

**Ecosystem and Fishery Management (EFM) Plan
Information for the Marine Aquarium Council's
Collection Area Management Plan (CAMP)
for Walt Smith International, Fiji**

Coral and Live Rock

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1.0 Introduction

Collection Area Management Plans (CAMP) are required as part of the Marine Aquarium Council's (MAC) criteria for certification. Information contained in this report and the companion report *Creation of an Aquarium Fisheries Management (AFMP) for live rock, corals and other benthos in the Walt Smith International collection areas* (Lovell, 2002) will form part of the CAMP document and be assessed as part of the certification process. Reference is also made to the CAMP document concerned with fish collection, draft Collection Area Management Plan (CAMP) for Walt Smith International, Fiji by Helen Sykes.

This document contains reference to both the AFMP and Helen Sykes CAMP document where applicable. Information contained in this report is the historical collection data for live rock and live coral, updated product list for benthic species, a description of the monitoring programs and general recommendations pertaining to certification compliance.

Information follows the Implementation Manual for the Collection Area Management Plan (CAMP) provided by MAC.

2.0 Information relevant to the CAMP implementation outline

Information for the following CAMP section was taken from the Lovell, 2002 publication.

Section 2	<i>Description of the Collection Area</i>
2.1	Ecosystem
2.1.1	Geographical area of operation of the collection area
2.1.2	Features
2.1.3	Sensitive areas

2.1 Live Coral Collection: Location

The geographical area of operation for the Walt Smith International (WSI) operation falls within two separate areas. The live coral collection is on the reefs off Lautoka in an area extending broadly to Naviti Island in the Yasawas Islands. The second areas are the fringing reef qoliqoli's of Vatukarasa and Namada Villages adjacent Sovi and Tamanua Bay. An additional area is Namoli, Ba near Lautoka and a potential area of Sanasana Village, Nadroga near Natadola Bay.

2.2 Boundaries of the Collection

Figure 1. Shows the collecting areas of Walt Smith International in relation to the other collecting areas around Viti Levu.

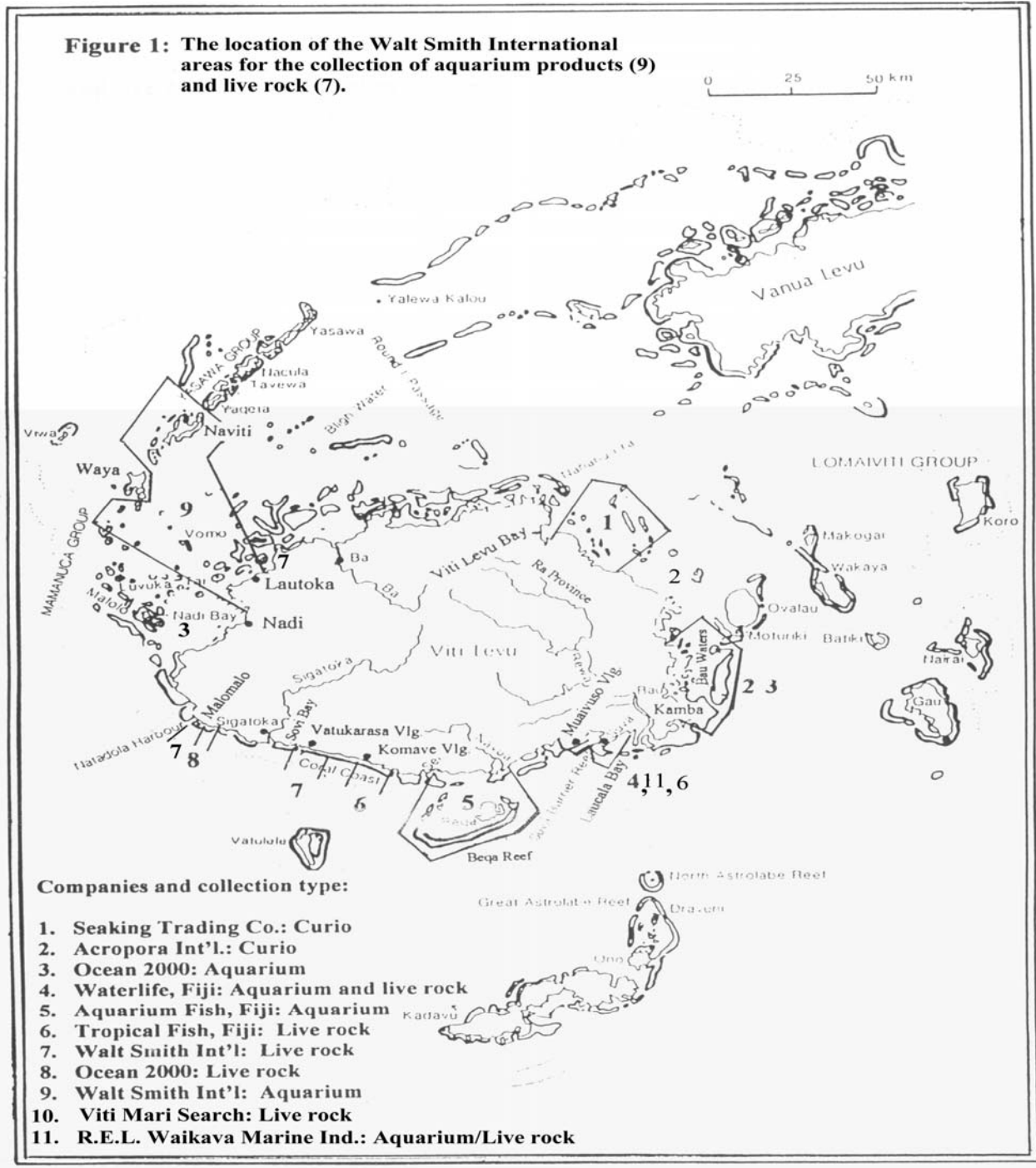


Figure 2. Landsat satellite image of the coral reefs in the Walt Smith collecting area As generally defined within the yellow line.

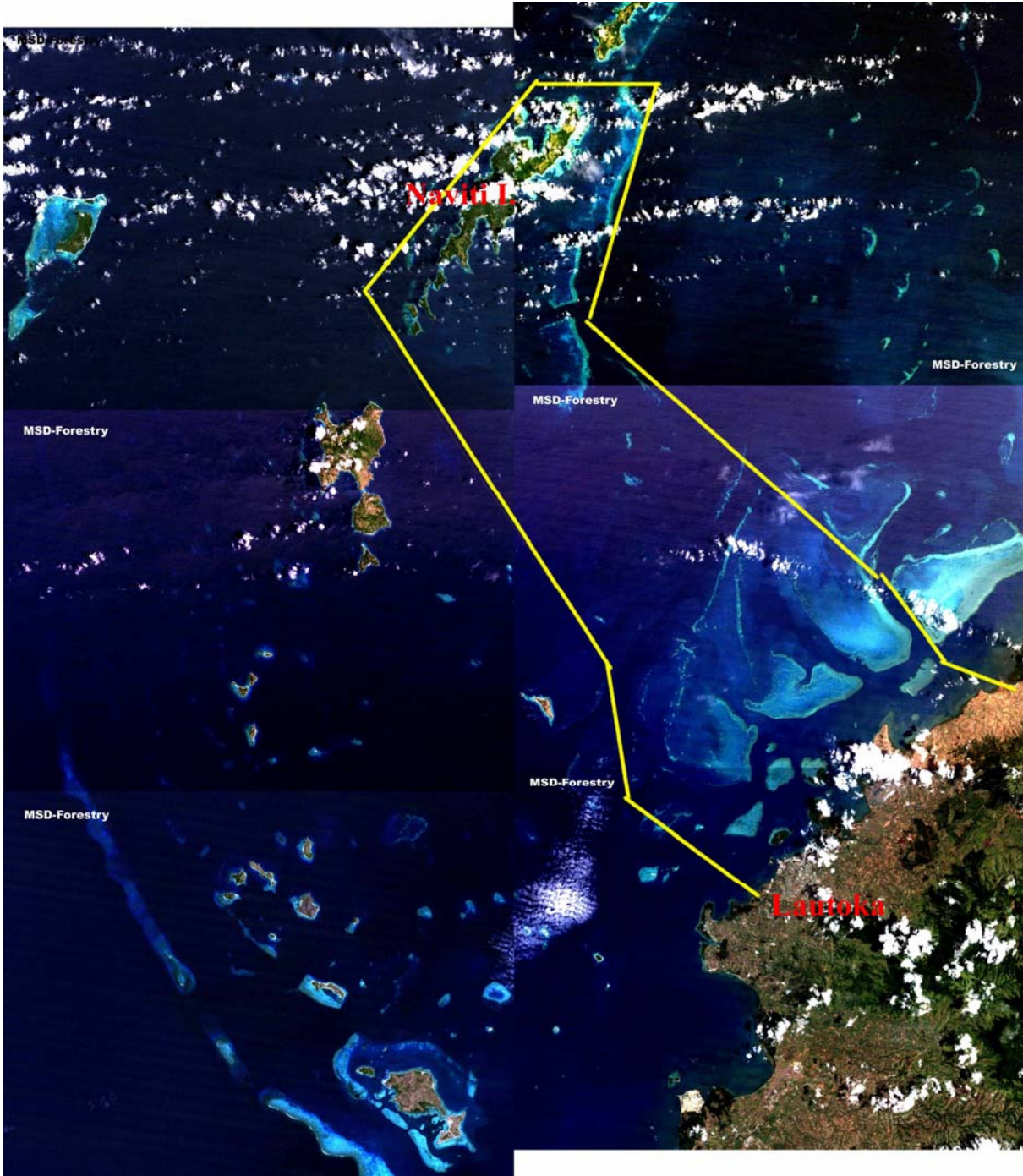


Figure 3. Precise boundaries of the collection areas of Walt Smith International according to the Native Lands and Fishery Commission assessment.



The collecting area for WSI is located north of Lautoka in the vanuas of Waya, Naviti and Marou (1); Naviti and Marou (2). Figure 3 defines the limits the collection area shown in figures 2 and 4, which spans an area of 1429km².

This area is located approximately within 177°13' to 177°33' and 17°03' to 17°36'.

The Vuda I Qoliquoli is also part of the WSI operation in developing a maricultural farm (Tivua Aquafarm), collection of fish and in providing a buffer area where no coral collection is allowed.

3.0 Habitat Types, Dimensions and Proximity to Other Reef Systems (Table 1, Figure 4, 5).

The nature of the range of reefs is relatively uniform in the general area listed in Table 1. The habitats can be defined as those typical of reefs characteristic of that range of reefs which extends from the mainland to offshore conditions. The reefs generally show relief that rises from surrounding soft bottom sediments to a reef flat. The reefs may or may not have a prominent seaward margin. All reef margins are characterised by a talus or sediment slope descends to a channel or inter-reef area. Patch reefs isolated from or adjacent to the main reefs are common. Lagoonal reefs may be manifest as a hard reef edge, reef knolls, patches or have a reticulated appearance as connecting reef ridges. Some areas have elongaat6e reefs with others being broad

or discontinuous as clusters of small reefs. There are areas of deeper reefs that don't appear on the aerial photographs. As such, the reefs have been designated within four categories. Those inshore, mid-shore, central, northern and Naviti (section 4.1).

Figure 4 shows the reefs numbered on the aerial photographs and Table 2 correlates the reef names and numbers within the zones. The inshore reefs contain R16, R17, R18, R19, R22, and R23. Mid-shore reefs contain R13, R14, R15, R20, and R21. The central reef contains the reefs R7, R8, R9, R10, R11, R12. The northern reefs are R1, R2, R3, R4, R5, and R6.

The inshore reefs are a series of 6 reefs, which are located within 4.2 nautical miles (nm) of the coast with the exception of R18 5.0nm. The reefs considered in these areas are those with the potential for collection and not those reefs near the coasts (e.g. Pinder Rfs.) or as fringing reefs about the islands of Naivak, Yawalau and Bekana.

The mid-shore reefs are distinctive in being represented by several large reef areas along with smaller ones.

The central reef area is characterised by elongate or a series of small patch reefs.

The northern reefs are characterised by similar reefs with patch reefs in the southern area and elongate reefs and a large barrier reef east of Naviti.

Naviti I. is one of the three largest islands in the Yasawa Island chain. Four smaller islands to the southwest are associated being adjacent and within the collecting area of Waya and Naviti. These reefs are surrounded by fringing reefs.

3.1 Description of reef areas and types

The collecting areas has been divided into zones. These zones represent reef groupings where active collection is being undertaken. Also shown, are areas for which the rights have been obtained but active collecting is not being undertaken. These areas are not included in the assessment with the exception of the estimation of the overall size of the i-qoliqoli areas.

Zone 1 is represented by the Naviti Island fringing reefs. As these are fringing reefs around one of the Yasawa Islands, they are unique to the reef types in the main collecting area. Naviti I. area is not actively collected.

Zone 2 encompasses and Cakau Na Sawa and the two Taba Ni Qarau and Naitovalase Reefs. The first two reefs are represented by a consolidated reef front with barrier reef characteristics being elongate and continuous. There is a substantial back reef area. The reef areas are extensive and oriented into the easterly prevailing wind conditions. This area is largely outside the collecting area with only the southern portion of Taba Ni Qarau used as a collecting site for colony rock which is represented by colonies of brightly coloured zoanthids.

Zone 3 is comprised of patch reefs Navunirewa Rf., Namoka Rf. and Nasitua Reefs. These are reef patches with no well-defined reef front. Though they have contiguous reef flat areas, they are characterised by lagoons and small patch reefs. Some of the reef areas are deeper subtidal and not included in this reef assessment as they are only partially visible on the aerial photographs such as the Launitoqitoqi and Yamotulita Reefs. The Fiji Hydrographic Chart F5 indicates substantial area around these reef patches indicating three times the visible reef in the north and a much greater percentage in the Launitoqitoqi and Yamotulita Reefs. All of this area is listed as being part of the

reef complex and is a navigational hazard. None of this non-visible area is included in the assessment of reef area in Tables 2 and 3.

Zone 4 is the area of highest collection. These are comprised of Motunikeasulua Rfs., both west and east. They are unique in that the reefs are represented by highly elongate reefs, which form narrow reef flats. These extend as two lines of reef of 11 km (western) and 10 km (eastern). The northern portion of the western reef is not available for collection being outside the Naviti and Marou qoliqoli boundary. At the southwest end of the western reef it breaks up into a series of reef patches. The same occurs at the northern portion of the eastern reef.

