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Changes in the coral reef communities of Fagatele Bay National Marine Sanctuary and Tutuila Island (American Samoa), 1982-1995

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ABSTRACT

The condition of coral reefs in Fagatele Bay National Marine Sanctuary and at ten other sites around Tutuila was assessed during 12-28 July 1995. Reef-building corals were surveyed along 25 transects, other invertebrates along 23 transects, algae along 21 transects, and fishes along 22 transects in Fagatele Bay. All these groups were also surveyed along transects at the other ten sites around Tutuila. These transect were originally established in pairs in exposed and sheltered sites, and they were previously surveyed quantitatively in 1982, 1985, and 1988.

The most obvious finding from this survey was rather counterintuitive. Exposed reefs showed little damage from hurricanes and bleaching events, while protected areas showed extensive damage. The reasons for this are that the coral colonies in exposed areas are conditioned to frequent strong wave action and loose materials are scarce, while corals in sheltered areas grow into delicate forms and loose material accumulates on the substrata. Delicate arborescent “staghorn”, “elkhorn”, and especially “tabletop” corals, break under storm waves, and these large limestone objects are thrown back and forth by storm waves and smash into other corals. There are also rocks and gravel laying around in protected areas which become projectiles in high-energy wave conditions of hurricanes and which are damaging to corals. In exposed areas, the corals are conditioned to frequent wave action and therefore grow into compact, solid, or encrusting growth forms which are not as vulnerable to being broken by storm waves, and loose rocks are persistently removed by wave action so they do not accumulate as much as they do in sheltered areas.

Because of the processes mentioned above, the corals along Transects 1 and 6 in exposed locations at the outer edges of Fagatele Bay appeared to be in the same conditions as in previous surveys. However, the corals along Transects 2, 3, 4, and 5 in relatively sheltered sites inside Fagatele Bay were severely affected by hurricanes. Many large colonies were broken off and tumbled around. Although there were numerous young (less than three-year-old) recruits, there were relatively few older colonies. There was substantial structural damage to the reef from the toppling of older colonies. Likewise, the corals outside Masefau Bay appeared the same as in 1982, 1985, and 1988, while the reef community inside Masefau was totally devastated.

Although the damage to the coral communities from Hurricanes Ofa and Val were extensive, the reefs are in good health as evidenced by the abundance of young colonies. The recruitment of corals and the health and stability of the reef system is enhanced by the prevalence of coralline algae, especially *Porolithon onkodes.*

Coralline algae stabilize the reef by growing over and cementing dead corals. The planula larvae of many species of reef-building corals respond to chemical cues from coralline algae as signals or stimulants for settling and/or undergoing metamorphosis. Coralline algae provide smooth clean substrata on which corals can settle. Filamentous and fleshy algae, in contrast, abrade coral recruits, overgrow coral recruits, and produce sediment traps in which small corals are smothered. The coral communities at Fagatele Bay and most other sites around Tutuila which were devastated by waves from hurricanes and by bleaching (perhaps from temporary seawater temperature increases) are apparently recovering as indicated by the abundance of small recruits.

The coralline algae also facilitate reef construction. After the hurricanes, shards and rubble accumulate into mounds or fill channels. These mounds and fill are then cemented into place and solidified by coralline algae. In view of the overgrowth of one of the shallow stakes on Transect 3 by a relatively slow-growing massive *Porites lutea*, we suspect that a number of the permanent transect markers in Fagatele Bay may have been buried by the rubble which is now cemented by coralline algae. This form of reef growth, although relatively rapid, is of very porous construction. This makes it difficult to secure bolts and metal loops for permanent anchor buoys on these reefs of rapid, but porous, growth.

Considering the importance of coralline algae to the recovery and growth of the coral reef of Fagatele Bay, it was noted that the "coralline lethal orange disease" (CLOD) was common from shallow water down to 40-ft depth on Transects 4 and 5, and to a lesser extent on Transect 3. See Appendix A. There was also a black "lichen-like" disease of coralline algae on Transect 3.

Corals of the genus *Pocillopora* were conspicuous in their mortality in shallow water in the inner sections of Fagatele Bay. It has been suggested by Nancy Daschbach that while corals of many genera demonstrated a whitening during bleaching event of the summer of 1994, *Pocillopora* showed greater mortality than did other corals. This is consistent with the scientific literature on corals in which species of *Pocillopora* are perceived as "weedy" species that are rapid recruiters and rapid growers, but which are especially susceptible to physiological stresses such as temperature changes. This is corroborated by the observations that colonies of *Pocillopora* did not show exceptional mortality in exposed areas where the frequent turbulence and mixing of water would mollify any temperature changes.

Other invertebrates also showed dramatic changes since the previous survey in 1985. The pink-spined urchin *Echinometra mathaei* decreased in abundance by an order of magnitude, in some cases by over 95%. This is probably of ecological importance because *E. mathaei* is a major agent of bioerosion, making grooves and channels in the reef structure. The edible tridacnid clams *Tridacna squamosa* and *Tridacna maxima* were also very scarce around Tutuila, but they have been scarce in all our surveys.

The fish communities of Fagatele Bay and elsewhere around Tutuila Island have changed dramatically over the last two decades also. Fish abundance has decreased by more than one half at some sites, although species richness appears to have remained relatively consistent over time. The most dramatic changes to the fish communities have been in the Family Pomacentridae. In 1995 there were only 30-50% as many pomacentrids as there were when the study began in 1977-1978. This was largely due to a 91-99% decline in the abundance of one species, *Plectroglyphidodon dickii*. The change in abundance of this and other pomacentrid species can be understood in the context of habitat degradation, since most are small, site-attached species that are closely associated with particular habitat characteristics including coral cover. In contrast, other families such as the Acanthuridae showed no substantial decline in abundance over time. This was probably because the acanthurids were mostly roving herbivores, which were less likely to have been affected by the changes to their habitat characteristics.

The history of coral-reef communities at Tutuila has involved changes in pattern of depth distribution of disturbances over the past 16 years. The reefs in 1979-1988 were recovering from devastation by predation from the crown-of-thorns starfish. In this period it was the deeper reefs, below the surf zone or reef margin, that showed the greater effects of disturbance. This was because the crown-of-thorns was not well adapted to hanging on in turbulent water. Corals in shallow water were defended from crown-of-thorns predation by wave action. In contrast, the damage by waves from hurricanes directly impacted the shallow reef margin, and bleaching also extended into shallow water.

In view of the response of the coral-reef communities around Tutuila to disturbances such as an outbreak of the crown-of-thorns (1978/1979), two hurricanes (1990 and 1991), and a bleaching event (1994), the coral reefs of Tutuila appear robust. The adult colonies are killed and living coral cover is reduced to a large extent, but the abundant recruitment of juveniles indicate that the coral reefs are resilient to natural disturbances. However, events on the coral reef community near the Rainmaker Hotel indicate that chronic environmental effects from human activities such as sedimentation and pollution inhibit coral recruitment and so the reef community deteriorates by attrition. Although there is no spectacular mortality of adult colonies, occasionally one of them will die of natural causes and they are not replaced if there is severe sedimentation or pollution.

Sedimentation is a stress on adult colonies because of the calories required to produce the mucus necessary to shed off the silt. We observed a large area of mucus on a *Porites* colony in the cove just west of Fatu Rock. It has been shown that colonies of corals in areas of sedimentation are less fecund, i.e., produce fewer eggs, perhaps because the energy used to survive by shedding the mucus is diverted from energy used to produce eggs. Also, suspended sediment diminishes water clarity and therefore the light available for photosynthesis by zooxanthellae in the tissues of corals. Furthermore, the microscopic planula larvae of corals cannot settle and undergo metamorphosis on sediment; they need bare limestone or clean encrusting coralline algae. Sedimentation and pollution also interfere with the chemical cues needed by sperm and eggs in fertilization and by the planula larvae in recognition of appropriate substrata for settlement and metamorphosis. Nevertheless, without sedimentation or pollution, corals are remarkably recovery-prone to even the worst of natural disasters.

CORAL COMMUNITIES

by **Richard H. Randall** and **Charles Birkeland**

INTRODUCTION

This is a report of the findings of a survey of the corals and the condition of coral reefs in Fagatele Bay National Marine Sanctuary and at ten other sites around Tutuila during 12-24 July 1995. Reef-building corals were surveyed along 25 permanent transects that were established in 1985 in Fagatele Bay. The transects at ten sites at other locations around Tutuila (Fig. 1) were originally established in pairs in exposed and sheltered sites, and previously surveyed quantitatively in 1982, 1985, and 1988 (Birkeland et al. 1987, 1994). Detailed descriptions of the physiography of the marine habitats, the coral communities, the locations of the permanent transects, and vertical profiles along the six transects in Fagatele Bay National Marine Sanctuary are presented in Birkeland et al. 1987. The 1987 report also provides detailed descriptions of the reef-flat platform, reef margin, and forereef slope zones.

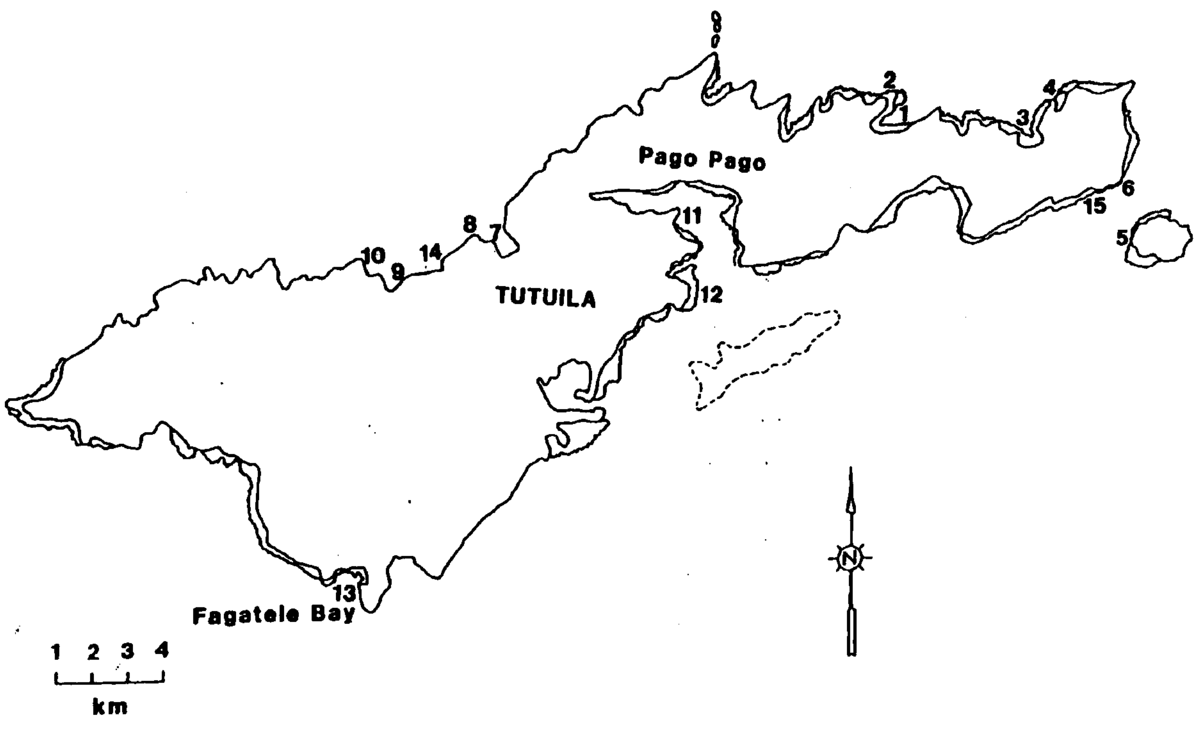

Fig. 1. Locations of ten survey sites on Tutuila Island, excluding sites in Fagatele Bay. 1-inside Masefau Bay; 2-outside Masefau Bay (Asaga Strait); 3-Aoa Bay; 4-Onenoa Bay; 5-Aunu'u Island; 6-Matuli Point; 7-Fagasa Bay; 8-Cape Larsen; 9-Fagafue Bay; 10-Massacre Bay; 11-Rainmaker Hotel; 12-Fatu Rock, 13-Fagatele Bay; 14-Sita Bay; 15-Auasi.

Our original survey in 1982 was to assess recovery of Samoan reef communities from predation by an outbreak of crown-of-thorns starfish *Acanthaster planci* in 1978-1979. Therefore, we expected to find the coral communities in later stages of recovery. However, since our previous survey in 1988, there have been two major cyclones (Hurricanes Ofa in 1990 and Val in 1991) and a coral-bleaching event (April 1994). Reefs and corals were subjected to extensive structural damage as a result of these two tropical cyclones passing close to American Samoa. Changes in the community structure of corals and other reef-associated organisms that have occurred since the initial *Acanthaster planci* predation during 1977-79 have been documented in Birkeland and Randall (1979), and Birkeland et al.(1987, 1994).

The main emphasis on corals in this report will be in their relation to the geomorphic structure of reefs and vulnerability or resistance to large swells and waves generated by storms and cyclones. Because intense *Acanthaster planci* predation on the reef corals can cause major changes in the community structure of reef-building corals as well as some structural changes, a section on the effects of intense *A. planci* predation on the reefs at selected sites around the island is also given.

METHODS

Coral communities were surveyed with the point-quarter method as used in previous surveys of Fagatele Bay National Marine Sanctuary and as described in detail in Birkeland et al. 1987. The locations of the permanent transects are given in Fig. 2.

Fig. 2. Six permanent sites in Fagatele Bay and transects at each site.

RESULTS

Data on size distributions (geometric mean diameters, standard deviations, and ranges in diameters) of coral colonies, the numbers and abundances (per m^2, relative abundances, frequencies) of the various species, and the percent cover of the reef substratum by living corals (per m^2 and relative percentages) are provided in Table 1, a-y, for the permanent transects in Fagatele Bay National Marine Sanctuary and in Table 2, a-t, for the other sites around Tutuila. Tables begin on page 18.

Summary statistics for the abundances of coral colonies, percent cover of the reef surface by living coral, and colony size distributions at five (5) depths along six (6) permanent transects in Fagatele Bay 1985, 1988, and 1995 are given in Tables 3 - 5. Likewise, these summary statistics are given for coral communities at two depths at each of ten other sites around Tutuila for 1982, 1985, 1988, and 1995 in Tables 6 - 8.

DISCUSSION

Previous Studies

The authors have conducted five separate studies of the reef systems around Tutuila Island in American Samoa between April 1979 and July 1995. The first of these studies was conducted from 24 March through 16 April 1979 to survey the coral reef communities, which at that time were undergoing severe predation by the coral-eating crown-of-thorns starfish *Acanthaster planci*. During this first survey, the distribution and abundance of *A. planci*, the relative degree of mortality to the coral community by *A. planci* predation, and the geomorphic structure of the reefs and species abundance of reef-building corals were assessed at 45 different stations around the island (Birkeland and Randall, 1979). During the 1979 assessment 525 specimens of reef-building corals were collected for systematic studies.

The second study was conducted during April 1982 to determine the degree of recovery of the coral reef communities from previous *A. planci* predation at twelve of the 45 stations studied during the 1979 survey. Six of these twelve stations were selected to represent wave-sheltered locations (coastal embayments) that were paired with six nearby wave-exposed locations (exposed coasts). In order to establish a quantitative baseline assessment of the coral communities at these twelve stations a plotless point-quarter technique was used to determine species size distribution, density, and percent surface coverage. During the 1982 assessment, 284 specimens of reef-building corals were collected for systematic studies.

The third study was conducted during April 1985 to continue an assessment of the degree of coral recovery from earlier *Acanthaster planci* predation at the twelve 1982 sites surveyed during 1982, and to conduct a biological marine survey at a newly established U. S. Marine Sanctuary located at Fagatele Bay along the southwest coast (Birkeland et al., 1987). At Fagatele Bay, corals were surveyed quantitatively by using the plotless point-quarter method of assessment along six permanently established transects and the general geomorphic reef structure and species abundance of corals were qualitatively assessed within the overall bay. During the 1985 coral assessment 446 coral specimens were collected for systematic studies.

The fourth (Birkeland et al., 1994) and fifth studies were conducted during April of 1988 and July of 1995 respectively, during which times assessments similar to those conducted during the 1985 study were made. During the 1995 study additional studies were conducted consisting of: 1) a quantitative resurvey of Mayor's 1917 reef flat platform transect in Pago Pago Bay, 2) a general qualitative assessment of a lagoon created by dredging on the reef flat platform adjacent to the Pago Pago Airport, and 3) general assessments at three embayment reefs along the southwest coast to determine effects of terrestrial sedimentation. During the 1988 and 1995 assessments, 102 coral specimens were collected for systematic studies.

Structural effects of Acanthaster planci *on reef communities*

Scattered damage to the surficial reef deposits, mainly by the collapse and fragmentation of some colony forms, as the result of *A. planci* predation has been observed at some of the assessment sites in Fagatele Bay and other sites around the island. To prevent confusion in regard to structural reef damage as a result of the 1977-79 *Acanthaster planci* predation and the reef damage resulting from the two typhoons that occurred in 1990 and 1991, a short summary of the effects resulting from the former is in order.

In regard to the magnitude of the *Acanthaster planci* predation events, one of us (Randall) witnessed the extensive predation on Guam and many other Micronesian and Pacific Islands from 1967 through 1972, and rates the predation event that occurred on the reefs of American Samoa from 1977 through 1979 just as devastating to the coral community, or possibly even greater, than that observed at any other island that experienced extensive starfish predation.

Immediate effects

When *Acanthaster planci* feeds on corals only the soft tissues are digested away, the integrity of coral corallum remains intact, thus there is no immediate structural damage. When all the living coral tissues are digested the colony is killed, and sometimes partial digestion of the colony tissues causes death as well, but commonly parts of the colony are left alive after the feeding event and the living zone(s) continues to grow in size and regenerate. Our observations show that where coral tissues are digested the underlying corallum becomes bleached white in color and is quickly recolonized. The first colonizers are generally endolithic and filamentous algae, which are quickly succeeded, or simultaneously recolonized by various species of calcareous algae and fleshy macro-algae. The rapidity by which freshly killed corals become recolonized by algae was generally observed wherever *A. planci* was feeding upon corals during our 1979 assessment and several accounts at specific sites are worth mentioning.

On 26 March 1979 near Siufaga Point, just inside the mouth of Fagasa Bay, two coral samples were chiseled from the lumpy dorsal surface of a pale brown *Porites lutea* colony, roughly 1.2 x 1.0 meters in diameter, that was growing on the outer edge of a submarine shelf at a depth of 3.0 meters. Sampling left two white concave depressions with a pale brown, fractured, peripheral margin about a centimeter wide that was invested with living tissues. On 12 April 1979 the sampling site was revisited and observations on the same *P. lutea* colony revealed that new polyps occupied the peripheral fractured regions and the previous white skeletal region was occupied by numerous, pink, 1-2 mm diameter discs of coralline algae and short green filaments of algae, the latter possibly a cyanophytic species. The coralline discs covered an estimated 25 percent of the previously fractured surface.

Another example which documents the rapidity of algal recolonization as well as the intensity of starfish predation was observed 11 April 1979 north of Agaoleatu Point on Aunu’u Island. Here a sand-floored terrace 12 to 15 meters deep had large scattered coral mounds that rose upward to within 4 to 6 meters of the surface. The mounds were predominantly occupied by arborescent thickets and scattered tabletop *Acropora* species which at places were infested with numerous *A. planci*. At our anchorage site, on top of one of the mounds about 100 x 75 meters in size near the seaward margin of the terrace, a large aggregation of *A. planci* were feeding on arborescent acroporoid corals. It was obvious that the feeding starfish had moved upslope to the mound crest, leaving a swath of dead corals behind about a 100 meters long and 5 to 10 meters wide. At the deeper trailing edge of the swath the coral branches were colonized by dark brown fleshy algae, which graded upward into a zone where the branches were colonized primarily with filamentous green algae, which in turn was preceded by a zone of white freshly killed branches, and at leading edge was a dense feeding band of starfish. Within the feeding band the starfish were stacked atop each other feeding on various interstitial levels between the coral branches. Here the entire sequence from actively feeding starfish to recolonization of the freshly killed branch surfaces by macroalgae was evident within a single swath of corals.

Another example of intense feeding activity by *Acanthaster planci* on large tabletop colonies was observed near Matuli Point on 31 March 1979. At the seaward edge of a submarine terrace scarp, in water about 4 to 5 meters deep, a large multi-tiered colony of *Acropora hyacinthus* about 1.7 meters across had 15 *A. planci* actively feeding on both the upper and lower polypoid surfaces. Although there was room for the starfish to individually feed over the colony surface, they were at places crowded together in overlapping aggregations.

Intermediate effects

Intermediate effects are here interpreted from observations of reef areas where the coral communities had undergone extensive *Acanthaster planci* predation 1 1/2 to 3 years earlier. Several reef areas reported by Wass (1979) as having undergone extensive *A. planci* predation during late 1977 and early 1978 were investigated during our 1979 assessment, and during April of 1982 we reassessed many of the areas that were intensively infested with *A. planci* during our 1979 assessment. Observations made during these reassessments at several of our field stations are given below which describes the structural condition of the reef and of the corals at several different habitats that were previously killed by *A. planci* predation. Taema and Nafanua Bank sites represent deep low wave energy slopes, Aunu’u Island site represents a moderate to heavy wave assaulted shallow terrace and adjacent deep seaward slope on the windward side of the island, and Aoa Bay site represents a protected embayment fringing reef habitat on the leeward side of the island.

On 30 March 1979, we investigated a region of Taema Bank that Richard Wass had reported as heavily infested with *A. planci* during the late part of 1977 and the early part of 1978. One of us (Birkeland) made a scuba dive down the seaward bank slope to a sand-floored terrace at 34 meters depth. An extensive coral community, previously consisting of numerous tabletop and scattered arborescent *Acropora* species, were nearly all dead and heavily encrusted with crustose coralline algae. A marginal piece of an in situ dead *A. cytherea* colony about 2.5 meters in diameter was collected near the base of the seaward bank slope at 34 meters depth. The fractured face of the coral revealed stems encrusted at places by crustose coralline algae up to a centimeter thick on the upper plate surface. The under plate algal encrustations were thinner and had numerous spats of a red colored adherent foraminiferan *Homotrema rubra* scattered over the surface. Ten marginal samples of dead *Acropora* tabletop colonies and five branch samples from arborescent colonies collected from the upper bank slope to a depth of 20 meters were all similarly encrusted with crustose coralline algae laminations up to a centimeter or more thick. With the exception of some arborescent *Acropora* patches, nearly all the dead corals on the seaward bank slope were "in place" and extensively encrusted by several crustose coralline algal species. About 25 percent of the bank slope surface was occupied by *Halimeda* species which produces extensive amounts of detrital sediment.

Nufanua Bank which extends southwest of Aunu'u Island was also reported by Richard Wass as intensely infested with *A. planci* during the early part of 1978. On 31 March 1979 we reassessed the upper bank platform (14 to 17 meters depth) and seaward bank slope to 34 meters depth. Our observations revealed a slope dominated by numerous dead "in place" *Acropora* colonies extensively encrusted by crustose coralline algae, similar to the conditions that were observed at Taema Bank.

The general pattern of most coral colonies retaining their structural integrity and becoming heavily encrusted by crustose coralline algae after being killed by *A. planci* predation was also observed in shallower more wave-assaulted reef habitats as well. A striking example of conditions before and after *A. planci* predation on a shallow, wave-assaulted, fringing reef habitat was observed at Aunu'u Island. On 31 March 1979, a shallow submarine terrace and adjacent steep seaward slopes and scarps to a depth of 34 meters was investigated about 250 meters southwest of Salevatia Point on Aunu'u Island. The terrace ranged from 2 to 3 meters deep on the inner part and gradually deepened to about 5 meters on the outer part where it abruptly terminated at a scarp edge. The terrace was conspicuously dominated by tabletop and other abundant to common corymbose and arborescent *Acropora* species. Encrusted patches of *Montipora* and cespitose heads of *Pocillopora* were also abundant to common as well. At the seaward margin of the terrace conspicuous mounds and ridges up to 2 meters high were composed of multiple tiers of living tabletop and corymbose *Acropora* species. Estimates of living coral coverage ranged from 70 to 80 percent on the inner terrace and 80 to 90 percent on the outer terrace. Actual coral coverage was much higher if all the multiple tiers of tabletop forms were considered.

On 5 April 1982 the same shallow terrace off of Salevatia Point on Aunu'u Island was reassessed. Most of the former living coral colonies were dead and thoroughly encrusted with crustose coralline algae. Collapse and fragmentation of arborescent and foliaceous species was apparent, but many were also intact and encrusted with coralline algae. Living corals were widely scattered and small, consisting mostly of a few arborescent *Acropora* patches with surviving stem tips, surviving patches of mostly dead *Pocillopora* heads, and an occasional newly recruited coral spat a few centimeters in diameter. Coral coverage on the terrace has been reduced to 1.7

percent from a previous estimate of 70 to 90 percent in 1979, and on the deeper adjacent scarp and steep slope coral coverage was only 0.06 percent (Birkeland et al., 1987). Surface coverage by crustose coralline algae on the shallow terrace was estimated at 80 to 90 percent.

An example of conditions before and after *A. planci* predation in a protected embayment reef along the leeward northeast coast was observed at Aoa Bay. During a tow survey on 1 June 1978 Richard Wass observed 270 *A. planci* on the reefs between Solo Point and Motsaga Point (Aoa Bay), but reported that about 90 percent of the corals were still alive. On 9 April 1979 the fringing embayment reef along the east side of Aoa Bay was reassessed and we found most of the corals intact, but dead and extensively encrusted with crustose coralline algae. Coral coverage on shallow terraces (2 to 5 m depth) along the outer bay was estimated at 2 to 3 percent and along the inner bay (1 to 2 m depth) at 1 to 2 percent. Fifteen *A. planci* were observed during our 1979 assessment, mostly along the inner part of the bay feeding on surviving corals, including *Millepora platyphylla*, but about half of them were actively moving about on sand-floored parts of the bay, possibly in search of living corals.

On 6 April 1982 we again reassessed the eastern side of Aoa Bay and found some small, widely scattered, newly recruited corals among numerous algal encrusted heads and tabletop corals along the outer part of the bay. Coral coverage along transects on the shallow terrace (2 to 5 m depth) was 3.1 percent and on the adjacent deeper slope (6 m depth) was 0.8 percent, and coralline algal coverage on the shallower terrace was estimated at 80 percent (Birkeland et al., 1987). Where the terrace grades into the reef flat platform coralline algal coverage was even higher.

Long-term effects

Long term effects are here interpreted from observations of reef areas from our 1985 and 1988 reassessments where the coral communities had undergone extensive *Acanthaster planci* predation 7 to 10 years earlier. With an elapse of this much time the reef areas should show a considerable amount of recovery by recruitment of new corals and regeneration of surviving spats. The recovery of coral communities that had undergone extensive *A. planci* predation in Guam are well documented (Randall, 1973a,b; Jones et al., 1976), and show that coral coverage as well as species abundance reached previous *A. planci* predation levels within 12 years (Colgan, 1987).

The shallow terrace and adjacent steep slopes at Aunu'u Island were reassessed 15 April 1985. The structural integrity of the shallow terrace appeared much the same as it did during the 1982 assessment. Crustose coralline algae dominated both the inner and outer parts of the terrace, and freshly fractured samples of "in place" tabletop colonies revealed crustose laminations up to two or more centimeters thick on the upper surface. Coral coverage on the shallow terrace was 1.6 percent, about the same as that during the 1982 assessment, and on the adjacent steep seaward slopes coral coverage increased from 0.06 percent during the 1982 assessment to 1.83 percent (Birkeland et al., 1987). Coralline algal coverage along a transect at 6 meters depth was 70.7 percent and on the shallower terrace was estimated at 80 to 90 percent.

The Aunu'u Island site was reassessed again on 14 April 1988, but because of breaking waves on shallow terrace, only the adjacent scarp and steep slopes at 6 meters depth could be quantitatively assessed. A short snorkeling excursion onto the outer part of the shallow terrace revealed that it was still dominated by crustose coralline algae, but corals appeared to more abundant. Especially conspicuous were the *Acropora hyacinthus* colonies which were now exhibiting tabletop colony forms. Some of the tabletop *Acropora* colonies appeared to be well over 0.5 meters across, which demonstrates the rapid growth rate of these colonies, which during the 1985 assessment were still in the encrusting-mound stage of development with colony diameters ranging from 3 to 15 centimeters. Coral coverage on seaward scarp and steep slopes at 6 meters depth was 17.8 percent (Birkeland et al., 1994), and an estimate of coral coverage on the outer part of the adjacent shallow terrace was estimated at 15 to 25 percent.

The fringing embayment reef along the east side of Aoa Bay was reassessed on 18 April 1985. The shallow terrace along the outer part of the terrace was dominated by encrusting crustose coralline algae, but new coral recruitment and regeneration of surviving spats were conspicuous, particularly on the outer half of the terrace. Newly recruited *Acropora hyacinthus* were especially noticeable, but were still in their encrusting-mound stage of development. Coral coverage along transects on the shallow terrace was 11.5 percent and on the adjacent deeper slope (6 m depth) was 1.8 percent, and coralline algal coverage along a transect at 6 meters depth was 68.8 percent and on the shallower terrace was estimated at 80 percent (Birkeland et al., 1987).

Aoa Bay was reassessed on 7 April 1988. Although encrusting coralline algae still dominated the shallow terrace, corals were conspicuously more abundant than during the 1985 assessment. Particularly noticeable were the *Acropora hyacinthus* colonies which were now forming their distinctive tabletop colony form, one of which was measured at 78 centimeters along the outer part of the terrace. Coral coverage along transects on the shallow terrace was 19.4 percent and on the adjacent deeper slope (6 m depth) was 15.8 percent (Birkeland et al., 1988), and coralline algal coverage on the shallower terrace was estimated at about 80 percent.

Discussion and summary of Acanthaster planci ***effects***

With exception of some arborescent and foliate colony forms, most coral skeletons did not collapse or fragment as might be expected by their death and the sudden loss of skeletal tissue accretion and increase in surface exposure to bioeroders. Increased bioersion would certainly weaken the coral skeleton, resulting in greater susceptibility to chemical and physical erosion. If fleshy algae was the climax colonizer of the exposed coral surfaces on arborescent, corymbose, cespitose, foliose, and tabletop forms, it is doubtful that structural integrity of the skeleton could be maintained until the coral community became reestablished. Coral recolonization would probably proceed at a much slower rate on surfaces covered with fleshy algae because of the difficulty of planulae to settle on such unstable substrates, and if they did by chance become settled, the relatively slow growing coral polyp could become smothered by the high rate of biomass production by the fleshy algae, as was demonstrated by Birkeland (1977) on settling plate studies.

After extensive *Acanthaster planci* predation many arborescent "staghorn" *Acropora* patches were observed to have collapsed and fragmented after being killed by *A. planci* predation. In general it was the large thicket-like patches several meters across and larger mounds up to tens of meters across that were more prone to collapse and fragment. Arborescent *Acropora* thickets consist of several distinct zones **--** a living dorsal region and a basal dead region where the branches still retain their structural integrity, and if the thicket has been growing for some time there will most likely be a third zone consisting of fragmented dead branches that accumulate from gravitational collapse as a result of the accumulating weight of the upper growing surface.

In living thickets the dead branches that have not collapsed are usually occupied by fleshy algae rather than coralline encrustations which are maintained and protected by pomacentrid "farmer" fishes which graze the algal gardens for food. Coralline algae are thus prevented from encrusting and strengthening the dead branches. Bioerosion soon weakens the fleshy algal coated branches, especially from boring sponges, resulting in their collapse. When the living branches suddenly die in thickets which have populations of "farmer" fishes present the upper branches become colonized by fleshy algal species promoted by them. Within several years the branches are weakened internally by bioerosion, the thicket rapidly collapses and is abandoned by the host fishes, and the fleshy algae is replaced by crustose corallines which cements the rubble into a more rigid mass. Small arborescent thickets of coral commonly do not have "farmer" fish associated with them, and after their death they generally become rapidly encrusted with crustose coralline algae. Even during our 1988 reassessment survey it was fairly common to see small dead arborescent branch clumps encrusted with coralline algae that had maintained their structural integrity for 7 to 10 years.

In conclusion, the coral reefs, as well as most of the individual coral colonies, retained their structural integrity in a wide range of habitats. Coral skeletal integrity was achieved primarily by the relatively rapid colonization and encrustation of the newly exposed corallum surfaces by another primary reef framework builder, the crustose corallines. Even without the reef-building corals, accretion of framework reef deposits was still occurring throughout much of the reef system, though at a slower rate than if the faster-growing corals were present.

Tropical cyclones of 1990 and 1991

Between our 1988 and 1995 coral reef assessments, two tropical cyclones (hurricanes or typhoons) caused substantial decreases in coral coverage and abundance as well as some structural damage to the reef framework deposits. The tropical cyclones also caused an increase in the production of detrital deposits and changes in sediment patterns by redistribution. Hurricane Ofa passed about 140 miles to the southwest of Tutuila during February of 1990, and Hurricane Val passed directly over Tutuila in December of 1991. Although the wind speeds associated with these two hurricanes were not exceptionally strong during their passage by or over Tutuila, storm waves and storm surge generated by the hurricanes were exceptionally destructive to the fringing reef systems and coastal areas. From a report supplied to us from the American Samoa Meteorological Service Office at the Airport, a short summary of each of the two hurricanes is given below.

The eye of Tropical Cyclone Ofa was estimated to have passed about 140 miles southwest of Tutuila Island on 4 February 1990. Strong winds began to be reported over the island from about 0200 UTC on February 2, with winds becoming very gusty and average speeds reaching gale force by 1200 UTC on February 3. About 0500 NTC on February 4 the winds peaked with maximum average speeds reported at 53 knots. The maximum gust reported was 93 knots which occurred at 0119 UTC on February 3. Heavy rain and large storm surge and storm waves washed away sections of roads and damaged bridges, buildings, and other structures. The coastal areas and villages in the northern part of the island were most severely affected.

Tropical Cyclone Val became organized northwest of the Samoa Islands, tracked southeast toward the island group, made a clockwise loop southwest of Savaii, and then tracked eastward and passed over Tutuila about 0000 UTC on 10 December 1991. Although no summary of the wind speed for Tropical Cyclone Val is given in the report from the Meteorological Services Office, anemometer graph charts from their office indicate a peak wind speed of 99 knots at 2350 on 9 December 1991. In conclusion, the report states that Val was a major tropical cyclone of this decade and will go on record as causing one of the most severe impacts in recent history. Apparently Tutuila has not experienced any major tropical cyclones since the middle 1960s.

Structural effects of tropical Cyclones Ofa and Val on the fringing reefs in Fagatele Bay

General effects of cyclones

Upon returning to American Samoa to conduct the 1995 coral reef reassessments, our team was well aware of the 1990 and 1991 Tropical Cyclones that passed near or over Tutuila Island, but we were somewhat unprepared to witness the degree of structural damage to the reef and coral communities we saw upon entering the waters of Fagatele Bay. One of us (Randall) has witnessed the effects of three "super typhoons" that passed directly over Guam since the middle 1960s, and found the level of structural reef damage around Tutuila Island to be generally greater than that observed on Guam after these more intense typhoons had passed over the island.

It must be kept in mind that the following observations from this assessment were made 3 to 4 years after the two cyclones affected the reefs, and thus we are unable to separate the individual effects of each cyclone. We are also unable to determine the immediate effects of the cyclones to the reef structure and associated communities, which was probably more severe than what we report, because of some recruitment and regeneration of marine organisms and redistribution of sediments since the cyclone events. It is also extremely difficult to determine whether the corals that we observed during the 1995 assessment are surviving patches or pieces of colonies that survived the cyclone events or are new corals recruited since the cyclones, or some combination of both. Another confounding factor in assessing the cyclone damage was a thermal event in 1994 that significantly elevated the water temperature, particularly in shallow reef margin and reef flat platform reef zones.

The cyclone-induced changes to the reefs in Fagatele Bay can be categorized into two broad types -- changes in the community structure of reef and reef-associated marine organisms and changes in the structural aspects of the reef framework and detrital deposits. Structural changes can be further subdivided into those of a minor or superficial nature (extant corals) where the physiography of the reef has not been significantly changed and those which have changed the physiographic features (buttresses, knobs, pinnacles) of the reef. To effectively evaluate both of these types of changes requires baseline knowledge of the reef system before and after the cyclone disturbances. Thus the basis for determining the structural and superficial aspects of the two cyclones is drawn primarily from a comparison of field notes taken during the 1979, 1985, and 1988 assessments with observations made during the present 1995 reassessment. Most of these field observations have been focused around the six transect sites in shoal-water regions of the bay from the surface to about 10 meters depth, but some general observations were made between the sites as well.

The general physiographic nature of the fringing reefs in Fagatele Bay, before Tropical Cyclones Ofa and Val affected the reefs, is given in the 1987 report (Birkeland et al., 1987: 26-37) and will not be repeated here. The structural and superficial effects from the cyclones are presented in a systematic manner, starting with Transects 1 through 6.

Assessment of the cyclone damage at Transects 1-6

Transect 1

General observations at this site were for the most part restricted to a submarine terrace 5 to 12 meters deep that extends from Steps Point to Matutuloa Point, with the most detailed observations at 5 to 6 meters depth in the vicinity of Transect 1. During the 1988 assessment waves and swells were to high to conduct a quantitative analysis at the 5 meter transect site, or make any detailed observations within the general area. The entire region was investigated during 1985 and reassessed again in 1995.

The reef structure at this location is not conspicuously different from that observed during the 1985 assessment, but some superficial changes have occurred. The most obvious change was the stripping away of many of the dead and living tabletop colony forms between 6 and 9 meters depth just seaward of the 5 meter transect area. Except for some abrasion and colony breakage, the coral community on the surface of the three mound tops that constitute the 5 meter transect sampling area appeared to be little effected by the cyclone. In fact, there was an increase in coral density, coverage, and colony size since the last assessment during 1985. Apparently the coral community at the 5 meter transect site is adjusted to the large waves and swells that normally sweep across the region, and thus was not seriously affected by the cyclone events. Most noticeable damage to the corals at the 5 meter transect site was abrasion and breakage of vertical plates on large *Millepora platyphylla* colonies.

Conspicuous scouring was observed on the floor of shallow troughs that follow joints in the volcanic rocks that extend seaward from a submarine cliff along the shoreline, as well as around the base of large volcanic rock blocks scattered along the base of the submarine cliff toward Matutuloa Point. Coral communities on the upper surfaces of these blocks appeared to be little affected by the cyclone events. Many of the large algal encrusted tabletop and cespitose colonies that were observed during the 1985 assessment along a 9 to 12 meter deep submarine terrace that extends south from Matutuloa Point were also not seriously affected by the cyclone event.

Transect 2

Significant structural reef changes have occurred at this site, both in its surficial and physiographic aspects. The site normally receives considerable water agitation from waves refracted around Matutuloa Point.

The reef flat in the vicinity of the transect was swept free of sediment except for minor accumulations in holes and depressions. Corals were scattered and patchy on the reef flat, nevertheless there was an increase coral coverage and density and a decrease in colony size since the 1988 assessment. Although the reef flat area south of the transect site was previously veneered by rubble across much of its surface, significant new deposits consisting mostly of *Acropora* shingle has been added to the surface. The new shingle deposits are especially conspicuous at the reef flat-reef margin boundary where the deposits form a linear ridge.

The most intense damage at this transect site was observed in the shallow reef margin and upper reef front slope to about 2 meters depth. The most conspicuous surficial change observed was the stripping away of most of the living and dead corals with arborescent, tabletop, and corymbose colony forms. In contrast, many small, dead algal encrusted heads of *Pocillopora* were observed at places on the buttress ridges. Apparently these *Pocillopora* colonies developed after the storm event and were killed by some other cause, possibly by the 1994 thermal event.

Very few living corals were observed within this shallow reef area, unlike the deeper adjacent reef front slope where small corals were much more abundant. Many corals that were not stripped away were badly damaged by abrasion and breakage from sand- to boulder-sized pieces that were vigorously moved about by storm surge and waves. Structural physiographic damage to the buttress ridges was also observed within the reef margin and upper reef front slope to a depth of 2 meters. Some of the more conspicuous damage included several buttress ridge sections 2 to 3 meters long that had been toppled over onto their sides, a section that had been overturned in an upside-down position, and several sections 1 to 2 meters across that had been hydraulically plucked off from buttress ridges. Channels situated between the buttress ridges have undergone considerable shoaling as a result of infilling by mostly coralline algal encrusted coral rubble and shingle. At places this coral and shingle accumulation was a meter or more in thickness and cemented together by encrusting algae.

Except for some toppled knobs and pillars the reef front slope areas deeper than 2 meters appeared to have less structural physiographic damage, but surficial damage to living and dead extant coral colonies was extensive. From 2 to about 8 meters depth the reef slopes were veneered with coralline algal encrusted coral rubble and shingle except where topographic knobs and low mounds and ridges occurred. At the 3 meter transect site a linear arrangement of meter-sized *Lobophyllia hemprichii* colonies growing alongside a buttress ridge, that were used to identify the transect location, had all but the very tops buried in rubble and shingle. Some of the individual pieces of shingle were a meter or more in their long dimension and at places some of the clasts were being cemented together by crustose algae.

In regard to the community structure of the corals, there was an increase in coral density, coverage, and colony size at both the 3 and 5 meter transect sites since the last assessment during

1988. Scattered living and dead corals occurred on both the rubble and shingle veneered areas as well as on extant topographic features. Most of the corals were relatively small and appeared to have become established since the cyclone events, but a few larger colonies were also scattered about. Judging from the amount of abrasion and breakage, some of these larger colonies must have survived the two cyclone events.

Transect 3

This site is situated within the broad convex head of the bay and is exposed directly to waves and swells that enter the mouth of Fagatele Bay. At this site significant structural reef changes have occurred primarily in the reef margin and adjacent reef front slope zones, both in its surficial and physiographic aspects. In comparison with the other transect sites at the head of the bay, there was less cyclone damage in the upper reef front slope than at transect sites 2 and 4, but the lower reef front slope appeared to have about the same amount of damage. The presence of a large depression with a patch reef at its outer edge may have given the upper reef front slope some degree of protection at transect 2.

The reef flat in the vicinity of the transect has a relatively flat truncated surface with scattered irregular-shaped holes and depressions up to 5 or more meters across and up to 2 meters deep. There was only minor evidence of storm damage along the inner two-thirds of the platform, except for some scattered pieces of coral rubble and shingle. Along the outer third of the platform the holes and depression are connected by channelways that extend seaward to the reef margin and reef front slope, which contained significantly more rubble and shingle than before the cyclone events. Many dead and living corals that were earlier observed in these channelways have been swept away, but many small algal encrusted *Pocillopora* heads were still in place.

The most significant change on the inner two-thirds of the reef platform was the presence of abundant dead in situ corals that were alive during the 1988 assessment. The dead corals are mostly located in the holes and depression and in a narrow moat along the shoreline. On the outer part of the effected platform arborescent *Acropora* patches and *Pocillopora* heads were selectively killed, leaving most of the other species unharmed.

