Preliminary report on the live rock assessment in the Kalokolevu collection area.

20- 21st, 24th- 26th January 2004

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Table of Contents

Figures

Tables

1.0 Introduction

The live rock collection site for Water Life Exporters Fiji (WLEF) Ltd is located at Kalokolevu Village along the coast, 15km off Suva on the mainland Viti Levu, Fiji (see Map 1). Water Life International has been collecting live rock in this area for the last 5 years. WLEF has a fishing agreement with the custodian for 15 years from ?

This is a baseline monitoring of their collection site.

1.1 Type of Live Rock at Kalokolevu

Live rock has been described as " a living organism or an assemblage thereof attached to a hard substrate (including dead coral or rock, usually calcareous). In Kalokolevu there are two different types of the collectable live rock:

- Hard Solid whole rock with bright colored algae (encrusting coralline) similar to the ones collected at **Coral Coast** – this is found in sandy silt substrate near the mangrove shoreline. Apparently, these rocks have been brought in during periodic disturbances.
- Hard porous rocks with macro-branches and have lots of holes in them. This is a traditional classic trademark variety for Kalokolevu. These are found further out behind the reef flat areas on dead Acropora and large boulder calcareous coral. These rocks are much lighter in mass compared to the ones near the coastline.

1.2 The Collectable Live Rock Species

The survey team spent some days before the actual survey with the collectors out in the field observing them collecting and interviewing them about their expertise in terms of identifying the collectable live rocks. When the live rocks were delivered to the WLEF warehouse, the team examined, weighed and categorized the rock separately to get a practice of estimating their mass when doing the actual survey. The rocks were later screened and treated by the warehouse worker before exporting overseas.

This exercise of becoming familiarized with the product is fundamental in helping to identify and estimate the collectable live rock during the field survey.

Figure 1: Map of Vitilevu, Fiji

1.3 Objectives

The objective of this survey for Water Life Exporters Fiji Ltd (WEF) were:

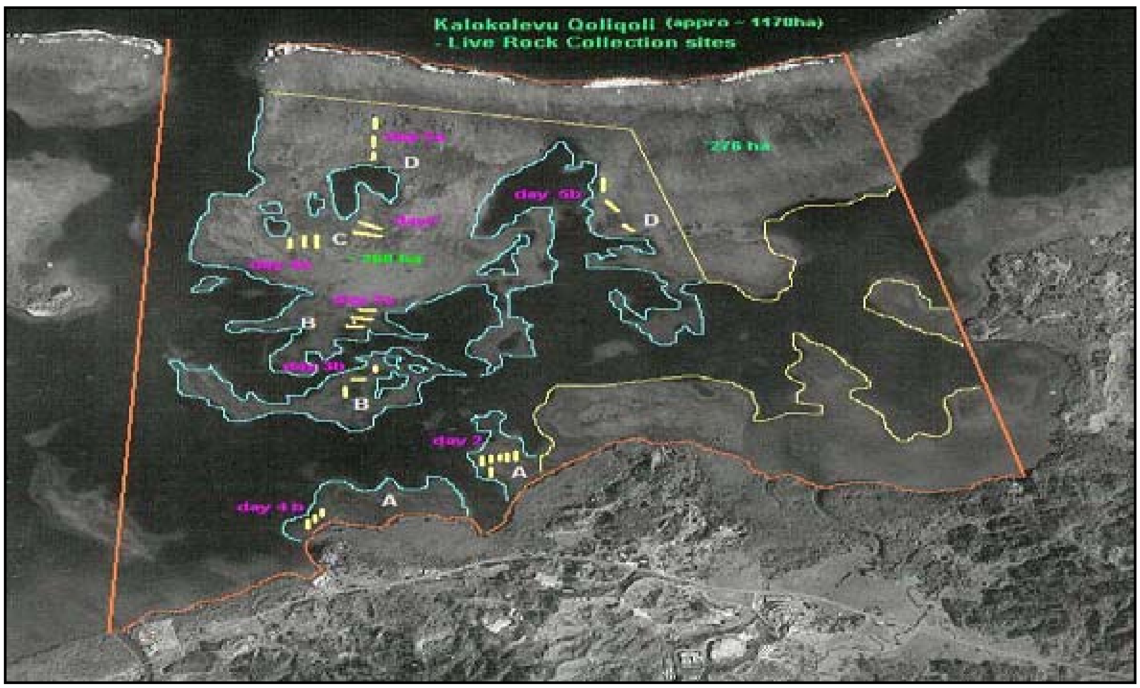
- ✓ To provide baseline Information as a requirement for the development of the (MAC Certifiable) Collection Area Management Plan (CAMP).
- ✓ To initiate MAQTRAC monitoring with recommendations for an on-going Monitoring Assessment
- ✓ To assist the Fiji Government's requirement for site-based resource quotas