Zone 5 is a series of reef areas the largest of which is Cakauvakababa-i-Yata Rf., Cakau-ni Sucuwalu Rf., Yamotuyamotu-i-Cakau Drua, Vunaqiliqili Rf. and north reef area of Nakubu Rf.

Zone 6 is comprised of three broad complex reefs with substantial reef flat areas and extensive lagoons containing reef patches and ridges. The reefs are three large reefs of Nakubu Rf., Vakarale Rf. and Cakau Udu Levu Rf.

Zone 7 are inshore platform reefs the nature of which is conditioned by the terrestrial conditions of the Viti Levu represent. They comprise the reefs of Savala I., Yakauke Rf., Covuli Rf., Rava Rf., Yawalo Rf. and island, Nukunimanu Rf., and Malevu Rf. The reefs are characterised by shallow lagoons and broad reef flats. These reefs have a large source of soft coral collecting areas.

Table 1. Reef zones, names and designated numbers.

Reef Zone	No. Designation	Name	
Northern	0*	Naviti Island group and Cakau Nasau	
	1	Cakau-Naitovalase (1) /Taba-Ni-Qarau Reef (1)	
	2	Taba-Ni-Qarau Reef (2)	
	3	Cakau-Naitovalase (2)	
	4	Navunirewa Rf. and Namoka Rf.	
Central	5	Nasittoa Reefs	
	6	Launitoqitoqi Reef	
	7	Yamotulita Reef	
	8	Motunikeasulua Rf. West	
	9	Motunikeasulua Rf. East	
	10	Cakauvakababa-i-Yata Rf.	
	11	Cakau-ni Sucuwalu Rf.	
	12	Yamotuyamotu-i-Cakau Drua .	
Mid-shore	13	Nakubu Rf.	
	14	Vunaqiliqili Rf.	
	15	Savala I.	
	16	Vakarale Reef	
	17	Cakau Udu Levu Reef	
	Inshore	18	Yakauke Rf.
		19	Covuli Rf.
20		Rava Rf.	
21		Yawalo Rf. and island	
22		Nukunimanu Rf.	
23		Malevu Rf.	

* Naviti Island also includes the islands to the south of Drawaqa I., Nanuya Balavu I., Vuvui I., Naukacuvu I., Narara I. and Nabawaqa I.

Figure 4. Aerial view of the Walt Smith International collecting area with reefs numbered in Table 1. The Naviti I. Groups and northern reefs are shown on Figure 5. The location names are in Figure 6.

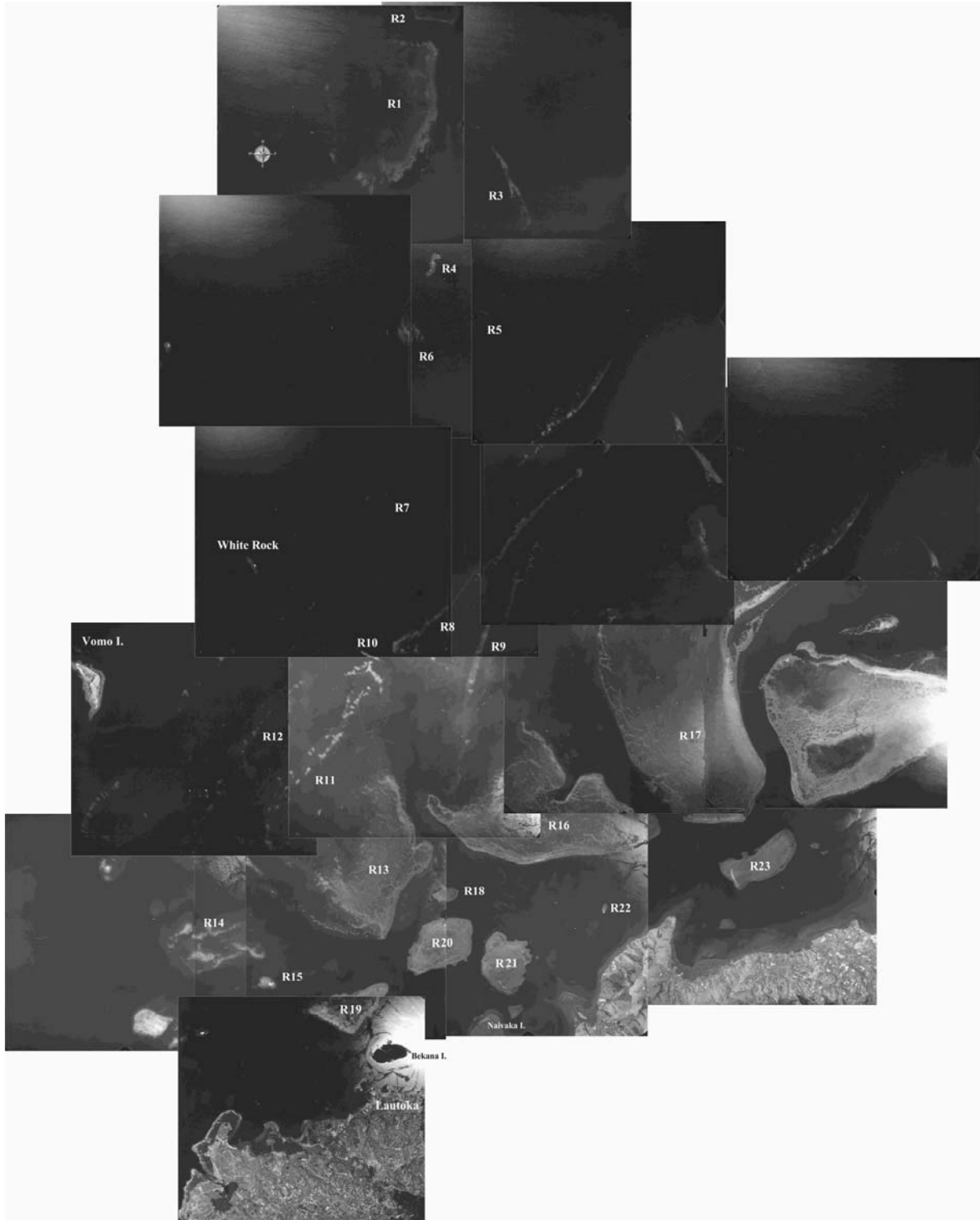


Figure 5. Portion of the Walt Smith Collecting area that includes Naviti I. and the northern most reefs.

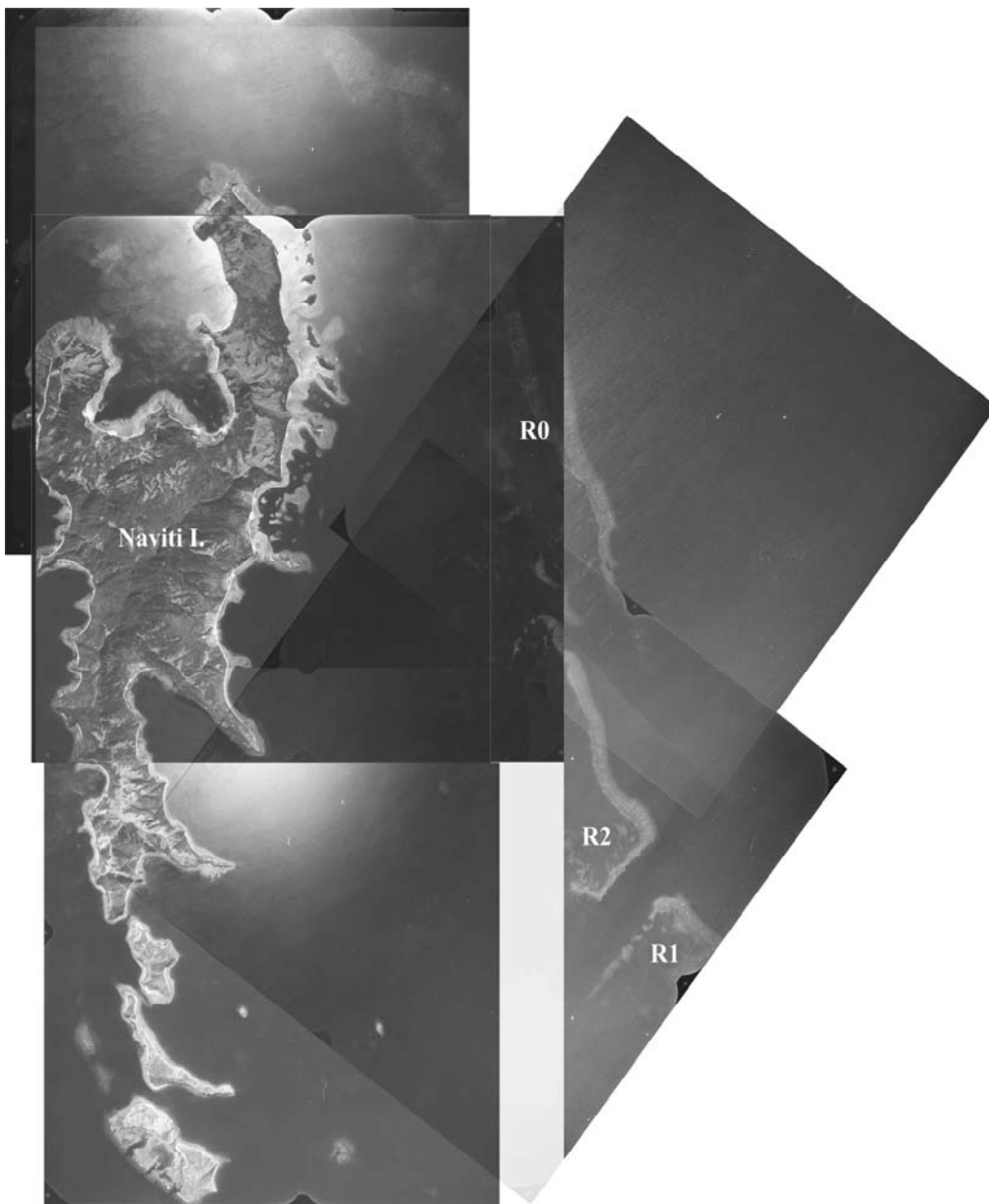


Figure 6. Chart of the WSI collecting area with reef names.



Fiji Hydrographic Office: Chart 5: 1986.

3.2 Assessment of Reef Area

Measurement of the area of the coral reefs in the WSI zone of collection area was derived from aerial photography. Aerial photos of all of the coral reefs were overlain by a 2mm^2 grid. The photos represent a 1:50,000 scale and 2mm^2 is equivalent to 1 hectare or $10,000\text{m}^2$.

Assessment of the reef areas in such a manner is subject to error but it is a good working approximation. Adjustments to the estimates were made to insure that the estimation is conservative. In the first instance the image from the photograph is two-dimensional and doesn't reflect the 3-dimensional relief of the reef. Vertical surfaces are not accounted for. As well, the full extent of the reef is not revealed in the photo with the image estimated to take into account surrounding depths to 3m. Collection is often from the vertical surfaces and from deeper water so this two dimensional appraisal is a conservative estimate. These errors don't diminish the importance of aerial photography in assessing coral reef areas for the purpose of determining the abundance of coral within particular habitats. It is important to have some estimation of reef area to understand what quantities of corals are likely to exist in the collecting area.

Table 2 illustrates an assessment of the coral reef based on accounting for all known habitat areas that includes those that are not visible on the aerial photograph. There is no question of the widespread reef areas deeper than 3m and this table accounts for that. Table 3, by contrast, is an assessment of only the visible reef image, which represents the principal collecting area of the reef flat and upper slope. It is half the spatial dimension of Table 2 and is thought to represent a conservative estimate of the area available for collection.

The Fiji Map Series is taken straight from these photos providing a composite with the same scale as the aerial photographs. This allows for orientation and the assessment of distances across and between reefs. Additionally, the Fijian names are designated on each reef, which is not available on existing nautical charts.

Table 4 shows the transects positions on the respective reefs. In two instances, the information summarises the collection by WSI divers during the period in which the reef was surveyed.

1	8	7.00	358		19		122	90	0
			28	64		10		55	7.5
3		12					25		4.00
4			32						4.02
5			32		17				4.75
6	13	5.75							
7	30	14.75	132						13
8	58	24					9		
9	53	19					128		
10	4		106						19.75
11	17	24	40				46		
12		23.5	13				27		
13	11			265	70	1681	37		35
14	2	9.75	12						
15	2	8.5	37						
16			442		18				17.5
17			387	102	8				
18	6	3.5	500						
19		5.7	25						
20				376	170	1400			10
21	46		505		50	2300			51
22			11						
23		7	418	190			18		
	250	185.45	2685	743	362	5381	394	145	166.52

Total collecting area: 981.93 km² Total collecting area available: 1429.68km²

Table 3. Estimates of hectares of reef area as assessed from the aerial photographs.

Coral Reef No.	Patch Reef	Reef Flat	Reef Flat Lagoon	Reticulated lagoon Inner Reef	Subtidal Reef	Sum Hectares of coral reef areas
1	8	358	19		122	507
2		64	10			74
3					25	25
4		32				32
5		32	17			49
6	13					13
7	30	132				164

17		387	8		395
18	6	500			506
19		25			25
20			170	460	630
21	46	505	50	767	1368
22		11			11
23		418			436
	252	3114	362	1720	412
Total collecting area: 981.93 km ²		Total collecting area available 1429.68km ²			
					Total (ha) 5860

Table 4. Transect, reef names and numbers with geographical positions of the transects.

