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BIOLOGICAL STUDY OF THE YANAWAI RIVER AND THE ADJACENT REEFAL SYSTEM

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BIOLOGICAL STUDY OF THE YANAWAI RIVER AND THE ADJACENT REEFAL SYSTEM

Milika Naqasima-Sobey, Biology Dept., Univ., of the South Pacific

0.0 Executive Summary

The survey was undertaken to monitor the state of the fisheries in the Yanawai river and the benthic community of the adjacent reefs to determine if there had been any impacts of the gold mining at Mt Kasi. A baseline survey was conducted by the Institute of Applied Sciences in 1995 which has been followed by two monitoring trips in 1996 and 1997. The gillnetting results of the present survey would indicate that the fisheries is in a relatively healthy state. The reef sites are typical of those close to freshwater input and impacted by sedimentation. There has been no significant change observed in benthic cover except for site 4 where there has been a substantial increase in algal growth.

1. Introduction

1.1 Background

The Institute of Applied Sciences at the University of the South Pacific was subcontracted by Harrison and Grierson (Fiji) in December 1994 to conduct a baseline survey of the Yanawai River and the adjacent reefal system to determine the existing fisheries and water quality of the river and the health of the surrounding reefs. It was part of an Environmental Impact Assessment commissioned by Pacific Islands Gold N.L, the company that was to mine Mount Kasi. The results of this baseline survey are presented in Naqasima (1995). The Institute has since conducted two trips to the study area in 1996 and 1997 to monitor the parameters investigated in the initial study.

The villagers from Dawara on the banks of the Yanawai River fish actively and engage largely in subsistence fishing. The villagers have expressed concern at the possible impacts of the mine on their fishing grounds thus regular monitoring of the catch rates in the river is necessary to determine any possible effects. A widely used index of relative abundance of fish is the catch per unit effort (CPUE). If standardised fishing gear is employed, comparisons of catch rates can be made between different areas or for the same area but at different times. Catch per unit effort can be expressed as kilograms caught per unit time (kg/hour) or number caught per unit time (number/hour). Gillnetting is a standard fishing technique that can be used to measure stock abundance. It was used in the initial survey to assess species abundance and diversity and has been used on subsequent trips for the same purpose.

Any impacts on the adjacent reefs would also need to be monitored since the reefs not only provide food for the villagers but also play other important functions in the coastal environment. Six reef sites were selected in the initial survey where the benthic community was assessed using the transect and quadrat method and a photographic record was compiled. Five of the original six sites have been revisited on both monitoring trips where the Line Intercept Transect (LIT) method has been used instead to assess the benthic community. Sites 1, 2, 3, 4 and 6 were found on subsequent trips using the GPS readings recorded on the initial survey, compass bearings and the marine chart.

1.2 Approach

In some fisheries, estimates of absolute abundance are required ie., total number of individuals. In many situations, however, it is sufficient to obtain estimates of relative abundance ie., the number present in one area in relation to the number present in another area, or in the same area at another time. There are several methods that can be used to determine absolute abundance of fish stocks. One can attempt to take a total count, which is only possible in very few cases. It is more common to take partial counts where parts, or samples, of the population are counted, and the total population estimated from these data. The stock abundance of fish can also be determined using the tagging-recapture method, depletion method, underwater visual census and by the use of acoustic methods. All of these are time-consuming methods and expensive. Given the time and financial constraints of the study, an estimate of relative abundance was deemed sufficient; a comparison of CPUE values obtained at different sampling times was made.

The 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 are covered by that object. There are, however, certain assumption 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).

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.

There are other methods that can be used for assessing the health of coral reefs and these include the manta tow, permanent quadrat, transect and quadrat method and the point quarter method. The LIT method was selected for this study for the following reasons:

(a.) LIT is a reliable and efficient sampling method for obtaining quantitative percent cover data.

(b.) It requires little equipment and is relatively simple.

(c.) The method is not as subjective. It allows the collection of useful information by persons with limited experience in coral reef studies but who have become familiar with the different lifeform categories.

(d.) LIT can provide detailed information on spatial pattern.

(e.) If LIT is repeated through time with sufficient replication, as is the case in this study, it can provide information on temporal change.

