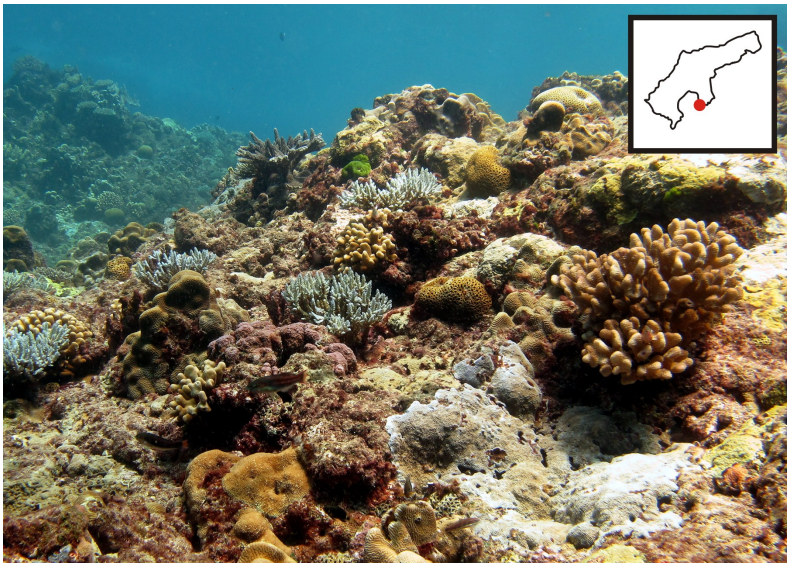
Rank 1/35: Forbidden Island



This is one of two sites surveyed located in the Forbidden Island Marine Sanctuary, a fully protected no-take area established in 2001. This survey site is located on the southern side of Forbidden Island. Forbidden Island gets its name for the difficult hike to access the island, along with the strong waves that can pose a danger to swimmers. This Forbidden Island site is a highly resilient site ranking first of all the sites with a resilience score of 0.84 (anchored to 1.00, the maximum possible score) (Table 1). Five of the nine variables received high scores (0.8+): coral diversity, temperature variability, macroalgae cover, nutrient input, and fishing access. Although there are other sites with more variables that received high scores, this Forbidden Island site did not have any variables with anchored scores less than 0.59. Coral recruitment, bleaching resistance, and sedimentation received medium scores. Coral diversity at this site is 0.93 (Simpson's Index) and about 35% of the coral community here is susceptible to bleaching. The benthos environment is mostly comprised of live coral (49%) and algae (44.3%) with the remainder being soft corals, CCA (Crustose Coralline Algae), and pavement (bare substrate) (Fig. 1). Four of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 4 species, 3 were proposed in November 2012 as 'threatened' and 1 species was proposed as 'not warranted' by NMFS (Table 2). About three-quarters of the corals observed at Forbidden Island were small (<16 cm in diameter) (Fig. 2). Herbivore biomass is relatively high – 1.95 kg/100m^2 (rank 6/35, Fig. 3; score of 0.59) – and most herbivorous fish present were grazers (Fig. 4). The size-class frequency distribution of Scarids had a wider range than that of Acanthurids; Scarids ranged in length from 11-40 cm and all Acanthurids observed were less than 20 cm (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.93	0.96
Recruitment	9.75	0.68
Bleaching Resistance	64.99	0.73
Temperature variability	0.96	0.97
Herbivore biomass	1.95	0.59
Macroalgae cover*	0.00	1.00
Nutrient input*	2.46	0.91
Sedimentation*	1.57	0.70
Fishing pressure	1440	1.00
Resilience score		0.84
Final anchored resilience score (**1**/35)		1.00

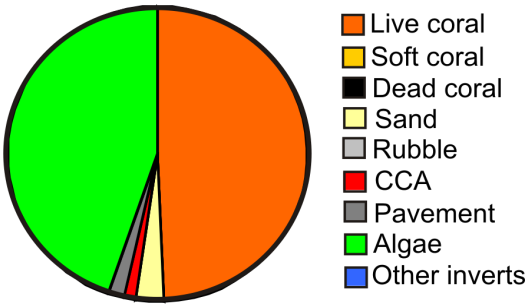


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (4/24)
Acropora vaughani[T]
Acropora verweyi[T]
Cyphastrea ocellina[NW]
Millepora tuberosa[T]

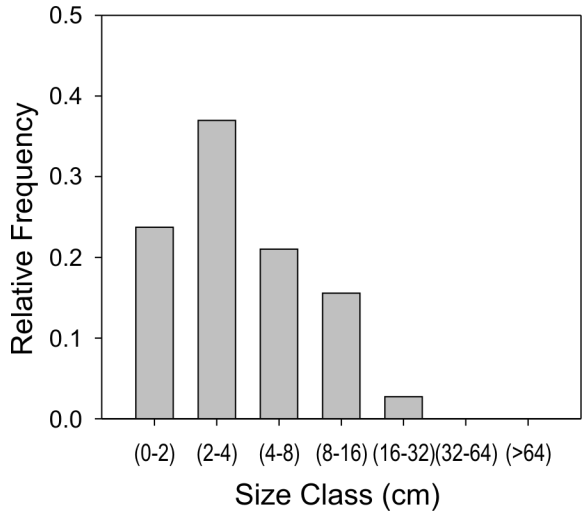


Figure 2. Size-class frequency distribution for stony corals.