Transect No.	Reef Names	Reef Nos.	Local Names	Latitude	Longitude	Date
1	Vunivesi Rf.	-	Ovulaovula	17 ⁰ 21.80' S	177 ⁰ 24.80' E	12/11/01
2	Nakuba Rf. Northwest	13	Sample Site 1	17 ⁰ 30.35' S	177 ⁰ 21.59' E	24/10/01
3	Cakau-Tava-Kolokolo Rf.	12	Jack's Reef	17 ⁰ 25.96' S	177 ⁰ 18.66' E	25/10/01
4	Nakuba Rf. West	13	-	17 ⁰ 31.10' S	177 ⁰ 21.35' E	12/11/01
5	Cakau-Tava-Kolokolo Rf.	12	-	17 ⁰ 29.11' S	177 ⁰ 18.51' E	23/10/01
6	Vunaqiliqili Rf.	14	Tivua Farm	17 ⁰ 34.76' S	177 ⁰ 20.36' E	16/11/01
7	Motunikeasulua Rf. East	9	Saqasaqa Rf.	17 ⁰ 24.34' S	177 ⁰ 24.61' E	13/11/01
8	Motunikeasulua Rf. West	8	Site A	17 ⁰ 26.23' S	177 ⁰ 22.64' E	14/11/01
9	Naitovalase Rf.	3	West Reef Flat Crest	17 ⁰ 16.16' S	177 ⁰ 20.54' E	14/10/01
10	Cakauvakababa-I-Yata Rf	10	Farm 2	17 ⁰ 26.84' S	177 ⁰ 22.11' E	12/11/01
11	Nakubu Rf.	13	-	17 ⁰ 30.14' S	177 ⁰ 24.65' E	12/11/01
12	Naitovalase Rf.	3	Site B	17 ⁰ 16.16' S	177 ⁰ 20.54' E	31/10/01
13	Motunikeasulua Rf. North (Collection only)	8	Site C (A)	17 ⁰ 26.23' S	177 ⁰ 22.64' E	14/11/01
14	Vunaqiliqili Rf.	14	Site D	17 ⁰ 34.61' S	177 ⁰ 20.32' E	02/11/01
15	Covuli Rf.	19		17 ⁰ 35.23' S	177 ⁰ 24.09' E	13/11/01
16	Motunikeasulua Rf. North	8	Site E	17 ⁰ 21.85' S	177 ⁰ 24.76' E	11/11/01
17	Motunikeasulua Rf. East (Collection only)	8	Site F (E)	17 ⁰ 21.85' S	177 ⁰ 24.76' E	11/11/01
18	Motunikeasulua Rf.	9	Site G	17 ⁰ 21.71' S	177 ⁰ 24.67' E	13/11/01
19	Cakavaka-I-Yata	10	Farm 2	17 ⁰ 26.8' S	177 ⁰ 21.98' E	1/08/02
20	Cakavaka-I-Yata	10	Farm 2	17 ⁰ 26.9' S	177 ⁰ 21.99' E	1/08/02
21	Nakuba Rf.	13	Northeast	17 ⁰ 30.0' S	177 ⁰ 24.45' E	1/08/02
22	Vakarale Reef	16	West	17 ⁰ 26.9' S	177 ⁰ 21.99' E	1/08/02

3.3 Reef Description and Transect Assessment

The following sections are descriptions of the coral reefs in the WSI collecting area in which transects were conducted. An assessment of transect information provides an understanding of the resource for the reef or reef complexes. Table 4 provides the details of the transects for the reefs described. The general description of the coral reefs are described in section 4.1. It should be noted that this assessment is being made after 7 years of collecting from these areas. The current transect information should be considered in the light of the knowledge that continuous collection has occurred and represents a monitoring assessment as much as baseline information.

3.3.1 Zone 2: Reef 3: Transect 11 - Naitovalase Reef

3.3.1.1. General Description

Naitovalase Reef is located in the northern reef complex of Zone 2.

It is an elongate reef line reef, which forms a narrow reef that extends for 6 km. It has a branch in its southern portion and as well as a series of patch reefs and knolls. The reef complex is represented by 2 line reefs and 35 patch reefs.

3.3.1.2 Reef Profiles

As with Zone 4 reefs, the reef flats are largely subtidal but with boulders exposed on the low water spring tides. The reef flats have little relief with ridges and depressions forming sandy bottom substrates. Due to its orientation and variability of the prevailing wind there is a lack of prominent wave action, the reef margins don't form a prominent reef crest.

The reef slopes drop abruptly into the deeper water (7m) to the west of the complex. This is the area where brightly coloured zooanthids known as colony rock are collected.

Table 5. Reef and transect information

Reef:

Coral reef Zones	Reef or reef complex	Reef Type	No. of Reefs	Visual reef area (ha)
2	3	Line reef with some reef patches	1 line reef with a detached reef to the north. At least 23 reef patches or knolls are located in the southerly portion.	79

Sample Transect:

No.	Reef Names	Local Names	Latitude	Longitude	Date
9	Naitovalase Rf.	West Reef Flat Crest	17 ⁰ 16.16' S	177 ⁰ 20.54' E	31/10/01
12	Naitovalase Rf.	Site B	17 ⁰ 16.16' S	177 ⁰ 20.54' E	31/10/01

Aerial Photo: AAM 2057, 25,000, 5.8.94; 192 Run 2

3.3.1.3 Transect results:

Transects 9 and 12 were run on the same reef but in different habitats. Transect 9 is on the reef flat in which a 50m by 5m transect was run noting only collectible specimens. This revealed 37 potentially collectible corals. When extrapolated to the entire reef area of 79ha., 116,920 collectible specimens are estimated .

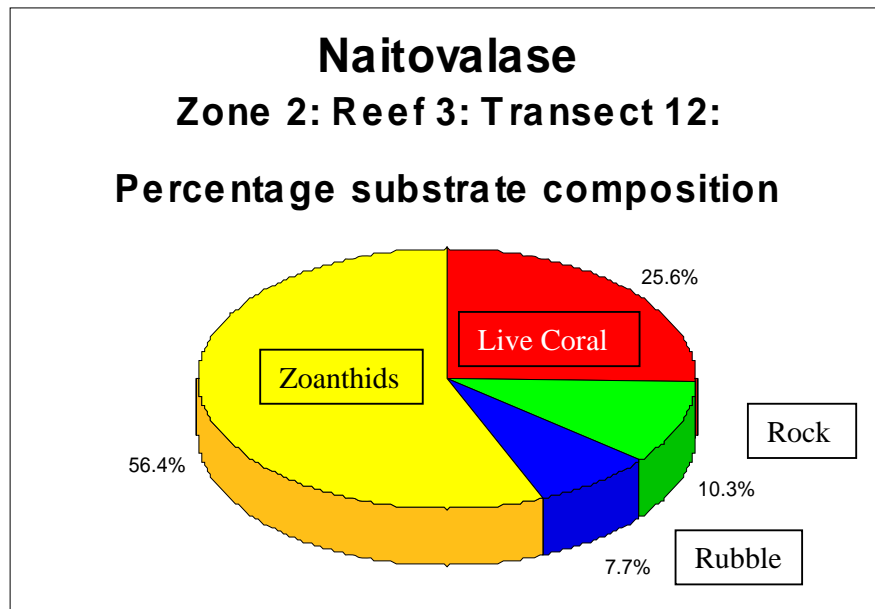
Transect 12 assessed the colony rock areas on the talus slope of the reef. These areas were 27m x 10m=270m² and 50m x 20m=1000m². Though this is not the only area of zooanthid occurrence, it is the principal collecting site because of the abundance of material. The total area is 1270m² or 12,500,000cm².

It is possible to estimate the extent of the resource. 400-500 pieces of material are taken on each trip. There is one trip per week. The size of the zooanthid covered rubble pieces range between 10cm x 2cm=20m² to 20cm x 3cm=60cm². The average size is 40cm². This implies that there are 312,500 pieces (12,500,000cm²/40cm = 312,500 pieces) on the surface of this rubble talus slope. If 500 are taken on each visit per week, then there is 12 years of material available (312500 pieces/ 500 pieces/week x 52 weeks =12 years). This does not take into account of the highly proliferating nature of the zoanths as the deeper rubble becomes available.

Table 6. Extrapolation to larger reef area of east and west Motunikeasulua Reefs.

Reef Complex No.	Reef Type	Habitat Sampled	Sample site	Area of extrapolation (ha)	Collectible coral (colonies)	Zooanthid resource
Zone 2 Reefs 3	Line Reef	Reef Flat and talus slope	25m ² Transects 9 and 12	79ha	116,920	12 years available at collection rate of 500 pieces per week.

3.3.1.4 Substrate composition of the sample area



3.3.2 North of Zone 4: Vunivesi Reef

3.3.2.1 General Description

Vunivesi Reef is a line reef located to the north of Motunikeasulua Rfs. in Zone 4. The reef is 5.75 km long and is generally thinner. Both this and the northern portion of the western reef are not available for collection being outside the Naviti and Marou qoliqoli boundary and as such make a good site for the establishment of control sites for comparison with the collecting area.

The reef complex is represented by a line reef which contains a series of 3 lagoons with a reef ridge enclosing some of the fore-reef area. 24 reef patches are present on the northwest side from the line reef. There are 6 broader reef flat areas present as expansions of the thin reef line.

Table 7. Reef and transect information

Reef:

Coral Zones	Reef or reef complex	Reef Type	No. of Reefs	Visual reef area (ha)
North of 4	Vunivesi Rf	Line reefs and reef patches	1line+24reef patches	89

Sample Transect:

No.	Reef Names	Project Names	Latitude	Longitude	Date
1	Vunivesi Rf.	Ovulaovula	17 ⁰ 21.80' S	177 ⁰ 24.80' E	12/11/01

Aerial Photo: AAM 2057; 25,000' 5.8.94 0170; Run 3

3.3.2.3. Transect results

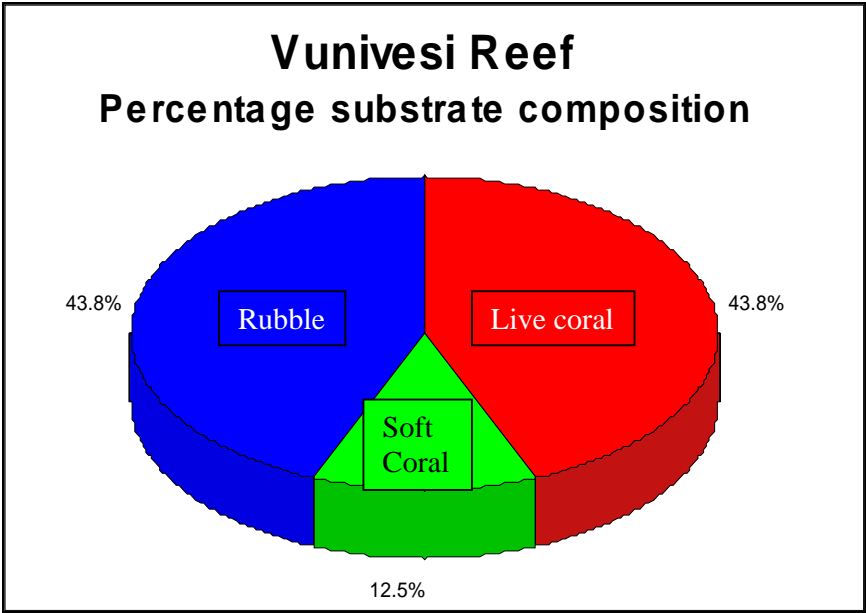
Transect 1 comprised a sample of 25m² and then extrapolated for the entire reef complex of 89ha.

41 collectible items were found in 25m², which is higher than the other transect areas. Extrapolating this to the entire area. 1,459,600 collectible items are estimated to be found on the reef complex. For non-collectible coral, the number per 25m² is 352 or 12,531,200 colonies on the reef.

Table 8. Extrapolation to the entire Vunivesi Reef

Reef Complex No.	Reef Type	Habitat Sampled	Sample site	Area of extrapolation (ha)	Collectible coral (colonies)	Non-collectible coral (colonies)
North of Zone 4	Line and patch Reef	Reef Flat	25m ² Transect 1	89ha	1,459,600	12,531,200

3.3.2.4 Substrate composition of the sample area.



3.3.3 Zone 4: Reef Complex 8, 9: Motunikeasulua Reefs (East and West)

3.3.3.1 General Description

These reefs comprise Zone 4, which are the two arms Motunikeasulua Rf. designated west and east. These reefs are unique in that they are represented by highly elongate reefs described as line reefs which form narrow reef flats which extend as two lines of reef 11 km (western) and 10 km (eastern). Patch reefs occur at the southern end of the west reef and at the northern end of the east reef. Additional patches occur between the two reefs, as do patches to the southern end of the eastern reef extending near Vakarale. The northern portion of the western reef is not available for collection being outside the Naviti and Marou qoliqoli boundary.

The reef complex is represented by 2 line reefs and 35 patch reefs.

3.3.3.2 Reef Profiles

As with Zone 5 reefs, the reef flats are largely subtidal but with boulders exposed on the low water spring tides. The reef flats have little relief with ridges and depressions forming sandy bottom substrates. Due to the lack of prominent wave action, the reef margins don't form a prominent reef crest. This is thought to be due to the protected nature of the reefs from the easterly wind and swell by the expansive Cakau Udu Levu Rf.

The reef slopes drop abruptly into the deeper water to the west of the complex from depths of 15m to 60m in the channel, extending up the western margin. A channel to the south of 30m depth separates the group from Nakubu Reef. Vakarale and Cakau Udu Levu are to the east.

This area experiences the highest collecting pressure.

Table 9. Reef and transect information

Reef:

Coral Zones	Reef or reef complex	Reef Type	No. of Reefs	Visual reef area (ha)
4	8	Line reefs and reef patches	1line+18reef patches	169
4	9		1line+17reef patches	150

Sample Transect:

No.	Reef Names	Local Names	Latitude	Longitude	Date
7	Motunikeasulua Rf. East	Saqasaqa Rf.	17 ⁰ 24.34' S	177 ⁰ 24.61' E	13/11/01
8	Motunikeasulua Rf. West	Site A	17 ⁰ 26.23' S	177 ⁰ 22.64' E	12/11/01
16	Motunikeasulua Rf. North	Site E	17 ⁰ 21.85' S	177 ⁰ 24.76' E	11/11/01

Aerial Photo: AAM 2070 Mamanuca 25,000 22.10.94 0019; 144 Run 3w

3.3.3.3 Transect results

Transects 7, 8, and 16 were clumped to make a sample of 75m² and then extrapolated for the entire reef complex of 327ha.