2.0 Methods

2.1 Site Selection

The collection sites for the live rock was about 3km away from Kalokolevu Village sea front and upwards toward the Barrier Reef. The survey team was accompanied by two local collectors who assisted in identification of collection sites and data collection. The sites studied were the areas that were previously collected from and those where current collection was taking place (see Fig 2).

Figure 2: Collection and non-collection sites within the Kalokolevu qoliqoli



2.2 Survey method

The survey method was based on MAQTRAC using the following:

1) Point intercept Transect (PIT);

   Point intercept transect (PIT) is used to describe the reef. The method assesses the substrate every 0.5m over a 20m length. To prove comparison of the reef structure, PIT were positioned to sample the environment among the reef systems under consideration. Readings are taken along the tape every 0.5m and the underlying benthic attributes recorded.

2) Belt Transect.

Belt transect is used to quantify and estimate the weight of Collectable LR in each site. The method assesses the reef on a 5m diameter over a 20m length. Each transect consist of four replicate, 5m wide x 20 m length segment. Each Replicate segment is separated at least by a 5m gap along a 100m transect line.

3) Swim Transect

Swim surveys are the most important of all survey techniques for assessing the occurrence of organisms suitable for aquarium collection due to their dispersed nature. Metered or timed swims are the preferred method for gathering information about a wider number of species than occurs using set transects. Swim searches and collecting is what the collectors do, so this method is more indicative of the nature of the resource which can be both dispersed or clumped depending on the species or habitat. This is important in assessing abundance, which is used to extrapolate to the larger collecting area.

Results of field data were pooled into 3 groups based on habitat and entered into EXCEL. Data was presented using pie charts.

2.0 Results

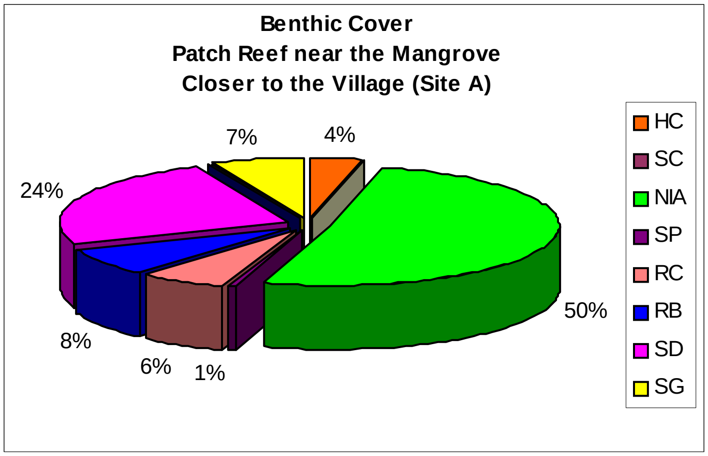
A total of 26 transects were surveyed in 5 days (See table 1).

Table 1: Site descriptions and types of Collectable Rocks and GPS coordinates

Day	Site description	Site	Type of Live Rock	Number of Transect	GPS Coordinates
1	Located in Middle of the barrier reef, closer to the reef crest than to the shoreline, sargassim dominated area	C	Porous branching rocks (Dead Acropora) with macro-algae covering	2	S18^{O}09.330, E178^{o}19.400
2	Located slightly to the west of the village on a Patch reef in front of the mangrove	A	Medium- large size solid type of rock with bright algae color	6	S18^{o}09.744, E178^{o}18.668
3	Patch Reef on the edge of the middle reef towards the lagoon channel	B	Solid rocks with lots of holes on it- used crowbar a lot here	3	S18^{o}09.067, E178^{o}19.158
	Patch Reef –close to the lagoon channel; Leone’s reef	B	Lot of hard solid rocks	3	S18^{o}09.881, E178^{o}19.135
4	Located in the middle of the barrier reef towards Namuka Island	C	Branching rock with holes covered by sargassum	3	S18^{O}09.332, E178^{o}19.545
	Located near the village closer to the mangrove patch, sargassum present but *Padina* predominated	A	Solid hard rock with colorful encrusting coralline algae	3	S18^{o}09.333, E178^{o}19.547

