**INSTITUTE OF APPLIED SCIENCES**

**THE UNIVERSITY OF THE SOUTH PACIFIC**

# Environmental Assessment of the proposed Area for the Expansion of Natovi Jetty

IAS ENVIRONMENTAL STUDIES REPORT NUMBER: 84

By

Kubuabola, Sereana L. and Naqasima-Sobey, Milika

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Sereana Kubuabola
Milika Naqasima-Sorbey

September, 1996

## ACKNOWLEDGEMENT

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# ENVIRONMENTAL ASSESSMENT OF THE PROPOSED AREA

# FOR THE EXPANSION OF NATOVI JETTY

## 1.0 INTRODUCTION

The Natovi Jetty is located along the Tailevu coast on Viti Levu, approximately 16 km NNE of Korovou town. In May 1983 it was suggested that the Natovi Jetty be declared a common user berth so that proper control can be monitored. This was in response to the expected increase in the volume of passenger and cargo traffic between Viti Levu and Vanua Levu as a direct consequence of the introduction of the new Ro-Ro ferry services which eventually lead to some minor upgrading being carried out. In 1985 the Marine Department responded to a request by Patterson Brothers to dredge the Natovi Jetty area deepening it to 30 meters to a distance 30 meters west of the old jetty.

The following report is for the Namena Tikina Council who have requested the Institute of Applied Sciences at the University of the South Pacific to undertake a study of the Natovi Jetty Area. This study is to be viewed as a base-line assessment of the marine environ where a further expansion to the Natovi Jetty is expected to take shape. The detail expansion proposal is unknown and it is hoped that this report will give an indication of the status quo.

The survey was conducted over three days : Tuesday 16/7/96, Thursday 18/7/96 and Wednesday 31/7/96. The marine study consisted of four components:

1. Assessing fish abundance by gillnetting at selected sites.

2. Assessment of the reefal area using Line Intercept Transect (LIT) method.

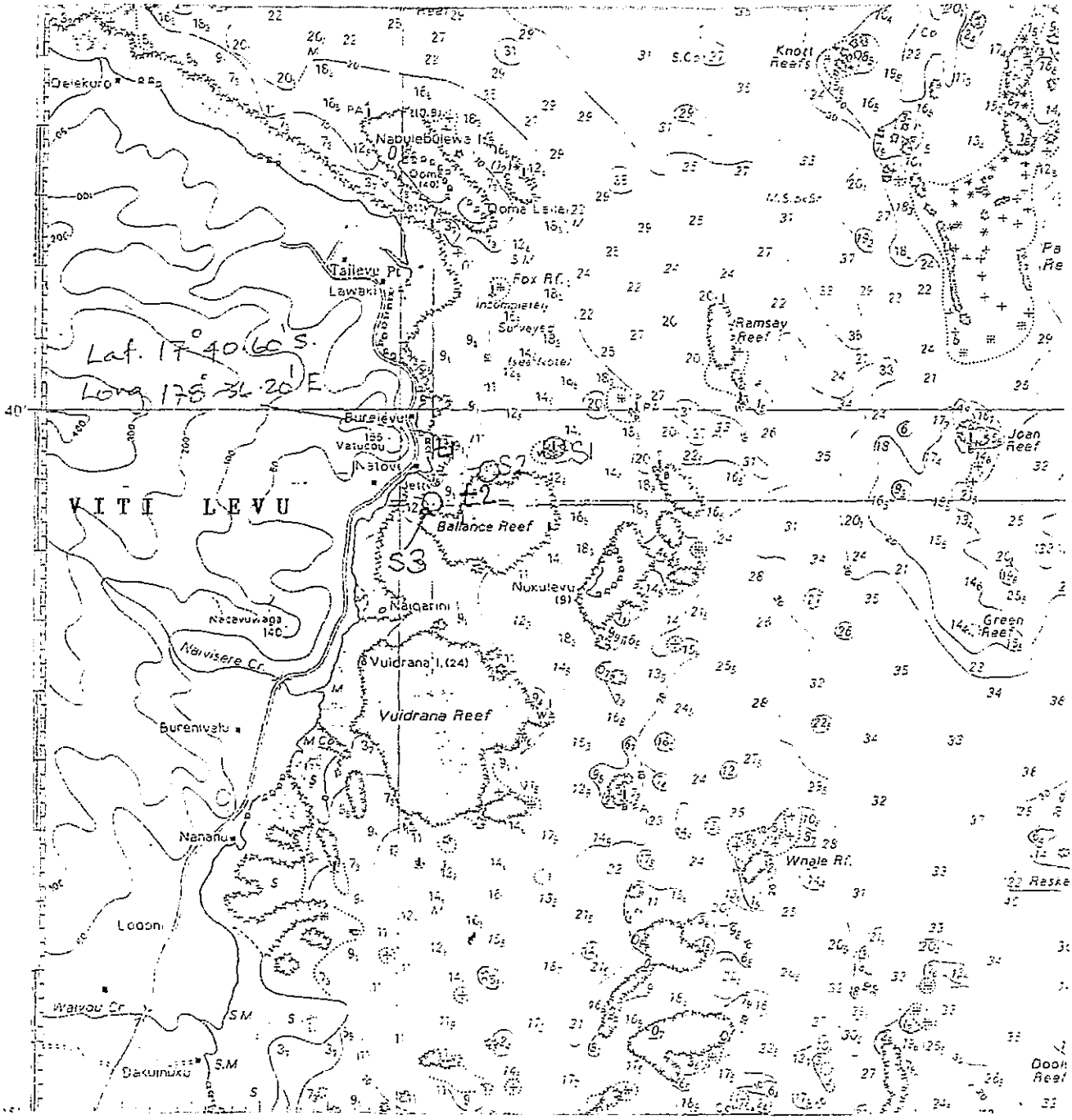
3. Trace metal analyses of sediment and shellfish collected from the foreshore.

