bohadschia argus*
Fijian Name: Vuls iks
Wet Length: 15-35cm
Export Length: 7.62cm
Value: Low

Surf red fish

Common Name : Surf red fish
Scientific Name : *Actinopyga mauritiana*
Fijian Name: Tarasea
Wet Length: 20-30cm
Export Length: 7.62cm
Value: Low
Features- Wet color: Similar to deep water red fish but no sand coat.

Stone fish

Common Name : Stone fish
Scientific Name : *Actinopyga lecanora*
Fijian Name: Dri vatu
Wet Length: 40cm
Export Length: 7.62cm
Value: Low
Features- Wet color: Varies but light color patch at the anus.

Prickly Red fish

http://www.scuba-equipment-usa.com/marine/AUG06/Pineapple_Sea_Cucumber(Thelenota_ananas).html

Common Name : Prickly Red Fish
Scientific Name : *Thelenota ananas*
Fijian Name: Sucudrau
Wet Length: 40-70cm
Export Length: 7.62cm
Value: Medium
Features- Wet color: Reddish Orange with tube feet

Sand fish (banned)

http://www.seafreshaustralia.com/index3.shtml

Common Name : Sand fish (banned)
Scientific Name : *Metryatyla scabra*
Fijian Name: Dairo
Wet Length: 25-45cm
Export Length: 7.62cm
Value: High
Features- Wet color: Greenish upper surface

Sand fish (Banned)

http://www.alibaba.com/product-free/104806274/Sea_Cucumber_Sand_Fish.html

Common Name : Sand fish (banned)
Scientific Name : *Metryatyla versicolor*
Fijian Name: Dairo
Wet Length: 25-45cm
Export Length: 7.62cm
Value: High
Features- Wet color: Variety color