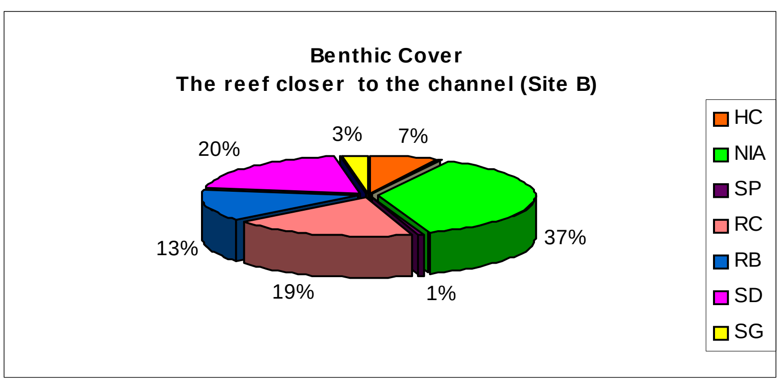
5	Barrier reef close to the crest. A lot of exposed rubble present	D	The LR rock is attached to the base. Coralline algae covered with *Sargassum*. The base is white.	3	S18°09.794, E178°19.631
	Barrier reef closer to the end of their Qoliqoli boundary towards the western end of the reef	D	Large boulder rocks covered with Sargassum. Crowbar is used to chip rocks into small pieces	3	S18°09.794, E178°19.538

Figure 4: Assessment of reef Substrate and general health-site A



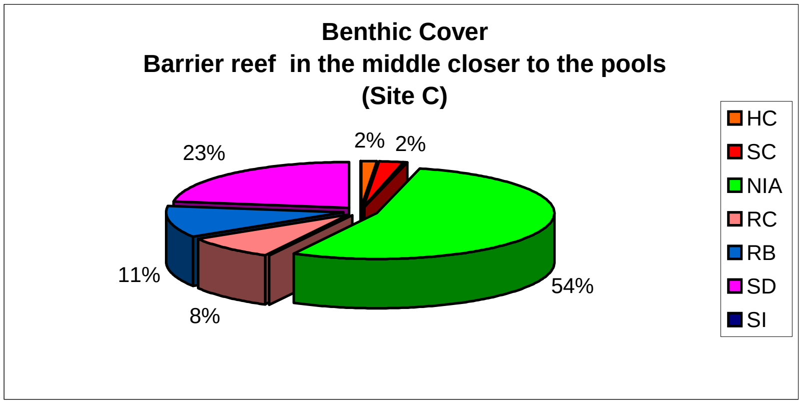
The Nutrient indicator algae (NIA) referred to on all the 4 graphs mainly consists of *Sargassum*. It is becoming one of the most conspicuous features of reef flats in the Qoliqoli. On this graph 81% of the *Sargassum* was growing on top of the collectable live rock, 14% was on rubble and 5% was on sand. The RC on the 4 graphs refers to the non-collectable material characterized by dead corals or rocks without coralline algae.

Figure 5: Assessment of reef Substrate and general health-site B



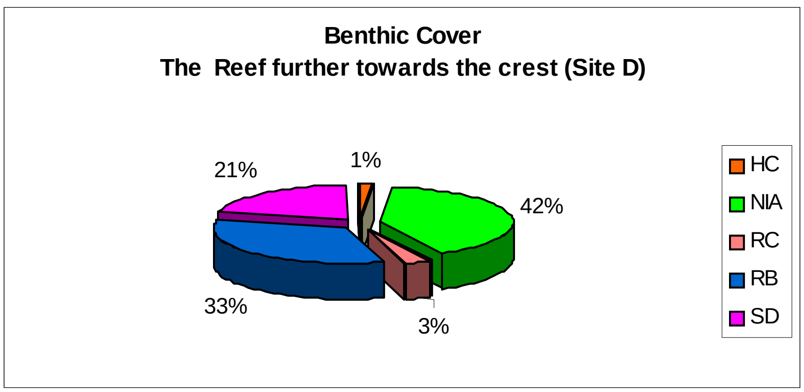
The NIA in the above graph is Sargassum and 57% of it grew on top of the Collectable Live Rock, 42% was on Rubble and 1% was on sand.

