

QUANTITATIVE SURVEY OF KAHUWAI BAY

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Project Leader
G. Keoki Stender

Project Members
Yuko Stender
Bob & Tina Owens
Lisa Chau
Heather McGill
William Smith

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INTRODUCTION

In November 1998 a quantitative survey of Kahuwai Bay's coral, invertebrate and fish communities was completed, a follow-up to the June 1992 baseline conducted by students from the University of Hawaii's Marine Option program. The bay and reef system offshore of the Kona Village Resort, in the district of Ka'upulehu, was designated Fish Replenishment Area (FRA) #3 on October 1, 1998. Ka'upulehu FRA includes 3.6 miles of shoreline from the northern boundary of Ka'upulehu *ahupua'a* to the south side of Kalae O Kikaua, Kuki'o Bay. The purpose of the FRA is to restrict the collection of reef animals for the aquarium trade. The bay's remote location has allowed a rich community of marine life to exist with comparatively low fishing pressure compared to areas in close proximity to boat harbors.

A total of seven 50-meter belt transects were conducted, representative of four distinct habitat types present: Zone 1, Inner Reef; Zone 2, Sand Channel; Zone 3, Reef Dropoff (control); and Zone 4, Outer Reef. Their locations were marked with stainless steel eyebolts to allow researchers to resample these sites in the future.

Zones 1 and 2 are subject to considerable activity by swimmers, snorkelers, and boat traffic, in addition to abundant freshwater input by springs and fissures in the rocky shore. A cool freshwater lens is normally present in the inner bay, reaching depths of two meters in places. Wind-driven waves stir up these waters by late morning, reducing visibility due to suspended sediments and mixing of the freshwater lens. Southwesterly "Kona" winds create a longshore current that carries this turbid water mass northward past the resort. Survey results indicate that the reef platform supports a large fish community, and live coral coverage increases with distance from shore.

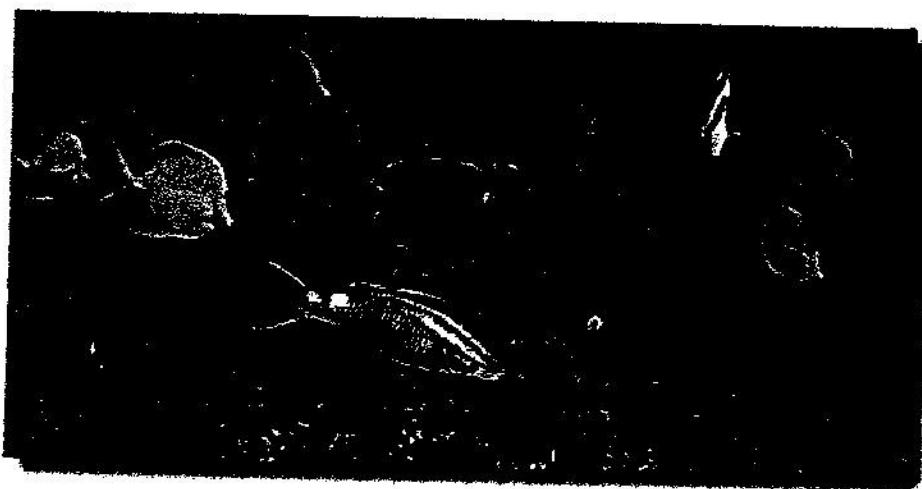


Figure 1. Marine life at the Outer Reef

Coral coverage and species diversity is high at the Outer Reef and Reef Drop-off region. Excellent visibility and varied terrain, coupled with this rich marine community makes the area very attractive to scuba divers. The scope of this project is centered on areas accessible by swimming from shore, therefore just a small portion of this extensive outer reef has been surveyed. Future surveys may benefit from including new transects farther offshore where large fish populations were observed during sport dives.

MATERIALS & METHODS

Seven fifty-meter belt transects were conducted at nearly the same locations done in 1992 (Figure 2). The beginning and end of each line was permanently marked with stainless steel eyebolts installed into the reef by DAR personnel. Each pair of transects were deployed along a straight line using a compass, with a 10 meter space between them. As with the previous survey, data from the pair of transects from each zone (except Zone 2) were treated as replicates to calculate mean substrate coverage, species diversity, and population densities.

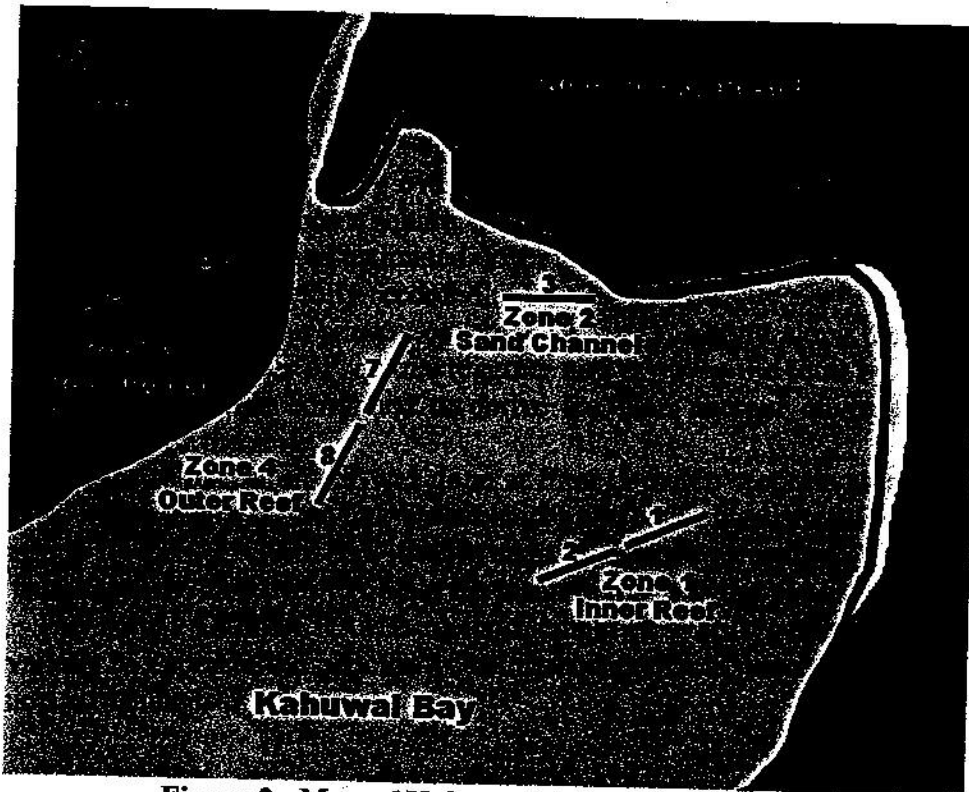


Figure 2. Map of Kahuwai Bay sampling areas

The Division of Aquatic Resources and CRAMP has adopted sampling methods different from those originally conducted during the 1992 baseline; therefore our current work was modified to complement those changes. Those changes are noted below.

Substrate - 1992

Estimation of substrate cover was done using a one-meter-square PVC quadrat at five meter intervals along the transect line, starting at 0-m and ending at 50m, for a total of eleven samples per line. The bottom-left corner of the quadrat was placed directly over the correct distance mark on the calibrated line. The area within the quadrat was subdivided into four equal squares, each totaling 100% coverage. The types of substrate within each section were identified and sketched on waterproof paper.

To find the total coverage of each type in each quadrat, the four sub-zone totals were added together, divided by four, and multiplied by 100%. The mean percent coverage and standard deviation values were then calculated for the entire line. The

results from both transects were combined to derive the final percent coverage and standard deviation values for the zone.

It has been determined that two problems with this process were found to invalidate the precision of the results. The first problem was diver bias in determining the percentage of items within individual subdivisions during analysis. The second problem was the assumption that an individual coral colony was entirely alive when drawn. In reality, the surfaces of many coral colonies observed this year were partially dead. Employing a new quadrat with 100 subdivisions greatly improved our precision this year, at the expense of dive time. The original number of quadrats sampled per line has been increased to 18 random instead of fixed points.

Substrate - 1998

A new one-meter-square PVC quadrat subdivided into 100-10x10cm squares was used to sample 18 random points along each transect line. The bottom-shoreward corner of the quadrat was placed directly over the correct distance mark on the calibrated line. The dominant substrate within a square was recorded as one percent except for small or rare corals; their coverage was estimated down to 0.25 percent. Living and dead portions of all coral heads were carefully recorded using this method.

Calculating the mean percent coverage of each substrate along the line was easily done by adding the number of squares together and dividing the total by 18. The results from both transects were combined to derive the final percent coverage and standard deviation values for the zone.

A rugosity measurement was done at three 5-meter sections along each transect using a 10 meter length of flat-link brass chain. The chain was carefully draped over the substrate at 10-15m, 25-30m, and 40-45m and the distance measured. The mean of these three values was divided by 5 to obtain the mean rugosity factor for each transect.

The actual DLNR/CRAMP method employs a still camera instead of diver observations to expedite the process. Our method is much slower but a higher level of precision is obtained.

Invertebrates - 1992

The invertebrate community along each transect line was estimated by counting all individuals along the length of the 50 meter line, out to a distance of 3 meters (10 feet) on both sides of the line, comprising a sample area of 250 square meters. A pair of divers swam abreast of each other along their respective side of the transect line. The total number of each species recorded by both divers was added together and divided by 250 to obtain the population density per square meter. Results from each transect were added and divided by two to find the mean species density from each zone.

In all instances, corals, infauna, plankton, and animals less than one cm in length were not recorded, nor was the substrate disturbed. This method was changed to reduce the amount of area sampled by adopting the grid-quadrat technique described below.

Invertebrates - 1998

A one-meter-square PVC quadrat without subdivisions was used to sample 18 random points along each transect line for invertebrates. The bottom-shoreward corner

of the quadrat was placed directly over the correct distance mark on the calibrated line. Divers simply recorded the number of each species found within a quadrat.

Calculating the mean population density of each species per square-meter was easily done by adding the number of individuals together and dividing the total by 18. The results from both transects were combined to derive the final population densities and standard deviations for the zone.

This method is much more efficient than the previous. Invertebrate sampling methods have not been adopted by DAR/CRAMP to date.

Fishes - 1992

Fish communities were sampled by conducting a strip transect, 50 meters long and 3 meters on each side, including the water column above the reef, to the ocean's surface. The fish strip divers are always the first sampling team to begin work after the five minute "equilibrium period" following deployment of the line. Other teams begin work at least 8 meters (25 feet) behind this team and do not encroach upon this buffer zone.

Each diver identifies, counts, and estimates the total length in inches (tip of snout to trailing edge of caudal fin, excluding highly elongated rays) of each fish observed on his/her side of the line, taking care not to double count fishes moving from one side to the other. Therefore it was extremely important that both divers remain directly abreast of each other and control their pace. Coral heads and holes were also examined for cryptic and nocturnal forms taking shelter.

Totals from each side of the line were combined, providing the number of species and individuals (abundance) from each transect, plus estimated biomass for each species. Biomass and abundance results from both lines were combined, then divided by two to find averages for each zone.

Note: Biomass results from 1992 are not included in this report since the method has been abandoned.

Fishes - 1998

All techniques remained the same except for the abandonment of length records for biomass estimation. The method now includes categories for adults and juveniles observed during a census. A runtime comparison between the standard 3-meter and an experimental 2-meter lane width was conducted at Zone 3.

RESULTS

Cumulative results from surveys of 1992 and 1998 are shown below. The most noticeable trend was the marked decrease of fishes and invertebrates on the Inner Reef, Zone 1 and an increase in the invertebrate population density at all remaining zones.

| 1992 / 1998 | Zone 1 | Zone 2 | Zone 3 | Zone 4 |
|-------------------------------|---------------|---------------|---------------|---------------|
| Coral % | 14.12 / 4.38 | 0.68 / 0.77 | 74.60 / 47.10 | 68.57 / 45.86 |
| species | 6 / 8 | 3 / 4 | 7 / 9 | 11 / 7 |
| Invert/10m² | 75.48 / 17.83 | 19.00 / 75.56 | 29.78 / 44.44 | 35.82 / 81.94 |
| species | 16 / 19 | 11 / 14 | 11 / 10 | 9 / 6 |
| Fishes | 915.0 / 223.0 | 83.0 / 27.0 | 575.0 / 489.0 | 497.0 / 466.5 |
| species | 65 / 42 | 24 / 16 | 74 / 49 | 54 / 53 |

Table 1. Survey results from 1992 and 1998

Substrate

Substrate results, as indicated in the Materials & Methods section, should not be compared between 1992 and 1998 directly due substantial changes to the sampling technique. The net result of changes made produced a more accurate assessment of the percent coverage of all substrate types taking into account dead zones upon coral heads.

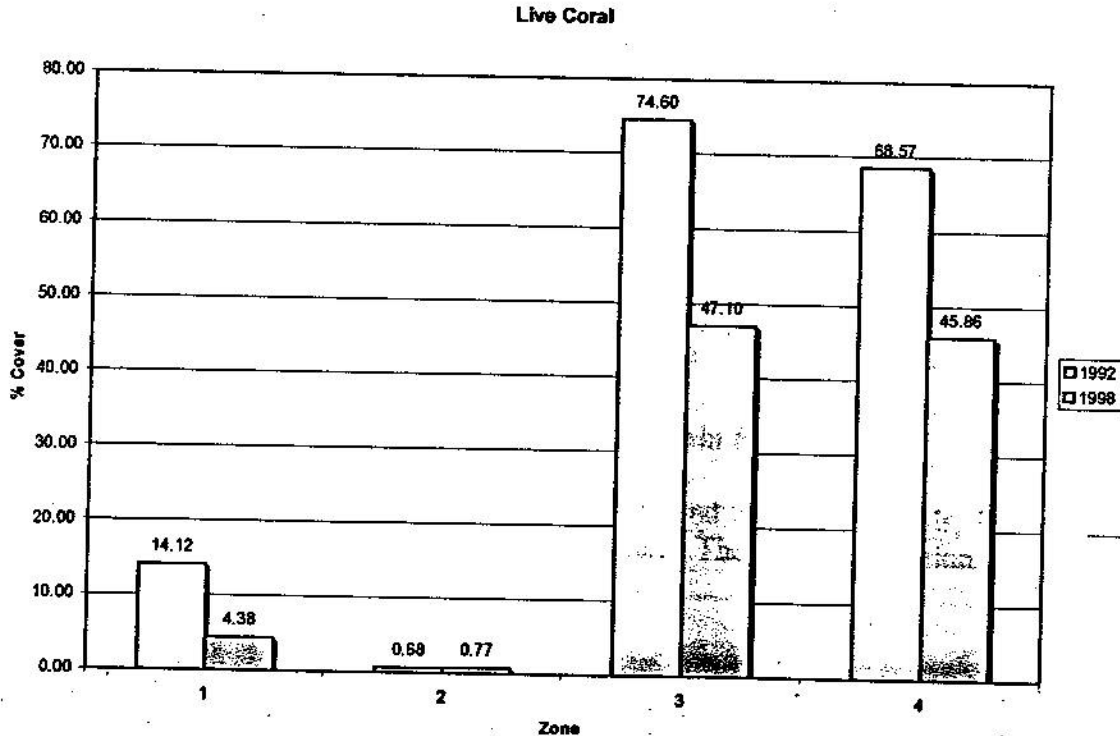


Figure 3. Coral coverage within Kahuwai Bay

Reduction in percent coverage of live corals in Zones 1, 3 and 4 may simply be a result of the new sampling technique, but surveyors from 1992 (Keoki & Yuko Stender)

noticed that over 50% of all Lobe Corals in Zones 3 and 4 were partially dead and in a state of decline this year. The cause for this decline in Kahuwai Bay are unknown, and may be occurring in other areas along the Kona Coast. Possibilities include increased nutrient runoff, sediment load, water temperature, ultraviolet light, and bio-erosion.

Invertebrates

Invertebrate census results are illustrated in Figure 4 below. All zones showed an increase with the exception of the Inner Reef, Zone 1. The dominant species in all zones was the Pale Rock-boring Urchin, unchanged from results of 1992.

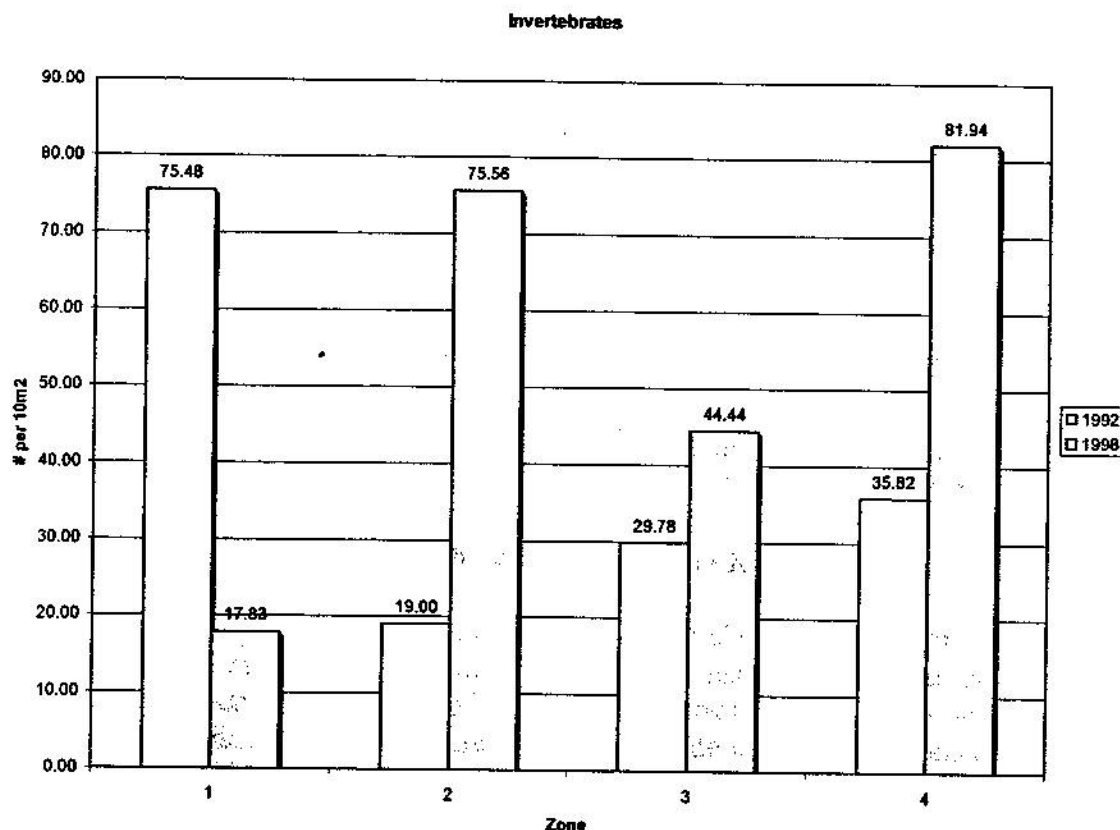


Figure 4. Invertebrate density within Kahuwai Bay

With the exception of Rock-boring Urchins and attached animals, invertebrates move about the reef in search of food and shelter. Therefore population density and diversity values tend to vary considerably over time.

