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CORAL DIVERSITY SURVEY
MAMANUCA ISLANDS AND CORAL
COAST, FIJI, 2005

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by

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Coral Diversity Survey, Mamanuca Islands and Coral Coast, Fiji, 2005

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Executive Summary

- A list of corals was compiled for 21 sites in Fiji, including 19 sites in the Mamanuca Islands and 2 sites on the Coral Coast. The survey involved about 25 hours of scuba diving by D. Fenner to a maximum depth of 35 meters.

- The reefs of Fiji have a diverse coral fauna. A total of 253 species and 61 genera of hard corals (237 species and 54 genera of zooxanthellate Scleractinia) were observed during the present survey. This is more than the number found in a similar study by the author in American Samoa (220 species), in Danjugan (236), and Cagdanao (234) Philippines, and much more than the total known in Hawaii (66: Fenner, 2005), but slightly less than that found by the author in the Leyte Island, Philippines (264), and eastern Australia (257), and significantly less than from eastern Papua New Guinea (332). However, these numbers do not reflect equivalent search time, area, or effort. The number 253 is approximate, due to difficulties in identifying corals.

- The total number of corals found in this brief study (253 species) is nearly that known from all work done by previous workers in work soon to be published (259 species).

- The number of species found after 11 one-hour dives was 215 species, which is more than the number found after the same number of hours diving in American Samoa (150) and eastern Australia (190), but a little less than that found after the same number of hours in Leyte, Philippines (223) and Papua New Guinea (228). The number of species found after 21 dives was 243, which is more than after the same number of dives in the GBR (231), but less than after the same number of dives in Papua New Guinea (261). This indicates that the diversity is very high indeed, approaching that of the Coral Triangle.

- The number of species at individual sites ranged from 54 to 98, with an average of 70 per site. Sites in Leyte, Philippines averaged 104 per site, and the average number per site for 12 other areas in the "Coral Triangle" area of highest diversity was 93.6 species per site. In eastern Australia there was an average of 71 species per site, and in American Samoa 71 species per site. Hawaii averages about 18 species per site.

- The coral diversity of Fiji is much greater than in Hawaii, slightly greater than in American Samoa, comparable or slightly more than that in eastern Australia, and somewhat less than that found in eastern Papua New Guinea, Leyte (Philippines)

and other sites in the Coral Triangle. This fits well with its geographic location between American Samoa to the east and Australia, Papua New Guinea and the Coral Triangle to the west. Coral diversity increases to the west and decreases to the east in the Pacific.

- 59% of the species found have ranges that extend both east and west, 41% have ranges that extend only westward, and no species have ranges that extend only eastward.

- About half of all non-endemic Hawaiian species were found, allowing a very tentative estimate that the total fauna in Fiji might be as many as 500 species. Several assumptions are required for this estimate, and it is likely that the ultimate number will be found to be less than 500, though it seems certain to be over 300 and may well be 400 or more species. A second estimate, using the portion of the species shown in Veron (2000) which have ranges including Fiji, which were found in this study, produced a nearly identical estimate of 500. This is the first such estimate for anywhere in the world to the author's knowledge.

- *Acropora, Montipora, Porites, Fungia* and *Pavona* were the genera richest in species, with 59, 12, 12, 10, and 10 species. This is typical of rich Indo-Pacific reefs.

- The overwhelming majority (94%) of corals on these reefs are zooxanthellate Scleractinia, with only a few non-sclearctinian and azooxanthellate species, as is typical of Indo-Pacific reefs.

- 11 rare species were found.

- A total of 29 species were found which are outside the known ranges for those species.

- A total of 66 species were found which were not previously reported, bringing the total number of species of coral known in Fiji to 325 species.

- Ten species were found that could only be identified to genus, and may possibly be new species. Much more study will be required to determine if they are new species, including collecting samples and studying their cleaned skeletons. Several of these are likely to be previously named but not be well known.

- 234 species were found in the Mamanucas, and 136 on the Coral Coast. *Acropora* appeared to be abundant and diverse in the Mamanucas, but rare on the Coral Coast. There were 55 species of *Acropora* in the Mamanucas, but only 21 on the Coral Coast. Because there many more dives and sites in the Mamanucas, these are not good comparisons. After two dives, there were 98 species in the Mamanucas and 85 species on the Coral Coast. After two dives there were 22 species of *Acropora* in the Mamanucas but only 8 species on the Coral Coast, and there were 76 non-*Acropora* in the Mamanucas and 77 non-*Acropora* on the Coral Coast. Thus, the main reason there were more species found in the Mamanucas was because of more dives there, however, with equated dives there was three times as many *Acropora* in the Mamanucas. The diversity of non-*Acropora* at the two sites was identical. A reef crest area on the Coral Coast that was not searched has an *Acropora* community, so there are probably more *Acropora* species there than this study found.

- An average of 77 species were found at sites in the Mamanucas that have been suggested by Coral Cay Conservation (CCC) for MPA sites, while an average of 66 species were found in sites not suggested for MPA sites. This difference was significant, though small.

- General observations revealed that the Mamanuca Islands and reefs are highly protected from wave action, while the Coral Coast reef slope is directly exposed to heavy wave action. Reefs of the Mamanuca Islands are heavily dominated by *Acropora* species, and some sites have particularly spectacular *Acropora* communities in shallow water with high coral cover and diversity. Some parts of the Mamanuca Islands have cyanobacteria blooms or dense brown macroalgae that indicate nutrient enrichment. The reef flat on the Coral Coast also has dense brown macroalgae communities, but the reef slope has essentially no macroalgae. Reef slopes on the Coral Coast have a variety of massive and encrusting corals and very little *Acropora*. The reef slopes there are similar to those in American Samoa except that the latter are dominated by crustose coralline algae between corals while the former are dominated by turf algae.

- The spectacular shallow *Acropora* communities of the Mamanucas are world class reefs for aesthetic quality as well as diversity. They have very high value for tourism, and should receive complete no-take protection.

Introduction

The following is a report of the reef coral fauna of 19 sites in the Mamanuca Islands and 2 sites on the Coral Coast of Fiji, based on results of the author's observations during a visit to the CCC base at Ravunake in the Mamanucas and to Mike's Divers on the Coral Coast in September, 2005.

The principle aim of the coral survey was to provide an inventory of the coral species growing on reefs and associated habitats and compare the coral fauna on different sites. The primary group of corals is the zooxanthellate scleractinian corals, that is, those that contain single-cell algae and which contribute to building the reef. Also included are a small number of zooxanthellate non-scleractinian corals which also produce large skeletons which contribute to the reef (e.g., *Millepora* and *Tubipora*: fire coral and organ-pipe coral, respectively), and a small number of azooxanthellate scleractinian corals (*Balanophyllia*, *Tubastrea, Dendrophyllia,* and *Rhizopsammia*). And lastly, there are a few azooxanthellate non-scleractinian corals (*Distichopora, Stylaster*). All produce calcium carbonate skeletons that contribute to reef building to some degree.

The results of this survey facilitate a comparison of the faunal richness of the reefs of these two areas of Fiji with those of American Samoa to the east and Hawaii to the northeast, and the Great Barrier Reef, Papua New Guinea, and the Philippines to the west. However, the list of corals presented below is incomplete, due to the limited number of dives in the survey (about 27 hours of diving and snorkeling), the highly patchy distribution of corals and the difficulty in identifying some species in the water. Corals are sufficiently difficult to identify that there are significant differences between leading experts on some identifications. Visual identifications are tentative and require confirmation from microscopic examination of the cleaned skeletons of collected specimens.