Figure 6: Assessment of reef Substrate and general health-site C



53% of the Nutrient indicator algae (Sargassum) were on top of the live rock, 45% were on rubbles and 2 % were on sandy patch.

Figure 7: Assessment of reef Substrate and general health-site D



74% of the NIA was laying on top of the Collectable LR Species 25% was on rubble and 1% was on sand

Table 2: Summary of the estimated Live Rocks (Kg) using the Belt transect

20-Jan-05	**Day 1**							
		Segment 1	**Segment 2**	**Segment 3**	**Segment 4**	**Total (kg)**	**Mean**	**STDEV**
9.00am	**Transect 1**	200.6	98.9	102.3	116.2	518	129.5	47.99
10:45am	**Transect 2**	106.3	120	123.3	106.6	456.2	114.05	8.88
	(2x400m^2)				**Total**	**974.2**	**243.55**	
21-Jan-05	**Day 2**							
		Segment 1	**Segment 2**	**Segment 3**	**Segment 4**	**Total (kg)**	**Mean**	**STDEV**
8:00am	**Transect 1**	301.4	107.3	129.5	125.4	663.6	165.90	90.85
8:50am	**Transect 2**	258.1	217.5	99.5	245.5	820.6	205.15	72.45
9:30am	**Transect 3**	369	325.3	263.4	235	1192.7	298.18	60.42
10:15am	**Transect 4**	180.6	218.4	139.4	135.9	674.3	168.58	38.93
11:15am	**Transect 5**	305.3	277.8	335.9	458.45	1377.45	344.36	79.67

12.05pm	**Transect 6**	325.1	175.6	296.9	187.8	985.4	246.35	75.70
	(6x400m^2)				**Total**	**5714.05**	**1428.51**	
24-Jan-05	**Day 3**							
		Segment 1	**Segment 2**	**Segment 3**	**Segment 4**	**Total (kg)**	**Mean**	**STDEV**
9:10am	**Transect 1**	171.1	127.2	124.5	285.4	708.2	177.05	75.33
10:01am	**Transect 2**	234.8	246.9	481.4	433.4	1396.5	349.13	126.65
10:46am	**Transect 3**	293.8	271.5	267.1	sandy patches	832.4	277.47	14.32
11:45am	**Transect 4**	306.7	241.2	273.7	174.9	996.5	249.13	56.25
12:40pm	**Transect 5**	107	193.3	347.9	346.5	994.7	248.68	119.10
1:15pm	**Transect 6**	174.9	157.2	88.3	79.6	500	125.00	48.08
	(6x400m^2)-100m^2				**Total**	**5428.3**	**1426.44**	
25-Jan-05	**Day 4**							
		Segment 1	**Segment 2**	**Segment 3**	**Segment 4**	**Total (kg)**	**Mean**	**STDEV**
9:15am	**Transect 1**	100.3	193.7	219.7	145	658.7	164.68	52.92
10:25am	**Transect 2**	280.9	256.8	219.8	211	968.5	242.13	32.59
11.05am	**Transect 3**	172.2	179.1	213	163.3	727.6	181.90	21.72
11:55am	**Transect 4**	345.9	349.7	215.9	141.8	1053.3	263.33	102.14
12:35am	**Transect 5**	263.7	313.7	368.6	393.8	1339.8	334.95	58.09
1:15pm	**Transect 6**	242.4	254.7	264.6	341.7	1103.4	275.85	44.83
	(6x400m^2)				**Total**	**5851.3**	**1462.83**	
26-Jan-05	**Day 5**							
		Segment 1	**Segment 2**	**Segment 3**	**Segment 4**	**Total (kg)**	**Mean**	**STDEV**
9:30am	**Transect 1**	152.3	150.6	183.2	144.1	630.2	157.55	17.46
10:34am	**Transect 2**	189.3	252.7	268.2	262.2	972.4	243.10	36.43
11:19am	**Transect 3**	185.9	221.6	171.7	123.1	702.3	175.58	40.80
12:03am	**Transect 4**	425	357.5	353.6	362.8	1498.9	374.73	33.73
12:56pm	**Transect 5**	250.8	285.9	226	361.3	1124	281.00	58.90
1:50pm	**Transect 6**	212.4	244.2	165.5	235.9	858	214.50	35.33
	(6x400m^2)				**Total**	**5785.8**	**1446.45**	