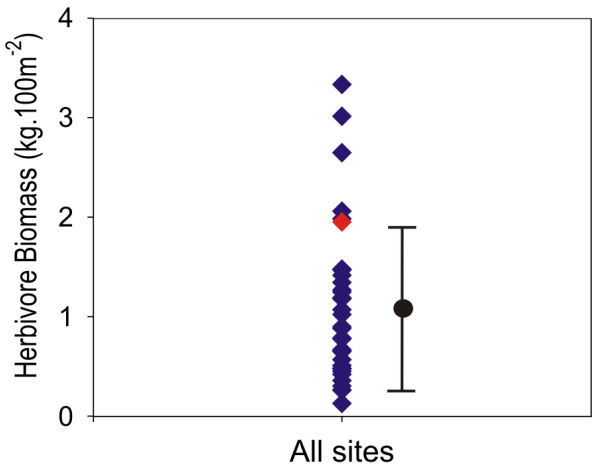


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

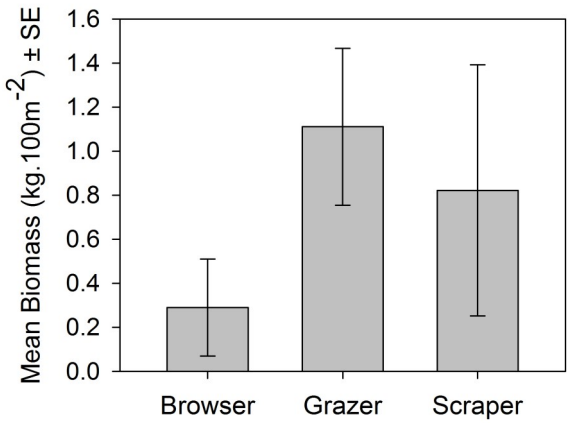


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

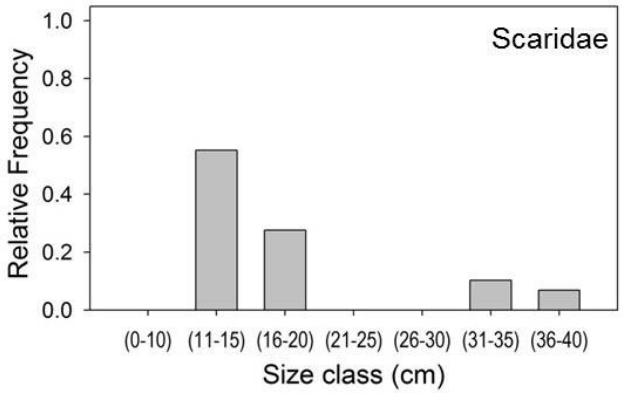


Figure 5. Size-class frequency distribution of Scaridae.

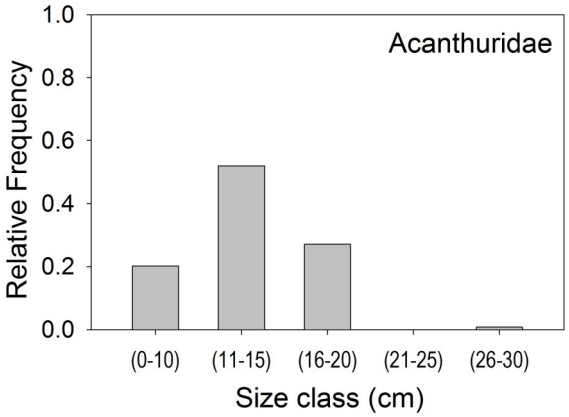
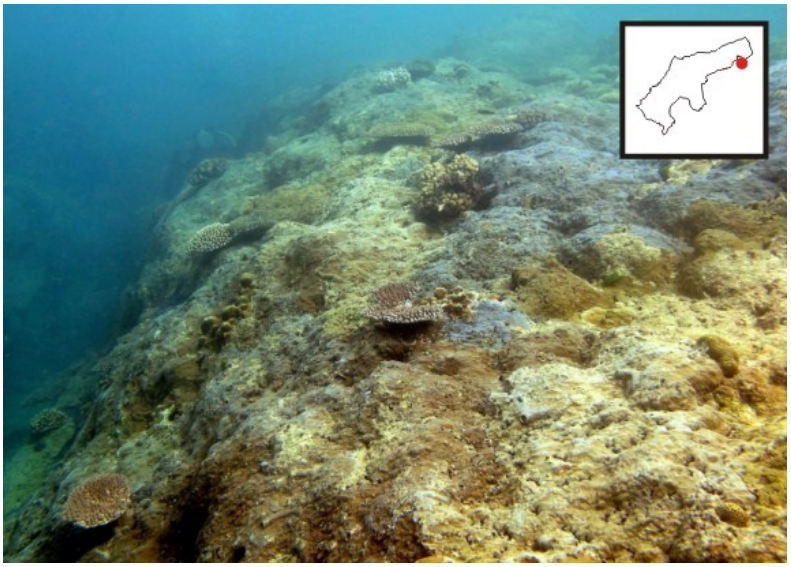


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 2/35: Bird Island



This site is located within the Bird Island Marine Sanctuary, a fully protected no-take area established in 2000 that extends from the Grotto in the north to the Bird Island lookout point in the south. This site is a Marine Monitoring Team survey site. Bird Island has the second highest resilience score of 0.83 (anchored to 0.99) and is classified as a high resilience site. High coral diversity, temperature variability, and high herbivore biomass, along with low macroalgae cover, nutrient input and fishing access contribute to the high resilience of this site (Table 1). Most of the benthos (70%) is made up of hard corals, with the remaining being algae, pavement (bare substrate), CCA, rubble and sand (Fig. 1). Eleven of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these eleven species, 7 species were proposed in November 2012 as 'threatened' and 4 species were proposed as 'not warranted' (Table 2). Corals at the site are mostly small (<16 cm) – more than half are less than 8 cm in diameter (Fig. 2). Herbivore biomass was greatest at this site (3.33 kg/100 m^2, Fig. 3, rank 1/35) and most of the herbivorous fish community observed at the site are browsers (Fig. 4). The size class distributions of Acanthurids and Scarids are similar (Figs. 5 & 6). More than half of the fish in these families observed at the site were less than 20 cm in length. Invertebrates encountered include trochus and sea cucumbers (*Actinopyga miliaris*), though not in high densities. The reef at this site is unique in that the topography is very complex. Encrusting and small bushy corals grow here in a sort of patchwork quilt on large fingers of rock extending to the shallows (<5 m) and divided by deeper (15 m) water.