Farther inshore more species of corals, such as *Pavona divaricata, Porites lutea, P. cylindrica, P. annae,* and *Psammocora contigua,* as well as the encrusting corallines have been partially to completely killed. Where crustose coralline algae has been killed the surfaces are occupied by dark-colored fleshy algal species. It is suspected that the coral communities on the reef flat platform have been selectively killed by the 1994 thermal event, with the effects being greatest on the inner shallower part of the platform and attenuating in a seaward direction to the outer reef margin. Similar selective thermal coral kills have been observed on reef platforms on Guam and Saipan in the Mariana Islands that were related to periods of exceptionally low tides and calms. In regard to the community structure of the corals on the reef flat, there was a decrease in coral density, coverage, and colony size since the last assessment during 1988.

Although some damage was observed in the shallow reef margin and upper reef front slope zones, it was not nearly so severe as that observed at transect areas 2 an 4. The most obvious damage was the accumulation coral rubble and shingle. Physiographic reef damage consisted of several toppled knobs several meters across in the reef margin, and a partly living colony of *Psammocora* sp.1 (2.2 x 1.7 meters across) that was broken off from a prominent pinnacle on the lower reef front slope and transported upslope to a reef margin channel.

On the upper reef front slope there was more survival of pre-cyclone dead and living coral colonies than at transect sites 2 and 4. Some of the more conspicuous survivors included; damaged and fragmented patches of *Porites* (*S.*) *rus* and *P.* (*S.*) *convexa* on the reef front slope, and a partially dead *Acropora robusta* colony 3.1 meters in diameter and a partly dead corymbose *Acropora* cf. *paxilligera* colony 2.8 meters in diameter and 1 meter high in the reef margin zone. There were also a number of large living colonies growing on the reef slope, which irregardless of their size, appeared to have been recruited since the cyclone events. Examples of these living colonies include; two *Acropora hyacinthus* colonies whose tabletop measurements were 115 x 76 cm and 90 x 88 cm, a pedicellated corymbose *Acropora pagoensis* colony 72 x 53 cm, a compound tabletop *Acropora* sp. 2 colony 103 x 74 cm., and a clump of *Acropora nobilis* 174 cm across. These large living colonies show no evidence of storm damage, even though there were growing amidst, as well as on, storm accumulated plates of shingle.

In regard to the community structure of the corals on the upper reef front slope, there was a decrease in coral density and an increase in coverage and colony size at the 3 meter transect site, and a decrease in coral density and coverage and a slight increase in colony size at the 5 meter transect site since the last assessment during 1988. Nearly 50 percent of the colonies encountered along the 3 and 5 meter transects were *Porites* sp. 2 with a mean diameter of only 5.9 cm, that been recruited since the cyclone events.

Reef front slope areas deeper than 6 meters appeared to have less structural physiographic damage than the shallower parts, but surficial damage to living and dead extant coral colonies was extensive. Although there has been some collapse of extensive arborescent thickets of *Acropora* and foliaceous patches of *Merulina, Echinopora*,and *Turbinaria* after *Acanthaster planci* predation, most of the extant dead and living corals were striped away by the cyclone events. Except for some topographic mounds, ridges, and knobs, algal encrusted coral rubble and shingle now veneers much of the lower reef slopes.

Transect 4

Like transect area 3, this site is situated within the broad convex head of the bay and is exposed directly to waves and swells that enter the mouth of Fagatele Bay. In comparison with the other transect sites at the head of the bay there was more surficial cyclone damage observed in the reef margin and reef front slope zones than at transect sites 2 and 3. Although some physiographic reef damage was observed, it was not as extensive as that at transect areas 2 and 3.

The reef flat platform in the vicinity of the transect has a relatively flat surface with scattered irregular-shaped holes and depressions up to 2 or more meters across and up to a meter deep on the outer half of the platform, and a very flat truncated surface with widely scattered shallow holes and depressions on the inner half of the platform. Along the transect itself there was only minor evidence of storm damage on the inner half of the platform, except for some scattered pieces of coral rubble and shingle. The outer half of the platform has minor amounts of coral rubble and shingle scattered over the surface, mainly on the floors of holes and depressions. To the west of transect area the platform has accumulated considerably more coral rubble and shingle than was observed there during the 1985 assessment. No assessment was conducted at this transect site during the 1988 assessment because of high waves and swells breaking on the platform.

There appeared to be more damage to the coral community from the 1994 thermal event than from the two cyclones. Nevertheless, in regard to the community structure of the corals on the reef flat, there was an increase in coral density and coverage and a slight decrease in colony size since the last assessment during 1985. Some of the community structural differences is probably due to a slight shift of the 1995 transect area toward the west into a region occupied by abundant truncated beds of *Pavona divaricata*. Apparently the new storm rubble and shingle accumulation on the platform (described above) has shifted deposits eastward and the transect was thus shifted eastward as well.

Except for a few minor toppled knobs and pillars, most of the cyclone damage is of a surficial nature on reef margin and reef front slope areas. Reef margin channels and the adjacent reef front slopes to about 10 meters depth are now veneered with extensive amounts algal encrusted coral rubble and shingle, except where topographic knobs and low mounds and ridges occurred. Apparently the numerous extant dead and living corals that were present on the slopes during the 1988 assessment were broken loose and the surface overlain by reworked coral rubble and shingle during the cyclone events. A shallow reentry channel that extends into the reef platform at this site was veneered with an unbroken layer of mostly large pieces of shingle. Judging from the tops of some large *Porites lutea* colonies that are now just barely emergent, the shingle accumulation in the reentry channel is at places is over a meter thick.

In regard to the community structure of the corals, there was an decrease in coral density and coverage and colony size was unchanged at the 3 meter transect site, and an increase in density and coverage and a decrease in colony size at the 5 meter transect site since the last assessment during 1988. Scattered living and dead corals occurred on both the rubble and shingle veneered areas as well as on extant topographic features.

Transect 5

This transect site is located on the west side of Fagatele Bay and is thus exposed to waves and swells that directly enter the bay mouth or are refracted around Fagatele Point. The shoreline is a vertical volcanic rock wall that extends downward below the water level 2 to 5 meters. Waves reflected from the shoreline wall and underwater scarp meet oncoming waves and swells causing a very agitated water mass in the vicinity of the transect. Seaward from the submarine scarp the bottom dip downward rather steeply and the topography is very irregular, consisting of various sized blocks of rock slumped from the adjacent cliff and mounds, knobs, and ridges that have no consistent orientation or shape. Coarse sediment forms a patchy veneer at places between the topographic features and in undercut troughs and open joints along the submarine wall. The 3 meter transect area is located along submarine scarp and the 5 meter transect area just a few meters father seaward.

Within the 3 and 5 meter transect areas there was very little noticeable physiographic damage and no noticeable changes in the amount or distribution of sediments. Bottom sediments ranged from sand- to rubble-sized clasts and a few rounded boulders, similar to what was present during the pre-cyclone assessments. Most of the cyclone damage was of a surficial nature consisting of sediment scouring along basal regions of some topographic features and along the base of the submarine scarp. Many of the living corals showed some evidence of abrasion and breakage, but it did not appear that many corals were actually striped away by the cyclone events. During the 1988 assessment table top corals within the 3 and 5 meter transect areas were rare, but on the adjacent deeper slopes some were observed. In regard to the community structure of the corals, there was a decrease in coral density, coverage, and colony size at both the 3 and 5m transect sites.

Transect 6

General observations at this site were for the most part restricted to a short, isolated, submarine ridge with peripheral steep to vertical scarps that lies a short distance off of Fagatele Point. Transect sampling was restricted to the upper surface of the ridge which ranged from 4 to 6 meters deep.

No obvious or structural reef damage was apparent on the upper surface of the ridge, and only minor surficial damage was noted in the form of sediment scouring around the basal peripheral region of the ridge, and the obvious removal of the tabletop colonies that were present during the 1988 assessment.

The community structure of the corals at this location is conspicuously different from that observed during the 1988 assessment. There has been some significant changes in species composition and a decrease in coral density, coverage, and colony size. Similar variation in the community structure of the corals also occurred between the 1985 and 1988 assessments. During 1995, nearly half the corals encountered on the transect had never been observed at this station before. In our 1985 assessment, 14 colonies of *Acropora azurea* were encountered on the transect. None were encountered on the transect in 1988, but one was observed in the area, and during the 1995 assessment, none were encountered on the transect or observed in the area.

In the 1985 and 1988 assessments, *Galaxea fascicularis* was encountered on the transect 11 and 7 times respectively, but during the 1995 assessment it was neither encountered on the transect or observed in the area. The top of the short ridge where this transect area is located is easily recognized and quite small in area, so there is little doubt about not sampling the same region. Rapid turnover in the corals here, except possibly for the very stout species like *Millepora platyphylla*, is not surprising when considering that it is a just a veneering community. The fact that there is no true reef deposit here presupposes a rapid turnover of the corals, unlike the wave assaulted 5 meter coral community at the transect 1, where the community appears to be fairly stable and is building up an underlying reef deposit.

Discussion and summary of cyclone effects

It is quite apparent that Tropical Cyclones Ofa and Val caused considerable surficial damage, as well as some structural physiographic damage, to nearly all the reef communities within Fagatele

Bay, but it is also probable that not all the surficial damage observed could be ascribed to the effects of the cyclones alone. Some of the rubble has been derived from the collapse and fragmentation of certain colony forms after they were killed by *Acanthaster planci* predation.

The thermal event of 1994 appears to have had a significant effect on the corals and living patches that initially survived the cyclones as well the new recruits. Many of the dead corals observed on the shallow reef flat platform and reef margin zones may have been recruited after the cyclones, and then killed by water temperature elevation to lethal levels during this thermal event, which explains why they were not swept away by the cyclone waves.

One of the most conspicuous surficial effects of the cyclones was stripping away of many of extant dead and living corals that offered a high coefficient of drag to the storm waves. Many of these storm-prone corals that retained their structural integrity after *A. planci* predation, by becoming rapidly encrusted with coralline algae, gave the reef surface a high degree of three-dimensionality and microhabitat diversity, which provided ideal substrates for rapid recruitment and re-establishment of diverse coral communities. The collapse and fragmentation of such storm-prone dead and living corals produced a prodigious amount of new rubble and shingle, which along with precyclone sediments underwent considerable redistribution. At some places there was sediment accretion, commonly in places where there was little sediment accumulation before, and at other places sediment depletion occurred.

In the shoal-water reef zones strong wave surge transported considerable amounts of coarse sediment into the reef margin surge channels. This newly accumulated material is rapidly being cemented into a wave-resistant reef fabric. Such accumulations hasten the reef-building process by propagation of the reef front framework deposits seaward and over the newly accumulated detrital material. Much of the newly produced rubble and shingle was also worked downslope where it builds up the forereef detrital deposits. Strong cyclone waves and currents comminute coarser sediments into finer grains, some of which is transported out of the bay to the deeper island slopes. Finally, a relatively small part of the sediment was transported to shoreward to become part of the ephemeral beach deposits along the rocky shoreline of the bay.

The cyclones also caused some structural physiographic damage to the reef as well, particularly in the reef margin and reef front slope zones, where sections of reef buttresses, pinnacles, and knobs were overturned or toppled. Such structural reef damage is impressive to an observer, but is relatively inconsequential when compared to the volume new sediment produced and its widespread redistribution.

Some of the above cyclone effects to the reef system may seem catastrophic, but reefs are features of tropical seas where cyclonic systems breed and blow, and in spite of such storms they flourish and persist, possibly because of them.

In conclusion, it appears that the species diversity, density, coverage, and colony size (community structure) that we observe on the reefs of Fagatele Bay at any one point in time are dependent to a great degree on chance historical events. Because of the unpredictable nature of these events, such as their temporal spacing and variability in intensity, it is difficult for corals to adapt to them. Had we visited the reefs of Fagatele Bay just once in 1979, we would know the community structure of the corals there, but now after four more trips to these reefs the concept seems to have become an elusive goal. It's like the old saying of the man with a watch: with one, he knows what the time is, but if he carried four watches, he is uncertain of what time it is.

Table 1. Coral communities at 6 transects in Fagatele Bay, based on 25 quantitative point-quarter transect surveys done in July 1995.

1(a)	Transect 1	5-6m depth
1(b)	Transect 1	9 m depth
1(c)	Transect 1	12 m depth
1(d)	Transect 2	1 m depth
1(e)	Transect 2	3 m depth
1(f)	Transect 2	5 m depth
1(g)	Transect 2	9 m depth
1(h)	Transect 2	12 m depth
1(i)	Transect 3	1 m depth
1(j)	Transect 3	3 m depth
1(k)	Transect 3	5 m depth
1(l)	Transect 3	9 m depth
1(m)	Transect 3	12 m depth
1(n)	Transect 4	1 m depth
1(o)	Transect 4	3 m depth
1(p)	Transect 4	5 m depth
1(q)	Transect 4	9 m depth
1(r)	Transect 4	12 m depth
1(s)	Transect 5	3 m depth
1(t)	Transect 5	5 m depth
1(u)	Transect 5	9 m depth
1(v)	Transect 5	12 m depth
1(w)	Transect 6	5-6m depth
1(x)	Transect 6	9 m depth
1(y)	Transect 6	12 m depth

Table 1a. Fagatele Bay, Transect 1, 5-6 m depth

Fagatele - Transect 1 5-6 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Millepora platyphylla	12	26.5	21.1	6.5/68.5	0.47	1.76	20.00	15.42	58.12
Montipora grisea	3	23.4	30.8	5.3/59.0	0.20	0.44	5.00	4.09	15.42
Pocillopora elegans	2	25.4	8.4	19.4/31.3	0.13	0.29	3.33	1.57	5.92
Montipora ehrenbergii	8	10.9	4.6	6.0/20.0	0.27	1.18	13.33	1.26	4.75
Pocillopora verrucosa	5	12.5	6.8	3.5/22.0	0.33	0.73	8.33	1.11	4.18
Montipora verrilli	5	12.9	3.8	7.3/16.7	0.20	0.73	8.33	1.04	3.92
Pocillopora danae	2	15.2	1.8	13.9/16.5	0.13	0.29	3.33	0.53	2.00
Pocillopora eydouxi	4	8.7	1.4	7.3/10.5	0.27	0.59	6.67	0.36	1.36
Pocillopora meandrina	3	8.5	3.8	4.8/12.5	0.20	0.44	5.00	0.28	1.06
Galaxea fascicularis	6	5.8	2.1	3.0/8.5	0.33	0.88	10.00	0.26	0.98
Porites (P.) lutea	2	9.3	1.6	8.1/10.4	0.07	0.29	3.33	0.20	0.75
Porites (P.) sp.2	2	7.7	2.5	5.9/9.4	0.13	0.29	3.33	0.14	0.53
Psammocora haimeana	2	6.0	0.7	5.5/6.5	0.13	0.29	3.33	0.08	0.30
Acropora (I.) craterformis	1	6.9	-	-	0.07	0.15	1.67	0.06	0.23
Millepora tuberosa	1	7.5	-	-	0.07	0.15	1.67	0.06	0.23

Leptoria phrygia	1	5.7	-	-	0.07	0.15	1.67	0.04	0.15
Acropora (A.) hyacinthus	1	5.3	-	-	0.07	0.15	1.67	0.03	0.11
COMMUNITY	60	13.8	13.8	3.0/68.5		8.80		26.53	

Table 1b. Fagatele Bay, Transect1, 9 m depth

Fagatele - Transect 1 9 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Pocillopora eydouxi	17	14.9	4.27	6.9- 23.2	.70	187.4	20.6	3.27	30.16
Leptoria phrygia	3	28.2	9.24	17.9- 35.8	.13	33.0	3.6	2.06	19.00
Montipora grisea	6	14.9	11.5	6.5- 37.7	.22	65.9	7.2	1.15	10.61
Pocillopora verrucosa	6	13.3	3.46	7.0- 15.9	.22	65.9	7.2	0.92	8.48
Montipora verrilli	12	9.2	4.89	2.6- 19.5	.39	132.5	14.5	0.88	8.12
Platygyra daedalea	1	25.0	-	-	.04	11.0	1.2	0.54	4.98
Montipora ehrenbergii	2	17.0	4.31	13.9- 20.0	.22	22.0	2.4	0.50	4.61
Pocillopora meandrina	6	8.0	5.84	3.5- 19.0	.09	65.9	7.2	0.33	3.04
Favites russelli	2	13.2	16.6	2.4- 25.9	.17	22.0	2.4	0.30	2.77
Pavona sp. 3	4	8.3	6.65	3.5- 18.0	.13	44.0	4.9	0.24	2.21
Montipora granulosa	3	6.7	2.02	3.9- 12.0	.04	33.0	3.6	0.12	1.11
Favia rotumana	1	9.4	-	-	.04	11.0	1.2	0.08	0.74
Montipora caliculata	1	9.0	-	-	.04	11.0	1.2	0.64	0.65
Porites lichen	1	2.8	-	-	.04	11.0	1.2	0.06	0.55
Montipora monasteriata	3	4.3	3.51	1.2- 8.1	.13	33.0	3.6	0.05	0.46

Porites sp. 2	3	3.7	0.50	3.2- 4.2	.13	33.0	3.6	0.04	0.37
Psammocora nierstraszi	1	6.9	-	-	.04	11.0	1.2	0.37	0.37
Psammocora superficialis	1	6.5	-	-	.04	11.0	1.2	0.33	0.37
Leptastrea purpurea	1	6.0	-	-	.04	11.0	1.2	0.28	0.28
Favites complanata	2	3.2	-	3.2- 3.2	.04	22.0	2.4	0.2	0.18
Hydnophora microconos	1	5.5	-	-	.04	11.0	1.2	0.24	0.18
Astreopora sp. 1	1	4.5	-	-	.04	11.0	1.2	0.16	0.18
Astreopora sp. 1	1	4.9	-	-	.04	11.0	1.2	0.02	0.18
Astreopora sp. 1	1	4.5	-	-	.04	11.0	1.2	0.02	0.18
Astreopora sp. 1	1	4.0	-	-	.04	11.0	1.2	0.01	0.09
Astreopora sp. 1	1	3.9	-	-	.04	11.0	1.2	0.01	0.09
Astreopora sp. 1	1	2.0	-	-	.04	11.0	1.2	0.03	0.03
COMMUNITY	83	11.3	7.56	1.2-37.7		913.6		12.67	

Table 1c. Fagatele Bay, Transect1, 12 m depth

Fagatele - Transect 1 12 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Pocillopora eydouxi	10	19.4	18.2	6.0- 61.4	.35	93.7	12.1	2.75	17.41
Montastrea curta	2	33.2	25.0	15.5- 50.9	.10	19.0	2.5	1.64	10.39
Acropora gemmifera	1	41.4	-	-	.05	9.6	1.2	1.29	8.17
Montipora grisea	7	15.2	6.01	5.9- 25.8	.20	66.0	8.6	1.19	7.53
Platygyia pini	2	28.0	16.7	16.2- 39.8	.10	19.0	2.5	1.17	7.41
Acropora digitifera	1	37.9	-	-	.05	9.6	1.2	1.08	6.84
Hydrophora exesa	1	37.5	-	-	.05	9.6	1.2	1.06	6.71
Leptoria phrygia	5	16.8	12.8	3.5- 31.7	.20	47.1	6.1	1.04	6.59
Astreopora sp. 1	3	21.3	15.4	10.4- 32.2	.15	28.3	3.7	1.01	6.40
Pocillopora verrucosa	1	35.7	-	-	.05	9.6	1.2	0.96	6.08
Montipora verrilli	12	8.82	3.93	2.5- 16.5	.45	112.4	14.5	0.96	4.37
Montipora ehrenbergii	1	23.8	-	-	.05	9.6	1.2	0.43	2.72
Pavona sp. 3	6	8.07	8.89	1.4- 25.5	.30	56.4	7.3	0.29	1.84
Favites russelli	3	10.4	8.59	5.0- 20.3	.10	28.3	3.7	0.24	1.52
Favia matthaii	3	9.03	6.33	4.2- 16.2	.15	28.3	3.7	0.18	1.14

Favia rotumana	1	14.0	-	-	.05	9.6	1.2	0.15	0.95
Montipora elschneri	1	12.6	-	-	.05	9.6	1.2	0.12	0.76
Montipora turgescens	1	12.5	-	-	.05	9.6	1.2	0.12	0.76
Porites sp.2	7	3.57	1.69	1.7- 6.3	.20	65.7	8.5	0.07	0.44
Pavona venosa	2	6.75	1.77	5.5- 8.0	.10	19.0	2.5	0.07	0.44
Gardineroseris plantuata	1	9.4	-	-	.05	9.6	1.2	0.07	0.44
Fungia fungites	1	7.9	-	-	.05	9.6	1.2	0.05	0.32
Fungia scutaria	1	6.7	-	-	.05	9.6	1.2	0.03	0.19
Millepora tuberosa	1	5.9	-	-	.05	9.6	1.2	0.03	0.19
Porites (Synaraea) rus	4	2.9	1.00	2.0- 4.0	.20	37.9	4.9	0.023	0.15
Acropora verweyi	1	4.9	-	-	.05	9.6	1.2	0.02	0.13
Montipora monasteriata	1	4.5	-	-	.05	9.6	1.2	0.02	0.13
Pavona varians	1	3.2	-	-	.05	9.6	1.2	0.008	0.05
Galaxea fascicularis	1	3.2	-	-	.05	9.6	1.2	0.008	0.05
Leptastrea purpurea	1	1.7	-	-	.05	9.6	1.2	0.002	0.01
COMMUNITY	83	35.9	18.9	1.4-61.4		784.3		14.27	

Table 1d. Fagatele Bay, Transect 2, 1 m depth

Fagatele - Transect 2 1 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Porites (P.) lutea	6	12.8	10.5	6.9/33.0	0.24	0.63	8.82	1.44	28.69
Porites (S.) rus	12	7.2	8.8	2.0/34.3	0.35	1.27	17.65	1.22	24.30
Galaxea fascicularis	9	7.7	3.1	4.9/13.5	0.35	0.95	13.24	0.51	10.16
Porites (P.) annae	6	6.6	6.6	1.4/19.7	0.24	0.63	8.82	0.41	8.17
Leptoria phrygia	3	11.7	5.3	6.0/16.5	0.06	0.32	4.41	0.39	7.77
Gardineroseris planulata	2	12.3	6.2	7.0/16.7	0.12	0.21	2.94	0.28	5.58
Montipora verrilli	1	15.9	-	-	0.06	0.11	1.47	0.21	4.18
Acropora (I.) crateriformis	3	7.0	6.2	2.4/15.7	0.06	0.32	4.41	0.18	3.59
Porites (P.) sp. 2	13	3.8	1.3	1.0/6.0	0.47	1.37	19.12	0.17	3.39
Porites (P.) lobata	2	5.4	3.3	3.0/3.5	0.06	0.21	2.94	0.06	1.20
Echinopora hirsutissima	1	6.7	-	-	0.06	0.11	1.47	0.04	0.80
Millepora tuberosa	3	3.6	0.7	2.8/4.0	0.12	0.32	4.41	0.03	0.60
Stylocoeniella armata	4	3.2	0.4	2.8/3.5	0.12	0.42	5.88	0.01	0.60
Montipora tuberculosa	1	5.5	-	-	0.06	0.11	1.47	0.02	0.40
Montipora ehrenbergii	1	4.9	-	-	0.06	0.11	1.47	0.02	0.40

Leptastrea purpurea	1	4.0	-	-	0.06	0.11	1.47	0.01	0.02
COMMUNITY	68	7.1	6.2	1.0/34.3		7.20		5.02	

Table 1e. Fagatele Bay, Transect 2, 3 m depth

Fagatele - Transect 2 3 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Acropora (A.) crateriformis	13	13.2	8.0	3.0/29.9	0.40	2.96	21.7	5.48	23.39
Galaxea fascicularis	19	8.1	2.7	3.0/15.4	0.67	4.32	31.57	2.46	14.54
Pocillopora eydouxi	2	21.9	15.1	11.2/32.6	0.13	0.45	3.33	2.13	12.59
Acropora (A.) gemmifera	4	14.4	4.4	11.0/21.4	0.20	0.91	6.67	1.85	10.93
Montipora verrilli	3	12.7	7.0	5.0/18.7	0.20	0.68	5.00	1.05	6.21
Goniastrea retiformis	1	23.8	-	-	0.07	0.23	1.67	1.02	6.03
Pocillopora elegans	1	22.0	-	-	0.07	0.23	1.67	0.87	5.14
Montipora ehrenbergii	2	14.2	1.1	13.4/15.0	0.07	0.45	3.33	0.72	4.26
Acropora (A.) humilis	1	16.5	-	-	0.07	0.23	1.67	0.49	2.90
Porites (A.) sp.2	7	4.3	1.5	2.4/6.0	0.04	1.59	11.67	0.26	1.54
Acropora tenuis	1	8.7	-	-	0.07	0.23	1.67	0.13	0.77
Favia stelligera	3	5.0	0.0	5.0/5.0	0.13	0.68	5.00	0.13	0.77
Pocillopora verrucosa	2	3.8	5.3	4.0/7.5	0.07	0.45	3.33	0.13	0.77
COMMUNITY	60	10.6	6.7	2.4/32.6		13.64		16.92	

Table 1f. Fagatele Bay, Transect 2, 5 m depth

Fagatele - Transect 2 5 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Acropora (I.) carterformis	11	15.7	9.7	3.0/34.9	0.47	1.09	18.33	2.86	20.78
Montipora verrilli	6	20.4	11.5	8.1/42.4	0.33	0.60	10.00	2.46	17.88
Goniastrea retiformis	2	30.0	19.0	16.5/43.4	0.13	0.20	3.33	1.68	12.21
Acropora (A.) gemmifera	2	28.1	21.3	13.0/43.1	0.13	0.20	3.33	1.58	11.48
Pocillopora eydouxi	2	19.3	19.2	5.7/32.9	0.13	0.20	3.33	0.87	6.32
Galaxea fascicularis	10	9.8	3.2	4.5/14.1	0.27	1.00	16.67	0.82	5.96
Montipora ehrenbergii	3	15.4	10.2	4.2/24.3	0.20	0.30	5.00	0.72	5.23
Acropora (A.) c.f. digitifera	2	13.8	11.0	6.0/21.5	0.13	0.20	3.33	0.39	2.82
Montipora elschneri	2	12.5	12.8	3.5/21.6	0.07	0.20	3.33	0.37	2.69
Pavona venosa	1	21.3	-	-	0.07	0.10	1.67	0.36	2.62
Montipora sp.2	1	21.0	-	-	0.07	0.10	1.67	0.35	2.54
Acropora (A.) delicatula	2	13.5	4.9	10.0/16.9	0.13	0.20	3.33	0.30	2.18
Montipora grisea	1	19.1	-	-	0.07	0.10	1.67	0.29	2.11
Porites (P.) sp.2	5	4.5	3.5	1.4/13.5	0.33	0.90	15.00	0.22	1.60
Montipora tuberculosa	1	15.4	-	-	0.07	0.10	1.67	0.19	1.38

Pocillopora verrucosa	2	10.3	2.5	8.5/12.0	0.13	0.20	3.33	0.17	1.24
Hydnophora microconos	1	9.4	-	-	0.07	0.10	1.67	0.07	0.51
Acropora (A.) hyacinthus	1	7.0	-	-	0.07	0.10	1.67	0.04	0.29
Montastrea curta	1	5.0	-	-	0.07	0.10	1.67	0.02	0.15
COMMUNITY	60	13.9	10.1	1.4/43.4		5.99		13.76	

Table 1g. Fagatele Bay, Transect 2, 9 m depth

Fagatele - Transect 2 9 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Porites sp.2	24	3.9	1.9	1.0-6.9	0.39	3.23	0.29	0.01	0.001
Porites (Synaraea) rus	14	19.7	35.7	2.4-138.6	0.39	1.89	0.17	0.34	0.03
Montipora grisea	10	21.0	9.7	5.5-43.5	0.39	1.35	0.12	0.38	0.04
Montipora venosa	3	5.0	1.5	3.5-6.5	0.15	0.40	0.04	0.02	0.002
Pocillopora eydouxi	3	18.6	8.5	10.5-27.4	0.15	0.40	0.04	0.30	0.03
Montipora ehrenbergii	3	14.5	6.3	9.5-21.6	0.10	0.40	0.04	0.18	0.02
Pavona sp. 3	3	11.0	3.4	8.4-17.9	0.15	0.40	0.04	0.10	0.01
Porites vaughani	3	6.1	1.6	4.2-7.1	0.10	0.40	0.04	0.03	0.002
Pavona duerdeni	2	27.2	19.0	13.7-40.6	0.10	0.27	0.02	0.64	0.06
Montipora pagoensis	2	16.2	4.6	13.0-19.4	0.10	0.27	0.02	0.23	0.02
Acropora tenuis	2	14.8	1.9	13.5-16.1	0.10	0.27	0.02	0.19	0.02
Porites lutea	2	5.7	4	2.8-8.5	0.10	0.27	0.02	0.03	0.003
Acropora pagoensis	1	86	-	-	0.05	0.13	0.01	6.42	0.59
Pavona sp.1	1	24.4	-	-	0.05	0.13	0.01	0.52	0.05
Montipora tuberculosa	1	23.6	-	-	0.05	0.13	0.01	0.48	0.04
Pocillopora meandrina	1	20.3	-	-	0.05	0.13	0.01	0.36	0.03
Pocillopora verrucosa	1	20	-	-	0.05	0.13	0.01	0.35	0.03
Acropora hyacinthus	1	12.2	-	-	0.05	0.13	0.01	0.13	0.01

Galaxea fascicularis	1	10.1	-	-	0.05	0.13	0.01	0.09	0.008
Montipora elschneri	1	8.0	-	-	0.05	0.13	0.01	0.05	0.005
Acropora gemmifera	1	4.9	-	-	0.05	0.13	0.01	0.02	0.002
Montastrea curta	1	5.5	-	-	0.05	0.13	0.01	0.02	0.002
Leptoria phrygia	1	2.7	-	-	0.05	0.13	0.01	0.007	0.0006
COMMUNITY	82	13.3	18.8	-		11.05	1	10.9	1

Table 1h. Fagatele Bay, Transect 2, 12 m depth

Fagatele - Transect 2 12 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	**n**	**Y**	**s**	**w**	**frequency**	**density per m^2**	**relative % density**	**% cover**	**relative % cover**
Montipora venosa	33	4.1	1.6	1.0-8.1	0.62	5.79	0.39	0.02	0.002
Montipora grisea	11	20.2	10.8	8-49	0.38	1.93	0.13	0.47	0.06
Porites (Synaraea) rus	10	12.1	1.8	2.4-30.8	0.43	1.75	0.12	0.17	0.02
Pocillopora eydouxi	4	25.9	4.6	20.8-27.4	0.19	0.70	0.05	0.78	0.10
Montipora monasteriata	3	20.2	3.8	16-23.5	0.14	0.53	0.04	0.47	0.06
Montipora verrilli	3	8.1	7.6	3.5-16.9	0.10	0.53	0.04	0.08	0.009
Galaxea faxicularis	3	6.6	0.4	6.2-7.1	0.05	0.53	0.04	0.05	0.006
Porites sp.2	3	5.5	0.6	4.9-6.0	0.10	0.53	0.04	0.03	0.004
Acropora cerealis	2	27.2	5.3	23.5-30.9	0.10	0.35	0.02	0.86	0.11
Pavona sp.3	2	4.4	2.7	2.4-6.3	0.10	0.35	0.02	0.02	0.002
Pavona varians	1	65	-	-	0.045	0.18	0.01	4.89	0.60
Favia pallida	2	9.4	10.0	2.3-16.5	0.10	0.35	0.02	0.10	0.01
Leptoria phrygia	1	7.5	-	-	0.05	0.18	0.01	0.06	0.007
Favites russelli	1	6	-	-	0.05	0.18	0.01	0.04	0.005
Acropora azure	1	5.9	-	-	0.05	0.18	0.01	0.04	0.005
Acropora hyacinthus	1	5	-	-	0.05	0.18	0.01	0.03	0.004
Montipora ehrenbergii	1	4.9	-	-	0.05	0.18	0.01	0.03	0.003

Porites annae	1	3	-	-	0.05	0.18	0.01	0.01	0.001
Psammocora samoensis	1	1.7	-	-	0.05	0.18	0.01	0.003	0.0004
COMMUNITY	84	10.5	11.1	-		14.7	1	8.16	1

Table 1i. Fagatele Bay, Transect 3, 1 m depth

Fagatele - Transect 3 1 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	**n**	**Y**	**S**	**w**	**Frequency**	**density per m^2**	**relative % density**	**% cover**	**relative % cover**
Pavona divaricata	37	20.5	17.6	2.0/68.6	0.57	3.44	30.83	19.45	51.74
Porites (S.) rus	14	23.6	21.4	3.0/78.4	0.33	1.30	11.67	10.07	26.79
Porites (P.) cylindrica	6	17.9	13.8	6.3/43.9	0.20	0.56	5.00	2.09	5.56
Porites (P.) annae	4	21.1	18.3	4.0/45.9	0.13	0.37	3.33	2.04	5.43
Porites (P.) lutea	5	18.0	11.8	8.9/37.9	0.13	0.47	4.17	1.59	4.23
Acropora (I.) crateriformis	11	11.5	5.0	4.9/20.8	0.20	1.02	9.17	1.22	3.25
Porites (P.) sp.2	28	4.1	1.9	1.4/8.5	0.40	2.61	23.33	0.42	1.12
Acropora (A.) robusta	1	22.4	-	-	0.03	0.09	0.83	0.37	0.98
Psammmocora contigua	2	10.3	10.3	3.0/17.5	0.07	0.19	1.67	0.23	0.62
Stylocora contigua	6	3.0	0.7	2.4/4.0	0.07	0.56	5.00	0.04	0.11
Leptoria phrygia	1	6.6	-	-	0.03	0.09	0.83	0.03	0.08
Leptastrea purpurea	2	2.2	2.5	2.4/4.0	0.07	0.19	1.67	0.02	0.05
Cyphastrea sp. 1	1	3.2	-	-	0.03	0.09	0.83	0.01	0.03
Fungia (L.) scutaria	2	2.5	0.7	2.0/3.0	0.07	0.19	1.67	0.01	0.03
COMMUNITY	120	14.1	15.2	1.4/78.4		11.17		37.59	

Table 1j. Fagatele Bay, Transect3, 3 m depth

Fagatele - Transect 3 3 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Acropora (A.) robusta	1	79.5	-	-	0.07	0.21	1.67	10.43	28.23
Platygyra daedalea	1	61.4	-	-	0.07	0.21	1.67	6.23	16.86
Acropora (A.) gemmifera	2	36.0	13.5	26.4/45.5	0.13	0.42	3.33	4.45	12.29
Acropora (A.) irregularis	1	52.2	-	-	0.07	0.21	1.67	4.50	12.18
Acropora (I.) craterformis	11	11.9	5. 8	3.0/24.0	0.04	2.30	18.33	3.09	8.36
Acropora (A.) hyacinthus	1	36.8	-	-	0.07	0.21	1.67	2.23	6.04
Pavona venosa	3	19.8	8.6	10.6/27.7	0.20	0.63	5.00	2.19	5.93
Porites (P.) sp.2	26	6.3	3.0	1.4/16.4	0.93	5.45	43.33	2.05	5.55
Acropora (A.) nobilis	1	24.9	-	-	0.07	0.21	1.67	1.02	2.76
Psammocora haimeana	2	9.4	4.3	6.3/12.4	0.07	0.42	3.33	0.32	0.87
Acropora (I.) palifera	2	8.4	1.5	7.3/9.4	0.13	0.42	3.33	0.32	0.62
Stylocoeniella armata	5	2.9	0.4	2.4/3.5	0.20	1.05	8.33	0.07	0.19
Acropora (A.) ocellata	1	3.5	-	-	0.07	0.21	1.67	0.02	0.05
Fungia (L.) scutaria	1	2.4	-	-	0.07	0.21	1.67	0.01	0.03
Galaxea fascicularis	1	3.0	-	-	0.07	0.21	1.67	0.01	0.03

Leptastrea purpurprea	1	3.0	-	-	0.07	0.021	1.67	0.01	0.03
COMMUNITY	60	12.0	14.9	1.4/79.5		12.58		36.95	

Table 1k. Fagatele Bay, Transect 3, 5 m depth

Fagatele - Transect 3 5 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Porites (S.) rus	6	15.8	21.3	5.0/59.0	0.20	1.43	10.00	7.05	33.64
Acropora (I.) crateriformis	7	14.2	5.6	7.0/20.9	0.27	1.67	11.67	2.97	14.17
Hydnopora exesa	1	34.0	-	-	0.07	0.24	1.67	2.16	10.31
Pocillopora eydouxi	1	33.7	-	-	0.07	0.24	1.67	2.12	10.11
Porites (P.) sp. 2	27	5.5	3.0	2.4/13.0	0.73	6.42	45.00	1.99	9.49
Porites (S.) convexa	6	9.8	6.8	3.0/22.2	0.13	1.43	10.00	1.51	7.20
Acropora (A.) samoensis	1	23.0	-	-	0.07	0.24	1.67	0.99	4.72
Leptoria phrygia	1	20.5	-	-	0.07	0.24	1.67	0.79	3.72
Montipora verrilli	1	16.5	-	-	0.07	0.24	1.67	0.51	2.43
Acropora (A.) digitifera	1	15.0	-	-	0.07	0.24	1.67	0.42	2.00
Montastrea curta	1	8.8	-	-	0.07	0.24	1.67	0.14	0.67
Porites (P.) cylindrica	2	5.5	0.7	5.0/6.0	0.07	0.48	3.33	0.11	0.52
Goniastrea pectinata	1	6.5	-	-	0.07	0.24	1.67	0.08	0.38
Acropora (A.) hyacinthus	1	4.5	-	-	0.07	0.24	1.67	0.04	0.19
Porites (P.) superfusa	1	4.9	-	-	0.07	0.24	1.67	0.04	0.19

Alveopora sp. 1	1	3.9	-	-	0.07	0.24	1.67	0.03	0.14
Fungia (L.) scutaria	1	2.4	-	-	0.07	0.24	1.67	0.01	0.05
COMMUNITY	60	9.7	9.7	2.4/59.0		14.31		20.96	

Table 1l. Fagatele Bay, Transect 3, 9 m depth

Fagatele - Transect 3 9 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Porites sp.2	36	4.0	1.3	2.0-7.7	0.73	3.76	0.44	0.01	0.003
Pocillopora eydouxi	6	20.2	17.5	5.3-46.5	0.24	0.63	0.07	0.27	0.08
Pavona sp.3	6	14.7	7.2	3.9-24.7	0.24	0.63	0.07	0.15	0.04
Echinopora hirsutissima	4	17.0	20.1	3.2-46.5	0.15	0.42	0.05	0.20	0.06
Montipora verrilli	3	4.2	0.1	4.1-14	0.15	0.31	0.04	0.01	0.003
Pocillopora verrucosa	2	17.4	11.3	9.4-25.4	0.10	0.21	0.02	0.20	0.06
Favia stelligera	2	12.4	9.2	5.9-18.9	0.05	0.21	0.02	0.10	0.03
Montipora ehrenbergii	2	12.0	2.1	10.5-13.4	0.10	0.21	0.02	0.10	0.03
Hydnophora exesa	2	11.3	9.4	4.7-18	0.10	0.21	0.02	0.09	0.02
Montipora culiculata	2	9.0	3.6	6.5-11.5	0.10	0.21	0.02	0.05	0.02
Acropora hyacinthus	2	8.2	2.5	6.5-10	0.10	0.21	0.02	0.05	0.01
Porites (Synaraea) rus	2	4.3	0.9	3.7-4.9	0.10	0.21	0.02	0.01	0.004
Fungia scutaria	2	1.8	1.1	1-2.5	0.10	0.21	0.02	0.002	0.0006
Pavona duerdeni	1	41.0	-	-	0.05	0.10	0.01	1.13	0.32
Montipora grisea	1	23.9	-	-	0.05	0.10	0.01	0.38	0.11
Favites flexuosa	1	23.2	-	-	0.05	0.10	0.01	0.36	0.10
Hydnophora rigida	1	16.0	-	-	0.05	0.10	0.01	0.17	0.05
Favites russelli	1	10.4	-	-	0.05	0.10	0.01	0.07	0.02

Porites murrayensis	1	8.8	-	-	0.05	0.10	0.01	0.05	0.01
Galaxea fascicularis	1	5.9	-	-	0.05	0.10	0.01	0.02	0.007
Acropora yongei	1	7.3	-	-	0.05	0.10	0.01	0.04	0.01
Porites annae	1	4.5	-	-	0.05	0.10	0.01	0.01	0.004
Leptoria phrygia	1	3.5	-	-	0.05	0.10	0.01	0.01	0.002
Favites sp.	1	1.4	-	-	0.05	0.10	0.01	0.001	0.0004
COMMUNITY	82	8.9	9.7	-		8.56	1	3.49	1

Table 1m. Fagatele Bay, Transect 3, 12 m depth

Fagatele - Transect 3 12 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Porites sp.2	42	4.0	1.7	1.4-9.2	0.78	7.91	0.55	0.02	0.01
Galaxea fascicularis	8	7.3	1.9	3.9-9.4	0.26	1.51	0.10	0.06	0.02
Porites (Synaraea) rus	7	11.5	9.8	4.6-25.7	0.21	1.32	0.09	0.15	0.06
Montipora grisea	4	10.4	5.1	5.9-17.3	0.16	0.75	0.05	0.12	0.05
Stylocoeniella armata	3	2.1	0.6	1.7-2.8	0.10	0.57	0.04	0.01	0.002
Pavona sp.3	2	3.5	2.1	2-5	0.10	0.38	0.03	0.01	0.006
Pavona (collines)	2	2.7	1.03	2-3.5	0.10	0.38	0.03	0.01	0.003
Goniastrea favulus	1	33.4	-	-	0.05	0.19	0.01	1.27	0.51
Fungia fungites	1	16	-	-	0.05	0.19	0.01	0.29	0.12
Pocillopora meandrina	1	13.3	-	-	0.05	0.19	0.01	0.20	0.08
Montipora verrilli	1	12	-	-	0.05	0.19	0.01	0.16	0.07
Pocillopora verrucosa	1	10.5	-	-	0.05	0.19	0.01	0.13	0.05
Psammocora samoensis	1	4.6	-	-	0.05	0.19	0.01	0.02	0.01
Favites abdita	1	3.9	-	-	0.05	0.19	0.01	0.02	0.01
Hydnophora exesa	1	3.7	-	-	0.05	0.19	0.01	0.02	0.01
Porites sp.	1	3.2	-	-	0.05	0.19	0.01	0.01	0.005
COMMUNITY	77	6.1	5.3	-		14.5	1	2.5	1