Fishes

Fish census results for 1998 showed significant decreases in population and species diversity at Zones 1, 2 and 3, with the greatest changes taking place closer to shore at the Inner Reef and Sand Channel. The Reef Dropoff showed a moderate decrease while the Outer Reef remained stable.

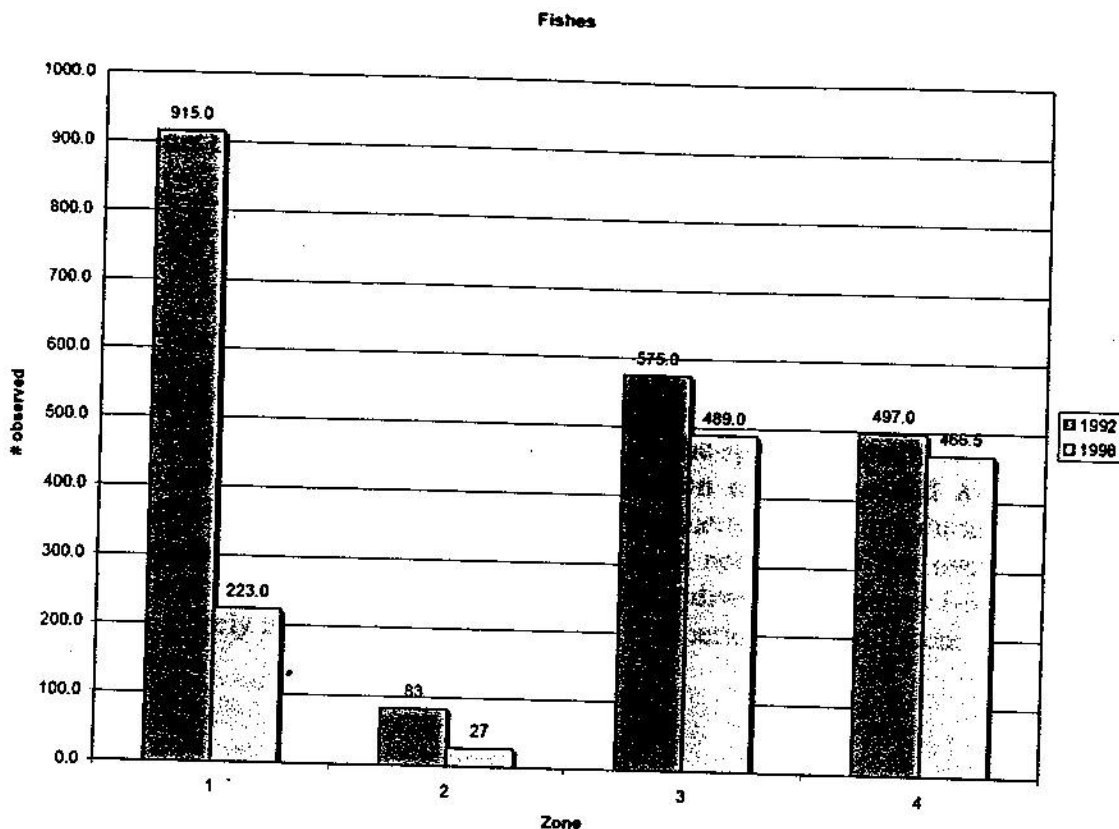


Figure 5. Fish population within Kahawai Bay

Factors contributing to these changes are unclear without data from the last 6 years, but factors may include diurnal migration patterns, seasonal changes to the community structure, food availability (i.e. filamentous algae), fishing activity, reaction to divers, and changes in water quality or the substrate composition. Since a fish census is simply a snapshot in time, a single set of data should not be used to form a conclusion.

DISCUSSION

Substrate

Decreases in the numeric abundance of live corals are partially attributed to the new sampling technique used this year. However the number of partially dead coral colonies observed indicates that this is a real condition and implementation of a coral monitoring study would be valuable. Comparison with similar surveys along the Kona Coast may shed light on this situation, whether it is a widespread or isolated incident. It can be expected that invertebrate and fish communities change in response to such incidents.

Invertebrates

A Pale Rock-boring Urchin feeds upon bits of algae that wash into the home depression it has scoured. This scouring activity called bio-erosion effectively eats away

at any hard substrate including massive coral heads. In time these pitted coral heads become weakened, giving algae a foothold and the colony eventually dies or is broken apart by wave action. The Inner Reef population experienced a major decrease while all remaining three zones increased. The reason for this change remains unclear and the bay does not support a substantial seaweed crop. Few seaweeds were encountered anywhere during the survey.

Fishes

Changes to the fish populations within the bay are difficult to interpret since the species showing the greatest change are neither sought as food or for aquariums. These species include *Ma'i'i'i* (*Acanthurus nigrofuscus*), *Manini* (*A. triostegus*), *Kole* (*Ctenochaetus strigosus*), *Hinalea* (*Thalassoma duperrey*), and *Humuhumu 'ele'ele* (*Melichthys niger*). These are normally the most prolific species in many areas in Hawaii and occur in sizable aggregations, with the exception of *Hinalea* and *Kole*. Lower numbers of schooling fish can be due to random movement of the group during a survey.

The random movement of fish schools does not address the overall drop in numbers of all other species or the decrease in species diversity in Zones 1-3. Hopefully this change is merely a seasonal one, as summer is a period of recruitment for juveniles of many species.

CONCLUSION

Changes to Kahuwai Bay's reef community are inevitable. Changes are an integral part of all complex ecosystems and it is a great challenge to interpret and understand them. As responsible stewards of our environment we must ensure that our activities do not adversely affect it, and by establishing a regular monitoring program we will be able to identify such changes. Kahuwai Bay remains of the finest reef systems in our state and we should do our part to protect it for the benefit of many future generations.

ACKNOWLEDGEMENTS

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APPENDIX

Summary of Survey Results from 1998 and 1992

SUBSTRATE

Substrate Survey Comparison 1992 and 1998

Substrate Survey Results, 1992

Summary

Transect 1

Transect 2

Transect 3

Transect 5

Transect 6

Transect 7

Transect 8

Substrate Survey Results, 1998

Summary

Transect 1

Transect 2

Transect 3

Transect 5

Transect 6

Transect 7

Transect 8

INVERTEBRATES

Invertebrate Census 1992 and 1998 Comparisons

Zone 1

Zone 2

Zone 3

Zone 4

Invertebrate Census Results

Transect 1

Transect 2

Transect 3

Transect 5

Transect 6

Transect 7

Transect 8

FISHES

Fish Census Results and Comparisons

Zone 1

Zone 2

Zone 3

Zone 4

Zone 3, 2m vs. 3m width comparison

Common and Hawaiian names of fishes in Kahuwai Bay

Survey Results from 1988 and 1992

| LIVE CORAL | ZONE 1 | | ZONE 2 | | ZONE 3 | | ZONE 4 | | Total | T-7 | T-8 | Total |
|----------------------|--------|-------|--------|-------------|--------|-------|--------|-------|-------|-------|-------|-------|
| | T-1 | T-2 | Total | T-3 (Total) | T-5 | T-6 | T-7 | T-8 | | | | |
| Percent Cover | | | | | | | | | | | | |
| 1988 | 3.35 | 5.40 | 4.38 | 0.77 | 47.08 | 47.11 | 32.25 | 59.47 | 47.10 | 32.25 | 59.47 | 45.86 |
| 1992 | 17.55 | 10.68 | 14.12 | 0.68 | 77.55 | 71.64 | 78.27 | 58.86 | 74.60 | 78.27 | 58.86 | 68.57 |
| Species | | | | | | | | | | | | |
| 1988 | 7 | 6 | 8 | 4 | 8 | 7 | 9 | 6 | 7 | 7 | 7 | 7 |
| 1992 | 5 | 5 | 6 | 3 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 11 |
| INVERTEBRATES | | | | | | | | | | | | |
| # / 10m ² | | | | | | | | | | | | |
| 1988 | 25.00 | 10.67 | 17.83 | 75.56 | 51.67 | 37.22 | 68.89 | 95.00 | 44.44 | 68.89 | 95.00 | 81.94 |
| 1992 | 75.04 | 75.93 | 75.48 | 19.00 | 31.56 | 28.00 | 62.12 | 9.52 | 29.78 | 62.12 | 9.52 | 35.82 |
| Species | | | | | | | | | | | | |
| 1988 | 11 | 14 | 19 | 14 | 8 | 8 | 10 | 5 | 10 | 4 | 5 | 6 |
| 1992 | 16 | 12 | 16 | 11 | 8 | 10 | 7 | 7 | 11 | 7 | 7 | 9 |
| FISHES | | | | | | | | | | | | |
| 1988 | 199 | 247 | 223.0 | 27 | 514 | 464 | 305 | 628 | 489.0 | 305 | 628 | 466.5 |
| 1992 | 883 | 947 | 915.0 | 83 | 450 | 700 | 578 | 416 | 575.0 | 578 | 416 | 497.0 |
| Species | | | | | | | | | | | | |
| 1988 | 28 | 27 | 42 | 16 | 39 | 37 | 49 | 43 | 49 | 36 | 43 | 53 |
| 1992 | 48 | 51 | 65 | 24 | 61 | 43 | 74 | 44 | 74 | 47 | 44 | 54 |

Substrate Survey Comparison 6/92 and 11/98

| TYPE | SCIENTIFIC NAME | 92-21 | 98-21 | 92-22 | 98-22 | 92-23 | 98-23 | 92-24 | 98-24 |
|---------------------|---------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Cauliflower Coral | <i>Pocillopora meandrina</i> | 1.84 | 1.49 | 0.27 | 0.51 | 0.86 | 0.60 | 2.03 | 1.40 |
| Pitted Lobe Coral | <i>Porites brighami</i> | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Finger Coral | <i>Porites compressa</i> | 0.00 | 0.00 | 0.00 | 0.00 | 32.96 | 11.00 | 7.60 | 0.67 |
| Green Finger Coral | <i>Porites diuerti</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 |
| Brown Lobe Coral | <i>Porites evermanni</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.17 | 0.00 | 0.00 |
| Lobe Coral | <i>Porites lobata</i> | 10.75 | 2.45 | 0.27 | 0.01 | 33.41 | 34.48 | 46.73 | 40.89 |
| Blue Rice Coral | <i>Montipora capitata</i> | 0.18 | 0.17 | 0.00 | 0.14 | 1.87 | 0.35 | 7.00 | 0.35 |
| Ringed Rice Coral | <i>Montipora flabellata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.23 | 0.00 |
| Porkchop Coral | <i>Montipora patula</i> | 0.37 | 0.20 | 0.00 | 0.11 | 0.73 | 0.14 | 1.23 | 2.14 |
| False Brain Coral | <i>Pavona diuerti</i> | 0.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 |
| Rusty Volcano Coral | <i>Pavona varians</i> | 0.00 | 0.06 | 0.00 | 0.00 | 4.46 | 0.32 | 3.05 | 0.35 |
| Crater Coral | <i>Cyphastrea ocellina</i> | 0.30 | 0.01 | 0.14 | 0.00 | 0.32 | 0.00 | 0.37 | 0.00 |
| Petaloid Coral | <i>Leptastrea purpurea</i> | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.06 |
| Colonial Zoanthid | <i>Psammocora profundacella</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| Total Live Coral | <i>Zoanthus pacificus</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 |
| Coralline algae | <i>Porolithon sp.</i> | 14.12 | 4.38 | 0.68 | 0.77 | 74.60 | 47.10 | 66.67 | 49.86 |
| Basalt pavement | | 0.96 | 0.23 | 2.45 | 0.06 | 1.00 | 0.02 | 0.46 | 0.03 |
| Dead coral head | | 70.61 | 86.84 | 0.18 | 7.67 | 0.00 | 2.45 | 0.00 | 11.93 |
| Coral rubble | | 0.00 | 6.13 | 0.00 | 0.22 | 0.00 | 25.62 | 2.73 | 30.96 |
| Sand | | 13.41 | 2.34 | 17.27 | 3.75 | 3.96 | 7.68 | 0.00 | 1.28 |
| | | 0.91 | 0.11 | 79.41 | 67.63 | 20.46 | 14.93 | 28.25 | 9.84 |

Substrate Survey Results 6/92

| TYPE | SCIENTIFIC NAME | T-1 | T-2 | Zone 1 | Zone 2 | T-5 | T-6 | Zone 3 | T-7 | T-8 | Zone 4 |
|---------------------|-------------------------------|-------|-------|--------|--------|-------|-------|--------|-------|-------|--------|
| Cauliflower Coral | <i>Pocillopora mesandrina</i> | 1.36 | 2.32 | 1.84 | 0.27 | 1.45 | 0.27 | 0.86 | 3.82 | 0.23 | 2.03 |
| Finger Coral | <i>Porites compressa</i> | 0 | 0 | 0.00 | 0 | 34.73 | 31.18 | 32.96 | 7.55 | 7.64 | 7.60 |
| Lobe Coral | <i>Porites lobata</i> | 14.41 | 7.09 | 10.75 | 0.27 | 31.82 | 35 | 33.41 | 51.91 | 41.55 | 46.73 |
| Rice Coral | <i>Montipora capitata</i> | 0.36 | 0 | 0.18 | 0 | 2.82 | 0.91 | 1.87 | 8.82 | 5.18 | 7.00 |
| Blue Rice Coral | <i>Montipora flabellata</i> | 0 | 0 | 0.00 | 0 | 0 | 0 | 0.00 | 0 | 0.45 | 0.23 |
| Ringed Rice Coral | <i>Montipora patula</i> | 0 | 0.73 | 0.37 | 0 | 0.64 | 0.82 | 0.73 | 2 | 0.45 | 1.23 |
| Porkchop Coral | <i>Pavona divergens</i> | 1.09 | 0.27 | 0.86 | 0 | 0 | 0 | 0.00 | 0.27 | 0 | 0.14 |
| False Brain Coral | <i>Pavona varians</i> | 0 | 0 | 0.00 | 0 | 6.09 | 2.82 | 4.46 | 3.91 | 2.18 | 3.06 |
| Ruaty Volcano Coral | <i>Cyphastrea ocellina</i> | 0.32 | 0.27 | 0.30 | 0.14 | 0 | 0.64 | 0.32 | 0 | 0.73 | 0.37 |
| Crater Coral | <i>Lepidastrea purpurea</i> | 0 | 0 | 0.00 | 0 | 0 | 0 | 0.00 | 0 | 0.18 | 0.09 |
| Colonial Zoanthid | <i>Zoanthus pacificus</i> | 0 | 0 | 0.00 | 0 | 0 | 0 | 0.00 | 0 | 0.27 | 0.14 |
| Total Live Coral | | 17.55 | 10.68 | 14.12 | 0.88 | 77.55 | 71.64 | 74.60 | 78.27 | 68.86 | 68.57 |
| Coralline algae | <i>Porolithon sp.</i> | 1.91 | 0 | 0.96 | 2.45 | 0.18 | 1.82 | 1.00 | 0 | 0.91 | 0.48 |
| Basalt pavement | | 60.45 | 80.77 | 70.61 | 0.18 | 0 | 0 | 0.00 | 0 | 0 | 0.00 |
| Dead coral head | | 0 | 0 | 0.00 | 0 | 0 | 0 | 0.00 | 0 | 5.45 | 2.73 |
| Coral rubble | | 18.27 | 8.55 | 13.41 | 17.27 | 5.36 | 2.55 | 3.96 | 0 | 0 | 0.00 |
| Sand | | 1.82 | 0 | 0.91 | 78.41 | 16.91 | 24 | 20.46 | 21.73 | 34.77 | 28.25 |

Substrate Survey, Zone 1, Transect 1 6/92

| TYPE | SCIENTIFIC NAME | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | % Cover | +/- |
|--------------------------|------------------------------|----|------|----|----|----|----|------|------|-----|----|------|---------|-------|
| Basalt pavement | | 91 | 0 | 67 | 0 | 94 | 99 | 0 | 38.5 | 100 | 77 | 88.5 | 60.45 | 42.80 |
| Branched coralline algae | <i>Porolithon</i> sp. | 7 | 2 | 7 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 1.91 | 2.81 |
| Coral rubble | | 0 | 84.5 | 0 | 19 | 0 | 0 | 47.5 | 50 | 0 | 0 | 0 | 18.27 | 28.30 |
| Sand | | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.82 | 6.03 |
| Cauliflower Coral | <i>Pocillopora meandrina</i> | 2 | 1 | 0 | 6 | 0 | 0 | 2 | 1.5 | 0 | 2 | 0.5 | 1.36 | 1.76 |
| Porchop Coral | <i>Pavona duerdeni</i> | 0 | 10 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1.09 | 3.02 |
| Rusty Volcano Coral | <i>Cyphastrea ocellina</i> | 0 | 0 | 3 | 0 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0.32 | 0.90 |
| Lobe Coral | <i>Porites lobbata</i> | 0 | 2.5 | 0 | 75 | 0 | 0 | 50 | 10 | 0 | 20 | 1 | 14.41 | 25.20 |
| Rice Coral | <i>Montipora capitata</i> | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.36 | 0.92 |
| Total Live Coral | | | | | | | | | | | | | 17.55 | 6.38 |