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.95	0.98
Recruitment	5.81	0.41
Bleaching Resistance	59.91	0.68
Temperature variability	0.98	0.99
Herbivore biomass	3.33	1.00
Macroalgae cover*	0.00	1.00
Nutrient input*	5.18	0.81
Sedimentation*	2.28	0.57
Fishing pressure	550	1.00
Resilience score		0.83
Final anchored resilience score (**2**/35)		0.99

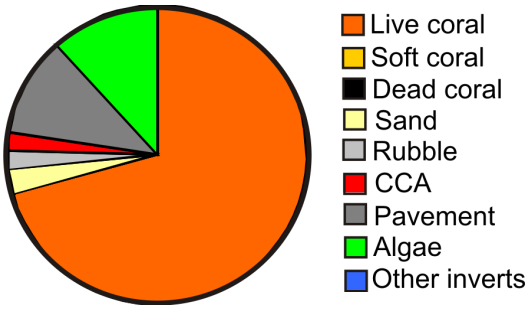


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (11/24)
Acanthastrea brevis[T]
Acropora palmerae[T]
Cyphastrea agassizi[NW]
Cyphastrea ocellina[NW]
Heliopora coerulea[NW]
Millepora tuberosa[T]
Montipora caliculata[T]
Montipora lobulata[T]
Pocillopora danae[T]
Pocillopora elegans[T]
Turbinaria stellulata[NW]

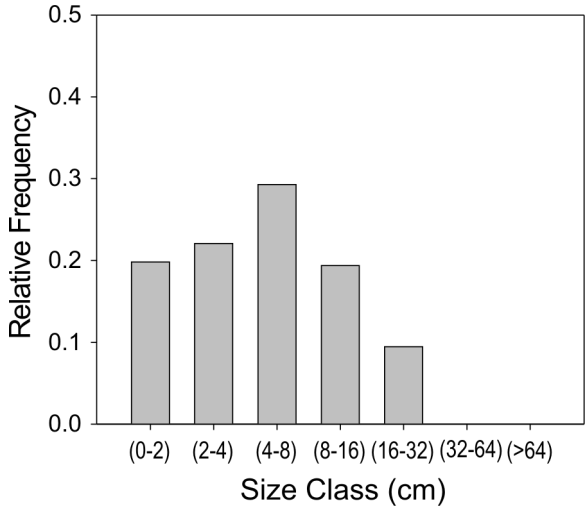


Figure 2. Size-class frequency distribution for stony corals.

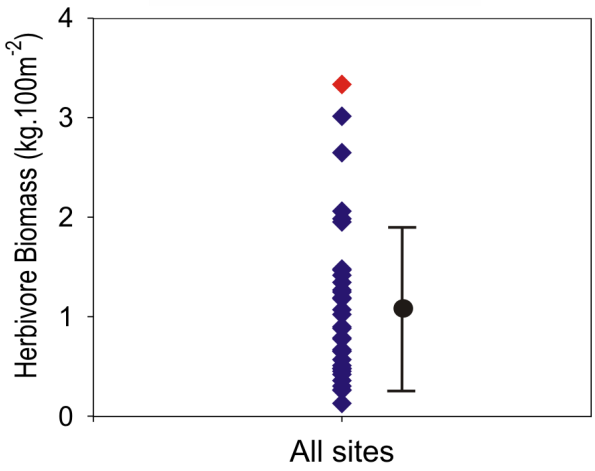


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

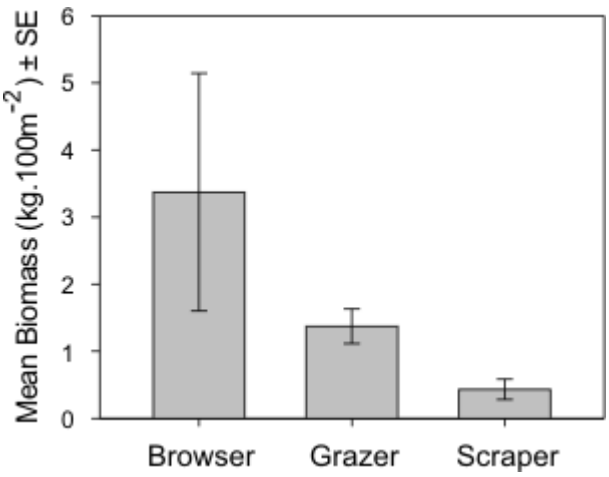


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

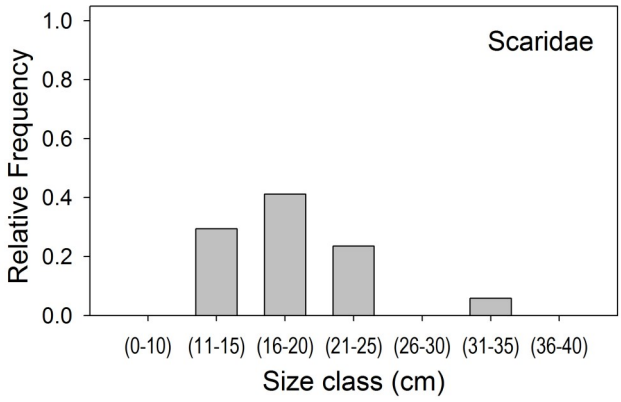


Figure 5. Size-class frequency distribution of Scaridae.

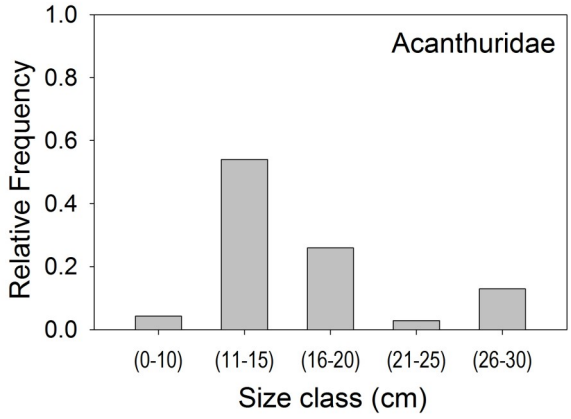
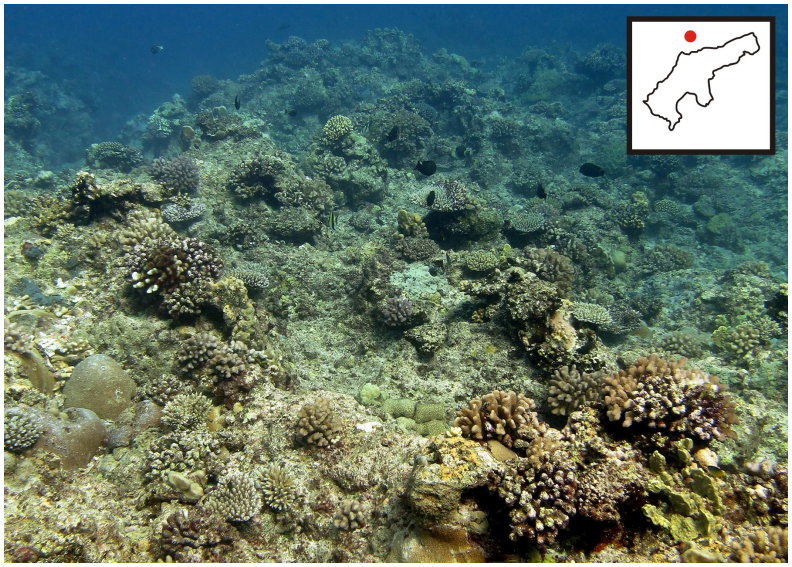