4. Water quality survey to describe the chemical and microbiological characteristics of the water.

## 2.0 METHODOLOGY

The survey area is shown on Chart 1 while the Global Positional System readings are of study sites are summarised in Table 1.

CHART 1




SURVEY AREA

Table 1 : Position of gillnet sets and reef transects

| Site | Position | Description |
|---|---|---|
| S1 | 17°40.60'S<br>178°36.20'E | |
| S2 | 17°40.489'S<br>178°35.609'E | |
| S3 | 17°40.695'S<br>178°35.204'E | |
| t1 | GPS incorrect | |
| t2 | 17°40.538'S<br>178°35.450'E | reef flat |
| | 17°40.687'S<br>178°35.501'E | reef slope |

## 2.1 Fish survey

This study examined the fish stock and its abundance in the waters off Natovi Jetty. There are several methods of measuring stock abundance each with their own assumptions. One can either choose to estimate the absolute abundance of individuals in a population (which can be an expensive, tedious exercise) or obtain an estimate of relative abundance which in most cases is sufficient. The most commonly used index of relative abundance is catch per unit effort (CPUE) which relates the abundance in one area to that in another or the abundances in the same area but at different times. Catch per unit effort can be expressed as kg caught per unit time (kg/hour) or number caught/unit time (#/h). Gillnetting is a standard fishing technique that can be used to measure stock abundance. Like all fishing techniques, it shows some degree of selectivity since its mesh will only select for a particular size range of fish. Fish that are smaller or larger than the mesh size will not be accounted for. The CPUE therefore, is related to but usually less than the absolute abundance in the gear's area of influence (King & McIllgorm, 1989).

A gillnet 50m in length with 3" mesh size was deployed at three sites (s1, s2 and s3 shown in Chart 1) for varying lengths of time during the day, to assess the abundance and diversity of fish in the study area. The net was first deployed at s1 for a soak time of 3 hours on an ebb tide. The second deployment at s2 was for a soak time of 2 hours at low tide and the final deployment at s3 was for a soak time of 2 hours on an ebb tide.

## 2.2 Reef Assessment

The Line Intercept Transect (LIT) method is used to assess the sessile benthic community of coral reefs. The community is described using lifeform categories that provide a morphological description of the reef community. The technique uses a classification system that is based on structural attributes of lifeforms rather than their taxonomic identification. The cover of an object or group of objects within a specified area is estimated by calculating the fraction of the length of the line that is intercepted by the object. The measure of cover is usually expressed as a percentage and is considered to be an unbiased estimate of the proportion of the total area covered by that object. There are, however, certain assumptions made:

(i) the size of the object is small relative to the length of the line;

(ii) the length of the line is small relative to the area of interest (English et al.. 1994);

Two sites were selected for the reef studies (t1 and t2 in Chart 1) and at each site a total of six 20m transects were laid; three at a depth of 3m and three on the reef flat. SCUBA gear was used for surveying the transects laid at 3m whilst the transects on the reef flat were surveyed by walking the study area.

Once a transect is laid, the observer moves along the transect recording the lifeforms encountered under the tape. Where the benthic lifeform changes, the observer records the transition point in centimetres and the code of the lifeform. The lifeform categories and codes used are attached as Appendix 1. Data analysis is carried out using the AIMS Data Entry System (ARMDES) developed by the Australian Institute of Marine Sciences.

## 2.3 Sediment and Shellfish analyses

Sediments from 2 sites were collected and analysed for lead and oil and grease. The North End site was along the shore from dive site $t_1$ while the South End site was on shore at a perpendicular point 10 meters north of the jetty and 20 meters from the high water mark. For lead analyses the sediments were air-dried at room temperature, ground so that 60 mesh samples were obtained and then determined by Atomic Absorption Spectrophotometry (AAS) after acid digestion (UNEP method). For oil and grease analyses a sub-sample of wet sediment (10-15g) was weighed and then ground with sodium sulphate. The mixture was then extracted with hexane for about 4 hours (20 cycles) using a soxhlet extractor. Final results were calculated on a dry weight basis.

A composite sample of oysters were collected along the shore between the two sediment collection sites. The tissues were frozen dried and lead determined by graphite furnace AAS after acid digestion (UNEP method).

## 2.4 Water Quality

Dissolved oxygen was determined with a YSI model 51B oxygen meter while salinity was read with a hand refractometer serial No. 8098. Water clarity measurements were made with a black and white *secchi disc*.