Table 3: Total Collectable Live Rock Surveyed

Total Live Rock Surveyed (Kg)	23753.65
Total Area Surveyed(m^2)	10300
Density (Kg/M^2)	2.28

Table 4: *Area of reef within the Kalokolevu lagoon and coastal areas*

Zones	Area in hectare (Calculated from Arial Map)	The collectable Live Rock (extrapolative) from the survey	
Qoliqoli of Kalokolevu (including Reef and sea)	1170	In Kilograms	In Tones
The Collection sites (reef surface)	257	5859600	**5859.6**
The non-collection sites (reefs surface)	276	6292800	**6292.8**

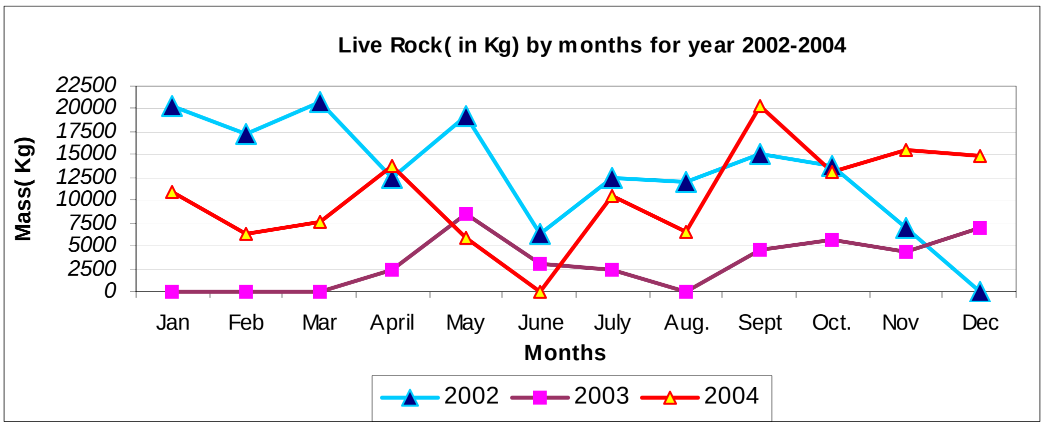
Export Data

Table 5: Live Rock by Mass (Kg) by Month for Years 2002-2004

Live Rock Exported (in Kg) per Month														
YEAR	**Jan**	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug.**	**Sept**	**Oct.**	**Nov**	**Dec**	**Average (Kg) per month**	**Total (Kg) per year**
2002	20380	17275	20800	12465	19309	6440	12558	12075	15180	13800	6900	-	14289.3	157182
2003		-	-	2300	8510	3105	2300	-	4600	5750	4347	6969	4735.13	37881
2004	10925	6256	7659	13846	5980	-	10580	6555	20355	13179	15410	14950	11426.8	125695

Source: WLEF

Figure 8: Graph showing the pattern of the exported live rock by month for Years 2002-2004



4.0 Discussion

General Reef Characteristics

Site A is a shallow reef in front of the mangrove patches closer to the village. The reef is subjected to nutrients and sedimentation runoff from the land. The corals are mostly solid and loose as from periodic disturbance. The water is about 1-2M deep during low tide. Sites B and C were topographically very similar, being flat shallow reef tops on a tide-washed barrier reef. The water is generally 1-2 M deep on these areas. Hard coral consisted mostly of large *Porities*, or micro atolls of branching *Porities*. Site D on the other hand was physically dissimilar, consisting of more rubble and sand as well as large dead coral boulders. In addition, it was more subjected to wave action due to its closeness to the reef crest.