Substrate Survey, Zone 1, Transect 2 6/92

| TYPE | SCIENTIFIC NAME | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | % Cover | +/- |
|--------------------|-------------------------------|----|----|----|----|----|----|-----|-----|-----|----|------|---------|-------|
| Basalt pavement | | 0 | 85 | 87 | 93 | 88 | 50 | 100 | 100 | 100 | 79 | 98.5 | 80.77 | 30.52 |
| Coral rubble | | 94 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.55 | 28.34 |
| Cauliflower Coral | <i>Pocillopora meandrina</i> | 0 | 15 | 3 | 0 | 4 | 0 | 0 | 0 | 0 | 3 | 0.5 | 2.32 | 4.47 |
| Porkchop Coral | <i>Pavona duerdeni</i> | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.27 | 0.80 |
| Lobe Coral | <i>Porites lobata</i> | 3 | 0 | 0 | 7 | 8 | 50 | 0 | 0 | 10 | 0 | 0 | 7.09 | 14.73 |
| Rusty Volano Coral | <i>Cyathastrea ocellifera</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0.27 | 0.90 |
| Ringed Rice Coral | <i>Montipora patula</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0.73 | 2.41 |
| Total Live Coral | | | | | | | | | | | | | 10.68 | 4.68 |

Substrate Survey, Zone 2, Transect 3 6/92

| TYPE | SCIENTIFIC NAME | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | % Cover | +/- |
|--------------------------|------------------------------|----|----|------|-----|-----|-----|----|-----|-----|-----|-----|---------|-------|
| Basalt pavement | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.18 | 0.60 |
| Branched coralline algae | | 0 | 0 | 20 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2.45 | 6.02 |
| Coral rubble | <i>Porolithon</i> sp. | 5 | 0 | 20 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 17.27 | 34.15 |
| Sand | | 95 | 74 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 79.41 | 35.75 |
| Cauliflower Coral | | 0 | 25 | 58.5 | 100 | 100 | 100 | 90 | 100 | 100 | 100 | 100 | 0.27 | 0.65 |
| Lobe Coral | <i>Pocillopora meandrina</i> | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0.27 | 0.90 |
| Rusty Volcano Coral | <i>Porites lobata</i> | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0.14 | 0.32 |
| Total Live Coral | <i>Cyphastrea ocellina</i> | 0 | 0 | 0.5 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.68 | 0.62 |

Substrate Survey, Zone 3, Transect 5 6/92

| TYPE | SCIENTIFIC NAME | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | % Cover | +/- |
|--------------------------|------------------------------|----|----|----|----|----|----|----|----|----|----|----|---------|-------|
| Branched coralline algae | <i>Porolithon</i> sp. | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0.18 | 0.60 |
| Coral rubble | | 20 | 28 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.36 | 10.12 |
| Sand | | 0 | 0 | 0 | 0 | 20 | 28 | 78 | 20 | 20 | 10 | 10 | 18.91 | 22.63 |
| Cauliflower Coral | <i>Pocillopora meandrina</i> | 0 | 0 | 0 | 0 | 0 | 4 | 12 | 0 | 0 | 0 | 0 | 1.45 | 3.70 |
| False Brain Coral | <i>Pavona varians</i> | 3 | 7 | 20 | 15 | 7 | 15 | 0 | 0 | 0 | 0 | 0 | 6.09 | 7.41 |
| Finger Coral | <i>Porites compressa</i> | 12 | 10 | 45 | 55 | 50 | 15 | 0 | 40 | 5 | 75 | 75 | 34.73 | 27.62 |
| Lobe Coral | <i>Porites lobata</i> | 65 | 50 | 25 | 30 | 20 | 30 | 10 | 30 | 60 | 15 | 15 | 31.82 | 18.61 |
| Rice Coral | <i>Montipora capitata</i> | 0 | 0 | 0 | 0 | 3 | 6 | 0 | 10 | 12 | 0 | 0 | 2.82 | 4.49 |
| Ringed Rice Coral | <i>Montipora patula</i> | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0.94 | 1.43 |
| Total Live Coral | | | | | | | | | | | | | 77.55 | 10.54 |

Substrate Survey, Zone 3, Transect 6 6/92

| TYPE | SCIENTIFIC NAME | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | % Cover | +/- |
|--------------------------|------------------------------|----|----|----|----|----|----|----|----|----|----|----|---------|-------|
| Branched coralline algae | <i>Porolithon</i> sp. | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 1.82 | 2.52 |
| Coral rubble | | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.56 | 8.44 |
| Sand | | 10 | 0 | 72 | 40 | 0 | 10 | 0 | 30 | 7 | 60 | 35 | 24.00 | 25.34 |
| Ceaflower Coral | <i>Pocillopora meandrina</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0.27 | 0.90 |
| False Brain Coral | <i>Pavona varians</i> | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 3 | 0 | 2.82 | 5.62 |
| Finger Coral | <i>Porites compressa</i> | 30 | 25 | 3 | 0 | 70 | 50 | 40 | 38 | 60 | 15 | 12 | 31.18 | 22.92 |
| Lobe Coral | <i>Porites lobata</i> | 40 | 35 | 25 | 60 | 25 | 35 | 55 | 15 | 30 | 20 | 45 | 35.00 | 14.14 |
| Rusty Volcano Coral | <i>Cyphastrea ocellina</i> | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0.64 | 1.57 |
| Rice Coral | <i>Montipora capitata</i> | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0.91 | 2.02 |
| Ringed Rice Coral | <i>Montipora patula</i> | 2 | 2 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0.82 | 1.60 |
| Total Live Coral | | | | | | | | | | | | | 71.64 | 6.97 |

| TYPE | SCIENTIFIC NAME | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | % Cover | ±/- |
|-------------------|------------------------------|----|-----|----|----|----|----|----|----|----|----|----|---------|-------|
| Sand | | 10 | 100 | 40 | 18 | 4 | 12 | 37 | 18 | 0 | 0 | 0 | | |
| Cauliflower Coral | <i>Pocillopora meandrina</i> | 25 | 0 | 0 | 2 | 2 | 0 | 7 | 0 | 3 | 3 | 0 | 21.73 | 29.47 |
| False Brain Coral | <i>Pavona varians</i> | 25 | 0 | 0 | 0 | 3 | 0 | 0 | 15 | 0 | 0 | 0 | 3.82 | 7.35 |
| Porkchop Coral | <i>Pavona duerdeni</i> | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.91 | 8.31 |
| Finger Coral | <i>Porites compressa</i> | 0 | 0 | 0 | 25 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0.27 | 0.90 |
| Lobe Coral | <i>Porites lobata</i> | 40 | 0 | 50 | 25 | 60 | 70 | 50 | 35 | 84 | 90 | 67 | 7.55 | 10.53 |
| Rice Coral | <i>Montipora capitata</i> | 0 | 0 | 7 | 25 | 25 | 15 | 6 | 7 | 3 | 3 | 6 | 51.91 | 26.37 |
| Ringed Rice Coral | <i>Montipora pertusa</i> | 0 | 0 | 0 | 5 | 0 | 3 | 0 | 0 | 3 | 4 | 7 | 8.82 | 8.99 |
| Total Live Coral | | | | | | | | | | | | | 78.27 | 9.28 |

Substrate Survey, Zone 4, Transect 8 6/92

| TYPE | SCIENTIFIC NAME | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | % Cover | +/- |
|--------------------------|------------------------------|----|-----|------|----|-----|----|----|----|----|----|----|---------|-------|
| Branched coralline algae | <i>Pocillopora sp.</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.91 | 3.02 |
| Dead coral head | | 0 | 0 | 0 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.45 | 18.09 |
| Sand | | 0 | 100 | 54.5 | 0 | 100 | 10 | 20 | 20 | 52 | 20 | 6 | 34.77 | 37.03 |
| Cauliflower Coral | <i>Pocillopora meandrina</i> | 0 | 0 | 0.5 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0.23 | 0.61 |
| False Brain Coral | <i>Pavona varians</i> | 8 | 0 | 0 | 0 | 0 | 0 | 2 | 14 | 0 | 0 | 0 | 2.18 | 4.80 |
| Finger Coral | <i>Porites compressa</i> | 16 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 15 | 25 | 20 | 7.84 | 9.64 |
| Lobe Coral | <i>Porites lobata</i> | 70 | 0 | 45 | 40 | 0 | 80 | 60 | 62 | 25 | 25 | 50 | 41.55 | 26.71 |
| Rice Coral | <i>Montipora capitata</i> | 4 | 0 | 0 | 0 | 0 | 0 | 10 | 4 | 4 | 25 | 10 | 5.18 | 7.60 |
| Blue Rice Coral | <i>Montipora flabellata</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0.45 | 1.51 |
| Ringed Rice Coral | <i>Montipora patula</i> | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0.45 | 1.51 |
| Rusty Volcano Coral | <i>Cyphastrea ocellina</i> | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 0 | 4 | 0.73 | 1.42 |
| Crater Coral | <i>Leptastrea purpurea</i> | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.18 | 0.60 |
| Colonial Zoanthid | <i>Zoanthus pacificus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0.27 | 0.90 |
| Total Live Coral | | | | | | | | | | | | | 58.86 | 6.51 |

| TYPE | SCIENTIFIC NAME | T-1 | T-2 | Zone 1 | Zone 2 | T-5 | T-6 | Zone 3 | T-7 | T-8 | Zone 4 |
|---------------------|---------------------------------|-------|-------|--------|--------|-------|-------|--------|-------|-------|--------|
| Cauliflower Coral | <i>Pocillopora meandrina</i> | 0.92 | 2.05 | 1.49 | 0.51 | 0.61 | 0.58 | 0.60 | 1.83 | 0.97 | 1.40 |
| Pitted Lobe Coral | <i>Porites brighami</i> | 0.02 | 0.02 | 0.02 | 0 | 0 | 0 | 0.00 | 0 | 0 | 0.00 |
| Finger Coral | <i>Porites compressa</i> | 0 | 0 | 0.00 | 0 | 12.22 | 9.78 | 11.00 | 0.36 | 0.97 | 0.87 |
| Green Finger Coral | <i>Porites duerdeni</i> | 0 | 0 | 0.00 | 0 | 0.11 | 0 | 0.06 | 0 | 0 | 0.00 |
| Brown Lobe Coral | <i>Porites evermanni</i> | 0 | 0 | 0.00 | 0 | 0 | 0.33 | 0.17 | 0 | 0 | 0.00 |
| Lobe Coral | <i>Porites lobata</i> | 1.88 | 3.01 | 2.45 | 0.01 | 33.22 | 35.69 | 34.48 | 28.83 | 54.94 | 40.89 |
| Ridge Coral | <i>Montipora capitata</i> | 0.08 | 0.26 | 0.17 | 0.14 | 0.26 | 0.44 | 0.35 | 0.33 | 0.39 | 0.36 |
| Ringed Rice Coral | <i>Montipora patula</i> | 0.39 | 0 | 0.20 | 0.11 | 0.11 | 0.17 | 0.14 | 2.38 | 1.89 | 2.14 |
| Portulacop Coral | <i>Pavona duerdeni</i> | 0 | 0 | 0.00 | 0 | 0 | 0 | 0.00 | 0 | 0 | 0.00 |
| False Brain Coral | <i>Pavona varians</i> | 0.06 | 0.08 | 0.06 | 0 | 0.53 | 0.11 | 0.32 | 0.5 | 0.19 | 0.35 |
| Rusty Volcano Coral | <i>Cyphastrea coccinea</i> | 0 | 0.01 | 0 | 0 | 0 | 0 | 0.00 | 0 | 0 | 0.00 |
| Crater Coral | <i>Leptastrea purpurea</i> | 0.01 | 0 | 0.01 | 0 | 0 | 0 | 0.00 | 0 | 0.11 | 0.06 |
| Petaloid Coral | <i>Psemmocora profundacella</i> | 0 | 0 | 0.00 | 0 | 0.01 | 0 | 0.01 | 0 | 0 | 0.00 |
| Total Live Coral | | 3.36 | 5.4 | 4.38 | 0.77 | 47.08 | 47.11 | 47.10 | 32.25 | 69.47 | 45.86 |
| Coralline algae | <i>Porolithon sp.</i> | 0.33 | 0.12 | 0.23 | 0.06 | 0.03 | 0 | 0.02 | 0.06 | 0 | 0.03 |
| Basal pavement | | 91.11 | 82.56 | 86.84 | 7.67 | 2.33 | 2.56 | 2.46 | 16.11 | 7.75 | 11.93 |
| Dead coral head | | 4.21 | 8.04 | 6.13 | 0.22 | 26.37 | 24.86 | 25.62 | 35.31 | 26.61 | 30.96 |
| Coral rubble | | 0.78 | 3.89 | 2.34 | 3.78 | 6.5 | 8.86 | 7.68 | 1.83 | 0.72 | 1.28 |
| Sand | | 0.22 | 0 | 0.11 | 87.63 | 18.08 | 11.78 | 14.93 | 14.44 | 5.44 | 9.94 |

SUBSTRATE SURVEY, ZONE 1, HAISELL I 11/11/30

| TYPE | SCIENTIFIC NAME | 10 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 95 | 96.9 | 91.8 | 89 | 100 | 98.8 | 94.9 | 88 | 97 | 73 | 87.7 | 98.8 | % Cover | +/- | |
|--------------------------|------------------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|-----|-----|------|------|-----|-----|-----|------|------|---------|-------|-----|
| Basal pavement | | 10 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Branched coralline algae | <i>Porolithon sp.</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 91.11 | 21.29 | |
| Coral rubble | | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 0.33 | 0.49 | |
| Dead coral head | | 75.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.78 | 1.73 | |
| Sand | | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.21 | 17.87 | |
| Cauliflower Coral | <i>Pocillopora meandrina</i> | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 8 | 0 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0.22 | 0.94 | |
| Crater Coral | <i>Leptastrea purpurea</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 0.92 | 1.99 | |
| Fake Brain Coral | <i>Pavona varians</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0.05 | |
| Lobe Coral | <i>Porites lobata</i> | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0.08 | 0.24 | |
| Pitted Lobe Coral | <i>Porites brighami</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0.2 | 0 | 0 | 0 | 0.1 | 0 | 0 | 24 | 4 | 1.7 | 1.88 | 5.67 | |
| Rice Coral | <i>Montipora capitata</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.02 | 0.05 | |
| Ringed Rice Coral | <i>Montipora patula</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.5 | 0 | 0 | 0 | 0 | 0 | 0.08 | 0.35 | |
| Total Live Coral | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 4 | 0 | 0.39 | 1.04 | |
| Rugosity = 1.5 | | | | | | | | | | | | | | | | | | | | | | | | | | 3.35 | 1.34 | |

Substrate Survey, Zone 2, Transect 3 11/7/98

| TYPE | SCIENTIFIC NAME | 74.1 | 45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 13 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | % Cover | +/- | |
|--------------------------|------------------------------|------|----|-----|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|---------|-------|------|
| Bearat pavement | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Branched coralline algae | <i>Porolithon</i> sp. | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.67 | 19.76 | |
| Coral rubble | | 12 | 5 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 6 | 25 | 4 | 3 | 3 | 3 | 3 | 3 | 0.5 | 2 | | | | | | | | | | | | | | 0.06 | 0.24 |
| Dead coral head | | 1 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.75 | 6.08 | |
| Sand | | 8 | 40 | 100 | 97 | 99 | 100 | 99 | 97 | 86 | 94 | 73 | 94 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 0.22 | 0.73 |
| Cauliflower Coral | <i>Pocillopora meandrina</i> | 0.2 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 87.53 | 24.63 | |
| Lobe Coral | <i>Porites lobata</i> | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.51 | 2.12 |
| Rice Coral | <i>Montipora capitata</i> | 2.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0.05 | |
| Ringed Rice Coral | <i>Montipora patula</i> | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.14 | 0.59 | |
| Total Live Coral | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0.11 | 0.47 |
| Rugosity = 1.0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0.77 | 0.81 |

Substrate Survey, Zone 3, Transect 6 11/6/98

| TYPE | SCIENTIFIC NAME | | | | | | | | | | | | | | | % Cover | + | | | | | | | |
|-------------------|-----------------|----|------|------|------|----|------|----|----|-----|-----|------|----|----|----|---------|----|----|----|---|---|---|-------|-------|
| Basalt pavement | 0 | 0 | 0 | 0 | 0 | 21 | 0 | 4 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 5 | 2.56 | 5.55 |
| Coral rubble | 3 | 22 | 38 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 31.5 | 4 | 0 | 4 | 11 | 19 | 10 | 0 | 0 | 0 | 0 | 8.86 | 11.93 |
| Dead coral head | 61 | 28 | 31.5 | 28.5 | 27.5 | 34 | 4 | 5 | 0 | 0 | 10 | 11 | 8 | 24 | 42 | 55 | 72 | 6 | 0 | 0 | 0 | 0 | 24.86 | 21.70 |
| Sand | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11.78 | 32.22 |
| Brown Lobe Coral | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.33 | 1.03 |
| Cauliflower Coral | 0 | 0 | 0 | 0.5 | 0.5 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.58 | 0.96 |
| Fake Brain Coral | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.32 |
| Finger Coral | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.32 |
| Lobe Coral | 1 | 0 | 9 | 6 | 14 | 9 | 9 | 4 | 0 | 0 | 0 | 1 | 17 | 10 | 58 | 8 | 13 | 1 | 16 | 0 | 0 | 0 | 0.11 | 0.32 |
| Rice Coral | 28 | 33 | 17 | 16 | 37 | 57 | 82.5 | 79 | 0 | 0 | 17 | 68 | 82 | 14 | 20 | 13 | 8 | 71 | 0 | 0 | 0 | 0 | 9.78 | 13.32 |
| Ringed Rice Coral | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.44 | 29.36 |
| Total Live Coral | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.17 | 0.48 |
| Rugosity = 2.0 | | | | | | | | | | | | | | | | | | | | | | | 47.11 | 6.64 |