Samples for chemical and microbiological analyses were collected from surface water only at two sites. Water chemical analyses used standard methods from the American Public Health Association as shown in Table 2.

**Table 2 : Water Quality: Chemical Methods**

| Parameter | Method |
|---|---|
| Nitrate | Cadmium reduction, colorimetric |
| Orthophosphate | Phosphomolybdate, ascorbic acid reduction |
| Oil & Grease | Partition-Gravimetric |

# 3.0 RESULTS

## 3.1 Fish Survey

There were no fish caught in any of the three sites indicating a very low abundance of fish in the area.

## 3.2 Reef Assessment

The pie charts generated by the ARMDES package showing the percent cover of the main benthic forms is attached as Appendix 2. Table 3 is a summary of the results shown in the pie charts.

**Table 3 : Comparison of reefs assessed using the Line Intercept Transect method**

| Reef | Reef zone | Percent Cover of Benthic Life Forms | | | |
|---|---|---|---|---|---|
| | | Hard Corals | Algae | Other | Abiotic |
| Cokota | flat | 0 | 7 | 0 | 93 |
| Ballance | flat | 1 | 12 | 0 | 87 |
| Dravuni | flat | 20 | 25 | 30 | 25 |
| Sandbank | flat | 2 | 34 | 11 | 53 |

3.3 Table 4 : Trace Metal and Oil and Grease

| Description | Oyster Tissue | Sediment | |
|---|---|---|---|
| | | North End | South End |
| Date | 16/07/96 | 16/07/96 | |
| Lab No. | 96/859 | 96/857 | 96/858 |
| Lead (mg/kg) | 0.31 | <1 | <1 |
| Oil & Grease (mg/kg) | | 381.5 | 722.7 |

3.4 Table 5 : Water Quality

| Description | South End Jetty Area | North End |
|---|---|---|
| Date | 16/07/96 | |
| Lab No. | 96/855 | 96/856 |
| Turbidity (meter depth) | 3.0 | 2.5 |
| Salinity (ppt) | 34 | 34 |
| Dissolved oxygen (mg/L) | 6 | 7 |
| Temperature | 27°C | 27°C |
| Nitrate ( $\mu gNO_3/L$) | <34 | <34 |
| Orthophosphate ($\mu gPO_4/L$) | <20 | <20 |
| Total coliforms (/100 mL) | 9 | 210 |
| Faecal coliforms (/100 mL) | 37 | 1700 |
| Oil & Grease (mg/L) | 11 | |

## 4.0 DISCUSSION

### 4.1 Fisheries Assessment

The CPUE for all three sets of the gillnet was 0 kg/hr indicating that the abundance of fish in the study area is low. Discussions with women from the area revealed that the locals no longer fish near the jetty because of poor catches and that fishing is actively carried out in waters further north near Qoma Island. There was certainly no one seen fishing in the study area during the survey. Similar fisheries studies have been carried out in Yanawai River and Malau in Vanua Levu, both of which registered higher CPUE values (Naqasima, 1995). It would appear that the main reason for the low abundance is due to habitat degradation. The reefal system has been severely affected by siltation from the land which has affected coral cover and subsequently led to the decline in fish stocks.

The low catch rate might also be attributed to the time of day that the net was being set. It was set during the day when the larger predators are not as active. A similar fisheries study conducted at Vuda Point (Environmental Consultants, 1995) found that the largest catch was secured when the gillnet was left overnight and the smallest catch when it was set and retrieved during the day. This is because the larger predators are usually more active at dawn and dusk when they are less visible to any potential prey (Myers, 1990). The soak times in this survey were possibly too short but the net was being deployed in an area that had a relatively large volume of boat traffic therefore the soak times were restricted to the mornings before the ferries would arrive in the early afternoon. Time constraints because of travel to and from the study area each day also severely restricted the soak time for each set. Ideally an overnight set would have been desirable but due to the fragmented study period, this was also not possible.

### 4.2 Reef Assessment

The first site surveyed was the fringing reef between Natovi Jetty and Burelevu Village named Cokota Reef by the locals. The reef flat was largely made up of barren consolidated rock with patches of sand and rubble (see Plate 1). There were no faunal organisms observed with a complete absence of hard corals in the middle and outer reef flat. There were some algae observed along the transects with the calcareous *Halimeda sp.* being one of the more conspicuous species (see Table 3). Coral growth was observed only at the reef crest which was exposed at extremely low spring tides which occurred during the survey period (Plate 2). There were hard corals which included *Acropora sp.*, *Favites sp.*, and *Montipora sp.* and soft corals such as *Sinularia sp.* and *Sarcophyton sp.*

The reef slope had greater hard and soft coral cover but it also had an extremely high silt load which contributed to the muddy substratum. The suspended sediments made the water very turbid and consequently the visibility underwater was approximately 1m. The slightest disturbance by divers' fins stirred up the mud making it impossible at times to see the transect tape. The terrigenous sediments have probably been deposited during periods of heavy rainfall. Soft corals prefer silty environments thus the presence of *Sarcophyton sp.* and *Sinularia sp.* colonies on the slope. Hard corals of different growth forms were observed: massive, branching, submissive and encrusting. They were species obviously adapted to living in areas with a high silt load and included *Acropora sp., Millepora sp.* and favids. Sponges were also observed. There were very few fish seen even from among those groups commonly associated with the shallow reef front such as butterfly fishes and damselfishes. There was a total absence of any large herbivorous or carnivorous fish.