Table 1n. Fagatele Bay, Transect 4, 1 m depth

Fagatele - Transect 4 1 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Porites (P.) cylindrica	16	14.6	15.0	2.0/48.3	0.36	1.97	18.18	6.53	57.13
Pavona divaricata	37	6.1	5.1	1.4/22.6	0.73	4.55	42.05	2.26	19.77
Goniastrea retiformis	1	33.3	-	-	0.05	0.12	1.14	1.08	9.45
Porites (P.) annae	12	5.4	4.4	2.0/18.3	0.32	1.44	13.64	0.52	4.55
Porites (S.) rus	4	7.7	6.8	3.0/17.7	0.14	0.49	4.55	0.37	3.24
Porites (P.) lutea	5	5.4	3.2	2.0/10.4	0.14	0.62	5.68	0.18	1.57
Psammocora nierstraszi	1	12.5	-	-	0.05	0.12	1.14	0.15	1.31
Porites (S.) convexa	2	7.5	1.3	6.5/8.4	0.05	0.25	2.27	0.10	0.87
Acropora (A.) robusta	1	9.8	-	-	0.05	0.12	1.14	0.09	0.79
Galaxea fascicularis	3	4.9	1.0	3.9/5.9	0.05	0.37	3.41	0.07	0.61
Leptoria phrygia	1	5.3	-	-	0.05	0.12	1.14	0.03	0.26
Pavona venosa	1	4.6	-	-	0.05	0.12	1.14	0.02	0.17
Stylocoeniella armata	3	2.3	1.2	1.0/30	0.14	0.37	3.41	0.02	0.17
Porites (P.) sp. 2	1	3.4	-	-	0.05	0.12	1.14	0.01	0.09
COMMUNITY	88	7.8	8.6	1.4/48.3		10.78		11.43	

Table 1o. Fagatele Bay, Transect 4, 3 m depth

Fagatele - Transect 4 3 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	Density per m^2	relative % density	% cover	relative % cover
Goniastrea retiformis	4	24.4	35.8	6.0/78.0	0.13	0.22	6.67	2.72	48.48
Porites (S.) rus	5	22.5	12.0	12.2/39.9	0.13	0.29	8.33	1.36	24.24
Montipora ehrenbergii	2	17.6	1.3	16.7/18.5	0.07	0.11	3.33	0.27	4.81
Acropora (A.) gemmifera	3	13.3	1.3	11.8/14.0	0.20	0.17	5.00	0.23	4.10
Montipora verrilli	2	13.7	5.4	9.9/17.5	0.13	0.11	3.33	0.18	3.21
Porites (P.) sp. 2	14	4.5	2.1	3.0/9.0	0.60	0.78	23.33	0.15	2.67
Acropora (A.) digitifera	1	16.5	-	-	0.07	0.06	1.67	0.12	2.14
Acropora (A.) crateriformis	3	8.4	1.4	7.0/9.8	0.20	0.17	5.00	0.09	1.60
Acropora (A.) palifera	3	8.1	2.5	6.0/10.8	0.20	0.17	5.00	0.09	1.60
Galaxea fascicularis	4	6.5	2.4	3.4/9.0	0.27	0.22	6.67	0.08	1.43
Acropora (A.) nasuta	2	8.3	3.3	5.9/10.6	0.13	0.11	3.33	0.06	1.07
Pocillopora verrucosa	2	7.3	6.1	3.0/11.6	0.13	0.11	3.33	0.06	1.07
Acropora (A.) hyacinthus	2	7.7	1.1	6.9/8.5	0.13	0.11	3.33	0.05	0.89
Montipora grisea	1	9.4	-	-	0.07	0.06	1.67	0.04	0.71
Aleopora sp. 1	2	5.5	0.8	4.9/6.0	0.13	0.11	3.33	0.03	0.53

Montipora venosa	1	8.5	-	-	0.07	0.06	1.67	0.03	0.53
Psammocora haimeana	1	6.9	-	-	0.07	0.06	1.67	0.02	0.36
Stylocoeniella armata	7	2.1	-	1.0/3.5	0.47	0.39	11.67	0.02	0.36
Porites (P.) lobata	1	4.6	-	-	0.07	0.66	1.67	0.01	0.18
COMMUNITY	60	9.5	11.2	1.0/78.0		3.37		5.61	

Table 1p. Fagatele Bay, Transect 4, 5 m depth

Fagatele - Transect 4 5 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Goniastrea retiformis	1	41.9	-	-	0.07	0.10	1.67	1.42	19.14
Platygyra daedalea	2	26.3	4.6	23.0/29.5	0.07	0.21	3.33	1.13	15.23
Acropora (A.) c.f. convexa	1	30.2	-	-	0.07	0.10	1.67	0.74	9.97
Fungia (F.) fungites	2	19.5	2.2	17.9/21.0	0.07	0.21	3.3	0.61	8.22
Porites (S.) rus	3	15.2	4.8	7.9/19.2	0.13	0.31	5.00	0.60	8.09
Acropora (I.) crateriformis	4	12.2	6.6	7.3/21.5	0.20	0.41	6.67	0.58	7.82
Porites (P.) sp. 2	22	5.2	2.2	2.4/10.4	0.93	2.26	36.67	0.56	7.55
Montipora berryi	2	14.9	0.8	14.3/15.4	0.07	0.21	3.33	0.36	4.85
Acropora (A.) gemmifera	1	20.5	-	-	0.07	0.10	1.67	0.34	4.58
Acropora (A.) hyacinthus	3	8.3	4.0	4.0/12.0	0.20	0.31	5.00	0.19	2.56
Pavona varians	1	14.9	-	-	0.07	0.10	1.67	0.18	2.43
Montipora elschneri	1	13.2	-	-	0.07	0.10	1.67	0.14	1.89
Acropora (I.) palifera	3	8.1	2.1	6.5/10.5	0.20	0.31	5.00	0.13	1.75
Goniopora somaliensis	1	10.5	-	-	0.07	0.10	1.67	0.09	1.21
Lobophyllia hemprichii	1	10.2	-	-	0.07	0.10	1.67	0.08	1.08

Caulastrea furreata	1	9.5	-	-	0.07	0.10	1.67	0.07	0.94
Acropora (A.) loripes	2	5.5	0.7	5.0/6.0	0.13	0.21	3.33	0.05	0.67
Montipora verrilli	1	7.0	-	-	0.07	0.10	1.67	0.04	0.54
Psammocora contigua	1	7.0	-	-	0.07	0.10	1.67	0.04	0.54
Stylocoeniella aramta	3	3.0	0.6	2.4/3.5	0.20	0.31	5.00	0.02	0.27
Psammocora nierstraszi	1	5.0	-	-	0.07	0.10	1.67	0.02	0.27
Alveopora sp. 1	1	4.0	-	-	0.07	0.10	1.67	0.01	0.13
Fungia (L.) scutaria	1	3.0	-	-	0.07	0.10	1.67	0.01	0.13
Psammocora haimeana	1	4.0	-	-	0.07	0.10	1.67	0.01	0.13
COMMUNITY	60	9.7	7.9	2.4/41.9		6.15		7.42	

Table 1q. Fagatele Bay, Transect 4, 9 m depth

Fagatele - Transect 4 9 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Acropora paxilligera	2	63.6	60.4	20.9- 106	.08	1.91	1.90	0.61	32.3
Montipora grisea	11	18.8	7.95	7.1- 32.5	.35	10.52	9.53	0.31	16.4
Porites (Synaraea) rus	11	18.1	13.5	5.5- 49.5	.27	10.53	10.48	0.27	14.3
Acropora pagoensis	1	51.0	-	-	.01	0.96	0.95	0.19	10.0
Porites sp. 2	41	6.26	4.12	1.4- 21.8	.77	39.25	39.05	0.12	6.3
Favia stelligera	1	30.3	-	-	.04	0.96	0.95	0.07	3.7
Goniastrea edwardsi	1	27.5	-	-	.04	0.96	0.95	0.06	3.2
Acropora gemmifera	2	19.8	8.06	14.1- 25.5	.08	1.91	1.90	0.06	3.2
Montipora verrilli	5	12.6	9.35	3.9- 28.5	.15	4.78	4.76	0.06	3.2
Pavona varians	5	11.5	7.06	3.5- 19.0	.12	4.78	4.76	0.05	2.6
Acropora samoensis	1	15.9	-	-	.04	0.96	0.95	0.02	1.1
Porites lichen	4	5.45	3.52	2.0- 10.0	.15	3.83	3.81	0.009	0.5
Favites abdita	1	9.80			.04	0.96	0.95	0.007	0.4
Montipora elschneri	1	9.80			.04	0.96	0.95	0.007	0.4
Galaxea fascicularis	2	6.65	3.04	4.5- 8.8	.08	1.91	1.90	0.007	0.4

Porites lutea	4	4.92	3.33	2.8- 9.9	.15	3.83	3.81	0.007	0.4
Acropora digitifera	1	9.0	-	-	.04	0.96	0.95	0.006	0.3
Pavona sp. 3	1	7.5	-	-	.04	0.96	0.95	0.004	0.2
Psammocora nierstraszi	1	7.3	-	-	.04	0.96	0.95	0.004	0.2
Pavona (colline)	1	7.3	-	-	.04	0.96	0.95	0.004	0.2
Echinopora hirsutissima	1	6.9	-	-	.04	0.96	0.95	0.004	0.2
Pavona venosa	1	6.5	-	-	.04	0.96	0.95	0.003	0.2
Hydnophora exesa	1	5.3	-	-	.04	0.96	0.95	0.002	0.1
Fungia repanda	1	5.0	-	-	.04	0.96	0.95	0.002	0.1
Montipora floweri	1	4.9	-	-	.04	0.96	0.95	0.002	0.1
Gardineroseris planulata	1	4.2	-	-	.04	0.96	0.95	0.001	0.1
Favia pallida	1	3.2	-	-	.04	0.96	0.95	0.001	0.1
Pocillopora meandrina	1	2.7	-	-	.04	0.96	0.95	0.001	0.1
COMMUNITY	105	11.4	13.2	1.4/106		100.5		1.89	

Table 1r. Fagatele Bay, Transect 4, 12 m depth

Fagatele - Transect 4 12 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Platygyra daedalea	1	56.5	-	-	.06	10.6	.015	2.66	28.7
Montipora grisea	10	14.3	6.30	6.9- 26.0	.47	104.0	.147	1.67	18.0
Porites (S.) rus	7	15.8	18.4	4.0- 55.3	.41	72.9	.103	1.44	15.6
Pavona (collines)	4	17.2	17.1	7.7- 42.8	.24	41.8	.059	0.97	10.5
Porites sp. 2	25	5.42	2.45	1.4- 10.8	.82	260.5	.368	0.60	6.5
Pocillopora verrucosa	2	16.7	13.9	6.9- 26.5	.12	20.5	.029	0.45	4.9
Montipora verrilli	4	9.65	4.69	5.9- 16.5	.24	41.8	.059	0.31	3.3
Leptastrea purpurea	1	17.7	-	-	.06	10.6	.015	0.26	2.8
Pavona varians	1	17.0	-	-	.06	10.6	.015	0.24	2.6
Acropora palifera	1	16.1	-	-	.06	10.6	.015	0.22	2.4
Fungia repanda	1	13.0	-	-	.06	10.6	.015	0.14	1.5
Pavona sp. 3	1	10.2	-	-	.06	10.6	.015	0.09	1.0
Echinopora hirsutissima	2	7.20	.424	6.9- 7.5	.12	20.5	.029	0.08	0.9
Montipora monasteriata	3	5.00	2.88	2.4- 8.1	.18	31.1	.044	0.06	0.6
Montipora venosa	1	6.90	-	-	.06	10.6	.015	0.04	0.4

Acropora gemmifera	2	2.95	1.34	2.0- 3.9	.12	20.5	.029	0.01	0.1
Montipora granulosa	1	3.50	-	-	.06	.06	.015	0.01	0.1
Psammocora nierstraszi	1	2.80	-	-	.06	.06	.015	0.01	0.1
COMMUNITY	68	10.4	10.6			709.0		9.26	

Table 1s. Fagatele Bay, Transect 5, 3 m depth

Fagatele - Transect 5 3 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	Frequency	density per m^2	relative % density	% cover	relative % cover
Millepora platyphylla	16	16.0	10.7	3.9/39.7	0.40	1.22	26.67	3.50	48.08
Acropora (A.) gemmifera	2	29.9	2.8	27.9/31.8	0.07	0.15	3.33	1.07	14.70
Acropora (A.) ocellata	10	11.1	4.4	6.0/21.0	0.33	0.76	16.67	0.85	11.68
Favites complanata	3	13.1	8.0	3.9/17.9	0.07	0.23	5.00	0.38	5.22
Montipora ehrenbergii	1	22.0	-	-	0.07	0.08	1.67	0.29	3.98
Millepora tuberosa	1	19.4	-	-	0.07	0.08	1.67	0.23	3.16
Goniastrea retiformis	3	10.6	2.5	8.5/13.3	0.20	0.23	5.00	0.19	2.61
Pavona sp. 3	1	14.5	-	-	0.07	0.08	1.67	0.13	1.79
Pocillopora meandrina	5	6.3	3.5	3.0/11.0	0.20	0.38	8.33	0.13	1.79
Montipora elschneri	2	8.3	7.4	3.0/13.5	0.07	0.15	3.33	0.11	1.51
Porites (P.) sp. 2	1	1.5	-	-	0.07	0.08	1.67	0.08	1.10
Lobophyllia hemprichii	1	10.5	-	-	0.07	0.08	1.67	0.07	0.96
Galaxea fascicularis	2	6.2	3.7	3.5/8.8	0.13	0.15	33.3	0.05	0.69
Leptastrea transversa	4	4.6	1.1	3.0/5.7	0.20	0.31	6.67	0.05	0.69
Pocillopora eydouxi	1	8.8	-	-	0.07	0.08	1.67	0.05	0.69

Pavona duerdeni	1	7.5	-	-	0.07	0.08	1.67	0.03	0.41
Montastrea curta	1	5.7	-	-	0.07	0.08	1.67	0.02	0.27
Montipora verrilli	4	2.6	1.6	1.0/4.0	0.27	0.31	6.67	0.02	0.27
Pocillopora elegans	1	7.5	-	-	0.07	0.08	1.67	0.03	0.41
COMMUNITY	60	11.6	8.5	1.0/39.7		4.61		7.28	

Table 1t. Fagatele Bay, Transect 5, 5 m depth

Fagatele - Transect 5 5 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Leptastrea transversa	5	20.5	19.0	4.9/47.3	0.13	0.42	8.33	2.32	29.12
Montipora verrilli	13	9.6	7.2	2.0/23.0	0.60	1.09	21.67	1.19	14.94
Goniastrea retiformis	6	12.6	11.9	4.0/33.9	0.20	0.50	10.00	1.09	13.68
Millepora platyphylla	8	9.9	6.6	3.9/20.0	0.27	0.67	13.33	0.72	9.04
Acropora (A.) robusta	1	28.5	-	-	0.07	0.08	1.67	0.70	8.79
Acropora (A.) gemmifera	1	28.0	-	-	0.07	0.08	1.67	0.51	6.40
Acropora (A.) crateriformis	3	13.2	2.3	11.0/15.2	0.13	0.25	5.00	0.35	4.39
Acropora (A.) digitifera	2	14.0	1.4	13.0/15.0	0.13	0.17	3.33	0.25	3.26
Leptoria phrygia	3	11.2	2.1	8.8/12.5	0.20	0.25	5.00	0.25	3.14
Pocillopora eydouxi	3	10.7	4.0	6.5/14.5	0.20	0.25	5.00	0.24	3.01
Galaxea fascicularis	5	6.6	2.4	3.5/10.2	0.20	0.42	8.33	0.16	2.01
Pocillopora meandrina	4	4.7	2.5	2.0/8.0	0.20	0.33	6.67	0.08	1.00
Acropora (A.) nasuta	1	8.0	-	-	0.07	0.08	1.67	0.04	0.50
Porites sp. 2	2	5.7	0.3	5.5/5.9	0.07	0.17	3.33	0.04	0.50
Cyphastrea serailia	1	3.9	-	-	0.07	0.08	1.67	0.01	0.13

Montipora elschneri	1	2.4	-	-	0.07	0.08	1.67	0.004	0.05
Stylocoeniella armata	1	2.0	-	-	0.07	0.08	1.67	0.003	0.04
COMMUNITY	60	10.8	9.1	2.0/47.3		5.00		7.967	

Table 1u. Fagatele Bay, Transect 5, 9 m depth

Fagatele - Transect 5 9 m - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	Freq.	density per m^2	Relative % density	% cover	Relative % cover
Montipora grisea	19	10.5	3.5	6-16	0.63	1.91	0.27	0.06	0.08
Montipora ehrenbergii	14	12.3	3.6	5-17.3	0.46	1.40	0.2	0.08	0.11
Montipora verrilli	11	8.5	2.4	4-13.4	0.46	1.10	0.16	0.04	0.06
Pocillopora meandrina	6	4.4	1.1	2.4-5.9	0.34	0.60	0.09	0.01	0.01
Porites sp.2	5	3.8	1.4	2.4-5.3	0.23	0.50	0.07	0.01	0.01
Montipora venosa	3	10.6	5.3	4.5-14	0.11	0.30	0.04	0.06	0.09
Acropora cerealis	2	10.6	3.7	8-13.3	0.11	0.20	0.03	0.06	0.09
Montipora monasteriata	2	8.7	1.1	7.9-9.5	0.11	0.20	0.03	0.04	0.06
Porites (Synaraea) rus	2	5.1	0.3	4.9-5.3	0.11	0.20	0.03	0.01	0.02
Montipora elschneri	1	20.5	-	-	0.06	0.10	0.01	0.23	0.32
Galaxea fascicularis	1	8.4	-	-	0.06	0.10	0.01	0.04	0.05
Acropora hyacinthus	1	7.7	-	-	0.06	0.10	0.01	0.03	0.05
Montipora granulosa	1	5.7	-	-	0.06	0.10	0.01	0.02	0.02
Acropora crateriformis	1	3.5	-	-	0.06	0.10	0.01	0.01	0.01
Pocillopora damicornis	1	2.4	-	-	0.06	0.10	0.01	0.003	0.005
COMMUNITY	70	9.1	4.3	-		7.02	1	0.71	1

Table 1v. Fagatele Bay, Transect 5, 12 m depth

Fagatele - Transect 5 12 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	**n**	**Y**	**s**	**w**	**frequency**	**density per m^2**	**relative % density**	**% cover**	**relative % cover**
Montipora grisea	28	8.9	4.1	2-21	0.93	2.14	0.38	0.03	0.09
Montipora ehrenbergii	13	14.3	2.5	11.4-13.9	0.44	1.00	0.18	0.09	0.22
Montipora verrilli	13	10.8	3.6	2.4-17.9	0.66	1.00	0.18	0.05	0.13
Acropora hyacinthus	3	7.8	2.5	5.5-10.5	0.11	0.23	0.04	0.03	0.07
Pocillopora meandrina	3	3.6	1.3	2.4-5	0.16	0.23	0.04	0.01	0.01
Porites (Synaraea) rus	2	9.3	1.7	8.1-10.5	0.11	0.15	0.03	0.04	0.09
Acropora yongei	2	9.2	3.2	6.9-11.5	0.11	0.15	0.03	0.04	0.09
Acropora cerealis	2	8.0	5.0	4.5-11.5	0.11	0.15	0.03	0.03	0.07
Porites sp.2	2	4.8	0.7	4.2-5.3	0.11	0.15	0.03	0.01	0.02
Acropora crateriformis	1	9.2	-	-	0.06	0.08	0.01	0.04	0.09
Pocillopora verrucosa	1	6.9	-	-	0.06	0.08	0.01	0.02	0.05
Pavona sp.3	1	5.5	-	-	0.06	0.08	0.01	0.01	0.03
Montipora monasteriata	1	3.9	-	-	0.06	0.08	0.01	0.01	0.02
Montipora culiculata	1	2.7	-	-	0.06	0.08	0.01	0.003	0.01
COMMUNITY	73	9.6	4.6			5.59	1	0.40	1

Table 1w. Fagatele Bay, Transect, Fagatele Bay 6 m depth

Fagatele - Transect 2 3 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	**n**	**Y**	**s**	**w**	**frequency**	**density per m^2**	**relative % density**	**% cover**	**relative % cover**
Pocillopora danae	26	6.9	5.5	2.0/23.9	0.87	2.87	43.33	1.17	29.53
Pocillopora meandrina	13	8.9	7.5	3.0/27.5	0.67	1.43	21.67	1.60	27.63
Pocillopora verrucosa	8	9.7	8.1	3.0/27.5	0.27	0.88	13.33	1.05	18.13
Millepora platyphylla	6	10.5	6.7	6.0/23.7	0.20	0.66	10.00	0.76	13.13
Pocillopora elegans	1	22.9	-	-	0.07	0.11	1.67	0.46	7.94
Pocillopora eydouxi	2	8.7	1.1	7.9/9.5	0.13	0.22	3.33	0.13	2.25
Acropora (A.) ocellata	1	5.9	-	-	0.07	0.11	1.67	0.03	0.52
Acropora (A.) crateriformis	1	4.5	-	-	0.07	0.11	1.67	0.02	0.35
Pocillopora setchelli	1	4.5	-	-	0.07	0.11	1.67	0.02	0.35
Pavona varians	1	3.9	-	-	0.07	0.11	1.67	0.01	0.17
COMMUNITY	60	8.4	6.4	2.0/27.5		6.61		5.79	

Table 1x. Fagatele Bay, Transect 6, 9 m depth

Fagatele - Transect 6 9 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Montipora verrilli	15	14.8	11.0	3.5-30.6	0.5	1.09	0.19	0.10	0.04
Pocillopora meandrina	10	9.2	7.4	1.0-21.9	0.4	0.73	0.13	0.04	0.02
Pocillopora eydouxi	14	18.4	4.4	10.5-29.7	0.6	1.02	0.18	0.15	0.07
Pocillopora verrucosa	6	11.0	6.3	2.4-18.3	0.2	0.44	0.08	0.05	0.02
Galaxea fascicularis	3	7.3	2.3	5.9-9.9	0.1	0.22	0.04	0.02	0.01
Montipora grisea	5	14.6	8.4	2.5-25.5	0.3	0.36	0.06	0.10	0.04
Porites (Synaraea) rus	2	7.2	3.2	4.9-9.5	0.1	0.15	0.03	0.02	0.01
Millepora platyphylla	2	16.9	18.5	3.9-30	0.1	0.15	0.03	0.13	0.06
Porites lutea	2	11.0	4.3	7.9-14.0	0.1	0.15	0.03	0.05	0.02
Favia speciosa	2	6.5	3.5	4-8.9	0.1	0.15	0.03	0.02	0.01
Favia matthaii	2	3.7	0.8	3.2-4.2	0.1	0.15	0.03	0.01	0.003
Acropora nasuta	2	4.6	0.2	4.5-4.7	0.1	0.15	0.03	0.01	0.004
Hydnophora exesa	2	30.2	8.1	29-36	0.1	0.15	0.03	0.42	0.18
Astreopora sp.	1	44.0	-	-	0.05	0.07	0.01	0.88	0.37
Leptastrea purpurea	1	17.1	-	-	0.05	0.07	0.01	0.13	0.06
Leptoria phrygia	1	15.5	-	-	0.05	0.07	0.01	0.11	0.05
Favites complanata	1	7.9	-	-	0.05	0.07	0.01	0.03	0.01
Acropora gemmifera	1	7.1	-	-	0.05	0.07	0.01	0.02	0.01

Cyphastrea sp.	1	6.6	-	-	0.05	0.07	0.01	0.02	0.01
Acropora hyacinthus	1	6	-	-	0.05	0.07	0.01	0.02	0.01
Acropora crateriformis	1	5	-	-	0.05	0.07	0.01	0.01	0.005
Montipora caliculata	1	3.9	-	-	0.05	0.07	0.01	0.01	0.003
Favites halicora	1	3.7	-	-	0.05	0.07	0.01	0.01	0.003
Montipora monasteriata	1	3.2	-	-	0.05	0.07	0.01	0.005	0.002
Porites sp.2	1	2	-	-	0.05	0.07	0.01	0.001	0.001
Porites sp.3	1	1.6	-	-	0.05	0.07	0.01	0.001	0.0005
COMMUNITY	80	12.7	9.4			5.82		2.38	

Table 1y. Fagatele Bay, Transect 6, 12 m depth

Fagatele - Transect 6 12 m - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	Freq.	density per sq. meter	relative% density	% cover	Relative % cover
Montipora verrilli	17	12.3	9.3	1.0-40.7	0.61	1.75	0.26	0.08	0.12
Pocillopora meandrina	12	6.6	3.6	2-12	0.42	1.24	0.18	0.02	0.03
Pocillopora verrucosa	5	9.2	5.9	2-16	0.18	0.51	0.08	0.05	0.07
Acropora crateriformis	5	7.7	1.8	6-10	0.30	0.51	0.08	0.03	0.05
Porites lutea	4	15.7	14.4	5.9-36.9	0.24	0.41	0.06	0.13	0.19
Leptastrea purpurea	3	5.1	0.8	4.2-5.6	0.18	0.31	0.05	0.01	0.02
Pavona haimeana	3	4.4	1.4	3.2-6	0.18	0.31	0.05	0.01	0.01
Acropora nasuta	2	9.6	2.6	7.7-11.4	0.12	0.21	0.03	0.05	0.07
Montipora venosa	2	5.4	0.13	5.3-5.5	0.12	0.21	0.03	0.02	0.02
Favites halicora	2	1.6	0.20	1.5-1.7	0.12	0.21	0.03	0.001	0.002
Montipora granulosa	1	12.2	-	-	0.06	0.10	0.02	0.08	0.12
Favites pentagona	1	12.0	-	-	0.06	0.10	0.02	0.08	0.11
Leptoria phrygia	1	8.5	-	-	0.06	0.10	0.02	0.04	0.06
Montipora calculata	1	4.9	-	-	0.06	0.40	0.06	0.01	0.02
Montipora ehrenbergii	1	4.9	-	-	0.06	0.10	0.02	0.01	0.02
Favia favus	1	3.5	-	-	0.06	0.10	0.02	0.01	0.01
Montipora grisea	1	1.4	-	-	0.06	0.10	0.02	0.001	0.002

Pocillopora eydouxi	4	10.6	4.9	-	0.06	0.41	0.06	0.06	0.09
COMMUNITY	66	8.9	7.0			7.09		0.69	

TABLE 2. Coral communities at 10 locations around Tutuila, American Samoa, based on 20 quantitative point-quarter surveys done in July 1995.

2(a)	Inside Masefau Bay	2-3 m depth
2(b)	Inside Masefau Bay	6 m depth
2(c)	Outside Masefau Bay	2-4 m depth
2(d)	Outside Masefau Bay	6 m depth
2(e)	Aoa Bay	1.5-2.5 m depth
2(f)	Aoa Bay	6 m depth
2(g)	Onenoa Bay	1-2.5 m depth
2(h)	Onenoa Bay	6 m depth
2(i)	Fagasa	1.5-3 m depth
2(j)	Fagasa	6 m depth
2(k)	Cape Larsen	2.5-3.5 m depth
2(l)	Cape Larsen	6 m depth
2(m)	Fagafue	1.5-2 m depth
2(n)	Fagafue	6 m depth
2(o)	Massacre Bay	1.5-2 m depth
2(p)	Massacre Bay	6 m depth
2(q)	Rainmaker Hotel	0.5-1.5 m depth
2(r)	Rainmaker Hotel	6 m depth
2(s)	Fatu Rock	2.5-4 m depth
2(t)	Fatu Rock	6 m depth

Table 2a . Size distribution, frequency, density and percent cover of coral at Masefau Bay- Inside, 2-3 m.

Masefau Bay- Inside 2-3 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Porites (S.) rus	9	15.6	5.6	6.0/22.6	0.04	1.10	15.00	2.36	28.84
Montipora berryi	1	28.8	-	-	0.07	0.12	1.67	0.79	9.65
Pavona varians	2	16.5	16.3	5.0/28.0	0.07	0.25	3.33	0.78	9.53
Montipora verrilli	6	10.7	3.2	8.0/16.7	0.33	0.74	10.00	0.71	8.68
Millepora tuberosa	1	25.3	-	-	0.07	0.12	1.67	0.62	7.58
Montipora monasteriata	3	11.6	5.4	7.5/17.7	0.07	0.37	5.00	0.44	5.38
Acropora (A.) gemmifera	2	11.7	8.0	6.0/17.3	0.13	0.25	3.33	0.32	3.91
Porites (P.) lobata	2	10.8	8.1	5.0/16.5	0.13	0.25	3.33	0.29	3.54
Acropora (I.) crateriformis	4	6.9	5.3	3.0/14.7	0.27	0.49	6.67	0.27	3.30
Pocillopora eydouxi	2	11.0	6.4	6.5/15.5	0.13	0.25	3.33	0.27	3.30
Pocillopora elegans	1	16.2	-	-	0.07	0.12	1.67	0.25	3.05
Millepora dichotoma	1	15.2	-	-	0.07	0.12	1.67	0.22	2.69
Pocillopora verrucosa	4	6.3	3.0	3.9/10.0	0.27	0.49	6.67	0.18	2.20
Porites (P.) cylindrica	2	8.4	6.2	4.0/12.8	0.13	0.25	3.33	0.17	2.08
Porites (P.) sp.2	8	3.8	1.5	1.4/6.0	0.27	0.98	13.33	0.13	1.59

Galaxea fascicularis	2	8.0	0.1	7.9/8.0	0.13	0.25	3.33	0.12	1.47
Montastrea curta	2	6.2	1.6	5.0/7.3	0.07	0.25	3.33	0.08	0.98
Pavona duerdeni	2	5.2	0.4	4.9/5.5	0.07	0.25	3.33	0.05	0.61
Porites (P.) annae	1	7.5	-	-	0.07	0.12	1.67	0.05	0.61
Psammocora samoensis	2	5.3	1.1	4.5/5.5	0.13	0.25	3.33	0.05	0.61
Acropora (A.) digitifera	1	4.5	-	-	0.07	0.12	1.67	0.02	0.24
Montipora grisea	1	3.9	-	-	0.07	0.12	1.67	0.01	0.12
Pocillopora (juv. Spec) sp.	1	2.0	-	-	0.07	0.12	1.67	0.004	0.05
COMMUNITY	60	9.9	6.7	1.4/28.8		7.38		8.184	

- Note: This is not the overall community structure of this station. Only the buttress ridges and knobs were sampled (as shown in diagram) as the intervening area was composed of loose shingle-boulder and sand-to cobble-sized sediments which were devoid of corals.

Table 2b . Size distribution, frequency, density and percent cover of coral at Masefau Bay- Inside, 6 m.

Masefau Bay - Inside 6 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Montipora grisea	22	10.9	5.6	2.4-21	0.83	1.60	0.30	0.05	0.03
Montipora turgescens	7	9.7	3.8	6.3-15.3	0.22	0.51	0.10	0.04	0.02
Millepora tuberosa	6	13.4	8.7	3.9-25	0.33	0.44	0.08	0.07	0.04
Montipora ehrenbergii	6	11.0	2.9	6.9-14.4	0.17	0.44	0.08	0.05	0.03
Leptastrea purpurea	6	2.0	0.3	1.9-2.5	0.28	0.44	0.08	0.002	0.001
Montipora verrilli	4	5.5	3.8	3.2-11.2	0.22	0.29	0.05	0.01	0.01
Porites lutea	3	12.6	16.3	2-31.4	0.11	0.22	0.04	0.07	0.04
Porites lichen	3	9.9	6.5	4.6-17.1	0.17	0.22	0.04	0.04	0.02
Psammocora samoensis	3	7.2	2.9	3.9-9.2	0.17	0.22	0.04	0.02	0.01
Porites cylindrica	2	17.3	0.5	17.0-17.7	0.06	0.15	0.03	0.13	0.07
Acropora crateriformis	2	16.8	4.7	13.5-20.2	0.11	0.15	0.03	0.12	0.07
Acropora humilis	2	12.0	1.4	11-13	0.11	0.15	0.03	0.06	0.04
Porites sp.2	2	3.2	1.5	2.1-4.2	0.11	0.15	0.03	0.004	0.002
Goniastrea favulus	1	45.5	-	-	0.06	0.07	0.01	0.86	0.51
Montipora verrucosa	1	18.5	-	-	0.06	0.07	0.01	0.14	0.08
Acropora yongei	1	5.9	-	-	0.06	0.07	0.01	0.01	0.01
Millepora "yellow"	1	5.5	-	-	0.06	0.07	0.01	0.01	0.01

Porites “clean annae”	1	1.4	-	-	0.06	0.07	0.01	0.001	0.0005
COMMUNITY	73	10.3	7.5			5.3		1.69	

Table 2c . Size distribution, frequency, density and percent cover of coral at Masefau Bay- Outside, 6 m.

Masefau Bay- Outside 6 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Goniastrea favulus	32	9.0	2.7	4.5/16.0	1.00	7.14	53.33	4.90	37.84
Montipora verrilli	8	10.6	7.5	3.0/23.1	0.47	1.78	13.33	2.26	17.45
Montipora ehrenbergii	2	20.4	3.7	17.7/23.0	0.13	0.45	3.33	1.48	11.43
Montipora grisea	3	14.4	6.1	7.4/18.6	0.13	0.67	5.00	1.22	9.42
Pocillopora elegans	2	13.8	0.4	13.5/14.0	0.13	0.45	3.33	0.69	5.33
Pocillopora meandrina	1	17.5	-	-	0.07	0.22	1.67	0.54	4.17
Pocillopora eydouxi	2	12.0	3.0	9.8/14.1	0.13	0.45	3.33	0.45	3.94
Montipora monasteriata	2	11.0	2.1	9.5/12.5	0.13	0.45	3.33	0.27	3.47
Montipora elschneri	1	12.5	-	-	0.07	0.22	1.67	0.27	2.08
Pocillopora verrucosa	1	12.5	-	-	0.07	0.22	1.67	0.21	2.08
Goniastrea retiformis	2	6.9	4.7	3.5/10.2	0.07	0.45	3.33	0.09	1.62
Pavona verians	1	7.3	-	-	0.07	0.22	1.67	0.02	0.69
Favia stelligera	1	3.0	-	-	0.07	0.22	1.67	0.02	0.15
Porites (P.) sp.2	1	3.5	-	-	0.07	0.22	1.67	0.02	0.15
Psammocora samoensis	1	3.4	-	-	0.07	0.22	1.67		0.15
COMMUNITY	60	10.0	4.7	3.0/23.1		13.38		12.95	

Table 2d . Size distribution, frequency, density and percent cover of coral at Masefau Bay- Inside, 6 m.

Masefau Bay - Outside 6 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Montipora grisea	16	13.9	5.8	2.8-20.4	0.57	4.31	0.21	0.32	0.05
Montipora ehrenbergii	12	18.4	6.3	7.7-27.1	0.52	3.24	0.16	0.55	0.08
Pocillopora eydouxi	8	9.6	3.7	3.9-16	0.05	2.16	0.10	0.15	0.02
Porites sp.2	7	3.5	2.3	1-7	0.31	1.89	0.09	0.02	0.003
Pocillopora verrucosa	3	13.7	7.7	8.4-22.5	0.16	0.81	0.04	0.31	0.05
Montipora verrilli	3	7.8	8.0	3 - 17	0.16	0.81	0.04	0.10	0.01
Pavona varians	3	5.1	2.7	2-6.9	0.16	0.81	0.04	0.04	0.006
Favites flexuosa	2	18.6	8.0	13-24.2	0.10	0.54	0.03	0.56	0.08
Montipora granulosa	2	18.0	9.9	11-25	0.10	0.54	0.03	0.53	0.08
Pocillopora meandrina	2	12.2	6.0	7.9-16.5	0.10	0.54	0.03	0.24	0.04
Porites (Synaraea) rus	2	9.0	0.04	8.9-9	0.10	0.54	0.03	0.13	0.02
Psammocora samoensis	2	5.1	3.2	2.8-7.3	0.10	0.54	0.03	0.04	0.01
Montipora caliculata	2	4.2	0.3	4-4.5	0.10	0.54	0.03	0.03	0.004
Montastrea curta	2	3.9	-	-	0.10	0.54	0.03	0.02	0.004
Platygyra pini	1	30.4	-	-	0.05	0.27	0.01	1.51	0.23
Favites abdita	1	20.3	-	-	0.05	0.27	0.01	0.67	0.10
Astreopora sp.	1	18.2	-	-	0.05	0.27	0.01	0.54	0.08
Montipora elschneri	1	14.0	-	-	0.05	0.27	0.01	0.32	0.05

Montipora verrucosa	1	12	-	-	0.05	0.27	0.01	0.23	0.04
Montipor venosa	1	9	-	-	0.05	0.27	0.01	0.13	0.02
Montipora monasteriata	1	8.8	-	-	0.05	0.27	0.01	0.13	0.02
Galaxea fascicularis	1	5.7	-	-	0.05	0.27	0.01	0.05	0.01
Leptastrea purpurea	1	3.5	-	-	0.05	0.27	0.01	0.02	0.003
Acropora hyacinthus	1	2.5	-	-	0.05	0.27	0.01	0.01	0.002
Favia pallida	1	2	-	-	0.05	0.27	0.01	0.01	0.001
COMMUNITY	77	11.6	7.4			20.76		6.67	

Table 2e . Size distribution, frequency, density and percent cover of coral at Aoa Bay, 1.5-2.5 m.

Aoa Bay 1.5-2.5 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Montipora verrilli	12	10.3	4.1	3.5/16.0	0.53	1.47	20.00	1.40	26.91
Pavona venosa	10	9.3	3.6	5.7/16.5	0.53	1.23	16.67	0.89	17.11
Montipora grisea	2	16.5	11.3	8.5/24.5	0.13	0.25	3.33	0.64	12.30
Montipora ehrenbergii	4	10.2	5.7	6.3/17.3	0.27	0.49	6.67	0.57	10.96
Montipora sp. 2	1	17.3	-	-	0.07	0.12	1.67	0.29	5.57
Acropora (A.) samoensis	4	8.4	2.1	5.3/10.2	0.27	0.49	6.67	0.28	5.38
Acropora (A.) gemmifera	1	15.1	-	-	0.07	0.12	1.67	0.22	4.23
Porites (P.) lobata	3	7.6	4.9	3.0/12.0	0.13	0.37	5.00	0.20	3.84
Pocillopora verrucosa	1	12.8	-	-	0.07	0.12	1.67	0.16	3.08
Pocillopora eydouxi	2	7.2	-	-	0.13	0.25	3.33	0.10	1.92
Pocillopora ligulata	1	10.4	-	-	0.07	0.12	1.67	0.10	1.92
Porites (P.) sp.2	5	3.7	1.2	2.4/4.9	0.27	0.61	8.33	0.07	1.35
Acropora (I.) carteriformis	2	5.6	2.2	4.0/7.1	0.13	0.25	3.33	0.06	1.15
Acropora (A.) hyacinthus	3	4.5	1.8	3.0/6.5	0.20	0.37	5.00	0.06	1.15
Montipora monasteriata	1	6.3	-	-	0.07	0.12	1.67	0.04	0.77

Acropora (A.) digitifera	1	5.9	-	-	0.07	0.12	1.67	0.03	0.58
Goniastrea retiformis	3	3.3	1.1	2.0/4.0	0.07	0.37	5.00	0.03	0.58
Montastrea annuligera	1	6.0	-	-	0.07	0.12	1.67	0.03	0.58
Acropora (A.) sp. 2	1	5.0	-	-	0.07	0.12	1.67	0.02	0.38
Montastrea curta	1	3.9	-	-	0.07	0.12	1.67	0.01	0.19
Poncillopora (juv.spec)	1	2.0	-	-	0.07	0.12	1.67	0.004	0.08
COMMUNITY	60	8.3	4.7	2.0/24.5		7.35		5.203	

Table 2f . Size distribution, frequency, density and percent cover of coral at Aoa Bay, 6 m.

Aoa Bay 6 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Psammocora samoensis	11	4.7	1.7	1.4-7.5	0.50	2.12	0.14	0.03	0.01
Montipora grisea	8	17.1	8.5	6.9-30.5	0.40	1.54	0.10	0.35	0.10
Montipora verrilli	9	17.2	4.4	4.9-38.1	0.30	1.73	0.11	0.36	0.10
Leptastrea purpurea	8	3.9	2.3	1-6.9	0.30	1.54	0.10	0.02	0.01
Porites sp.2	6	6.3	2.0	2.8-7.7	0.30	1.15	0.08	0.05	0.01
Acropora hyacinthus	5	7.2	1.7	5.3-9.0	0.25	0.96	0.06	0.06	0.02
Montipora ehrenbergii	6	15.0	4.5	10-21.9	0.25	1.15	0.08	0.27	0.08
Pocillopora verrucosa	4	10.8	4.4	4.9-14.4	0.15	0.77	0.05	0.14	0.04
Porites (Synaraea) rus	2	11.9	11.2	4-19.9	0.10	0.38	0.03	0.17	0.05
Montipora caliculata	2	3.7	0.4	3.5-4	0.10	0.38	0.03	0.02	0.005
Montipora granulosa	2	11.0	8.5	5-17	0.10	0.38	0.03	0.15	0.04
Pavona venosa	2	12.7	1.1	12-13.5	0.10	0.38	0.03	0.20	0.06
Montipora sp.3	1	17.9	-	-	0.05	0.19	0.01	0.39	0.11
Acropora samoensis	1	16.5	-	-	0.05	0.19	0.01	0.33	0.10
Acropora valida	1	11.5	-	-	0.05	0.19	0.01	0.16	0.05
Acropora nasuta	1	9.5	-	-	0.05	0.19	0.01	0.11	0.03
Pavona sp.3	1	10.4	-	-	0.05	0.19	0.01	0.13	0.04
Pavona (collines)	1	7.9	-	-	0.05	0.19	0.01	0.08	0.02

Montipora hoffmeisteri	1	8.9	-	-	0.05	0.19	0.01	0.10	0.03
Fungia repanda	1	8	-	-	0.05	0.19	0.01	0.08	0.02
Astreopora sp.	1	7	-	-	0.05	0.19	0.01	0.06	0.02
Pavona varians	1	6.3	-	-	0.05	0.19	0.01	0.05	0.01
Montastrea curta	1	5.5	-	-	0.05	0.19	0.01	0.04	0.01
Goniastrea favulus	1	5.3	-	-	0.05	0.19	0.01	0.03	0.01
Favites abdita	1	6	-	-	0.05	0.19	0.01	0.04	0.01
Montopora sp.4	1	5.3	-	-	0.05	0.19	0.01	0.03	0.01
Goniastrea edwardsi	1	3.2	-	-	0.05	0.19	0.01	0.01	0.004
COMMUNITY	80	9.9	7.0			13.66	1	3.44	1

Table 2g . Size distribution, frequency, density and percent cover of coral at Onenoa Bay, 1. -2.5 m.