Methods

Corals were surveyed in about 25 hours of diving in 25 scuba dives by D. Fenner to a maximum depth of 35 m, plus two snorkels. Lists of coral species were recorded at 20 sites. The basic method consisted of underwater observations, during one 40 minute dive to less than 18 meters at each dive site, plus 20 minutes in less than 5 meters depth in the Mamanucas. On the Coral Coast dives were 40 minutes, but the maximum depth was 35 m. The name of each species identified was marked on a plastic sheet on which species names were printed. A direct descent was made in most cases to the maximum depth of the dive (usually 17 m) or of the reef, whichever was less. The bulk of the dive consisted of a slow ascent along the reef in a zigzag path to about 5 meters depth. Areas of less than 5 meters depth were examined on a separate dive, for a total of 60 minutes. Sample areas of all habitats encountered were surveyed. Many corals can be identified to species with certainty in the water and a few must be identified alive since they cannot be identified without living tissues. Also, there are some that are easier to identify alive than from skeletons. However, some are difficult to identify in the field or require confirmation from collected specimens. Field guides assisted identification (Veron and Stafford-Smith, 2002; Veron, 2000; Wallace, 1999ab). Additional references supporting identification are listed in references (Best & Suharsono, 1991; Boschma, 1959; Cairns & Zibrowius, 1997; Claereboudt, M. 1990; Dai, 1989; Dai & Lin 1992; Dineson, 1980; Fenner, in preparation; Hodgson, 1985; Hodgson & Ross, 1981; Hoeksema, 1989; Hoeksema & Best, 1991; Hoeksema & Best 1992; Moll & Best, 1984; Lamberts, 1982; Nemenzo 1986; Nishihira, 1986; Ogawa & Takamashi, 1993, 1995; Randall & Cheng, 1984: Sheppard & Sheppard, 1991; Suharsono, 1996; Veron, 1985, 1986, 1990, 2000; Veron & Nishihira, 1995; Veron & Pichon 1976, 1980, 1982; Veron, Pichon & Wijman-Best, 1977; Wallace 1994, 1997a, Wallace & Wolstenholme 1998).

Dive sites are listed in Appendix A table at the end of the report, and shown in a GIS map based on a satellite image in Fig 1.

Results

A total of 253 species and 61 genera of stony corals (237 species and 54 genera of zooxanthellate Scleractinia) were found in the survey of these reefs (Appendix A). All of these species are illustrated in Veron (2000) and Veron and Stafford-Smith (2002). The total of 253 species is more than that found by the author on Tubbataha Reef, Philippines (243 species) and the Cagancillio island group, Philippines (244 species), but slightly less than found by the same observer in the "Coral Triangle" area of highest diversity using the same methodology: 257 in eastern Australia, 264 species at Leyte, Philippines, 303 species in the Calamaian Is., Philippines, 315 sp. in Sulawesi, Indonesia, 332 in Milne Bay, PNG, and 331 in Raja Ampats, Irian Jaya, Indonesia. However, many more dives were made in these other surveys, and additional dives increase the number of species found. Further, the total of 235 species of Scleractinia is just 10 species short of the current total for Fiji found by others in newly published work (Lovell, 2005).

The present numbers of species are approximate, due to the difficulty in identifying coral species in the water, and the fact that skeletons were not examined.

The number of species found after 11 one-hour dives was 215 species, which is more than the number found after the same number of hours diving in American Samoa (150) and eastern Australia (190), but a little less than that found after the same number of hours in Leyte, Philippines (223) and Papua New Guinea (228). The number of species found after 21 dives was 243, which is more than after the same number of dives in the Great Barrier Reef (231), but less than after the same number of dives in Papua New Guinea (261).

The number of species at individual sites ranged from 54 to 98, with an average of 70 per site. Sites in Leyte, Philippines averaged 104 per site, and the average number per site for 12 other areas in the "Coral Triangle" area of highest diversity was 93.6 species per site. In eastern Australia there was an average of 71 species per site, and in American Samoa 71 species per site. Hawaii averages about 18 species per site.

The coral diversity of Fiji is much greater than in Hawaii, slightly greater than in American Samoa, comparable or slightly more than that in eastern Australia, and somewhat less than that found in eastern Papua New Guinea, Leyte (Philippines) and other sites in the Coral Triangle. This fits well with its geographic location between American Samoa to the east and Australia, Papua New Guinea and the Coral Triangle to the west. Coral diversity increases to the west and decreases to the east in the Pacific.

General faunal composition

The coral fauna consists mainly of Scleractinia. The genera with the largest numbers of species found were *Acropora, Montipora, Porites, Fungia* and *Pavona.* These five genera account for about 41% of the total observed species (Table 1). (Families are less stable and useful in corals than genera, and thus were not used.)

Table 1

Genera with the greatest number of species

Rank	Genus	No. species
1	*Acropora*	59
2	*Montipora*	12
3	*Porites*	12
4	*Pavona*	10

5	*Fungia*	10

Acropora, Montipora, and *Porites* are usually the three most species-rich genera on rich Indo-Pacific reefs. The farther down the list one moves, the more variable the order becomes, with both the number of species and the differences between genera decreasing.

Most of the corals were zooxanthellate (algae-containing, reef-building) Scleractinian corals, with 94% of the corals in this group. There were four species that are azooxanthellate (lacking algae) Scleractinia for 1.6% of the total, and there were 12 corals that were not Scleractinia, for 3.5% of the total.

Zoogeographic affinities of the coral fauna

The reef corals of Fijian reefs belong to the overall Indo-west Pacific faunal province, which stretches from the Red Sea to the Pacific coast of the Americas. A few species span the entire range of the province, but most do not. The area of highest biodiversity in corals ("Coral Triangle") appears to be an area enclosing the Philippines, central and eastern Indonesia, and northern (Hoeksema 1992) and eastern Papua New Guinea and the Solomon Islands. Diversity declines in all directions from this center, reaching low levels in Hawaii and even lower levels on the Pacific coast of the Americas.

The biodiversity of corals falls off from the Coral Triangle in all directions, reaching 80 species at an island near Tokyo, 65 species at Lord Howe Island southeast of Australia, about 66 species in Hawaii, and about 20 species at Pacific Panama. Species fall-off is significantly less to the west in the Indian Ocean and Red Sea. About 300 species may currently be known in the Red Sea, though this area, like many others, is insufficiently studied to provide accurate figures.

Most coral species found in this area have fairly wide distributions within the Indo-Pacific. A majority of corals have a pelagic larval stage, with a minimum of a few days pelagic development for broadcast spawners (a majority of species), and larval settling competency lasting for at least a few weeks. A minority of species release brooded larvae that may be capable of anything from immediate settlement to a long pelagic dispersal period. 124 (59%) of the coral species found in this study have ranges that extend both east and west from Fiji, based on the maps in Veron (2000). 87 (41%) have ranges that extend only west from Fiji. That is, Fiji is at the end of the known range for these species. No species in Fiji have ranges that extend only to the east. Thus there is a strong asymmetry in the ranges of coral species found in Fiji with many extending to the west but none extending to the east. Fiji is at the eastern end of the range of many species, which is part of the diversity gradient with high diversity in the west fading out to low diversity in the east.

Estimate of total diversity

The fact that no species have ranges that extend eastward along with the fact that the corals of Hawaii are relatively well studied (Fenner, 2005) allows an estimate of the proportion of the total coral fauna that the present study represents. If all the corals in Hawaii have been found (it seems likely that most have), and all non-endemic species have ranges that extent toward the west (as found in Fiji), then the proportion of the Hawaiian non-endemic species that have been found in Fiji might be representative of the whole Fijian fauna. There are several unproven assumptions here, the last perhaps being one of the most tenuous. Hawaii is not only east of Fiji, but far to the north and highly isolated. The assumption that the non-endemic Hawaiian species are all in Fiji may prove to be unfounded. Nevertheless, there are 53 non-endemic coral species known in Hawaii, and of these species, 27-29 or 51-54% were found in Fiji in this study. Thus, this method would produce an estimate that the present findings of 253 species may represent only half of the coral species ultimately to be found in Fiji. That would give an ultimate total of about 500 species. This seems a very high number indeed, considering that only a few years ago the country with the highest total known in the world (the Philippines) had only 411 species known. However, studies in recent years have greatly increased the number of coral species known in different areas, and now approximately 600 species are known from the Coral Triangle.

A second method was to look at the species shown in the maps in Veron (2000) to have ranges that include Fiji. These maps do not indicate what is actually in Fiji, merely that Fiji is within the known range of particular species. Fiji is within the range of 365 species as shown in Veron (2000). If you look at the list of species in this report, and count the number of those 365 species which I found, you find that I found 186 of them, or 51%. This agrees very closely with the estimate that I have found 51-54% of the Fiji corals derived above from the Hawaii data. The fact that they agree so closely suggests that the ultimate total of around 500 species may be fairly accurate.

The estimate of a total of 500 species is also consistent with the findings reported above that the number of species found in one dive or 11 or 21 dives is less than in the Coral Triangle but not a great deal less. Although a projected total of 500 species seems very large, it should be remembered that the present study was a very brief study, conducted in only two small areas, by only one person, and thus can be expected to only find a small part of the total coral fauna of Fiji. In Hawaii, there are many very observant scientific divers who have spent the better part of their lives recording corals there in many sites, and the knowledge of the fauna is likely to be very high. It seems likely that 500 may be an upward bound, and the ultimate total may be significantly less, but it is sure to be over 300, and may well be 400 or more. In the process of finding coral species, there are diminishing returns, so that it takes an ever increasing amount of effort and study to find more species (Figure 1). It will take many years of searching by many people to find all the coral species in Fiji.