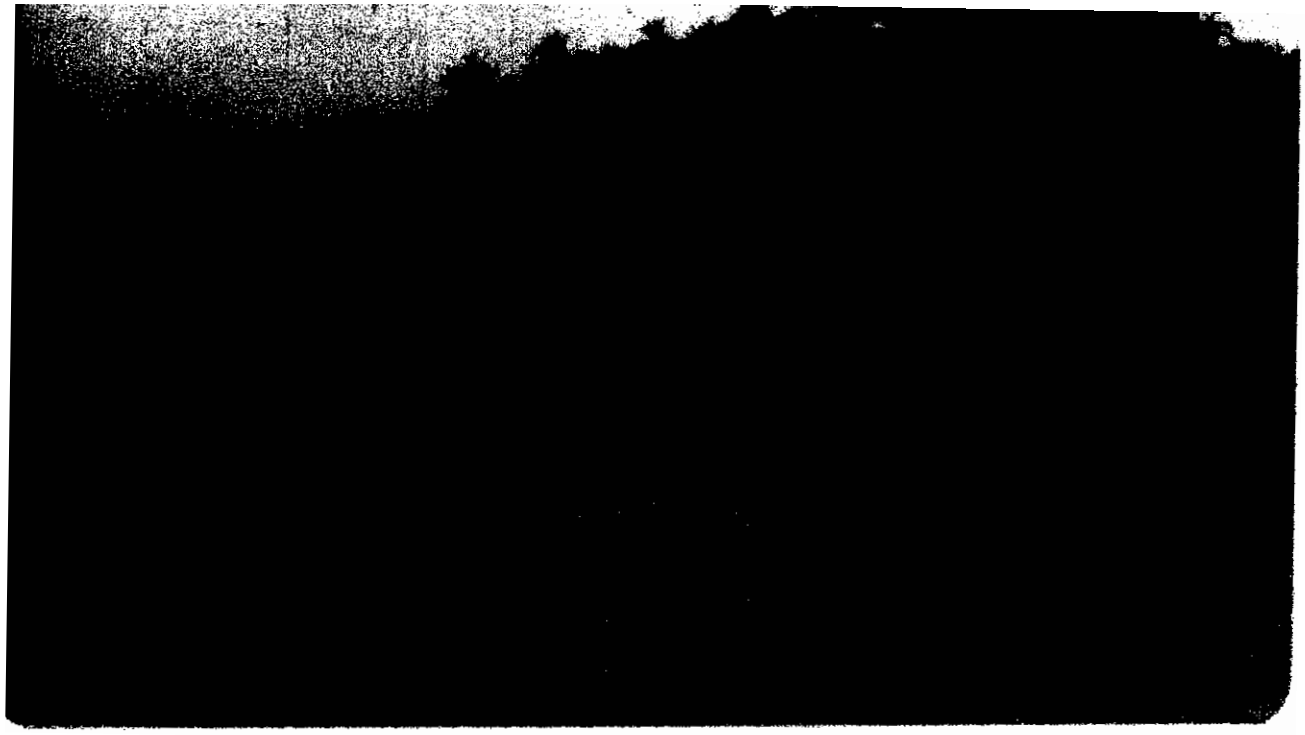
This fringing reef is typical of one growing close to the shore of a large volcanic island and one that is constantly subjected to an influx of sediments from the adjacent land. The reef flat is barren with the greatest coral cover observed on the crest where constant wave action is able to keep sediments from settling on the corals and provide oxygen replenishment.

The second site was on Ballance reef which was an offshore reef. The reef flat is totally exposed during periods of low tide and is predominantly consolidated rock with patches of rubble and sand. The flat does not appear as barren as that of Cokota Reef. The floral cover is significantly greater (Table 3) with the dominant species being *Halimeda sp.*. The few hard corals observed were at the crest where they were covered by water at low tide thus protecting them from desiccation. Extreme temperature and salinity changes which can occur during periods of low tide can be lethal to corals.

The slope supported a much greater diversity and abundance of faunal organisms than the slope of Cokota Reef. The visibility underwater was significantly greater, however, it would have still been less than 5m. There were gorgonians found at 3m and an abundance of soft corals, in particular *Sinularia sp.* and *Sarcophyton sp.*. There was a variety of growth forms seen among the hard corals; massive, submissive, branching and encrusting. The slope had a sandy bottom with a layer of fine silt on top whereas the reef slope at Cokota had more mud.