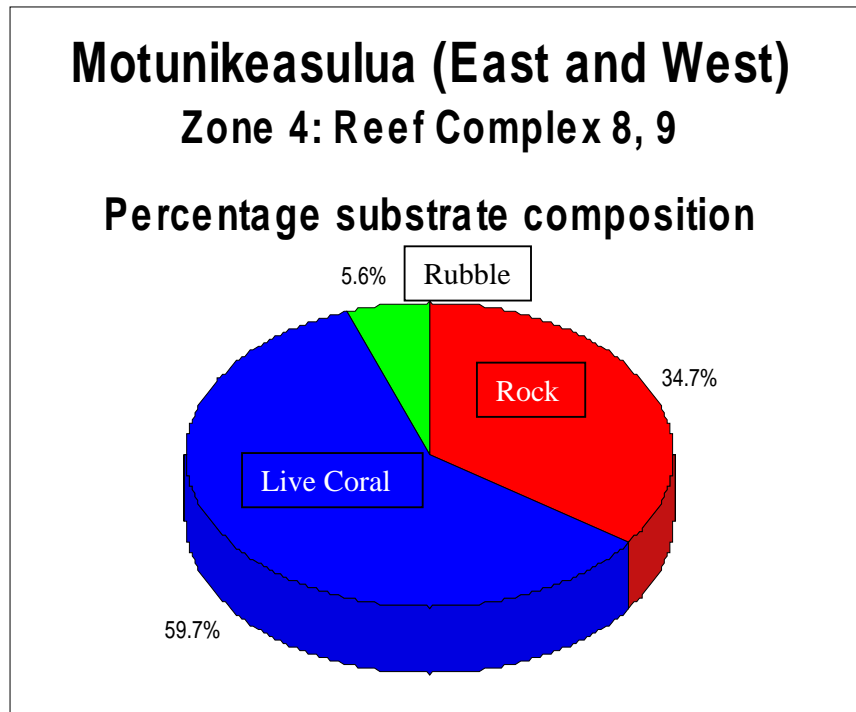
An average of 16.75 collectible items were found in three samples of 25m². Extrapolating from this to the entire area of the reef, 2,167,356 collectible items are estimated for the reef complex. For non-collectible coral, the number per 25m² is 299.5 or 39,174,600 colonies on the reef.

The vertical nature of the environment, which is substantial on the reef margins and in the relief of the reef flat makes these estimates conservative.

Table 10. Extrapolation to larger reef area of east and west Motunikeasulua Reefs.

Reef Complex No.	Reef Type	Habitat Sampled	Sample site	Area of extrapolation (ha)	Collectible coral (colonies)	Non-collectible coral (colonies)
Zone 4 Reefs 8, 9	Line Reefs	Reef Flat	25m ² Transects 7, 8 and 16	327ha	2,167,356	39,174,600

3.4.3.4 Substrate composition of the sample area



3.3.4 Zone 4: Reef Complex 10 : Farm 2

3.3.4.1 General Description

These are the reefs of Cakauvakababa-i-Yata and the northern part of Cakau-ni-Sucuwalu.

These reefs are represented by 19 distinct reefs, of which, two have a length of 1.25km and all with widths of 100-300m. There are 18 small reef pinnacles, which weren't included in the area assessment though they are no doubt fruitful areas for collection. Also an unmeasured area due to its uncertain nature to the southeast represents an area equal to the area in which measurement was made. Further fieldwork will be required to ascertain the nature of this area.

Clearly, this area is an underestimate of perhaps up to 100%.

3.3.4.2 Reef Profiles

The reefs are characteristic of the central collecting area with reef flats that are largely subtidal but are exposed on the low water spring tides. The reef flats have little relief with ridges and depressions with sandy bottom substrates. Due to the lack of prominent wave action, the reef margins don't form a prominent reef crest. The presence of Viti Levu causes the prevailing wind to come from both the south and northeast as the wind wraps around the island (Annex 9). The diurnal thermal influence of the island often gives rise to a northwesterly wind. Swell also affects the reef areas from the southwest, as there are no barrier reef systems offering protection, as is the case to the south.

The reef slopes drop abruptly into the deeper water to the north (channel) and northwest descending to 45-54m to the southwest the depths are 22m. This is in contrast to areas to the south that are gentler sloping. These shallow to 6-7m on the eastside, which effectively represent the northern margin of Nakubu Rf (Reef 13).

The collecting areas on these reefs are on the reef top, the crest and from the top of the slope to 4-6 metres.

Table 11. Reef and transect information

Reef:

Coral zones	Reef or reef complex	Reef Type	No. of Reefs	Reef Flat (ha)	Sum of coral reef area (ha)
	4	10 Patch reefs	19	89	89

Sample Transect:

No.	Reef Names	Local Names	Latitude	Longitude	Date
Transect 1 10, 19, 20	Cakauvakababa-I-Yata Rf.	Farm 2	17 ⁰ 26.84' S	177 ⁰ 22.11' E	12/11/01

Aerial Photo: AAM 2070 Mamanuca 25,000 22.10.94 0019 Run 3w

3.3.4.3 Transect results:

The transects were conducted on Cakauvakababa-i-Yata Reef which has an area of 15ha.

In the three transects (10, 19, 20) collectible items were found in a 10m x 2.5m transect or 25m². Extrapolating from this, 85,500 collectible items might be found on the reef. For non-collectible coral, the number per 25m² is 233 or 1,398,000 for the reef.

For the entire reef area (89ha), the number of collectibles is 509,080 and the non-collectibles are 8,294,000 colonies

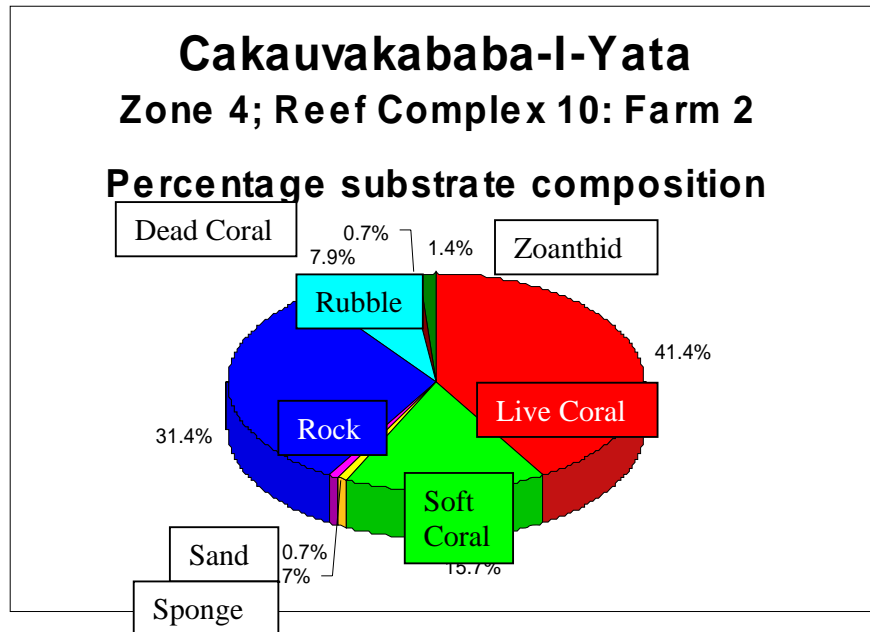
Table 12. Extrapolation to larger reef area

Reef Complex No.	Reef Type	Habitat	Sample site	Area of extrapolation (ha)	Collectible coral (colonies)	Non-collectible coral (colonies)
Reef 10	Patch Reefs	Reef Flat	755m ² on Cakauvaka-I-Yata	89ha	509,080	8,294,800

Transect details on Cakavaka-I-Yata

Transect	Collectible	Non-collectible
10	23	374
19	12	187
20	8	138
Total	43	699

3.3.4.4 Substrate composition of the sample area



3.3.5 Zone 6: Reef Complex 13: Nakubu Rf. (East).

3.3.5.1 General Description

This reef is the western most reef in the mid-shore region. The reefs are large with a well-defined reef flat around the reef margin from the west-southwest to the eastern margin. The lee sides of the reef are represented as an open lagoon partitioned by reef ridges.

3.3.5.2 Reef Profiles

Table 13. Reef and transect information

Reef:

Coral Zones	Reef or reef complex	Reef Type	No. of Reefs	Visual reef area (ha)
6	13	Platform reef and lagoon	Reef flat 353ha Central lagoon 336ha Line reefs 64ha	753

Sample Transect:

No.	Reef Names	Local Names	Latitude	Longitude	Date
6	Nakubu Rf	East lagoon	17 ⁰ 30.00' S	177 ⁰ 24.45' E	12/11/01
6	Nakubu Rf.		17 ⁰ 30.14' S	177 ⁰ 24.65' E	12/11/01

Aerial Photo: AAM 2053 Mamanuca 25,000 22.10.94 0053, Run 6;
AAM 2070, 0019, Run 3w

3.3.5.3 Transect results:

Transects 7, 8, and 16 were clumped to make a sample of 75m² and then extrapolated for the entire reef complex of 327ha.

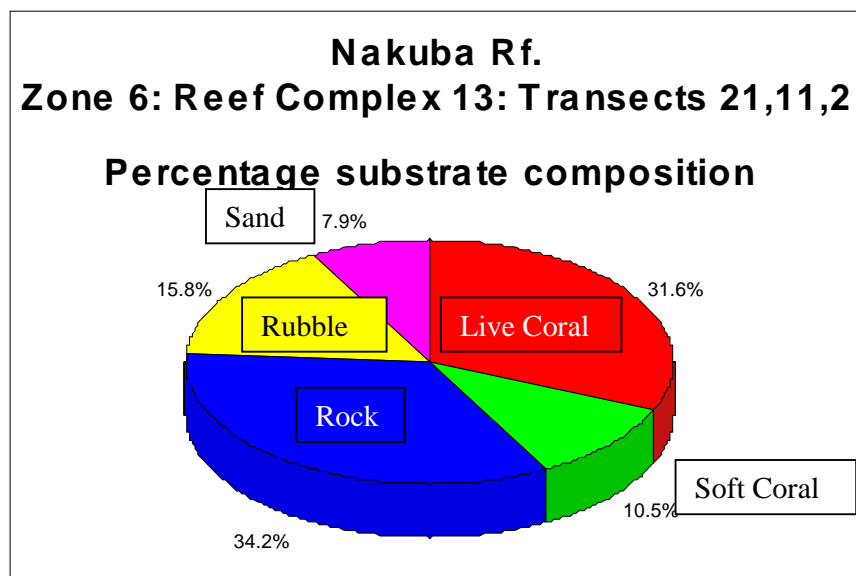
An average of 16.75 collectible items were found in three samples of 25m². Extrapolating from this to the area of the reef, 2,167,356 collectible items are estimated to be found on the reef complex. For non-collectible coral, the number per 25m² is 299.5 or 39,174,600 colonies on the reef.

These numbers are certainly estimates as they are two-dimensional assessments failing to take account of the complete vertical nature of the environment that is substantial on the reef margins and in the relief of the reef flat.

Table 14. Extrapolation to larger reef area of Nakubu Rf. East.

Reef Complex No.	Reef Type	Habitat Sampled	Sample site	Area of extrapolation (ha)	Collectible coral (colonies)	Non-collectible coral (colonies)
Zone 6 Reefs 13	Platform Reefs	Reef Flat	25m ² Transects 11, 21	753ha	3,915,600	70,782,000

3.3.5.4 Substrate composition of the sample area



3.3.6 Zone 5: Reef Complex 14: Vunaqiliqili Rf.

3.3.6.1 General Description

This reef is outside the collecting area of WSI but is used as a site for a coral farm. Material for the establishment of the farm has come from the reef area. This area is also the field venue for the live rock mariculture.

The reef complex is a proliferation of elongate reefs interspersed with reef patches. There is abundant shallow water 3-6m that offers protection for the farm racks and artificial rock.

3.3.6.2 Reef Profiles

Reef:

Coral Zones	Reef or reef complex	Reef Type	No. of Reefs	Visual reef area (ha)
5	14	Line and patch reefs	Complex of line reefs and subsidiary patches	161

Sample Transect:

No.	Reef Names	Local Names	Latitude	Longitude	Date
6	Vunaqiliqili Rf.	Tivua Farm	17 ⁰ 34.76' S	177 ⁰ 20.36' E	12/11/01
14	Vunaqiliqili Rf.	Site D	17 ⁰ 34.61' S	177 ⁰ 20.32' E	12/11/01

Aerial Photo: AAM 2053 Mamanuca 25,000 22.10.94 0053, Run 6;
AAM 2070, 0051, Run 3w

3.3.6.3 Transect results:

The transect was conducted within the proximity of the maricultural racks. Unlike the belt transects, this series utilised the free swim of known distance. The results varied and are tabled below:

Free swim transects assessing collectible species per 10m. In the latter 4 transects, the percentage of target species encountered that were suitable for collection is listed below.

Transect No.	Replicates	Collectibles	% of target species suitable for collection*
6	T1	4.6	-
	T2	5.2	-
14	T1	2.5	38%
	T2	1.3	19%
	T3	1	20%
	T4	1.3	13%
		Mean 2.6	

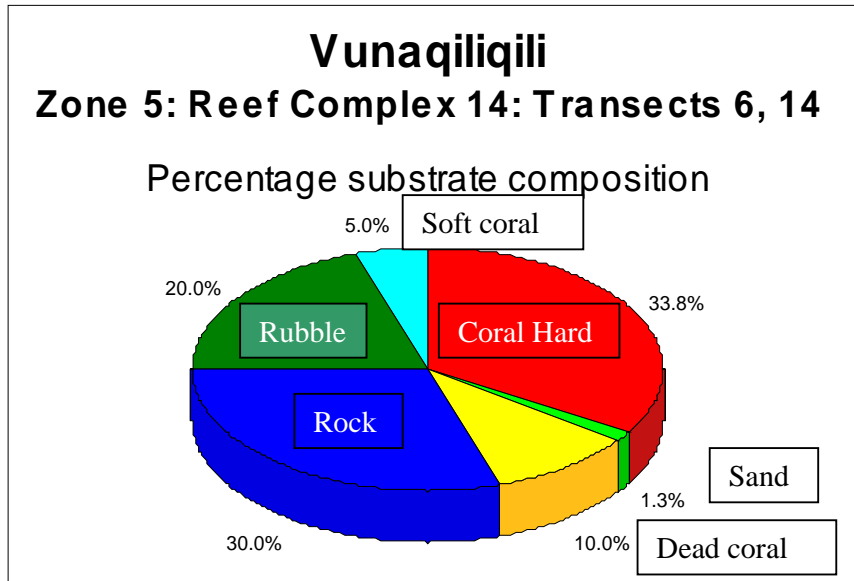
* Sum of target species observed both suitable and unsuitable for collection.
Sample rectified to 10m (~25m²)

An average of 2.6 collectible items were found for 10m swim transects (25m²). Extrapolating from the reef area of 161ha, 167,440 colonies are estimated to be found on Vunaqiliqili Reef. There is no non-collectible coral figure but rather the percentage of the coral taken as a proportion of the remaining target species left.