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 3/35: Lanyas



This site is located within the Managaha Marine Conservation Area, which is a fully protected no-take area established in 2000. This track of reef is also home to one of Saipan's more popular surf spots. This site is a Marine Monitoring Team survey site. Lanyas has the third highest resilience score (0.82, anchored to 0.98) and is classified as a high resilience site. High coral diversity and temperature variability, and low macroalgae cover, nutrient input, and fishing access contributed to the high resilience score (Table 1). Bleaching resistance, recruitment and sedimentation had medium scores. Of the nine variables in the analysis, only herbivore biomass had a low score, though many large fish were seen at the fringes of the survey area. The Simpson's Index of Diversity for corals was high at 0.94. 45% of the benthic sustrate is live coral with mostly bare substrate and <5% of other invertebrates making up the remaining area (Fig. 1). Four of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 4 species, 3 species were proposed in November 2012 as 'threatened' and 1 species was proposed as 'not warranted' (Table 2). Almost all of the corals observed at Lanyas are very small (<8 cm in mean diameter) (Fig. 2). The biomass of herbivores at the site during the surveys was 1.18 kg/100m^2 (14/35, Fig. 3) and herbivorous fish observed at the site were mostly grazers (Fig. 4). Larger Scarids were observed, mostly 16-20 cm in length; the Acanthurids observed were small, 11-15 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.94	0.98
Recruitment	11.00	0.77
Bleaching Resistance	59.66	0.67
Temperature variability	0.96	0.97
Herbivore biomass	1.18	0.35
Macroalgae cover*	0.00	1.00
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	142	1.00
Resilience score		0.82
Final anchored resilience score (**3**/35)		0.98

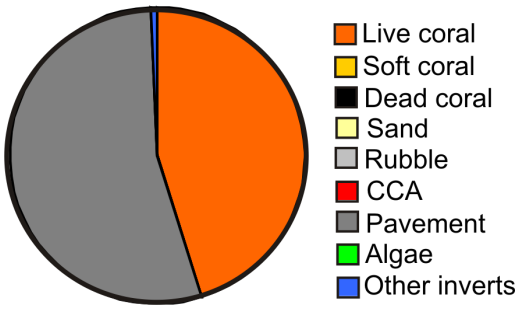


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (4/24)
Acropora vaughani[T]
Acropora verweyi[T]
Cyphastrea ocellina[NW]
Pocillopora danae[T]

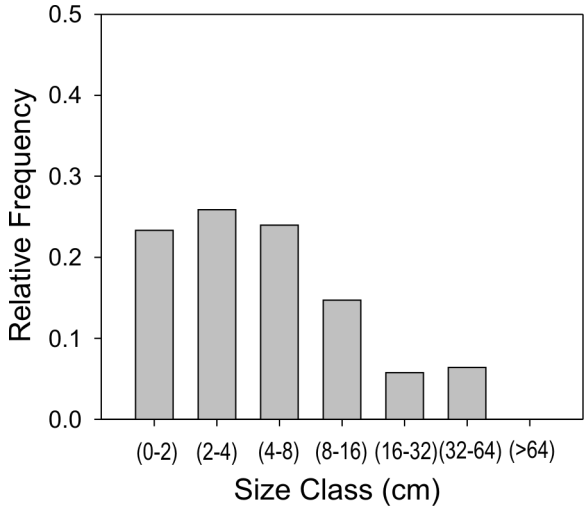


Figure 2. Size-class frequency distribution for stony corals.

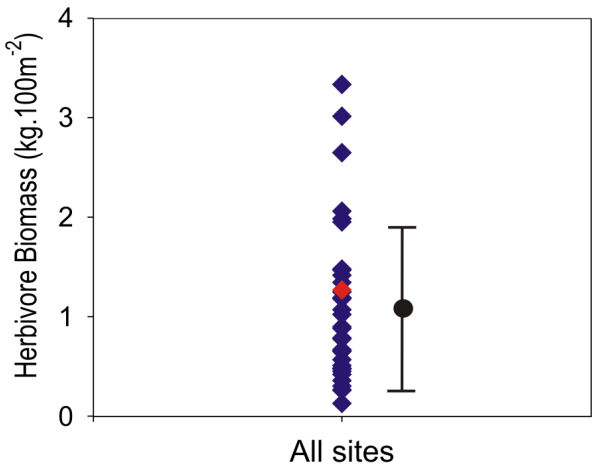


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

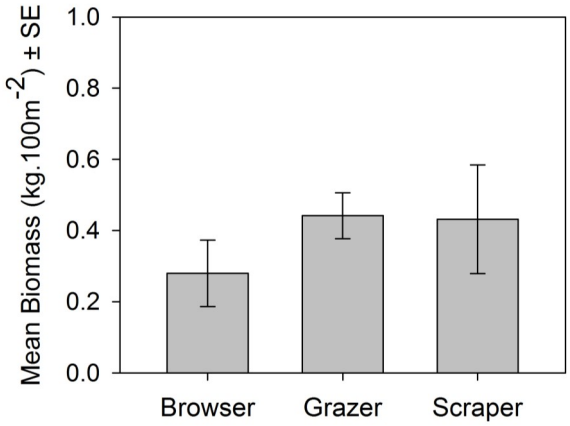


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

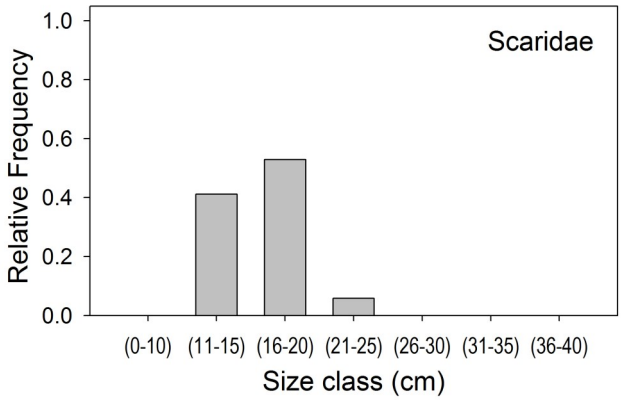


Figure 5. Size-class frequency distribution of Scaridae.