Invertebrate Census, Zone 1 Comparison

| TYPE | SCIENTIFIC NAME | 98 T-1 | | 98 T-2 | | 98 Zone 1 | | 92 T-1 | | 92 T-2 | | 92 Zone 1 | | Change |
|-------------------------|------------------------------------|----------------------|----------|----------------------|----------|----------------------|----------|----------------------|----------|----------------------|----------|----------------------|----------|--------|
| | | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | |
| Hermit Crab | <i>Cacichus</i> sp. | 2.22 | 4.28 | 10.56 | 22.09 | 6.39 | 5.89 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +6.39 |
| Coral Crab | <i>Trapezia</i> sp. | 1.11 | 3.23 | 0.00 | 0.00 | 0.58 | 0.79 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +0.58 |
| Swimming Crab | <i>Charybdis hewalensis</i> | 0.00 | 0.00 | 5.00 | 12.95 | 2.50 | 3.54 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +2.50 |
| Snapping Shrimp | <i>Alpheopsis</i> sp. | 0.00 | 0.00 | 1.11 | 4.71 | 0.56 | 0.79 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +0.56 |
| Cowry Shell | <i>Cypraea</i> sp. | 0.00 | 0.00 | 2.78 | 8.28 | 1.39 | 1.96 | 0.01 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | +0.56 |
| Soldier Cone | <i>Corvus miles</i> | 0.00 | 0.00 | 1.67 | 5.14 | 0.83 | 1.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +1.36 |
| Hebrew Cone | <i>Corvus ebraeus</i> | 0.00 | 0.00 | 0.56 | 2.36 | 0.28 | 0.39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +0.56 |
| Pearl Oyster | <i>Pinctada margaritifera</i> | 0.56 | 2.36 | 0.00 | 0.00 | 0.28 | 0.39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +0.28 |
| Cone Shell | <i>Corvus</i> sp. | 1.67 | 5.14 | 0.00 | 0.00 | 0.83 | 1.18 | 0.12 | 0.36 | 0.00 | 0.00 | 0.00 | 0.00 | +0.28 |
| Vermid Snail | <i>Serpulorbis variabilis</i> | 1.11 | 3.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +0.56 |
| Cushion Sea Star | <i>Cubita noveequineae</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +0.56 |
| Brittle Sea Star | <i>Ophiocoma</i> sp. | 60.56 | 66.90 | 15.56 | 24.06 | 38.08 | 31.82 | 0.08 | 0.08 | 0.00 | 0.00 | 0.04 | 0.06 | -0.04 |
| Collector Urchin | <i>Tripanus gratilla</i> | 0.56 | 2.36 | 0.00 | 0.00 | 0.28 | 0.39 | 8.60 | 3.12 | 5.86 | 3.87 | 32.2 | 0.25 | -2.10 |
| B & W Spiny Urchin | <i>Echinothrix calamaris</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.20 | 2.56 | 2.38 | 0.25 | 0.25 | 0.08 | -0.14 |
| Black Spiny Urchin | <i>Echinothrix diadema</i> | 0.00 | 0.00 | 0.06 | 0.24 | 0.03 | 0.04 | 0.04 | 0.04 | 0.00 | 0.02 | 0.03 | 0.03 | +0.01 |
| Pale Rock-boring Urchin | <i>Echinometra mathaei</i> | 173.89 | 129.71 | 53.33 | 49.47 | 113.61 | 85.25 | 62.64 | 61.76 | 62.20 | 62.20 | 62.20 | 62.20 | +61.41 |
| Black R.B. Urchin | <i>Echinometra oblonga</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.80 | 0.80 | 0.80 | 0.70 | 0.14 | 0.14 | -0.70 |
| Slate Pencil Urchin | <i>Heterocentrotus mammillatus</i> | 1.67 | 3.83 | 1.11 | 4.71 | 1.39 | 0.39 | 0.56 | 0.56 | 3.36 | 1.86 | 1.98 | 1.98 | -0.57 |
| Hard Black Cucumber | <i>Holothuria nobilis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.08 | 0.08 | 0.03 | 0.03 | -0.06 |
| Pink Sea Star | <i>Linckia multifora</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | -0.06 |
| Sponge | <i>Porifera</i> | 3.33 | 5.94 | 12.22 | 26.26 | 7.78 | 6.29 | 0.84 | 0.84 | 1.16 | 0.90 | 0.37 | 0.37 | +0.88 |
| Christmas-tree Worm | <i>Spirobranchus giganteus</i> | 3.33 | 11.88 | 1.11 | 3.23 | 2.22 | 1.57 | 0.88 | 0.88 | 1.72 | 1.30 | 0.59 | 0.59 | +0.92 |
| Tunicate | <i>Urochordata</i> | 0.00 | 0.00 | 0.56 | 2.36 | 0.28 | 0.39 | 0.04 | 0.04 | 0.08 | 0.08 | 0.03 | 0.03 | +0.22 |
| Segmented Worm | <i>Annelida</i> | 0.00 | 0.00 | 0.56 | 2.36 | 0.28 | 0.39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +0.28 |
| Brittle Worm | <i>Pherecardia striata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | +0.28 |
| Species: 1990-19 | | 25.00 | 17.12 | 10.67 | 9.22 | 17.83 | 10.14 | 76.04 | 75.93 | 75.48 | 75.48 | 75.48 | 75.48 | -0.02 |

Invertebrate Census, Zone 2 Comparison

| TYPE | SCIENTIFIC NAME | 98 Zone 2 | | 92 Zone 2 | | Change | |
|--------------------------|------------------------------------|-----------|----------------------|-----------|----------------------|--------|----------|
| | | Total | # / 10m ² | Std.Dev. | # / 10m ² | | Std.Dev. |
| Hermit Crab | <i>Calcinus sp.</i> | 2.00 | 1.11 | 3.23 | 0.00 | N/A | +1.11 |
| Swimming Crab | <i>Charybdis hawaiiensis</i> | 4.00 | 2.22 | 9.43 | 0.04 | N/A | +2.18 |
| Marbled Shrimp | <i>Saron sp.</i> | 1.00 | 0.56 | 2.36 | 0.00 | N/A | +0.56 |
| Marbled Cone | <i>Conus marmoreus</i> | 0.00 | 0.00 | 0.00 | 0.04 | N/A | -0.04 |
| Pearl Oyster | <i>Pinctada margaritifera</i> | 0.00 | 0.00 | 0.00 | 0.04 | N/A | -0.04 |
| Coral-loving Shell | <i>Quoyula monodonta</i> | 12.00 | 6.67 | 28.28 | 0.00 | N/A | +6.67 |
| Chiton | <i>Rhyssoplax linsleyi</i> | 1.00 | 0.56 | 2.36 | 0.00 | N/A | +0.56 |
| Vermetid Snail | <i>Serpulorbis variabilis</i> | 24.00 | 13.33 | 27.65 | 0.00 | N/A | +13.33 |
| Auger Shell | <i>Terebra felina</i> | 2.00 | 1.11 | 4.71 | 0.00 | N/A | +1.11 |
| Brittle Sea Star | <i>Ophiocoma sp.</i> | 1.00 | 0.56 | 2.36 | 1.64 | N/A | -1.08 |
| Collector Urchin | <i>Tripneustes gratilla</i> | 1.00 | 0.56 | 2.36 | 2.28 | N/A | -1.72 |
| Needle-spined Sea Urchin | <i>Echinostrephus aciculatus</i> | 2.00 | 1.11 | 4.71 | 0.00 | N/A | +1.11 |
| Pale Rock-boring Urchin | <i>Echinometra mathaei</i> | 81.00 | 45.00 | 110.47 | 13.16 | N/A | +31.84 |
| Black R.B. Urchin | <i>Echinometra oblonga</i> | 0.00 | 0.00 | 0.00 | 0.36 | N/A | -0.36 |
| B & W Spiny Urchin | <i>Echinothrix calamaris</i> | 0.00 | 0.00 | 0.00 | 0.16 | N/A | -0.16 |
| Slate Penicl Urchin | <i>Heterocentrotus mammillatus</i> | 0.00 | 0.00 | 0.00 | 0.28 | N/A | -0.28 |
| Featherduster Worm | <i>Sabellastarte sanctijosephi</i> | 1.00 | 0.56 | 2.36 | 0.00 | N/A | +0.56 |
| Christmas-tree Worm | <i>Spirobranchus giganteus</i> | 4.00 | 2.22 | 9.43 | 0.16 | N/A | +2.06 |
| Sponge | Porifera | 0.00 | 0.00 | 0.00 | 0.84 | N/A | -0.84 |
| Species: 1998=14 | 1992=11 | 136.00 | 75.56 | 128.30 | 19.00 | N/A | +56.56 |

Invertebrate Census, Zone 3 Comparison

| TYPE | SCIENTIFIC NAME | 96 T-5 | | 96 T-6 | | 98 Zone 3 | | 92 T-5 | | 92 T-6 | | 92 Zone 3 | | Change |
|-------------------------|------------------------------------|----------------------|----------|----------------------|----------|----------------------|----------|----------------------|----------|----------------------|----------|----------------------|----------|--------|
| | | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | |
| Hermit Crab | <i>Calcinus</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.02 | 0.03 | -0.02 |
| Flies Cone | <i>Conus pulchellus</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.04 | 0.04 | 0.00 | -0.04 |
| Pearl Oyster | <i>Pinctada margaritifera</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.10 | 0.14 | -0.10 |
| Rock Oyster | <i>Spondylus tenebrosus</i> | 1.11 | 3.23 | 1.11 | 3.23 | 1.11 | 3.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +1.11 |
| Nudibranch | <i>Opiellobranchia</i> | 0.56 | 2.36 | 0.00 | 0.00 | 0.28 | 1.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +0.28 |
| Day Octopus | <i>Octopus cyaneus</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.02 | 0.03 | -0.02 |
| Brittle Star | <i>Ophiocoma</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.56 | 0.08 | 0.08 | 0.32 | 0.34 | -0.32 |
| Collector Urchin | <i>Triplonustes gratilla</i> | 2.22 | 5.48 | 1.67 | 3.83 | 1.94 | 4.66 | 5.96 | 8.68 | 1.92 | 8.68 | 7.32 | 1.92 | -5.36 |
| Pale Rock-boring Urchin | <i>Echinometra methaeli</i> | 18.33 | 22.03 | 16.67 | 19.40 | 17.60 | 20.72 | 12.68 | 8.12 | 3.22 | 8.12 | 10.40 | 3.22 | +7.10 |
| Needle-spined Urchin | <i>Echinostrephus aculeatus</i> | 0.00 | 0.00 | 0.56 | 2.36 | 0.28 | 1.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +0.28 |
| Rough-spined Urchin | <i>Prionocidaris hawaiiensis</i> | 0.00 | 0.00 | 4.44 | 7.05 | 2.22 | 3.52 | 0.12 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | +2.16 |
| Slate Pencil Urchin | <i>Heterocentrotus mammillatus</i> | 16.67 | 19.70 | 6.11 | 12.90 | 11.39 | 16.30 | 9.60 | 9.88 | 0.20 | 9.88 | 9.74 | 0.20 | +1.65 |
| Sponge | Porifera | 8.89 | 28.05 | 2.78 | 5.75 | 5.83 | 16.90 | 1.08 | 0.36 | 0.72 | 0.36 | 0.72 | 0.51 | +5.11 |
| Christmas-tree Worm | <i>Spirobranchius giganteus</i> | 3.33 | 11.88 | 3.89 | 12.43 | 3.61 | 12.16 | 1.28 | 0.80 | 0.34 | 0.80 | 1.04 | 0.34 | +2.57 |
| Fishworm | Platyhelminthes | 0.56 | 2.36 | 0.00 | 0.00 | 0.28 | 1.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +0.28 |
| Species: 1998=10 | | 51.67 | 46.54 | 37.22 | 36.28 | 44.44 | 40.41 | 31.56 | 28.00 | 2.62 | 28.00 | 28.76 | 2.62 | +14.66 |

Invertebrate Census, Zone 4 Comparison

| TYPE | SCIENTIFIC NAME | 98 T-7 | | 98 T-8 | | 98 Zone 4 | | 92 T-7 | | 92 T-8 | | 92 Zone 4 | | Change |
|-------------------------|------------------------------------|----------------------|----------|----------------------|----------|----------------------|----------|----------------------|----------|----------------------|----------|----------------------|----------|--------|
| | | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | # / 10m ² | Std.Dev. | |
| Flea Cone | <i>Conus pulcherrimus</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.00 | 0.00 | 0.02 | 0.03 | -0.02 |
| Tiger Cowry | <i>Cypraea tigris</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.08 | 0.04 | 0.06 | -0.04 |
| Pearl Oyster | <i>Pinctada margaritifera</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.08 | 0.00 | 0.00 | 0.04 | 0.06 | -0.04 |
| Brittle Sea Star | <i>Ophiozona</i> sp. | 1.67 | 3.83 | 0.00 | 0.00 | 0.83 | 1.18 | 1.04 | 1.04 | 0.96 | 0.96 | 1.00 | 0.06 | -0.17 |
| Collector Urchin | <i>Triplonaster gretelle</i> | 1.11 | 3.23 | 0.56 | 2.36 | 0.83 | 0.39 | 18.04 | 18.04 | 2.72 | 2.72 | 10.38 | 10.83 | -9.65 |
| Pale Rock-boring Urchin | <i>Echinometra mathaei</i> | 59.44 | 47.95 | 85.00 | 51.25 | 72.22 | 18.07 | 17.84 | 17.84 | 2.92 | 2.92 | 10.38 | 10.55 | +61.84 |
| Black R.B. Urchin | <i>Echinometra oblonga</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.02 | 0.03 | -0.02 |
| Slate Pencil Urchin | <i>Heterocentrotus mammillatus</i> | 6.67 | 8.40 | 7.22 | 7.52 | 6.94 | 0.39 | 15.12 | 15.12 | 1.36 | 1.36 | 8.24 | 9.73 | -1.30 |
| Rough-spined Urchin | <i>Pronocidaris hawaiiensis</i> | 0.00 | 0.00 | 0.56 | 2.36 | 0.28 | 0.39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | +0.28 |
| Christmas-tree Worm | <i>Spirobranchius giganteus</i> | 0.00 | 0.00 | 1.67 | 7.07 | 0.83 | 1.18 | 9.96 | 9.96 | 1.44 | 1.44 | 6.70 | 6.02 | -4.87 |
| Species: 1998-8 | | 68.89 | 63.46 | 95.00 | 60.79 | 81.94 | 18.46 | 62.12 | 62.12 | 9.52 | 9.52 | 36.82 | 37.19 | +46.12 |

Invertebrate Census, Zone 1, Transect 1 11/7/98

| TYPE | SCIENTIFIC NAME | | | | | | | | | | | | | | | | | | | | Total | Mean | +/- | |
|-------------------------|-----------------------------------|----|---|---|---|---|----|---|----|----|----|---|----|----|----|----|----|----|----|-----|-------|------|-----|-----|
| Hermit Crab | <i>Calinus sp.</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 0.2 | 0.4 |
| Coral Crab | <i>Trapezia sp.</i> | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.1 | 0.3 |
| Pearl Oyster | <i>Pinctada margaritifera</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.1 | 0.2 |
| Cone Shell | <i>Conus sp.</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0.2 | 0.5 |
| Brittle Sea Star | <i>Ophiocoma sp.</i> | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 25 | 7 | 18 | 7 | 6 | 4 | 6 | 12 | 4 | 5 | 109 | 6.1 | 6.7 | |
| Collector Urchin | <i>Tripanoestus grailla</i> | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.1 | 0.2 | |
| Pale Rock-boring Urchin | <i>Echinomitris mathaei</i> | 21 | 7 | 6 | 5 | 4 | 12 | 7 | 10 | 24 | 22 | 9 | 59 | 21 | 13 | 28 | 25 | 21 | 19 | 313 | 17.4 | 13.0 | | |
| Slate Pencil Urchin | <i>Heterocentrotus marmoratus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 3 | 0.2 | 0.4 | |
| Sponge | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 6 | 0.3 | 0.6 | |
| Christmas-tree Worm | <i>Siphrbranchus giganteus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 0 | 0 | 6 | 0.3 | 0.6 | |
| Vermetid Snail | <i>Serpulorbis variabilis</i> | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.1 | 0.3 | |

Invertebrate Census, Zone 1, Transect 2 11/7/98

| TYPE | SCIENTIFIC NAME | | | | | | | | | | | | | | | | | | | Total | Mean | +/- |
|-------------------------|------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|----|---|---|---|---|-------|------|-----|
| Hermit Crab | <i>Calinus sp.</i> | 0 | 0 | 1 | 0 | 0 | 2 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 1.1 | 2.2 |
| Swimming Crab | <i>Cheryobis hawaiiensis</i> | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0.5 | 1.3 |
| Snapping Shrimp | <i>Alpheopsis sp.</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.1 | 0.5 |
| Cowry Shell | <i>Cypraea sp.</i> | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0.3 | 0.8 |
| Soldier Cone | <i>Conus miles</i> | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 0.2 | 0.5 |
| Hebrew Cone | <i>Conus ebraeus</i> | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.1 | 0.2 |
| Brittle Sea Star | <i>Ophiocoma sp.</i> | 0 | 0 | 4 | 0 | 0 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 | 1.6 | 2.4 |
| Black Spiny Urchin | <i>Echinofix diadema</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.1 | 0.2 |
| Pale Rock-boring Urchin | <i>Echinometra mathaei</i> | 1 | 8 | 5 | 2 | 4 | 2 | 5 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 96 | 5.3 | 4.9 |
| Slate Pencil Urchin | <i>Heterocentrotus mammillatus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.1 | 0.5 |
| Sponge | Porifera | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 1.2 | 2.6 |
| Tunicata | Urochordata | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 3 | 11 | 0 | 2 | 2 | 0 | 1 | 0.1 | 0.2 |
| Segmented Worm | Annelida | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.1 | 0.2 |
| Christmas-tree Worm | <i>Spirbranchus giganteus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.1 | 0.3 |