2.0 Materials & Methods

2.1 Fisheries assessment

A net 50m in length with 3" mesh size was deployed at each of the two sites sampled on previous trips: Sites n1 and n2 (see Map 1). The net was set three times at site n1 and four times at site n2. The first set at both sites was for 3.5 hours during an ebb tide. The second set was only at site n2 for 17 hours. The third set was at both sites for 6 hours during an ebb tide and the fourth and final set was at both sites for 18 hours. After each set, the catch was recorded, weighed and photographed.

2.2 Reef studies

Five reef sites were revisited in the present survey : sites 1, 2, 3, 4, & 6. At each site five 20m transects were laid at a depth of 3m and the LIT method employed with the aid of SCUBA gear. The data was analysed using the ARMDES programme and pie charts were generated (attached as Appendix 2). Photographs were also taken at each site.

3.0 Results & Discussion

3.1 Fisheries Assessment

The first set of the net at both sites yielded no catch after a soak time of 3.5 hours. The second set was at site n2 for a soak time of 17 hours and the catch included a mangrove crab (*Scylla serrata*), two Bluetail Mullets (*Valamugil seheli*) and one Flagtail (*Kuhlia rupestris*) - see Photo 1. The catch weighed 11.67g giving a CPUE value of 0.0007 kg/hr. There was nothing caught on the third set of the net at both sites. The net was set for a fourth time at each of the two sites for a soak time of 18 hours. At site n1, the catch included two mangrove crabs and seventeen fish which included two Bluetail Mullets, two Trevallies (*Caranx ignobilis*), two Mangrove Jacks (*Lutjanus argentimaculatus*), three Tilapia-like species, and four unidentified species (see Photo 2). The weight of the catch was 6.6kg giving a CPUE value of 0.36 kg/hr. The catch at site n2 included one trevally and one mangrove crab which weighed a total of 1.4kg giving a CPUE value of 0.077 kg/hr (see Photo 3).

Table 1 compares the CPUE values obtained at the two sites over the past two sampling trips.

Table 2 lists the fish species caught in the gill netting surveys in the Yanawai river.

Table 1 CPUE values obtained for sites n1 and n2 in 1996 and 1997

SITE	CPUE (kg/hr)		
	Sept., 1996		Oct., 1997
n1	0.24		0.36
n2	0		0.077

Table 2 Fish species caught in the gill netting surveys in the Yanawai river

Species Name	Common name	Local name
Valamugil seheli	Bluetail Mullet	kanace
Rastrelliger kanagurta	Chub Mackerel	salala
Caranx ignobilis	Great Trevally	saqa
Lutjanus argentimaculatus	Mangrove Jack	damu
Tilapia mossambica	Tilapia	maleya

The species abundance and diversity at both sites increased over the past year. There were only two species caught at site n1 in 1996 whereas there were at least twice that number caught in 1997. The catch at n2 was less than n1 which has been the case in the past however the CPUE value for site n2 increased by 7% whilst the CPUE for site n1 increased by 12%. Catches were recorded when the nets were set for a period long enough to include both a rising and falling tide. As observed on previous sampling trips, the fish caught were largely marine species. The river is evidently tidally influenced and thus reef and lagoonal fish would forage for food in the river at high tide. The increase in CPUE values would indicate that the fisheries in the Yanawai river is in a fairly healthy state. There was no sediment plume observed at the mouth of the river as seen in 1996 and the volume of soft sediment that was also observed at the junction of Vuci Creek and Yanawai river in 1996 was not seen on this trip. It could mean that sedimentation from the mine has been brought under control.

As seen on previous trips, there were men and women fishing in the river from dugout canoes and boats with outboard engines. The women were seen handlining from the dugouts whilst the men used lines as well as gillnets. The villagers are obviously still actively fishing in the river largely for subsistence purposes.

3.2 Reef Studies

The reef sites surveyed are comparable to those found off Viti Levu that are subjected to sedimentation and freshwater input like Ballance Reef, Tailevu and the Sandbank Reef in the Suva Barrier Reef complex (Kubuabola & Naqasima-Sobey, 1996). Of the five reef sites revisited, one site in particular showed a significant change in benthic cover from previous visits.. Site 4 showed a significant increase in algal cover with large clumps of the brown algae *Hydroclathrus sp.* forming a continuous cover (Photo 4).