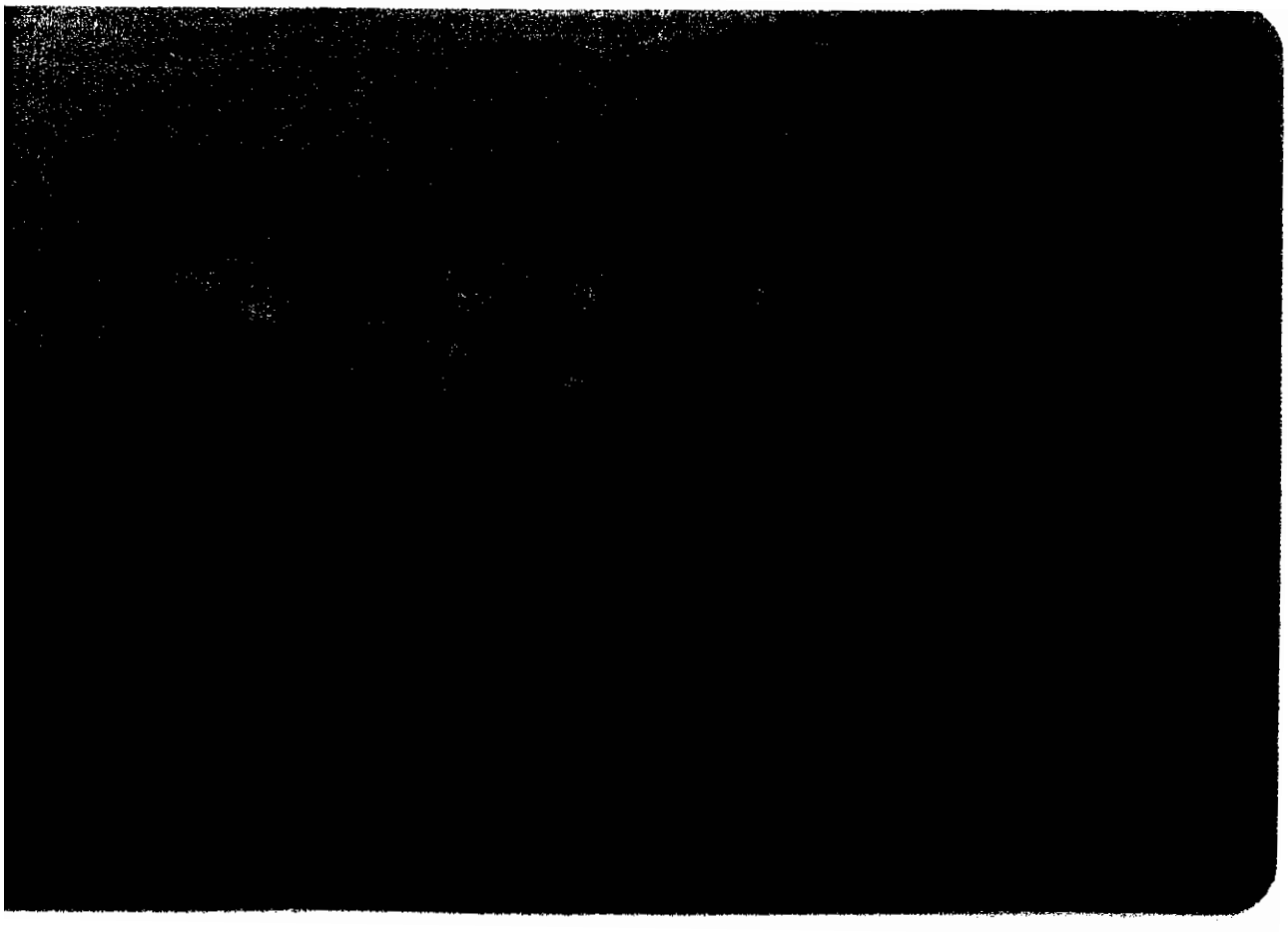
The species diversity on Ballance Reef was greater than that found on Cokota Reef largely because the former was less degraded. Its distance from the land and greater exposure to tidal flushing would certainly lessen the impact of terrigenous sediments and consequently improve habitat availability. There were more fish observed on Ballance Reef, however, there was still a notable absence of the larger carnivores. There were also no edible invertebrates seen along any of the transects on both reefs. Women were observed gleaning shellfish and other reef invertebrates on Ballance Reef where they are obviously still available, whereas there was no fishing/collecting observed at all on Cokota reef.

Similar reef assessments have been conducted in Dravuni, Kadavu and on the Sandbank Reef in Laucala Bay (see Table 3). Dravuni Reef is part of the Great Astrolabe Reef complex in Kadavu, a reef system that is internationally renown for its spectacular diving sites. Dravuni Reef is in a relatively pristine condition due to its remote location and subsequent lack of anthropogenic disturbances. The coral cover is significantly greater than that of the reefs surrounding Natovi Jetty and both divers can confirm from personal observations that the fish diversity and abundance is also significantly greater at Dravuni. The Sandbank Reef is part of the Suva Barrier Reef complex and is subjected to similar environmental conditions to those that exist around Natovi. There are several rivers that discharge into Laucala Bay causing the sediment load of the lagoon to increase dramatically during periods of flooding. As a result of the high sediment load, the hard coral cover on Sandbank Reef is similar to that on Ballance and Cokota Reefs, however, the algal cover is significantly greater. If one were to compare the status of the four reefs, Cokota Reef is impoverished in terms of species diversity and abundance.