Onenoa Bay 1-2.5 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Acropora (A.) hyacinthus	5	12.5	4.2	7.0/17.0	0.33	0.59	8.33	0.80	13.24
Montipora ehrenbergii	5	10.7	5.5	7.0/20.2	0.33	0.59	8.33	0.65	10.76
Pocillopora eydouxi	4	12.5	5.2	4.9/16.0	0.20	0.47	6.67	0.65	10.67
Acropora (A.) robusta	6	9.6	2.6	6.5/13.4	0.40	0.71	10.00	0.55	9.11
Montipora verrilli	8	7.5	2.9	2.0/11.2	0.33	0.95	13.33	0.46	7.62
Montipora grisea	1	21.0	-	-	0.07	0.12	1.67	0.41	6.79
Acropora (A.) gemmifera	5	8.0	1.5	5.9/9.4	0.27	0.59	8.33	0.31	5.13
Montipora monasteriata	1	18.0	-	-	0.07	0.12	1.67	0.30	4.97
Acropora (A.) samoensis	2	9.8	7.4	4.5/15.0	0.13	0.24	3.33	0.23	3.81
Pavona venosa	2	10.7	1.1	9.9.11.5	0.13	0.24	3.33	0.22	3.64
Pocillopora verrucosa	1	14.4	-	-	0.07	0.12	1.67	0.19	3.15
Acropora (A.) surculosa	2	9.5	3.6	6.9/12.0	0.13	0.24	3.33	0.18	2.98
Acropora (I.) crateriformis	3	6.5	2.2	3.9/8.0	0.20	0.36	5.00	0.13	2.15
Acropora (A.) humuis	1	12.0	-	-	0.07	0.12	1.67	0.13	2.15
Hydnopora microconos	1	11.6	-	-	0.07	0.12	1.67	0.13	2.15

Montipora verrucosa	1	11.0	-	-	0.07	0.12	1.67	0.11	1.82
Acropora (A.) sp.2	1	9.9	-	-	0.07	0.12	1.67	0.09	1.49
Montastrea curta	3	5.5	1.8	4.0/7.5	0.2	0.36	5.00	0.09	1.49
Astreopora myriophthalma	1	8.9	-	-	0.07	0.12	1.67	0.07	1.16
Goniastrea retiformis	1	8.5	-	-	0.07	0.12	1.67	0.07	1.16
Pavona sp.	1	8.0	-	-	0.07	0.12	1.67	0.06	0.99
Porites (P.) lobata	1	7.0	-	-	0.07	0.12	1.67	0.06	0.99
Cyphastrea chalcidicum	1	7.5	-	-	0.07	0.12	1.67	0.05	0.83
Favia matthaii	1	7.5	-	-	0.07	0.12	1.67	0.05	0.83
Porites (P.) sp.2	1	6.0	-	-	0.07	0.12	1.67	0.03	0.50
Acropora (A.) verweyi	1	5.0	-	-	0.07	0.12	1.67	0.02	0.33
COMMUNITY	60	9.6	4.0	2.0/21.0		7.14		6.04	

Table 2h . Size distribution, frequency, density and percent cover of coral at Onenoa Bay, 6 m.

Onenoa Bay 6 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Montipora grisea	12	11.8	4.5	6.3-18.4	0.33	2.88	0.14	0.22	0.03
Pocillopora eydouxi	10	9.6	3.4	3.7-15.3	0.28	2.40	0.12	0.15	0.02
Montipora verrilli	10	18.9	8.0	5.1-31.2	0.42	2.40	0.12	0.57	0.09
Porites sp.2	7	8.1	3.1	4-13	0.28	1.68	0.08	0.10	0.02
Montipora ehrenbergii	7	20.4	7.6	11.8-31.9	0.33	1.68	0.08	0.66	0.10
Montipora caliculata	6	9.7	5.9	3-20.2	0.24	1.44	0.07	0.15	0.02
Psammocora samoensis	4	4.4	2.8	2-7.3	0.19	0.96	0.05	0.03	0.005
Montipora turgescens	3	15.5	4.2	12.8-20.3	0.09	0.72	0.04	0.39	0.06
Montipora venosa	3	23.4	7.4	14.8-28	0.09	0.72	0.04	0.87	0.13
Pocillopora verrucosa	3	12.0	6.4	7.5-19.3	0.14	0.72	0.04	0.23	0.04
Acropora samoensis	3	11.4	1.4	9.9-12.8	0.14	0.72	0.04	0.20	0.03
Acropora hyacinthus	3	7.4	2.3	5.7-9.9	0.14	0.72	0.04	0.09	0.01
Montipora verrucosa	2	12.5	2.2	11-14	0.09	0.48	0.02	0.25	0.04
Montipora hoffmeisteri	2	9.6	2.4	7.9-11.3	0.05	0.48	0.02	0.15	0.02
Pavona varians	2	9.3	1.6	8.1-10.4	0.09	0.48	0.02	0.14	0.02
Montipora monasteriata	1	27.9	-	-	0.05	0.24	0.01	1.25	0.19
Montipora elschneri	1	15.5	-	-	0.05	0.24	0.01	0.38	0.06
Galaxea fascicularis	1	11.6	-	-	0.05	0.24	0.01	0.22	0.03

Acropora subglabra	1	11.0	-	-	0.05	0.24	0.01	0.19	0.03
Astrepora sp.	1	6.7	-	-	0.05	0.24	0.01	0.07	0.01
Porites lichen	1	6.5	-	-	0.05	0.24	0.01	0.07	0.01
Porites (Synaraea) rus	1	4	-	-	0.05	0.24	0.01	0.03	0.004
Pavona sp.3	1	7.5	-	-	0.05	0.24	0.01	0.09	0.01
COMMUNITY	85	12.5	7.0			20.4	1	6.51	1

Table 2i . Size distribution, frequency, density and percent cover of coral at Fagasa Bay, 1.5-23 m.

Fagasa Bay 1.5-3 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Montipora verrilli	20	11.9	10.3	2.0/42.0	0.73	5.03	33.3	9.59	38.76
Montipora ehrenbergii	9	15.3	5.9	6.0/22.2	0.40	2.26	15.00	4.70	19.00
Pocillopora eydouxi	3	19.5	8.4	13.5/28.3	0.20	0.75	5.00	2.52	10.19
Montipora grisea	4	16.7	5.4	10.9/23.1	0.27	1.01	6.67	2.36	9.54
Montipora elschneri	5	11.4	5.4	2.4/16.6	0.20	1.26	8.33	1.51	6.10
Pocillopora elegans	1	23.8	-	-	0.07	0.25	1.67	1.12	4.53
Porites (P.) sp.2	7	6.1	2.4	3.5/8.8	0.33	1.76	11.67	0.58	2.34
Favites complanata	1	16.9	-	-	0.07	0.25	1.67	0.57	2.30
Acropora (A.) nana	1	15.0	-	-	0.07	0.25	1.67	0.44	1.78
Acropora (A.) hyacithus	1	14.5	-	-	0.07	0.25	1.67	0.42	1.70
Galaxea fascicularis	3	7.1	0.6	6.5/7.5	0.02	0.75	5.00	0.30	1.21
Acropora (I.) crateriformis	1	11.8	-	-	0.07	0.25	1.67	0.28	1.13
Pavona venosa	1	9.9	-	-	0.07	0.25	1.67	0.19	0.77
Montastrea curta	1	7.9	-	-	0.07	0.25	1.67	0.12	0.49
Psammocora haimeana	1	3.9	-	-	0.07	0.25	1.67	0.03	0.12

Leptastrea purpurea	1	2.4	-	-	0.07	0.25	1.67	0.01	0.04
COMMUNITY	60	12.1	7.9	2.0/24.0		15.07		24.74	

Table 2j . Size distribution, frequency, density and percent cover of coral at Fagasa Bay, 6 m.

Fagasa Bay 6 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Porites lutea	5	27.0	6.8	18.9-35.9	0.28	0.87	0.10	0.58	0.21
Pocillopora verrucosa	6	14.6	4.6	7.9-19.3	0.41	1.04	0.10	0.17	0.06
Montipora grisea	10	10.9	7.0	4-21	0.55	1.74	0.17	0.09	0.03
Pavona venosa	4	5.8	5.3	1.4-13.4	0.28	0.70	0.07	0.03	0.01
Pavona sp.3	4	7.4	2.0	5.5-9.8	0.28	0.70	0.07	0.04	0.02
Pavona varians	4	4.4	3.0	1.2-8.5	0.28	0.70	0.07	0.02	0.01
Pocillopora eydouxi	3	10.9	0.5	10.5-11.4	0.21	0.52	0.05	0.10	0.04
Astreopora	3	8.4	2.8	6.3-11.6	0.21	0.52	0.05	0.06	0.02
Montipora verrilli	2	12.0	2.9	10-14	0.14	0.35	0.03	0.11	0.04
Acropora verweyi	2	12.7	1.0	12-13.5	0.14	0.35	0.03	0.13	0.05
Montastrea curta	2	19.6	7.20	14.5-24.7	0.14	0.35	0.03	0.30	0.11
Leptastrea purpurea	2	1.9	0.8	1.3-2.4	0.14	0.35	0.03	0.003	0.001
Psammocora superficialis	1	24.5	-	-	0.07	0.17	0.02	0.48	0.18
Acropora gemmifera	1	15.9	-	-	0.07	0.17	0.02	0.20	0.07
Coscinaraea columna	1	21.0	-	-	0.07	0.17	0.02	0.35	0.13
Montipora sp.10	1	2.2	-	-	0.07	0.17	0.02	0.004	0.001
Porites sp.2	1	2.4	-	-	0.07	0.17	0.02	0.005	0.002
Acropora hyacinthus	1	8.4	-	-	0.07	0.17	0.02	0.06	0.02

Favites sp.	1	5.5	-	-	0.07	0.17	0.02	0.02	0.002
Montipora elschneri	1	8.1	-	-	0.07	0.17	0.02	0.05	0.005
Leptoria phrygia	1	3	-	-	0.07	0.17	0.02	0.007	0.001
Montipora monasteriata	1	3.9	-	-	0.07	0.17	0.02	0.01	0.001
Porites (Synaraea) rus	1	4.2	-	-	0.07	0.17	0.02	0.01	0.001
COMMUNITY	58	11.2	7.7			10.1	1	2.72	1

Table 2k . Size distribution, frequency, density and percent cover of coral at Larsen Bay, 2.5-3.5 m.

Larsen Bay 2.5-3.5 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Montipora ehrenbergii	9	17.4	8.4	9.2/34.8	0.40	1.68	15.00	4.80	24.60
Montipora verrilli	11	13.3	6.7	3.0/22.2	0.40	2.06	18.33	3.55	18.20
Astreopora gracillis	1	40.0	-	-	0.07	0.19	1.67	2.35	12.05
Pocillopora eydouxi	4	13.6	6.8	7.3/23.0	0.20	0.75	6.67	1.29	6.61
Montipora grisea	2	16.1	11.9	7.7/24.5	0.13	0.37	3.33	0.97	4.97
Pocillopora elegans	3	14.1	3.7	9.9/16.5	0.20	0.56	5.00	0.92	4.72
Porites (P.) lutea	1	21.8	-	-	0.07	0.19	1.67	0.70	3.59
Montipora elschneri	2	14.4	6.3	9.9/18.4	0.13	0.37	3.33	0.64	3.28
Favites halicora	1	20.2	-	-	0.07	0.19	1.67	0.60	3.08
Favites complanata	2	12.3	9.1	5.9/12.5	0.13	0.37	3.33	0.57	2.92
Acropora (A.) sp. 1	2	11.0	9.2	4.5/17.5	0.13	0.37	3.33	0.48	2.46
Porites (S.) rus	1	15.7	-	-	0.07	0.19	1.67	0.36	1.85
Pocillopora verrucosa	2	11.0	2.2	9.4/12.5	0.13	0.37	3.33	0.36	1.85
Acropora (I.) crateriformis	3	7.0	3.6	3.0/9.9	0.20	0.56	5.00	0.25	1.28
Millepora platyphylla	1	13.0	-	-	0.07	0.19	1.67	0.25	1.28

Alvepora virdis	1	12.4	-	-	0.07	0.19	1.67	0.23	1.18
Galaxea fascicularis	2	8.7	1.1	7.9/9.4	0.13	0.37	3.33	0.22	1.13
Pavona varians	2	8.0	3.5	5.5/10.5	0.13	0.37	3.33	0.21	1.08
Goniastrea retiformis	2	8.0	0.7	7.5/8.5	0.07	0.37	3.33	0.21	0.97
Coscinaraea columna	1	9.9	-	-	0.07	0.19	1.67	0.15	0.77
Pocillopora liguata	1	8.8	-	-	0.07	0.19	1.67	0.11	0.56
Acropora (A.) digitifera	1	7.5	-	-	0.07	0.19	1.67	0.08	0.41
Astreopora myriophthalma	1	7.5	-	-	0.07	0.19	1.67	0.08	0.41
Montipora monasteriata	1	6.5	-	-	0.07	0.19	1.67	0.06	0.31
Psammocora samoensis	1	5.7	-	-	0.07	0.19	1.67	0.05	0.26
Alveopora sp. 1	2	3.8	1.1	3.0/4.5	0.07	0.37	3.33	0.04	0.21
COMMUNITY	60	13.0	7.4	3.0/40.0		11.22		19.51	

Table 2l . Size distribution, frequency, density and percent cover of coral at Larsen Bay, 6 m.

Cape Larsen 6 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Porites lutea	2	32.3	19.5	18.6-46.1	0.12	0.17	0.03	0.47	0.26
Montipora ehrenbergii	9	18.1	7.6	6.9-27.9	0.48	0.79	0.14	0.15	0.08
Montipora grisea	14	13.2	4.4	3.5-21	0.85	1.22	0.21	0.08	0.04
Montipora verrilli	6	19.8	6.8	11.8-29.4	0.30	0.52	0.09	0.18	0.10
Montipora turgescens	4	18.6	12.2	11-36.8	0.24	0.35	0.06	0.16	0.09
Pocillopora verrucosa	3	13.0	5.8	8.5-19.6	0.18	0.26	0.05	0.08	0.04
Cyphastrea	3	13.7	2.1	11.7-15.9	0.12	0.26	0.05	0.08	0.04
Pocillopora elegans	2	9.7	2.5	7.9-11.5	0.12	0.17	0.03	0.04	0.02
Acropora gemmifera	2	11.9	3.9	9.2-14.7	0.12	0.17	0.03	0.06	0.04
Astreopora	2	14.3	0.3	14.1-14.5	0.12	0.17	0.03	0.09	0.05
Montastrea curta	2	5.4	0.5	5-5.7	0.12	0.17	0.03	0.01	0.01
Pocillopora eydouxi	10	11.0	4.6	4.5-17.5	0.61	0.87	0.15	0.05	0.03
Galaxea faxicularis	1	6.9	-	-	0.06	0.09	0.02	0.02	0.01
Pavona venosa	1	4.9	-	-	0.06	0.09	0.02	0.01	0.01
Favites russelli	1	10.6	-	-	0.06	0.09	0.02	0.05	0.03
Favia sp.	1	3.0	-	-	0.06	0.09	0.02	0.004	0.002
Porites (Synaraea) rus	1	9.2	-	-	0.06	0.09	0.02	0.04	0.02
Montipora elschneri	1	15.5	-	-	0.06	0.09	0.02	0.11	0.06

Pavona sp.3	1	14.1	-	-	0.06	0.09	0.02	0.09	0.05
COMMUNITY	66	14.6	7.7			5.77	1	1.79	1

Table 2m. Size distribution, frequency, density and percent cover of coral at Fagafue Bay, 1.5-2 m.

Fagafue Bay 1.5-2 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Montipora ehrenbergii	10	21.6	9.7	11.0/40.2	0.53	1.30	16.67	5.63	38.46
Montipora verrilli	20	13.7	5.4	5.5/23.4	0.67	2.59	33.33	4.58	31.28
Acropora (A.) hyacinthus	4	14.4	2.9	11.0/17.0	0.27	0.52	6.67	0.87	5.94
Pocillopora verrucosa	4	14.3	3.4	9.5/17.1	0.27	0.52	6.67	0.87	5.94
Pocillopora eydouxi	3	13.5	6.3	9.9/20.8	0.20	0.39	5.00	0.64	4.37
Acro pora (A.) samoensis	1	19.9	-	-	0.07	0.13	1.67	0.40	2.73
Goniastrea retiformis	2	13.1	0.4	12.8-13.4	0.07	0.26	3.33	0.35	2.39
Acro pora (A.) cf. gemmifera	2	11.2	2.3	9.5/12.8	0.13	0.26	3.33	0.26	1.78
Acro pora (A.) humilis	1	14.0	-	-	0.07	0.13	1.67	0.20	1.37
Acropora (A..) nana	1	12.8	-	-	0.07	0.13	1.67	0.17	1.16
Montipora sp. 2	1	12.8	-	-	0.07	0.13	1.67	0.17	1.16
Montipora elschneri	1	12.0	-	-	0.07	0.13	1.67	0.15	1.02
Acropora (A..) sp. 1	2	6.5	0.7	6.0/7.0	0.13	0.26	3.33	0.09	0.61
Pavona sp. 2	1	9.2	-	-	0.07	0.13	1.67	0.09	0.61
Galaxea fascicularis	2	5.2	1.6	4.0/6.3	0.13	0.26	3.33	0.06	0.41

Leptastrea purpurea	2	4.5	0.8	3.9/5.0	0.13	0.26	3.33	0.04	0.27
Psammocora samoensis	1	5.9	-	-	0.07	0.13	1.67	0.04	0.27
Acropora (A..) cytherea	1	4.5	-	-	0.07	0.13	1.67	0.02	0.14
Montipora monasteriata	1	3.2	-	-	0.07	0.13	1.67	0.01	0.07
COMMUNITY	60	13.9	7.0	3.2/40.2		7.79		14.64	

Table 2n . Size distribution, frequency, density and percent cover of coral at Fagafue Bay, 6 m.

Fagafue Bay 6 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Montipora ehrenbergii	18	15.9	6.2	3.9-28	0.73	2.32	0.25	0.18	0.08
Montipora grisea	9	9.8	4.3	3-14	0.45	1.16	0.13	0.07	0.03
Acropora hyacinthus	6	10.4	2.9	6.9-13	0.28	0.77	0.08	0.08	0.03
Pavona varians	6	15.4	9.7	10.5-30.7	0.23	0.77	0.08	0.17	0.07
Pocillopora verrucosa	4	15.6	1.7	13.5-17	0.17	0.52	0.06	0.17	0.07
Montipora granulosa	4	4.1	1.7	1.5-5	0.11	0.52	0.06	0.01	0.01
Montipora verrilli	2	16.2	4.6	13-19.5	0.11	0.26	0.03	0.19	0.08
Acropora samoensis	2	16.4	0.8	15.9-17	0.11	0.26	0.03	0.19	0.08
Montipora monasteriata	2	10.1	9.7	3.2-16.9	0.11	0.26	0.03	0.07	0.03
Montipora caliculata	2	7.3	5.5	3.5-11.2	0.06	0.26	0.03	0.04	0.02
Pocillopora elegans	2	10.0	2.1	8.5-11.5	0.11	0.26	0.03	0.07	0.03
Pocillopora meandrina	1	15.4	-	-	0.06	0.13	0.01	0.17	0.07
Favites abdita	1	15.7	-	-	0.06	0.13	0.01	0.18	0.07
Pavona decussata	1	13	-	-	0.06	0.13	0.01	0.12	0.05
Pavona sp.2	1	12	-	-	0.06	0.13	0.01	0.10	0.04
Montipora turgescens	1	11.8	-	-	0.06	0.13	0.01	0.10	0.04
Montipora verrucosa	1	10.8	-	-	0.06	0.13	0.01	0.08	0.04
Galaxea fascicularis	1	9.9	-	-	0.06	0.13	0.01	0.07	0.03

Astreopora sp.	1	7.9	-	-	0.06	0.13	0.01	0.05	0.02
Pocillopora eydouxi	1	7.8	-	-	0.06	0.13	0.01	0.04	0.02
Alveopora	1	6.7	-	-	0.06	0.13	0.01	0.03	0.01
Montastrea curta	1	6.5	-	-	0.06	0.13	0.01	0.03	0.01
Montipora sp.13	1	10.5	-	-	0.06	0.13	0.01	0.08	0.03
Favia sp.	1	8.5	-	-	0.06	0.13	0.01	0.05	0.02
Leptastrea purpurea	1	3.5	-	-	0.06	0.13	0.01	0.01	0.004
COMMUNITY	71	12.0	5.9			9.15	1	2.37	1

Table 2o. Size distribution, frequency, density and percent cover of coral at Massacre Bay, 1.5-2 m.

Massacre Bay 1.5-2 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Montipora verrilli	14	8.4	4.6	3.0/18.6	0.73	4.71	23.33	3.32	25.21
Montipora ehrenbergii	4	13.6	3.3	10.8/18.4	0.27	1.34	6.67	2.04	15.49
Pocillopora verrucosa	3	14.2	1.0	13.1/15.0	0.13	1.00	5.00	1.58	12.00
Porites (P.) sp.2	15	5.6	3.0	2.4/12.5	0.73	5.00	25.00	1.58	12.00
Montipora elschneri	1	18.3	-	-	0.07	0.33	1.67	0.88	6.68
Montipora grisea	3	8.6	3.0	4.5/11.5	0.20	1.00	5.00	0.63	4.78
Pocillopora eydouxi	2	9.5	3.6	6.9/12.0	0.13	0.67	3.33	0.50	3.80
Acropora (A.) sp.2	1	13.5	-	-	0.07	0.33	1.67	0.48	3.64
Acropora (A.) samoensis	3	6.2	4.8	1.4/11.0	0.20	1.00	5.00	0.42	3.19
Galaxea fascicularis	1	11.0	-	-	0.07	0.33	1.67	0.31	2.35
Acropora (A.) gemmifera	1	9.9	-	-	0.07	0.33	1.67	0.26	1.97
Acropora (A.) verweyi	1	9.5	-	-	0.07	0.33	1.67	0.24	1.82
Pavona sp. 3	3	5.3	0.3	5.0/5.5	0.20	1.00	5.00	0.22	1.67
Montipora	1	8.9	-	-	0.07	0.33	1.67	0.21	1.59
Montipora monasteriata	1	7.7	-	-	0.07	0.33	1.67	0.16	1.21

Acropora (A.) nana	1	7.5	-	-	0.07	0.33	1.67	0.15	1.14
Porites (P.) lobata	1	4.9	-	-	0.07	0.33	1.67	0.06	0.46
Acropora (A.) hyacinthus	1	4.5	-	-	0.07	0.33	1.67	0.05	0.38
Pavona varians	1	4.5	-	-	0.07	0.33	1.67	0.05	0.38
Acropora (A.) crateriformis	1	3.0	-	-	0.07	0.33	1.67	0.02	0.15
Alveopora sp. 1	1	2.0	-	-	0.07	0.33	1.67	0.01	0.08
COMMUNITY	60	8.1	4.4	1.4/18.6		20.01		13.17	

Table 2p . Size distribution, frequency, density and percent cover of coral at Massacre Bay, 6 m.

Massacre Bay 6 m - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Montipora grisea	18	14.5	6.5	6.9-29.6	0.52	3.61	0.19	0.31	0.02
Montipora verrilli	15	20.7	9.2	13-30	0.43	3.61	0.16	0.63	0.04
Montipora caliculata	7	5.9	1.6	2.45-12.4	0.22	1.40	0.08	0.05	0.003
Montipora ehrenbergii	8	22.2	7.2	9.5-27.8	0.21	1.61	0.09	0.72	0.05
Porites (Synaraea) rus	6	22.7	11.1	9.8-41.6	0.26	1.20	0.06	0.76	0.05
Pocillopora verrucosa	5	18.0	12.7	6.9-37	0.13	1.00	0.05	0.47	0.03
Pocillopora samoensis	4	4.7	1.3	3-6	0.17	0.80	0.04	0.03	0.002
Montipora elschneri	2	7.0	3.0	4.9-9.2	0.04	0.40	0.02	0.07	0.005
Pocillopora eydouxi	2	17.7	5.4	13.9-21.5	0.09	0.40	0.02	0.46	0.03
Montipora venosa	2	9.0	1.2	8.1-9.8	0.09	0.40	0.02	0.012	0.008
Favites russelli	2	15.6	6.9	10.7-20.4	0.04	0.40	0.02	0.35	0.02
Acropora digitifera	2	17.2	6.0	13.0-21.4	0.09	0.40	0.02	0.43	0.03
Acropora hyacinthus	2	5.2	0.4	4.9-5.5	0.09	0.40	0.02	0.04	0.003
Montipora spumosa	2	4.0	0.7	3.5-4.5	0.04	0.40	0.02	0.02	0.001
Porites sp.2	2	4.0	0.7	3.5-4.5	0.04	0.40	0.02	0.02	0.002
Montipora tuberculosa	1	36.4	-	-	0.04	0.20	0.01	1.94	0.12
Montipora granulosa	1	19.5	-	-	0.04	0.20	0.01	0.56	0.04
Montipora verrucosa	1	6.5	-	-	0.04	0.20	0.01	0.06	0.004

Montipora turgescens	1	25.3	-	-	0.04	0.20	0.01	0.94	0.06
Montipora monasteriata	1	14.5	-	-	0.04	0.20	0.01	0.31	0.02
Pocillopora meadrina	1	13.5	-	-	0.04	0.20	0.01	0.27	0.02
Goniastrea retiformis	1	44.0	-	-	0.04	0.20	0.01	2.83	0.18
Montastrea curta	1	32.9	-	-	0.04	0.20	0.01	1.58	0.10
Favia speciosa	1	37.4	-	-	0.04	0.20	0.01	2.05	0.13
Acropora nasuta	1	11.0	-	-	0.04	0.20	0.01	0.18	0.01
Leptastrea transversa	1	7.9	-	-	0.04	0.20	0.01	0.09	0.01
Coscinaraea columna	1	9.4	-	-	0.04	0.20	0.01	0.13	0.01
Pavona varians	1	7.9	-	-	0.04	0.20	0.01	0.09	0.01
Pavona sp.3	1	4	-	-	0.04	0.20	0.01	0.02	0.002
COMMUNITY	93	15.8	10.1			19.26	1	15.55	1

Table 2q . Size distribution, frequency, density and percent cover of coral at Rainmaker Hotel, 0.5-1.5 m.

Rainmaker Hotel 0.5-1.5 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Millepora platyphylla	10	21.9	18.3	5.2/51.3	0.47	1.54	16.67	9.35	77.65
Pocillopora danae	39	5.6	2.8	1.0/11.4	0.93	6.02	65.00	1.87	15.53
Pocillopora verrucosa	3	10.7	1.3	9.5/120	0.13	0.46	5.00	0.42	3.49
Acropora (A.) digitifera	1	9.9	-	-	0.07	0.15	1.67	0.12	1.00
Pavona divaricata	1	9.2	-	-	0.07	0.15	1.67	0.10	0.83
Pavona venosa	1	7.9	-	-	0.07	0.15	1.67	0.08	0.66
Pocillopora damicornis	1	6.3	-	-	0.07	0.15	1.67	0.05	0.42
Leptastrea purpurea	2	2.8	2.5	1.0/4.6	0.13	0.31	3.33	0.03	0.25
Psammocora samoensis	1	4.0	-	-	0.07	0.15	1.67	0.02	0.17
Porites (P.) sp.2	1	1.0	-	-	0.07	0.15	1.67	0.001	0.01
COMMUNITY	60	8.4	9.8	1.0/51.3		9.23		12.041	

Table 2r . Size distribution, frequency, density and percent cover of coral at Rainmaker Hotel, 6 m.

Rainmaker Hotel 6 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Diploastrea heliopora	5	185	189	15.9-478	0.25	0.10	0.10	2.68	0.88
Montipora ehrenbergii	6	7.7	2.4	5.9-11.4	0.5	0.12	0.13	0.005	0.002
Pocillopora damicornis	4	10.1	9.3	2-20	0.25	0.08	0.08	0.008	0.003
Psammocora samoensis	5	4.3	2.3	2-7.9	0.33	0.10	0.10	0.001	0.0004
Pavona (collines)	4	7.3	5.5	2-13	0.25	0.08	0.08	0.004	0.001
Montipora grisea	3	19.3	27.8	2.6-51	0.17	0.06	0.06	0.03	0.01
Acroproa acuminata	3	16.3	6.2	12-23	0.17	0.06	0.06	0.02	0.01
Acropora yongei	3	6.7	2.0	5.5-9	0.17	0.06	0.06	0.003	0.001
Millepora tuberosa	2	27.3	33.3	3.7-50.7	0.08	0.04	0.04	0.06	0.02
Millepora platyphylla	2	27.5	28.0	7.7-47.3	0.17	0.04	0.04	0.06	0.02
Pavona varians	2	4.0	0.7	3.5-4.5	0.17	0.04	0.04	0.001	0.0004
Lobophyllia hemprichii	1	38.9	-	-	0.08	0.02	0.02	0.12	0.04
Fungia danai	1	6.7	-	-	0.08	0.02	0.02	0.004	0.001
Acropora latistella	1	22	-	-	0.08	0.02	0.02	0.04	0.01
Acropora digitifera	1	13.5	-	-	0.08	0.02	0.02	0.01	0.004
Pavona sp.3	1	9.8	-	-	0.08	0.02	0.02	0.008	0.002
Fungia repanda	1	7.5	-	-	0.08	0.02	0.02	0.004	0.001
Astreopora randalli	1	3.9	-	-	0.08	0.02	0.02	0.001	0.0004

Porites sp.2	1	4	-	-	0.08	1.0	0.02	0.001	0.0004
Porites lutea	1	2.5	-	-	0.08	1.0	0.02	0.0005	0.0002
COMMUNITY	48	29.5	77.8			2.95	1	3.06	1

Table 2s . Size distribution, frequency, density and percent cover of coral at Fatu Rock, 0.5-1.5 m.

Rainmaker Hotel 0.5-1.5 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	n	Y	s	w	frequency	density per m^2	relative % density	% cover	relative % cover
Pocillopora verrucosa	9	9.1	2.8	5.9/14.4	0.47	3.66	15.00	2.57	19.11
Montipora verrilli	4	9.0	6.0	12.0/19.0	0.93	1.63	6.67	2.53	18.81
Porites (P.) sp.2	27	4.9	2.0	2.0/12.0	0.13	10.99	45.00	2.39	17.77
Acropora (A.) nana	5	10.6	3.9	5.0/26.0	0.07	2.03	8.33	2.06	15.32
Galaxea fascicularis	5	7.8	2.4	6.3/11.6	0.07	2.03	8.33	1.05	7.81
Pocillopora danae	4	7.5	5.1	3.5/15.0	0.07	1.63	6.67	0.97	7.21
Acropora (A.) gemmifera	1	15.1	-	-	0.07	0.41	1.67	0.73	5.43
Pocillopora cf.meandrina	1	12.0	-	-	0.13	0.41	3.33	0.46	3.42
Acropora (A.) samoensis	1	11.5	-	-	0.07	0.41	1.67	0.42	3.12
Pocillopora damicornis	1	6.5	-	-	0.07	0.41	1.67	0.13	0.97
Pocillopora eydouxi	1	6.0	-	-	0.07	0.41	1.67	0.12	0.89
Acropora (A.) ocellata	1	2.4	-	-	0.07	0.41	1.67	0.02	0.15
COMMUNITY	60	7.4	3.9	2.0/19.0		24.43		13.45	

Table 2t . Size distribution, frequency, density and percent cover of coral at Fatu Rock, 6 m.

Fatu Rock 6 m depth - July 1995	Size distribution of colonies Diameters in cm								
corals	**n**	**Y**	**s**	**w**	**frequency**	**density per m^2**	**relative % density**	**% cover**	**relative % cover**
Porites sp.2	33	4.6	2.8	1-11.4	0.66	11.93	0.45	0.04	0.01
Porites xmas	18	7.1	3.5	1-11.4	0.49	6.51	0.25	0.11	0.02
Pocillopora verrucosa	7	9.0	6.6	3-18.6	0.38	2.53	0.10	0.17	0.03
Porites (Synaraea) rus	2	12.6	6.0	8.4-16.9	0.05	0.72	0.03	0.33	0.06
Montipora grisea	2	10.5	4.9	7.1-14.0	0.11	0.72	0.03	0.23	0.04
Pocillopora danae	2	5.7	0.4	5.5-6	0.11	0.72	0.03	0.07	0.01
Montipora verrilli	2	2.4	2.0	1-3.9	0.11	0.72	0.03	0.01	0.002
Echinopora hirsutissima	1	31.0	-	-	0.01	0.36	0.01	1.99	0.36
Pocillopora eydouxi	1	28.1	-	-	0.01	0.36	0.01	1.64	0.30
Acropora nana	1	14.4	-	-	0.01	0.36	0.01	0.43	0.08
Pocillopora meandrina	1	9.8	-	-	0.01	0.36	0.01	0.20	0.04
Acropora crateriformis	1	7.9	-	-	0.01	0.36	0.01	0.13	0.02
Montipora ehrenbergii	1	6.9	-	-	0.01	0.36	0.01	0.10	0.02
Pavona sp.3	1	5.9	-	-	0.01	0.36	0.01	0.07	0.01
COMMUNITY	73	7.0	5.4			26.39	1	5.53	1

Table 3.	Abundance of hermatypic corals (colonies per m^2) in Fagatele Bay National Marine Sanctuary in April 1985, April 1988, and July 1995.					
Depth	**Permanent Transect Number**					
	1	**2**	**3**	**4**	**5**	**6**
Reef Flat						
1985		7.2	9.1	8.8		
1988		3.6	25.4			
1995		7.2	11.2	10.8		
3 m						
1985		2.0	23.3	3.2	15.4	
1988		8.0	33.4	6.2	10.3	
1995		13.6	12.6	3.4	4.6	
5 m						
1985	6.8	2.5	34.5	1.4	3.7	20.4
1988		3.4	25.2	2.6	5.2	8.3
1995	8.8	6.0	14.3	6.2	5.0	6.6
9 m						
1985	10.0	3.3	9.3	3.2	6.7	5.7
1988	11.9	5.5	15.3	3.4	9.6	
1995	9.1	11.0	8.6	1.0	7.0	5.8
12 m						
1985	10.4	2.6	2.3	2.3	3.2	7.1
1988	7.1	17.1	14.8	14.7	5.8	8.1
1995	7.8	14.7	14.5	7.1	5.6	7.1

Table 4. Percent cover of substrata by hermatypic corals in Fagatele Bay National Marine Sanctuary in April 1985, April 1988, and July 1995.

Depth	Permanent Transect Number					
	1	2	3	4	5	6
Reef Flat						
1985		4.0	45.2	6.6		
1988		3.5	43.4			
1995		5.0	37.6	11.4		
3 m						
1985		1.1	25.6	2.2	46.2	
1988		7.3	31.8	6.1	15.8	
1995		16.9	37.0	5.6	7.3	
5 m						
1985	17.1	1.2	11.8	0.9	12.9	20.2
1988		2.3	32.4	4.0	17.9	37.6
1995	26.5	13.8	21.0	7.4	8.0	5.8
9 m						
1985	10.5	64.4	2.3	2.4	11.7	4.5
1988	31.6	3.9	6.9	2.8	7.6	
1995	12.7	10.9	3.5	1.9	0.7	2.4
12 m						
1985	10.7	0.9	0.8	1.0	1.3	8.4
1988	10.9	7.2	5.2	6.5	5.6	10.9
1995	14.3	8.2	2.5	9.3	0.4	0.7

Table 5. Mean coral colony diameter (cm) in Fagatele Bay National Marine Sanctuary in April 1985, April 1988, and July 1995.

Depth	Permanent Transect Number					
	1	2	3	4	5	6
Reef Flat						
1985		6.4	14.4	8.6		
1988		9.1	10.9			
1995		7.1	14.1	7.8		
3 m						
1985		7.0	8.2	8.4	14.4	
1988		9.5	8.8	9.5	11.8	
1995		10.6	12.0	9.5	11.6	
5 m						
1985	11.9	6.3	5.2	7.7	15.7	9.1
1988		7.6	9.3	10.8	14.8	16.2
1995	13.8	13.9	9.7	9.7	10.8	8.4
9 m						
1985	8.3	18.9	5.1	7.1	10.8	8.7
1988	16.2	8.0	10.0	8.0	7.7	
1995	11.3	13.3	8.9	11.4	9.1	12.7
12 m						
1985	10.3	5.4	5.3	6.0	6.5	11.0
1988	11.2	6.4	6.3	5.4	8.3	9.7
1995	35.9	10.5	5.3	10.4	9.6	8.9

Table 6. **Abundance (number per m²) of hermatypic coral colonies at 12 sites around Tutuila Island in April 1982, April 1985, April 1988, and July 1995 at two depths at each site.**

Location	Depth	Year	Number of coral colonies per m^2
Inside Masefau Bay	2-3 m	1982	2.89
		1985	3.51
		1988	4.2
		1995	7.38/4
	6 m	1982	5.93
		1985	8.14
		1988	12.41
		1995	5.3
Outside Masefau Bay	2-3 m	1982	30.62
		1985	33.94
		1988	24.5
		1995	10.0
	6 m	1982	2.68
		1985	5.3
		1988	15
		1995	20.76
Aoa Bay	2-3 m	1982	3
		1985	18.62
		1988	12.11
		1995	7.35
	6 m	1982	1.14
		1985	3.63
		1988	9.42
		1995	13.66
Onenoa	2-3 m	1982	6.0
		1985	9.0
		1988	10.79
		1995	7.14

Table 6 continued

Location	Depth	Year	Number of coral colonies per m^2
Fagasa Bay	2-3 m	1982	7.98
		1985	4.29
		1988	16.61
		1995	15.07
	6 m	1982	3.13
		1985	5.6
		1988	7.76
		1995	10.1
Cape Larsen	2-3 m	1982	7.88
		1985	7.81
		1988	14.13
		1995	11.22
	6 m	1982	7.57
		1985	12.17
		1988	12
		1995	5.77
Fagafue Bay	2-3 m	1982	8.0
		1985	12.4
		1988	10.17
		1995	7.79
	6 m	1982	5.41
		1985	13.88
		1988	12.2
		1995	9.2
Massacre Bay	2-3 m	1982	11.92
		1985	28.83
		1988	14.8
		1995	20.01
	6 m	1982	5.9
		1985	18.23
		1988	15.57
		1995	19.26

Table 6 continued

Location	Depth	Year	Number of coral colonies per m^2
Rainmaker Hotel	2-3 m	1982	4.69
		1985	8.25
		1988	7.54
		1995	9.23
	6 m	1982	11.58
		1985	0.84
		1988	0.25
		1995	2.95
Fatu Rock	2-3 m	1982	22.19
		1985	18.79
		1988	21
		1995	24.43
	6 m	1982	19.66
		1985	17.41
		1988	18.7

Table 7. **Percent cover of substrata by hermatypic coral colonies at 12 sites around Tutuila Island in April 1982, April1985, April 1988, and July 1995 at two depths at each site.**

Location	Depth	Year	Percent cover by coral colonies
Inside Masefau Bay	2-3 m	1982	12.31
		1985	3.69
		1988	8.7
		1995	8.18/4
	6 m	1982	32.85
		1985	66.08
		1988	2.8
		1995	1.69
Outside Masefau	2-3 m	1982	41.94
		1985	28.44
		1988	15.6
		1995	13.0
	6 m	1982	2.59
		1985	3.3
		1988	23.2
		1995	6.67
Aoa Bay	2-3 m	1982	3.12
		1985	11.52
		1988	19.4
		1995	5.2
	6 m	1982	0.78
		1985	1.8
		1988	15.8
		1995	3.44
Onenoa	2-3 m	1982	2.7
		1985	11.5
		1988	27.6
		1995	6.04
	6 m	1982	3.13
		1985	9.22
		1988	38.4
		1995	6.51

Table 7 continued

Location	Depth	Year	Percent cover by coral colonies
Fagasa Bay	2-3 m	1982	16.77
		1985	1.93
		1988	61.3
		1995	24.74
	6 m	1982	2.48
		1985	21.33
		1988	51.3
		1995	2.72
Cape Larsen	2-3 m	1982	10.65
		1985	14.25
		1988	34.8
		1995	19.51
	6 m	1982	7.35
		1985	22.34
		1988	29.7
		1995	1.79
Fagafue Bay	2-3 m	1982	80.1
		1985	85.5
		1988	32.9
		1995	14.64
	6 m	1982	115.44
		1985	98.43
		1988	93.5
		1995	2.4
Massacre Bay	2-3 m	1982	59.99
		1985	88.69
		1988	45.4
		1995	13.17
	6 m	1982	60.6
		1985	91.68
		1988	127.1
		1995	15.55

Table 7 continued

Location	Depth	Year	Percent cover by coral colonies
Rainmaker Hotel	2-3 m	1982	6.65
		1985	11.38
		1988	3.2
		1995	12.04
	6 m	1982	27.72
		1985	19.19
		1988	18.7
		1995	3.06
Fatu Rock	2-3 m	1982	17.34
		1985	61.49
		1988	30.3
		1995	13.45
	6 m	1982	
		1985	
		1988	23.2
		1995	5.5

Table 8. **Mean diameter (cm) of hermatypic coral colonies at 12 sites around Tutuila Island in April 1982, April 1985, April 1988, and July 1995 at two depths at each site.**

Location	Depth	Year	Number of coral colonies per m^2
Inside Masefau Bay	2-3 m	1982	13.2
		1985	8.9
		1988	9.1
		1995	9.9
	6 m	1982	14.9
		1985	30.6
		1988	4.2
		1995	10.3
Outside Masefau Bay	2-3 m	1982	9.1
		1985	8.2
		1988	7.7
		1995	10.0
	6 m	1982	5.6
		1985	7.5
		1988	10.1
		1995	11.6
Aoa Bay	2-3 m	1982	7.2
		1985	7.3
		1988	11.3
		1995	8.3
	6 m	1982	5.2
		1985	7.1
		1988	9.5
		1995	9.9
Onenoa	2-3 m	1982	6.9
		1985	11.0
		1988	15.6
		1995	9.6
	6 m	1982	5.8
		1985	10.1
		1988	16.3
		1995	12.5

Table 8. Continued

Location	Depth	Year	Number of coral colonies per m^2
Fagasa Bay	2-3 m	1982	10.9
		1985	6.3
		1988	16.4
		1995	12.1
	6 m	1982	6.6
		1985	15.2
		1988	20.3
		1995	11.2
Cape Larsen	2-3 m	1982	8.9
		1985	12.3
		1988	14.7
		1995	13
	6 m	1982	7.7
		1985	11.9
		1988	14.4
		1995	14.6
Fagafue Bay	2-3 m	1982	28.0
		1985	22.1
		1988	17.2
		1995	13.9
	6 m	1982	32.4
		1985	20.1
		1988	20.6
		1995	12.0
Massacre Bay	2-3 m	1982	17.4
		1985	14.7
		1988	16.5
		1995	8.1
	6 m	1982	26.0
		1985	21.8
		1988	22.4
		1995	15.8

Table 8. Continued

Location	Depth	Year	Number of coral colonies per m^2
Rainmaker Hotel	2-3 m	1982	8.8
		1985	9.3
		1988	6.6
		1995	8.4
	6 m	1982	11.9
		1985	22.4
		1988	40.6
		1995	29.5
Fatu Rock	2-3 m	1982	9.8
		1985	11.4
		1988	10.6
		1995	7.4
	6 m	1982	8.3
		1985	19.2
		1988	8.8
		1995	7.0

MACROBENTHIC INVERTEBRATE COMMUNITIES

by **Barry D. Smith**

INTRODUCTION

The baseline survey of marine nonscleractinian macrobenthos of the Fagatele Bay National Marine Sanctuary was performed in April 1985 (Birkeland et al., 1987), soon after the sanctuary was officially established. Echinoderms were the predominant benthic invertebrates in terms of standing crop, but gastropods constituted the most diverse assemblage.

A rapid ecological assessment of Fagatele Bay was performed during the American Samoa Coastal Resources Inventory in 1992. Although macroinvertebrates were surveyed in this program, the qualitative nature of the rapid assessment technique precluded all but broad comparisons with earlier baseline study.