These estimates are to the author's knowledge the first such estimates in the world.

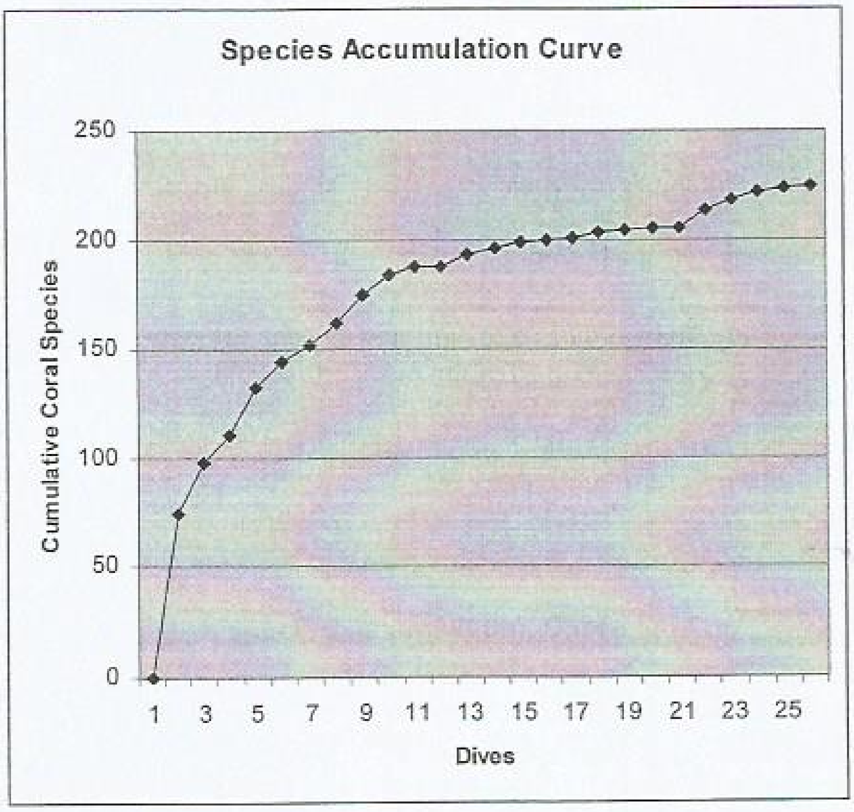
Diversity at individual sites

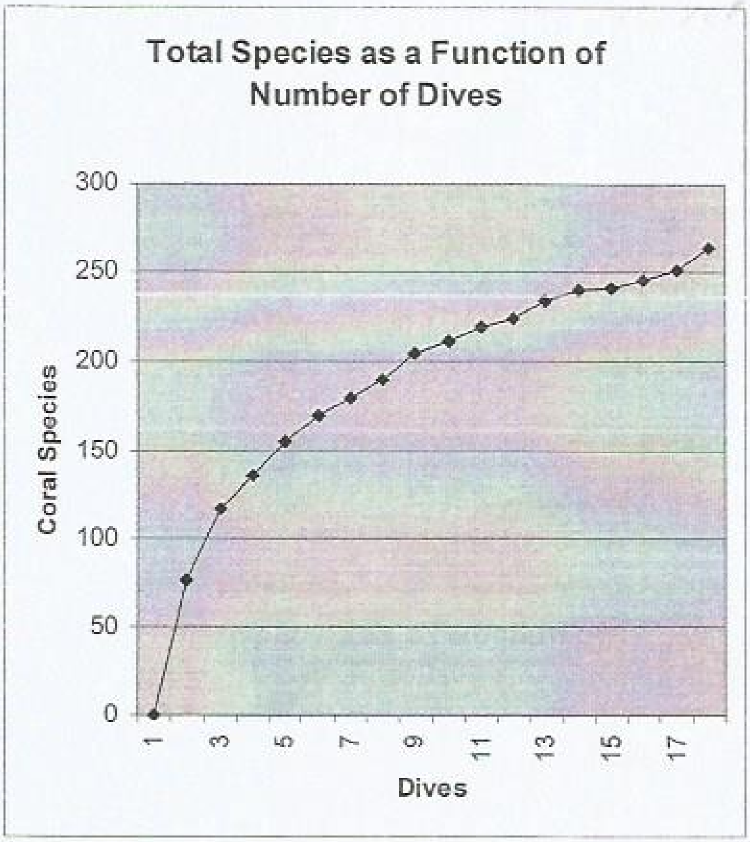
The number of coral species was highest at Kaka and Honeymoon, with 98 and 92 species, respectively. The number of coral species was lowest at Chief's Beach and N. Castaway, with 44 and 47 species, respectively.

The number of species at all sites is presented in Appendix A.

Species are found quickly at first, but additional species are found at a slower and slower pace as more species are found. Thus there are diminishing returns for additional work, yet species continue to be found. The first 19 dive sites were at the Mamanuca Islands, and the last 5 at the Coral Coast. A small bump in the rate of finding species can be seen starting with the move to the Coral Coast, due to the coral species being somewhat different at the Coral Coast from the assemblage in the Mamanucas. Figure 1 also includes data points from two snorkels.

Figure 1





Habitats and Reefs

Corals are habitat-builders and appear to have less niche-specialization than some other groups. Some zonation occurs by depth and exposure to waves or currents. Thus, there are a few corals that are restricted to zones such as very shallow areas, protected areas, deep water, shaded niches, soft bottoms, or exposed areas. However, many corals can be found over a relatively wide range of exposure and light intensity. Corals are primarily autotrophic, relying on the products of the photosynthesis of their symbiotic algae, supplemented by plankton caught by filter-feeding and suspension feeding. Most require hard substrate for attachment, but a few grow well on soft substrates.

There were five different habitats in the two study areas which differ greatly in environmental conditions. The first is shallow, nearly flat zones of the Mamanuca sites. All of the Mamanuca sites are highly protected from wave action. The shallow flat areas are also exposed to intense sun. These areas often had dense, diverse communities of *Acropora* which were quite spectacular. The second habitat is the steep, medium-depth habitat at Mamanuca sites. This habitat had even less wave action than the flat shallow areas, but has much less sunlight. Zooxanthellate corals are much less dense in this zone, and the community is not as heavily dominated by *Acropora*. Coral density is determined by how vertical the site is, with overhanging sites having the least light and the fewest zooxanthellate corals. Data were not collected separately for these two different zones.

The remaining three habitats are all on the Coral Coast. The first is the shallow reef flat, which is exposed to air at extreme low tides, is exposed to high intensity light, and is exposed to some wave action and strong currents at high tide. This zone is dominated by brown algae, primarily *Turbinaria*, and has small quantities of a few species of coral. The second habitat is reef slope on the Coral Coast. These slopes are exposed to very strong wave surge. Both wave surge and light levels decrease with increasing depth. Where the slope is less than vertical, coral cover appears to be about 20 – 25% (visual estimate only), and is completely dominated by massive and encrusting species, with *Acropora* being very rare indeed. Spaces between corals are dominated by turf (filamentous) algae, with small amounts of crustose coralline algae. There is no macroalgae. The last habitat is vertical walls along the Coral Coast. These walls begin as shallow as about 5 meters, and are also exposed to strong wave surge, but low light levels. There are very few zooxanthellate corals, but many small azooxanthellate stylasterid corals, *Distichopora nitida* and *Stylaster*.

Dominant Species

The genus *Acropora* dominates shallow reef tops in the Mamanuca Islands as stated above, however no one species dominates and diversity is high. In one site, N. Castaway, three species of coral together dominated the site: *Porites rus*, *Porites cylindrica*, and massive *Porites*. The first two of these are typical of the most protected lagoon sites. This site had a large population of *Padina* algae, and appeared to have little circulation and high nutrients.

Nuku had high *Acropora* cover on the reef top. Yalo 2 was similar, and one of the very best sites. Namoa had huge amounts of cyanobacteria on the lower wall. Rocky's had lots of *Acropora* on the reef top, but about half of it was dead and covered with a black coating of algae. A few colonies were recently dead, and other colonies had White Syndrome disease killing them. Some colonies had only branch tips dead, and a few Crown of Thorns starfish were seen. Motuse had lots of White Syndrome disease on table corals. Waigdigi had very little coral, as did Nayauul and Chief's Beach.