Exposed Reefflat of Cokota Reef

PLATE 2



Soft coral at the crest of Cokota Reef

## 4.3 Sediment and Shellfish

Standards for oil and grease in sediments/soil is not available to us and neither have we been able to get background level but as mentioned elsewhere Ports Authority of Fiji standards for discharges state the level at 50 mg/l. The amount determined in the South end is so much higher than the levels in the North end for obvious reasons - the sediment sample was collected about ten meters from the actual jetty where any oil spillage from boats is most likely to originate.

The Australian Health & Medical Research Council (ANC & MRC) have specified maximum lead concentration of 10 mg/kg in shellfish for human consumption. Oyster collected from along the Natovi coastline was 0.31 mg/kg which is well below the limit.

## 4.4 Water Quality

Except for turbidity, water quality around the Natovi jetty was found to be within acceptable levels for recreational waters. Temperatures at the two sites were 27$^{0}$C while dissolved oxygen measurements were both near saturation (8 mg/l) reading 6 and 7 mg/l. Salinity at 34 ppt for both sites indicated normal conditions; open seawater usually read 35 ppt.

It seems that water turbidity/(clarity) poses the greatest problem. Marine charts indicate that depths at the sampling sites were between 9 to 10 meters; secchi depth measurements for turbidity in the area was limited to 2.5m at the North end and 3m near the jetty. The rather low reading (high turbidity) implies that there is a lot of suspended materials suggesting heavy siltation - this was also evident on this survey day when the ferry boat Adi Savusavu docked at about 1.00 pm - particulate matter were resuspended resulting in very murky waters.

Nutrient concentration (phosphate and nitrate) compare well with cleaner waters. Laucala Bay and Suva Harbour waters have been found to have average concentration of phosphate at 39 ug/l and nitrate at 76.6 ug/l. Phosphate levels considered favourable for normal coral growth is 10 - 30 ug/l while nitrate in unpolluted waters have showed concentrations from 30 - 300 ug/l.

The World Health Organisation guidelines for levels of total and faecal coliform in recreational waters are 1000/100 ml and 200/100 ml respectively so numbers obtained from the survey tend to imply a reasonably clean water. The higher faecal coliforms count found in the sample collected from the North end of the study area could be attributed to possible sewage enrichment from the nearby village.

Oil and grease level at 11 mg/l was below the standard (50 mg/l) set by the Ports Authority of Fiji for discharges into port areas.

## 5.0 CONCLUSION

Even though water quality compares well with less polluted waters around Fiji the reefal system along the shoreline is already very badly degraded. Results of this study suggest strongly that the present impoverished state of the area as a fishery has been influenced a great deal by the high silt load. It must be emphasised that this survey was conducted only as a preliminary assessment of the marine environment around the proposed area for the expansion of the Natovi jetty.

## BIBLIOGRAPHY

English, C., Wilkinson, C. Baker V. (eds) 1994. Survey Manual for Tropical Marine Resources. Australian Institute of Marine Science, Townsville, Australia, 368pp.

King M and McIlgorm A. 1989. Fisheries Biology and Management for Pacific Island Students. International Development Program of Australian University and Colleges, Flinders University. 67pp.

Myers, M.R.F. 1989. Micronesian Reef Fishes. Coral Graphics, Guam.

Naqasima, M. 1995. Baseline Biological Study of the Yanawai River and the adjacent reefal system. IAS Environmental Report No. 77, University of the South Pacific, Suva.

Tamata, Bale R., LLoyd, C.R. and Green, D. Water Quality in the Ports of Fiji - 1992 Monitoring Programme. IAS Environmental Studies Report No. 67, University of the South Pacific, 82p + appendices.

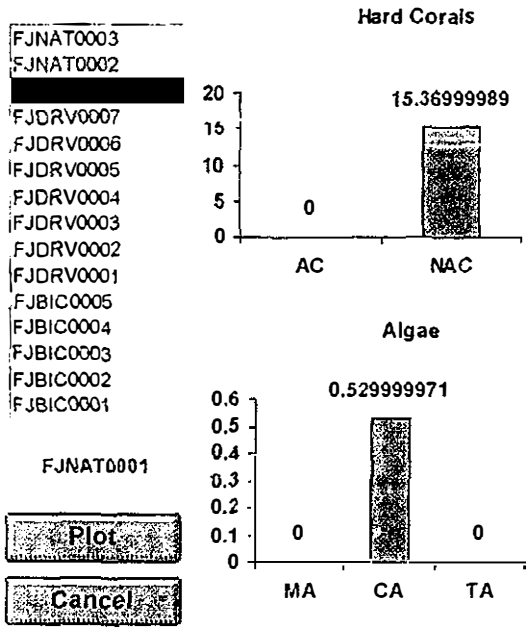
Environmental Consultants Fiji. 1995. A Marine Survey of Vuda Point, Ba Province, Viti Levu.