Table 15. Extrapolation to larger reef area of Nakubu Rf. (East and West)

Reef Complex No.	Reef Type	Habitat Sampled	Sample site	Area of extrapolation (ha)	Collectible coral (colonies)	Non-collectible target species (colonies)	% of target corals eligible for collection
Zone 5 Reefs 14	Line and patch reefs	Reef Flat	25m ² Transects 6, 14	161ha	167,440	744,178	22.5%

3.3.6.4 Substrate composition of the sample area



3.3.7 Zone 7: Reef 3: Transect 11 - Covuli Reef

3.3.7.1 General Description

Covuli Reef is typical among the inshore reefs in being characterised as a single broad reef. It is triangular in shape and moderate in area (564ha). There is a 1.5m vertical shelf on the southern margin. Behind this there is a wide reef flat extending 400-500m into the reef that becomes increasingly characterised by discrete or adjoining lagoonal systems (~13).

The reef is affected by terrestrial influences (turbidity, sedimentation and freshwater). As such, soft corals dominate its fauna.

3.3.7.2 Reef Profiles

Table 16. Reef and transect information

Reef:

Coral Zones	Reef or reef complex	Reef Type	No. of Reefs	Visual reef area (ha)
7	19	Platform reef	1	Entire reef area 564 Reef margin 89ha/4=22.3 (25m band around reef)

Sample Transect:

No.	Reef Names	Local Names	Latitude	Longitude	Date
15	Covuli Rf.	19	17 ⁰ 35.23' S	177 ⁰ 24.09' E	13/11/01

3.3.7.3 Transect results:

Table 17. Extrapolation to margin of the reef area of Covuli Reef.

Reef Complex No.	Reef Type	Habitat Sampled	Sample site	Area of extrapolation (ha)	Collectible soft coral (colonies)
Zone 7 Reefs 19	Platform reef	Margin of Reef Flat	25m ² Transect 15	22.3ha	223,000- 1,850,900

3.3.7.4 Substrate composition of the sample area

With regard to hard corals, the areas at 1.5m depth are characterised *Porites lobata*, *P. rus* with large *Diploastrea* colonies and *Millepora platyphylla* present. On the reef crest there is an abundance of *Sinularia flexibilis*.

The number of colonies of *Sinularia flexibilis* found in 1m² ranged from 1-8.3 colonies per metre. The maximum number of colonies per metre sampled was 22.

There is a wide band of *Sinularia* occurring around the reef including the vertical reef edge. Most colonies are too large to be shipped. Small colonies exist intermittently resulting from both asexual reproduction and new settlement.

The reef slope descends to 20m to a fine soft bottom environment of mud w/ boulders forming isolated coral assemblages.

Table 18. Summary of the reef area, hard coral populations and collectible or commercial component. Covuli Reef is not included as it is the site for soft coral collection.

Reef No.	Reef Type	Habitat Sample	Reef Name	Sample site	Area of extrapol. (Ha)	Collectible coral (Colonies)	Non-collectible coral (Colonies)	Total Coral	Percent collectible corals/total
Zone 2 Reef 3	Line Reef	Reef Flat and talus slope	Naitovalase Reef	25m ² Transects 9 and 12	79ha	116,920	12 years available at collection rate of 500 pcs. per week.		
Zone 4 Reefs 8, 9	Line Reefs	Reef Flat	Motunikeasulu a Rf.	25m ² Transects 7.8 and 16	327ha	2,167,356	39,174,600	41,341,956	5.24%
Reef 10	Patch Reefs	Reef Flat and 3m vertical margin	Cakau-I-Yata Rf. and Nth Sucuwalu	25m ² on Cakauvaka-I-Yata Transects 10,19,20	89ha	509,080	8,294,800	8,803,880	5.78%
Zone 6 Reefs 13	Platform Reefs	Reef Flat	East and west Nakubu Rf.	25m ² Transects 2, 11, 21	753ha	3,915,600	70,782,000	74,697,600	5.24%
Totals						6,708,956	118,251,400	124,843,436	5.37%
*Total exports permitted in 2001: 344,895 pcs. of live coral						344,895	Permitted/collectible 5.1%	Permitted/total colonies 0.28%	
*Actual exports shipped in 2001: 42,433 pcs. of live coral						42,433	Export/ total collectible .63%	Exported coral/total coral present .03%	

* Permitted exports are the number of pieces of live coral for which export permits are issued. The actual exports are the pieces of live coral actually sent. Unfortunately, the permitted export figures has been used to record the actual exports which have made the export statistics in error by a factor of x8.

Table 19. Estimates of coral numbers and collection percentages for the entire collecting area.*

Coral Reef Area and Exports	Collectible corals	Non-collectible coral	Total coral
Total number of corals for 21.3% of WSI area	6,708,956	118,251,400	124,843,436
Estimated coral nos. and percentage of collection for the total WSI area (x3.69 to account for 78.7% unsurveyed).	31,465,004	554,599,066	586,064,070
Total exports permitted in 2001: 344,895			
a) Percentage of permitted nos./estimated coral subject to collection. for 21.3% of area surveyed.	5.1%	0.29%	0.28%
b) Percentage of permitted nos./estimated coral subject to collection. for the total area surveyed.	1.1%	0.06%	0.06%
Actual exports shipped in 2001: 42,433 pcs. of live coral calculated as a % of collectible, non-collectible and total coral.	0.13%	.008%	.007%

*These figures don't account for the reef areas of Naviti I, associated islands and the northern reef of Cakau Nasau which are available for collection but not actually collected

Table 20. Reefs where no collection has occurred.

Reef No.	Reef Type	Habitat Sample	Reef Name	Sample site	Area of extrapol. (ha)	Collectible coral (colonies)	Non-collectible coral (colonies)	Total Coral	Percent collectible corals/ total
North of Zone 4	Line and patch Reef	Reef Flat	Vunivesi Rf.	25m ² Transects 1	89ha	1,459,600	12,531,200	13,990,800	10.4%
Zone 5 Reefs 14	Line Reefs	Reef Flat	Vuniqiliqili Reef	Transect 6, 14	161ha	167,440	-	-	-

Table 21. Summary table of coral reefs in the WSI collecting area denoting survey and non-survey area.

Reef Zone	No. designation	Name	Minimum reef area	Maximum coral reef area
Northern	Naviti I.	Fringing reefs	Unassessed	
	0	Cakau Nasau Reef	Unassessed	
	1	Cakau-Naitovalase (1) /Taba-Ni-Qarau Reef (1)	507	628
	2	Taba-Ni-Qarau Reef (2)	74	175
	3	Cakau-Naitovalase Reef (2)	25	50
	4	Namoka Reef	32	44
	5	Nasitua Reef	49	66
Central	6	Navunirewa Reef	13	24
	7	Yamotulita Reef and Launitoqitoqi Reef	164	209
	8	Motunikeasulua Reef West	67	99
	8a	Vunivesi Reef		
	9	Motunikeasulua Reef East	181	209
	10	Cakauvakababa-i-Yata Rf. and Nth Cakau-ni Sucuwalu Reef	110	159
	11	Cakau-ni Sucuwalu Reef	103	138
	12	Yamotuyamotu-I-Cakau Drua Reef	40	75
Mid-shore	13	Nakubu Reef	611	2141
	14	Vunaqiliqili Reef	14	37
	15	Savala I. Reef	39	62
	16	Vakarale Reef	460	503
	17	Cakau Udu Levu Reef	395	537
	18	Yakauke Reef	506	542
	19	Covuli Reef	25	49
Inshore	20	Rava Reef	630	2037
	21	Yawalo Reef and island	1368	3028
	22	Nukunimanu Reef	11	46
	23	Malevu Reef	436	680
			Estimate of Total Area (see Tables 2&3)	5860ha
Legend:				
		Reefs where transects were conducted		
		Reefs where no survey has occurred		
		Reefs surveyed outside of the collecting area		
		Reef where only soft coral was surveyed		

4.0 Company Information

4.1 Objective

A concise summary of basic information as to the management operation (e.g. any ownership, history and organizational structure) and the geographical area that is being harvested; species types, management history, fishing practices, historical fishing levels, other resource attributes and constraints; and

The owners of Walt Smith International Ltd. were developed by Walt and Deborah Smith of the United States. The company was formed in 1995 in partnership with Loti Rasiga of Fiji. The Fiji general manager is Tim Mcleod. The maricultural arm of the company is Pacific Aqua Farms, which is also the wholesaling facility in Los Angeles for the South Pacific products from Fiji, Tonga, the Solomon Islands and to a limited extent Asia. The Fiji operation represented an expansion of the companies operation in Tonga which had been active for ??? years.

They currently have 36 employees in the warehouse, who are involved in the care of the system and reef products, processing of the live rock, and packaging for export.

The contracted field workers number 65, with 43 of these from Vatukarasa village where they specialize in *live rock* extraction. The remainder is concerned with live material collection. Their present area of live collection is in the qoliqoli of Naviti and Marou from Naviti Island with rights for fish collection and mariculture in the Vuda qoliqoli.

4.2 Field Operations

4.2.1 Collection of live organisms

This activity involves the removal of live reef organisms and subsequently the holding and packaging for trans-shipment to the foreign destinations. The collection in all cases is contracted out to villages with a qoliqoli (customary reef rights area) from which divers collect specified reef animals. No underwater breathing apparatus is used (except with Fisheries Div. exemption) and collection is from relatively shallow reef areas <6m. An exception to this is the collection of colony rock from 7m depth in which SCUBA is used. The divers are trained in the removal and care of the organisms during transit back to the holding facility. The means of capture involves removing the organism with an iron bar, chisel or screwdriver, which preferably includes a small portion of the reef to which it is attached. Most of the hard and soft corals are collected as whole colonies but some are fragmented. Both branching and massive species of hard coral are collected. In the case of the hard and soft coral, the size of the material is limited (<15 cm diameter) by the nature of the market demands. In the case of the anemones, they may be much larger.

Figure 7. Collectors removing and positioning small Acropora colonies prior to transfer to the boat.



Upon collection, the material is brought back to the boat where it is protected by placing the specimen in sealed plastic bag of water with an air space or covered with a plastic wrap to prevent injury. These are placed in a holding bin until unloading at the holding facility.

Figure 8. Best practice during collection, care of product and transport to the holding facility is important to minimize mortality.



4.2.2 Holding Facility Infrastructure

There are five separate holding systems for the live aquarium products. One of these is live rock and will be dealt with in a separate section (5.3.2). This includes, hard and soft coral, *Tridacna* clams, anemones and starfish. The system devoted to anemones and starfish has a capacity of 6800 l., comprising three 8' x 4' flat tanks. Two of the systems, which can be linked, are devoted to (1) clams and hard coral and (2) only hard coral. The combined capacity is 27,240 l. An isolated system is devoted to soft corals that has a capacity of 31,780 l. There is also a system of equivalent volume devoted to tropical fish. Each system has a 50% water change every week. The holding tanks are illuminated by a large array of metal halide lamps, which mimic the solar spectrum. High water quality is maintained by regular water renewal, filtering with mucus and biological residue removed through a protein skimmer. Refrigeration is used to maintain the facility water temperatures at sea temperatures. The water is sterilized by ultra-violet light, ozone injection and chemical additives (fish), which provide additional anti-bacterial protection.

With this level of technological support, mortality is limited during the transition from the natural reef environment to that of the wholesaler's aquarium. Care at this early stage in the collection and holding is important in providing a product to market, which assures good survival for the end consumer.

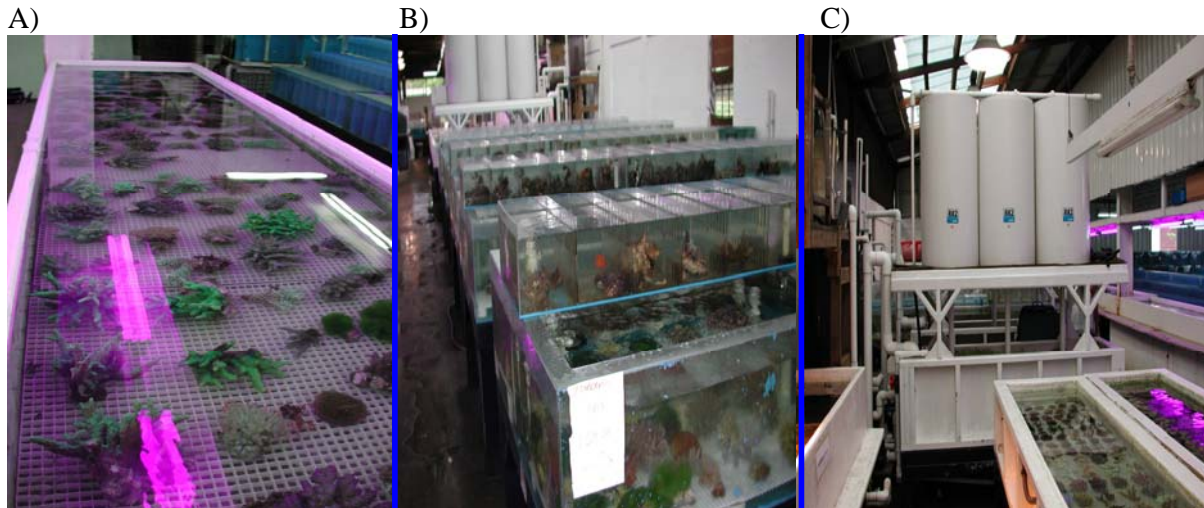
4.2.3. Product Handling

The coral collection and other benthos are brought into the warehouse where they are removed from the collecting bins and placed into shallow troughs for initial washing and acclimatization to the warehouse system. The most stressful part of the collection and transport process is when the organism is removed from the reef until it enters the warehouse system. The stress is the result of temperature and oxygen fluctuations coupled with mechanical damage resulting from the boat and truck ride to the holding system. Whether going or coming, the poor nature of the roads, particularly adjacent the facility, must contribute to product stress.