The purpose of this study was to reassess the macrobenthos assemblage of the Fagatele Bay National Marine Sanctuary 10 years after the original baseline study. For comparison, macroinvertebrates at 10 additional sites around Tutuila, American Samoa were surveyed by the same methods used during the baseline study.

METHODS

Conspicuous, epibenthic macroinvertebrates other than scleractinian corals were censused by either of two methods. The belt transect method ("line transect" in Birkeland *et al.,* 1987) was used throughout the survey, except for one species. Transects were established in the same zones as in the baseline survey in 1985. On the forereef slope, a 30-m transect line was placed along the 10-, 15-, 30-, and 40-ft isobaths and approximately parallel to shore. Macroinvertebrates occurring within 1 m on both sides of the transect line were identified and recorded along 5-m intervals of the line. Therefore, each transect on the forereef consisted of 6 quadrats, each covering an area of 10 m^2.

Transects on the reef flat were placed perpendicular to shore, extending from the waterline to the reef margin. Therefore, the number of 10 m^2 quadrats sampled on the reef flat was a function of the extent of reef flat development.

Quantification of asexually reproducing, colonial organisms, such as alcyonacean corals and encrusting sponges, poses some difficulties for the belt transect method because determination of what constitutes an individual is problematic. For the purposes of this study, alcyonacean corals and encrusting sponges were counted as individuals only when they were not connected by any tissue to surrounding clones. Interconnected clones were counted as single individuals.

The small, boring echinoid *Echinostrephus aciculatus* was too numerous to count by the belt transect method on oblique limestone surfaces in areas exposed to strong wave surge. In these areas, *Echinostrephus aciculatus* was sampled with a 25 cm x 25 cm quadrat (= 0.0625 m^2). The quadrat was thrown randomly twice at 5-m intervals and within 1 m of the transect line, yielding 12 samples from which population densities were estimated.

When time permitted, the reef adjacent to transects were examined to record observations of macroinvertebrates not encountered along the transect line. These records were compiled to compose a faunal list for the areas surveyed.

RESULTS

The densities of nonscleractinian macroinvertebrates along 21 belt transects at six sites in Fagatele Bay are presented in Tables 9-12. Coral reef echinoderms were the predominant macroinvertebrates, occurring on all transect in Fagatele Bay. At outer sites, where exposure to water motion is greatest (Transect 1 and 6), the small echinoid *Echinostrephus aciculatus* was the principal species. This species reached densities as great as 208 urchins/m^2 on oblique surfaces, where it bores a round burrow into the limestone substrate. However, in more sheltered areas and on the deeper isobaths, the densities of *Echinostrephus aciculatus* diminished to fewer than 1 individual/m^2. This species occurred on 18 of the 21 transects in Fagatele Bay.

Another echinoid, *Echinometra mathaei,* also occurred with high frequency on transects in Fagatele Bay, but at lower densities than those attained by *Echinostrephus aciculatus.* *Echinometra mathaei* occurred on 15 of the 21 transects, and reached densities as great as 0.5 urchins/m^2 in the more sheltered areas of Transects 3 and 4.

Although *Echinometra mathaei* occurred with greater frequency on transects in the more sheltered areas, sponges were predominant in terms of biomass present. The *Dysidea herbacea* species-complex was particularly noteworthy. Mats of these encrusting sponges attained densities as great as 4.4/m^2 at Transect 3. Considerable areas of substrate were covered by these sponges.

Alcyonacean corals were a conspicuous and abundant component of the macroinvertebrate assemblage in Fagatele Bay. *Cladiella* sp. cf. *C. pachyclados,* a small soft coral, occurred with the highest frequency of all the macroinvertebrates. *Cladiella cf. pachyclados* was encountered on 19 of 21 transects in Fagatele Bay. This species occurred at densities in excess of 5 colonies/m^2. Larger species, such as *Sinularia* and *Lobophytum* species, were present but in relatively low densities. Encrusting mats of the zoanthid *Palythoa tuberculosa* were widespread in Fagatele Bay, but the species reached its greatest density at Transect 5 along the 10-ft and 15-ft isobaths.

Molluscs comprised the most diverse macroinvertebrate assemblage on transects in Fagatele Bay. The higher diversity was represented by predatory neogastropods, which constituted some 74% of the gastropod assemblage and 40% of total macroinvertebrate diversity in Fagatele Bay. Mollusc species of interest because of their potential for harvest for human consumption included two species of giant clams and one species of octopus. *Tridacna maxima* and *Tridacna squamosa* were present on transects, but they occurred as scattered individuals. One *Octopus cyaneus* was also noted.

Densities of macroinvertebrates occurring on belt transects along the 20-ft isobath at 10 additional sites around Tutuila are presented in Tables 13 and 14. A species list of macroinvertebrates observed in Fagatele Bay and at 10 additional sites is given in Table 15.

DISCUSSION

Several noteworthy changes have occurred in the macroinvertebrate assemblage of Fagatele Bay since the baseline survey in 1985. The densities of the burrowing echinoid *Echinometra mathaei* have declined significantly on all but two transects (Transect 4, 10-ft and 30-ft isobaths). High densities of these sea urchins in 1985 (Birkeland et al., 1987) were cause for some concern because of the potential impact on the reef structure of their burrowing. Formation of urchin grooves, which may be 1 m in length, is a form of bioerosion that could weaken the reef framework and cause slumping. The drop in *Echinometra mathaei* densities follows the pattern previously reported by Birkeland (1981) in which abundance of herbivorous sea urchins increased following an infestation of *Acanthaster planci* in Palau before World War II and declined over the next decades. I view the reduction in population densities of *Echinometra mathaei* as a healthy sign for continued recovery of the Fagatele Bay coral reef ecosystem.

The densities of the boring urchin *Echinostrephus aciculatus* remain essentially unchanged since 1985. However, because the burrow of *Echinstephus aciculatus* is a short (5-6 cm) straight, round hole perpendicular to the substrate, it is less damaging to the reef framework. Furthermore, this species attains its greatest abundance in areas exposed to considerable wave energy, where the substrate is continually scoured by unconsolidated debris. Therefore, bioerosion by this species is not a cause for great concern.

There are also indications of increasing diversity within the macroinvertebrate community. For example, the number of neogastropod species increased from 14 in 1985 to 20 in 1995, while proportionately neogastropods declined from 78% to 74% of the total gastropod assemblage. Similarly, the diversity of alcyonacean corals increased from unidentified species in two genera in 1985 to five species in three genera in 1995.

Further evidence of the diversity of macroinvertebrates is presented in Table 15. Of 96 species of macroinvertebrates observed on transects or the reef adjacent to transects at Fagatele Bay and the ten additional sites examined during this study, 81 species (>84%) were observed in Fagatele Bay. Twenty four species observed at Fagatele Bay were not recorded from the ten other sites. Significantly, two specimens of the coral reef holothurian *Actinopyga mauritiana* were observed at Fagatele Bay during the 1995 reassessment study. Although none were observed in 1985, the suitability of habitat for this species in Fagatele Bay was noted (Birkeland et al., 1987). Also, no *Acanthaster planci* were recorded in 1995, while two were reported in 1985.

One group of macroinvertebrates has increased dramatically in abundance since the baseline survey in 1985. The encrusting sponge *Dysidea* sp. (*Dysidea herbacea* complex) was not recorded in 1985, but this sponge covered considerable areas of substrate in 1995. The decline in sea urchins and the increase in sponges and overall diversity may be successional stages in recovery of the ecosystem. However, as noted by Birkeland et al. (1987), successional patterns within macroinvertebrate communities following devastation of coral reefs by *Acanthaster planci* have received little attention. Further monitoring in Fagatele Bay and other areas affected by *Acanthaster planci* will be required to make such a determination

Table 9. Densities of macroinvertebrates occurring on the forereef slope at Transects 1 and 2 (Figure 2) in Fagatele Bay. Data are means ± standard deviations of taxa observed in six 10-m² quadrats, except where noted.

	Transect 1			Transect 2			
	15 ft	30 ft	40 ft	10 ft	15 ft	30 ft	40 ft
Porifera							
Calcarea							
Leucetta sp.			0.33±0.82				
Demospongiae							
Stylotella aurantium			0.67±0.52				
Dysidea spp.				0.17±0.41	0.67±0.82		
Cnidaria							
Anthozoa							
Cladiella cf. pachyclados		5.50±5.28	1.33±1.75	14.83±16.04	53.67±68.23	2.50±4.23	18.00±25.88
Lobophytum pachyclados		0.17±0.41					
Lobophytum crebriplicatum		1.00±2.44	0.17±0.41				
Sinularia densa							0.33±0.82
Palythoa tuberculosa	0.33±0.82	3.83±2.99	7.50±5.75	0.83±0.75	0.50±0.84	0.17±0.41	
Mollusca							
Gastropoda							
Astralium rhodostoma					0.17±0.41		0.17±0.41
Cypraea caputserpentis				0.17±0.41			
Drupa grossularia				0.33±0.82			
Drupa morun	3.17±4.40						
Drupa ricinus	0.83±0.98		0.50±0.84	0.17±0.41			0.33±0.52
Drupella cornus			0.17±0.41				
Morula uva	0.17±0.41			2.50±2.35	1.50±1.38	0.33±0.52	0.83±0.75
Thais tuberosa	1.17±1.47						
Thais armigera	3.33±1.75						
Cantharus undosus				0.17±0.41			
Latiroglens smaragdula	0.17±0.41			0.33±0.52			
Peristernia fastigium		0.33±0.82	1.00±1.26	0.67±0.82	1.67±1.51	0.33±0.52	0.17±0.41
Conus miles					0.17±0.41	0.17±0.41	

Table 9 continued

	Transect 1			Transect 2			
	15 ft	30 ft	40 ft	10 ft	15 ft	30 ft	40 ft
Conus sponsalis	0.33±0.82		0.33±0.52	0.50±0.55	0.17±0.41		
Phyllidiella pustulosa		0.33±0.82				0.17±0.41	
Bivalvia							
Tridacna maxima		0.33±0.52					
Tridacna squamosa				0.17±0.41			
Arthropoda							
Crustacea							
Trizopagurus strigatus		0.17±0.41					
Echinodermata							
Asteroidea							
Linckia multifora	0.33±0.82					0.17±0.41	0.17±0.41
Echinoidea							
Echinometra mathaei	0.33±0.52			0.17±0.41		0.17±0.41	
Echinostrephus aciculatus	13.00±10.42	0.67±1.78a	0.33±0.89a	5.00±7.77	11.00±17.31		
Chordata							
Ascidiacea							
Polycarpa cf. cryptocarpa			0.17±0.41				

Sampled with 25 x 25 cm quadrats at this site. Data are mean + standard deviation of twelve 0.0625-m^2 quadrats.

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Table 10. Densities of macroinvertebrates occurring on the forereef slope at Transect 3 and 4 at Fagatele Bay. Data are means ± standard deviations of taxa observed in six 10-m² quadrats.

	Transect 3				Transect 4			
	10 ft	**15 ft**	**30 ft**	**40 ft**	**10 ft**	**15 ft**	**30 ft**	**40 ft**
Porifera								
Demospongiae								
Stylotella aurantium			0.67±1.03	0.33±0.52			0.33±0.82	
Dysidea spp.	40.00±21.26	44.33±20.09	2.17±214	0.17±0.41	5.50±4.72	8.00±5.40	3.67±2.50	1.00±0.00
Cnidaria								
Anthozoa								
Cladiella sf.*pachyclados*	0.83±2.04	10.33±16.03	5.33±9.79	0.83±2.04	2.50±5.17	2.50±3.89	2.50±3.33	1.50±2.35
Sinularia densa							7.83±19.19	
Heterodactyla hemprichii						0.17±0.41		
palythoa tuberculosa				0.17±0.41	0.33±0.52		0.33±0.52	0.17±0.41
Mollusca								
Gastropoda								
Trochus laciniatus	0.50±0.84	0.33±0.52	0.33±0.52			0.17±0.41		
Australium rhodostoma			0.17±0.41					
Cypraea annulus							0.17±0.41	
Cypraea caputserpentis	0.17±0.41	FB						
Cypraea moneta	0.33±0.82							
Drupa grossularia		0.17±0.41						
Drupa ricinus					0.17±0.41	0.17±0.41		
Drupa rubusidaeus				0.17±0.41				
Morula uva	0.17±0.41		0.67±0.52		0.50±0.84	0.67±0.82	0.17±0.41	0.33±0.82
Coralliophila violacea	0.50±0.84							
Latirus polygonus barclayi							0.17±0.41	
Peristernia fastigium	0.33±0.82	0.17±0.41	0.33±0.52	0.50±0.84	0.33±0.52	0.67±0.82	0.50±0.84	0.50±0.55
Peristernia nassatula					0.17±0.41			
Mitra cucumerina					0.17±0.41			
Conus miles					0.17±0.41			
Conus sponsalis			0.33±0.52	0.33±0.82	0.17±0.41	0.17±0.41		
Phyllida varicosa							0.17±0.41	
Phyllidiella pustulosa				0.67±0.82			0.17±0.41	0.17±0.41

Table 10 continued

	Transect 3				Transect 4			
	10 ft	**15 ft**	**30 ft**	**40 ft**	**10 ft**	**15 ft**	**30 ft**	**40 ft**
Bivalvia								
Tridacna maxima								0.17±0.41
Cephalopoda								
Octopus cyaneus				0.17±0.41				
Echinodermata								
Crinoidea								
Comanthus parvicirrus			0.17±0.41					
Asteroidea								
Linckia multifora								
Fromia monilis							0.17±0.41	0.17±0.41
Echinoidea								
Diadema setosum					0.17±0.41			
Echinometra mathaei	4.67±3.27	3.50±1.38	0.83±1.17	0.67±0.82	5.67±6.25	5.00±3.03	3.67±2.16	4.00±1.10
Echinostrephus aciculatus	1.50±2.81	0.17±0.41	1.33±1.51	4.17±3.43	2.33±3.01		0.33±0.82	0.50±0.84

Table 11. Densities of macroinvertebrates occurring on the forereef slope at Transects 5 and 6 in Fagatele Bay. Data are means ± standard deviations of taxa observed in six 10-m² quadrats, except where noted.

	Transect 5				Transect 6	
	10 ft	**15 ft**	**30 ft**	**40 ft**	**30 ft**	**40 ft**
Porifera						
Demospongiae						
Stylotella aurantium					0.67±1.03	0.33±0.52
Dysidea spp.	3.00±4.69	0.83±0.75			2.17±0.75	0.17±0.41
Cnidaria						
Anthozoa						
Cladiella cf. pachyclados	0.83±2.04	2.33±3.93	1.00±1.26		14.67±10.31	10.00±5.18
Lobophytum crebriplicatum	2.83±5.98					0.17±0.41
Lobophytum pauciflorum						0.33±0.82
Lobophytum Sp.	8.17±18.16					
Heteractis crispa					0.17±0.41	
Palythoa tuberculosa	*	32.83±24.85	0.83±0.75		0.17±0.41	
Mollusca						
Gastropoda						
Tectus pyramis		0.17±0.41				
Astralium rhodostoma				0.33±0.52	0.17±0.41	
Cypraea caputserpentis	0.17±0.41	0.67±1.03				
Drupa grossularia		0.50±1.22				
Drupa ricinus	0.17±0.41	0.33±0.52				
Morla uva	0.33±0.82	2.50±1.22	0.50±0.84	0.33±0.52	0.17±0.41	0.17±0.41
Thais tuberosa		0.17±0.41				
Thais armigera		0.17±0.41				
Latiroglena smaragdula		0.17±0.41			0.17±0.41	
Latirus polygonus barclayi	0.17±0.41					
Paristernia fastigium			0.33±0.52	1.17±1.33		0.67±0.82
Paristernia nassatula					0.17±0.41	
Vasum ceramicum					0.17±0.41	

Table 11 continued

	Transect 5				Transect 6	
	10 ft	15 ft	30 ft	40 ft	30 ft	40 ft
Conus miles			0.33±0.82		0.17±0.41	
Conus rattus		0.17±0.41				
Conus sanguinolentus					0.17±0.41	
Conus sponsalis		0.17±0.41	0.50±1.22	0.17±0.41		0.17±0.41
Phyllidiella pustulosa		0.33±0.82	0.17±0.41	0.33±0.52	0.17±0.41	0.17±0.41
Echinodermata						
Crinoidea						
Comaster multifidus			0.50±1.22			
Asteroidea						
Linckia multifora			0.17±0.41		0.17±0.41	0.17±0.41
Echinoidea						
Echinometra mathaei	1.67±1.97	0.33±0.52	0.17±0.75	0.33±0.82		
Echinostrephus aciculatus	5.83±5.72a	3.75±8.50a	2.83±6.94	1.00±2.00	5.92±8.87a	5.67±4.31a

Sampled with 25 x 25 cm quadrats at this site. Data are mean + standard deviation of twelve 0.0625-m² quadrats.
***too numerous to count.**

Table 12. Densities of macroinvertebrates occuring on the reef flat at Transects 3 and 4 in Fagatele Bay. The reef at Transect 3 was 90 m in width and, therefore, consisted of 18 quadrats; the reef flat at Transect 4 was 145 m and consisted of 29 quadrats. Data are means + standard deviations of taxa observed in 10 m^2 quadrats.

	Transect 3	Transect 4
Porifera		
Demospongiae		
Dysidea spp.	1.48±2.92	0.83±0.99
Mollusca		
Gastropoda		
Cypraea annulus		0.39±1.24
Cypraea moneta		0.22±0.43
Drupa ricinus		0.11±0.32
Morula uva		0.22±0.43
Echinodermata		
Echinoidea		
Echinostrephus aciculatus	0.03±0.19	
Echinometra mathaei	4.69±5.61	0.11±0.32
Echinothrix diadema	0.07±0.26	0.08±0.29
Heterocentrotus mammillatus	0.07±0.26	

Table 13. Densities of macroinvertebrates occurring on the forereef slope at Sites 1 to 4 (Figure1) around Tutuila, American Samoa. Data are means ± standard deviations of taxa observed in six 10-m^2 quadrats.

	Transects			
	1	**2**	**3**	**4**
Porifera				
Calcarea				
Leucetta sp.		0.33±0.52		
Demospongiae				
Stylotella aurantium	0.17±0.41			0.50±0.55
Dysidea spp.			0.33±0.82	
Cnidaria				
Anthozoa				
Cladiella cf. pachyclados		1.50±1.38		1.33±1.37
Sinularia densa				0.33±0.82
Heterodactyla hemphrichii				0.17±0.41
Palythoa tuberculosa			0.17±0.41	1.17±1.33
Mollusca				
Gastropoda				
Tectus pyramis	0.17±0.41			
Trochus laciniatus				0.33±0.82
Cypraea caputserpentis		0.33±0.82		
Lambis scorpius			0.17±0.41	
Drupa ricinus		0.17±0.41		0.33±0.52
Drupella cornus		0.33±0.52		
Morula uva	0.33±0.52	6.33±3.14		2.67±1.63
Peristernia fastigium		0.17±0.41		2.00±1.55
Crnus sponsalis	0.83±0.75	0.17±0.41	0.33±0.82	
Phyllidiella pustulosa	0.17±0.41	0.33±0.52		
Bivalvia				
Tridacna maxima			0.83±0.75	0.83±1.33
Echinodermata				
Crinoidea				
Comanthus parvicirrus				0.17±0.41
Asteroidea				
Linckia multifora	0.17±0.41	0.17±0.41	1.17±0.75	
Echinoidea				
Echinothrix diadema	0.17±0.41			0.17±0.41
Echinometra mathaei			0.67±0.82	0.33±0.52
Echinostrephus aciculatus	3.00±1.90	3.67±8.50	46.33±40.06	2.33±3.44
Holothuroidea				
Holothuria nobilis	0.17±0.41			

Table 14. Densities of macroinvertebrates occurring on the forereef slope at Sites 7 to 12 (Figure1) around Tutuila, American Samoa. Data are means ± standard deviations of taxa observed in six 10-m^2 quadrats, except where noted.

	Transects					
	7	**8**	**9**	**10**	**11**	**12**
Porifera						
Calcarea						
Leucetta sp.	0.50±0.84					
Demospongiae						
Stylotella aurantia	3.67±1.86	0.33±0.52	0.17±0.41	2.50±2.51	2.83±1.72	2.83±3.06
Dysidea spp.	2.67±1.63	1.17±0.75				
Cnidaria						
Alcyonacea						
Cladiella cf. pachyclados			0.50±1.22	4.00±7.78		243.00±180.95
Sarcophyton trocheiophorum					2.33±5.72	
Sinularia cf. frondosa					0.17±0.41	
Sinuclaria sp.				2.00±4.90		
Palythoa tuberculosa		0.17±0.41	0.33±0.82			0.33±0.52
Mollusca						
Gastropoda						
Tectus pyramis				0.17±0.41		
Trochus laciniatus						0.17±0.41
Australium rhodostoma			0.17±0.41	0.17±0.41		0.17±0.41
Drupa ricinus				0.50±0.55		
Drupa rubusidaeus			0.50±.084			
Drupella cornus	0.17±0.41		1.00±1.55	0.33±0.52		0.17±0.41
Morula uva				2.00±1.41		0.67±0.82
Peristernia fastigium						0.17±0.41
Conus sanguinolentus		0.17±0.41				
Phyllidiella pustulosa	0.33±0.82	0.33±0.52	0.33±0.82	0.17±0.41		

Table 14 continued

	Transects					
	7	**8**	**9**	**10**	**11**	**12**
Bivalva						
Tridacna maxima	0.33±0.52					
Echinodermata						
Crinoidea						
Comanthus parvicirrus						0.17±0.41
Comaster multifidus	0.50±0.84			0.33±0.82		
Asteroidea						
Linckia multifora				0.33±0.52		
Echinoidea						
Echinometra mathaei		0.17±0.41				
Echinostrephus aciculatus	0.58±0.79a	1.92±1.16a	1.67±1.21	1.00±2.45		0.67±0.82
Holothuroidea						
Bohadshia argus					0.33±0.52	
Chordata						
Ascidacea						
Polycarpa cf. *cryptocarpa*	0.33±0.52					

Sampled with 25 x 25 cm quadrats at this site. Data are means ± standard deviation of twelve 0.0625 m^2 quadrats.

Table 15. Species list of non-scleractinian macroinvertebrates observed adjacent to transects at 11 sites (see Figure 1) around Tutuila, American Samoa. Presence of a species is denoted by the symbol *.

	1	2	3	4	7	8	9	10	11	12	13
PORIFERA											
Calcarea											
Leucetta sp.		*		*	*						*
Demospongiae											
Cinachyra sp.									*		*
Stylotella aurantium	*	*		*	*	*	*	*	*	*	*
Dysidea spp.			*		*	*					*
CNIDARIA											
Hydroza											
Physalia physalis (Linnaeus)										*	
Lytocarpus sp.					*			*			*
Anthozoa											
Cladiella cf. pachyclados (Klunzinger)		*	*	*			*	*		*	*
Lobophytum crebriplicatum (Ehrenberg)											*
Lobophytum pauciflorum											*
Sarcophyton trocheliphorum Marenzeller									*		
Sinularia densa (Whitelegge)											*
Sinularia cf. frondosa									*		
Sinularia spp.	*							*			*
Stereonephthya cf. unicolor (Gray)											*
Rhodactis howesii (Saville-Kent)											*
Discosoma sp.											*
Heterodactyla hemphrichii Ehrenberg				*							*
Entacmaea quadricolor (Rüppel & Leukart)											*
Heteractis crispa (Ehrenberg)											*
Palythoa tuberculosa (Esper)		*	*	*		*	*			*	*
Zoanthus pacificus Walsh & Bowers		*		*			*			*	*
Zoanthus sp.		*	*	*				*		*	*
PLATYHELMINTHES											
Turbellaria											
Pseudoceros zebra Leuckart			*								
ANNELIDA											
Polychaeta											
Spirobranchus giganteus (Pallas)		*	*	*	*	*	*	*		*	*
Liomia medusa (Savigny)					*						
MOLLUSCA											
Gastropoda											
Patelloida saccharina (Linnaeus)											*
Tectus Pyramis (Born)	*							*			*
Trochus laciniatus Reeve				*						*	*
Astralium rhodostoma (Lamarck)							*	*		*	*
Dendropoma maxima Sowerby			*	*							*

Table 15 continued.

	1	2	3	4	7	8	9	10	11	12	13
Pedaloconchus sp.		*									*
Serpulorbis Sp.		*	*	*				*		*	*
Lambis scorpius (Linnaeus)			*								
Cypraea annulus Linnaes											*
Cyraea caputserpentis Linnaeus											*
Cypraea moneta Linnaeus											*
Cymatium lotorium (Linnaeus)					*						
Cymatium nicobaricum (Röding)											*
Drupa grossularia Röding	*		*	*	*	*					
Drupa morum Röding											*
Drupa ricinus (Linnaeus)		*		*				*			*
Drupa rubusidaeus Röding							*				*
Drupella cornus (Röding)		*		*	*		*	*	*	*	*
Moruls uva (Röding)	*	*		*			*	*		*	*
Thais armigera (Link)											*
Thais tuberosa (Röding)											*
Coralliophila violacea (Kiener)											*
Cantharus undosus (Linnaeus)											*
Pleuroploca filamentosa (Röding)											*
Latirus polygonus barclayi (Reeve)					*						*
Latiroglen smaragdula (Linnaeus)										*	*
Peristernia fastigium (Reeve)		*		*						*	*
Peristernia nassatula (Lamarck)	*					*	*				*
Vasum ceramicum (Linnaeus)											
Mitra coffea Schubert & Wagner							*				
Mitra curcumerina Lamarck											*
Conus catus Hwass											*
Conus flavidus Lamarck						*					
Conus miles Linnaeus	*	*									*
Conus rattus Hwass				*				*			*
Conus sanguinolentus Quoy &Gaimard						*					*
Conus sponsalis Hwass	*	*	*		*	*					*
Conus vitulinus Hwass	*										
Phyllidia coelestis Bergh											*
Phyllidia ocellata Cuvier											*
Phyllidia varicosa Lamarck					*						*
Phyllidiella pustulosa (Cuvier)	*	*			*	*	*	*			*
Phyllidiopsis striata Bergh											*
Bivalva											
Tridacna maxima (Röding)	*		*	*	*	*					*
Tridacna squamosa Lamarck											*
Cephalopoda											
Octopus Cyanea Gray	*										*

Table 15 continued.

	1	2	3	4	7	8	9	10	11	12	13
ARTHROPODA											
Crustacea											
Thalassina anomala (Herbst)			*								
Paguritta harmsi (Gordon)				*		*	*	*		*	*
Clibanarius spp.	*	*	*		*		*	*			*
Calcinus gaimardi (H.Milne Edwards)				*		*					*
Dardanus lagopodes (Forsskål)		*	*		*	*	*		*		*
Trizopagurus strigatus (Herbst)		*		*		*					*
Trapezia sp.		*	*					*			
ECHINADERMATA											
Crinoidea											
Comanthus parvicirrus (J. Miller)				*				*		*	*
Comaster multifidus (J. Miller)					*						
Asteroidea											
Fromia monilis Perrier					*						*
Neoferdina cumingii (Gray)											*
Linckia multifora (Lamarck)	*	*	*					*			*
Culcita novaeguineae Muller & Troschel											*
Echinoidea											
Echinothrix diadema (Linnaeus)	*			*		*					*
Diadema setosum (Leske)											*
Echinometra mathaei (Blainville)		*	*			*					*
Echinostrephus aciculatus A. Agassiz	*	*	*	*	*	*	*	*		*	*
Heterocentrotus mammillatus Linneaus											*
Holothuroidea											
Actinopyga mauritiana (Quoy & Gaimard											*
Bohadschia argus Jaeger									*		
Holothuria nobilis (Selenka)	*										
CHORDATA											
Ascidacea											
Didemnum molle (Herdman)	*				*						
Diplosoma similis (Sluiter)								*			*
Lissoclinum voeltzkowi (Michealsen)								*			*
Polycarpa cf. cryptocarpa (Sluiter)	*	*			*	*		*			*

ALGAL COMMUNITIES

by **Suzanne Wilkins**

INTRODUCTION

Most of the older information on algal communities of American Samoa is sparse and frequently quite general (Setchell, 1924; Dahl, 1971; Guinther and Madden, 1980). A more recent quantitative study of the benthic marine plant community was done by this author in March of 1985 (Birkeland *et al.,* 1987). The current study was conducted in July of 1995 and followed the same methods and surveyed the same transects in Fagatele Bay and 10 other sites around Tutuila as those of the 1985 survey, with the exception of two sites. Many algal species are seasonal and since both of the recent surveys have been conducted during different seasons it is difficult to make meaningful comparisons about the algal community and residual or secondary-impact from environmental changes until more data is available.

METHODS

Marine plants and the substrate were quantified by the point-quadrat method along 30-m transects following a series of depth contours (10, 15, 30, and 40 feet). Since areas covered by algal turf, crustose coralline algae, and other encrusting organisms are difficult to measure by dimensions, it is more appropriate to survey such organisms by the point-quadrat method. This method provides data from which a rapid assessment of percent cover and frequency of occurrence of any algal species is possible. Thus, distribution patterns, evenness or patchiness of the benthic algal species, can easily be recognized.

This method consists of quantifying organisms or substrate types under the points of intersection of strings tied across a quadrat (25 x 25 cm) frame creating 25 squares with 16 cross-points. Whatever algal species occurred under each point was recorded. In cases when the point fell on two layers of algae the base alga was recorded and the overlying alga was noted as present. When identification of an alga was impossible to accomplish in the field a specimen was collected and pressed for later identification. If no alga was found under the point, than whatever was present, e.g., sand, live coral or rubble, was recorded.

The quadrat was tossed randomly at 5-m intervals along the length of the transect. Therefore, data were collected from 6 quadrats, or at 96 points, along a transect. Each of these transects were positioned perpendicular to Permanent Transects (1, 2, 3, 4, 5, and 6) established during a previous survey (Birkeland *et al.,* 1987) and followed a series of depth contours (10, 15, 30, or 40 feet; 3.0, 4.6, 9.1, or 12.2 m).

Permanent Transect 1 accommodated transects at 15, 30, and 40 feet, Transect 6 had only transects at 20 and 40 feet, while all other Permanent Transects had transects at all four depths.

Percent cover for each transect was calculated by taking the number of points occupied by a particular categories divided by the total number of points per transect. Frequency of occurrence was calculated by taking the number if quadrat tosses in which a benthic constituent occurred, divided by the number of tosses per transect. Both cover and frequency values were converted to percent by multiplying by 100. Other algal species seen along the transect were recorded as observed.

In addition, 10 previously established 30-m transects at a depth of 20 (6.1 m) feet were resurveyed around Tutuila. The same methods were applied as described above.

RESULTS AND DISCUSSION

Results of the quantitative survey of marine benthic algae in Fagatele Bay are presented in Tables 16 and 17. A total of 26 species of benthic marine algae were encountered along the 21 transects in Fagatele Bay. Overall percent cover of the marine benthic algal community was 75 (s=12) of which crustose and articulate coralline algae made up 69 (s=14) percent. *Peysonnelia* (maximum cover 25%), a very common component, formed a firmly adherent reddish crust covering dead corals and rubble over large areas especially along the 30 and 40 feet depth contour. *Porolithon onkodes* (as high as 80 percent cover), the most conspicuous component of the algal cover throughout Fagatele Bay, appears to have formed an almost continuous smooth crust covering, cementing and stabilizing the loose surface below.

The well scrubbed appearance of the *Porolithon* crust showed relatively little evidence of epiphytic algal growth, only *Gelidium pussilum, Ceramium* and *Herposiphonia* were found tightly adhered to the surface of this crust. *Amphiroa* and *Chilosporum*, and other common component of the coralline algal assemblage, were also frequently found entangled with other species of algae forming dense clumps. The algal composition of these clumps was similar to that of algal turfs and was composed of algal species such as *Dictyota, Dictyopteris, Ceramium, Polysiphonia, Jania, Herposiphonia, Gelidium, Gelidiopsis, Gelidiella, Sphacelaria,* and *Pterocladia.*

Tables 19 and 20 provide a overview of the benthic marine floral community of the two recent surveys (Birkeland et al., 1987 and the 1995 survey). They summarize the overall percent algal and coralline algal cover along the four depth contours (Table 19) and the Permanent Transects in Fagatele Bay (Table 20). Encrusting and articulate coralline algal cover generally increased while percent cover of non-coralline algae decreased since the last survey.

The composition of the plant assemblages from the 10 transects (Table 18) surveyed at sites around Tutuila were similar to those found in Fagatele. The total number of plant species recorded along the transects is lower than that from the previous survey (53 species in 1985 and 27 species in the 1995 survey), however, the mean value for percent algal cover increased slightly since 1985 (from 56.1 ± 24 to 62.0 ± 24). Previously recorded fleshy and filamentous algae seem to be confined to algal turf assemblages or were hidden in depressions and interstices of the substrate, thus many areas seem to have a much "cleaner" appearance. Coralline algae, in particular encrusting coralline algae, showed an overall increase in percent cover (from 38.4 ± 24 to 48.1 ± 19) from the values recorded during the 1985 survey (Table 21).

Table 16. **Frequency and percent cover of the benthic flora in Fagatele Bay, American Samoa, (transects 1, 2 3). Plain numbers indicate percent cover, numbers in parenthesis indicate frequency of occurrence converted to percent (see Methods in text). Algal species occurring epiphytically on other algae or occurring in the vicinity of the transect are marked with and X.**

	TRANSECTS 1			2				3			
	15	**30**	**40**	**10**	**15**	**30**	**40**	**10**	**15**	**30**	**40**
CYANOPHYTA (blue-green)											
Colothrix crustaces Schousboe & Thuret	x										
Microcoleus lyngbyaceus (Kutz.) Crouan	2.1 (16)		3.1 (33)	1.0 (16)						1.0 (16)	1.0 (16)
Schizothrix calcicola (Ag.) Gomont										2.1 (16)	1.0 (16)
CHLOROPHYTA (green)											
Bryopsis pennata Lamx.			X		X						
Chloropytha fastigiata (C.Ag.) Ducker					1.0 (16)		X				
Dictyospheria vesluysii W.v. Bosse	13.5 (50)	1.0 (16)		2.1 (16)					3.1 (50)	1.0 (16)	1.0 (16)
Halimeda gracilis Harv.							4.2 (33)			1.0 (16)	3.1 (33)
Halimeda opuntia (L.) Lamx.						1.0 (16)			1.0 (16)		
Valonia fastigiata Har.								1.0 (16)	1.0 (16)		
PHAEOPHYTA (brown)											
Dictyopteris repens (okam.) Boerg.	2.1 (33)	1.0 (16)	1.0 (16)		X						

Table 16 continued

	TRANSECTS										
	1			2				3			
	15	30	40	10	15	30	40	10	15	30	40
Dictyota friabilis Setch.	X		1.0 (16)	1.0 (16)				X		1.0 (16)	X
Ralfsia pangoensis Setch.		X	X						X		
Sphacelaria sp.											
RHODOPHYTA (red)											
Caloglossa leprieurii (Montagne) J.Ag.								X			
Ceramium gracillimum Griff. @ Harv.										X	
Cramium mazatlenense Dawson				X					X		
Gelidiopsis intricata (Ag.) Vickers		X						X			
Gelidium pussilum (Stackh.) LeJolis	X		X						X		
Goniotrichum alsidii (Zanardini) Howe					X						
Hypnea pannosa J.Ag.				X							
Herposiphonia tenella (C.Ag.) Naegele			X			X	X				
Leveillea jungermannioides (Her. @ Mart.) Harv.					X				X		X
Polysiphonia scopulorum Harv.								X			

Table 16 continued

	TRANSECTS										
	1			2				3			
	15	30	40	10	15	30	40	10	15	30	40
Pterocladia parva Dawson	X	1.0 (16)						1.0 (16)	2.1 (33)		
Symploca hydnoides Gomont											X
Crustose and Articulate											
Coralline Algae											
Amphiroa anceps (Lamark)Desaisne							1.0 (16)				
Amphiroa foliacea Lamx.	1.0 (16)	2.1 (33)				1.0 (16)	2.1 (33)	3.1 (33)	6.2 (66)	1.0 (16)	
Amphiroa fragilissima Lamx.		1.0 (16)									X
Cheilosporum maximum Yendo			X	1.0 (16)		2.1 (16)	3.1 (33)	3.1 (16)	11.4 (66)	2.1 (16)	
Hydrolithon reindoldii (W.V. Bosse @ Foslie) Foslie	7.3 (33)	1.0 (16)	2.1 (16)			1.0 (16)		1.0 (16)	2.1 (16)		
Jania capillacea Harvey				X						X	X
Lithoporella pacifica (Heydr.) Fosile						X			X		
Lithothamnium asperulum Foslie			X								
Lithophyllum moluccense Foslie	1.0 (16)										X
Mesophyllum mesomorphum (Foslie) Adey	1.0 (16)	2.1 (33)		2.1 (33)	2.1 (16)	2.1 (33)	1.0 (16)	4.2 (33)	6.2 (50)	2.1 (16)	

Table 16 continued

	TRANSECTS										
	1			2				3			
	15	30	40	10	15	30	40	10	15	30	40
Neogoniolithon sp.				1.0 (16)			1.0 (16)				
Peyssonelia rubra (Grev.) J.Ag.	7.3 (50)	12.5 (66)	13.5 (83)	12.5 (100)	10.4 (83)	15.6 (83)	22.9 (100)	13.5 (50)	16.7 (66)	15.6 (83)	17.7 (83)
Porolithon onkodes (Heydrich) Foslie	22.9 (100)	33.3 (100)	49.0 (100)	44.8 (100)	46.9 (100)	47.9 (100)	37.5 (100)	22.9 (100)	20.8 (100)	43.8 (100)	40.6 (100)
Squamaracea		X				X					
Turf	11.4 (33)				X	8.3 (50)	2.1 (16)	1.0 (16)	5.2 (33)	9.4 (50)	4.2 (33)
Dead coral											
Coral rock	6.2 (16)	3.1 (33)		1.0 (16)	3.1 (33)					3.1 (33)	
Live coral	16.7 (33)	37.5 (100)	16.7 (66)	22.9 (83)	25.0 (50)	15.6 (50)	25.0 (83)	26.0 (83)	21.9 (50)	3.1 (33)	9.4 (33)
Palithoa					1.0 (16)						
Rubble	3.1 (33)		3.1 (33)	3.1 (16)		3.1 (16)				9.4 (50)	15.6 (50)
Sand	3.1 (33)	3.1 (33)	8.3 (50)	7.3 (33)						2.1 (16)	5.2 (33)
Sponge								22.9 (66)	2.1 (33)		
Soft coral				2.1 (16)	2.1 (16)					1.0 (16)	1.0 (16)
Scuzz										1.0 (16)	
Urchin	1.0 (16)	1.0 (16)	2.1 (33)		1.0 (16)						
Number of plant genera/transect	9	8	6	8	4	7	8	8	9	10	6
Number of plant species/transect	9	9	6	8	4	7	8	8	10	10	6

Total plant genera	17
Total plant species	20

Table 17. **Frequency and precent cover of the benthic flora in Fagatele Bay, American Samoa (Transects 4, 5, 6). Plain numbers indicate percent cover, numbers in parenthesis indicate frquency of occurrence converted to percent (see Methods in text). Algal species occurring epiphytically on other algae or in the vicinity of the transect are marked with an X.**

	TRANSECTS									
	4				5				6	
	10	15	30	40	10	15	30	40	30	40
CYANOPYTHA (blue-green)										
Microcoleus lyngbyaceus (Kutz.) Crouan	1.0 (16)	1.0 (16)								2.1 (33)
Schizothrix calcicola (Ag.) Gomont						2.0 (33)			X	
Schizothrix mexicana Gomont					1.0 (16)				1.0 (16)	
CHLOROPYTHA (green)										
Bryopsis pennata Lamx.						1.0 (16)				
Chlorodesmis fastigiata (C. Ag.)		X								
Dictyosperia versluysii W.v. Bosse	4.2 (16)	X							1.0 (16)	2.1 (33)
Halimeda discoidea Decaisne						X				
Halimeda gracilis Harv.	X	3.1 (16)	1.0 (16)							
Halimeda opuntia (L.) Lamx				2.1 (16)						
Valonia fastigiata Har.	X								1.0 (16)	

Table 17 continued

	TRANSECTS 4				5				6	
	10	15	30	40	10	15	30	40	30	40
PHAEOPYTHA (brown)										
Dictyopteris repens (Okam.) Boerg.	X		X							X
Dictyota friabilis Setch.			1.0 (16)	X			X	1.0 (16)		
Ralfsia pangoensis Setch.				X		X				
Sphacelaria sp.		X								X
RHODOPYTHA (red)										
Actinorichia fragillis Boerg.			2.1 (16)							
Ceramium gracillium Griff. @ Harv.						X	X		X	
Cramium mazatlenense Dawson				X						
Galaxaura filamentosa Dawson								X		
Gelidiopsis intricata (Ag.) Vickers			1.0 (16)			X				
Gelidium pussilum (Stackh.) LeJolis			X	X			X			
Halymenia sp.			X							
Herposiphonia tenella (C.Ag.)Naegele				X						

Table 17 continued

	TRANSECTS									
	4				5				6	
	10	15	30	40	10	15	30	40	30	40
Martensia fragilis Harv.		X								
Polysiphonia scopulorum Harv.							X			X
Crustose and Articulate Coralline Algae										
Amphiroa anceps (Lamark) Dscaisne						X				
Amphiroa foliacea Lamx.	X	1.0 (16)		2.1 (33)			1.0 (16)	2.1 (33)		1.0 (16)
Amphiroa fragilissima Lamx.	1.0 (16)		2.1 (16)		X				1.0 (16)	
Cheilosporum maximum Yendo	X	2.1 (16)	X	2.1 (33)	3.1 (33)	X				1.0 (16)
Cheilosporum multifidium (Kuetz) Manza						X			3.1 (33)	
Hydrolithon reinboldii (W.V. Bosse @ Foslie) Foslie	4.2 (33)			1.0 (16)						
Jania capillacea Harvey	X					X	X	X		
Lithoporella pacifica (Heydr.) Foslie					X	2.1 (16)				
Lithothamnium asperulum Foslie						1.0 (16)	X	1.0 (16)		

Table 17 continued

	TRANSECTS									
	4				5				6	
	10	15	30	40	10	15	30	40	30	40
Lithophyllum kotschyanum (Unger) Foslie										X
Lithophyllum mollucense Foslie	X								2.1 (33)	
Mesophyllum mesomorphum (Foslie) Adey	10.4 (50)	4.2 (50)	3.1 (33)	1.0 (16)	1.0 (16)	2.1 (16)		3.1 (33)	4.2 (50)	2.1 (33)
Neogoniolithon sp.	2.1 (16)	X			4.2 (33)			1.0 (16)	2.1 (16)	
Peyssonelia rubra (Grev.) J.Ag.	7.3 (33)	4.2 (33)	18.8 (83)	19.8 (83)	12.5 (83)	24.0 (100)	8.3 (100)	15.6 (83)	18.8 (100)	13.5 (83)
Porolithon onkodes (Heydrich) Foslie	72.9 (100)	74.0 (100)	42.7 (83)	58.3 (100)	60.4 (100)	36.4 (100)	80.2 (100)	62.5 (100)	52.1 (100)	40.6 (100)
Squamaracea								2.1 (33)		
Turf			1.0 (16)		4.2 (16)	3.1 (33)		3.1 (16)		
Coral rock					1.0 (16)	2.1 (16)				9.4 (50)
Live coral	1.0 (16)		25.0 (83)	13.5 (33)	4.2 (33)	4.2 (50)	4.2 (16)	2.1 (16)	13.5 (83)	12.5 (66)
Rubble		1.0 (16)	1.0 (16)							2.1 (16)
Palithoa					6.2 (33)	12.5 (83)				
Sand					1.0 (16)	6.2 (33)	1.0 (16)	1.0 (16)	2.1 (16)	11.4 (66)
Sponge						2.1 (16)				2.1 (16)
Scuzz		5.2 (33)	1.0 (16)				5.2 (33)	5.2 (50)		
Urchin					1.0 (16)	1.0 (16)				

Table 18. **Frequency and percent cover of the benthic flora along 10 transects in 5 different bays of American Samoa. Plain numbers indicate percent cover, numbers in parenthesis indicate frequency of occurrence converted to percent (see Methods in text). Algal species occurring epiphytically on other algae or occurring in the vicinity of the transect ae marked with an X.**

	TRANSECTS									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CYANOPYTHA (blue green)										
Microcoleus lyngbyaceus (Kutz.) Crouan	1.0 (16)		6.2 (33)		7.3 (50)				1.0 (16)	X
Schizothrix calcicola (Ag.) Gomont		1.0 (16)	1.0 (16)					4.2 (33)		
CHLOROPYTHA (green)										
Bryopsis pennata Lamx.										X
Chlorodesmis fastigiata (C. Ag.)				X		2.1 (33)				
Dictyosperia versluysii W.v. Bosse		1.0 (16)		X						1.0 (16)
Halimeda discoidea Decaisne				4.2 (50)						
Halimeda gracilis Harv.			1.0 (16)		2.1 (33)		1.0 (16)			1.0 (16)
Halimeda incrassata (Ellis) Lamx					1.0 (16)					
Halimeda opuntia (l.) Lamx.			3.1 (33)		X	2.1 (16)	2.1 (16)	8.3 (50)	1.0 (16)	3.1 (16)
PHAEOPYTHA (brown)										
Dictyopteris repens (Okam.) Boerg.			X							
Dictyota friabilis Setch.			2.1 (33)		9.4 (83)	4.2 (33)		2.1 (33)		

Table 18 continued

	TRANSECTS									
	1	2	3	4	5	6	7	8	9	10
Dictyota divericata					X					
Lamx.										
Padina japonica						1.0 (16)				
Yamada										
Ralfsia pangoensis					X		X			X
Setch.										
Sphacelaria sp.	X									
RHODOPYTHA (red)										
Actinotrichia fragilis				X	2.1 (33)	2.1 (16)	10.4 (83)			
Boerg.										
Ceramium gracillium			X		X	X				
Griff. @ Harv.										
Cramium mazatlenense		X								
Dawson										
Desmia hornemanni								1.0 (16)		
Lyngb.										
Galaxaura filamentosa					X					
Dawson										
Galaxaura marginata			3.1 (33)				2.1 (16)	1.0 (16)		
Lamx.										
Galaxaura oblongata	X		8.3 (33)		X	1.0 (16)				
(E.@S.) Lamx.										
Gelidiella sp.									X	
Gelidiopsis intricata				X		X				
(Ag.) Vickers.										
Gelidium pussilum		X	X			X	X			
(Stackh.) Lejolis										
Herposiphonia tenella		X								
(C.Ag.)										