Algae Problems

The reefs of the Mamanucas and their coral assemblages have no parallel in American Samoa, which has no such large enclosed lagoon. The reef slope on the Coral Coast is much more similar to American Samoa, due to the exposure to heavy wave surge. However, crustose coralline algae is much more common in American Samoa, and is replaced on the Coral Coast by filamentous algae. The abundance of algae on the reef flat of the Coral Coast and near beaches and on a few reefs in the Mamanucas indicate there are elevated nutrient levels in the water, and/or reduced herbivore populations. Elevated nutrients on the Coral Coast have been documented by Mosley and Aalbersberg (2003; 2004). Reduced herbivore populations would likely be due to reduced Surgeonfish and Parrotfish, and can best be evaluated with Coral Cay Conservation data or other data; the author has no data to confirm or deny this. Nutrient levels may need to be measured directly in water, in a pattern to try to find out whether the source in the Mamanucas is the resorts or the rivers of Viti Levu or a combination thereof. Stable nitrogen isotopes might be used to determine if the source is sewage. For the river in Viti Levu, agriculture may also be a potential source of nutrients (Mosley and Aalbersberg, 2004), as it may be on the Coral Coast.

In the latter, village septic systems may contribute as well (Mosley and Aalbersberg, 2004).

On the Coral Coast, the reef flat reportedly used to have lots of coral, and only in recent years has it been overgrown by algae (Mosley and Aalbersberg, 2004). Some hotels reportedly have their sewage outfall pipes releasing their sewage directly on the reef flat. Reportedly they are building additional sewage treatment facilities. A less expensive and more cost-effective action might be to extend the outfall pipe over the reef crest, down the reef slope beyond the reef in deeper water. The effluent would probably quickly disperse into the huge volume of ocean water with no discernable effects (Dollar, 1994). This could greatly reduce nutrient input from the hotels into the reef flat, and might be the most cost-effective action they could take. It could also reduce the risk of disease transmission to snorkelers. This action should be considered in addition to any new sewage treatment facilities; it may improve the situation whether there are new treatment facilities or not, and should be relatively inexpensive. The strong currents on the reef flat should flush nutrients out relatively fast once the outfalls are moved. There are undoubtably other sources of nutrients onto the reef flats of the Coral Coast. One is from villages, since they use latrines and septic tank systems (Mosley and Aalbersberg, 2004). Another is streams, with nutrients originating in agriculture and piggeries (Mosley and Aalbersberg, 2004). Mosley and Aalbersberg (2003) found elevated nutrients around hotels, population centers, and in rivers. With increases in population, village and agricultural sources have no doubt grown. All sources of nutrients add to the nutrients on the reef flats and likely contribute to the algae problem. The fact that the algae are not just in front of the resorts, but continuous up and down the coast, with long stretches between the resorts, indicates that the resorts are only part of the problem.

The algae bloom in the reef flat on the Coral Coast has a parallel in Kaneohe Bay, Hawaii, where a sewage outfall in the enclosed bay produced an algae bloom that covered and killed coral. Moving the outfall outside the bay was followed by noticeable improvement (Hunter and Evans, 1995). The situation on the Coral Coast may also be similar to that in Jamaica, where overfishing had occurred for many years, and likely nutrient inputs has increased as well. In spite of this the reef continued to look good, until a hurricane killed coral and opened up space, and a disease killed the last herbivores (sea urchins). Then a sudden phase shift occurred from coral to algae (Hughes, 1994), and has not reverted in over 25 years. The same may have happened on the Coral Coast: chronic overfishing, nutrient inputs increasing, but no observable change until a disturbance like bleaching or a hurricane or a Crown of Thorns outbreak killed much of the coral, and then the dead surfaces were colonized by algae, making a very quick and obvious phase shift. But the causes had been building for a long time. Such major changes often have multiple causes, and it is likely that all of the causes must be addressed to effect a phase change back to coral. It may be wise to assume that all possible causative factors contribute, and ask how much each contributes, instead of asking which is the problem. So assume overfishing of herbivores, nutrients from hotels, villages, and agriculture, are all part of the problem. In American Samoa, the reef flats do not have the heavy brown algae populations, yet they do not have high coral cover. People say the reef flats there used to have a lot more coral cover. Bleaching and/or Crown of Thorns may have killed large amounts of coral in the past. And in just the past year they lost significant coral cover from unusually low tides in a totally natural "lawn mowing" effect. With high herbivorous fish densities (surgeons) and relatively low nutrient inputs, hopefully algae will not bloom on American Samoa reef flats. With a rapidly growing population, though, all this could change.

Species of special interest

Several species where found that are uncommon to rare, which are listed in Table 1. All were documented with photographs.

Table 1

Rare Corals

1. *Acropora abrolhosensis*
2. *Acropora plana*
3. *Astreopora eliptica*
4. *Cantharelus jebbi*
5. *Distichopora nitida*
6. *Echinomorpha nishihirai*
7. *Fungia corona*
8. *Fungia spinifer*
9. *Polyphyllia novohibernae*
10. *Acanthastrea ishagakiensis*

In addition, *Acropora loripes* was very common, the author has never seen a site where it is common before. The author saw more colonies of *Echinomorpha nishihirai* in the Mamanucas than he has seen on all other dives and sites combined. This species was originally discovered in Japan, then found in the Philippines, then in Australia, and now in Fiji, where it is the most abundant the author knows of. Even in Fiji, however, it is not common.

There were some notable absences. First, there was no *Anacropora, Diaseris, Halomitra*, or *Heliopora* found. All of these were reported from Fiji by Lovell (2005). Some of the other genera may also be here and be found with additional searching. In addition, there was only one species of *Alveopora*, two species of Euphyllidae, and three species of *Goniopora*.

A total of 29 species were found for which Fiji is beyond the known range as shown in Veron (2000), Wallace (1999), Lamberts (1984) and Randall and Cheng (1984). A few were sighted only once, and identification is tentative. Photos were taken of 27 of these species to help verify identifications, but specimens need to be examined to verify all of them. These species are listed in Table 2. Some of these species have been found in previous, unpublished, studies, such as those by Ed Lovell (in press).

Table 2
Range extensions. "x" indicates a single sighting or tentative identification.

1.	*Seriatopora aculeata*	x
2.	*Acropora cophodactyla*	

3. *Acropora lokani*
4. *Acropora pectinatus* x
5. *Acropora plana*
6. *Astreopora eliptica*
7. *Montipora stellata*
8. *Pachyseris gemmae*
9. *Cycloseris hexagonalis*
10. *Cantharellus jebbi*
11. *Fungia corona*
12. *Fungia klunzingeri*
13. *Fungia spinifer*
14. *Acanthastrea brevis*
15. *Acanthastrea hemprichii*
16. *Lobophyllia robusta*
17. *Symphyllia hassi*
18. *Caulastrea echinulata*
19. *Caulastrea tumida*
20. *Favites paraflexuosa*
21. *Goniastrea minuta*
22. *Trachyphyllia geoffroyi*
23. *Echinomorpha nishihirai*
24. *Echinophyllia patula* x
25. *Echinophyllia orpheensis* x
26. *Oxypora crassispinosa* x
27. *Mycedium robokakai*
28. *Millepora intricata*
29. *Millepora tuberosa*

A total of 10 species were recognized which could not be identified to species. Some of these may be discovered to already be named, with their names hidden in obscure literature. There was one species of *Acropora*, three of *Porites*, one of *Fungia*, and five of *Tubipora*. In addition, there were a good number of photographs of corals that could only be identified to genus. There may be new species among these. Considerable time and work, including examining skeletons of samples, will be necessary to document these.

A total of 66 species were found which were not reported previously in Fiji. Lovell (2005) summarizes the previous knowledge of corals in Fiji, and reports a total of 259 species.

Comparisons between sites in the Mamanucas suggested by CCC for MPA designation, and those not suggested.

There were nine sites among the study sites that are in areas suggest by CCC for MPA designation, and 10 sites that were not suggested. The hypothesis was that the MPA sites would have more species than the non-MPA sites, since they were judged to be better sites. There was an average of 77 coral species in the suggested MPA sites with a range of 62-92, and an average of 66 species in the sites not suggested to be MPAs, with a range of 44 to 98. Thus there was a great deal of overlap. The difference between the means was tested with a t-test assuming unequal variances (which was true). The t was 1.86 with a df of 16, which is a $p < .05$ for a one-tailed test, which is justified given the hypothesis. So the difference is significant, though relatively small.