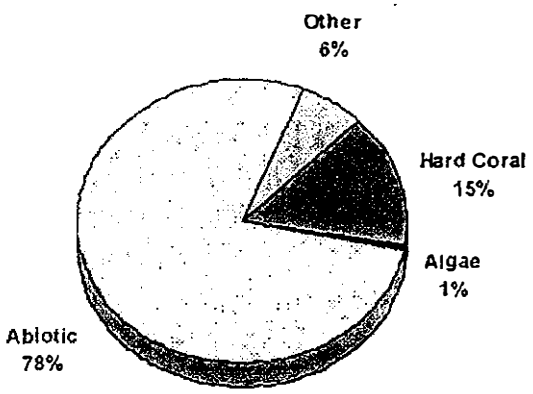
APPENDIX 1

Lifeform categories and codes.

| CATEGORIES | | CODE | NOTES / REMARKS |
|---|---|---|---|
| **Hard Coral:** | | | |
| Dead Coral | | DC | recently dead, white to dirty white |
| Dead Coral with Algae | | DCA | this coral is standing, but no longer white |
| Acropora | Branching | ACB | at least 2° branching, e.g. *Acropora palmata, A. formosa.* |
| | Encrusting | ACE | usually the base-plate of immature *Acropora* forms, e.g. *A. palifera* and *A. cuneata* |
| | Submassive | ACS | robust with knob or wedge-like form e.g. *A. palifera* |
| | Digitate | ACD | no 2° branching, typically includes *A. humilis, A. digitifera* and *A. gemmifera* |
| | Tabulate | ACT | horizontal flattened plates e.g. *A. hyacinthus* |
| Non-*Acropora* | Branching | CB | at least 2° branching e.g. *Seriatopora hystrix* |
| | Encrusting | CE | major portion attached to substratum as a laminar plate e.g. *Porites vaughani, Montipora undata.* |
| | Foliose | CF | coral attached at one or more points, leaf-like appearance e.g. *Merulina ampliata, Montipora aequituberculata.* |
| | Massive | CM | solid boulder or mound e.g. *Platygyra daedalea.* |
| | Submassive | CS | tends to form small columns, knobs, or wedges e.g. *Porites lichen, Psammocora digitata* |
| | Mushroom | CMR | solitary, free-living corals of the *Fungia* |
| | *Millepora* | CME | fire coral |
| | *Heliopora* | CHL | blue coral |

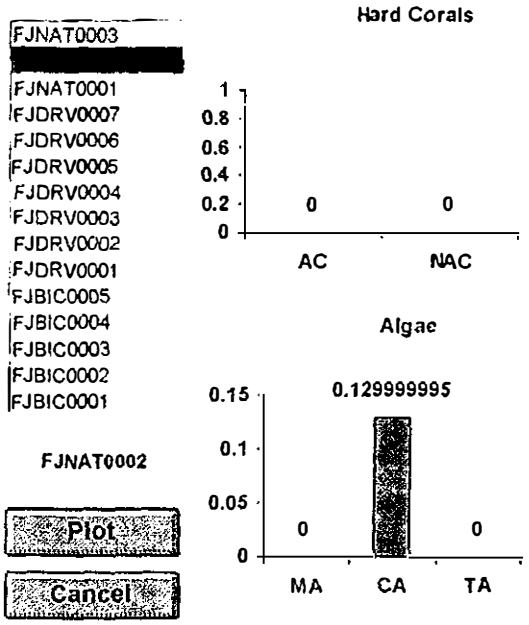
| CATEGORIES | | CODE | NOTES / REMARKS |
|---|---|---|---|
| **Other Fauna:** | | | |
| Soft Coral | | SC | soft bodied corals |
| Sponges | | SP | |
| Zoanthids | | ZO | examples are *Platythoa, Protopalythoa* |
| Others | | OT | Ascidians, anenomes, gorgonians, giant clams etc. |
| Algae | Algal Assemblage | AA | consists of more than one species |
| | Coralline Algae | CA | |
| | *Halimeda* | HA | |
| | Macroalgae | MA | weedy/fleshy browns, reds, etc. |
| | Turf Algae | TA | lush filamentous algae, often found inside damselfish territories |
| Abiolic | Sand | S | |
| | Rubble | R | unconsolidated coral fragments |
| | Silt | SI | |
| | Water | WA | fissures deeper than 50 cm |
| | Rock | RCK | |
| Other | | DDD | Missing data |