Table 18 continued

	TRANSECTS									
	1	2	3	4	5	6	7	8	9	10
Hypena sp.		X			X				X	
Martensia fragilis Harv.		X								
Polysiohonia scopulorum Harv.			X		X					
Polysiphonia tongatensis Harv.									X	
Pterocladia parva Dawson		1.0 (16)								
Crustose and Atriculate Coralline Algae										
Amphiroa foliacea Lamx.		2.1 (16)	16.7 (50)		8.3 (50)	6.2 (66)	3.1 (50)	2.1 (33)		X
Amphiroa fragilissima Lamx.			2.1 (16)	X		X				1.0 (16)
Cheilosporum maximum Yendo		X			X	X	X			3.1 (33)
Cheilosporum multifidium (Kuetz) Manza		X								X
Hyrolithon reinboldii (W.V. Bosse @ Foslie	5.2 (33)					1.0 (16)				
Jania capillacea Harvey.				X			X	X		
Lithoporella pacifica (Heydr.) Foslie		X								
Lithothamnium asperulum Foslie		2.1 (16)				1.0 (16)	2.1 (16)			
Lithophyllum kotschyanum (Unger) Foslie	1.0 (16)								X	

Table 18 continued

	TRANSECTS									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Lithophyllum moluccense Foslie			1.0 (16)							
Mesophyllum mesomorphum (Foslie) Adey			1.0 (16)	3.1 (33)				2.1 (16)		1.0 (16)
Neogoniolithon sp.				3.1 (33)						
Peyssonelia rubra (Grev.) J.Ag.	7.8 (83)	9.4 (83)	13.5 (83)	10.4 (66)	10.4 (83)	12.5 (50)	5.2 (66)	16.7 (83)		31.2 (100)
Porolithon onkodes (Heydrich) Foslie	14.6 (33)	51.0 (100)	22.9 (100)	46.9 (100)	33.3 (100)	21.9 (50)	32.3 (100)	32.3 (100)	4.2 (33)	37.5 (100)
Turf		3.1 (33)	4.2 (50)		9.4 (50)	10.4 (66)		3.1 (33)		
Coral rock					3.1 (16)	10.4 (50)	15.6 (66)			
Live coral	6.3 (33)	29.2 (100)	8.3 (50)	28.2 (83)	19.8 (83)	12.5 (33)	26.0 (100)	13.5 (83)	7.3 (16)	16.6 (83)
Palithoa						3.1 (16)				1.0 (16)
Rubble	1.0 (16)								30.2 (100)	
Sand	63.5 (83)		5.2 (33)	4.2 (16)				8.3 (33)	56.2 (100)	
Soft coral								3.1 (33)		3.1 (33)
Tunicate								1.0 (16)		
Urchin						1.0 (16)		1.0 (16)		
Number of plant genera/transect	5	7	10	5	7	12	7	9	3	6
Number of plant species/transect	5	7	13	5	8	12	8	9	3	7

Total number of plant genera	21
Total number of plant species	27

1- Inside Masefau, 2- Outside Masefau, 3- Aoa, 4- Onenoa, 5- Fagasa, 6- Cape Larsen, 7- Fagafue, 8- Massacre Bay, 9- Rainmaker, 10- Fatu Rock

Table 19. Summary of mean percent cover and standard deviation of algae at different depths in Fagatele Bay of the 1985 and 1995 survey.

	total		10 ft.		15 ft.		30 ft.		40 ft.	
	n=20	n=21	n=3	n=4	n=5		n=6		n=6	
	85	95	85	95	85	95	85	95	85	95
1	78.0+18	75.5+12	85.3+13	75.5+18	85.6+0	72.6+12	75.2+7	76.9+11	72.8+28	75.2+10
2	57.1+14	68.9+14	65.6+3	72.1+9	63.9+2	62.9+14	56.3+8	70.7+12	48.5+19	70.0+11

1 - all algae , 2 - crustose and articulate coralline algae

Table 20. Summary of mean percent cover and standard deviation of algae at the Permanent Transects 1 - 6 at Fagatele Bay of the 1985 and 1995 survey.

	T1		T2		T3		T4		T5		T6	
	n=3		n=4		n=4		n=4		n=3	n=4	n=2	n=3
	85	95	85	95	85	95	85	95	85	95	85	95
1	68.3+6	61.9+6	85.7+6	70.1+7	75.3+11	69.0+11	94.2+4	88.0+10	86.3+6	84.1+7	43.6+6	73.4+11
2	50.3+6	52.4+10	55.9+11	64.8+4	55.9+9	58.6+7	56.8+6	83.6+11	49.8+3	80.5+9	43.6+26	69.8+12

1 - all algae , 2 - crustose and articulate coralline algae

Table 21. **Summary of overall percent algal and coralline algal cover in 5 days of American Samoa from the 1985 and 1995 survey.**

	TRANSECTS											
	Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Mean**
Total cover	85	27.9	62	92.9	48.8	90.1	69.4	84.1	59.1	5.1	43.6	56.1+24
	95	29.2	70.9	86.3	67.6	77.1	72.9	58.3	71.9	6.3	79	62.0+24
Coralline algal cover	85	17.6	36.3	68.8	36.5	50.5	39.4	62.4	32.1	2.1	38.5	38.4+24
	95	28.2	64.7	57.3	63.4	52	42.6	42.7	52.2	4.2	73.8	48.1+19

1-Inside Masefau , 2-Outside Masefau, 3-Aoa, 4-Onenoa, 5-Fagasa, 6-Cape Larsen, 7-Fagafue,
8-Massacre Bay, 9-Rainmaker, 10-Fatu Rock

FISH COMMUNITIES

by **Alison Green**

INTRODUCTION

The coral reefs of American Samoa have suffered many destructive impacts in the last two decades, including a major outbreak of the corallivorous starfish *Acanthaster planci,* two devastating hurricanes and a mass coral bleaching event (see Coral Communities). In addition, the reefs in some locations, such as Pago Pago Harbor, have been subjected to human impacts including sedimentation, eutrophication and pollution (Craig *et al*. 1995, see Coral Communities). As a direct result of these disturbances, the coral reefs of Fagatele Bay National Marine Sanctuary and other locations around Tutuila Island have changed dramatically in recent years. Of particular importance have been the physical changes to the reef framework and the decrease in coral cover that have occurred in some locations (see Coral Communities).

Coral communities provide important habitat for fishes that inhabit coral reefs and a decline in their condition may have major consequences for the associated fish fauna. The purpose of this study was to determine if the coral reef fish communities in Fagatele Bay and elsewhere around Tutuila Island have changed substantially over the last two decades along with the changes in their habitat characteristics. Changes in the fish communities are described based on the results of several fish surveys that have been done over the last 18 years (Birkeland *et al*. 1987, Birkeland *et al*. 1994, this study).

METHODS

This study is divided into three sections which vary in terms of the sites surveyed, the methods used and the duration of the study:

Changes in the fish communities of Fagatele Bay from 1985 to 1995

The changes in the fish communities in Fagatele Bay are described based on the results of three surveys over the last ten years: 1985 (Birkeland *et al*. 1987), 1988 (Birkeland *et al*. 1994) and 1995 (this study). The physical and biological characteristics of the Bay are described in Birkeland *et al*. (1987), as well as a description of each transect including its exact location (see Fig. 2 in Coral Communities). All transects included in previous surveys were re-surveyed in this study (Table 31). This included counts at two depths (9m and 12m) at Sites 1 and 6, and at four depths (3m, 6m, 9m and 12m) at Sites 2 through 5. Each transect was established as close as possible to the transect locations used during previous surveys of the Bay. In addition, fishes were surveyed on the reef flat at two sites (Sites b and c: see Fig. 2 in Coral Communities) for the first time in this survey (Table 27). Standard transect dimensions of 30 x 2 m were used throughout this study, and surveys were done using the fish survey techniques described below. Fish communities are compared through time based on their species richness and abundance.

Short term changes in the fish communities around Tutuila Island (from 1988 to 1995)

The short term changes in the fish communities around Tutuila Island were examined based on two surveys done over the last six years: 1988 (Birkeland *et al.* 1994) and 1995 (this study). In each survey, fishes were counted at two depths (3m and 6m) at ten sites around Tutuila (Sites 1-4 and 7-12 in Fig. 1 in Coral Communities). As described by Randall and Birkeland (see Coral Communities), these sites were originally established in pairs of exposed and sheltered sites around the island. Transects were surveyed using the same dimensions as those used in Fagatele Bay (30 x 2 m). Fish communities are compared among years on the basis of their species richness and abundance.

Long term changes in the fish communities around Tutuila Island (from 1977 to 1995)

This long-term study was originally designed to describe the impact of an outbreak of *Acanthaster planci* on the reef fish communities on Tutuila Island. One transect was surveyed at each of three sites (Fagatele Bay, Sita Bay and Cape Larsen: see Fig. 1 in Coral Communities) on four occasions over an 18 year period. These surveys included times before and after the *Acanthaster* outbreak that occurred in late 1978: 1977-1978 and 1985 (Birkeland *et al.* 1987), 1988 (Birkeland *et al.* 1994) and 1995 (this study). Two of these sites (Fagatele Bay and Cape Larsen) were severely impacted at the time of the outbreak, while the other site (Sita Bay) was largely untouched (Birkeland *et al.* 1987). Since that time all three sites have been subjected to two major hurricanes (in 1990 and 1991) and a mass coral bleaching event (in 1994).

Larger transects (100 x 2 m) were used here than in the other two sections, because these transects were originally designed as part of a different project (see Wass 1982). The exact location of each transect is described in Birkeland *et al.* (1987), and care was taken to re-establish the transects as close as possible to their original locations.

Changes in the fish community at each of these sites was described by comparing trends in species richness and abundance over the last 18 years. These changes were then examined in more detail by comparing the number of individuals of each family that were recorded in each survey. Changes in the fish assemblages were also examined at the species level by comparing the abundance of each species of the two most abundant families, the Pomacentridae and Acanthuridae, during each survey.

Fish survey techniques

Fishes were surveyed using the same underwater visual census techniques that were used in previous surveys, which are described in detail in Birkeland *et al.* (1987, 1994). In each year of the survey, a single observer did the fish counts. However, the surveys were done by different observers in different years: R. Wass in 1977-1978 and 1985 (Birkeland *et al.* 1987), S. Amesbury in 1988 (Birkeland *et al.* 1994) and A. Green in 1995 (this study).

RESULTS

A total of 6792 individuals of 191 species were recorded on all of the 45 transects re-surveyed in Fagatele Bay and elsewhere around Tutuila Island in 1995 (see Tables 22-25). An additional 30 species were observed off the transects, one of which *(Acanthurus albipectoralis)* was a new record for American Samoa.

Changes in the fish communities of Fagatele Bay from 1985 to 1995

A total of 133 fish species were recorded on the reef slope transects in Fagatele Bay in 1995. This fish community was characterized by three acanthurid species *(Ctenochaetus striatus, Acanthurus nigrofuscus* and *Acanthurus nigricans),* one labrid species *(Thalassoma quinquevittatum),* five pomacentrid species *(Chrysiptera leucompoma, Pomacentrus vaiuli, Chromis acares, Pomacentrus brachialis* and *Plectrogylphidodon lacrymatus)* and one species of scarid *(Scarus sordidus)* Tables 22a-c.

Species richness was slightly higher on the reef slope in 1995 than it was in 1985 (Table 26). This was despite the fact that the area surveyed in 1985 was only 60% of that surveyed in 1995 (Table 26). In contrast, species richness in both 1985 and 1995 was almost twice that recorded in 1988 (Table 26). These trends in species richness were consistent at all depths surveyed in the Bay (Fig. 3).

A total of 2501 individuals were recorded on the reef slope transects at Fagatele Bay in 1995. Fish abundance was slightly less than that recorded in 1985 (Table 26), although the area surveyed in 1995 was almost twice as large as that surveyed in 1985 (Table 26). In a similar pattern to that recorded for species richness, the number of individuals recorded in 1988 was almost half that recorded in 1995 (Table 26). This trend in abundance was also consistent across depths within the Bay (Fig. 3).

Fishes were surveyed on the reef flats in Fagatele Bay for the first time in 1995, which added another nine species and 449 individuals to the total count for the Bay that year. The reef flat fish community was characterized by three pomacentrid species *(Stegastes albifasciatus, Chrysiptera cyanea* and *Chrysiptera leucopoma),* three acanthurid species *(Ctenochaetus striatus, Acanthurus nigrofuscus* and *Acanthurus triostegus),* one labrid species *(Thalassoma hardwicke)* and unidentified juvenile scarids (Table 23). Three of these species were not abundant on the adjacent reef slope *(S. albifasciatus, A. triostegus and T. hardwicke:* Tables 22a-c).

Species richness on the reef flat was slightly less than that recorded on the reef slope in the same year (1995: Fig. 3a). In contrast, fish abundance on the reef flat was more than twice as high as that recorded on the reef slope in the same year (1995: Fig. 3b). This was mostly because of the higher abundance of pomacentrids on the reef flat (Table 23) compared to the reef slope (Tables 22a-c) in the Bay.

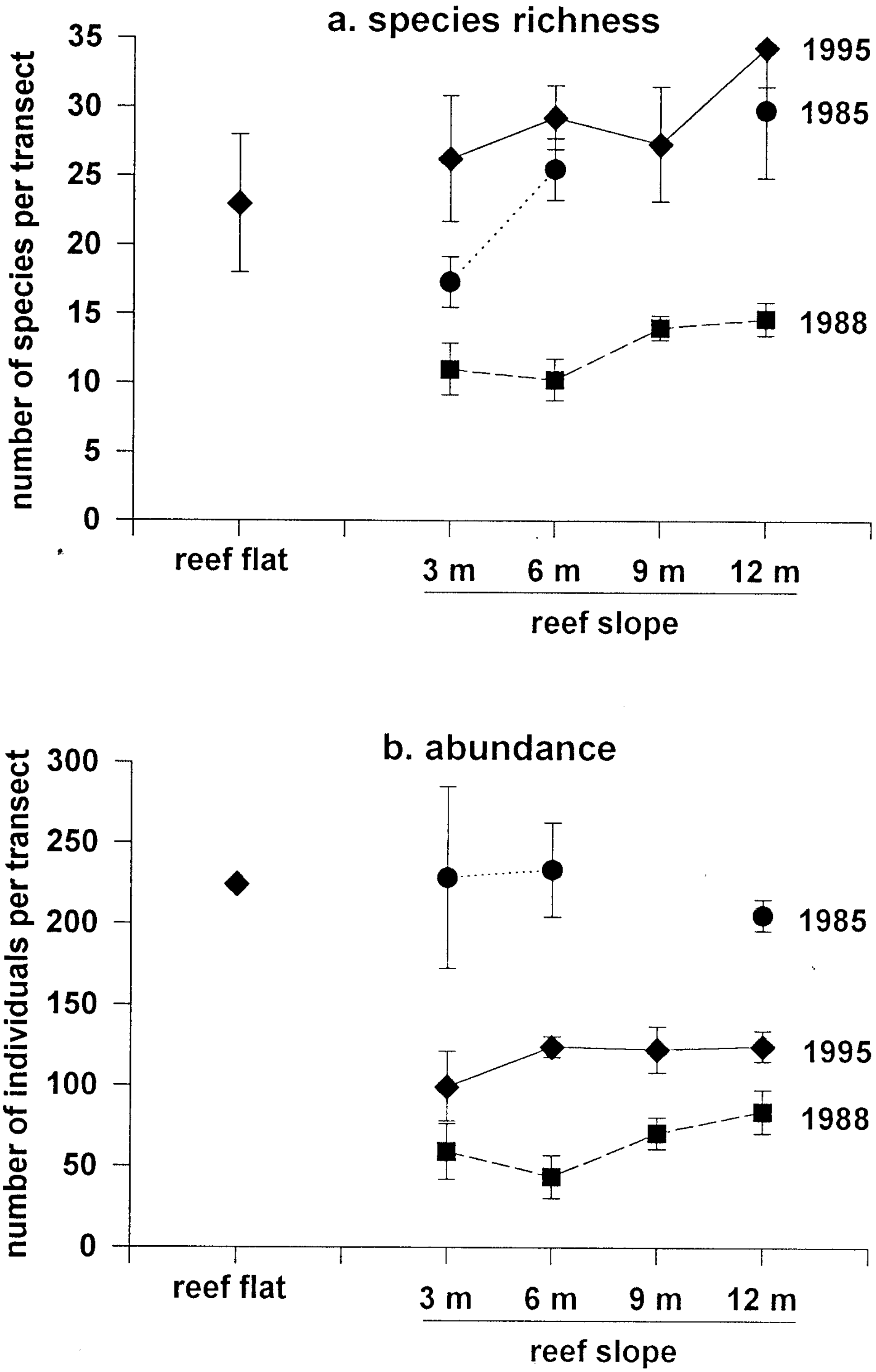


Fig. 3 Mean (and se) species richness (a) and abundance (b) of fishes in Fagatele Bay during each of three surveys over the last ten years. Please note that the number of transects surveyed varied among depths and years (see Table 31).

Short term changes in the fish communities around Tutuila Island (from 1988 to 1995)

This short-term study did not detect any clear patterns of variation in the fish communities around Tutuila Island associated with exposure, depth or year (Fig. 4, Tables 24a-c). Fish communities did not vary between exposed and sheltered sites in any consistent manner. In some cases, species richness and abundance was lower at sheltered than exposed sites (e.g. Fagasa vs Cape Larsen respectively: Fig. 4). However this pattern was more the exception than the rule, with species richness and abundance varying in no consistent pattern with exposure.

Fish communities did not vary in any consistent pattern associated with depth either (Fig. 4). At some sites, species richness or abundance was higher at 6m than at 3m. However, the opposite was true at other sites.

Similarly, fish communities around the island showed no consistent differences between the two years of the survey. At most sites, species richness was much higher in 1995 compared to 1988 (Fig. 4). However this was not true at 3m at Fagafue or at 6m in Massacre Bay, where species richness was similar in both years. At most sites, fish abundance was also higher in 1995 compared to 1988 (Fig. 4b). However the opposite was true at 6m at Massacre Bay and Rainmaker, where fish abundance was lower in 1995 compared to 1988.

Long term changes in the fish communities around Tutuila Island (from 1977 to 1995)

Some changes were detected in the fish communities at Fagatele Bay, Sita Bay and Cape Larsen over the last 18 years (Fig. 5). Species richness was similar at each site in 1977-1978, 1985 and 1995, but was much lower in 1988 (Fig. 5a). In contrast, fish abundance was higher in the two earlier surveys (1985 and 1977-1978), and lower in the two later surveys (1995 and 1988: Fig. 5b). These trends in species richness and abundance through time were consistent at all three sites (Fig. 5).

Changes were also evident over the last two decades in the composition of the fish communities at the three sites. Comparisons among families showed that the most dramatic change has been in the abundance of the dominant family, the Pomacentridae (Fig. 6). In the last survey in 1995, there were only 30-50% as many pomacentrids as there were in first survey in 1977-1978. An examination of this family at the species level showed that the most obvious change has been the dramatic decline in the abundance of *Plectroglyphidodon dickii* throughout the study (Fig. 7). *P. dickii* was the most abundant pomacentrid species in 1977-1978, but it is now relatively uncommon. In fact, there were only 1-9% as many individuals of this species recorded in 1995 as there were in 1977-1978. At Fagatele Bay and Cape Larsen, this decrease in abundance occurred sometime between 1977-1978 and 1985. However at Sita Bay, this decline did not occur until after 1985. Some other species, such as *Pomacentrus brachialis* and *Chromis acares,* have also decreased in abundance at some sites over time. In contrast, one species, *Chrysiptera cyanea*, has increased in abundance at one of the study sites (Cape Larsen: Fig. 7).

In contrast to the pomacentrids, the Family Acanthuridae has been relatively stable throughout the study (Fig. 8). The obvious exception to this was in 1985 when there was a peak in acanthurid abundance that occurred at all three sites (Fig. 8). However Birkeland *et al.* (1987)

reported that the vast majority of these individuals were juvenile *Ctenochaetus striatus* which had recently recruited to the reef (see Fig. 8 also). Observations at that time suggested that many of the individuals were in bad condition and were unlikely to survive to recruit to the adult population (Birkeland *et al*. 1987). In fact, this does appear to have been the case, since this increase in abundance was not maintained in subsequent years (Fig. 8). With the exception of this *C. striatus* peak in 1985, there were no apparent changes in the relative abundance of any acanthurid species through time (Fig. 8).

The other families represented in this study showed no obvious trends in abundance over time that were consistent at all three sites (Fig. 9). Only one family, the Scaridae, showed a dramatic increase in abundance, although this was apparent at one site only (Fagatele Bay: Fig. 9, Table 26).

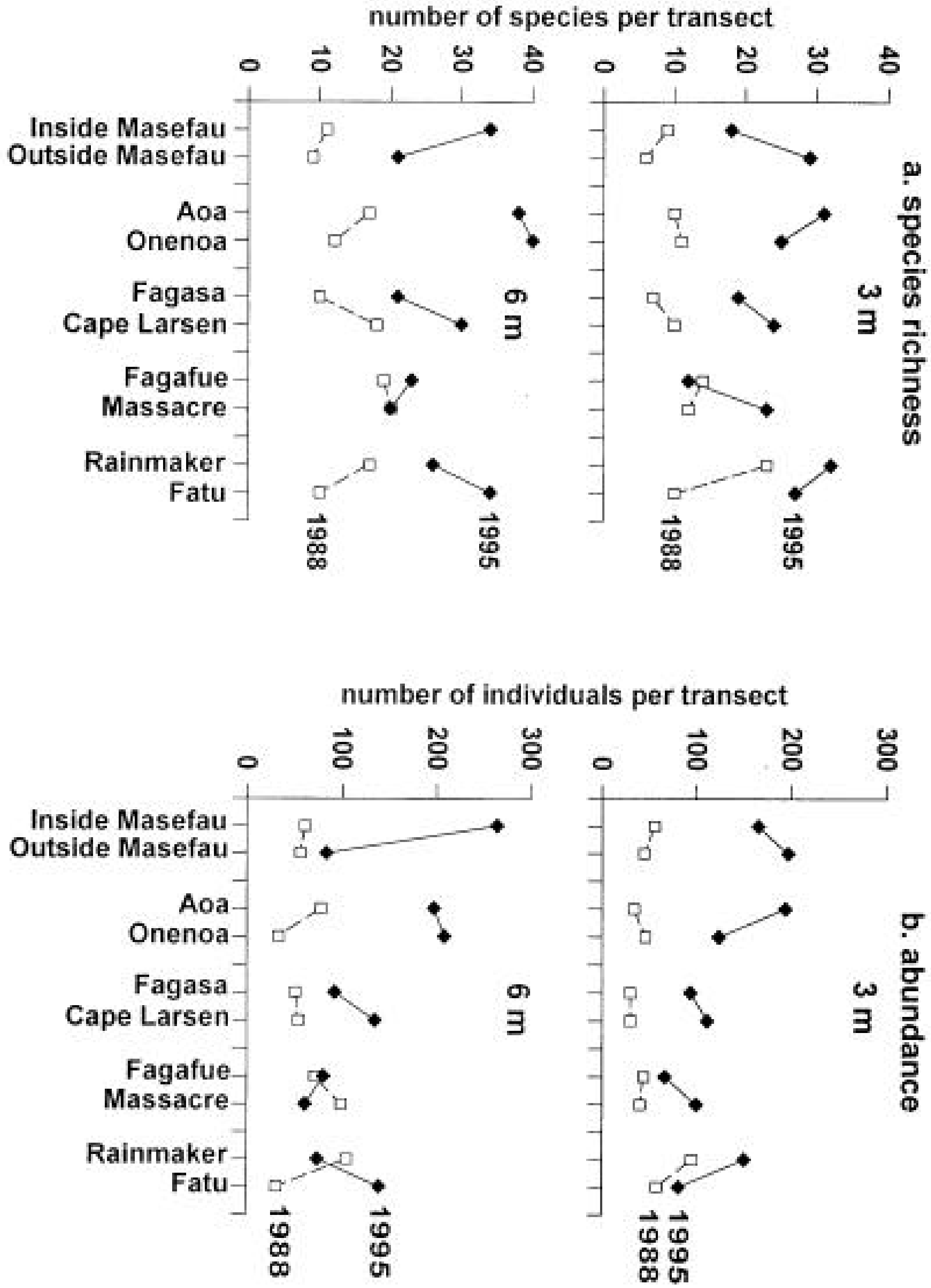
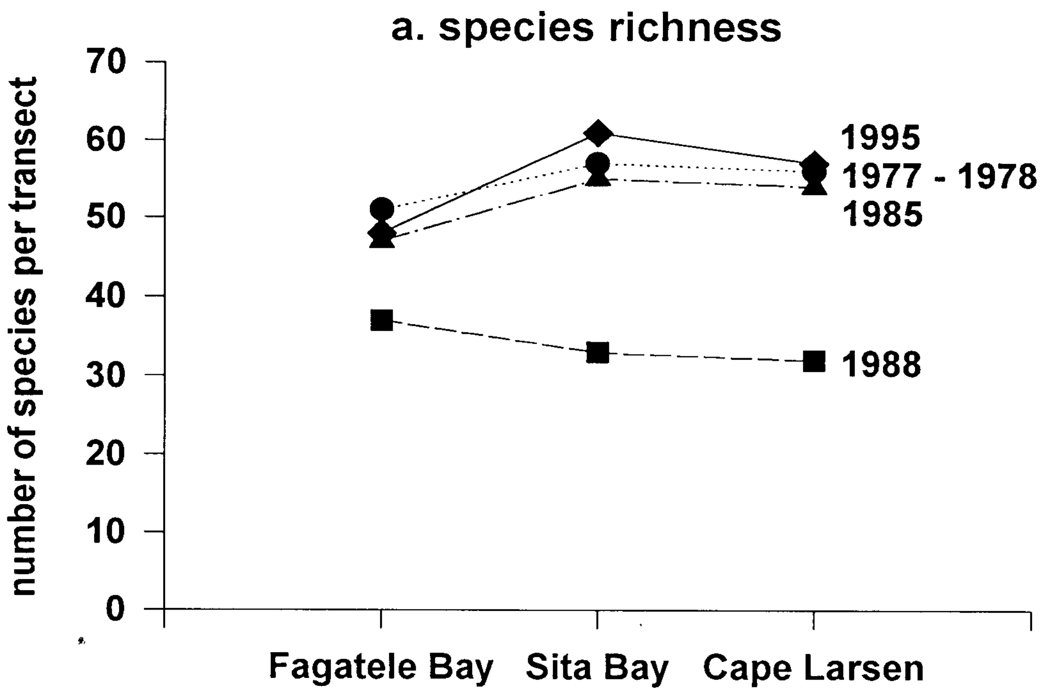


Figure 4. Comparison of species richness (a) and abundance (b) between surveys in 1988 and 1995 on the reef slope at ten sites around Tutuila Island.



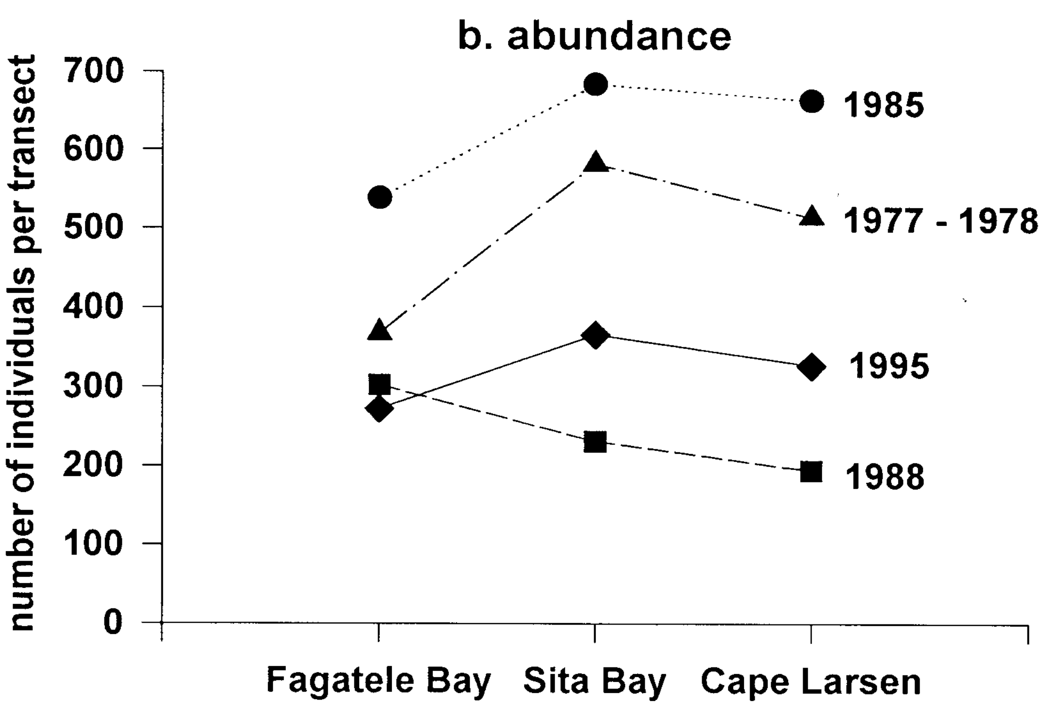


Fig. 5 Species richness (a) and abundance (b) of fishes on the reef slope at three sites around Tutuila Island on four occasions over the last 18 years.

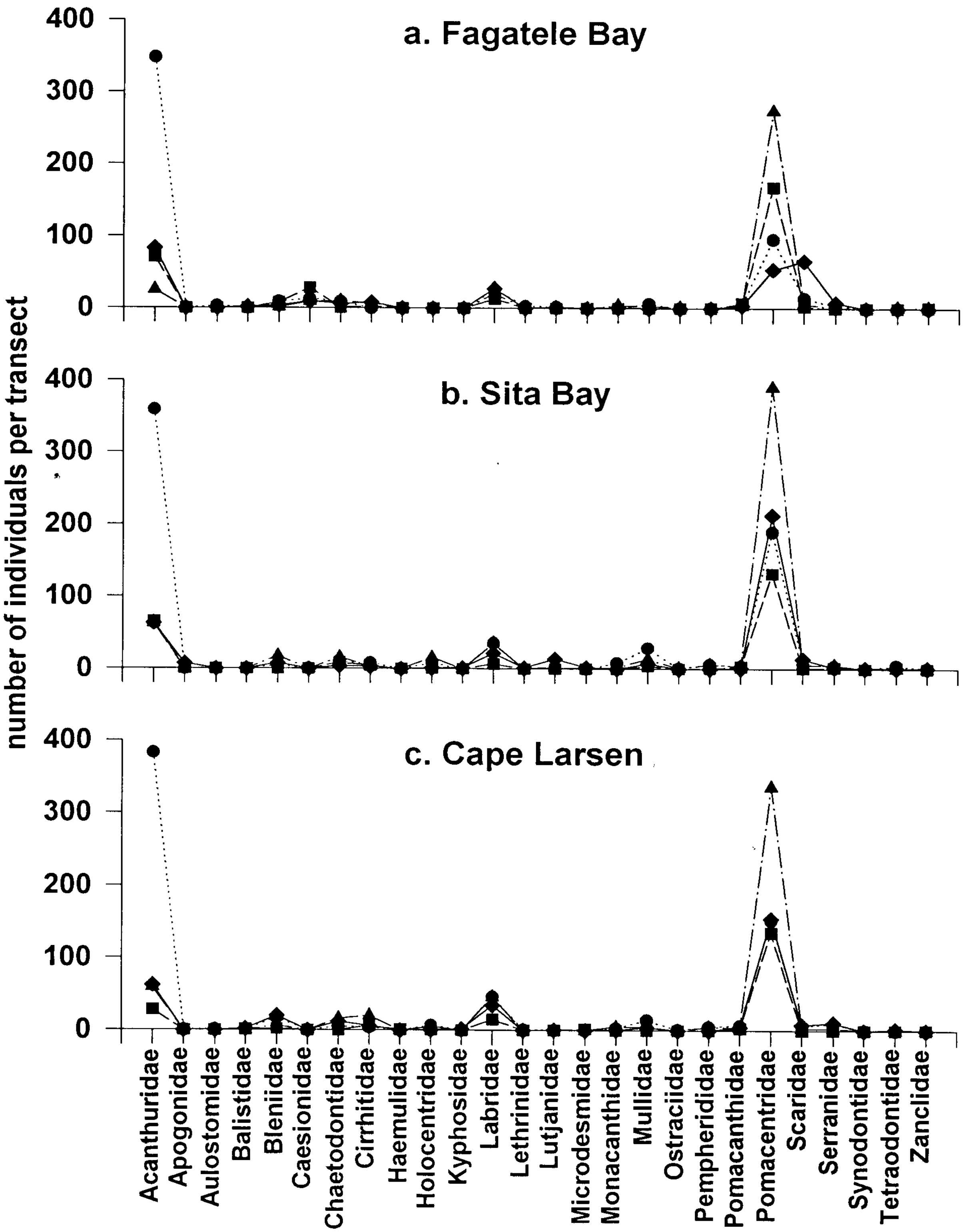


Fig. 6 Abundance of each family of fishes at three sites around Tutuila Island on four occasions over the last 18 years.
Where: ▲ =1977 - 1978, ● = 1985, ■ = 1988, and ◆ =1995.

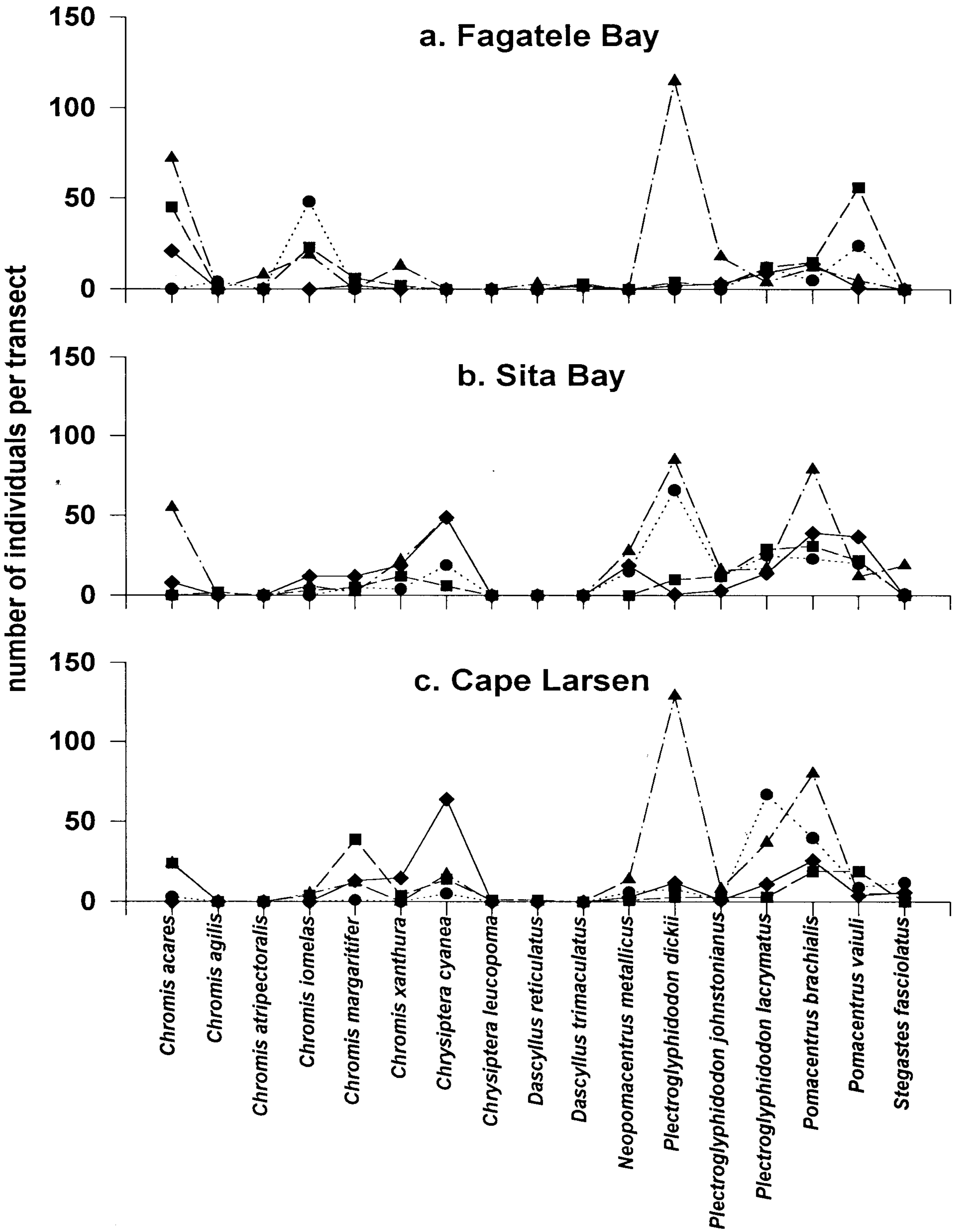


Fig. 7 Abundance of each pomocentrid species at three sites around Tutuila Island on four occasions over the last 18 years.
Where: ▲ =1977 - 1978, ● = 1985, ■ = 1988, and ◆ =1995.

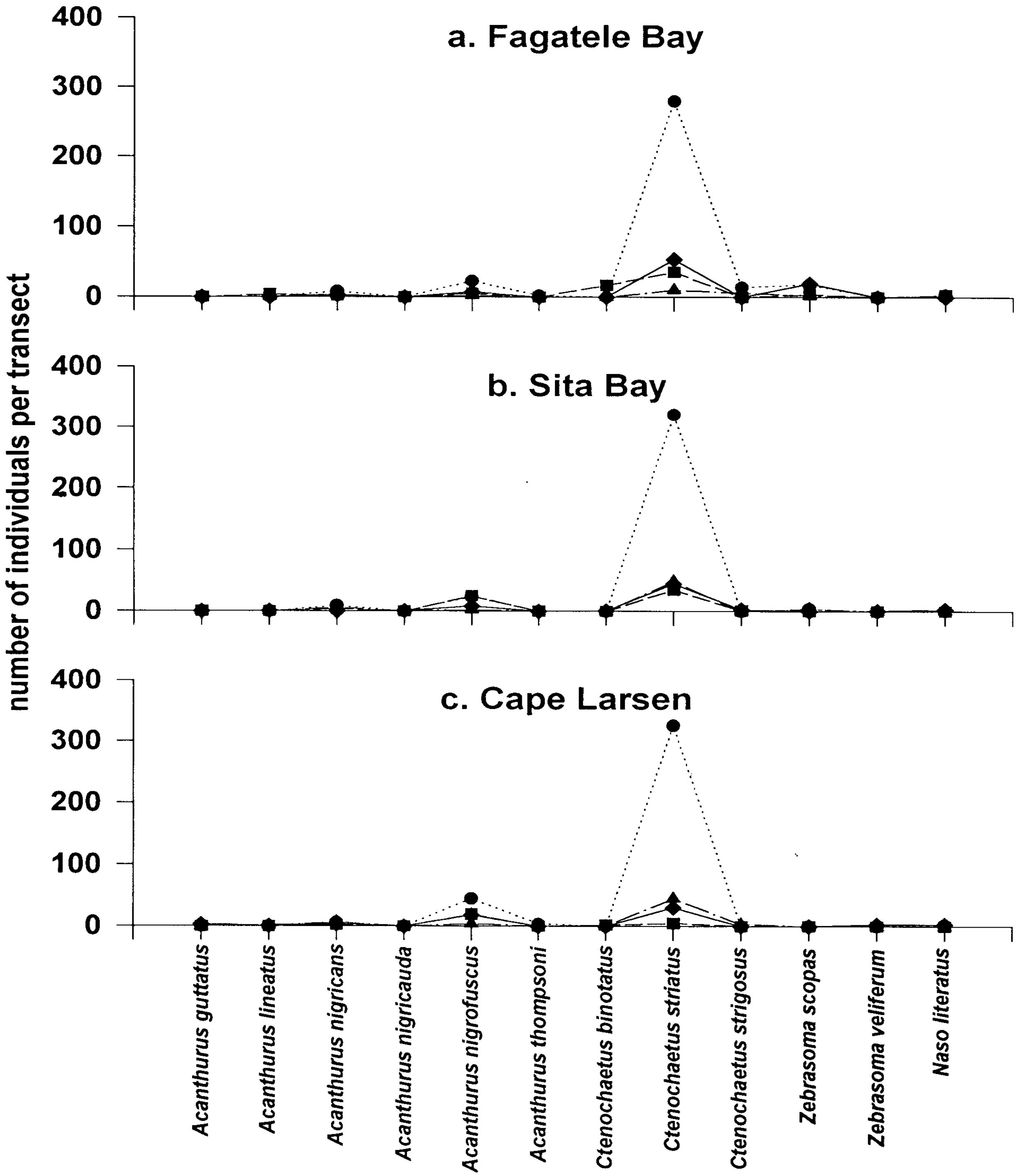


Fig. 8 Abundance of each acanthurid species at three sites around Tutuila Island on four occasions over the last 18 years.
Where: ▲ =1977 - 1978, ● = 1985, ■ = 1988, and ◆ =1995.