Once in the facilities' shallow washing troughs, the water is of high quality being characterised by good current flow, low temperature fluctuation and oxygen content. Bacterial levels are low due to ozone and underwater treatment. Mucus and other biological waste products are continuously removed.

Figure 9. Holding trough and aquaria.

The purple reflection (A, C) is specialized lighting to provide both photosynthetic wavelength for the health of the specimens and indication of the iridescent quality of the colonies. B) Holding aquaria. C) Shows halide (above) and UV actinic lights and filtration units. Refrigeration and protein skimmers are located in the left hand margin of the picture.



Live material received from their business in Tonga and from other parts of the South Pacific are re-exported through Fiji. They also deal in both wild caught and hatchery bred *Tridacna* clams.

4.2.4 Shipping

For trans-shipment abroad, the material is repacked into water filled, oxygenated plastic bags and shipped out several times weekly by air freight. Generally, this is to the United States but worldwide interest in aquarium products has opened up markets elsewhere.

Figure 10. Packing coral specimens for shipment overseas. Items are placed in oxygen filled plastic bags.



4.3 Mariculture

The cultivation of hard coral and live rock has been successfully initiated by WSI. Product has been marketed (Annex 10). The approach employed has been to establish two farms (Vunaqiliqili and Cakaavaka-I-Yata Reefs) that cultivate coral fragments into commercial colonies and to produce artificial live rock.

For the coral, steel racks have been established within which bases are positioned with a living fragment of coral on it. These fragments are allowed to grow into marketable pieces.

Figure 11. One colony is divided into many fragments that are grown for the market. B) Colonies cultivated. C) Fragmented colony ready for market.

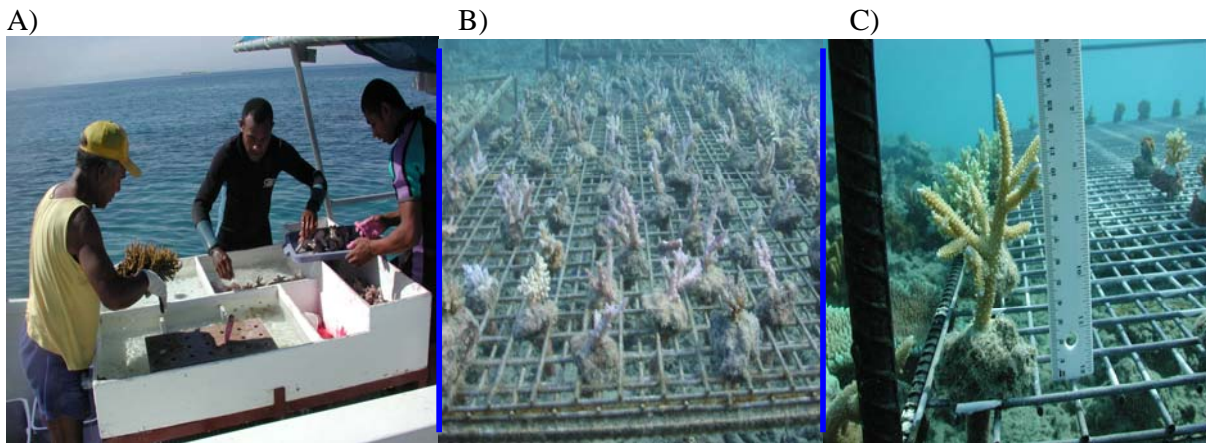
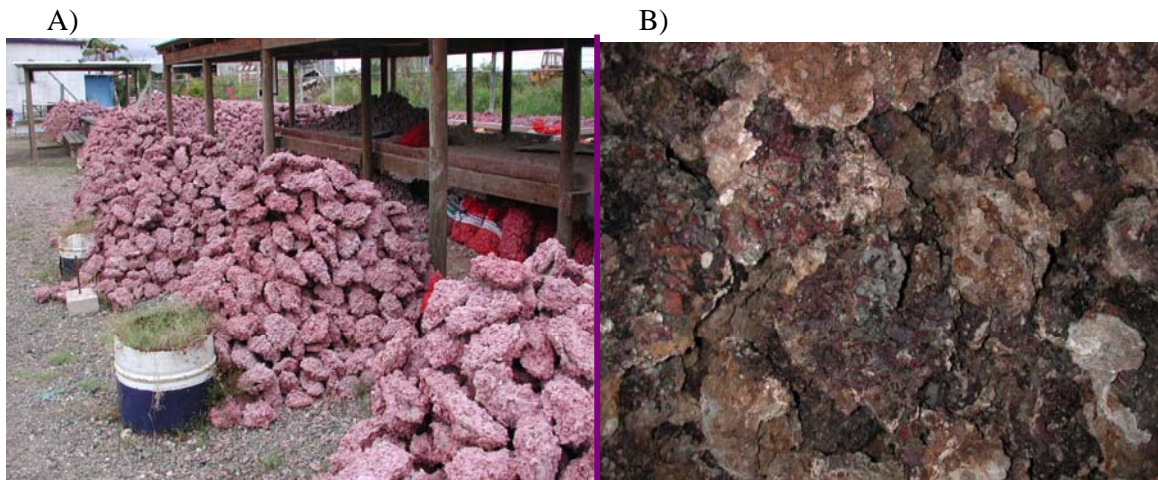


Figure 12. A) Artificial live rock concrete base produced in the warehouse yard. B) Maricultured live rock in the holding facility ready for market.



For the cultivation of live rock, a concrete representation of a piece of a natural reef fragment is placed on the aquafarms at Vunaqiliqili Reef at 5m depth. Here it is colonised by coralline alga's and other fouling organisms such as bacteria, bryozoans, serpulid worms, etc.

5.0 Compilation of Historical Data

Table 22. Actual shipment numbers by Walt Smith Intl. for the years 1999-2003.

Genus	Species	EXPORTS-Actual shipped by Piece				
		Historical				
		1999	2000	2001	2002	2003
Acropora	sp.	4,852	9,866	21,362	27,050	21,741
Acrhelia	horrescens	12	0	14	214	405
Blastomussa	wellsi	2	11	2	0	-
Catalaphyllia	jardinei	244	1	0	8	-
Caulestrea	sp.	720	1,125	751	668	617
Cynarina	lacrymalis		33		14	-
Dendrophyllia	sp.					-
Distichopora	sp.	1,290	60	69	43	1
Echinopora	sp.	2	5	0	0	15
Euphyllia	ancora	1,176	1,347	195	387	19
	cristata					
	glabrescens					
	yaeyamaensis					
Favia	sp.					7
Favites	sp.	699	1,015	1,345	1,195	572
Fungia	sp.	855	1,095	686	496	582
Galaxea	astreata	266	666	6	19	73
	fascicularis					
Goniastrea	sp.	769	1,337	1,741	869	386
Goniopora	sp.	578	513	300	277	295
Heliofungia	sp.	266	236	0	54	-
Heliopora	caerulea	8	33	1	22	-
Hydnophora	exesa	1,013	1,512	1,611	832	588
	microconis					
	rigida					
Leptastrea	sp.				0	-
Leptoseris	sp.				0	-
Leptoria	phrygia				0	-
Lobophyllia	sp.	1,599	2,921	2,820	2,535	1,198
Merulina	ampliata				0	-
	scabricula					-
Millepora	sp.	278	492	280	304	76
Montastrea	sp.	4	0	5	20	14
Montipora	sp.	1,008	1,005	19	422	1,342
Mycedium	elephantotus	202	596	704	614	552
Oxypora	sp.	82	0	0	0	-
Pachyseris	rugosa	350	249	113	628	314
	speciosa					-
Pavona	sp.	367	796	857	977	582
Pectinia	sp.	340	695	561	390	429
Platygyra	sp.	619	1,419	990	1,092	805

Plerogyra	sinuosa	844	1,013	845	410	431
	simplex					
Pocillopora	sp.	530	451	1,271	1,644	1,118
Polyphyllia	talpina	115	17	18	118	359
Porites	sp.	908	1,313	857	1,798	1,064
Scolymia	vitiensis	304	224	90	198	255
Seriatopora	hysterix	862	906	2,208	1,311	359
	caliendrum					
Stylaster	sp.	964	989	480	239	135
Stylophora	sp.	375	177	303	48	24
Symphyllia	sp.					-
Trachyphyllia	geoffroyi	136	369	97	2	-
Tubastrea	sp.	907	522	52	282	136
Tubipora	musica		720	453	417	120
Turbinaria	sp.	624	1,252	1,327	830	680
Total		24,170	34,981	42,433	46,427	34,516

Table 23. Top twelve coral genera shipped in the years of 1999-2003 (Aug.).

Genera	<u>Years</u>				
	<u>1999</u>	<u>2000</u>	<u>2001</u>	<u>2002</u>	<u>2003</u>
Acropora	4852	9866	21362	27050	21741
Lobophyllia	1599	2921	2820	2535	1198
Porites	908	1313	857	1798	1064
Pocillopora	530	451	1271	1644	1118
Favites	699	1015	1345	1195	572
Platygyra	619	1419	990	1092	805
Pavona	367	796	857	977	582
Hydnophora	1013	1512	1611	832	588
Turbinaria	624	1252	1327	830	680
Mycedium	202	596	704	614	552
Fungia	855	1095	686	496	582
Montipora	1008	1005	19	422	1342

Table 24. Top six exports (pieces) for the period of 1999-2003 (Aug.)

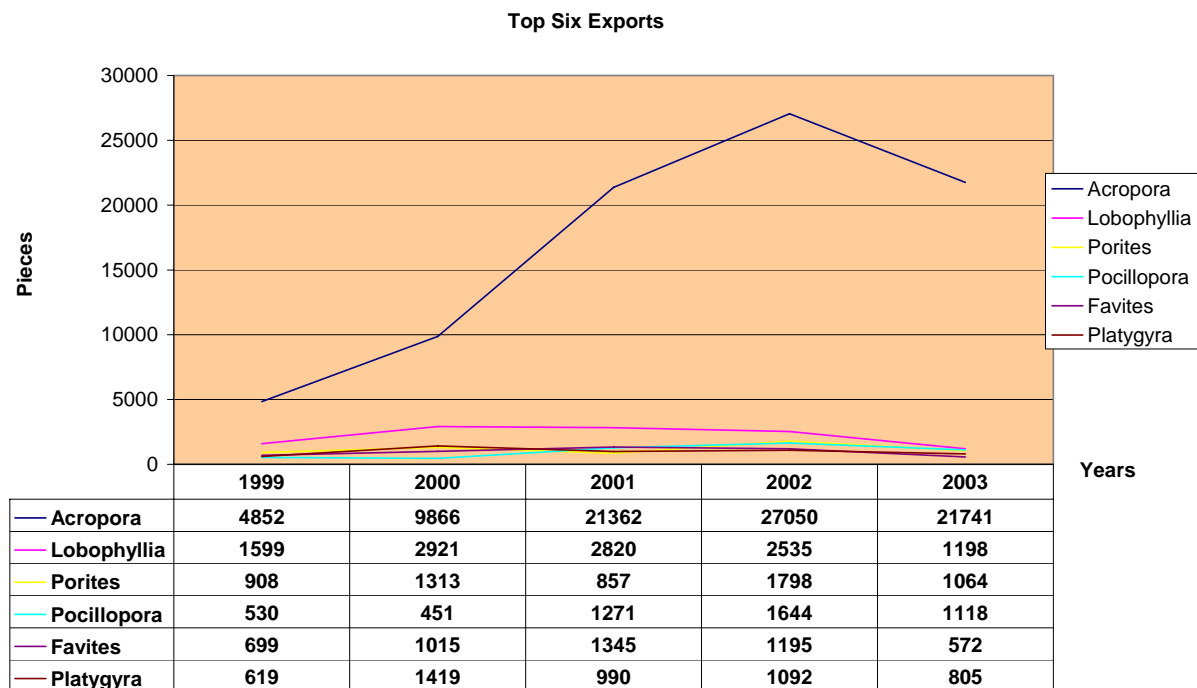


Table 25. The 6-12 genera exported during the period 1999-2003 (Aug.)