Species richness is likely to be a rather insensitive measure of the condition of a reef, since it is gathered by swimming around looking for different species. If there are few corals or few species, the observer just swims on to the next coral or species. Thus, because the area covered is not a fixed area, a site with fewer coral colonies can still yield a similar number of species. The number of species (or colonies for that matter) in a fixed area is likely to be a more sensitive measure.

The author's informal observations of the reefs indicated that several of the reefs suggested for MPA status had dense, diverse *Acropora* stands on their tops, while several of the reefs not suggested for MPA status had poor coral cover, algae growth, and low aesthetic value.

Comparisons between the Mamanucas and the Coral Coast

234 species were found in the Mamanucas, and 136 on the Coral Coast. *Acropora* appeared to be abundant and diverse in the Mamanucas, but rare on the Coral Coast. There were 55 species of *Acropora* in the Mamanucas, but only 21 on the Coral Coast. Because there many more dives and sites in the Mamanucas, these are not good comparisons. The number of corals found goes up with additional dives and locations. On the Coral Coast, dives after the first two were on the same dive sites, so only the first two dives are strictly comparable to in the Mamanucas. After two dives, there were 98 species in the Mamanucas and 85 species on the Coral Coast. After two dives there were 22 species of *Acropora* in the Mamanucas but only 8 species on the Coral Coast, and there were 76 non-*Acropora* in the Mamanucas and 77 non-*Acropora* on the Coral Coast. Thus, the main reason there were more species found in the Mamanucas was because of more dives there, however, with equated dives there was three times as many *Acropora* in the Mamanucas. The diversity of non-*Acropora* at the two sites was identical. It is not entirely clear why the Mamanucas has so much more *Acropora* than on the Coral Coast, but the principle difference between the two sites is the large difference in wave exposure. It may be that a strong bleaching event several years ago selectively removed most *Acropora* from the Coral Coast. Victor Bonito (personal communication) has found that an *Acropora* community persists on the outer reef flat along the edge of the channel, an area not searched in the present study. Had that area been searched, more *Acropora* species might have been found.

Overview of the coral fauna

The coral fauna of the Mamanucas and the Coral Coast is a little richer than American Samoa, but compares well with that of the Great Barrier Reef. Further, it is surprisingly close to the diversity of the Coral Triangle. Three different estimates all agree that there are many additional species in Fiji waiting to be discovered, and the total number of species eventually found may be as high as 500.

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Appendix A

Fiji sites and numbers of species:

	Number species	Suggested MPA	Location
			Mamanucas
SN1	11		Raviniyake
1	74	No	Cakaunilolo
2	68	Yes	Motuse
3	64	No	Cakaunilolo
4	82	Yes	Nuku
5	79	Yes	Sunflower
6	98	No	Kaka
7	92	Yes	Honeymoon
8	68	No	Wadigi
9	88	Yes	Namoa
10	62	No	Sally
11	62	Yes	Charlie's
12	74	No	Nayuul
13	65	Yes	Yalodrivi
14	73	Yes	Rocky's
15	47	No	N. Castaway
16	85	Yes	Nuku
17	65	No	Malolo Lailai
18	65	No	Namotu
19	44	No	Chief's Beach
			Coral Coast
S2	18		MPA reef flat
21	58		Morgan's Wall
22	54		Refuge west
23	69		Morgan's Wall
24	37		Refuge east
25	39		Morgan's Wall
26	62		Morgan's Wall

Species records. "New record" indicates that the species is not listed in Lovell (in press) for Fiji. A blank under "Site Records" indicates that the site where the species was seen was not recorded. In most cases the record is from a photograph. Range extension indicates that Fiji is outside the range indicated in Veron (2000), and for *Acropora* also outside the range shown in Wallace (1999), for *Astreopora* also outside the range indicated in Lamberts (1982), and for *Millepora* outside the range indicated in Randall and Cheng (1984).

No. gen.	No. sp.	SPECIES	New Record	Range Extension	SITE RECORDS
		Family Astrocoeniidae			
1	1	*Stylocoeniella guentheri* Bassett-Smith, 1890			1R,3R,7R,
		Family Pocilloporidae			
2	2	*Pocillopora damicornis* (Linneaus, 1758)			1C,2C,3C,4U,S1C,5A,6C,7R,8C,9A,10A,11C,12C, 13C,14U,15C,16C,17U,18A,19R,SN2C,21R,23U,
	3	*Pocillopora eydouxi* Milne Edwards & Haime, 1860			1R,2R,3R,4R,5R,6R,7R,9R,10R,11R,13R,16R,18R ,21U,22R,23R,24U,26R
	4	*Pocillopora meandrina* Dana, 1846			2R,5R,11R,24R,
	5	*Pocillopora verrucosa* (Ellis & Solander, 1786)			2R,3R,4R,5R,6R,7R,8R,14R,15R,18R,21C,22U,23 A,24C,26C
3	6	*Seriatopora aculeata* Qlulelch, 1886	X	X	13R,14R,
	7	*Seriatopora caliendrum* Ehrenberg, 1834			2C,3U,S1A,6A,11U,13R,14U,
	8	*Seriatopora hystrix* Dana, 1846			1U,2R,3R,7U,8C,15U,16U,19R,
4	9	*Stylophora pistillata* Esper, 1797			21C,22C,23C,24C,25U,26C
	10	*Stylophora subseriata* Ehrenberg, 1834	X		1U,4R,5U,7U,9U,11U,12R,13R,14R,15R,16C,17R, 18U,19U,
		Family Acroporidae			
5	11	*Acropora abrolhosensis* Veron,1985	X		16C
	12	*Acropora abrotanoides* (Lamarck, 1816)			4U,6R,7R,11R,13R,14R,17A,18R,24R,
	13	*Acropora aculeus* (Dana, 1846)			??6R,15R,17R,19R,
	14	*Acropora aspera* (Dana, 1846)			7U,8U,12C,17C,SN2U,

15	*Acropora austera* (Dana, 1846)			4U,5U6U,10R,13R,14R,16R,21R,26U
16	*Acropora carduus* (Dana, 1846)			12U,15U,16U,18U,
17	*Acropora carolineana* Nemenzo, 1976			1C,2U,3R,4R,7R,8R,9R,10R,11R,16U,17R,18R,
18	*Acropora cerealis* (Dana, 1846)			1U,2U,4U,5U,6U,10U,13C,14U,16R,18R,
19	*Acropora chesterfieldensis* Veron & Wallace, 1984	X		11R,
20	*Acropora clathrata* (Brook, 1891)			1R,6R,11U,13R,18R,
21	*Acropora cophodactyla* (Brook, 1842)	X	X	21R,23R,
22	*Acropora crateriformis* (Gardiner, 1898)			21U,23U,24R,25R,26U
23	*Acropora cuneata* (Dana, 1846)			S1U,6U,7R,8U,14U,17R,SN2U,
24	*Acropora cytherea* (Dana, 1846)			1R, 2R, 3R,4U,5U,6U,9R,10R,13U,15R,16U,
25	*Acropora digitifera* (Dana, 1846)			2R,4U,5U,6U,7U,8C,12U,13R,14R,17C,23R,26R,
26	*Acropora divaricata* (Dana, 1846)			??1R,2U,
27	*Acropora donei* Veron & Wallace, 1984 (spicifera?)	X		1U,2R,4U,5U,9R,10U,14R,15R,16U,
28	*Acropora echinata* (Dana, 1846)			3U,7U,9R,14U,
29	*Acropora florida* (Dana, 1846)			1R,2U,3C,4C,6U,7U,9U,10U,11U,12R,13R,14R,16U,17R,18R,
30	*Acropora gemmifera* (Brook, 1892)			1R,4C,5C,6U,7C,8C,9U,10U,11C,12U,13U,14C,15C,16U,17C,18U,
31	*Acropora granulosa* (Milne Edwards & Haime, 1860)			4U,5U,12U,14C,16C,18U,19U,23R,
32	*Acropora* humilis-like			1R,4R,5R,6R,7R,10R,11R,17R,18R,26R
33	*Acropora humilis* (Dana, 1846)			12R,16R,17R,
34	*Acropora hyacinthus* (Dana, 1846)			1U,3U,4C,5C,6C,7C,8C,9U,10C,11C,12R,13U,14U,16U,17C,18U,23R,
35	*Acropora insignis* Nemenzo, 1967	X		13R,15U,16R,18R,24R,
36	*Acropora latistella* (Brook, 1891)			13R,14R,
37	*Acropora lokani* Wallace, 1994	X	X	7R,11R,17R,
38	*Acropora longicyathus* (Milne Edwards & Haime, 1860)			12R,