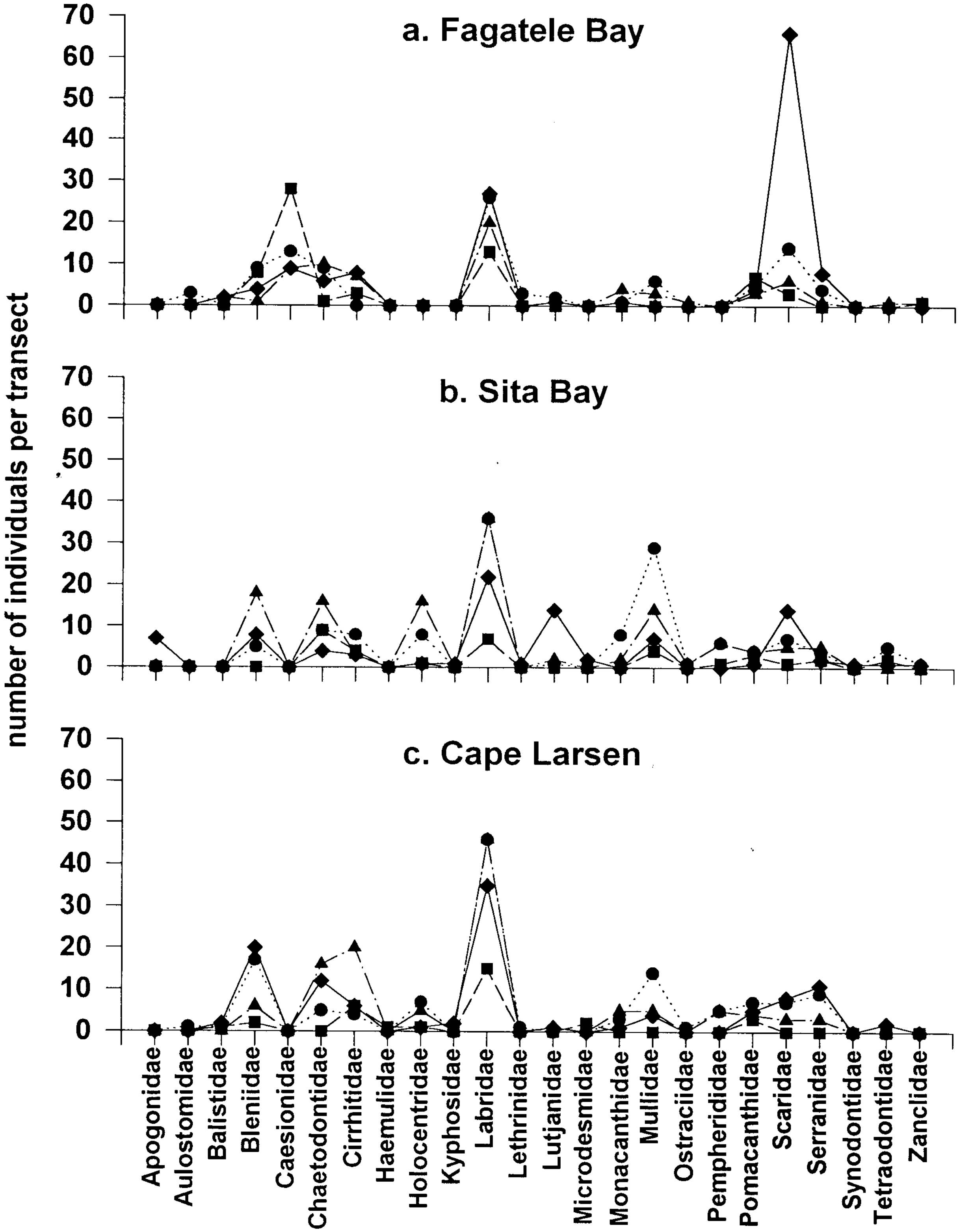


Fig. 9 Abundance of each acanthurid species at three sites around Tutuila Island on four occasions over the last 18 years.
Where: ▲ =1977 - 1978, ● = 1985, ■ = 1988, and ◆ =1995.

DISCUSSION

The coral reefs of Fagatele Bay and elsewhere around Tutuila Island have suffered many major impacts in the last two decades (see Introduction). These impacts have resulted in physical and biological changes to the coral communities, which provide important habitat for their associated fish fauna (see Introduction). This study has demonstrated that the fish communities in Fagatele Bay and elsewhere around Tutuila Island have also changed over the last two decades, concomitant with these changes in their habitat characteristics. However the degree to which these assemblages appear to have changed depends on the index used to assess the changes.

Species richness does not appear to have decreased throughout the course of this study, with similar species richness recorded during the surveys in 1977-1978, 1985 and 1994 (Figs. 3, 5). In contrast, species richness was consistently much lower in the 1988 survey than in those done in the other years (Figs. 3, 5). However this was probably the result of a difference in methodology between surveys and not an actual decline in species richness that year. The 1988 survey was done while other groups of divers were present in the water at the same time (C. Birkeland pers. comm.), which was not the case in the other surveys. As a result, the presence of other divers may have caused a greater disturbance to the fish community in 1988, resulting in a lower number of species being observed that year. This suggestion is supported by my observations that many fishes either hid or swam rapidly away when other divers entered the survey area (A. Green pers. obs.). Therefore, as a result of this difference in methodology, the 1988 survey was probably not comparable to surveys done in the other years.

In contrast to species richness, fish abundance appears to have decreased over time, with the highest number of individuals recorded in the earliest two surveys and the lowest recorded in the last two surveys (Figs. 3, 5). Once again, the lowest abundances were consistently recorded in 1988 (Figs. 3, 5). This was probably due to the same methodological differences that resulted in the lower species richness detected in that year (see above).

The difference between the survey methods used in 1988 and 1995 may also be partly responsible for the fact that the short term study of the ten sites around the island (from 1988 to 1995), failed to produce any consistent patterns of species richness or abundance with exposure, depth or year. For this reason I recommend that this section of the study be disregarded until surveys can be done in future years using the same methods as those used in 1995.

The most dramatic changes in the fish communities around Tutuila Island have been in the changes in abundances of some families and species over the last two decades. The most abundant family, the Pomacentridae, is now represented by only 30-50% as many individuals as it was in the 1970s. This decline was largely due to a 91-99% decrease in the abundance of one species, *Plectroglyphidodon dickii,* which may be explained in the context of habitat degradation. *P. dickii* is a territorial inhabitant of robustly branching *Pocillopora* and *Acropora* corals (Myers 1989), and since coral cover has decreased dramatically at these study sites throughout the study, it is likely that habitat degradation has been responsible for the decline in this species. This suggestion is further supported by the fact that the decline at Fagatele Bay and Cape Larsen occurred after the 1977-1978 survey, which coincided with the decrease in coral cover at those sites due to an outbreak of the crown-of-thorns starfish (Birkeland *et al.* 1994). In contrast, the decrease in the abundance of *P. dickii* did not occur at Sita Bay at that time, since that site was unaffected by the starfish outbreak (Birkeland *et al*. 1994). In contrast, the decline of this species occurred sometime between 1985 and 1994 at Sita Bay, during which time two major hurricanes caused extensive damage to the coral communities around the island (see Coral Communities). The decline in other pomacentrid species, *Chromis acares* and *Pomacentrus brachialis,* may also be related to the decrease in live coral cover at these sites. In contrast, the one pomacentrid species that increased in abundance, *Chrysiptera cyanea,* is known to be associated with rubble patches that may have increased throughout the course of the study. However the case for habitat degradation being responsible for these changes in abundance is largely circumstantial, and it is possible that other confounding factors such as recruitment variability may have contributed to these patterns also.

In contrast to the pomacentrids, the Family Acanthuridae did not show a similar decline in abundance throughout the study. *Ctenochaetus striatus* has remained the dominant acanthurid species on the reef slopes of Fagatele Bay and elsewhere around the island throughout the last two decades. Furthermore, the relative abundance of the other acanthurid species remained similar throughout the study. The fact that this family did not appear to decrease in response to the changes in the coral communities was not surprising, since they are roving herbivores that are less likely to be affected by the loss of coral cover than are small site-attached pomacentrids. In fact the only family that showed an increase in abundance was another family of roving herbivores, the Scaridae (Fig. 9). However, this increase was apparent at one site only (Fagatele Bay).

At this point, it is important to take note of the limitations of this study. One important limitation, the problem of different methodologies among years, has already been mentioned. However, inter-observer bias may have been a confounding factor in this study in more ways than one. For example, the observers may have differed in their ability to judge the width of the transect, or their ability to identify species. Another methodological problem was the fact that the surveys were done at different months in different years (the 1995 survey was done in July, while the others were done in April). Consequently, seasonal differences could have contributed to some of the patterns described in this study. Since methodological differences among surveys can cause substantial problems in the long term monitoring of fish communities, it is recommended that the same observer using a standardized set of methods be used in all subsequent surveys.

Another limitation of this survey was the lack of replication in some aspects of the study design. In other situations, unequal replication of transects was also limiting, because it made testing for significant differences among years and sites problematic. In future years it is recommended that the experimental design for this study be expanded to rectify this situation. Despite these limitations, the results of this study are still valuable, since they are quantitative and comprise a long time series of information.

In conclusion, the fish communities of Fagatele Bay and elsewhere around Tutuila Island have changed in the last two decades. This is probably the result of habitat degradation caused by the effects of several major disturbances on the coral reefs. At present, these reefs are in an important stage of recovery. Fortunately, coral colonies are recruiting and growing quickly at most sites around the island (see Coral Communities, A. Green pers. obs.) and recovery appears to be well underway (see Coral Communities). In the absence of any major perturbations in the next few years, most of the coral communities in this study should continue to recover (see Coral Communities) and, along with them, their associated fish communities.

Table 22a. Fishes censused on the reef slope at Fagatele Bay in 1995, Sites 1 and 2. Numbers indicate the number of individuals of each species counted on the transect, and the letter P indicates the presence of a species in the vicinity of the transect line.

	Site 1		Site 2			
	9m	12m	3m	6m	9m	12m
ACANTHURIDAE						
Acanthurus achilles			7			
A. albipectoralis						
A. blochii						
A. guttatus						
A. lineatus	P	1	2	P		
A. nigricans	2	4	8	5	3	2
A. nigricauda	2					
A. nigrofuscus			11	5	2	
A. nigroris						
A. olivaceus		P				
A. pyroferus						
A. thompsoni	P					
A. triostegus						
Ctenochaetus binotatus						
C. striatus	7	14	37	50	33	17
C. strigosus		6				
Naso annulatus		P				
N. brevirostris						
N. hexacanthus						
N. literatus	P				1	P
N. unicornis						
N. spp.						
Zebrasoma scopas					4	4
Z. veliferum						
APOGONIDAE						
Apogon doederleini						
AULOSTOMIDAE						
Aulostomus chinensis		P				
BALISTIDAE						
Balistapus undulatus	1	1		P	1	1
Balistoides viridescens						
Melichthys vidua	2	2		P		P
M. niger						
Pseudobalistes flavimarginatus						
Rhinecanthus rectangulus						
Sufflamen bursa	1	P			P	
S. chrysopterus						
S. freanatus						

Table 22a continued	Site 1		Site 2			
	9m	12m	3m	6m	9m	12m
BLENNIIDAE						
Aspidontus dussumieri						
Escenius bicolor						
Meiacanthus atrodorsalis						
Plagiotremus tapeinosoma						
unidentified blenniids	1			2	1	
BOTHIDAE						
Bothus pantherinus						
CAESIONIDAE						
Caesio cunning	P	P				
Pterocaesio tile					1	
P. trilineata					33	37
CARANGIDAE						
Caranx melampygus						P
Scomberoides lysan						
CHAETODONTIDAE						
Chaetodon bennetti						
C. citrinellus						
C. ephippium		P				
C. lunula		P				
C. mertensii						
C. ornatissimus		1		2		
C. pelewensis						
C. reticulatus	P	2	P			1
C. semeion		1	1			P
C. trifascialis			P	1		
C. trifasciatus			P	P		
C. ulietensis						
C. unimaculatus	P	1				
C. vagabundus			P			
Forcipiger flavissimus	P	P				
F. longirostris	P					
Hemitaurichthys polylepis	P	2				
Heniochus chrysostomus						
H. monoceros						
H. varius						
CIRRHITIDAE						
Cirrhitichthys pinnulatus						
Paracirrhites arcatus	7	P		3	2	P
P. forsteri		P	P	1	2	2
P. hemisticus			P	P		
CORYPHAENIDAE						
Coryphaena hippurus						

Table 22a continued	Site 1		Site 2			
	9m	12m	3m	6m	9m	12m
GOBIIDAE						
Valenciennea strigata						
HAEMULIDAE						
Plectorhynchus orientalis		P				
HOLOCENTRIDAE						
Myripristis berndti						
M. kuntee						
M. violacea						
Neoniphon sammara						
Sargocentron caudimaculatum						
S. spiniferum		P				
KYPHOSIDAE						
Kyphosus cinerascens						
K. vaigiensis		P				
LABRIDAE						
Anampsis caeruleopunctatus						
A. twistii						
Bodianus axillaris		P		P		
B. loxozonus						
Cheilinus diagrammus					1	
C. fasciatus						
C. oxycephalus						
C. trilobatus			P			
C. undulatus						
C. unifasciatus		1			1	2
Coris aygula		1				
C. gaimard	1	1		P		
Epibulus insidiator		2			1	P
Gomphosus varius		P		4	1	1
Halichoeres biocellatus						
H. hortulanus	1	2	2	1	P	
H. margaritaceus					P	
H. marginatus			1			
H. melanurus						
H. ornatissimus		P				
H. trimaculatus						
Hemigymnus fasciatus		1		P	1	1
H. melapterus	P	1	P			
Labrichthys unilineatus						3
Labroides bicolor		1		1	1	2
L. dimidiatus			1			
L. rubrolabiatus				1	P	P
Labropsis xanthonota	1					P
Macropharyngodon meleagris						

Table 22a continued	Site 1		Site 2			
	9m	**12m**	**3m**	**6m**	**9m**	**12m**
Macropharyngodon negrosensis						
Novaculichthys taeniourus						
Pseudocheilinus evanidus		P				
P. hexataenia		1				
P. octotaenia						
Pseudodax moluccanus	P	1				
Stethojulis bandanensis						
S. trilineata						
Thalassoma amblycephalum	33					
T. hardwicke				P	2	P
T. lutescens	1	1				P
T. purpureum						
T. quinquevittatum	6	3	9	12	3	
T. trilobatum						
LETHRINIDAE						
Gnathodentex aureolineatus		9		5		
Lethrinus harak						
L. obsoletus						
Monotaxis grandoculis		P				
LUTJANIDAE						
Aphareus furca	1				P	P
Aprion virescens						
Lutjanus bohar		P				
L. fulvus						
L. monostigma						
Macolor niger		P				
M. macularis				1		
MALACANTHIDAE						
Malacanthus latovittatus						
MICRODESMIDAE						
Nemateleotris magnifica						
Ptereleotris evides						
Ptereleotris heteroptera						
P. zebra						
MONACANTHIDAE						
Amanses scopas						P
Cantherhinus dumerilii		1				P
C. spp.						
MULLIDAE						
Mulloides flavolineatus						
M. vanicolensis					17	
Parupeneus barberinus						
P. bifasciatus		P				
P. cyclostomus	P		P	P		

Table 22a continued	Site 1		Site 2			
	9m	**12m**	**3m**	**6m**	**9m**	**12m**
P. multifasciatus		P		P	P	1
OSTRACIIDAE						
Ostracion meleagris						
O. cubicus				1		
PEMPHERIDAE						
Pempheris oualensis					2	
PINGUIPEDIDAE						
Parapercis clathrata			P			
POMACANTHIDAE						
Apolemichthys trimaculatus						
Centropyge bicolor						
C. bispinosus		P				1
C. flavissimus	4	3	P		1	P
Pomacanthus imperator		P				
Pygoplites diacanthus	P	1		1		
POMACENTRIDAE						
Abudefduf septemfasciatus						
A. sexfasciatus						
A. vaigiensis						
Amphiprion chrysopterus						
A. clarkii						
A. melanopus						
Chromis acares		4	P	P	P	P
C. agilis						
C. amboinensis						
C. iomelas		13				P
C. margaritifer	24	4		P		P
C. vanderbilti		7	P	1		
C. xanthura		P				
C. spp.						
Chrysiptera cyanea	P		7	2		
C. glauca						
C. leucopoma			14			
Dascyllus trimaculatus	P	3				1
Neopomacentrus metallicus						
Plectroglyphidodon dickii	6	2		1	1	2
P. johnstonianus	4	1			P	2
P. lacrymatus				4	6	1
P. leucozonus						
P. phoenixensis						
Pomacentrus brachialis		4		2	11	10
P. vaiuli	5	6	P	2		
Pomachromis richardsoni	7					
Pristotis jerdoni	3					

Table 22a continued	Site 1		Site 2			
	9m	12m	3m	6m	9m	12m
Stegastes albifasciatus						
S. fasciolatus			3	1		
S. nigricans						
SCARIDAE						
Calotomus carolinus						
Cetoscarus bicolor		12				
Hipposcarus longiceps						
Scarus altipinnus						
S. forsteni	P	1		P	1	P
S. frenatus			P	1	1	
S. frontalis						
S. ghobban						
S. globiceps			P			
S. microrhinos		P			P	
S. niger						
S. oviceps	P	2	1	1	3	2
S. psittacus		1	9	1	2	12
S. pyrrhurus	P		1	2		
S. rubroviolaceus	P	4	P	P		
S. schlegeli						
S. sordidus	1	P	2	7	10	13
S. spinus		P		P	1	1
S. trilineata						
juveniles					2	
SERRANIDAE						
Aethaloperca rogaa						P
Cephalopholis argus	P	1	1			P
C. leopardus						
C. urodeta	2	1				
Epinephelus howlandi				P		
E. maculatus						
E. merra						
Plectropomus leopardus						
Variola louti						2
SIGANIDAE						
Siganus argenteus						
SYGNATHIDAE						
Corythoichthys intestinalis						
SYNODONTIDAE						
Synodus spp.						
TETRAODONTIDAE						
Arothron meleagris						
A. nigropunctatus						
Canthigaster solandri						

Table 22a continued

	Site 1		Site 2			
	9m	**12m**	**3m**	**6m**	**9m**	**12m**
ZANCLIDAE						
Zanclus cornutus	P	2	P			
Total No. Species	45	72	37	47	39	45
On-Transect Species	24	44	18	30	31	25
On-Transect Individuals	125	122	117	138	135	122

Table 22b. Fishes censused on the reef slope at Fagatele Bay in 1995, Sites 3 and 4. Numbers indicate the number of individuals of each species counted on the transect, and the letter P indicates the presence of a species in the vicinity of the transect line.

	Site 3				Site 4			
	3m	6m	9m	12m	3m	6m	9m	12m
ACANTHURIDAE								
Acanthurus achilles					1			
A. albipectoralis				P				
A. blochii								
A. guttatus								
A. lineatus					8	4		
A. nigricans		1	2	1	1		1	8
A. nigricauda								
A. nigrofuscus	5	6	7	6	12	8	9	3
A. nigroris								
A. olivaceus								
A. pyroferus								
A. thompsoni								
A. triostegus	7							
Ctenochaetus binotatus								
C. striatus	33	26	18	26	42	29	49	23
C. strigosus				2	2	5	2	
Naso annulatus			P	P				
N. brevirostris								
N. hexacanthus								
N. literatus	P		P					
N. unicornis								
N. spp.								
Zebrasoma scopas	1	6	7	9			3	7
Z. veliferum	P				P			
APOGONIDAE								
Apogon doederleini								

Table 22b continued	Site 3				Site 4			
	3m	6m	9m	12m	3m	6m	9m	12m
AULOSTOMIDAE								
Aulostomus chinensis								
BALISTIDAE								
Balistapus undulatus		P	1		1	P	1	2
Balistoides viridescens								
Melichthys vidua	1	P	2	2	P		3	
M. niger								
Pseudobalistes flavimarginatus								
Rhinecanthus rectangulus								
Sufflamen bursa								
S. chrysopterus								
S. freanatus								
BLENNIIDAE								
Aspidontus dussumieri								
Escenius bicolor								
Meiacanthus atrodorsalis								
Plagiotremus tapeinosoma								
unidentified blenniids		7	4			3	3	
BOTHIDAE								
Bothus pantherinus								
CAESIONIDAE								
Caesio cunning								
Pterocaesio tile			10					
P. trilineata			20	50			6	P
CARANGIDAE								
Caranx melampygus								
Scomberoides lysan								
CHAETODONTIDAE								
Chaetodon bennetti		1						
C. citrinellus						1		
C. ephippium	P							

Table 22b continued	**Site 3**				**Site 4**			
	3m	**6m**	**9m**	**12m**	**3m**	**6m**	**9m**	**12m**
C. lunula								
C. mertensii								
C. ornatissimus	P							
C. pelewensis		2		1				1
C. reticulatus	2	2	1	P	1			P
C. semeion	P		P		2			
C. trifascialis								
C. trifasciatus								
C. ulietensis	P	2						
C. unimaculatus								
C. vagabundus		1	P		1			
Forcipiger flavissimus								
F. longirostris							P	P
Hemitaurichthys polylepis								
Heniochus chrysostomus								
H. monoceros				P				
H. varius						P		
CIRRHITIDAE								
Cirrhitichthys pinnulatus								
Paracirrhites arcatus		2	P		P		2	
P. forsteri		P	1			P		1
P. hemisticus								
CORYPHAENIDAE								
Coryphaena hippurus								
GOBIIDAE								
Valenciennea strigata								
HAEMULIDAE								
Plectorhynchus orientalis	P	P						
HOLOCENTRIDAE								
Myripristis berndti						1		
M. kuntee								

Table 22b continued	Site 3				Site 4			
	3m	6m	9m	12m	3m	6m	9m	12m
M. violacea								
Neoniphon sammara								
Sargocentron caudimaculatum								
S. spiniferum								
KYPHOSIDAE								
Kyphosus cinerascens								
K. vaigiensis	1							
LABRIDAE								
Anampsis caeruleopunctatus								
A. twistii		1	1				1	3
Bodianus axillaris								
B. loxozonus								1
Cheilinus diagrammus		1	P				1	1
C. fasciatus								
C. oxycephalus	2			1				
C. trilobatus								
C. undulatus								
C. unifasciatus		1	P	1		1		
Coris aygula							P	
C. gaimard								
Epibulus insidiator			P	1		P		
Gomphosus varius	2	1	3	3		2	1	2
Halichoeres biocellatus								
H. hortulanus							1	
H. margaritaceus								
H. marginatus								
H. melanurus								
H. ornatissimus								
H. trimaculatus								
Hemigymnus fasciatus	P	P		P			P	
H. melapterus				P				

Table 22b continued	Site 3				Site 4			
	3m	6m	9m	12m	3m	6m	9m	12m
Labrichthys unilineatus	P	2	1	3				
Labroides bicolor	P	1	2	1	2			
L. dimidiatus	1	2	2	1		1	1	2
L. rubrolabiatus		1	1	1		2	P	2
Labropsis xanthonota			2	P			8	2
Macropharyngodon meleagris								
Macropharyngodon negrosensis								
Novaculichthys taeniourus								
Pseudocheilinus evanidus								
P. hexataenia		P	1	1			P	1
P. octotaenia								
Pseudodax moluccanus								
Stethojulis bandanensis								
S. trilineata								
Thalassoma amblycephalum								
T. hardwicke	4	3	1		P	2	P	
T. lutescens			1	P				
T. purpureum								
T. quinquevittatum	3	4			7	8		
T. trilobatum								
LETHRINIDAE								
Gnathodentex aureolineatus								
Lethrinus harak	3				P			
L. obsoletus								
Monotaxis grandoculis		1						P
LUTJANIDAE								
Aphareus furca	P	P	1	3				1
Aprion virescens								
Lutjanus bohar								
L. fulvus		P						
L. monostigma	2							

Table 22b continued	Site 1				Site 2			
	3m	6m	9m	12m	3m	6m	9m	12m
Macolor niger		P	1					
M. macularis		P						
MALACANTHIDAE								
Malacanthus latovittatus								
MICRODESMIDAE								
Nemateleotris magnifica								
Ptereleotris evides			P	1				
Ptereleotris heteroptera								
P. zebra								
MONACANTHIDAE								
Amanses scopas		P	P	P				
Cantherhinus dumerilii								
C. spp.								
MULLIDAE								
Mulloides flavolineatus								
M. vanicolensis								
Parupeneus barberinus								
P. bifasciatus								
P. cyclostomus	2	P	P	3		4	P	3
P. multifasciatus								
OSTRACIIDAE								
Ostracion meleagris								
O. cubicus								
PEMPHERIDAE								
Pempheris oualensis			P					
PINGUIPEDIDAE								
Parapercis clathrata								
POMACANTHIDAE								
Apolemichthys trimaculatus								
Centropyge bicolor								
C. bispinosus			1	2				

Table 22b continued	**Site 3**				**Site 4**			
	3m	**6m**	**9m**	**12m**	**3m**	**6m**	**9m**	**12m**
C. flavissimus	P	P	2		P		P	
Pomacanthus imperator								
Pygoplites diacanthus	P			1			P	
POMACENTRIDAE								
Abudefduf septemfasciatus								
A. sexfasciatus								
A. vaigiensis								
Amphiprion chrysopterus		P		P				2
A. clarkii								
A. melanopus	P	P		P				5
Chromis acares			17		4	13	21	
C. agilis			2	P				1
C. amboinensis			1	2				
C. iomelas			1	4			1	19
C. margaritifer			1					3
C. vanderbilti							P	
C. xanthura		P	P	3			3	1
C. spp.								
Chrysiptera cyanea	4	P			21	2		
C. glauca								
C. leucopoma					12			
Dascyllus trimaculatus			P	P		P		
Neopomacentrus metallicus								
Plectroglyphidodon dickii	2	3	P				1	
P. johnstonianus			1	4				2
P. lacrymatus		8	6	8		10	17	5
P. leucozonus								
P. phoenixensis								
Pomacentrus brachialis	2	5	15	2	5	4	1	1
P. vaiuli		5	1	11	8	8	11	10
Pomachromis richardsoni								

Table 22b continued	Site 3				Site 4			
	3m	6m	9m	12m	3m	6m	9m	12m
Pristotis jerdoni								
Stegastes albifasciatus								
S. fasciolatus	1	1	1			8		
S. nigricans	7							
SCARIDAE								
Calotomus carolinus		P		P				
Cetoscarus bicolor								
Hipposcarus longiceps								
Scarus altipinnus								
S. forsteni		1		P		P	1	
S. frenatus	2	1			P	1		
S. frontalis								
S. ghobban							P	
S. globiceps	1		P					
S. microrhinos								
S. niger			1				1	
S. oviceps	3	1	P	1	1	2		P
S. psittacus	1	1		P	6	P	1	P
S. pyrrhurus	P	5	2	1	1	5	1	1
S. rubroviolaceus		P		P				
S. schlegeli								
S. sordidus	2	8	2	1	2	3	10	1
S. spinus	P	P	1	1		P		1
S. trilineata								
juveniles								
SERRANIDAE								
Aethaloperca rogaa								
Cephalopholis argus		1	1	3		P		1
C. leopardus								
C. urodeta		1	1			1	1	1
Epinephelus howlandi								

Table 22b continued	Site 3				Site 4			
	3m	6m	9m	12m	3m	6m	9m	12m
E. maculatus								
E. merra						1		
Plectropomus leopardus								
Variola louti								
SIGANIDAE								
Siganus argenteus	1	P						
SYGNATHIDAE								
Corythoichthys intestinalis								
SYNODONTIDAE								
Synodus spp.								
TETRAODONTIDAE								
Arothron meleagris								
A. nigropunctatus								
Canthigaster solandri								
ZANCLIDAE								
Zanclus cornutus								1
Total No. Species	42	55	60	52	31	34	37	40
On-Transect Species	26	35	41	36	22	24	29	34
On-Transect Individuals	95	117	147	163	144	110	158	134

Table 22c. Fishes censused on the reef slope at Fagatele Bay in 1995, Sites 5 and 6. Numbers indicate the number of individuals of each species counted on the transect, and the letter P indicates the presence of a species in the vicinity of the transect line.

	Site 5				Site 6	
	3m	6m	9m	12m	9m	12m
ACANTHURIDAE						
Acanthurus achilles		P	P			P
A. albipectoralis						
A. blochii				P		
A. guttatus	P					
A. lineatus	3	5	1	1		
A. nigricans						
A. nigricauda						
A. nigrofuscus		1	11		8	3
A. nigroris						
A. olivaceus						
A. pyroferus						
A. thompsoni						
A. triostegus	P					
Ctenochaetus binotatus						
C. striatus	1	60	15	20	P	20
C. strigosus			1	1		P
Naso annulatus						4
N. brevirostris						P
N. hexacanthus						
N. literatus		1	2			1
N. unicornis						
N. spp.						
Zebrasoma scopas				3		
Z. veliferum	P	4				
APOGONIDAE						
Apogon doederleini						
AULOSTOMIDAE						
Aulostomus chinensis						
BALISTIDAE						
Balistapus undulatus		P	1	P		1
Balistoides viridescens						P
Melichthys vidua	P	P	P	P	2	P
M. niger				P		
Pseudobalistes flavimarginatus						
Rhinecanthus rectangulus	P					P
Sufflamen bursa		1	P	2		
S. chrysopterus						
S. freanatus						

Table 22c continued	Site 5				Site 6	
	3m	6m	9m	12m	9m	12m
BLENNIIDAE						
Aspidontus dussumieri						
Escenius bicolor						
Meiacanthus atrodorsalis						
Plagiotremus tapeinosoma						
unidentified blenniids	3	3	6	2	1	1
BOTHIDAE						
Bothus pantherinus						
CAESIONIDAE						
Caesio cunning						P
Pterocaesio tile						
P. trilineata						
CARANGIDAE						
Caranx melampygus						
Scomberoides lysan						
CHAETODONTIDAE						
Chaetodon bennetti						
C. citrinellus						
C. ephippium				1		1
C. lunula						
C. mertensii						
C. ornatissimus						
C. pelewensis						
C. reticulatus		P	P		1	
C. semeion		1				
C. trifascialis						
C. trifasciatus						
C. ulietensis		P				
C. unimaculatus						
C. vagabundus		P				
Forcipiger flavissimus				P		
F. longirostris			P			1
Hemitaurichthys polylepis						1
Heniochus chrysostomus						
H. monoceros						
H. varius						
CIRRHITIDAE						
Cirrhitichthys pinnulatus	P					
Paracirrhites arcatus				P		3
P. forsteri		1		1		
P. hemisticus						
CORYPHAENIDAE						
Coryphaena hippurus						P

Table 22c continued	Site 5				Site 6	
	3m	6m	9m	12m	9m	12m
GOBIIDAE						
Valenciennea strigata					P	
HAEMULIDAE						
Plectorhynchus orientalis						
HOLOCENTRIDAE						
Myripristis berndti						
M. kuntee						
M. violacea						
Neoniphon sammara						
Sargocentron caudimaculatum						
S. spiniferum						
KYPHOSIDAE						
Kyphosus cinerascens						
K. vaigiensis						
LABRIDAE						
Anampsis caeruleopunctatus		P				
A. twistii		P	1			
Bodianus axillaris				1		
B. loxozonus						
Cheilinus diagrammus						
C. fasciatus						
C. oxycephalus						
C. trilobatus						
C. undulatus						
C. unifasciatus		1	P	P		
Coris aygula						P
C. gaimard				P		P
Epibulus insidiator				3		P
Gomphosus varius		2	1			1
Halichoeres biocellatus						
H. hortulanus	3	1		1	P	2
H. margaritaceus						
H. marginatus	1	1				
H. melanurus						
H. ornatissimus					P	3
H. trimaculatus						
Hemigymnus fasciatus			1	1		1
H. melapterus						
Labrichthys unilineatus						
Labroides bicolor			P	1		
L. dimidiatus			1	1		2
L. rubrolabiatus		2	1			P
Labropsis xanthonota			P	1		
Macropharyngodon meleagris						

Table 22c continued	Site 5				Site 6	
	3m	6m	9m	12m	9m	12m
Macropharyngodon negrosensis						P
Novaculichthys taeniourus						
Pseudocheilinus evanidus						
P. hexataenia						1
P. octotaenia						
Pseudodax moluccanus	1					
Stethojulis bandanensis		P				
S. trilineata						
Thalassoma amblycephalum			1			6
T. hardwicke						
T. lutescens				1		1
T. purpureum						
T. quinquevittatum	6	9	15	2	18	10
T. trilobatum	4					
LETHRINIDAE						
Gnathodentex aureolineatus						
Lethrinus harak						
L. obsoletus						
Monotaxis grandoculis				P		
LUTJANIDAE						
Aphareus furca	P					P
Aprion virescens					P	
Lutjanus bohar				2		
L. fulvus						
L. monostigma						
Macolor niger						
M. macularis						
MALACANTHIDAE						
Malacanthus latovittatus						
MICRODESMIDAE						
Nemateleotris magnifica						1
Ptereleotris evides						
Ptereleotris heteroptera						
P. zebra						P
MONACANTHIDAE						
Amanses scopas		P	1			
Cantherhinus dumerilii	1					
C. spp.						
MULLIDAE						
Mulloides flavolineatus						
M. vanicolensis						
Parupeneus barberinus		P				
P. bifasciatus	P					P
P. cyclostomus	P	P	P	1	P	P

Table 22c continued	Site 5				Site 6	
	3m	6m	9m	12m	9m	12m
P. multifasciatus						
OSTRACIIDAE						
Ostracion meleagris						P
O. cubicus						
PEMPHERIDAE						
Pempheris oualensis		1				
PINGUIPEDIDAE						
Parapercis clathrata			P		1	1
POMACANTHIDAE						
Apolemichthys trimaculatus						P
Centropyge bicolor						
C. bispinosus						
C. flavissimus				P	P	1
Pomacanthus imperator						
Pygoplites diacanthus		P	1			P
POMACENTRIDAE						
Abudefduf septemfasciatus						
A. sexfasciatus						
A. vaigiensis	2					
Amphiprion chrysopterus						
A. clarkii						
A. melanopus			18	3		3
Chromis acares						
C. agilis						
C. amboinensis						
C. iomelas						
C. margaritifer						2
C. vanderbilti			5			1
C. xanthura			1	P		
C. spp.						
Chrysiptera cyanea	P	1				2
C. glauca						
C. leucopoma	8				34	
Dascyllus trimaculatus				P		
Neopomacentrus metallicus						
Plectroglyphidodon dickii						1
P. johnstonianus						1
P. lacrymatus			2	4		
P. leucozonus	5					
P. phoenixensis	1					
Pomacentrus brachialis		1	3	6	1	
P. vaiuli		1	1	17		7
Pomachromis richardsoni						
Pristotis jerdoni						

Table 22c continued	Site 5				Site 6	
	3m	6m	9m	12m	9m	12m
Stegastes albifasciatus						
S. fasciolatus	3	14	4	1		
S. nigricans						
SCARIDAE						
Calotomus carolinus						
Cetoscarus bicolor						
Hipposcarus longiceps						
Scarus altipinnus						
S. forsteni				1		1
S. frenatus		P	P			
S. frontalis				1		
S. ghobban						
S. globiceps						
S. microrhinos		1				
S. niger	P	2	P	2		P
S. oviceps		P	2	1	P	1
S. psittacus	P	2	P			1
S. pyrrhurus						3
S. rubroviolaceus						
S. schlegeli						
S. sordidus	P	1	1	P	P	
S. spinus			P			
S. trilineata						
juveniles						
SERRANIDAE						
Aethaloperca rogaa						
Cephalopholis argus		P		P		P
C. leopardus						
C. urodeta	P	2	3	2	1	3
Epinephelus howlandi			1			
E. maculatus						
E. merra						
Plectropomus leopardus						
Variola louti						
SIGANIDAE						
Siganus argenteus		1	P			
SYGNATHIDAE						
Corythoichthys intestinalis						
SYNODONTIDAE						
Synodus spp.						
TETRAODONTIDAE						
Arothron meleagris						
A. nigropunctatus						
Canthigaster solandri						

Table 22c continued	Site 5				Site 6	
	3m	6m	9m	12m	9m	12m
ZANCLIDAE						
Zanclus cornutus		1			P	5
Total No. Species	53	44	43	42	22	60
On-Transect Species	39	28	29	28	10	39
On-Transect Individuals	42	132	111	93	60	114

Table 23. Fishes censused on the reef flat at Fagatele Bay in 1995. Numbers indicate the number of individuals of each species counted on the transect, and the letter P indicates the presence of a species in the vicinity of the transect line.

	Site B	Site C
	1 m	1 m
ACANTHURIDAE		
Acanthurus achilles	1	
A. albipectoralis		
A. blochii		
A. guttatus		
A. lineatus	3	
A. nigricans	3	
A. nigricauda		
A. nigrofuscus	34	18
A. nigroris		
A. olivaceus		
A. pyroferus		
A. thompsoni		
A. triostegus	6	6
Ctenochaetus binotatus		
C. striatus	19	
C. strigosus		
Naso annulatus		
N. brevirostris		
N. hexacanthus		
N. literatus	2	P
N. unicornis		
N. spp.		
Zebrasoma scopas	3	P
Z. veliferum	P	
APOGONIDAE		
Apogon doederleini		
AULOSTOMIDAE		
Aulostomus chinensis		
BALISTIDAE		
Balistapus undulatus		P
Balistoides viridescens		
Melichthys vidua		
M. niger		
Pseudobalistes flavimarginatus	P	
Rhinecanthus rectangulus		
Sufflamen bursa		
S. chrysopterus		
S. freanatus		

Table 23 continued	Site B	Site C
	1 m	**1 m**
BLENNIIDAE		
Aspidontus dussumieri		
Escenius bicolor		
Meiacanthus atrodorsalis		
Plagiotremus tapeinosoma		
unidentified blenniids	2	
BOTHIDAE		
Bothus pantherinus		
CAESIONIDAE		
Caesio cunning		
Pterocaesio tile		
P. trilineata		
CARANGIDAE		
Caranx melampygus		
Scomberoides lysan		
CHAETODONTIDAE		
Chaetodon bennetti		
C. citrinellus	P	P
C. ephippium	P	
C. lunula	P	
C. mertensii		
C. ornatissimus		
C. pelewensis		
C. reticulatus	1	P
C. semeion	P	
C. trifascialis		P
C. trifasciatus	1	1
C. ulietensis	1	
C. unimaculatus		
C. vagabundus		P
Forcipiger flavissimus		
F. longirostris		
Hemitaurichthys polylepis		
Heniochus chrysostomus		
H. monoceros		
H. varius		
CIRRHITIDAE		
Cirrhitichthys pinnulatus	P	
Paracirrhites arcatus		
P. forsteri		
P. hemisticus		
CORYPHAENIDAE		
Coryphaena hippurus		

Table 23 continued	Site B	Site C
	1 m	1 m
GOBIIDAE		
Valenciennea strigata		
HAEMULIDAE		
Plectorhynchus orientalis		
HOLOCENTRIDAE		
Myripristis berndti		
M. kuntee		
M. violacea		
Neoniphon sammara		
Sargocentron caudimaculatum		2
S. spiniferum		
KYPHOSIDAE		
Kyphosus cinerascens	P	
K. vaigiensis		
LABRIDAE		
Anampsis caeruleopunctatus		
A. twistii		
Bodianus axillaris		
B. loxozonus		
Cheilinus diagrammus		
C. fasciatus		
C. oxycephalus		
C. trilobatus	P	
C. undulatus		
C. unifasciatus		
Coris aygula		
C. gaimard		
Epibulus insidiator		
Gomphosus varius		1
Halichoeres biocellatus		
H. hortulanus	4	1
H. margaritaceus		
H. marginatus	2	1
H. melanurus		
H. ornatissimus		
H. trimaculatus		
Hemigymnus fasciatus		
H. melapterus		1
Labrichthys unilineatus		
Labroides bicolor		P
L. dimidiatus	1	
L. rubrolabiatus		1
Labropsis xanthonota		
Macropharyngodon meleagris		

Table 23 continued	Site B	Site C
	1 m	1 m
Macropharyngodon negrosensis		
Novaculichthys taeniourus		
Pseudocheilinus evanidus		
P. hexataenia		
P. octotaenia		
Pseudodax moluccanus		
Stethojulis bandanensis	1	
S. trilineata		
Thalassoma amblycephalum		
T. hardwicke	6	6
T. lutescens	P	P
T. purpureum		
T. quinquevittatum	2	P
T. trilobatum	P	
LETHRINIDAE		
Gnathodentex aureolineatus		
Lethrinus harak		
L. obsoletus		
Monotaxis grandoculis		
LUTJANIDAE		
Aphareus furca		
Aprion virescens		
Lutjanus bohar		
L. fulvus		
L. monostigma		
Macolor niger		
M. macularis		
MALACANTHIDAE		
Malacanthus latovittatus		
MICRODESMIDAE		
Nemateleotris magnifica		
Ptereleotris evides		
Ptereleotris heteroptera		
P. zebra		
MONACANTHIDAE		
Amanses scopas		
Cantherhinus dumerilii		
C. spp.		
MULLIDAE		
Mulloides flavolineatus		
M. vanicolensis		
Parupeneus barberinus		
P. bifasciatus	1	P
P. cyclostomus	1	P
P. multifasciatus	1	

Table 23 continued	Site B	Site C
	1 m	1 m
OSTRACIIDAE		
Ostracion meleagris		
O. cubicus		
PEMPHERIDAE		
Pempheris oualensis		
PINGUIPEDIDAE		
Parapercis clathrata		
POMACANTHIDAE		
Apolemichthys trimaculatus		
Centropyge bicolor		
C. bispinosus		
C. flavissimus		
Pomacanthus imperator		
Pygoplites diacanthus		
POMACENTRIDAE		
Abudefduf septemfasciatus	2	P
A. sexfasciatus	P	
A. vaigiensis		
Amphiprion chrysopterus		
A. clarkii		
A. melanopus		
Chromis acares		
C. agilis		
C. amboinensis		
C. iomelas		
C. margaritifer		
C. vanderbilti		
C. xanthura		
C. spp.		
Chrysiptera cyanea	17	53
C. glauca	3	
C. leucopoma	63	31
Dascyllus trimaculatus		
Neopomacentrus metallicus		
Plectroglyphidodon dickii		
P. johnstonianus		
P. lacrymatus		
P. leucozonus		
P. phoenixensis		
Pomacentrus brachialis		
P. vaiuli		
Pomachromis richardsoni		
Pristotis jerdoni	37	
Stegastes albifasciatus		53

Table 23 continued	Site B	Site C
	1 m	**1 m**
S. fasciolatus		
S. nigricans	4	5
SCARIDAE		
Calotomus carolinus		
Cetoscarus bicolor		
Hipposcarus longiceps		
Scarus altipinnus		
S. forsteni		
S. frenatus	P	1
S. frontalis		
S. ghobban		
S. globiceps		
S. microrhinos		
S. niger		
S. oviceps		
S. psittacus		P
S. pyrrhurus		
S. rubroviolaceus		
S. schlegeli		
S. sordidus	P	P
S. spinus		
S. trilineata		
juveniles	1	25
SERRANIDAE		
Aethaloperca rogaa		
Cephalopholis argus		
C. leopardus		
C. urodeta		
Epinephelus howlandi		
E. maculatus		
E. merra	4	1
Plectropomus leopardus		
Variola louti		
SIGANIDAE		
Siganus argenteus	P	
SYGNATHIDAE		
Corythoichthys intestinalis		
SYNODONTIDAE		
Synodus spp.		
TETRAODONTIDAE		
Arothron meleagris		
A. nigropunctatus		
Canthigaster solandri		

Table 23 continued	Site B	Site C
	1 m	**1 m**
ZANCLIDAE		
Zanclus cornutus		
Total No. Species	44	33
On-Transect Species	28	18
On-Transect Individuals	26	223

Table 24a. Fishes censused on transects at various sites around Tutuila Island in 1995: Masefau inside, Masefau outside, Aoa and Onenoa. Numbers indicate the number of individuals of each species counted on the transect, and the letter P indicates the presence of a species in the vicinity of the transect line.