Invertebrate Census, Zone 2, Transect 3 11/6/98

| TYPE | SCIENTIFIC NAME | | | | | | | | | | | | | | | | | | | | | | | | Total | Mean | +/- |
|--------------------------|------------------------------------|----|----|---|---|---|---|---|---|---|---|----|---|---|---|---|---|---|---|---|---|---|----|----|-------|------|-----|
| Hermit Crab | <i>Calcinus</i> sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.1 | 0.3 |
| Swimming Crab | <i>Charybdis hawaiiensis</i> | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0.2 | 0.9 | |
| Marbled Shrimp | <i>Saron</i> sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0.1 | 0.2 | |
| Chiton | <i>Rhyssoplex linsleyi</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.1 | 0.2 | |
| Brittle Sea Star | <i>Ophiocoma</i> sp. | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.1 | 0.2 | |
| Collector Urchin | <i>Tripreustus gratilla</i> | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.1 | 0.2 | |
| Needle-spined Sea Urchin | <i>Echinostrephus eckulatus</i> | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.1 | 0.5 | |
| Pale Rock-boring Urchin | <i>Echinometra mathaei</i> | 42 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 81 | 4.5 | 11.0 | |
| Christmas-tree Worm | <i>Spirobranchus giganteus</i> | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0.2 | 0.8 | |
| Featherduster Worm | <i>Sabellastarte sanctijosephi</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0.1 | 0.2 | |
| Auger Shell | <i>Terebra felina</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0.1 | 0.5 | |
| Vermetid Snail | <i>Serpulorbis variabilis</i> | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 24 | 1.3 | 2.8 | |
| Coral-loving Shell | <i>Quoyula monocorata</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 12 | 0.7 | 2.8 | |

| TYPE | SCIENTIFIC NAME | | | | | | | | | | | | | | | | | Total | Mean | +/- | |
|-------------------------|------------------------------------|---|---|----|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|------|-----|-----|
| Rock Oyster | <i>Spondylus tenebrosus</i> | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 0.1 | 0.3 |
| Collector Urchin | <i>Triplonastes gratilla</i> | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0.2 | 0.5 |
| Pale Rock-boring Urchin | <i>Echinometra mattheei</i> | 1 | 0 | 3 | 0 | 0 | 3 | 0 | 4 | 3 | 2 | 0 | 2 | 0 | 0 | 1 | 1 | 8 | 5 | 1.8 | 2.2 |
| Slate Pencil Urchin | <i>Heterocentrotus mammillatus</i> | 0 | 3 | 2 | 1 | 0 | 5 | 0 | 3 | 6 | 0 | 1 | 1 | 0 | 0 | 0 | 5 | 2 | 1 | 1.7 | 2.0 |
| Sponge | Porifera | 1 | 0 | 12 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 0.9 | 2.8 |
| Christmas-tree Worm | <i>Spirobranchus giganteus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 1 | 0 | 0 | 0 | 6 | 0.3 | 1.2 |
| Nudibranch | <i>Opisthobranchia</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.1 | 0.2 |
| Flatworm | Platyhelminthes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0.1 | 0.2 |

Invertebrate Census, Zone 3, Transect 6 11/6/98

| TYPE | SCIENTIFIC NAME | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Total | Mean | +/- |
|-------------------------|------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------|------|-----|
| Rock Oyster | <i>Spondylus tenebrosus</i> | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 0.1 | 0.3 |
| Collector Urchin | <i>Tripreustes grevillei</i> | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0.2 | 0.4 |
| Needle-spined Urchin | <i>Echinostrephus aculeatus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.1 | 0.2 |
| Pale Rock-boring Urchin | <i>Echinometra mathaei</i> | 0 | 3 | 0 | 2 | 0 | 0 | 0 | 1 | 5 | 4 | 0 | 5 | 4 | 3 | 0 | 0 | 3 | 30 | 1.7 | 1.9 |
| Slate Pencil Urchin | <i>Heterocentrotus mammillatus</i> | 0 | 0 | 0 | 0 | 5 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 11 | 0.6 | 1.3 |
| Rough-spined Urchin | <i>Pterocidaris hawaiiensis</i> | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 1 | 8 | 0.4 | 0.7 |
| Sponge | Porifera | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 5 | 0.3 | 0.6 |
| Christmas-tree Worm | <i>Spirobranchus giganteus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 7 | 0.4 | 1.2 |

Invertebrate Census, Zone 4, Transect 7 11/5/98

| TYPE | SCIENTIFIC NAME | | | | | | | | | | | | | | | | | | | | Total | Mean | +/- | |
|-------------------------|------------------------------------|---|---|---|---|---|---|----|---|----|---|---|---|---|----|----|---|---|---|-----|-------|------|-----|-----|
| Brittle Sea Star | <i>Ophiocoma</i> sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0.2 | 0.4 |
| Collector Urchin | <i>Tripreustes gratilla</i> | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.1 | 0.3 |
| Pale Rock-boring Urchin | <i>Echinometra mathaei</i> | 8 | 6 | 5 | 0 | 0 | 0 | 12 | 5 | 13 | 5 | 0 | 6 | 8 | 14 | 13 | 0 | 7 | 5 | 107 | 5.9 | 4.8 | 4.8 | |
| Slate Pencil Urchin | <i>Heterocentrotus mammillatus</i> | 0 | 1 | 1 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 12 | 0.7 | 0.8 | 0.8 | |

Invertebrate Census, Zone 4, Transect 8 11/5/98

| TYPE | SCIENTIFIC NAME | | | | | | | | | | | | | | | | | | | | Total | Mean | +/- | |
|-------------------------|------------------------------------|---|---|---|---|---|---|---|---|---|----|---|----|----|----|---|----|----|---|---|-------|------|-----|-----|
| Collector Urchin | <i>Trianeustes grailia</i> | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.1 | 0.2 |
| Pale Rock-boring Urchin | <i>Echinometra mathaei</i> | 1 | 8 | 4 | 7 | 2 | 6 | 7 | 7 | 2 | 12 | 7 | 13 | 18 | 20 | 9 | 12 | 10 | 8 | | | 153 | 8.5 | 5.1 |
| Slate Pencil Urchin | <i>Heterocentrotus merrillatus</i> | 0 | 0 | 1 | 1 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | | | 13 | 0.7 | 0.8 |
| Rough-spined Urchin | <i>Phonocidaris hawaiiensis</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | | | 1 | 0.1 | 0.2 |
| Christmas-tree Worm | <i>Spirobranchius giganteus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 3 | 0.2 | 0.7 |

Fish Census, Zone 1 11/7/98

| Species Name | 98 T-1 | 98 T-2 | 98 Mean | S.Dev. | 98 Juv. Mean | 92 T-1 | 92 T-2 | 92 Mean | S.Dev. | Change |
|---------------------------------------|--------|--------|---------|--------|--------------|--------|--------|---------|--------|--------|
| <i>Abudefduf abdominalis</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 0 | 1.0 | 1.4 | -1.0 |
| <i>Abudefduf sordidus</i> | 3 | 0 | 1.5 | 2.1 | 0.0 | 1 | 0 | 0.6 | 0.7 | +1.0 |
| <i>Acanthurus achilles</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 2 | 1.0 | 1.4 | -1.0 |
| <i>Acanthurus dussumieri</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.6 | 0.7 | -0.6 |
| <i>Acanthurus guttatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.6 | 0.7 | -0.5 |
| <i>Acanthurus leucopareus</i> | 4 | 0 | 2.0 | 2.6 | 0.0 | 27 | 0 | 13.5 | 19.1 | -11.5 |
| <i>Acanthurus nigrofasciatus</i> #1 | 63 | 87 | 75.0 | 17.0 | 1.0 | 242 | 248 | 244.0 | 2.8 | -169.0 |
| <i>Acanthurus olivaceus</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 1 | 0 | 0.6 | 0.7 | 0.0 |
| <i>Acanthurus triostegus</i> | 1 | 0 | 0.6 | 0.7 | 0.5 | 31 | 101 | 66.0 | 49.5 | -66.6 |
| <i>Acanthurus xanthopterus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 6 | 0 | 3.0 | 4.2 | -3.0 |
| <i>Arothron meleagris</i> | 2 | 0 | 1.0 | 1.4 | 0.0 | 0 | 0 | 0.0 | 0.0 | +1.0 |
| <i>Caranx melanocephalus</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 1 | 0 | 0.5 | 0.7 | 0.0 |
| <i>Caranx melanocephalus</i> #3 | 7 | 14 | 10.6 | 4.9 | 0.0 | 3 | 4 | 3.6 | 0.7 | +7.0 |
| <i>Caranx melanocephalus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 1 | 0.6 | 0.7 | -0.5 |
| <i>Cephalopholis argus</i> | 1 | 0 | 0.6 | 0.7 | 0.0 | 0 | 2 | 1.0 | 1.4 | -0.6 |
| <i>Cheilodactylus argus</i> | 0 | 7 | 3.5 | 4.9 | 0.0 | 2 | 7 | 4.6 | 3.5 | -1.0 |
| <i>Cheilodactylus lineolatus</i> | 2 | 0 | 1.0 | 1.4 | 0.0 | 0 | 0 | 0.0 | 0.0 | +1.0 |
| <i>Cheilodactylus lunula</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 10 | 3 | 6.5 | 4.9 | -6.6 |
| <i>Cheilodactylus lunulatus</i> | 2 | 0 | 1.0 | 1.4 | 0.0 | 0 | 3 | 1.8 | 2.1 | -0.5 |
| <i>Cheilodactylus millaris</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 6 | 2 | 4.0 | 2.8 | -4.0 |
| <i>Cheilodactylus multirictus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 7 | 3.6 | 4.9 | -3.6 |
| <i>Cheilodactylus ornatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 2 | 1.8 | 0.7 | -1.5 |
| <i>Cheilodactylus quatrifasciatus</i> | 2 | 0 | 1.0 | 1.4 | 0.0 | 5 | 4 | 4.5 | 0.7 | -3.6 |
| <i>Chlorurus sordidus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 5 | 1 | 3.0 | 2.8 | -3.0 |
| <i>Chromis vanderbilii</i> | 2 | 2 | 2.0 | 2.0 | 0.0 | 49 | 42 | 45.6 | 4.9 | -43.6 |
| <i>Cirrhitops fasciatus</i> | 0 | 2 | 1.0 | 1.4 | 0.0 | 1 | 11 | 6.0 | 7.1 | -6.0 |
| <i>Cirrhitops vanderbilii</i> | 1 | 0 | 0.5 | 0.7 | 0.0 | 0 | 0 | 0.0 | 0.0 | +0.6 |
| <i>Coris flavovittata</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 3 | 1 | 2.0 | 1.4 | -2.0 |
| <i>Coris gaimard</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 1 | 0.5 | 0.7 | -0.6 |
| <i>Coris venusta</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 1 | 1.0 | 0.0 | -1.0 |
| <i>Ctenochaetus strigosus</i> | 0 | 4 | 2.0 | 2.8 | 0.0 | 7 | 20 | 13.5 | 9.2 | -11.5 |
| <i>Desmystus abisella</i> | 2 | 0 | 1.0 | 1.4 | 0.0 | 6 | 0 | 2.8 | 3.5 | -1.6 |

| Species Name | 98 T-1 | 98 T-2 | 96 Mean | S.Dev. | 98 Juv. Mean | 92 T-1 | 92 T-2 | 92 Mean | S.Dev. | Change |
|-------------------------------------------|--------|--------|---------|--------|--------------|--------|--------|---------|--------|--------|
| <i>Fistularia commersonii</i> | 0 | 2 | 1.0 | 1.4 | 0.0 | 0 | 1 | 0.6 | 0.7 | +0.6 |
| <i>Forcipiger flavissimus</i> | 4 | 0 | 2.0 | 2.8 | 0.0 | 1 | 0 | 0.6 | 0.7 | +1.6 |
| <i>Forcipiger longirostris</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 0 | 1.0 | 1.4 | -1.0 |
| <i>Gomphosus varius</i> | 1 | 7 | 4.0 | 4.2 | 0.0 | 1 | 11 | 6.0 | 7.1 | -2.0 |
| <i>Gymnothorax flavimarginatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 1 | 0.5 | 0.7 | -0.6 |
| <i>Gymnothorax melalegns</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 1 | 1.6 | 0.7 | -1.5 |
| <i>Halichoeres ornateus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 2 | 1.0 | 1.4 | -1.0 |
| <i>Labroides phillipponis</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 4 | 3.0 | 1.4 | -3.0 |
| <i>Lutjanus fulvus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 0 | 1.0 | 1.4 | -1.0 |
| <i>Melichthys niger</i> #3 | 17 | 4 | 10.5 | 9.2 | 0.0 | 25 | 38 | 31.5 | 9.2 | -20.0 |
| <i>Melichthys victus</i> | 0 | 3 | 1.6 | 2.1 | 0.0 | 2 | 2 | 2.0 | 0.0 | -0.6 |
| <i>Naso fluridus</i> | 0 | 2 | 1.0 | 1.4 | 0.0 | 6 | 6 | 6.0 | 0.0 | -5.0 |
| <i>Novaculichthys taeniourus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 1 | 0.6 | 0.7 | -0.6 |
| <i>Ostracion meleagris</i> | 5 | 1 | 3.0 | 2.8 | 0.0 | 1 | 1 | 1.0 | 0.0 | +2.0 |
| <i>Oxycheilichthys bimaculatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 3 | 1.5 | 2.1 | -1.5 |
| <i>Oxycheilichthys unifasciatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 2 | 1.0 | 1.4 | -1.0 |
| <i>Paracanthites arcatus</i> | 0 | 4 | 2.0 | 2.8 | 0.0 | 0 | 12 | 6.0 | 8.5 | -4.0 |
| <i>Paracanthites forsteri</i> | 1 | 0 | 0.5 | 0.7 | 0.5 | 0 | 2 | 1.0 | 1.4 | -0.5 |
| <i>Parupeneus bifasciatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 1 | 0.6 | 0.7 | -0.5 |
| <i>Parupeneus cyclostomus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 5 | 3.0 | 2.6 | -3.0 |
| <i>Parupeneus multifasciatus</i> | 0 | 2 | 1.0 | 1.4 | 0.0 | 23 | 13 | 18.0 | 7.1 | -17.0 |
| <i>Plegiobremus goslineri</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 2 | 0 | 1.0 | 1.4 | -0.6 |
| <i>Plectroglyphidodon imperipennis</i> #5 | 5 | 8 | 6.5 | 2.1 | 0.0 | 8 | 31 | 19.5 | 16.3 | -13.0 |
| <i>Plectroglyphidodon johnstonianus</i> | 0 | 3 | 1.5 | 2.1 | 0.0 | 2 | 10 | 6.0 | 5.7 | -4.5 |
| <i>Rhinacanthus aculeatus</i> | 0 | 2 | 1.0 | 1.4 | 0.0 | 1 | 0 | 0.6 | 0.7 | +0.6 |
| <i>Rhinacanthus rectangulus</i> | 6 | 0 | 3.0 | 4.2 | 0.0 | 14 | 1 | 7.5 | 9.2 | -4.5 |
| <i>Scarus dubius</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 3 | 1.5 | 2.1 | -1.5 |
| <i>Scarus psittacus</i> | 1 | 1 | 1.0 | 0.0 | 0.5 | 17 | 21 | 19.0 | 2.8 | -18.0 |
| <i>Scarus rubrovittatus</i> | 0 | 1 | 0.6 | 0.7 | 0.0 | 0 | 0 | 0.0 | 0.0 | +0.5 |
| <i>Sebastes concolor</i> | 1 | 0 | 0.5 | 0.7 | 0.0 | 8 | 14 | 11.0 | 4.2 | -10.5 |
| <i>Stegastes fasciatus</i> #4 | 2 | 12 | 7.0 | 7.1 | 0.0 | 18 | 24 | 21.0 | 4.2 | -14.0 |
| <i>Stethojulis balteata</i> | 5 | 5 | 5.0 | 0.0 | 3.5 | 6 | 33 | 19.5 | 19.1 | -14.5 |

Fish Census, Zone 1 11/7/98

| Species Name | 98 T-1 | 98 T-2 | 98 Mean | S.Dev. | 98 Juv. Mean | 92 T-1 | 92 T-2 | 92 Mean | S.Dev. | Change |
|---------------------------------|------------|------------|--------------|-------------|--------------|------------|------------|--------------|-------------|---------------|
| <i>Sufflamen bursa</i> | 1 | 4 | 2.5 | 2.1 | 0.0 | 2 | 2 | 2.0 | 0.0 | +0.5 |
| <i>Thalassoma duperney</i> #2 | 45 | 65 | 56.0 | 14.1 | 21.0 | 285 | 228 | 256.6 | 41.7 | -200.6 |
| <i>Zanclus cornutus</i> | 1 | 0 | 0.5 | 0.7 | 0.0 | 1 | 1 | 1.0 | 0.0 | -0.6 |
| <i>Zebrafish flavescens</i> #4 | 12 | 2 | 7.0 | 7.1 | 0.0 | 40 | 12 | 26.0 | 19.8 | -19.0 |
| <i>Zebrafish veliferum</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 0 | 1.0 | 1.4 | -1.0 |
| Species: 1998-42 1992=65 | 199 | 247 | 223.0 | 33.9 | 27.0 | 863 | 947 | 918.0 | 46.3 | -892.0 |