39	*Acropora loripes* (Brook, 1892)			1C,2C,3C,4C,5R,6U,7C,9U,10C,11C,14U, 15R,16U,17U,18C,22R,24R,25R,
40	*Acropora lovelli* Veron & Wallace, 1984	X		7R,14C,17U,
41	*Acropora lutkeni* Crossland, 1952	X		?5R,
42	*Acropora microphthalma* (Verrill, 1859)			4R,5R,6U,10R,12R,14U,18C,
43	*Acropora millepora* (Ehrenberg, 1834)			1C,2R,3R,5R,8U,9U,11C,12C,13C,14U,15U,16R,17U,18U,19U,
44	*Acropora monticulosa* (Brüggemann, 1879)			22R,26R
45	*Acropora muricata* (Linneaus, 1758) (=*A. formosa*)			1R,4C,5u,7U,8R,9U,17C,18D,SN2R,
46	*Acropora nana* (Studer, 1878)			2R,4U,5U,6U,7R,11R,12U,13U,14R,18C,21R,23U,
47	*Acropora nasuta* (Dana, 1846)			4C,5C,6U,7R,8U,11R,12U,14C,15R,16R,17U,18U, SN2R,
48	*Acropora nobilis* (Dana, 1846)			1R,5U,6R,7R,12R,13U,14R,17R,18R,
49	*Acropora* nobilis-like			10R,11R,15R,18U,
50	*Acropora paniculata* Verrill, 1902			3R,4U,5R,6R,9R,10U,11U,13R,16U,18U
51	*Acropora pectinatus* Veron, 2002	X	X	5U,
52	*Acropora plana* Nemenzo, 1967	X	X	24R,
53	*Acropora polystoma* Brook, 1891			2R,6R,10R,13R,
54	*Acropora pulchra* (Brook, 1891)			3R,S1R,7R,12U,15U,
55	*Acropora retusa* (Dana, 1946)	X		4R,13R,24R,
56	*Acropora robusta* (Dana, 1846)			2C,4C,5U,6U,7U,10R,11R,12R,13U,14U,
57	*Acropora rosaria* (Dana, 1846)			8R,13R,16R,
58	*Acropora samoensis* (Brook, 1891)			2U,4U,
59	*Acropora sarmentosa* Brook, 1892			1C,2C,3C,4U,6U,7U,8U,9U,10C,11C,12C,13C,14C,15U,16U,17U,18U,19U,22R,
60	*Acropora selago* (Studer, 1878)			1C, 2U, 4U,7U,
61	*Acropora speciosa* (Quelch, 1886)			23U,
62	*Acropora subglabra* (Brook, 1891)			5C,

	63	*Acropora subulata* (Dana, 1846)			?4R,6R,7R,
	64	*Acropora tenuis* (Dana, 1846)			18R,
	65	*Acropora valenciennesi* (Milne Edwards & Haime, 1860)			1U,2R,3U,4U,5U,7U,8R,9U,10U,11U,12U,16U,17U,18U,
	66	*Acropora valida* (Dana, 1846)			4R,6R,11R,21R,22R,26R,
	67	*Acropora vaughani* Wells, 1954			4R,5C,6U,7U,9R,10R,16U,17R,18C,
	68	*Acropora verweyi* Veron & Wallace, 1984			3R,5R,10R,
	69	*Acropora yongei* Veron & Wallace, 1984	X		4U,9U,10R,11R,13U,16U,
	70	*Acropora* aspera-like			5U,
	71	*Acropora* sp 1			4C,5U,7U,9U,10U,12R,14C,
6	72	*Astreopora eliptica* Yabe and Sugiyama 1941	X	X	21U,
	73	*Astreopora listeri* Bernard, 1896			13R,
	74	*Astreopora myriophthalma* (Lamarck, 1816)			1R,2R,3R,4R,S1R,5R,6R,7R,8R,9R,10R,11R,12R,16R,17U,21U,23U,25R,
	75	*Astreopora randalli* Lamberts, 1980			18R,22R,25U,26U,
	76	*Astreopora suggesta* Wells, 1954			6R,14R,18R,19U,23R,
7	77	*Montipora altasepta* Nemenzo, 1967	X		S1R,8U,Sn2C,
	78	*Montipora caliculata* (Dana, 1846)			7R,21C,23R,24R,26R
	79	*Montipora capitata* Dana, 1846	X		1R,3R,4R,S1R,7R,8R,9R,10R,11R,16U,19R,22R,23R,24R,26R
	80	*Monitpora danae* (Milne Edwards & Haime, 1851)			3R,8R,
	81	*Montipora digitata* Dana, 1846			S1U,?8R,12R,17C,SN2A,
	82	*Montipora foveolata* (Dana, 1846)			11R,13U,14U,16U,21R,23R,24R,26R
	83	*Montipora hispida* Dana, 1846	X		5R,17U,21R,23R,24R,26R
	84	*Montipora informis* Bernard, 1897			7R,9R,
	85	*Montipora nodosa* (Dana, 1846)	X		4R,7R,9R,12R,14U,16U,17U,19U,23R,
	86	*Montipora stellata* Bernard, 1897	X	X	12U,17R,19C,
	87	*Montipora tuberculosa* Lamarck, 1816)			11R,13R,18R,
	88	*Montipora undata* Bernard, 1897	X		

	89	*Montipora verrucosa* (Lamarck, 1816)		5R,5R,7R,8U,9U,10R,12R,14U,15R,16R,17R,19U, 25R,
		Family Poritidae		
8	90	*Alveopora spongiosa* Dana, 1846		25R,
9	91	*Goniopora djiboutiensis* Vaughan, 1907	X	??15U,19U,
	92	*Goniopora fruiticosa* Saville-Kent, 1893	X	S1R,6R,11R,21R,26U
	93	*Goniopora somaliensis* Vaughan, 1907	X	1R,7R,9R14R,15R,16R,17R,19U,22U,23R,26U
10	94	*Porites annae* Crossland, 1952		8U,9C,11R,14R,15R,19R,SN2C,
	95	*Porites cylindrica* Dana, 1846		1R,4R,5R,6R,7R,8U,9R,12U,15A,17R,19U,SN2U, 21R,23R,
	96	*Porites horizontalata* Hoffmeister, 1925	X	1R,8R,9R,19U,
	97	*Porites lobata* Dana, 1846		?15A,23A,
	98	*Porites lutea* Milne Edwards & Haime, 1851		5R,6R,9R,12R,15R,18R,21R,23R,26U
	99	*Porites monticulosa* Dana, 1846	X	9U,19R,
	100	*Porites rus* (Forskål, 1775)		1R,S1U,8R,9U,11R,12R,14R,15A,16R,17R,19C,2 1R,22R,24R,25R,
	101	*Porites vaughani* Crossland, 1952	X	18R,19R,
	102	*Porites* spots		19R, 22R,25R,
	103	*Porites* smooth branches, plate, dark polyps		9R,25R,26U
	104	*Porites* pits		4U,5U,8R,
		Family Siderasteridae		
11	105	*Coscinaraea columna* (Dana, 1846)		2R,3R,4R,6U,7U,9R,10R,11R,12R,13U,16R,SN2R ,21U,22U,23U,25U,26U,
	106	*Coscinaraea exesa* (Dana, 1846)		15R
12	107	*Psammocora contigua* (Esper, 1797)		S1U,SN2U,
	108	*Psammocora digitata* Milne Edwards & Haime, 1851		2U,3R,5R,11R,13U,16R,18R,21R,24R,25R,26R
	109	*Psammocora haimeana* Milne Edwards & Haime, 1851		1R,3R,9R,