Benthic Cover

The survey showed that all areas had a high percentage of Nutrient Indicator Algae (NIA), Sand (SD) and Rubble (RB). Consequently the way the survey was carried out was virtually targeting the areas where the collectors had been and were currently extracting live rock from. For this reason hard coral cover was significantly less in all the sites that were surveyed. Algal cover was high in all areas, mostly consisting of *Sargassum* with some *Padina.* According to Swarup (2004), *Sargassum* is an opportunistic beneficiary that is proliferating due to the degradation of reef conditions. It is a brown macro alga that is kept afloat by its air filled pneumatocysts that resemble berries. *Sargassum* persists on Kalokolevu reef as far as the crest, which indicated a high level of nutrients on the area

Although the *Sargassum* was dominant in our results (see figures 4-7), consideration was taken to re-examine and quantify the substrate that the *Sargassum* was growing on top of. The *Sargassum* was noted growing on top of either on rubble, sand or live rocks. The result showed that 58.4% of the *Sargassum* surveyed were growing on collectable live rock, 30% were on the rubble and 6.7 % were on sand.

Collectable Live Rock Species

There is an interesting difference in the type and composition of collectable live rock types between the 4 sites. From the historical data it was calculated that an average of 10.2 tonnes/month and 107 tonnes/year of live rock was exported from 2002- 2004 (see table 5). Using the survey data (see Tables 3 & 4) the estimated standing stock of collectable live rock material is 5859.6 tonnes in the current collection area and 6292.8 tonnes were in the non-collection area. However, from the historical data a total of 320 tonnes had been exported from the collection site from 2002-2004. Hence assuming that these are the only live rocks that have been removed from the collection area, the standing stock will be calculated as the difference between the extrapolated figure from the surveyed collection area minus and the total weight of the rock exported in the 3 mentioned years (See Table 6 for details).

Table 6: Summary of harvest data gathered from the historical records and resource assessment

Average Tonnes of rocks exported per month for the 3 years	Average tonnes of rocks exported per year	Total live rock exported from years 2002-2004 (t)	Extrapolated Collectable Stock from Resource Survey (kg)	Percentage extraction per year	Recommended Total allowable extraction rate per year
10.2	**107**	**320**	**5859.6**	**1.9%**	**1.9%**

5.0 Conclusion

This is the first comprehensive baseline assessment of this area, and it is suggested that it be repeated annually, and possibly 6- monthly, intervals to record the future process of the extraction. Within regards to the extraction rate, it is only prudent that the total allowable extraction rate per year for the next 15 years (based on the fishing contract agreement) for the Kalokolevu collection area should be 1.9% of the standing stock. Live rock collection is basically a mining practice because it is not a renewable resource. The MAQTRAC survey methods have been based on the assumption that these organisms reproduce and grow. However, significant recruitment of the live rock in the Kalokolevu collection area is subjected only to natural disturbance such as a hurricane to replenish the collectable material.

6.0.Recommendations

1. To aid in the formation of the survey, historical data from each company collecting in the area should be analyzed before the actual monitoring is carry out
2. Reduce observer bias through on-site training in the field and also at the company warehouse with respect to recognition of classification of the different types of live rock and also weight of different rocks. THIS WOULD BE THE MOST APPROPRIATE TRAINING FOR SURVEYING LIVE ROCK IN GENERAL
3. Continue and expand monitoring programs to give definitive answers to the questions posed, and to set sustainable quotas for collection based on actual regeneration rates
4. Adequate time is needed between extractions to allow the coralline algae to re-grow on the large boulder type rocks. This cannot be established properly without full surveys to determine the re-growth rate. Observation made by collectors is that it takes 3-4 months before an area is worth extracting from again. It is therefore logical to limit collection of an area or site to a maximum of once every 6 months, if not once a year
5. Establish a no take zone for a year initially, and monitor the rate of recovery
6. If extraction is extended to the non-collection site, baseline surveys should be carried out before extraction so that studies after extraction can really state the effect of extraction
7. The issue of waste needs to be addressed to reduce the amount of unnecessary damage in the collection areas. These are some of the ways this could be done;

i. Change the large crow-bars into smaller ones
ii. Train all collectors to grade their rocks while heaping them before placing them into the boat
iii. Limit the amount of harvesters per site

7.0 Reference

Swarup. S, 2005, The Ecological Relationships between Sargassum and the Coral reef with Particular emphasis on Suva Reef. Submitted for MS411, USP Marine School, Suva Fiji.