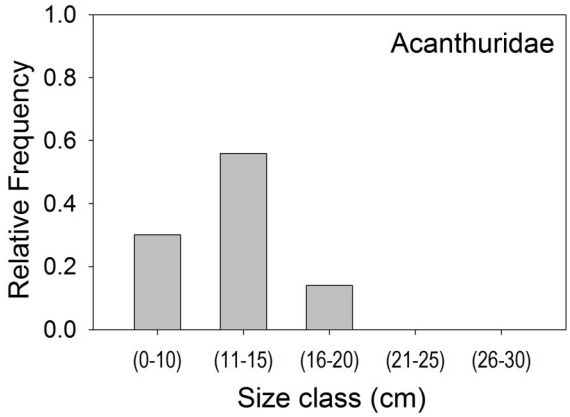
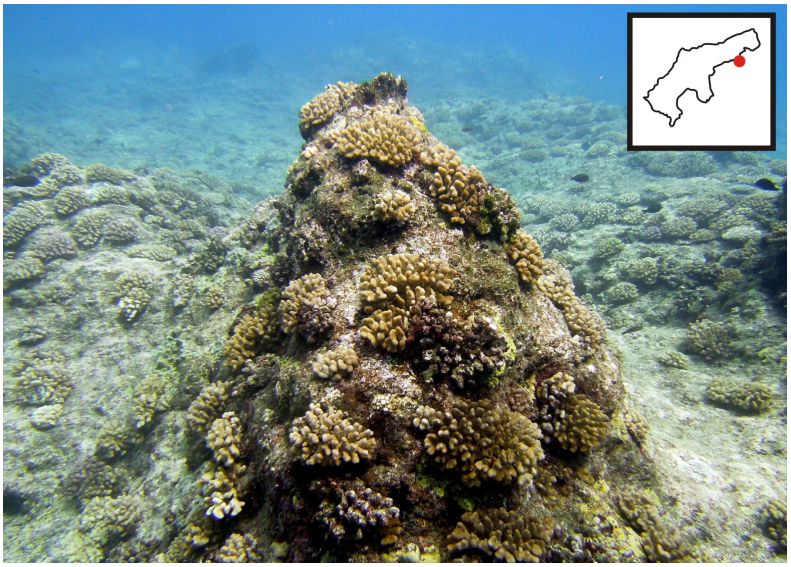


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 4/35: Nanasu Reef



Nanasu Reef is located on the windward side of Saipan, on the boundary of the Bird Island Convservation Area boundary. The majority of the eastern coast of Saipan has poor reef development due to high wave exposure, but Nanasu is one of the few exceptions. Nanasu Reef has a high resilience score of 0.80 (anchored to 0.95) and is ranked 4/35. Six of the nine variables included in the resilience analysis had high scores: coral diversity, temperature variability, herbivore biomass, macroalgae cover, nutrient input, and fishing access (Table 1). Bleaching resistance and sedimentation received medium scores, with just one variable (coral recruitment) receiving a low score. Coral diversity is high with a Simpson's Index of Diversity value of 0.92. The benthos at this site is diverse with algae (33.3%), live coral (23.7%), pavement (bare substrate) (23.3%), and rubble (16.7%) all having coverage greater than 15% (Fig. 1). Negligible amounts of sand, CCA, and invertebrate species make up the rest of the benthos. Seven of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 7 species, 6 species were proposed in November 2012 as 'threatened' and 1 species was proposed as 'not warranted' (Table 2). Corals ranged in diameter from <1 cm-32 cm, but more than half of the corals were recruits (<4 cm in diameter) (Fig. 2). Nanasu Reef has the second greatest amount of herbivore biomass at 3.01 kg/100m^2 (2/35, Fig. 3), and most herbivorous fish were identified as grazers (Fig. 4). Most members of the Scaridae family that were observed were 16-25 cm in length. The Acanthurids observed were slightly smaller with the majority being 11-20 cm (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.92	0.95
Recruitment	7.44	0.52
Bleaching Resistance	53.85	0.61
Temperature variability	0.99	1.00
Herbivore biomass	3.01	0.90
Macroalgae cover*	6.00	0.92
Nutrient input*	3.97	0.86
Sedimentation*	1.99	0.62
Fishing pressure	1429	0.81
Resilience score		0.80
Final anchored resilience score (**4**/35)		0.95

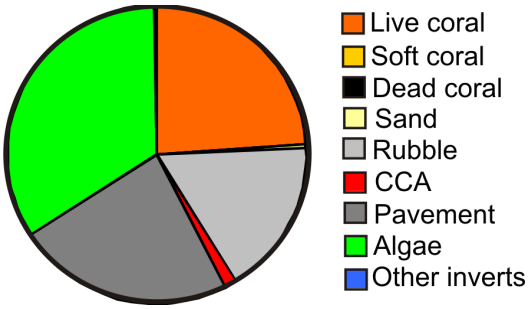


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (7/24)
Acropora vaughani[T]
Acropora verweyi[T]
Heliopora coerulea[NW]
Millepora tuberosa[T]
Pavona diffluencs[T]
Pocillopora danae[T]
Pocillopora elegans[T]

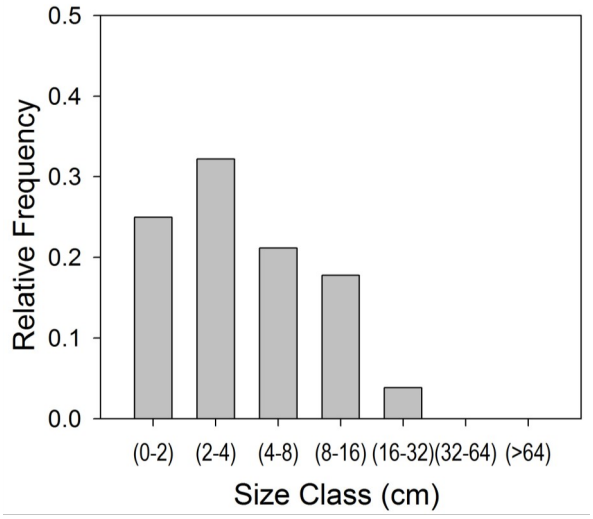


Figure 2. Size-class frequency distribution for stony corals.