	110	*Psammocora nierstraszi* van der Horst, 1921			1R,2R,6R,9R,11R,12R,15R,16R,17R,19R,22R,25R,
	111	*Psammocora profundacella* Gardiner, 1898			1R,4R,5R,6R,9R,12U,16R,17R,21R,22R,23R,
		<u>Family Agariciidae</u>			
13	112	*Gardineroseris planulata* Dana, 1846			1R,1R,6R,8U,9R,12R,16U,17R,18R,21U,25R,
14	113	*Leptoseris explanata* Yabe & Sugiyama, 1941			23R,24U,
	114	*Leptoseris mycetoseroides* Wells, 1954			3R,13R,14U,22R,25R,
	115	*Leptoseris scabra* Vaughan, 1907			3R,25R,
	116	*Leptoseris yabei* (Pillai & Scheer, 1976)			26R
15	117	*Pachyseris gemmae* Nemenzo, 1955	X	X	1U,6R,9R,10R,14R16R,17R,19U,21R,22R,25R,
	118	*Pachyseris rugosa* (Lamarck, 1801)			1R,4R,7R,9R,
	119	*Pachyseris speciosa* (Dana, 1846)			1R,2R,4U,8R,9R,12R,14R,15R,16C,17R,19U,22U, 24U,25C,
16	120	*Pavona cactus* (Forskål, 1775)			8R,12C,16C,19R,
	121	*Pavona clavus* (Dana, 1846)			1R,6R,7R,8U,12C,14R,
	122	*Pavona decussata* (Dana, 1846)			S1U,7R,8U,12R,19R,SM2U,
	123	*Pavona duerdeni* Vaughan, 1907			21U,25R,26R
	124	*Pavona explanulata* (Lamarck, 1816)			1R,2R,5R,6U,7R,8R,9R,10R,11R,12U,13R,16R,18 R,21R,22R,23U,24R,
	125	*Pavona frondifera* (Lamarck, 1816)			8R,SN2C,
	126	*Pavona maldivensis* (Gardiner, 1905)			1R,11R,22R,25R,26R
	127	*Pavona minuta* Wells, 1954			23R,26R
	128	*Pavona varians* Verrill, 1864			S1R,1R,4R,5R,6R,7R,9U,10R,11R,12R,13R,16R,1 7R,18R,19R,21R,23R,26R
		<u>Family Fungiidae</u>			
17	129	*Cantharellus jebbi* Hoekesema, 1993		X	2R, 3R,4U,6R,7R,9R,14R,16R,17U,19R,
18	130	*Ctenactis albitentaculata* Hoeksema, 1989	X		5U,9R,10R,12U,16U,25R,26R
	131	*Ctenactis crassa* (Dana, 1846)	X		2R,3R,4U,5C,6R,9R,10U,12U,14U,16U,17U,19U, 21U,22R,

	132	*Ctenactis echinata* (Pallas, 1766)			1U,5U,9R,11R,12R,14U,16U,19R,
19	133	*Cycloseris costulata* Ortmann, 1889			?8R,
	134	*Cycloseris hexagonalis* Milne Edwards & Haime, 1848	X	X	8R,
	135	*Cycloseris tenuis* (Dana, 1846)	X		14U,26R,
	136	*Cycloseris vaughani* (Boschma, 1923)			?8R,
20	137	*Fungia concinna* Verrill, 1864			3R,4R,7R,9U,10R,12U,14R,17R,
	138	*Fungia corona* Doederlein, 1901	X	X	21R,
	139	*Fungia danai* Milne Edwards and Haime, 1851			11R,21R,
	140	*Fungia fungites* (Linneaus, 1758)			1R,5U,6U,8R,9U,10R,11R,12R,13U,16R,18R,SN2R,
	141	*Fungia granulosa* Klunzinger, 1879			2R,4R,9R,10R,14U,15R,16R,19R,26R,
	142	*Fungia horrida* Dana, 1846			4U,5U,6R,9R,12R,14R,15U,16U,19R,24R,
	143	*Fungia klunzingeri* Döderlein, 1901	X	X	4R,5R24R,
	144	*Fungia paumotensis* Stutchbury, 1833			1P,3R,5R,9R,14R,17R,23U,
	145	*Fungia scruposa* Klunzinger, 1816			5R,6R,
	146	*Fungia scutaria* Lamarck, 1816			2U,3R,6R,11R,13R,16R,21U,25U,26U
	147	*Fungia spinifer* Claereboudt & Hoeksema 1987	X	X	9R,16R,
21	148	*Herpolitha limax* (Houttuyn, 1772)			2R,3U4U,5U,12R,14U,16R,21U,25R,26U
	149	*Herpolitha weberi* Horst, 1921	X		1R,4R,5R,10R,15R,26R
22	150	*Podabacia crustacea* (Pallas, 1766)			1R,
	151	*Podabacia motuporensis* Veron, 1990			2R,6R,9R,10U,14R,16R,23R,
23	152	*Polyphyllia novohibernaea* (Lesson, 1831)	X		5U,S1R
	153	*Polyphyllia talpina* Lamarck, 1801			3R,6R,7U,9R,10U11R,12R,15U,17R,18R,19R,
24	154	*Sandalolitha dentata* Quelch, 1884			4R,
	155	*Sandalolitha robusta* Quelch, 1886			22R,23R,25U,26U
25	156	*Zoopilus echinatus* Dana, 1846			3R,5C,9R,11R,12R,
		Family Oculinidae			

26	157	*Galaxea astreata* (Lamarck,. 1816)			1R,2R,3R,4R,6R,7R,8R.10R,11R.12R,14R,15R,16R,17R,21R,22R,23R,
	159	*Galaxea fascicularis* (Linneaus, 1767)			1R,2R,3R,5R,6U,7R,8U,9R,10R,11R,12R, 13R,15R,18R,21U,23R,25R,26U
	160	*Galaxea horrescens* (Dana, 1846)			5R,7R,8R,14U,17R,19R,
		Family Pectinidae			
27	161	*Echinomorpha nishihirai* (Veron 1990)		X	1R,6R,7R,10U,12R,18R,24R,26R,
	162	*Echinophyllia aspera* (Ellis & Solander, 1788)			2R,
	163	*Echinophyllia echinata* (Saville-Kent, 1871)			1R,
	164	*Echinophyllia orpheensis* Veron & Pichon, 1980	X	X	
	165	*Echinophyllia patula* (Hodgson & Ross, 1982)	X	X	?3R
28	166	*Mycedium elephantotus* (Pallas, 1766)			1C,2C,4R,5R,6U,7R,9U,10U,11R,12R,113U,14R,18R,21U,22U,23R,25U,
	167	*Mycedium robokaki* Moll & Borel-Best, 1984	X	X	16U,22R,23R,25R,
	168	*Mycedium sp.*	X		26R
29	169	*Oxypora crassispinosa* Nemenzo, 1979	X	X	?1R,
	170	*Oxypora lacera* Verrill, 1864			1C,2U,3U4U,5R,6U,9U,10U,11U,13U,15U,16U,21U,22R,24R,25U,26R
30	171	*Pectinia alcicornis* (Saville-Kent, 1871)			1R,4R,5R,7R,9R,12U,14R,16R,17U,19U
		Family Mussidae			
31	172	*Acanthastrea brevis* Milne Edwards & Haime, 1849	X	X	1R,4R,6R,
	173	*Acanthastrea echinata* (Dana, 1846)			6R,10R,11R,14R,18R,22U,23U,25U,26U,
	174	*Acanthastrea hemprichii* (Ehrenberg, 1834)	X	X	22R,23R,24U
	175	*Acanthastrea ishigakiensis* Veron, 1990	X		22R,24R,
	176	*Acanthastrea subechinata* Veron, 2002	X		?4R,6R,7R,9U,
32	177	*Lobophyllia corymbosa* Forskål, 1775			1U,2R,3R,6R,9R,17R,
	178	*Lobophyllia hataii* Yabe & Sugiyama, 1936			3R,4R,9R,
	179	*Lobophyllia hemprichii* (Ehrenberg, 1834)			1U,2R,S1R,5R,6U,9R,11R,13R,14R,19R,22U,23R, 24R,26U