Table 3 is a summary of the percent cover of the main benthic lifeforms observed at the five sites and Table 4 makes a comparison between benthic data collected in 1996 with those collected on this trip.

Table 3 Percent cover of the main benthic forms as observed in the five reef sites

Site	Reef zone	Percent cover of Benthic Life Forms			
		Hard corals	Algae	Other	Abiotic
1	slope	21	14	4	61
2	slope	24	20	11	45
3	slope	10	14	4	72
4	slope	17	46	5	32
6	slope	18	28	15	39

Table 4 Comparison of benthic data collected in 1996 & 1997

Site	Reef zone	Percent cover of Benthic Life Forms							
		Hard corals		Algae		Other		Abiotic	
		1996	1997	1996	1997	1996	1997	1996	1997
1	slope	9	21	0	14	2	4	89	61
2	slope	20	24	14	20	7	11	59	45
3	slope	4	10	14	14	12	4	70	72
4	slope	15	17	25	46	50	5	10	32
6	slope	21	18	13	28	60	15	6	39

Site 1 had a greater hard coral and algal cover than that seen the previous year although the volume of silt was still significant (Photo 5). Of the five sites, the visibility was lowest at this site due to suspended sediment in the water. The sediments are probably terrigenous since it is the site closest to the mainland and to the mouth of the Yanawai river and the high sediment load is probably a contributing factor to the increased algal cover. The hard corals observed were those species that are adapted to living in a silty environment like *Montipora sp.* and *Porites sp.*

Of all the sites surveyed, site 2 boasted the most luxuriant growth of hard and soft corals (Photo 6). The most dominant species of hard corals were of the genus *Acropora* and there were particularly large stands of *A. subglabra* commonly referred to as bottlebrush coral. The other dominant genera included *Pocillopora, Montipora* and *Porites*. The sponge *Gelliodes sp.* was also quite abundant.

The most notable feature observed at site 3 was the prolific growth of sponges belonging to the genera *Gelliodes* and possibly *Clathria* (Photo 7). The low coral cover and high abiotic content observed at this site can be attributed to its high degree of exposure and the impact of heavy wave action during periods of rough weather. The extensive growth of the brown algae *Hydroclathrus sp.* observed at site 4 was a very notable change from the previous visit. When a reef becomes degraded, there is a shift from a coral-dominated to an algae-dominated system. The excessive algal growth is usually attributed to excessive nutrient and sediment input. Since this site is not far from the mouth of the river it is very possible that nutrients brought down the river are responsible for the algal bloom.

Site 6 was seen to have a greater volume of sand than seen on the last visit. The encrusting blue-grey sponge first observed in 1996 was still dominant although not as ubiquitous as in the previous survey (Photo 8). The algal cover increased possibly as a result of increased sedimentation. The most dominant coral species were those belonging to the genera *Porites* and *Montipora*, both of which are common inhabitants of shallow back reefs with a sandy bottom and minimal wave action.

4.0 Conclusions

* Reefs that are subjected to human activities and terrigenous sediments will have a greater abiotic content and algal cover and low live coral cover as observed at four of the five sites revisited.

* The most significant change in benthic cover was the increase in the brown algae *Hydroclathrus sp.* observed at site 4.

* The relative abundance of fish in the Yanawai river appears to have increased as seen by the rise in CPUE values over the past year.

5.0 Suggestions for Future Work

a. Sediment traps should be deployed at stations along the river and regular turbidity measurements taken to monitor the sediment load being discharged by the river.

b. The fishery should also be monitored by sampling with gillnets at the same sites (ie.n1 and n2) on the same days of the lunar month for 12 months. This would be to determine if the changes in CPUE values observed on this survey are a true indication of a healthy fishery and whether there are any seasonal fluctuations.

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Photo 1 Catch recorded at site n2 after the second set of the net

Photo 2 Catch recorded at site n1 after the fourth set of the net

Photo 3 Catch recorded at site n2 after the fourth set of the net

Photo 4 Extensive growth of the brown algae *Hydroclathrus sp.* observed at reef site #4