	Masefau Inside		Masefau Outside		Aoa		Onenoa	
	3m	6m	3m	6m	3m	6m	3m	6m
ACANTHURIDAE								
Acanthurus achilles			P	1			P	
A. albipectoralis								
A. blochii		1						1
A. guttatus								
A. lineatus	P		3	P	P	P		3
A. nigricans	P	P	2	1	P	1	3	P
A. nigricauda								
A. nigrofuscus	7	15		7	10	6	20	7
A. nigroris								
A. olivaceus		P						
A. pyroferus		1						
A. thompsoni						7		1
A. triostegus	1							
Ctenochaetus binotatus						P		
C. striatus		2	4	13	9	19	29	21
C. strigosus		1		P		1		2
Naso annulatus								
N. brevirostris								
N. hexacanthus						P		
N. literatus				1		1		1
N. unicornis								
N. spp.								
Zebrasoma scopas				P		P		
Z. veliferum	P			P	1	P	1	2
APOGONIDAE								
Apogon doederleini								

Table 24a continued	**Masefau Inside**		**Masefau Outside**		**Aoa**		**Onenoa**	
	3m	**6m**	**3m**	**6m**	**3m**	**6m**	**3m**	**6m**
AULOSTOMIDAE								
Aulostomus chinensis								
BALISTIDAE								
Balistapus undulatus	P		P			P		P
Balistoides viridescens								
Melichthys vidua			3	3		P	P	1
M. niger								
Pseudobalistes flavimarginatus								
Rhinecanthus rectangulus			1	P			P	
Sufflamen bursa				2	3			
S. chrysopterus	P	1						
S. freanatus								
BLENNIIDAE								
Aspidontus dussumieri								
Escenius bicolor	4	P			1			
Meiacanthus atrodorsalis						11		1
Plagiotremus tapeinosoma			P				1	P
unidentified blenniids		2		P	3	1	P	
BOTHIDAE								
Bothus pantherinus								
CAESIONIDAE								
Caesio cunning								
Pterocaesio tile								
P. trilineata								
CARANGIDAE								
Caranx melampygus								
Scomberoides lysan								
CHAETODONTIDAE								
Chaetodon bennetti								
C. citrinellus	1	P			3		P	
C. ephippium	P							

Table 24a continued	Masefau Inside		Masefau Outside		Aoa		Onenoa	
	3m	6m	3m	6m	3m	6m	3m	6m
C. lunula			2				P	P
C. mertensii								
C. ornatissimus			P					
C. pelewensis				P		1		
C. reticulatus			1	P	P	1	1	3
C. semeion			P					
C. trifascialis								
C. trifasciatus			2			P	P	
C. ulietensis								
C. unimaculatus								
C. vagabundus	P	P	P	P		1	2	P
Forcipiger flavissimus	P		P			P		P
F. longirostris								
Hemitaurichthys polylepis								
Heniochus chrysostomus		P						
H. monoceros								
H. varius								
CIRRHITIDAE								
Cirrhitichthys pinnulatus			P					
Paracirrhites arcatus				1		P	P	P
P. forsteri		2	1	1		P	2	
P. hemisticus			P					P
CORYPHAENIDAE								
Coryphaena hippurus								
GOBIIDAE								
Valenciennea strigata	P	2	2					
HAEMULIDAE								
Plectorhynchus orientalis			P					1
HOLOCENTRIDAE								
Myripristis berndti								
M. kuntee								

Table 24a continued	Masefau Inside		Masefau Outside		Aoa		Onenoa	
	3m	6m	3m	6m	3m	6m	3m	6m
M. violacea								
Neoniphon sammara								
Sargocentron caudimaculatum		1						
S. spiniferum				P				
KYPHOSIDAE								
Kyphosus cinerascens								
K. vaigiensis	P						P	3
LABRIDAE								
Anampsis caeruleopunctatus								
A. twistii								
Bodianus axillaris								P
B. loxozonus								
Cheilinus diagrammus						P		1
C. fasciatus								
C. oxycephalus								
C. trilobatus	P	P	3			P		
C. undulatus								
C. unifasciatus		P		1	P	P	P	
Coris aygula			P					
C. gaimard	P	2	1					
Epibulus insidiator		P						
Gomphosus varius	P		1	P		1	P	
Halichoeres biocellatus								
H. hortulanus	1	1	3	P	P	1	P	
H. margaritaceus	18	1	2					
H. marginatus	2		2	P	1	P	1	P
H. melanurus								
H. ornatissimus					1			
H. trimaculatus		4						
Hemigymnus fasciatus					P		P	
H. melapterus	P							

Table 24a continued	Masefau Inside		Masefau Outside		Aoa		Onenoa	
	3m	**6m**	**3m**	**6m**	**3m**	**6m**	**3m**	**6m**
Labrichthys unilineatus					2	P		
Labroides bicolor				P				
L. dimidiatus	3	1	2		2	3	1	1
L. rubrolabiatus		1		P		1	P	2
Labropsis xanthonota		P				P		1
Macropharyngodon meleagris	P	1			4	1		
Macropharyngodon negrosensis								
Novaculichthys taeniourus		P						
Pseudocheilinus evanidus								
P. hexataenia	P	P		P	P	1		2
P. octotaenia								
Pseudodax moluccanus								
Stethojulis bandanensis	5	2	P				P	
S. trilineata								
Thalassoma amblycephalum	15		P		P		2	
T. hardwicke				P	2	1	P	P
T. lutescens		P						3
T. purpureum								
T. quinquevittatum	1	2	13	15	2	3	9	6
T. trilobatum	2				10		20	
LETHRINIDAE								
Gnathodentex aureolineatus								
Lethrinus harak								
L. obsoletus	P							
Monotaxis grandoculis		1						P
LUTJANIDAE								
Aphareus furca						P		1
Aprion virescens								
Lutjanus bohar								P
L. fulvus				P		P		P
L. monostigma								P

Table 24a continued	Masefau Inside		Masefau Outside		Aoa		Onenoa	
	3m	6m	3m	6m	3m	6m	3m	6m
Macolor niger								
M. macularis								
MALACANTHIDAE								
Malacanthus latovittatus		P						
MICRODESMIDAE								
Nemateleotris magnifica								
Ptereleotris evides		P	P		2	P	P	
Ptereleotris heteroptera		P						
P. zebra				P				
MONACANTHIDAE								
Amanses scopas								
Cantherhinus dumerilii			P					
C. spp.								1
MULLIDAE								
Mulloides flavolineatus								
M. vanicolensis						P		P
Parupeneus barberinus	P					P		
P. bifasciatus		P	P				1	7
P. cyclostomus		P	P	1	P	P	1	
P. multifasciatus	6	7	P	1	2	1	P	P
OSTRACIIDAE								
Ostracion meleagris								
O. cubicus								
PEMPHERIDAE								
Pempheris oualensis				P				
PINGUIPEDIDAE								
Parapercis clathrata	1	1	P					
POMACANTHIDAE								
Apolemichthys trimaculatus								
Centropyge bicolor		P						

Table 24a continued	**Masefau Inside**		**Masefau Outside**		**Aoa**		**Onenoa**	
	3m	**6m**	**3m**	**6m**	**3m**	**6m**	**3m**	**6m**
C. bispinosus								
C. flavissimus		1		P	2	2	2	1
Pomacanthus imperator	P							
Pygoplites diacanthus			P		P	1		
POMACENTRIDAE								
Abudefduf septemfasciatus								
A. sexfasciatus								
A. vaigiensis								
Amphiprion chrysopterus				P				
A. clarkii								
A. melanopus								
Chromis acares				5		1	3	25
C. agilis								
C. amboinensis								
C. iomelas		1						5
C. margaritifer		1		1	1	P		5
C. vanderbilti								
C. xanthura		10		P		25		36
C. spp.								
Chrysiptera cyanea	50	126	18	P	60	29	1	7
C. glauca								
C. leucopoma	29		72	15	31	3	11	
Dascyllus trimaculatus		P						
Neopomacentrus metallicus							P	P
Plectroglyphidodon dickii			1	P			1	1
P. johnstonianus								1
P. lacrymatus		6				3		1
P. leucozonus								
P. phoenixensis								
Pomacentrus brachialis		1		2	7	6	5	42
P. vaiuli	3	57	1	9	14	37	4	3
Pomachromis richardsoni	16	5	P	P	8		P	1

Table 24a continued	Masefau Inside		Masefau Outside		Aoa		Onenoa	
	3m	6m	3m	6m	3m	6m	3m	6m
Pristotis jerdoni								
Stegastes albifasciatus								
S. fasciolatus		47		2	P	1	1	
S. nigricans								
SCARIDAE								
Calotomus carolinus								
Cetoscarus bicolor						P		
Hipposcarus longiceps								
Scarus altipinnus								1
S. forsteni				P				
S. frenatus					P			
S. frontalis	P							
S. ghobban								1
S. globiceps			1	P				
S. microrhinos						P		
S. niger				P				P
S. oviceps				1				2
S. psittacus	P		1		4	3		2
S. pyrrhurus	P	P	4	P	1	8	1	
S. rubroviolaceus				P	1	1		
S. schlegeli								P
S. sordidus	P	P	1	P	4	P		P
S. spinus				P				
S. trilineata								
juveniles					1			
SERRANIDAE								
Aethaloperca rogaa								
Cephalopholis argus			P	P		1	1	
C. leopardus						1		
C. urodeta	P	2	2	1	1	2	P	
Epinephelus howlandi		1	P					
E. maculatus		P						
E. merra					P	1		

Table 24a continued	Masefau Inside		Masefau Outside		Aoa		Onenoa	
	3m	6m	3m	6m	3m	6m	3m	6m
Plectropomus leopardus								P
Variola louti		P						
SIGANIDAE								
Siganus argenteus								
SYGNATHIDAE								
Corythoichthys intestinalis								
SYNODONTIDAE								
Synodus spp.								
TETRAODONTIDAE								
Arothron meleagris		1						
A. nigropunctatus								
Canthigaster solandri	P	P						
ZANCLIDAE								
Zanclus cornutus	P		P		1	1	P	P
Total No. Species	45	59	53	55	44	66	47	63
On-Transect Species	18	34	29	21	31	38	25	40
On-Transect Individuals	165	264	197	84	194	197	124	20

Table 24b. Fishes censused on transects at various sites around Tutuila Island in 1995: Fagafue, Massacre Bay, Rainmaker and Fatu Rock. Numbers indicate the number of individuals of each species counted on the transect, and the letter P indicates the presence of a species in the vicinity of the transect line.

	Fagafue		Massacre Bay		Rainmaker		Fatu Rock	
	3m	6m	3m	6m	3m	6m	3m	6m
ACANTHURIDAE								
Acanthurus achilles	P	1			1		1	P
A. albipectoralis								
A. blochii		P		P		P		P
A. guttatus				P			2	
A. lineatus	16	2	3	P	P		5	2
A. nigricans			3	3	P	9		2
A. nigricauda		P		P				
A. nigrofuscus		11	9	2	17	7	4	2
A. nigroris								
A. olivaceus								
A. pyroferus					2	4		
A. thompsoni								
A. triostegus								
Ctenochaetus binotatus							1	
C. striatus	1	10	12	4	16	12	12	21
C. strigosus					3	1		
Naso annulatus								
N. brevirostris								
N. hexacanthus								
N. literatus		2	8	P	P			8
N. unicornis						1		
N. spp.								22
Zebrasoma scopas		3			2	1	P	P
Z. veliferum								P
APOGONIDAE								
Apogon doederleini								

Table 24b continued	Fagafue		Massacre Bay		Rainmaker		Fatu Rock	
	3m	6m	3m	6m	3m	6m	3m	6m
AULOSTOMIDAE								
Aulostomus chinensis								
BALISTIDAE								
Balistapus undulatus		P		1	P	2	1	1
Balistoides viridescens								
Melichthys vidua			1	1				P
M. niger								
Pseudobalistes flavimarginatus								
Rhinecanthus rectangulus								
Sufflamen bursa					2	1		
S. chrysopterus								
S. freanatus								
BLENNIIDAE								
Aspidontus dussumieri								
Escenius bicolor		P						
Meiacanthus atrodorsalis		1		1	2	4		
Plagiotremus tapeinosoma								
unidentified blenniids			1	1			1	
BOTHIDAE								
Bothus pantherinus								
CAESIONIDAE								
Caesio cunning								P
Pterocaesio tile								P
P. trilineata								
CARANGIDAE								
Caranx melampygus								
Scomberoides lysan			P					
CHAETODONTIDAE								
Chaetodon bennetti								
C. citrinellus	2		P	P	3	P		
C. ephippium					1	P		1

Table 24b continued	Fagafue		Massacre Bay		Rainmaker		Fatu Rock	
	3m	**6m**	**3m**	**6m**	**3m**	**6m**	**3m**	**6m**
C. lunula								1
C. mertensii						P		
C. ornatissimus	P						2	
C. pelewensis		2			P			
C. reticulatus		P	2	1	2	P	P	P
C. semeion							P	
C. trifascialis								
C. trifasciatus								
C. ulietensis					1			
C. unimaculatus								
C. vagabundus	P		P		P	P	P	
Forcipiger flavissimus					1		P	P
F. longirostris		P						
Hemitaurichthys polylepis								
Heniochus chrysostomus					P	P		
H. monoceros					2			1
H. varius			P					1
CIRRHITIDAE								
Cirrhitichthys pinnulatus							1	
Paracirrhites arcatus							P	3
P. forsteri			P					3
P. hemisticus								
CORYPHAENIDAE								
Coryphaena hippurus								
GOBIIDAE								
Valenciennea strigata				P				
HAEMULIDAE								
Plectorhynchus orientalis								
HOLOCENTRIDAE								
Myripristis berndti					1			
M. kuntee					1			

Table 24b continued	Fagafue		Massacre Bay		Rainmaker		Fatu Rock	
	3m	6m	3m	6m	3m	6m	3m	6m
M. violacea								
Neoniphon sammara				P				1
Sargocentron caudimaculatum	P							
S. spiniferum								
KYPHOSIDAE								
Kyphosus cinerascens	P							
K. vaigiensis				P	P			
LABRIDAE								
Anampsis caeruleopunctatus	P		P				1	
A. twistii								P
Bodianus axillaris								
B. loxozonus								
Cheilinus diagrammus					P	P	P	
C. fasciatus						P		
C. oxycephalus							P	
C. trilobatus			1		P		P	
C. undulatus	P				P		P	
C. unifasciatus								
Coris aygula								
C. gaimard								
Epibulus insidiator						P	1	
Gomphosus varius	1		2				2	3
Halichoeres biocellatus								
H. hortulanus	2	1		P				1
H. margaritaceus								
H. marginatus	6	3	2				1	
H. melanurus					3	2		
H. ornatissimus								
H. trimaculatus								
Hemigymnus fasciatus							P	P
H. melapterus							P	

Table 24b continued	Fagafue		Massacre Bay		Rainmaker		Fatu Rock	
	3m	6m	3m	6m	3m	6m	3m	6m
Labrichthys unilineatus								
Labroides bicolor	1		P					P
L. dimidiatus	1	1	P	1	P		1	1
L. rubrolabiatus			1					1
Labropsis xanthonota								
Macropharyngodon meleagris								
Macropharyngodon negrosensis								
Novaculichthys taeniourus								
Pseudocheilinus evanidus								
P. hexataenia		P		1				P
P. octotaenia								
Pseudodax moluccanus								
Stethojulis bandanensis								
S. trilineata				P	P			
Thalassoma amblycephalum								
T. hardwicke			1		P		P	
T. lutescens								
T. purpureum	1							
T. quinquevittatum	0	4	3		P		5	1
T. trilobatum								
LETHRINIDAE								
Gnathodentex aureolineatus								
Lethrinus harak								
L. obsoletus								
Monotaxis grandoculis			P	2	1			
LUTJANIDAE								
Aphareus furca		P	2	1				
Aprion virescens								
Lutjanus bohar		P					1	
L. fulvus				P				1
L. monostigma		P		P				

Table 24b continued	Fagafue		Massacre Bay		Rainmaker		Fatu Rock	
	3m	6m	3m	6m	3m	6m	3m	6m
Macolor niger			P	P				
M. macularis				2		P		
MALACANTHIDAE								
Malacanthus latovittatus								
MICRODESMIDAE								
Nemateleotris magnifica								
Ptereleotris evides				1				
Ptereleotris heteroptera								
P. zebra								
MONACANTHIDAE								
Amanses scopas								
Cantherhinus dumerilii								
C. spp.								
MULLIDAE								
Mulloides flavolineatus						P		
M. vanicolensis	P	P	P		P			
Parupeneus barberinus						P		
P. bifasciatus	P	P	P		1		P	P
P. cyclostomus		P	P	P		1	1	
P. multifasciatus		3	P	P	3	1		
OSTRACIIDAE								
Ostracion meleagris								
O. cubicus								
PEMPHERIDAE								
Pempheris oualensis			1					1
PINGUIPEDIDAE								
Parapercis clathrata								
POMACANTHIDAE								
Apolemichthys trimaculatus								
Centropyge bicolor						1		
C. bispinosus								

Table 24b continued	Fagafue		Massacre Bay		Rainmaker		Fatu Rock	
	3m	**6m**	**3m**	**6m**	**3m**	**6m**	**3m**	**6m**
C. flavissimus		P			2	1	1	3
Pomacanthus imperator				P				
Pygoplites diacanthus				1	3	P	1	1
POMACENTRIDAE								
Abudefduf septemfasciatus								
A. sexfasciatus					8	3	P	P
A. vaigiensis								
Amphiprion chrysopterus								
A. clarkii								
A. melanopus								
Chromis acares								
C. agilis								
C. amboinensis								
C. iomelas		P						
C. margaritifer	P	3	P	1				13
C. vanderbilti								
C. xanthura		5	P	P				P
C. spp.								
Chrysiptera cyanea	11	8	10	12	28	2	2	2
C. glauca								
C. leucopoma							P	
Dascyllus trimaculatus					P	2		P
Neopomacentrus metallicus		P	27	P	P			
Plectroglyphidodon dickii			2				6	7
P. johnstonianus								
P. lacrymatus	2	1		11	1	2		1
P. leucozonus								
P. phoenixensis								
Pomacentrus brachialis	5	7		1	5	7		27
P. vaiuli		4						
Pomachromis richardsoni								

Table 24b continued	Fagafue		Massacre Bay		Rainmaker		Fatu Rock	
	3m	6m	3m	6m	3m	6m	3m	6m
Pristotis jerdoni								
Stegastes albifasciatus								
S. fasciolatus	6	1					22	1
S. nigricans						P		
SCARIDAE								
Calotomus carolinus		P						
Cetoscarus bicolor								
Hipposcarus longiceps								
Scarus altipinnus								
S. forsteni								
S. frenatus			P					
S. frontalis								P
S. ghobban						P		1
S. globiceps				P				
S. microrhinos								
S. niger		P	P	P	P			
S. oviceps								
S. psittacus			2	P	P			
S. pyrrhurus	P	4	4	4		1	1	1
S. rubroviolaceus				P				
S. schlegeli								
S. sordidus					3	1		1
S. spinus								
S. trilineata								
juveniles								
SERRANIDAE								
Aethaloperca rogaa								
Cephalopholis argus				P				P
C. leopardus								
C. urodeta	2	1		P			1	
Epinephelus howlandi								
E. maculatus								
E. merra								

Table 24b continued	Fagafue		Massacre Bay		Rainmaker		Fatu Rock	
	3m	6m	3m	6m	3m	6m	3m	6m
Plectropomus leopardus								
Variola louti								P
SIGANIDAE								
Siganus argenteus								
SYGNATHIDAE								
Corythoichthys intestinalis						2		
SYNODONTIDAE								
Synodus spp.								
TETRAODONTIDAE								
Arothron meleagris								
A. nigropunctatus				P				
Canthigaster solandri	P		1	P	4	3		
ZANCLIDAE								
Zanclus cornutus					1	1	1	2

Total No. Species	23	41	40	49	51	42	43	53
On-Transect Species	12	41	40	49	51	42	43	53
On-Transect Individuals	67	91	100	61	150	74	81	139

Table 24c. Fishes censused on transects at various sites around Tutuila Island in 1995: Fagasa Bay and Cape Larsen. Numbers indicate the number of individuals of each species counted on the transect, and the letter P indicates the presence of a species in the vicinity of the transect line.

	Fagasa Bay		Cape Larsen	
	3m	6m	3m	6m
ACANTHURIDAE				
Acanthurus achilles				
A. albipectoralis				
A. blochii				
A. guttatus				
A. lineatus	19	2	6	P
A. nigricans	P	1		5
A. nigricauda				
A. nigrofuscus	1	14	1	6
A. nigroris	P			
A. olivaceus				
A. pyroferus				
A. thompsoni				
A. triostegus				
Ctenochaetus binotatus		1		1
C. striatus		13	10	18
C. strigosus				
Naso annulatus				
N. brevirostris				
N. hexacanthus				
N. literatus		1	P	P
N. unicornis			1	
N. spp.				
Zebrasoma scopas				
Z. veliferum				
APOGONIDAE				
Apogon doederleini				
AULOSTOMIDAE				
Aulostomus chinensis				
BALISTIDAE				
Balistapus undulatus	P		1	P
Balistoides viridescens				
Melichthys vidua			1	1
M. niger				
Pseudobalistes flavimarginatus				P
Rhinecanthus rectangulus			1	
Sufflamen bursa	P			1
S. chrysopterus				P
S. freanatus			1	

Table 24c continued	Fagasa Bay		Cape Larsen	
	3m	6m	3m	6m
BLENNIIDAE				
Aspidontus dussumieri				
Escenius bicolor	1	1		1
Meiacanthus atrodorsalis				
Plagiotremus tapeinosoma				
unidentified blenniids			P	
BOTHIDAE				
Bothus pantherinus				1
CAESIONIDAE				
Caesio cunning				
Pterocaesio tile				
P. trilineata				
CARANGIDAE				
Caranx melampygus			P	
Scomberoides lysan				
CHAETODONTIDAE				
Chaetodon bennetti				
C. citrinellus	3	1	3	3
C. ephippium			2	P
C. lunula				
C. mertensii				
C. ornatissimus		P	2	P
C. pelewensis				
C. reticulatus	P		P	
C. semeion				
C. trifascialis				
C. trifasciatus				
C. ulietensis				
C. unimaculatus				
C. vagabundus	P		P	P
Forcipiger flavissimus				
F. longirostris				
Hemitaurichthys polylepis				
Heniochus chrysostomus				
H. monoceros				
H. varius				
CIRRHITIDAE				
Cirrhitichthys pinnulatus				
Paracirrhites arcatus	P			
P. forsteri	2			
P. hemisticus				
CORYPHAENIDAE				
Coryphaena hippurus				

Table 24c continued	**Fagasa Bay**		**Cape Larsen**	
	3m	**6m**	**3m**	**6m**
GOBIIDAE				
Valenciennea strigata				3
HAEMULIDAE				
Plectorhynchus orientalis				
HOLOCENTRIDAE				
Myripristis berndti				
M. kuntee				
M. violacea				
Neoniphon sammara				
Sargocentron caudimaculatum				
S. spiniferum				
KYPHOSIDAE				
Kyphosus cinerascens				
K. vaigiensis		P		
LABRIDAE				
Anampsis caeruleopunctatus				
A. twistii				
Bodianus axillaris				
B. loxozonus				
Cheilinus diagrammus				
C. fasciatus				
C. oxycephalus				
C. trilobatus		1		
C. undulatus				P
C. unifasciatus	P			1
Coris aygula				
C. gaimard				
Epibulus insidiator				
Gomphosus varius	P			
Halichoeres biocellatus				
H. hortulanus	1	2	4	3
H. margaritaceus				
H. marginatus	2		1	1
H. melanurus				
H. ornatissimus				1
H. trimaculatus				
Hemigymnus fasciatus				
H. melapterus				
Labrichthys unilineatus				
Labroides bicolor		P		
L. dimidiatus			1	1
L. rubrolabiatus				P
Labropsis xanthonota				

Table 24c continued	Fagasa Bay		Cape Larsen	
	3m	6m	3m	6m
Macropharyngodon meleagris				
Macropharyngodon negrosensis			P	
Novaculichthys taeniourus				
Pseudocheilinus evanidus				
P. hexataenia				
P. octotaenia				
Pseudodax moluccanus				
Stethojulis bandanensis	2			
S. trilineata				
Thalassoma amblycephalum	1			
T. hardwicke	P			
T. lutescens				
T. purpureum				
T. quinquevittatum	14	1	13	12
T. trilobatum				
LETHRINIDAE				
Gnathodentex aureolineatus				
Lethrinus harak				
L. obsoletus				
Monotaxis grandoculis				P
LUTJANIDAE				
Aphareus furca				P
Aprion virescens				
Lutjanus bohar				
L. fulvus				
L. monostigma				
Macolor niger				P
M. macularis				
MALACANTHIDAE				
Malacanthus latovittatus				
MICRODESMIDAE				
Nemateleotris magnifica				1
Ptereleotris evides				
Ptereleotris heteroptera				
P. zebra	P			7
MONACANTHIDAE				
Amanses scopas				
Cantherhinus dumerilii			1	P
C. spp.				
MULLIDAE				
Mulloides flavolineatus				
M. vanicolensis				
Parupeneus barberinus				

Table 24c continued	Fagasa Bay		Cape Larsen	
	3m	**6m**	**3m**	**6m**
P. bifasciatus	3			P
P. cyclostomus	P		1	
P. multifasciatus		2		
OSTRACIIDAE				
Ostracion meleagris				
O. cubicus				
PEMPHERIDAE				
Pempheris oualensis				
PINGUIPEDIDAE				
Parapercis clathrata	2	1	1	P
POMACANTHIDAE				
Apolemichthys trimaculatus				
Centropyge bicolor				
C. bispinosus				
C. flavissimus	1	2	1	2
Pomacanthus imperator				
Pygoplites diacanthus	P			1
POMACENTRIDAE				
Abudefduf septemfasciatus				
A. sexfasciatus				
A. vaigiensis				
Amphiprion chrysopterus				
A. clarkii				
A. melanopus				
Chromis acares				1
C. agilis				
C. amboinensis				
C. iomelas				
C. margaritifer				4
C. vanderbilti				
C. xanthura				1
C. spp.				
Chrysiptera cyanea	8	32	3	9
C. glauca				
C. leucopoma	14		47	10
Dascyllus trimaculatus				
Neopomacentrus metallicus	7			17
Plectroglyphidodon dickii	3			P
P. johnstonianus				
P. lacrymatus		1		
P. leucozonus				
P. phoenixensis				
Pomacentrus brachialis		1		4

Table 24c continued	Fagasa Bay		Cape Larsen	
	3m	6m	3m	6m
Stegastes albifasciatus				
S. fasciolatus	4	1	5	
S. nigricans				
SCARIDAE				
Calotomus carolinus				
Cetoscarus bicolor				
Hipposcarus longiceps				
Scarus altipinnus				
S. forsteni				
S. frenatus		P		
S. frontalis	P			
S. ghobban				
S. globiceps				
S. microrhinos				
S. niger				P
S. oviceps				
S. psittacus				P
S. pyrrhurus	P			P
S. rubroviolaceus			1	P
S. schlegeli				
S. sordidus		3		P
S. spinus				
S. trilineata				
juveniles				
SERRANIDAE				
Aethaloperca rogaa				
Cephalopholis argus				
C. leopardus				
C. urodeta	P	1	3	4
Epinephelus howlandi				
E. maculatus				
E. merra				
Plectropomus leopardus				
Variola louti				
SIGANIDAE				
Siganus argenteus				
SYGNATHIDAE				
Corythoichthys intestinalis				
SYNODONTIDAE				
Synodus spp.				
TETRAODONTIDAE				
Arothron meleagris				
A. nigropunctatus				
Canthigaster solandri				
ZANCLIDAE				
Zanclus cornutus			P	

Table 24c continued	Fagasa Bay		Cape Larsen	
	3m	6m	3m	6m
Total No. Species	34	25	31	52
On-Transect Species	19	21	24	30
On-Transect Individuals	94	92	111	135

Table 25. **Fishes censused along 100-m transects on the reef slopes at Fatatele Bay, Sita Bay, and Cape Larsen in 1995. Numbers indicate the number of individuals of each species counted on the transect, and the letter P indicates the presence of a species in the vicinity of the transect line.**

	Fagatele Bay	Sita Bay	Cape Larsen
ACANTHURIDAE			
Acanthurus achilles			
A. albipectoralis		P	
A. blochii			
A. guttatus			3
A. lineatus		1	1
A. nigricans	3	P	4
A. nigricauda		1	
A. nigrofuscus	7	8	18
A. nigroris			
A. olivaceus			
A. pyroferus			
A. thompsoni			
A. triostegus			
Ctenochaetus binotatus		1	P
C. striatus	54	45	30
C. strigosus		3	
Naso annulatus			
N. brevirostris			
N. hexacanthus			
N. literatus		3	3
N. unicornis			
N. spp.			
Zebrasoma scopas	19		
Z. veliferum		1	3
APOGONIDAE			
Apogon doederleini		7	
AULOSTOMIDAE			
Aulostomus chinensis			
BALISTIDAE			
Balistapus undulatus	2	P	1
Balistoides viridescens			
Melichthys vidua	P	P	1
M. niger			
Pseudobalistes flavimarginatus			P
Rhinecanthus rectangulus			
Sufflamen bursa			P
S. chrysopterus			P
S. freanatus			

Table 25 continued

	Fagatele Bay	Sita Bay	Cape Larsen
BLENNIIDAE			
Aspidontus dussumieri			
Escenius bicolor	P	1	P
Meiacanthus atrodorsalis		3	1
Plagiotremus tapeinosoma			
unidentified blenniids	4	4	19
BOTHIDAE			
Bothus pantherinus			P
CAESIONIDAE			
Caesio cunning			
Pterocaesio tile	9		
P. trilineata	P		
CARANGIDAE			
Caranx melampygus	P	P	
Scomberoides lysan			
CHAETODONTIDAE			
Chaetodon bennetti		P	
C. citrinellus		P	2
C. ephippium		P	P
C. lunula			
C. mertensii			
C. ornatissimus		P	4
C. pelewensis		2	
C. reticulatus	1	1	4
C. semeion			P
C. trifascialis			
C. trifasciatus			1
C. ulietensis			
C. unimaculatus			
C. vagabundus	2	P	P
Forcipiger flavissimus			
F. longirostris			
Hemitaurichthys polylepis			
Heniochus chrysostomus	3		
H. monoceros			
H. varius		1	1
CIRRHITIDAE			
Cirrhitichthys pinnulatus	P		
Paracirrhites arcatus	1	1	3
P. forsteri	7	2	3
P. hemisticus			
CORYPHAENIDAE			
Coryphaena hippurus			

Table 25 continued

	Fagatele Bay	Sita Bay	Cape Larsen
GOBIDAE			
Valenciennea strigata			**P**
HAEMULIDAE			
Plectorhynchus orientalis			
HOLOCENTRIDAE			
Myripristis berndti			1
M. kuntee			
M. violacea	1		
Neoniphon sammara			
Sargocentron caudimaculatum			
S. spiniferum			
KYPHOSIDAE			
Kyphosus cinerascens			
K. vaigiensis		1	2
LABRIDAE			
Anampsis caeruleopunctatus			
A. twistii	1		
Bodianus axillaris		1	1
B. loxozonus	P		
Cheilinus diagrammus	1	1	
C. fasciatus			
C. oxycephalus			
C. trilobatus		P	
C. undulatus			P
C. unifasciatus	3	1	1
Coris aygula			
C. gaimard			
Epibulus insidiator	P		
Gomphosus varius	4	3	3
Halichoeres biocellatus	2		
H. hortulanus		2	2
H. margaritaceus			
H. marginatus			1
H. melanurus			
H. ornatissimus			P
H. trimaculatus			
Hemigymnus fasciatus	1		
H. melapterus			1
Labrichthys unilineatus	1		
Labroides bicolor	1	2	5
L. dimidiatus	1	2	5
L. rubrolabiatus	3	1	2

Table 25 continued

	Fagatele Bay	Sita Bay	Cape Larsen
Labropsis xanthonota	P		
Macropharyngodon meleagris		1	1
Macropharyngodon negrosensis			
Novaculichthys taeniourus			
Pseudocheilinus evanidus			
P. hexataenia	6	1	1
P. octotaenia	1		
Pseudodax moluccanus			
Stethojulis bandanensis		1	
S. trilineata			
Thalassoma amblycephalum			
T. hardwicke		5	1
T. lutescens	1	1	
T. purpureum			
T. quinquevittatum	1	P	16
T. trilobatum			
LETHRINIDAE			
Gnathodentex aureolineatus			
Lethrinus harak			
L. obsoletus			
Monotaxis grandoculis		1	P
LUTJANIDAE			
Aphareus furca	1		P
Aprion virescens			
Lutjanus bohar		1	1
L. fulvus		8	
L. monostigma		3	
Macolor niger		P	P
M. macularis		2	
MALACANTHIDAE			
Malacanthus latovittatus			
MICRODESMIDAE			
Nemateleotris magnifica			P
Ptereleotris evides		2	
Ptereleotris heteroptera			
P. zebra			P
MONACANTHIDAE			
Amanses scopas	1		P
Cantherhinus dumerilii	P	1	P
C. spp.			
MULLIDAE			
Mulloides flavolineatus			
M. vanicolensis			
Parupeneus barberinus			

Table 25 continued

	Fagatele Bay	Sita Bay	Cape Larsen
P. bifasciatus		1	1
P. cyclostomus		1	2
P. multifasciatus		5	1
OSTRACIIDAE			
Ostracion meleagris			
O. cubicus			
PINGUIPEDIDAE			
Parapercis clathrata			P
POMACANTHIDAE			
Apolemichthys trimaculatus			
Centropyge bicolor			
C. bispinosus	3		
C. flavissimus	1	1	2
Pomacanthus imperator			
Pygoplites diacanthus	P	P	3
POMACENTRIDAE			
Abudefduf septemfasciatus			
A. sexfasciatus			
A. vaigiensis			
Amphiprion chrysopterus			
A. clarkii			
A. melanopus			
Chromis acares	21	8	P
C. agilis			
C. amboinensis			
C. iomelas	P	12	P
C. margaritifer	2	12	13
C. vanderbilti			
C. xanthura		19	15
C. spp.			
Chrysiptera cyanea		49	64
C. glauca			
C. leucopoma		P	P
Dascyllus trimaculatus	2		
Neopomacentrus metallicus		19	3
Plectroglyphidodon dickii	2	1	12
P. johnstonianus	3	3	1
P. lacrymatus	9	14	11
P. leucozonus			
P. phoenixensis			
Pomacentrus brachialis	14	39	26
P. vaiuli	1	37	4
Pomachromis richardsoni			P
Pristotis jerdoni			

Table 25 continued

	Fagatele Bay	Sita Bay	Cape Larsen
Stegastes albifasciatus			
S. fasciolatus			P
S. nigricans			
SCARIDAE			
Calotomus carolinus	P		
Cetoscarus bicolor			
Hipposcarus longiceps			1
Scarus altipinnus			
S. forsteni	P	1	
S. frenatus	2		
S. frontalis		1	
S. ghobban			
S. globiceps	3		
S. microrhinos			
S. niger			2
S. oviceps	1		
S. psittacus	16		P
S. pyrrhurus	1	11	3
S. rubroviolaceus		1	P
S. schlegeli			
S. sordidus	42		1
S. spinus	P		1
S. trilineata	1		
juveniles			
SERRANIDAE			
Aethaloperca rogaa	P		
Cephalopholis argus	6	2	4
C. leopardus			
C. urodeta	1	P	7
Epinephelus howlandi			
E. maculatus			
E. merra			
Plectropomus leopardus	P		
Variola louti	1	P	
SIGANIDAE			
Siganus argenteus			
SYGNATHIDAE			
Corythoichthys intestinalis			
SYNODONTIDAE			
Synodus spp.		1	
TETRAODONTIDAE			
Arothron meleagris			2
A. nigropunctatus		1	

Table 25 continued

	Fagatele Bay	Sita Bay	Cape Larsen
Canthigaster solandri		P	
ZANCLIDAE			
Zanclus cornutus		1	
Total No. Species	64	79	83
On-Transect Species	48	61	57
On-Transect Individuals	273	366	327

Table 26. Total species richness and abundance of fishes recorded on the reef slope transects in Fagatele Bay in each year of the survey. Where: Area = total area surveyed each year.

Year	Species Richness	Abundance	Area (m^2)
1985	119	2648	720
1988	61	1341	1200
1995	133	2501	1200

Table 27. Summary of the number of transects surveyed on the reef flat and reef slope at each depth in Fagatele Bay in each year.

Year	Reef Flat (< 1m)	Reef Slope			
		3m	6m	9m	12m
1985	-	3	4	-	5
1988	-	4	4	6	6
1995	2	4	4	6	6

APPENDIX A: Coralline Lethal Orange Disease

by **Charles Birkeland**

The recently discovered "orange band" disease was observed at several locations in Fagatele Bay during the 1995 assessment period. The host of the disease is encrusted coralline algae and the cause or pathogen is at present not known.

In the field the disease is easily recognized by the presence of a circular, narrow, bright orange ring that occurs on encrusted coralline algal surfaces (Fig. 10). Apparently the disease starts at some location, possibly at a damaged or stressed point, and then expands in a centrifugal manner leaving a trailing white band, about as wide as the orange band itself. The white band or area is presumably the crustose algal region that has been killed of affected.

Figure 10. Coralline lethal orange disease

Commonly the orange band and associated white zone appear as incomplete circles, forming semicircles or crescent shapes. Close inspection of the orange and white bands and the enclosed circular area reveals that the crustose algae recovers or rapidly recolonizes the affected regions. In no instances was the enclosed area of the peripheral bands completely killed (white). Generally the enclosed area was an overall pink or purplish red or a somewhat mottled mixture of these colors. In crescent-shaped affected areas it was sometimes difficult to discern the area behind the orange and white bands from the normal surrounding algal encrusted surfaces.

Observations of several orange band occurrences at transect 4 during the two-week duration of our assessment period revealed no apparent expansion or contraction of the orange band. Possibly the rate of growth is slow, sporadic, or was dormant.

In addition to general qualitative observations within the bay, the frequency of occurrence was determined at all six transects on the reef platform and the 3 and 5 meter depth locations during the same time the plotless point-quarter coral transects were run. At each transect point a search radius of one meter was used in each quadrant. It was noticed that a common grey colored encrusting sponge (*Dysidea*) was also conspicuously growing over a number of substrates, including crustose algae. The frequency of the grey sponge was also recorded along with the occurrence of the orange band disease (Table A-1, below).

The frequency of the orange band disease was expected to be higher from just general observations, but this was apparently an illusion because of its conspicuousness. A separate 50 meter long transect was laid down at a rubble covered reentry area at 3 meters depth at transect 4 because of the apparent abundance of the orange band occurrences there, but none was encountered with a 1 meter search radius. General observations, as well as the transect data, showed a greater abundance of the orange band disease at transect 5.

No occurrences of the orange band disease was recorded from any of our other 12 monitoring stations around Tutuila, but one occurrence was observed at the airport dredge site.

In conclusion, it appears that the orange band disease is not a serious threat to the health of the reefs of Tutuila. The disease has a very low frequency of occurrence, and apparently the infected areas quickly recover and become reestablished by crustose coralline algae. The common, but not so conspicuous, grey sponge was affecting about four times as much reef area—that included coral as well as coralline encrusted areas—as the orange band disease in Fagatele Bay.

Table 28. The frequency of occurrence for the orange band disease and grey sponge per quadrant for Transects 1-6.

	Quadrant /depth	CLOD	*Dysidea*	number of quadrants
	1-5m	0	0	60
	2-1m	0	0	68
	2-3m	0	0	60
	2-5m	0	1	60
	3-1m	0	1	120
	3-3m	0	1	60
	3-5m	0	3	60
	4-1m	0	0	88
	4-3m	1	2	60
	4-5m	0	0	60
	5-3m	2	0	60
	5-5m	1	3	60
	6-5m	0	0	60
Totals		**4**	**11**	**876**

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Fale had a great deal of technical skill. He organized the logistics of most of our trips, which included such administrative matters as obtaining permission from local residents for access to the Fagatele Bay National Marine Sanctuary via land and permission to launch a boat in the village of Onenoa. He was able to launch and retrieve the boat from a rocky beach which we would have thought was impossible. In Fagatele Bay, he was able to oversee the safe and efficient operation of scientists in four different sections of the bay simultaneously. He was a remarkably effective technician and was present every day, even on Sundays and holidays, to help us take advantage of every day of our limited visit.

Ultimately, of course, the whole project was brought about by Nancy Daschbach, Fagatele Bay National Marine Sanctuary Coordinator. She organized and secured the logistics and equipment, and she participated in most of the field work, even driving us to access by land and guiding us down the path by land when the seas were too rough to go by boat.

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