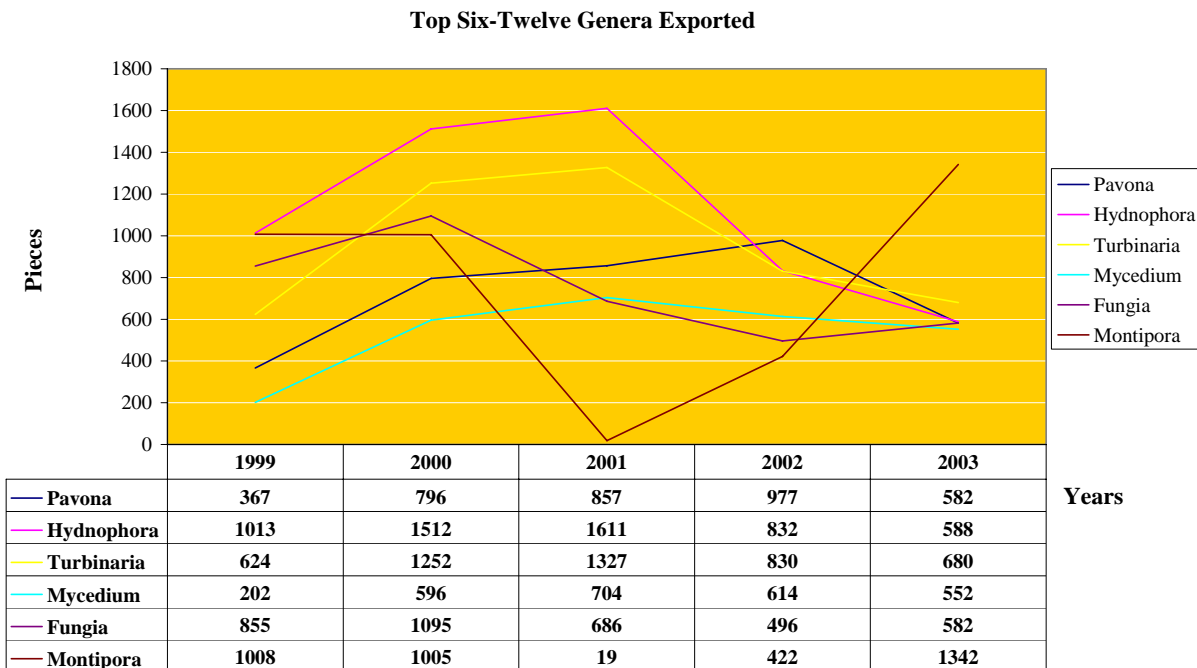


Table 26. 1999 Annual Coral Exports

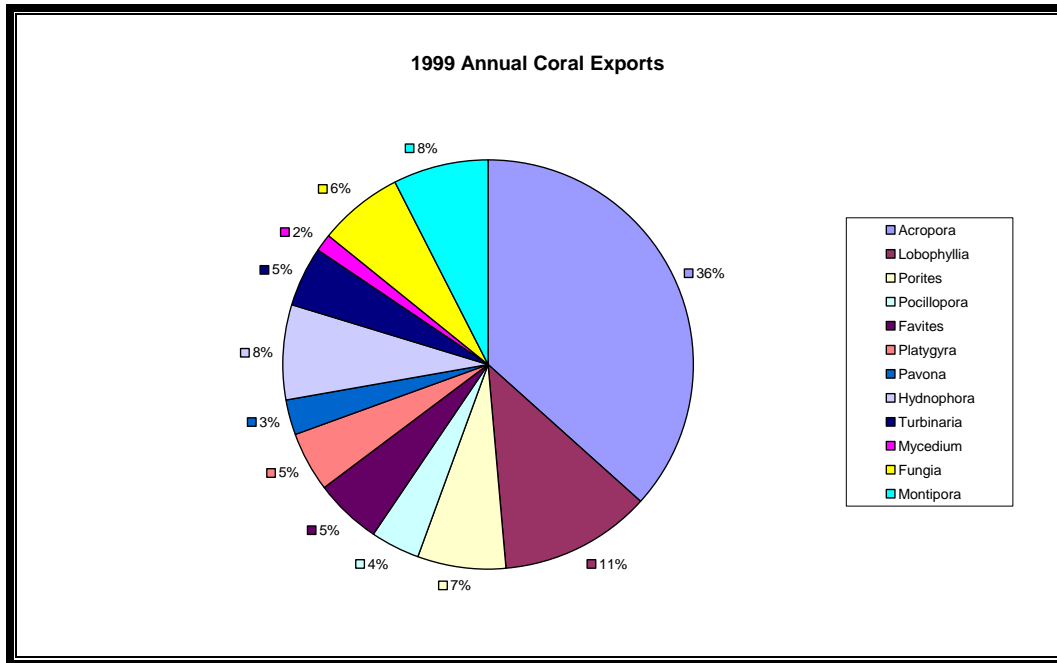


Table 27. 2000 Annual coral composition.

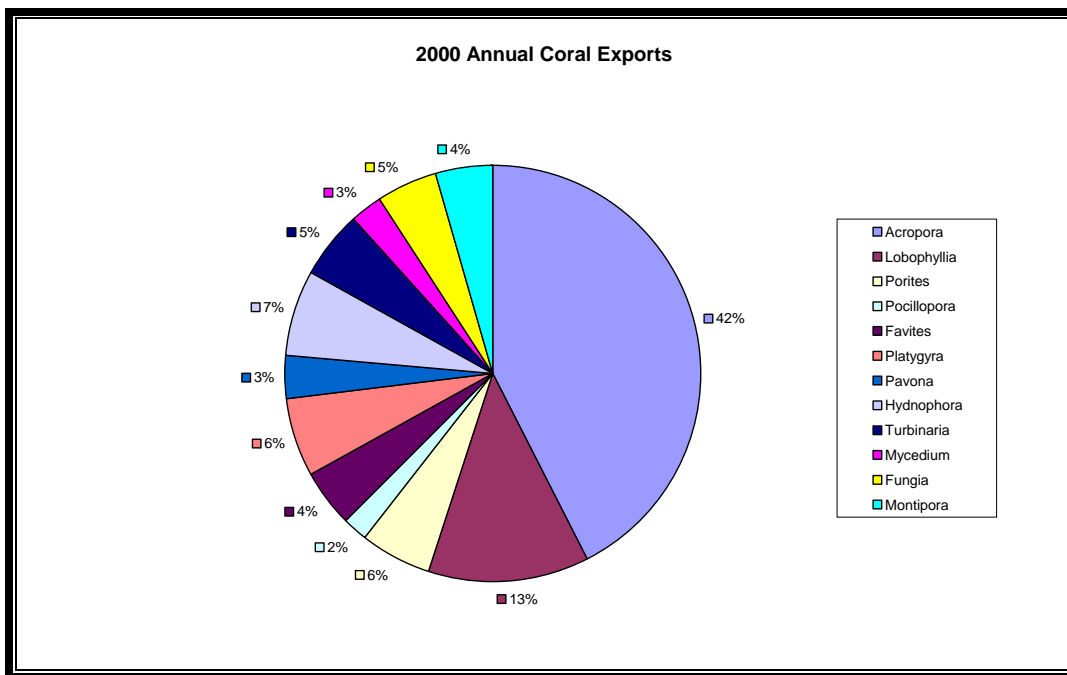


Table 28. 2001 Annual coral composition.

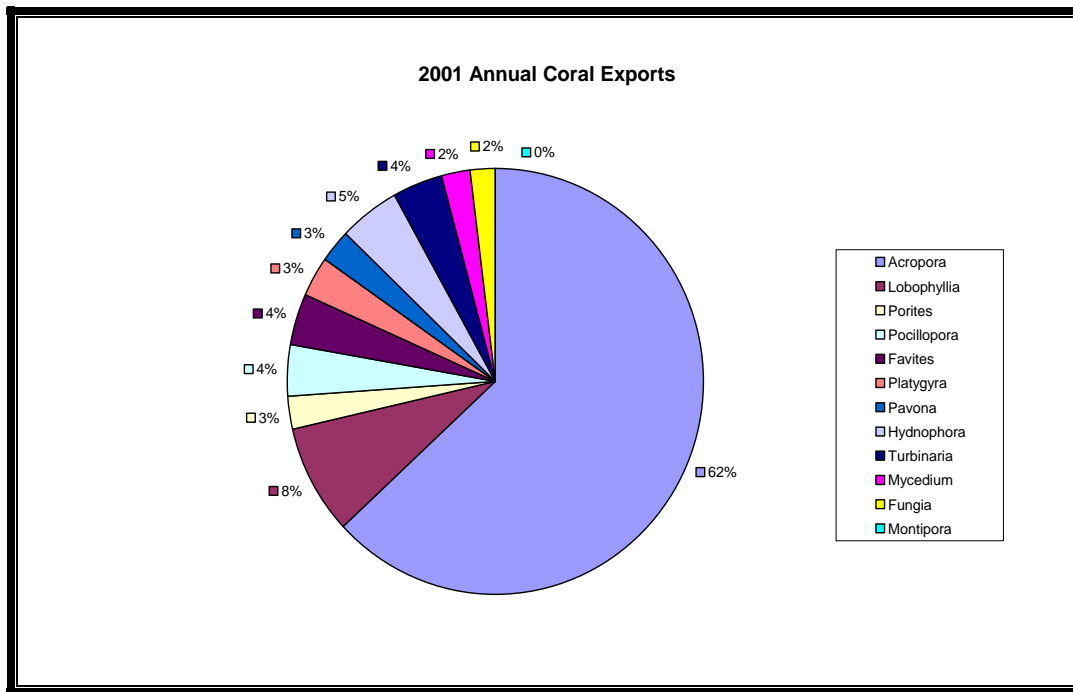


Table 29. 2002 Annual coral composition.

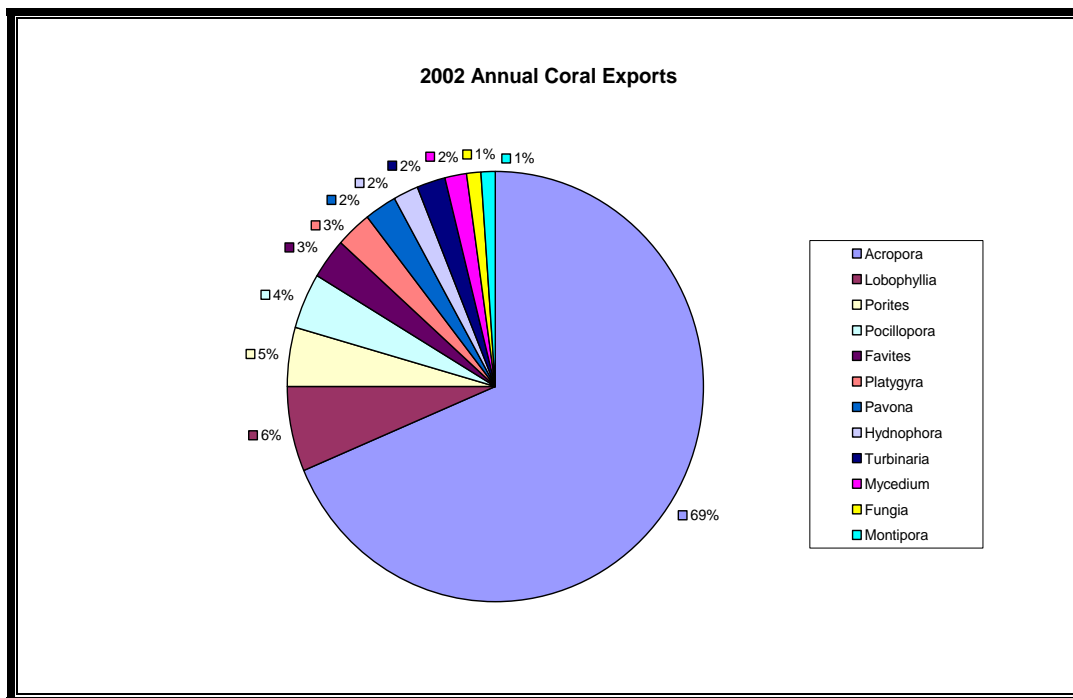
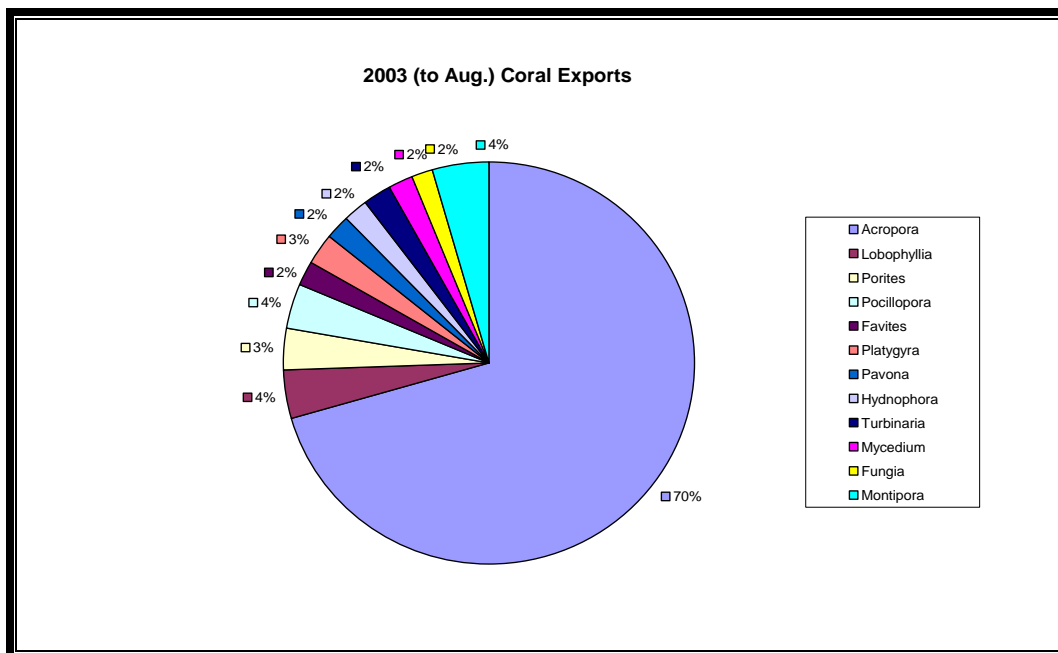


Table 30. 2003 (to Aug.) Annual coral composition.



6.0 Monitoring program of the live coral collection areas.

6.1 General program;

Biannual survey of the reef areas that have been surveyed will be conducted. Additionally, the areas in which there is no collection will be surveyed. Following are the categories to be included in the monitoring program.

6.1.1 Live coral: Objectives

- 1) General survey
- 2) Assessment of the heterogeneity of the reef areas
- 3) Assessment of 'reef health'
- 4) Survey of CITES coral categories
- 5) Assess details of coral farm details for the CITES mariculture proposal: numbers, exports, management plan with timeframe objectives.

6.1.2. Reefs to be used for re-survey

Reef Zone	No. designation	Name	GPS		Minimum reef area	Maximum coral reef area
Northern	3	Cakau-Naitovalase Reef (2)	17 ⁰ 16.16' S	177 ⁰ 20.54' E	25	50
Central	8	Motunikeasulua Reef West	17 ⁰ 26.23' S	177 ⁰ 22.64' E	67	99
“	9	Motunikeasulua Reef East	17 ⁰ 24.34' S	177 ⁰ 24.61' E	181	209
“	10	Cakauvakababa-i-Yata Rf. and Nth Cakau-ni Sucuwalu Reef	17 ⁰ 26.84' S	177 ⁰ 22.11' E	110	159
Mid-shore	13	Nakubu Reef - East lagoon and reef flat	17 ⁰ 30.14' S	177 ⁰ 24.65' E	611	2141

6.1.3 Non-collection area:

Reef Zone	No. designation	Name	GPS		Minimum reef area	Maximum coral reef area
Central	8a	Vunivesi Reef	17 ⁰ 21.80' S	177 ⁰ 24.80' E		
Mid-shore	14	Vunaqiliqili Reef	17 ⁰ 34.76' S	177 ⁰ 20.36' E	14	37

		Reefs where transects were conducted		
		Reefs surveyed outside of the collecting area		

6.2 Methods

1) Assessment of the heterogeneity of the reef areas

The MAQTRAC point transect method is used to determine both reef health and heterogeneity.