Fish Census, Zone 2 11/6/98

| Species Name | 98 Zone 2 | 98 Zone 2 juv | 92 Zone 2 | Change |
|-----------------------------------------|-----------|---------------|-----------|------------|
| <i>Acanthurus nigrofuscus</i> #1 | 6 | 0 | 17 | -17 |
| <i>Acanthurus olivaceus</i> | 0 | 0 | 2 | -2 |
| <i>Acanthurus triostegus</i> | 0 | 0 | 13 | -13 |
| <i>Aulostomus chinensis</i> | 1 | 1 | 0+1 | |
| <i>Canthigaster jactator</i> | 1 | 0 | 1 | 0 |
| <i>Carangoides orthogrammus</i> | 0 | 0 | 1 | -1 |
| <i>Cephalopholis argus</i> | 1 | 0 | 0+1 | |
| <i>Chaetodon auriga</i> | 1 | 0 | 2 | -1 |
| <i>Chaetodon lineolatus</i> | 0 | 0 | 2 | -2 |
| <i>Chanos chanos</i> | 0 | 0 | 2 | -2 |
| <i>Chlorurus sordidus</i> #2 | 4 | 4 | 0+4 | |
| <i>Chromis vanderbilti</i> #3 | 3 | 0 | 7 | -4 |
| <i>Cirrhilabrus fasciatus</i> | 0 | 0 | 1 | -1 |
| <i>Cirripectes vanderbilti</i> | 1 | 0 | 0+1 | |
| <i>Dascyllus albisella</i> | 0 | 0 | 1 | -1 |
| <i>Melichthys niger</i> | 0 | 0 | 2 | -2 |
| <i>Naso lituratus</i> | 1 | 1 | 5 | -4 |
| <i>Naso unicornis</i> | 1 | 1 | 0+1 | |
| <i>Paracirrhites arcatus</i> | 0 | 0 | 1 | -1 |
| <i>Paracirrhites forsteri</i> | 1 | 0 | 0+1 | |
| <i>Parupeneus multifasciatus</i> | 0 | 0 | 3 | -3 |
| <i>Plectroglyphidodon imparipennis</i> | 0 | 0 | 1 | -1 |
| <i>Plectroglyphidodon johnstonianus</i> | 1 | 1 | 1 | 0 |
| <i>Pseudocheilinus evanidus</i> | 1 | 0 | 0+1 | |
| <i>Pterois sphex</i> | 1 | 1 | 0+1 | |
| <i>Saurida gracilis</i> | 1 | 0 | 0+1 | |
| <i>Scarus psittacus</i> | 0 | 0 | 1 | -1 |
| <i>Sebastapistes conioarta</i> | 0 | 0 | 1 | -1 |
| <i>Stegastes fasciolatus</i> | 0 | 0 | 4 | -4 |
| <i>Stethojulis balteata</i> | 0 | 0 | 3 | -3 |
| <i>Sufflamen bursa</i> | 0 | 0 | 3 | -3 |
| <i>Thalassoma duperrey</i> #4 | 2 | 0 | 3 | -1 |
| <i>Zebrasoma flavescens</i> | 0 | 0 | 6 | -6 |
| Species: 1998=16 1992=24 | 27 | 9 | 83 | -56 |

Fish Census, Zone 3 11/5/98

| Species Name | 98 T-5 | 98 T-6 | 98 Mean | S.Dev. | 98 Juv. Mean | 92 T-5 | 92 T-6 | 92 Mean | S.Dev. | Change |
|----------------------------------------|--------|--------|---------|--------|--------------|--------|--------|---------|--------|--------|
| <i>Acanthurus echinoides</i> | 2 | 0 | 1.0 | 1.4 | 0.0 | 0 | 2 | 1.0 | 1.4 | 0.0 |
| <i>Acanthurus dussumieri</i> | 22 | 0 | 11.0 | 15.6 | 0.0 | 0 | 0 | 0.0 | 0.0 | +11.0 |
| <i>Acanthurus nigricans</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.5 | 0.7 | -0.5 |
| <i>Acanthurus nigrofasciatus</i> #3 | 57 | 61 | 59.0 | 2.8 | 3.5 | 40 | 60 | 60.0 | 14.1 | +9.0 |
| <i>Acanthurus nigricans</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 0 | 1.0 | 1.4 | -1.0 |
| <i>Acanthurus olivaceus</i> | 11 | 9 | 10.0 | 1.4 | 0.0 | 2 | 17 | 9.5 | 10.6 | +0.5 |
| <i>Acanthurus triostegus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 4 | 0 | 2.0 | 2.8 | -2.0 |
| <i>Anampses chrysocephalus</i> | 1 | 0 | 0.5 | 0.7 | 0.0 | 1 | 0 | 0.5 | 0.7 | 0.0 |
| <i>Aphareus furca</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.5 | 0.7 | -0.5 |
| <i>Apogon kallopterus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 1 | 1.0 | 0.0 | -1.0 |
| <i>Arothron hispidus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.5 | 0.7 | -0.5 |
| <i>Autostomus chinensis</i> | 2 | 0 | 1.0 | 1.4 | 0.0 | 1 | 1 | 1.0 | 0.0 | 0.0 |
| <i>Centrarchus dumerilii</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.6 | 0.7 | -0.5 |
| <i>Centrarchus jectator</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.6 | 0.7 | -0.5 |
| <i>Centropyge potteri</i> | 2 | 5 | 3.5 | 2.1 | 0.0 | 10 | 5 | 7.5 | 3.5 | -4.0 |
| <i>Cephalopholis argus</i> | 6 | 0 | 3.0 | 4.2 | 0.0 | 3 | 0 | 1.6 | 2.1 | +1.5 |
| <i>Cheilodactylus lunulatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 4 | 2.0 | 2.8 | -2.0 |
| <i>Cheilodactylus milleri</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | +0.5 |
| <i>Cheilodactylus multivittatus</i> #5 | 24 | 23 | 23.5 | 0.7 | 1.0 | 8 | 14 | 11.0 | 4.2 | +12.5 |
| <i>Cheilodactylus ornaticornis</i> | 5 | 0 | 2.5 | 3.5 | 0.0 | 2 | 1 | 1.5 | 0.7 | +1.0 |
| <i>Chlorurus perspicillatus</i> | 3 | 6 | 4.5 | 2.1 | 3.0 | 0 | 0 | 0.0 | 0.0 | +4.5 |
| <i>Chlorurus sordidus</i> | 10 | 26 | 18.0 | 11.3 | 11.0 | 0 | 3 | 1.5 | 2.1 | +16.5 |
| <i>Chromis agilis</i> | 10 | 27 | 18.5 | 12.0 | 0.5 | 12 | 22 | 17.0 | 7.1 | +1.5 |
| <i>Chromis hawaii</i> | 5 | 21 | 13.0 | 11.3 | 0.0 | 6 | 2 | 4.0 | 2.8 | +8.0 |
| <i>Chromis ovalis</i> | 6 | 10 | 8.0 | 2.8 | 0.0 | 0 | 0 | 0.0 | 0.0 | +8.0 |
| <i>Chromis vanderbilii</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 5 | 3.5 | 2.1 | -3.5 |
| <i>Cirripectes vanderbilii</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.5 | 0.7 | -0.5 |
| <i>Coris gaimard</i> | 1 | 8 | 4.5 | 4.9 | 0.5 | 0 | 4 | 2.0 | 2.8 | +2.5 |
| <i>Chromis hawaiiensis</i> | 0 | 1 | 0.5 | 0.7 | 0.5 | 0 | 1 | 0.5 | 0.7 | 0.0 |
| <i>Chromis striatus</i> #1 | 111 | 95 | 103.0 | 11.3 | 7.5 | 147 | 202 | 174.6 | 38.9 | -71.5 |
| <i>Discyodus abietalis</i> | 0 | 6 | 3.0 | 4.2 | 0.0 | 0 | 0 | 0.0 | 0.0 | +3.0 |

Fish Census, Zone 3 11/5/98

| Species Name | 98 T-5 | 98 T-6 | 98 Mean | S.Dev. | 98 Juv. Mean | 92 T-5 | 92 T-6 | 92 Mean | S.Dev. | Change |
|-------------------------------------|--------|--------|---------|--------|--------------|--------|--------|---------|--------|--------|
| <i>Exellus brevis</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.5 | 0.7 | -0.5 |
| <i>Fistularia commersonii</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 1 | 1.0 | 0.0 | -1.0 |
| <i>Forcipiger flavissimus</i> | 4 | 2 | 3.0 | 1.4 | 0.0 | 4 | 13 | 8.5 | 6.4 | -5.5 |
| <i>Forcipiger longirostris</i> | 2 | 1 | 1.5 | 0.7 | 0.0 | 1 | 1 | 1.0 | 0.0 | +0.5 |
| <i>Gomphosus varius</i> | 20 | 11 | 15.5 | 6.4 | 0.0 | 0 | 2 | 1.0 | 1.4 | +14.5 |
| <i>Gymnothorax eurostus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.5 | 0.7 | -0.5 |
| <i>Gymnothorax melanocephalus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.5 | 0.7 | -0.5 |
| <i>Halichoeres ornatus</i> | 2 | 8 | 5.0 | 4.2 | 2.5 | 1 | 0 | 0.5 | 0.7 | +4.5 |
| <i>Lebroides phthirophagus</i> | 4 | 0 | 2.0 | 2.8 | 1.0 | 2 | 1 | 1.5 | 0.7 | +0.5 |
| <i>Lutjanus fulvus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 4 | 0 | 2.0 | 2.8 | -2.0 |
| <i>Lutjanus kasmira</i> | 2 | 0 | 1.0 | 1.4 | 0.0 | 0 | 0 | 0.0 | 0.0 | +1.0 |
| <i>Micropharyngodon geoffroy</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 1 | 0 | 0.5 | 0.7 | 0.0 |
| <i>Melichthys niger</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 80 | 40.0 | 58.6 | -40.0 |
| <i>Melichthys vidua</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 3 | 0 | 1.5 | 2.1 | -1.5 |
| <i>Monotaxis grandoculis</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 9 | 6 | 7.5 | 2.1 | -7.0 |
| <i>Mulloidichthys flavolineatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 8 | 15 | 11.5 | 4.8 | -11.5 |
| <i>Myrbristis amaena</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 2 | 1.5 | 0.7 | -1.5 |
| <i>Myrbristis bennetti</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 9 | 3 | 6.0 | 4.2 | -6.0 |
| <i>Myrbristis kunitze</i> | 12 | 0 | 6.0 | 8.5 | 0.0 | 9 | 48 | 29.0 | 28.3 | -23.0 |
| <i>Naso brevirostris</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 3 | 1.5 | 2.1 | -1.5 |
| <i>Naso lituratus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.5 | 0.7 | -0.5 |
| <i>Neoniphon sammara</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 1 | 0.5 | 0.7 | -0.5 |
| <i>Ostracion meleagris</i> | 1 | 0 | 0.5 | 0.7 | 0.0 | 1 | 0 | 0.5 | 0.7 | 0.0 |
| <i>Oxycheilichthys unifasciatus</i> | 1 | 3 | 2.0 | 1.4 | 0.0 | 5 | 4 | 4.5 | 0.7 | -2.5 |
| <i>Paracirrhites arcatus</i> | 5 | 12 | 8.5 | 4.9 | 0.0 | 9 | 11 | 10.0 | 1.4 | -1.5 |
| <i>Paracirrhites forsteri</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 2 | 0 | 1.0 | 1.4 | 1.5 |
| <i>Parupeneus bifasciatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 0 | 1.0 | 1.4 | -1.0 |
| <i>Parupeneus cyclostomus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 0 | 1.0 | 1.4 | -1.0 |
| <i>Parupeneus multifasciatus</i> | 1 | 5 | 3.0 | 2.8 | 0.0 | 5 | 35 | 20.0 | 21.2 | -17.0 |
| <i>Parupeneus porphyreus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 0 | 1.0 | 1.4 | -1.0 |
| <i>Parupeneus spilosoma</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 0 | 0 | 0.0 | 0.0 | +0.5 |
| <i>Plagiotremus ewaensis</i> | 1 | 0 | 0.5 | 0.7 | 0.0 | 0 | 0 | 0.0 | 0.0 | +0.5 |

Fish Census, Zone 3 11/5/98

| Species Name | 98 T-5 | 98 T-6 | 98 Mean | S.Dev. | 98 Juv.Mean | 92 T-5 | 92 T-6 | 92 Mean | S.Dev. | Change |
|----------------------------------------|------------|------------|--------------|-------------|-------------|------------|------------|--------------|--------------|--------------|
| <i>Plectrogyphidodon johnstonianus</i> | 8 | 13 | 10.5 | 3.5 | 0.0 | 13 | 14 | 13.5 | 0.7 | -3.0 |
| <i>Pseudocheilichthys evanidus</i> | 2 | 8 | 5.0 | 4.2 | 0.0 | 0 | 0 | 0.0 | 0.0 | +8.0 |
| <i>Pseudocheilichthys octotaenia</i> | 6 | 8 | 7.0 | 1.4 | 0.0 | 9 | 6 | 7.5 | 2.1 | -0.5 |
| <i>Pseudocheilichthys tetrataenia</i> | 3 | 4 | 3.5 | 0.7 | 0.0 | 1 | 0 | 0.5 | 0.7 | -3.0 |
| <i>Pseudotulocides cerasfinus</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 0 | 0 | 0.0 | 0.0 | +0.5 |
| <i>Sargocentron diadema</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 1 | 0.5 | 0.7 | -0.5 |
| <i>Scarus psittacus</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 2 | 19 | 10.5 | 12.0 | -10.0 |
| <i>Scarus rubrovittatus</i> | 0 | 6 | 3.0 | 4.2 | 0.0 | 1 | 0 | 0.5 | 0.7 | +2.5 |
| <i>Scorpaenopsis caecopsis</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 2 | 1.0 | 1.4 | -1.0 |
| <i>Stegastes fasciolatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.5 | 0.7 | -0.5 |
| <i>Stethojulis balteata</i> | 23 | 15 | 19.0 | 5.7 | 0.0 | 2 | 0 | 1.0 | 1.4 | +18.0 |
| <i>Sumrarden bursae</i> | 5 | 5 | 5.0 | 0.0 | 0.0 | 4 | 1 | 2.5 | 2.1 | +2.5 |
| <i>Synodus bifasciatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 1 | 1.0 | 0.0 | -1.0 |
| <i>Synodus variegatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 1 | 0.5 | 0.7 | -0.5 |
| <i>Thalassoma ballieui</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 3 | 0 | 1.5 | 2.1 | -1.5 |
| <i>Thalassoma duperrey #4</i> | 31 | 20 | 25.5 | 7.8 | 3.5 | 26 | 28 | 27.0 | 1.4 | -1.5 |
| <i>Thalassoma triocellatum</i> | 0 | 2 | 1.0 | 1.4 | 0.0 | 0 | 0 | 0.0 | 0.0 | +1.0 |
| <i>Triacodon obesus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.5 | 0.7 | -0.5 |
| <i>Zanclus cornutus</i> | 1 | 1 | 1.0 | 0.0 | 0.0 | 0 | 5 | 2.5 | 3.5 | -1.5 |
| <i>Zebrafish flavescens #2</i> | 101 | 36 | 68.5 | 48.0 | 12.0 | 47 | 51 | 49.0 | 2.8 | +19.5 |
| <i>Zebrafish veliferum</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 0 | 1.0 | 1.4 | -1.0 |
| Species: 1998-49 1992-74 | 514 | 464 | 489.0 | 35.4 | 46.5 | 450 | 700 | 578.0 | 176.8 | -86.0 |

Fish Census, Zone 4 11/5/98

| Species Name | 98 T-7 | 98 T-8 | 98 Mean | S.Dev | 98 Juv. Mean | 92 T-7 | 92 T-8 | 92 Mean | S.Dev | Change |
|-------------------------------------|--------|--------|---------|-------|--------------|--------|--------|---------|-------|--------|
| <i>Abudefduf abdominalis</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 6 | 0 | 3.0 | 4.2 | -2.5 |
| <i>Acanthurus achilles</i> | 20 | 22 | 21.0 | 1.4 | 3.0 | 11 | 21 | 16.0 | 7.1 | +6.0 |
| <i>Acanthurus dussumieri</i> | 0 | 6 | 3.0 | 4.2 | 0.0 | 0 | 0 | 0.0 | 0.0 | +3.0 |
| <i>Acanthurus leucopareus</i> | 0 | 5 | 2.5 | 3.5 | 0.0 | 0 | 0 | 0.0 | 0.0 | +2.5 |
| <i>Acanthurus nigrofasciatus #3</i> | 36 | 60 | 48.0 | 17.0 | 0.0 | 0 | 56 | 28.0 | 39.8 | +20.0 |
| <i>Acanthurus nigroris #5</i> | 19 | 42 | 30.6 | 16.3 | 0.0 | 69 | 1 | 35.0 | 48.1 | -4.5 |
| <i>Acanthurus olivaceus</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 1 | 1 | 1.0 | 0.0 | -0.5 |
| <i>Acanthurus troslegus</i> | 2 | 32 | 17.0 | 21.2 | 0.0 | 2 | 3 | 2.5 | 0.7 | +14.5 |
| <i>Acanthurus chrysocephalus</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 0 | 0 | 0.0 | 0.0 | +0.5 |
| <i>Apogon kallopterus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 | +0.5 |
| <i>Austromus chinensis</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.5 | 0.7 | -0.5 |
| <i>Bodianus bimaculatus</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 0 | 0 | 0.0 | 0.0 | +0.5 |
| <i>Canthigaster emboinensis</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 1 | 0.5 | 0.7 | -0.5 |
| <i>Canthigaster jactator</i> | 0 | 8 | 4.0 | 5.7 | 0.0 | 0 | 0 | 0.0 | 0.0 | +4.0 |
| <i>Cephalopholis argus</i> | 3 | 5 | 4.0 | 1.4 | 0.0 | 3 | 3 | 3.0 | 0.0 | +1.0 |
| <i>Cheilodan aunga</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 4 | 1 | 2.5 | 2.1 | -2.5 |
| <i>Cheilodan frembii</i> | 1 | 0 | 0.5 | 0.7 | 0.0 | 0 | 0 | 0.0 | 0.0 | +0.5 |
| <i>Cheilodan lineolatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 2 | 1.0 | 1.4 | -1.0 |
| <i>Cheilodan lunula</i> | 4 | 1 | 2.5 | 2.1 | 0.0 | 4 | 1 | 2.5 | 2.1 | 0.0 |
| <i>Cheilodan lunulatus</i> | 4 | 0 | 2.0 | 2.8 | 0.0 | 2 | 2 | 2.0 | 0.0 | 0.0 |
| <i>Cheilodan miliaris</i> | 1 | 0 | 0.5 | 0.7 | 0.0 | 0 | 0 | 0.0 | 0.0 | +0.5 |
| <i>Cheilodan multirinctus</i> | 8 | 23 | 15.5 | 10.6 | 0.0 | 9 | 9 | 9.0 | 0.0 | +6.5 |
| <i>Cheilodan ornaticornis</i> | 5 | 2 | 3.5 | 2.1 | 0.0 | 3 | 5 | 4.0 | 1.4 | -0.5 |
| <i>Cheilodan quechiraculatus</i> | 3 | 0 | 1.5 | 2.1 | 0.0 | 0 | 0 | 0.0 | 0.0 | +1.5 |
| <i>Cheilodan unimaculatus</i> | 1 | 0 | 0.5 | 0.7 | 0.0 | 0 | 2 | 1.0 | 1.4 | -0.5 |
| <i>Chlorurus sordidus</i> | 3 | 3 | 3.0 | 0.0 | 1.0 | 3 | 2 | 2.5 | 0.7 | +0.5 |
| <i>Chromis egilis</i> | 1 | 0 | 0.5 | 0.7 | 0.0 | 0 | 0 | 0.0 | 0.0 | +0.5 |
| <i>Chromis vanderbilli #4</i> | 8 | 62 | 35.0 | 38.2 | 0.0 | 13 | 0 | 6.6 | 9.2 | +28.5 |
| <i>Cirrhilabrus fasciatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 3 | 0 | 1.5 | 2.1 | -1.5 |
| <i>Cirrhilabrus pinnulatus</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 0 | 0 | 0.0 | 0.0 | +0.5 |
| <i>Cirripectes vanderbilli</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 2 | 1.5 | 0.7 | -1.5 |
| <i>Ctenochaetus strigosus #1</i> | 56 | 80 | 73.0 | 24.0 | 0.5 | 77 | 79 | 78.0 | 1.4 | -5.0 |