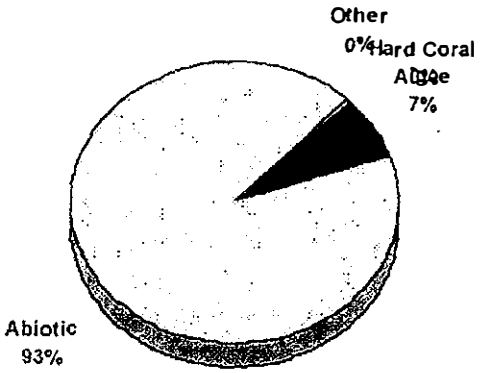



Percent Cover of Main Benthic Forms

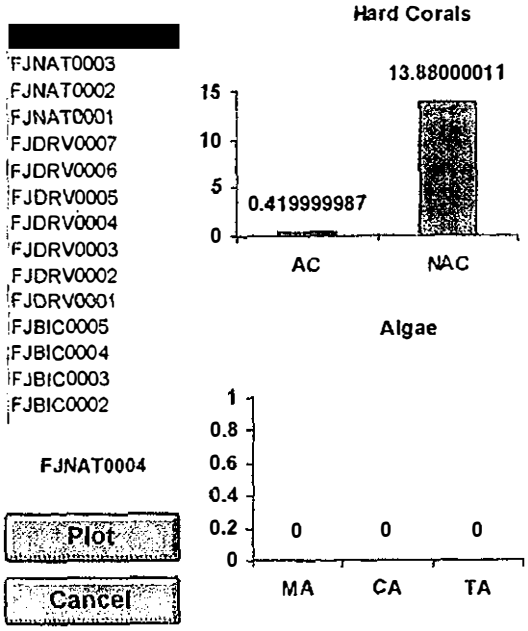
COKOTA REEF SLOPE

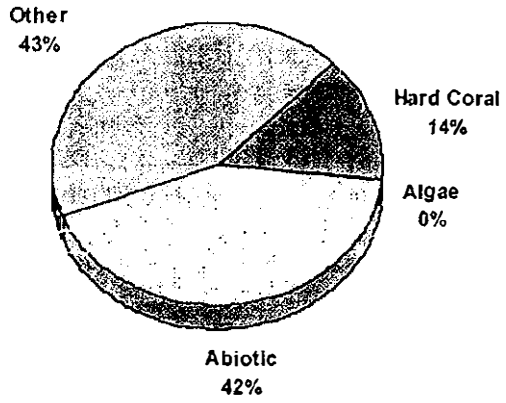



Percent Cover of Main Benthic Forms

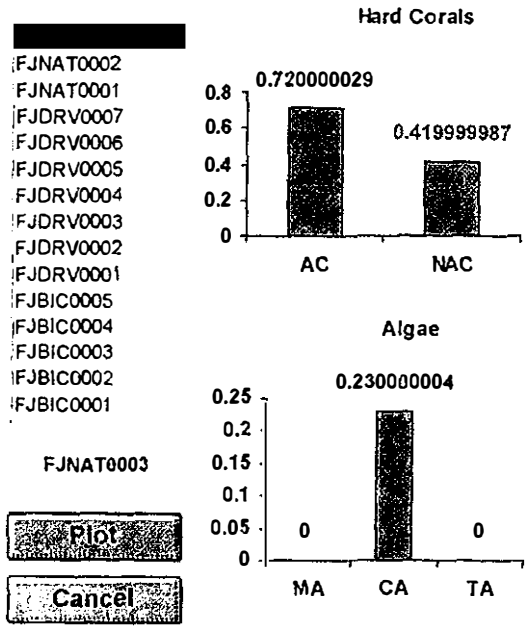
COKOTA REEF FLAT

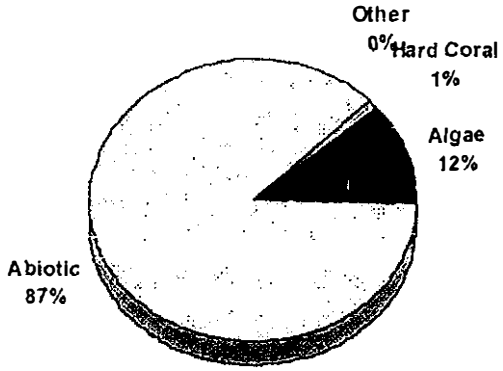



Percent Cover of Main Benthic Forms

BALLANCE REEF SLOPE




Percent Cover of Main Benthic Forms

BALLANCE REEF FLAT

**APPENDIX 3**

The following statements were made in response to the comments on the draft report from the Namena Tikina Council as stated below:

a) *An opinion on the future impact on the environment of the area surveyed if the current usage by boats, of the Natovi Jetty continues at the current level for say 5 years and 10 years from now.*

b) *We are planning as a follow- up to this project, a programme of Environment Education and Awareness for our people in the Tikina. Can you please put forward some recommendations or guidelines that can be adopted by the Namena Tikina Council in order to safeguard the marine life and resources from the sea in the area covered in the study?*

Point A

If usage of the Natovi Jetty continues at the current level there should not really be much change to the area from what it is now in time to come. I must add that because of the existing high silt loading in the area, the present jetty users could cause disturbance each time they dock or undock depending on the manner they conduct it i.e. whether it is stern or bow first and whether they will let the engine run for sometime while docking (users could be requested to always dock bow first). The Natovi Jetty is in a sheltered shore implying that any sediment reaching it is be protected from any ocean current effect and sediments will only shift from place to place within the area whenever there is disturbance by propellers.

Point B

The Namena Tikina Council could organise workshops in each village that will cover the following areas :

1. **Mangroves swamps**

a) protection of the mangrove swamp as a habitat with emphasis on the interdependence of plants and animals.
b) its importance as a breakwater and as a coastline guard.
c) the importance of selective cutting and replanting.

## 2. Coral reef

a) information on coral reef as a microhabitat- interdependence of plants and animals.
b) its importance in protecting the shoreline.

## 3. Fishing Methods

a) Adopting good fishing methods.
b) Identifying destructive fishing methods.
c) Overfishing.

## 4. Agricultural practices

Importance of good agricultural practice and minimising soil erosion to prevent coral reefs being smothered by sediment washed down by surface runoffs.

## 5. Forestry

Minimising forest removal and also selective cutting as a means of preventing soil erosion which as stated above is damaging to coral reefs.