2) Survey of CITES category of coral

20m swim surveys progressively conducted to monitor the levels and add to the assessment of standing stock.

3) General survey

Record of the information not collected during the purpose-oriented surveys.

4) Assess details of coral farm details for the CITES mariculture proposal: numbers, exports, management plan with timeframe objectives

6.3 Arrangements, responsibilities, and frequency for monitoring:

Monitoring will be conducted on a contractual basis at six monthly intervals by Walt Smith Intl. The program will be one of progressive collection of data for analysis and comparison. The monitoring will entail the methodology previously explained as well as the collation of the collection and export information for the previous period.

7.0 Live Rock

7.1 Extraction

This aquarium product is the collection of fragmented reef rock covered with coralline algae, which is used as a partially living substrate in creating relief or seascape in aquaria. It is a composite of skeletal material of algal or coral origin and associated plants and animals. The “live” part of the live rock refers to the coralline algae covering the surface, and any fauna or flora residing on or within. One of the principal functions of this coral-based substrate is bio-filtration. The living substrate of the rock, algae and bacteria remove organic waste products such as nitrates and phosphates, and stabilize the water parameters of pH and alkalinity. The bacteria have the capability to perform a nitrifying role in converting ammonia to nitrate and a denitrifying role in reducing nitrate to nitrogen gas. The bacterial component of the rock is perhaps the most important aspect of live rock use.

As with the collection of live reef animals, the extraction of live rock is contracted to the custodians of the *I-qoliqoli*. A license holder represents the team who are trained in the removal of the reef rock. The quantity of rock required is specified daily, and is purchased by the kilogram from the collectors minus any material that is rejected as unsuitable. The rejection rate is relatively small as the feed back to the village collectors is immediate.

Live rock is collected from the edges of the reef flat patch reefs within the shallow lagoon or along the outer algal flat. The removal strategy depends on the nature of the reef flat where both abundance and ease of extraction are considered.

The process involves the removal of blocks of rock with a diameter of 15-35cm. The rock is chosen on the basis of the presence of the pink to dark purple coralline algae on its surface. The rock is

removed using iron bars, which chip it from the reef. It is stockpiled and then loaded on a bamboo *bilibili* raft for transport ashore.

The method is to confine the collection to the seaward edge of the inshore lagoon of Oria Reef adjoining Vatukarasa Village and on to the outer algal flat on Navoto Reef adjacent to Sovi Bay. Collection is also undertaken in the Namada I-qoliqoli of Vunisese Reef adjacent Vatukarasa village to the east.

Collection is preferred at mid-tide for the ease of transport of the reef rock back to shore by *bilibili* raft.

Figure 13. A) The live rock product freshly collected and prior to curing. B) Live rock collector using goggles to find suitable material. C) Live rock being ferried ashore after collection.

A)

B)

C)



7.2 Curing and shipment

Once removed from the reef flat, the rock is transported to the holding facility where cleaning occurs which involves the removal of fleshy algae and any associated invertebrates. Some of the rock may be shipped with little cleaning but most is subjected to a process called *curing*. *Cured* rock is material that has been placed in a holding facility where it is kept moist by a fine spray of seawater. The objective is to keep the coralline algae and bacteria alive while the less hardy organisms die and are washed from the rock by the water spray. The product is considered of a much higher quality, as it is less likely to foul the hobbyist aquarium system. Because of the variety of organisms that may be associated with the live rock, it is important that any mortality associated with the rock occur outside of the tank. Failure to do this may severely affect the water quality in the tank. Rock, which is shipped from Fiji directly from the beach, will have to be cleaned or cured to some degree before it enters the intended tank. In this case, this task is left to the wholesaler or consumer, and as such the rock is considered of an inferior quality.

The live rock curing facility is unique in its design and automation. The water is circulated through a filters and a protein skimmer. It continuously provides spray over troughs that hold the rocks and has a capacity of 12-14 tons during the curing process. It has a 3400 l. reservoir, which is refilled weekly.

The 16-40 kg of this rock is placed into cardboard boxes and air freighted to the Pacific Aquafarms depot or other distributors in Los Angeles. The product is marketed in ten categories (Table X). Fiji Premium is the main commodity. Fiji Natural rock is the uncured rock and is also available in three categories. Fiji Ultra comes in two categories with a third Fiji Ultra Show. Fiji Base Rock is marketed in two categories. Fiji Fancy Branch is a related product but taken from the live collecting areas. These are large pieces of dead branching material. Colony Rock is similar though comprised of smaller pieces of rubble with the attraction of being covered with brightly coloured zooanthid colonies. Tonga Branch and Tonga Shelf are products that are transhipped through Fiji. Fiji Live Sand is sold as carbonate sand with such associated fauna such as marine bacteria, foraminifera and polychaete worms.

Live rock derived from the reef is a common village resource, the labour needed for live rock collection is drawn from a number of families who alternate in the work force and are trained. Those reliant on subsistent fishing utilize both the collection areas, as well as, other parts of the *I-qoliqoli* or adjacent ones where no live rock collection is made.

7.3 Vatukarasa Village

Walt Smith International has been extracting live rock for seven years. It is collected from three sites; Oria Reef has a small, shallow inshore lagoon area with a general lack of relief over the reef flat. There are two rivers, the Sovi and the Tamanua Rivers, which empty into bays on either side of the reef. This creates a cycle of periodic coral settlement, growth, and death due to flooding with subsequent deposition and consolidation by coralline algae. It is this material that is the source of live rock.

The other sites (Navoto Reef and Vunisese Reef) have an inner lagoon that is characterized by a good luxuriance of coral. Navoto Rf. is surrounded by an algal crest or flat which forms the western margin of Sovi Bay and the seaward edge of the south of the reef flat.

8.0 Monitoring of the live rock collection area

The collection area has been divided into 10 sectors with the aim of allowing rotational collection in a system which allows areas to remain undisturbed for several months between collecting periods. Two of the areas are non-collection areas with one being a FLAMMA marine protected area.

Below are the GPS readings for the boundaries along the three areas of coral reef subject to collection.

These are outlined on the aerial photos. The zones are listed with their western GPS coordinates and description.

Table 31. GPS locations of the buoyed margins of the live rock collection areas.

GPS locations: Sept. 1, 2003				
Zones		Latitude *	Longitude*	Description
1				FLAMMA marine protected area in front of Namada Village. East of GPS reading below.
2	Namada	18°11.35'S	177° 37.09'E	Series of white buoys extending seaward of 50m from last western hump bordering Namada.

3		18°11.31'S	177° 36.86'E	Series of red buoys extending from headland. Zone forms the western margin of the bay.
	Vatukarasa			
4				No collection in front of the village. Eastern margin of the bay.
5		18°11.20'S	177° 36.07'E	Three red buoys in line to delimit the area of collection (western boundary) and the village "no-collect area".
	Vatukarasa West			The following 4 readings are of a white buoy positioned on the outward edge of the reef.
6	1)	18°10.95'S	177° 35.08'E	White buoy near reef crest.
7	2)	18°10.96'S	177° 34.81'E	“
8	3)	18°10.90'S	177° 34.70'E	“
9	4)	18°10.91'S	177° 34.55'E	“
10	5)			Eastern side of the bay

* GPS readings are on the eastern side of the zone.

8.1 Information Assessment

Qualitative and quantitative information will be collected through the survey protocols developed by FLAMMA for the Namada Marine Protected Area. The principal method of survey is an adaptation of the MAQTRAC approach where point intercept and selected line transects are employed to assess the nature of the benthos. Fish transects are conducted following a modified MAQTRAC protocol. Additionally, the monitoring protocol involves record keeping, product control, rotational collection and comparison with a non-collection control area.

Record keeping involves the progressive recording of collection and the comparison with export quantities to determine return levels. Current collection levels are compared with historical levels. This statistic is used to assess the resource size, collection requirements and future management strategies.

Product control involves minimizing collateral damage and checking to see that the material collected is the product that is required. This reduces rejection of unsuitable material, reducing reef impact, increasing remunerative benefits at the village and company levels.

Rotational collection allows the disturbance created during the collection to be confined to periods with a subsequent period for the area to stabilize or function with out the influence of collection.

Control areas in the form of the FLAMMA marine protected area at Namada allow for comparison of collected areas with non-collected areas. Information collected as baseline information for the MPA will be compared with the data collected from the harvest areas using the same techniques.

8.2 Arrangements, responsibilities, and frequency for monitoring:

Monitoring will be conducted on a contractual basis at six monthly intervals by Walt Smith Intl. The program will be one of progressive collection of data for analysis and comparison. The monitoring will entail the methodology previously explained as well as the collation of the collection and export information for the previous period.

Table 32. Reef area on the Coral Coast of the WSI live rock collection with qoliqoli boundaries.

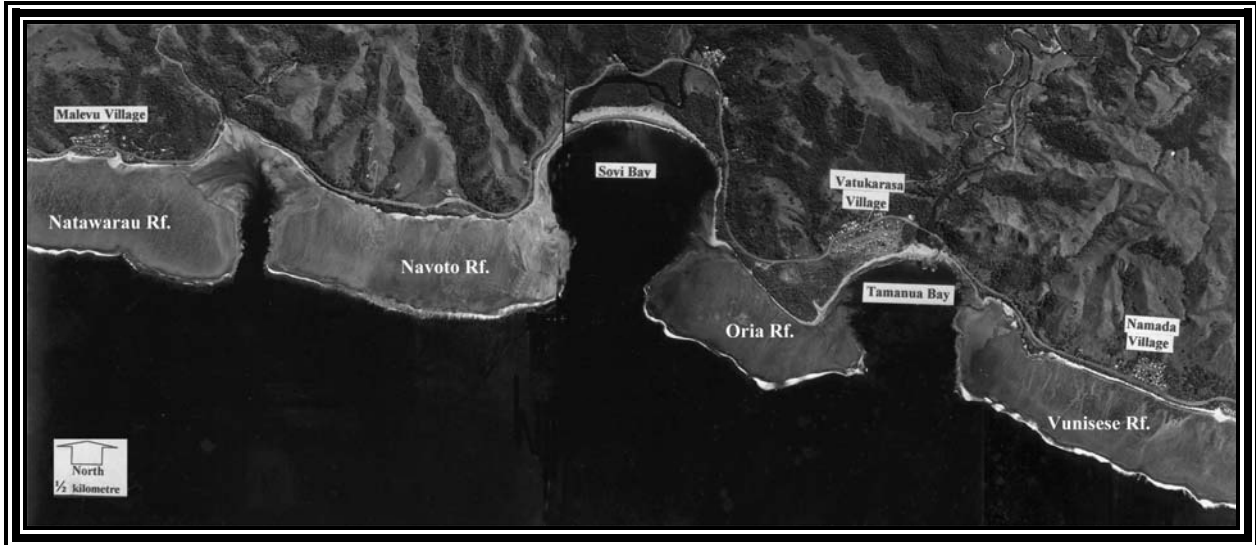


Table 33. I-qoliqoli of Vatukarasa and Namada collection areas.

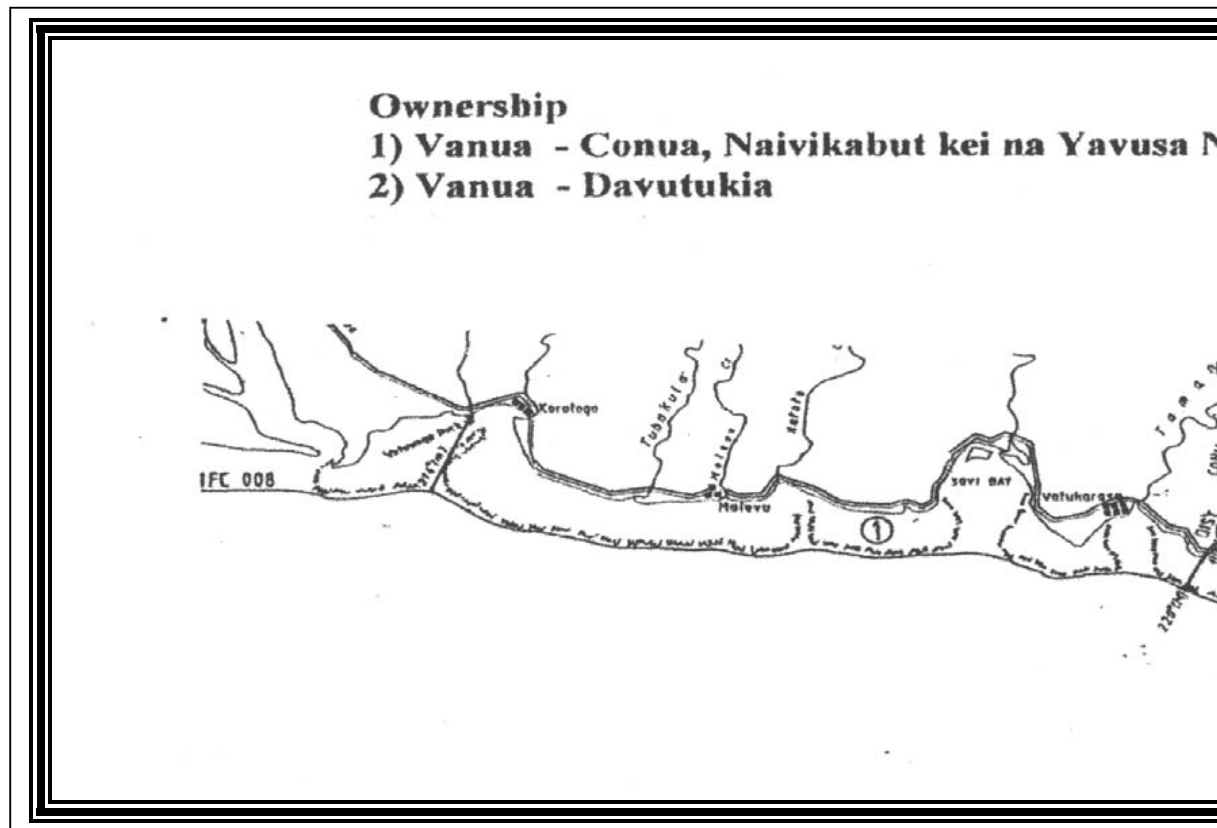


Table 34. Management zones in the Vatukarasa/Namada live rock collection area.