Fish Census, Zone 4 11/5/98

| Species Name | 98 T-7 | 98 T-8 | 98 Mean | S.Dev | 98 Juv. Mean | 92 T-7 | 92 T-8 | 92 Mean | S.Dev | Change |
|-----------------------------------------|--------|--------|---------|-------|--------------|--------|--------|---------|-------|--------|
| <i>Exallia brevis</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 1 | 1.0 | 0.0 | -1.0 |
| <i>Fistularia commersonii</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 2 | 2 | 2.0 | 0.0 | -2.0 |
| <i>Forcipiger flavissimus</i> | 6 | 3 | 4.5 | 2.1 | 0.0 | 2 | 4 | 3.0 | 1.4 | +1.6 |
| <i>Gomphosus varius</i> | 4 | 23 | 13.6 | 13.4 | 6.0 | 9 | 13 | 11.0 | 2.8 | +2.5 |
| <i>Haeflacheres ornateissimus</i> | 1 | 1 | 1.0 | 0.0 | 0.5 | 2 | 1 | 1.5 | 0.7 | -0.5 |
| <i>Labroides phithirophagus</i> | 4 | 16 | 10.0 | 8.5 | 0.0 | 8 | 1 | 4.6 | 4.9 | +6.6 |
| <i>Lutjanus fulvus</i> | 1 | 3 | 2.0 | 1.4 | 0.0 | 0 | 0 | 0.0 | 0.0 | +2.0 |
| <i>Melichthys niger</i> | 1 | 0 | 0.5 | 0.7 | 0.0 | 17 | 4 | 10.6 | 9.2 | -10.0 |
| <i>Melichthys vidua</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 13 | 2 | 7.6 | 7.8 | -7.6 |
| <i>Monotaxis grandoculis</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 4 | 2 | 3.0 | 1.4 | -3.0 |
| <i>Mulloidichthys flavolineatus</i> | 1 | 0 | 0.5 | 0.7 | 0.0 | 3 | 51 | 27.0 | 33.9 | -26.5 |
| <i>Myrbrisis aeneus</i> | 0 | 2 | 1.0 | 1.4 | 0.0 | 6 | 0 | 3.0 | 4.2 | -2.0 |
| <i>Myrbrisis bernoti</i> | 0 | 11 | 6.5 | 7.8 | 0.0 | 0 | 0 | 0.0 | 0.0 | +5.5 |
| <i>Myrbrisis kurtlee</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 14 | 1 | 7.6 | 9.2 | -7.6 |
| <i>Naso lituratus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 14 | 1 | 7.6 | 9.2 | -7.6 |
| <i>Ostracion meleagris</i> | 0 | 1 | 0.6 | 0.7 | 0.0 | 1 | 2 | 1.5 | 0.7 | -1.0 |
| <i>Oxycheilichthys unifasciatus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 5 | 3.0 | 2.8 | -3.0 |
| <i>Paracirrhites arcatus</i> | 3 | 8 | 6.6 | 3.5 | 0.0 | 27 | 10 | 18.6 | 12.0 | -13.0 |
| <i>Paracirrhites forsteri</i> | 1 | 2 | 1.5 | 0.7 | 0.0 | 4 | 1 | 2.5 | 2.1 | -1.0 |
| <i>Parupeneus bifasciatus</i> | 0 | 4 | 2.0 | 2.8 | 0.0 | 1 | 0 | 0.6 | 0.7 | +1.6 |
| <i>Parupeneus cyclostomus</i> | 2 | 0 | 1.0 | 1.4 | 0.0 | 2 | 0 | 1.0 | 1.4 | 0.0 |
| <i>Parupeneus multifasciatus</i> | 0 | 6 | 3.0 | 4.2 | 0.0 | 10 | 8 | 9.0 | 1.4 | -6.0 |
| <i>Parupeneus porphyreus</i> | 4 | 0 | 2.0 | 2.8 | 0.0 | 0 | 0 | 0.0 | 0.0 | +2.0 |
| <i>Parvagar aspricaudus</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.5 | 0.7 | -0.5 |
| <i>Plectrotrampus gossifrei</i> | 0 | 5 | 2.5 | 3.5 | 0.0 | 0 | 0 | 0.0 | 0.0 | +2.5 |
| <i>Plectroglyphidodon johnstonianus</i> | 3 | 17 | 10.0 | 9.9 | 0.0 | 28 | 19 | 23.6 | 6.4 | -13.6 |
| <i>Pseudochelinus tetraetensis</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 0 | 1 | 0.5 | 0.7 | 0.0 |
| <i>Sergoacentron punctatissimum</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 1 | 0 | 0.5 | 0.7 | -0.5 |
| <i>Sergoacentron sphaerum</i> | 0 | 1 | 0.5 | 0.7 | 0.0 | 1 | 0 | 0.6 | 0.7 | 0.0 |
| <i>Scarus psittacus</i> | 5 | 4 | 4.5 | 0.7 | 1.0 | 21 | 3 | 12.0 | 12.7 | -7.6 |
| <i>Scarus rubrovittaceus</i> | 0 | 6 | 3.0 | 4.2 | 0.0 | 0 | 0 | 0.0 | 0.0 | +3.0 |
| <i>Sebastapistes conraria</i> | 3 | 2 | 2.5 | 0.7 | 0.0 | 0 | 0 | 0.0 | 0.0 | +2.5 |

Fish Census, Zone 4 11/5/98

| Species Name | 98 T-7 | 98 T-8 | 98 Mean | S.Dev | 98 Juv. Mean | 92 T-7 | 92 T-8 | 92 Mean | S.Dev | Change |
|--------------------------------|--------|--------|---------|-------|--------------|--------|--------|---------|-------|--------|
| <i>Stegastes fasciatus</i> | 11 | 24 | 17.5 | 9.2 | 0.0 | 38 | 28 | 33.0 | 7.1 | -15.5 |
| <i>Stethojulis balteata</i> | 3 | 12 | 7.5 | 6.4 | 0.0 | 8 | 3 | 6.0 | 4.2 | +1.5 |
| <i>Sufflamen bursa</i> | 6 | 1 | 3.5 | 3.5 | 0.0 | 7 | 2 | 4.5 | 3.5 | -1.0 |
| <i>Thalassoma ballieui</i> | 0 | 0 | 0.0 | 0.0 | 0.0 | 0 | 1 | 0.5 | 0.7 | -0.5 |
| <i>Thalassoma diperryi</i> | 16 | 44 | 30.0 | 19.8 | 17.0 | 93 | 34 | 63.5 | 41.7 | -33.5 |
| <i>Zebрасoma flavescens</i> #2 | 55 | 65 | 60.0 | 7.1 | 1.0 | 26 | 24 | 25.0 | 1.4 | +35.0 |
| Species: 1988=63 1992=64 | 305 | 628 | 455.5 | 228.4 | 30.0 | 578 | 416 | 497.0 | 114.8 | -30.5 |

Fish Census, Zone 3, 2m vs. 3m width comparison 11/5/98

| Species Name | T-5 | T-5 2m | T-5 juv | T-5 juv 2m | T-6 | T-6 2m | T-6 juv | T-6 juv 2m | Zone 3 3m | Zone 3 2m | Zone 3 juv 3m | Zone 3 juv 2m |
|-------------------------------------|-----|--------|---------|------------|-----|--------|---------|------------|-----------|-----------|---------------|---------------|
| <i>Acanthurus achilles</i> | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| <i>Acanthurus dussumieri</i> | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 0 | 0 |
| <i>Acanthurus nigrofasciatus</i> | 57 | 45 | 0 | 6 | 61 | 32 | 7 | 3 | 118 | 77 | 7 | 8 |
| <i>Acanthurus olivaceus</i> | 11 | 3 | 0 | 0 | 9 | 5 | 0 | 2 | 20 | 8 | 0 | 2 |
| <i>Acanthurus triostegus</i> | 0 | 9 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 8 |
| <i>Anampses chrysocephalus</i> | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| <i>Arothron meleagris</i> | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| <i>Autostornus chinensis</i> | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 |
| <i>Centrocyge potteri</i> | 2 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 7 | 0 | 0 | 0 |
| <i>Cephalopholis argus</i> | 6 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 6 | 3 | 0 | 0 |
| <i>Cheilodactylus auriga</i> | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 |
| <i>Cheilodactylus lunulatus</i> | 1 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 1 | 8 | 0 | 0 |
| <i>Cheilodactylus multirictus</i> | 24 | 2 | 2 | 0 | 23 | 12 | 0 | 4 | 47 | 14 | 2 | 4 |
| <i>Cheilodactylus ornatus</i> | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 1 | 0 | 0 |
| <i>Chironus perspicillatus</i> | 3 | 1 | 0 | 0 | 6 | 2 | 6 | 0 | 9 | 3 | 8 | 0 |
| <i>Chironus sordidus</i> | 10 | 0 | 1 | 0 | 26 | 2 | 21 | 1 | 36 | 2 | 22 | 1 |
| <i>Chromis egilis</i> | 10 | 13 | 0 | 0 | 27 | 34 | 1 | 0 | 37 | 47 | 1 | 0 |
| <i>Chromis hanuli</i> | 5 | 7 | 0 | 0 | 21 | 16 | 0 | 0 | 26 | 23 | 0 | 0 |
| <i>Chromis ovalis</i> | 6 | 0 | 0 | 0 | 10 | 34 | 0 | 0 | 16 | 34 | 0 | 0 |
| <i>Coris gairdneri</i> | 1 | 0 | 1 | 0 | 8 | 0 | 0 | 0 | 9 | 0 | 1 | 0 |
| <i>Ctenochaetus hawaiiensis</i> | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| <i>Ctenochaetus strigatus</i> | 111 | 62 | 5 | 0 | 95 | 63 | 10 | 15 | 206 | 125 | 15 | 15 |
| <i>Dascyllus ebisella</i> | 0 | 0 | 0 | 0 | 6 | 15 | 0 | 0 | 6 | 15 | 0 | 0 |
| <i>Diodon hystrix</i> | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| <i>Forcipiger flavissimus</i> | 4 | 3 | 0 | 0 | 2 | 0 | 0 | 0 | 6 | 3 | 0 | 0 |
| <i>Forcipiger longirostris</i> | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| <i>Gomphosus varius</i> | 20 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 31 | 0 | 0 | 0 |
| <i>Gymnothorax meleagris</i> | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| <i>Halichoeres ornatus</i> | 2 | 2 | 1 | 1 | 8 | 2 | 4 | 0 | 10 | 4 | 5 | 1 |
| <i>Heteropriacanthus cruentatus</i> | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| <i>Labroides phthirophagus</i> | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 2 | 0 |

Fish Census, Zone 3, 2m vs. 3m width comparison 11/5/98

| Species Name | T-5 | T-5 2m | T-5 juv | T-5 juv 2m | T-6 | T-6 2m | T-6 juv | T-6 juv 2m | Zone 3 3m | Zone 3 2m | Zone 3 juv 3m | Zone 3 juv 2m | | | | |
|-----------------------------------------|-----------------------|------------|-----------|------------|-----------------------|------------|-----------|------------|-----------------------|------------|---------------|---------------|-----------------------|--|--|--|
| <i>Lutjanus kasmira</i> | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | | | | |
| <i>Micropharyngodon geoffroy</i> | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | | | |
| <i>Monolaxis grandoculis</i> | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | | | |
| <i>Mutibodichthys flavolineatus</i> | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | | | | |
| <i>Myrpristis berranti</i> | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | | | | |
| <i>Myrpristis kuntee</i> | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | | | | |
| <i>Naso lituratus</i> | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | | | | |
| <i>Ostracion meleagris</i> | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | | | |
| <i>Oxycheilinus unifasciatus</i> | 1 | 3 | 0 | 2 | 3 | 0 | 0 | 0 | 4 | 3 | 0 | 2 | | | | |
| <i>Paracirrhites arcatus</i> | 5 | 5 | 0 | 0 | 12 | 3 | 0 | 0 | 17 | 8 | 0 | 0 | | | | |
| <i>Paracirrhites forsteri</i> | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | | | |
| <i>Perupeneus multifasciatus</i> | 1 | 0 | 0 | 0 | 5 | 2 | 0 | 0 | 6 | 2 | 0 | 0 | | | | |
| <i>Perupor spilosoma</i> | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | | | |
| <i>Plectrothornus ewaensis</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | | | |
| <i>Plectroglyphidodon johnstonianus</i> | 8 | 3 | 0 | 0 | 13 | 6 | 0 | 0 | 21 | 9 | 0 | 0 | | | | |
| <i>Pseudocheilinus evanidius</i> | 2 | 1 | 0 | 0 | 8 | 3 | 0 | 0 | 10 | 4 | 0 | 0 | | | | |
| <i>Pseudocheilinus octotaenia</i> | 6 | 3 | 0 | 0 | 8 | 4 | 0 | 0 | 14 | 7 | 0 | 0 | | | | |
| <i>Pseudocheilinus tetrataenia</i> | 3 | 0 | 0 | 0 | 4 | 2 | 0 | 0 | 7 | 2 | 0 | 0 | | | | |
| <i>Pseudujubia cerasinus</i> | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | | | | |
| <i>Scarus psittacus</i> | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 2 | 0 | 0 | | | | |
| <i>Scarus rubrivittaceus</i> | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | | | | |
| <i>Stethojulis baiteata</i> | 23 | 3 | 0 | 0 | 15 | 0 | 0 | 0 | 38 | 3 | 0 | 0 | | | | |
| <i>Sufflamen bursa</i> | 5 | 1 | 0 | 0 | 5 | 2 | 0 | 0 | 10 | 3 | 0 | 0 | | | | |
| <i>Thalassoma duperrey</i> | 31 | 8 | 3 | 5 | 20 | 1 | 4 | 0 | 51 | 9 | 7 | 5 | | | | |
| <i>Thalassoma triboatum</i> | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | | | | |
| <i>Zanclus cornutus</i> | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | | | | |
| <i>Zebrasoma flavescens</i> | 101 | 34 | 14 | 17 | 36 | 42 | 10 | 21 | 137 | 76 | 24 | 38 | | | | |
| Totals | 614 | 233 | 29 | 39 | 464 | 299 | 64 | 47 | 978 | 632 | 93 | 86 | | | | |
| Runtime in minutes | T-5, 3 meter width=26 | | | | T-5, 2 meter width=18 | | | | T-6, 3 meter width=32 | | | | T-6, 2 meter width=20 | | | |

KONA VILLAGE 1998 FISH ID LIST

These fishes have been recorded at the Kona Village Resort. Common names may vary.