	180	*Lobophyllia robusta* Yabe & Sugiyama, 1936	X	X	6R,21R,22R,
33	181	*Scolymia vitiensis* Brüggemann, 1877	X		1R,7R,8R,13R,
34	182	*Symphyllia agaricia* Milne Edwards & Haime, 1849			6R,11R,13R,24U,
	183	*Symphyllia hassi* Pillai & Scheer, 1976	X	X	5U,7R,8R,9R,10R,12U,
	184	*Symphyllia radians* Milne Edwards & Haime, 1849			7R,13R,22U,23R,
	185	*Symphyllia recta* (Dana, 1846)			6R,13R,22R,23R,26R
	186	*Symphyllia valenciennesii* Milne Edwards & Haime, 1849	X		22R,
		Family Merulinidae			
35	187	*Hydnophora exesa* (Pallas, 1766)			1R,2R,3R,4R,5R,6R,7R,10R,14R,16R,21U,22U,23R,26R
	188	*Hydnophora grandis* Gardiner, 1904	X		1R,3R,4R,5R,S1R,6R,7R,9R,11R,16R,
	189	*Hydnophora microconos* (Lamarck, 1816)			2R,3R,5R,6U,8R,9R,10R,11R,12R,13R,18U,21R,23U,24U,
	190	*Hydnophora rigida* (Dana, 1846)	X		1R,3R,6R,7R,9R,11R,13R,15R,22R,26R
36	191	*Merulina ampliata* (Ellis & Solander, 1786)			1U,2R,3U,4R,5R,6R,7R,9U,10R,11R,12R, 13R,14R,16R,17R,18R,19R,21R,22U,23R,25R,
	192	*Merulina scabricula* Dana, 1846			1R,2R,3U,5A,6R,7R,8R,9U,10R,12R,13R,14R,15R,16R,18R,19U,SN2R,21R,23U,25U,26U
37	193	*Scapophyllia cylindrica* Milne Edwards & Haime, 1848			2R,6U,13R,18R21U,22R,23R,26U
		Family Faviidae			
38	194	*Caulastrea curvata* Wijsman-Best, 1972			7R,
	195	*Caulastrea echinulata* (Milne Edwards & Haime, 1849)	X	X	16R,
	196	*Caulastrea furcata* Dana, 1846			S1R,9R,12R,
	197	*Caulastrea tumida* Matthai, 1928	X	X	17R,
39	198	*Cyphastrea decadia* Moll & Borel-Best, 1984			4R,S1R,5R,7U,9U,12U,14C,15R,16R,17R,19C
	199	*Cyphastrea* encrusting			1U,4U,10R,16U,18R,

40	200	*Diploastrea heliopora* (Lamarck, 1816)			1C,2U,3C,4C,S1U,5U,6U,7U,8U,9C,10C,11C,12U,13C,14C,15C,16U,17U,18U,19U,21U,22U,23C,24U,25C,26U
41	201	*Echinopora gemmacea* Lamarck, 1816			2U,5U,13R,
	202	*Echinopora hirsuitissima* Milne Edwards & Haime, 1849	X		2R,6R,7R,11R,13R,22R,23U,24U,25U,26R
	203	*Echinopora horrida* Dana, 1846			1R,2R,3R,6R,7R,8R,9R,12R,15R,17R,
	204	*Echinopora lamellosa* Esper, 1795			1U,5A,6U,7U,8R,9U12R,13R,14R,16R,19U,21U,23R,25R,26R
42	205	*Favia matthai* Vaughan, 1918			11R,22R,23R,
	206	*Favia maxima* Veron & Pichon, 1977			6R,
	207	*Favia pallida* (Dana, 1846)			6U,7R,12R,13R,16R,17R,18R,21R,22R,23R,26R
	208	*Favia rotundata* Veron & Pichon, 1977			21R,
	209	*Favia stelligera* (Dana, 1846)			2R,4R,6R,7R,11R,13R,21U,22U,23U,24U,25U,26U
43	210	*Favites abdita* (Ellis & Solander, 1786)			4R,6U,21R,26R
	211	*Favites halicora* (Ehrenberg, 1834)			2U,6U,8R,10R,13R,
	212	*Favites paraflexuosa* Veron, 2002	X	X	21R,23R,26R
	213	*Favites pentagona* Esper, 1794			3R,21R,23R,25R,26R
44	214	*Goniastrea edwardsi* Chevalier, 1971			5R,7R,8R,
	215	*Goniastrea minuta* Veron, 2002		X	2U,6U,8R,11R,12R,13R,16R,18R,SN2U,21C,22U,23C,24C,25U,26C
	216	*Goniastrea pectinata* (Ehrenberg, 1834)			1C,2U,4U,5U,6C,7U,8R,9U,13R,14C,16U,17U,18R,19U,21U,22U,23U,24R,25R,26R
	217	*Goniastrea retiformis* (Lamarck, 1816)			2R,3R,4R,6R,7R,9R,10R,12R,13U,14U,16U,18R,
45	218	*Leptastrea pruinosa* Crossland, 1952	X		1R,2R,3R,4R,8R,9R,10R,11R,16R,17R,
	219	*Leptastrea purpurea* (Dana, 1846)			4R,6R,7R,8U,9R,14U,16U,SN2C,26U
	220	*Leptastrea transversa* Klunzinger, 1879			1R,2R,9R,16R,18R,21U,22R,23U,25R,
46	221	*Leptoria phrygia* (Ellis & Solander)			1R,3R,4R,5R,9R,10R,11R,12R,13R,14U,16R,17R,

					18R,21U,22U,25R,26U
47	222	*Montastrea annuligera* (Milne Edwards & Haime, 1849)	X		1R,2R,3R,4R,6R,7R,9R,13R,14R,16R,17R,22R,23R,24R,25R,
	223	*Montastrea curta* (Dana, 1846)			2R,4R,6R,10R,11R,13R,14R,16R,18R,21U,22R,23R,26R
	224	*Montastrea magnistellata* Chevalier, 1971			1R,2R,4R,6R,7U,8R,9R,14R,16U,17R,18R,19R,22R,
48	225	*Oulophyllia crispa* (Lamarck, 1816)			23R,
49	226	*Platygyra acuta* Veron, 2002	X		8R,26R
	227	*Platygyra daedalea* (Ellis & Solander, 1786)			1R,2R,3R,4R,S1R,5R,6U,7R,8R,11R,12R,13R,14R,15R,16R,17R,SN2R,21R,22R,24U,25R,26R
	228	*Platygyra lamellina* (Ehrenberg, 1834)			7R,
50	229	*Plesiastrea versipora* (Lamarck, 1816)			4R,8R,23R,25U,
		Family Trachyphyllidae			
51	230	*Trachyphyllia geoffroyi* Audouin, 1826		X	7R,10R,
		Family Euphilliidae			
52	231	*Euphyllia cristata* Chevalier, 1971			4R,5R,7R,8R,16R,
53	232	*Plerogyra sinuosa* (Dana, 1846)			1U,2U,3U,8U,10R,12R,15R,
		Family Dendrophylliidae			
54	233	*Balanophyllia sp*	X		3R
55	234	*Rhizopsammia verrilli* van der Horst, 1922	X		2R,8R,
56	235	*Tubastraea coccinea* Lesson, 1829			7C,8R,
	236	*Tubastraea micranthus* Ehrenberg, 1834			1R,2U,3R,4R,7R,9R,18R,
57	237	*Turbinaria frondens* Dana, 1846			7R,8R,22R,
	238	*Turbinaria mesenterina* (Lamarck, 1816)			6R,8R,12R,15U,19R,S2R,21U,23R,25R,26U
	239	*Turbinaria peltata* (Esper, 1794)			8R,22R,
	240	*Turbinaria reniformis* Bernard, 1896			S1R,7R,8R,9R,12R,14R,15U,
	241	*Turbinaria stellulata* (Lamarck, 1816)			3R,5C,9R,11R,14R,15U,16R,17R,18R,19R,
		Family Clavulariidae			

58	242	*Tubipora musica* Linneaus, 1758			4R,6R
	243	*Tubipora sp.*			
	244	*Tubipora sp.*			
	245	*Tubipora sp.*			
	246	*Tubipora sp.* "green center"			2R
		Family Milleporidae			
59	247	*Millepora dichotoma* Forskål, 1775	X		S1R,8R,9C,10R,12R,14R,24R,
	248	*Millepora exaesa* Forskål, 1775 (thick paddles)			2R,3R,4R,S1R,5R,7R,8U,9U,10R,11R,12R,13R,14 U,15R,16R,17R,18U,19U,21U,22C,23U,24C,26R
	249	*Millepora intricata* Milne-Edwards & Haime, 1857	X	X	?8R,24U,
	250	*Millepora tuberosa*		X	Mamanucas,
		Family Stylasteridae			
60	251	*Distichopora nitida* Verrill, 1864	X		21R,22A,23U,26U
	252	*Distichopora violacea* (Pallas, 1766)	X		7U,9U,10R,21U,23C,26U
61	253	*Stylaster* sp. 1 pink	X		2R,6R,7R,8C,13R,21R,22A,23R,