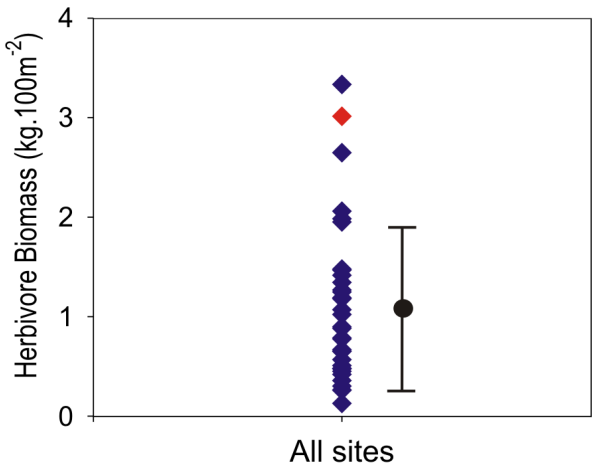


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

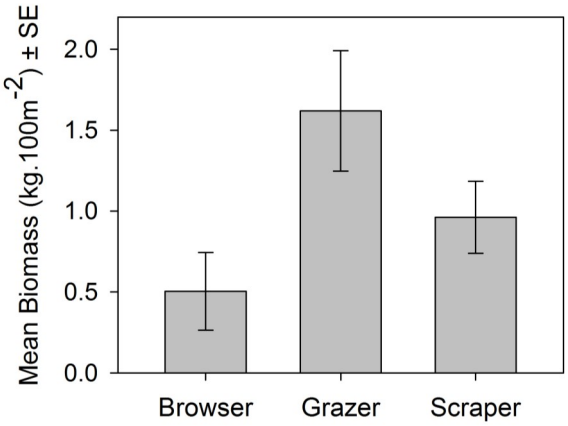


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

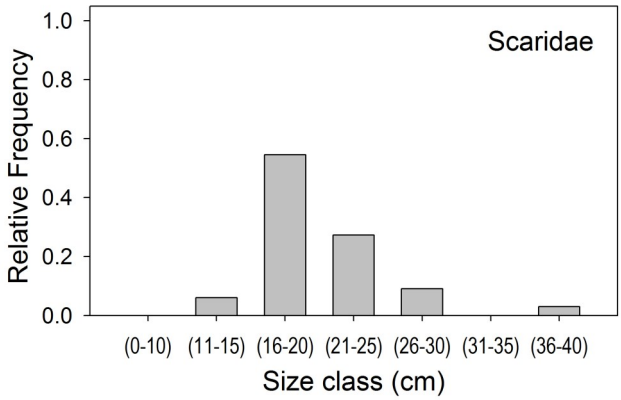


Figure 5. Size-class frequency distribution of Scaridae.

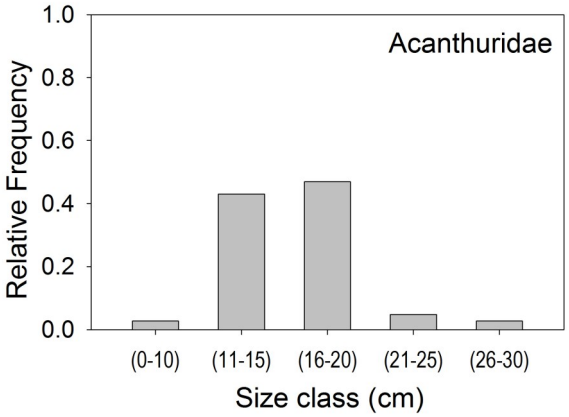
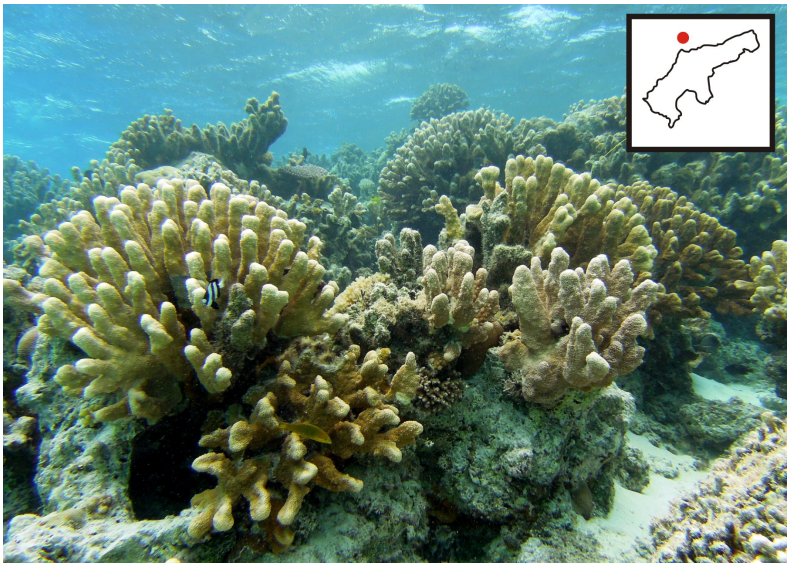


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 5/35: MMT Managaha MPA



This site is located in the Managaha Marine Conservation Area. The habitat here is primarily dominated by the coral *Isopora palifera*. Ranked 5th overall, the Managaha MPA has a resilience score of 0.79 (anchored to 0.94) and is classified as a high resilience site. Six of the nine variables included in the resilience analysis measured had high scores: coral diversity, bleaching resistance, temperature variability, macroalgae cover, nutrient input, and sedimentation (Table 1). Only sedimentation received a medium score, while coral recruitment and herbivore biomass received low scores. Live corals account for 43.3% of the benthic environment and algae for 33.3% (Fig. 1). The rest of the benthos is made up of sand, rubble, CCA, and pavement (bare substrate). Seven of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 7 species, 6 species were proposed in November 2012 as 'threatened' and 1 species was proposed as 'not warranted' (Table 2). Most corals observed at the site are 2-16 cm (Fig. 2). The MPA had one of the highest herbivore biomass concentrations, 1.48 kg/100m^2 (7/35, Fig. 3). The majority of the herbivore fish community observed are grazers (Fig. 4). Acanthurids we observed had a wider size class frequency range than the Scarids with lengths ranging from <5-20 cm (Figs. 5 & 6). All Scarids observed were 16-20 cm in length.