| SCIENTIFIC NAME | COMMON NAME | HAWAIIAN NAME |
|------------------------------------|---------------------------|---------------------------------|
| ACANTHURIDAE | Surgeonfishes | |
| <i>Acanthurus achilles</i> | Achilles Tang | <i>Paku'iku'i</i> |
| <i>Acanthurus blochii</i> | Ringtail Surgeonfish | <i>Pualu</i> |
| <i>Acanthurus dussumieri</i> | Whitespine Surgeonfish | <i>Palani</i> |
| <i>Acanthurus guttatus</i> | Whitespotted Surgeonfish | <i>'Api</i> |
| <i>Acanthurus leucopareius</i> | Whitebar Surgeonfish | <i>Maikoiko</i> |
| <i>Acanthurus nigricans</i> | Whitecheek Surgeonfish | |
| <i>Acanthurus nigrofuscus</i> | Lavender Tang | <i>Ma'i'i'i</i> |
| <i>Acanthurus nigroris</i> | Bluelined Surgeonfish | <i>Maiko</i> |
| <i>Acanthurus olivaceus</i> | Orangebar Surgeonfish | <i>Na'ena'e</i> |
| <i>Acanthurus thompsoni</i> | Thompson's Surgeonfish | |
| <i>Acanthurus triostegus</i> | Convict Tang | <i>Manini</i> |
| <i>Acanthurus xanthopterus</i> | Yellowfin Surgeonfish | <i>Pualu</i> |
| <i>Ctenochaetus hawaiiensis</i> | Chevron Tang | <i>Black Kole</i> |
| <i>Ctenochaetus strigosus</i> | Goldring Surgeonfish | <i>Kole</i> |
| <i>Naso brevirostris</i> | Spotted Unicornfish | <i>Kala lolo</i> |
| <i>Naso hexacanthus</i> | Sleek Unicornfish | <i>Opelu kala</i> |
| <i>Naso lituratus</i> | Orangespine Unicornfish | <i>Umaumalei</i> |
| <i>Naso unicornis</i> | Bluespine Unicornfish | <i>Kala</i> |
| <i>Zebrasoma flavescens</i> | Yellow Tang | <i>Lau'ipala</i> |
| <i>Zebrasoma veliferum</i> | Sailfin Tang | <i>Mane'one'o</i> |
| APOGONIDAE | Cardinalfishes | <i>Upapalu</i> |
| <i>Apogon kallopterus</i> | | |
| <i>Apogon taeniopterus</i> | | |
| AULOSTOMIDAE | Trumpetfish | <i>Nunu</i> |
| <i>Aulostomus chinensis</i> | | |
| BALISTIDAE | Triggerfishes | <i>Humuhumu</i> |
| <i>Melichthys niger</i> | Black Durgeon | <i>Humuhumu 'ele'ele</i> |
| <i>Melichthys vidua</i> | Pinktail Triggerfish | <i>Humuhumu hi'ukole</i> |
| <i>Rhinecanthus aculeatus</i> | Lagoon Triggerfish | <i>Humuhumu nukunuku apua'a</i> |
| <i>Rhinecanthus rectangulus</i> | Reef Triggerfish | <i>Humuhumu nukunuku apua'a</i> |
| <i>Sufflamen bursa</i> | Lei Triggerfish | <i>Humuhumu lei</i> |
| <i>Sufflamen fraenatus</i> | Bridled Triggerfish | <i>Humuhumu mimi</i> |
| <i>Xanthichthys auromarginatus</i> | Bluethroat Triggerfish | |
| BELONIDAE | Needlefishes | <i>'Aha'aha</i> |
| <i>Platybelone argalus</i> | | |
| BLENNIIDAE | Blennies | <i>Pao'o</i> |
| <i>Cirripectes vanderbilti</i> | Scarface or Purple Blenny | |
| <i>Exallias brevis</i> | Reticulated Blenny | |
| <i>Plagiotremus ewaensis</i> | Ewa Blenny | |

| SCIENTIFIC NAME | COMMON NAME | HAWAIIAN NAME |
|-------------------------------------------|-------------------------------|------------------------------------|
| <i>Plagiotremus goslinei</i> | Brown & white Blenny | |
| BOTHIDAE | Flounders | <i>Paki'i</i> |
| <i>Bothus mancus</i> | Flowery Flounder | |
| <i>Bothus pantherinus</i> | Panther Flounder | |
| CARANGIDAE | Jacks | |
| <i>Carangoides orthogrammus</i> | Yellowspot Jack | <i>Papio</i> |
| <i>Caranx ignobilis</i> | Giant Trevally | <i>White Ulua</i> |
| <i>Caranx melampygus</i> | Bluefin Trevally | <i>Omilu</i> |
| <i>Caranx sexfasciatus</i> | Bigeye Trevally | <i>Pake Ulua</i> |
| <i>Decapterus pinnulatus</i> | Mackerel Scad | <i>Opelu</i> |
| <i>Scomberoides lysan</i> | Leatherback | <i>Lai</i> |
| <i>Seriola dumerilii</i> | Greater Amberjack | <i>Kahala</i> |
| CARCHARHINIDAE | Requiem Sharks | <i>Mano</i> |
| <i>Carcharhinus amblyrhynchos</i> | Gray Reef Shark | <i>Mano</i> |
| <i>Triaenodon obesus</i> | Whitetip Reef Shark | <i>Mano lalakea</i> |
| CHAETODONTIDAE | Butterflyfishes | |
| <i>Chaetodon auriga</i> | Threadfin Butterflyfish | <i>Kikakapu</i> |
| <i>Chaetodon citrinellus</i> | Citron Butterflyfish | <i>Lauhau</i> |
| <i>Chaetodon ephippium</i> | Saddleback Butterflyfish | <i>Kikakapu</i> |
| <i>Chaetodon fremblii</i> | Bluestriped Butterflyfish | <i>Kikakapu</i> |
| <i>Chaetodon kleinii</i> | Blacklip Butterflyfish | <i>Lauhau</i> |
| <i>Chaetodon lineolatus</i> | Lined Butterflyfish | <i>Kikakapu</i> |
| <i>Chaetodon lunula</i> | Raccoon Butterflyfish | <i>Kikakapu</i> |
| <i>Chaetodon miliaris</i> | Milletseed Butterflyfish | <i>Lauwiliwili</i> |
| <i>Chaetodon multicinctus</i> | Pebbled Butterflyfish | <i>Kikakapu</i> |
| <i>Chaetodon ornatissimus</i> | Ornate Butterflyfish | <i>Kikakapu</i> |
| <i>Chaetodon quadrimaculatus</i> | Fourspot Butterflyfish | <i>Lauhau</i> |
| <i>Chaetodon lunulatus (trifasciatus)</i> | Oval Butterflyfish | <i>Kapuhili</i> |
| <i>Chaetodon unimaculatus</i> | Teardrop Butterflyfish | <i>Kikakapu</i> |
| <i>Forcipiger flavissimus</i> | Forcepsfish | <i>Lauwiliwili nukumuku 'oi'oi</i> |
| <i>Forcipiger longirostris</i> | Longnose Butterflyfish | <i>Lauwiliwili nukumuku 'oi'oi</i> |
| <i>Hemitaurichthys polylepis</i> | Pyramid Butterflyfish | <i>Kikakapu</i> |
| <i>Hemitaurichthys thompsoni</i> | Black Butterflyfish | <i>Kikakapu</i> |
| <i>Heniochus diphreutes</i> | Pennantfish | <i>Kihikih</i> |
| CARACANTHIDAE | Orbicular Velvetfishes | |
| <i>Caracanthus typicus (maculatus)</i> | Hawaiian Velvetfish | |
| CHANIDAE | Milkfish | <i>Awa</i> |
| <i>Chanos chanos</i> | | |
| CIRRHITIDAE | Hawkfishes | |
| <i>Cirrhitops fasciatus</i> | Banded Hawkfish | <i>Piliko'a</i> |
| <i>Cirrhitus pinnulatus</i> | Stocky Hawkfish | <i>Po'opa'a</i> |
| <i>Paracirrhites arcatus</i> | Arceye Hawkfish | <i>Hilu Piliko'a</i> |

| SCIENTIFIC NAME | COMMON NAME | HAWAIIAN NAME |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Paracirrhites forsteri</i> | Blackside Hawkfish | <i>Hilu Piliko'a</i> |
| CONGRIDAE <i>Conger cinereus</i> | Conger Eels | <i>Puhi 'uha</i> |
| DIODONTIDAE <i>Diodon holocanthus</i> <i>Diodon hystrix</i> | Porcupinefishes Clearfin porcupinefish Spotted Porcupinefish | <i>Kokala</i> |
| FISTULARIIDAE <i>Fistularia commersonii</i> | Cornetfish | <i>Nunu peke</i> |
| HEMIRAMPHIDAE <i>Hyporhamphus acutus</i> | Halfbeaks Slender Halfbeak | <i>'The 'ihe</i> |
| HOLOCENTRIDAE <i>Myripristis amaena</i> <i>Myripristis berndti</i> <i>Myripristis kuntee</i> <i>Neoniphon sammara</i> <i>Sargocentron diadema</i> <i>Sargocentron punctatissimum</i> <i>Sargocentron spiniferum</i> <i>Sargocentron tiere</i> <i>Sargocentron xantherythrum</i> | Squirrelfishes & Soldierfishes Brick Soldierfish Bigscale Soldierfish Smallscale Soldierfish Spotfin Squirrelfish Crown Squirrelfish Peppered Squirrelfish Spinecheek Squirrelfish Tahitian Squirrelfish Hawaiian Squirrelfish | <i>'U'u or Menpachi</i> <i>'U'u</i> <i>'U'u</i> <i>Ala'ihī</i> <i>Ala'ihī</i> <i>Ala'ihī</i> <i>Ala'ihī mama</i> <i>Ala'ihī</i> <i>Ala'ihī</i> |
| KUHLIIDAE <i>Kuhlia sandvicensis</i> | Mountain Bass | <i>Aholehole</i> |
| KYPHOSIDAE <i>Kyphosus bigibbus</i> <i>Kyphosus cinerascens</i> <i>Kyphosus vaigiensis</i> | Chubs Brown Chub Highfin Chub Lowfin Chub | <i>Nenuē</i> |
| LABRIDAE <i>Anampses chrysocephalus</i> <i>Anampses cuvier</i> <i>Bodianus bilunulatus</i> <i>Cheilio inermis</i> <i>Coris flavovittata</i> <i>Coris gaimard</i> <i>Coris venusta</i> <i>Gomphosus varius</i> <i>Halichoeres ornatissimus</i> <i>Labroides phthirophagus</i> <i>Macropharyngodon geoffroy</i> <i>Novaculichthys taeniourus</i> <i>Oxycheilinus bimaculatus</i> <i>Oxycheilinus unifasciatus</i> | Wrasses Psychedelic Wrasse Pearl Wrasse Hawaiian Hogfish Cigar wrasse Pinkstripe Wrasse Yellowtail Wrasse Elegant Wrasse Bird Wrasse Ornate Wrasse Cleaner Wrasse Shortbodied Wrasse Rockmover Twospot Wrasse Ringtail Wrasse | <i>Hinalea, Hilu</i> <i>'Opule</i> <i>'A'awa</i> <i>Kupoupou</i> <i>Hilu</i> <i>Hilu</i> <i>Hinalea 'akilolo</i> <i>Ohua</i> <i>Po'ou</i> |

| SCIENTIFIC NAME | COMMON NAME | HAWAIIAN NAME |
|-------------------------------------|--------------------------------|-------------------------|
| <i>Pseudocheilinus evanidus</i> | Chinstrap Wrasse | |
| <i>Pseudocheilinus octotaenia</i> | Eightlined Wrasse | |
| <i>Pseudocheilinus tetrataenia</i> | Fourlined Wrasse | |
| <i>Pseudojuloides cerasinus</i> | Slender Wrasse | |
| <i>Stethojulis balteata</i> | Belted Wrasse | <i>Omaka</i> |
| <i>Thalassoma ballieui</i> | Blacktail Wrasse | <i>Hinalea luahine</i> |
| <i>Thalassoma duperrey</i> | Saddle Wrasse | <i>Hinalea lauwili</i> |
| <i>Thalassoma purpuraceum</i> | Surge Wrasse | <i>Hou</i> |
| <i>Thalassoma trilobatum</i> | Christmas Wrasse | <i>Awela</i> |
| LETHRINIDAE | | |
| <i>Monotaxis grandoculis</i> | Bigeye Emperor | <i>Mu</i> |
| LUTJANIDAE | Snappers | |
| <i>Aphareus furca</i> | Bigmouth Snapper | <i>Wahanui</i> |
| <i>Lutjanus fulvus</i> | Blacktail Wrasse | <i>Toau</i> |
| <i>Lutjanus kasmira</i> | Bluestripe Snapper | <i>Ta'ape</i> |
| MOBULIDAE | | |
| <i>Manta birostris</i> | Manta Ray | <i>Hahalua</i> |
| MONACANTHIDAE | | |
| <i>Aluterus scriptus</i> | Filefishes & Leatherjackets | <i>'O'ili</i> |
| <i>Cantherhines dumerili</i> | Broomtail or Scrawled Filefish | |
| <i>Cantherhines sandwichiensis</i> | Gray Filefish | |
| <i>Pervagor aspricaudus</i> | Black Filefish | |
| <i>Pervagor spilosoma</i> | Peppered Filefish | |
| | Fantailed Filefish | <i>'O'ili 'uwi 'uwi</i> |
| MUGILIDAE | | |
| <i>Mugil cephalus</i> | Mullet | <i>'Ama'ama</i> |
| | Striped Mullet | <i>'Ama'ama</i> |
| MULLIDAE | | |
| <i>Mulloidichthys flavolineatus</i> | Goatfishes | |
| <i>Mulloidichthys vanicolensis</i> | Yellowstripe Goatfish | <i>White Weke</i> |
| <i>Parupeneus bifasciatus</i> | Yellowfin Goatfish | <i>Weke 'ula</i> |
| <i>Parupeneus cyclostomus</i> | Doublebar Goatfish | <i>Munu</i> |
| <i>Parupeneus multifasciatus</i> | Blue Goatfish | <i>Moana kali</i> |
| <i>Parupeneus pleurostigma</i> | Manybar Goatfish | <i>Moana</i> |
| <i>Parupeneus porphyreus</i> | Sidespot Goatfish | <i>Malu</i> |
| | Whitesaddle Goatfish | <i>Kumu</i> |
| MURAENIDAE | | |
| <i>Gymnothorax eurostus</i> | Moray Eels | <i>Puhi</i> |
| <i>Gymnothorax flavimarginatus</i> | Stout Moray | |
| <i>Gymnothorax meleagris</i> | Yellowmargin Moray | |
| <i>Gymnothorax undulatus</i> | Whitemouth Moray | |
| <i>Siderea picta</i> | Greenhead Moray | |
| | Speckled Moray | |
| MYLIOBATIDAE | | |
| <i>Aetobatus narinari</i> | Eagle ray | <i>Hihimanu</i> |

| SCIENTIFIC NAME | COMMON NAME | HAWAIIAN NAME |
|-----------------------------------------|-------------------------|-------------------|
| OSTRACIIDAE | Trunkfishes | <i>Moa</i> |
| <i>Ostracion meleagris</i> | Spotted Boxfish | |
| <i>Ostracion whitleyi</i> | Whitley's Boxfish | |
| POMACANTHIDAE | Angelfishes | |
| <i>Holacanthus arcuatus</i> | Bandit Angelfish | |
| <i>Centropyge fisheri</i> | Fisher's Angelfish | |
| <i>Centropyge loriculus</i> | Flame Angelfish | |
| <i>Centropyge potteri</i> | Potter's Angelfish | |
| POMACENTRIDAE | Damselfishes | |
| <i>Abudefduf abdominalis</i> | Hawaiian Sergeant | <i>Mamo</i> |
| <i>Abudefduf sordidus</i> | Blackspot Sergeant | <i>Kupipi</i> |
| <i>Abudefduf vaigiensis</i> | Indo-pacific Sergeant | <i>Mamo</i> |
| <i>Chromis agilis</i> | Agile Chromis | |
| <i>Chromis hanui</i> | Chocolate-dip Chromis | |
| <i>Chromis ovalis</i> | Oval Chromis | |
| <i>Chromis vanderbilti</i> | Blackfin Chromis | |
| <i>Chromis verater</i> | Threespot Chromis | |
| <i>Dascyllus albisella</i> | Hawaiian Dascyllus | <i>Alo'ilo'i</i> |
| <i>Plectroglyphidodon imparipennis</i> | Brighteye Damselfish | |
| <i>Plectroglyphidodon johnstonianus</i> | Blueeye Damselfish | |
| <i>Plectroglyphidodon sindonis</i> | Rock Damselfish | |
| <i>Stegastes fasciolatus</i> | Pacific Gregory | |
| PRIACANTHIDAE | Bigeyes | <i>Aweoweo</i> |
| <i>Heteropriacanthus cruentatus</i> | | |
| SCARIDAE | Parrotfishes | <i>Uhu</i> |
| <i>Calotomus carolinus</i> | Stareye Parrotfish | <i>Pomuhunuhu</i> |
| <i>Chlorurus perspicillatus</i> | Spectacled Parrotfish | <i>Uhu uliuli</i> |
| <i>Chlorurus sordidus</i> | Bullethead Parrotfish | <i>Uhu</i> |
| <i>Scarus dubius</i> | Regal Parrotfish | <i>Uhu</i> |
| <i>Scarus psittacus</i> | Palenose Parrotfish | <i>Uhu</i> |
| <i>Scarus rubroviolaceus</i> | Redlip Parrotfish | <i>Palukaluka</i> |
| SCORPAENIDAE | Scorpionfishes | <i>Nohu</i> |
| <i>Scorpaenopsis cacopsis</i> | Titan Scorpionfish | |
| <i>Scorpaenopsis diabolus</i> | Devil Scorpionfish | |
| <i>Sebastapistes ballieui</i> | Redspotted Scorpionfish | |
| <i>Sebastapistes coniorta</i> | Speckled Scorpionfish | |
| SERRANIDAE | Groupers | |
| <i>Cephalopholis argus</i> | Peacock Grouper | <i>Roi</i> |
| SPHYRAENIDAE | Barracudas | <i>Kaku</i> |
| <i>Sphyræna barracuda</i> | | |

| SCIENTIFIC NAME | COMMON NAME | HAWAIIAN NAME |
|---------------------------------|------------------------------------|-------------------|
| SYNODONTIDAE | Lizardfishes | <i>'Ulae</i> |
| <i>Saurida flamma</i> | Orangemouth Lizardfish | |
| <i>Synodus binotatus</i> | Twospot Lizardfish | |
| <i>Synodus dermatogenys</i> | Clearfin Lizardfish | |
| <i>Synodus variegatus</i> | Variiegated Lizardfish | |
| TETRAODONTIDAE | Balloonfishes & Puffers | <i>'O'opu hue</i> |
| <i>Arothron hispidus</i> | Stripebelly Puffer | |
| <i>Arothron meleagris</i> | Spotted Puffer | |
| <i>Canthigaster amboinensis</i> | Gray Sharpnosed Puffer | |
| <i>Canthigaster jactator</i> | Hawaiian Spotted Sharpnosed Puffer | |
| ZANCLIDAE | Moorish Idol | <i>Kihikihi</i> |
| <i>Zanclus cornutus</i> | | |