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.79	0.82
Recruitment	7.58	0.53
Bleaching Resistance	71.23	0.81
Temperature variability	0.96	0.97
Herbivore biomass	1.48	0.44
Macroalgae cover*	9.33	0.87
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	12	1.00
Resilience score		0.79
Final anchored resilience score (**5**/35)		0.94

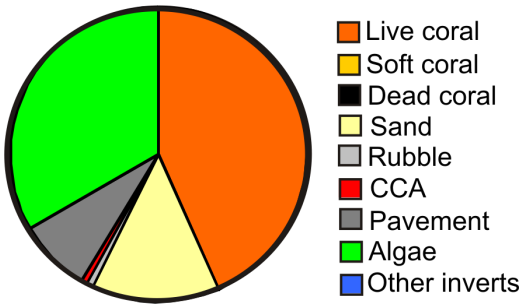


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (7/24)
Acropora paniculata[T]
Acropora verweyi[T]
Heliopora coerulea[NW]
Millepora tuberosa[T]
Montipora caliculata[T]
Pocillopora danae[T]
Pocillopora elegans[T]

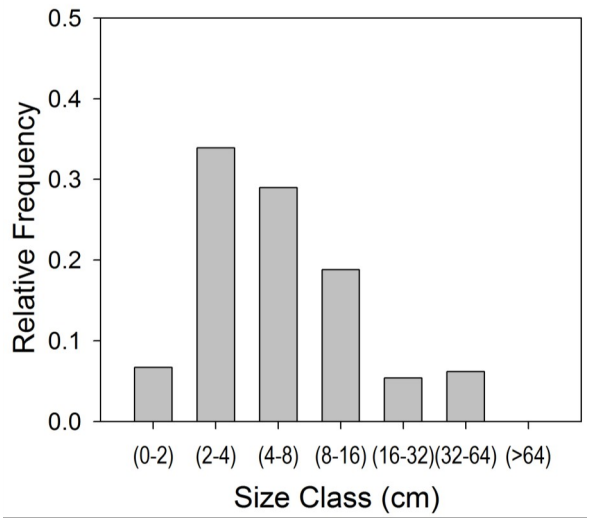


Figure 2. Size-class frequency distribution for stony corals.

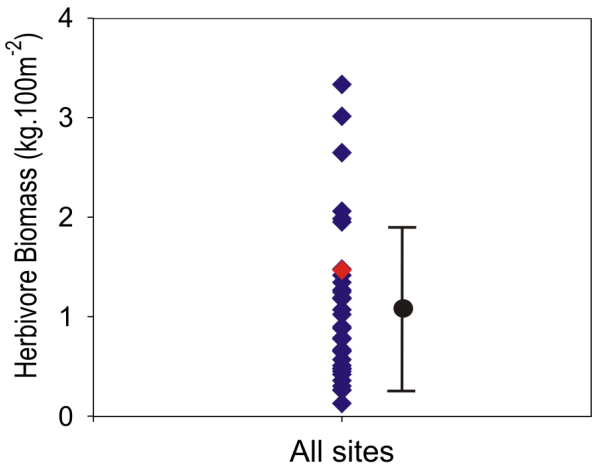


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

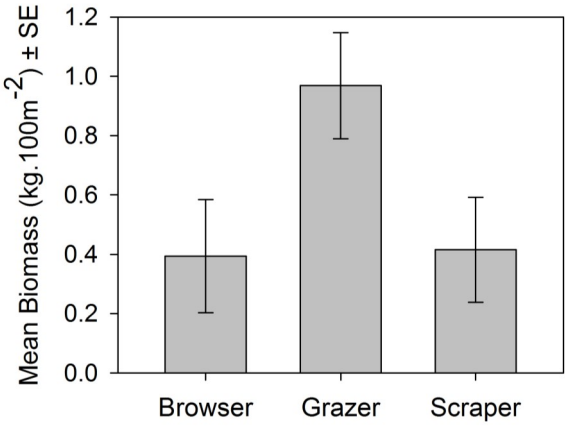


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

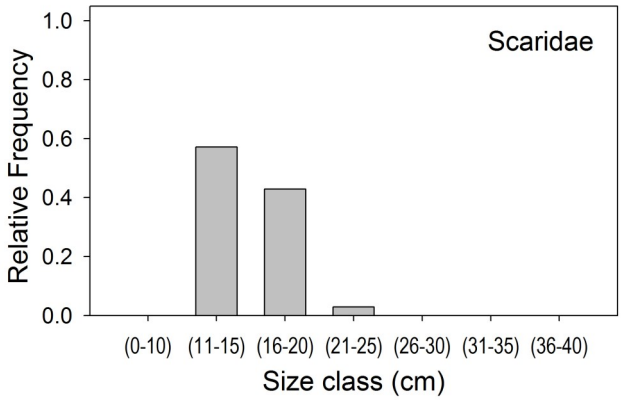


Figure 5. Size-class frequency distribution of Scaridae.

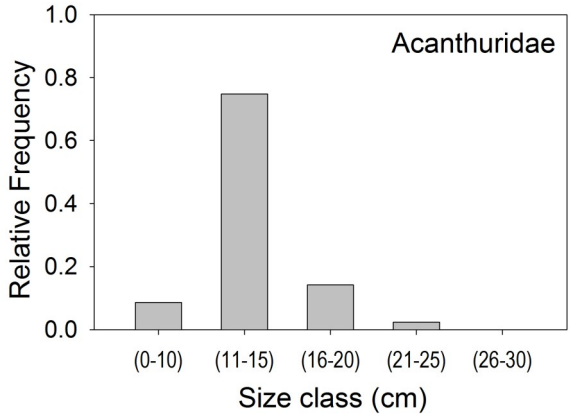
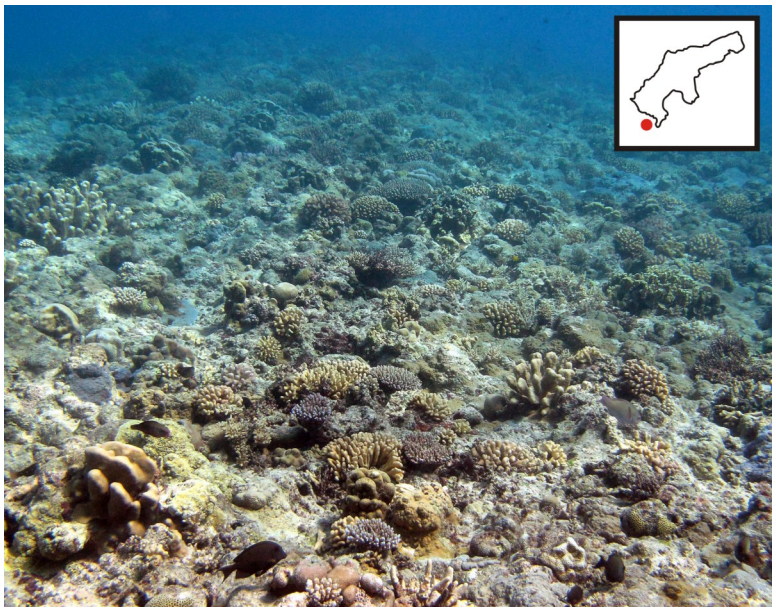


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 6/35: Obyan Beach



The survey site at Obyan Beach is home to an ancient Chamorro *Latte* village, a popular picnic area, a surf break, and is a common dive site and turtle nesting beach. This site is a Marine Monitoring Team survey site. Obyan Beach is the sixth ranked site overall with a resilience score of 0.76 (anchored to 0.90) and is classified as a high resilience site. Five variables at Obyan Beach received high scores: coral diversity, coral recruitment, temperature variability, macroalgae cover, and nutrient input (Table 1). Coral recruitment and herbivore biomass both received medium scores, with just fishing access receiving a low score. Coral diversity is high – the Simpson's Index of Diversity value is 0.90 (anchored score of 0.98). Obyan Beach supports a benthic environment of mostly pavement (bare substrate), but 39.7% is live coral and 1.3% CCA; no macroalgae was observed (Fig. 1). Nine of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 9 species, 7 species were proposed in November 2012 as 'threatened' and 2 species were proposed as 'not warranted' (Table 2). Most corals observed at Obyan Beach were 8 cm or less in diameter with only a few larger corals observed (Fig. 2). This site had the third highest concentration of herbivore biomass, 2.65 kg/100m^2 (Fig. 3), and most herbivorous fish present were scrapers (Fig. 4). The biomass ranking is probably inflated as the fish at this popular dive location exhibited behavior typical of fish used to being fed by divers. Of the Scarids and Acanthurids observed, more than half of both species were 16-20 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.95	0.98
Recruitment	13.50	0.94
Bleaching Resistance	59.27	0.67
Temperature variability	0.95	0.96
Herbivore biomass	2.65	0.79
Macroalgae cover*	0.00	1.00
Nutrient input*	4.41	0.84
Sedimentation*	2.10	0.60
Fishing pressure	54	0.03
Resilience score		0.76
Final anchored resilience score (**6**/35)		0.90

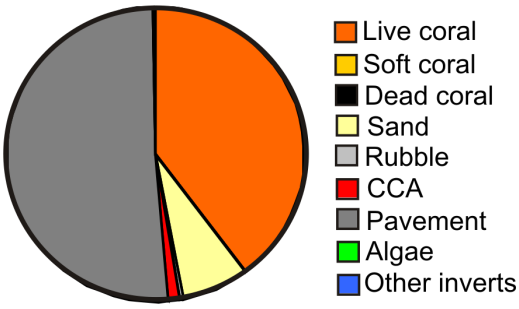


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (9/24)
Acanthastrea brevis [T]
Acropora verweyi [T]
Cyphastrea ocellina [NW]
Leptoseris incrustans [NW]
Millepora tuberosa [T]
Montipora caliculata [T]
Montipora lobulata [T]
Pocillopora danae [T]
Pocillopora elegans [T]

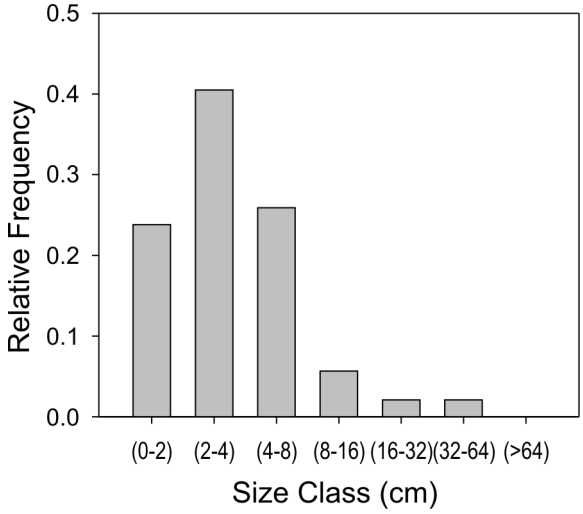


Figure 2. Size-class frequency distribution for stony corals.

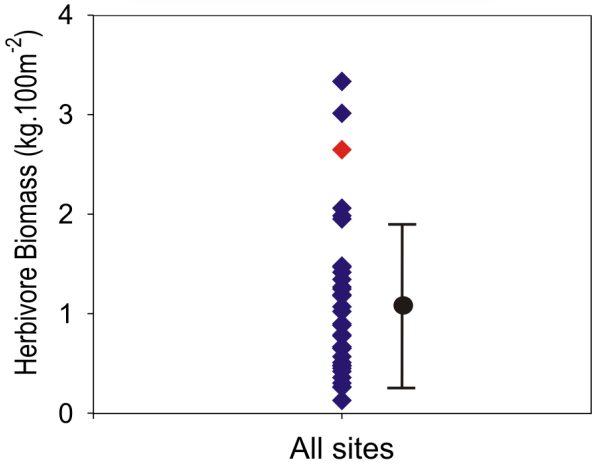


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

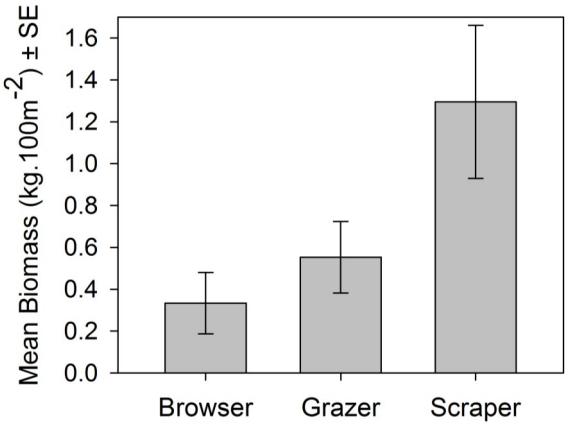


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

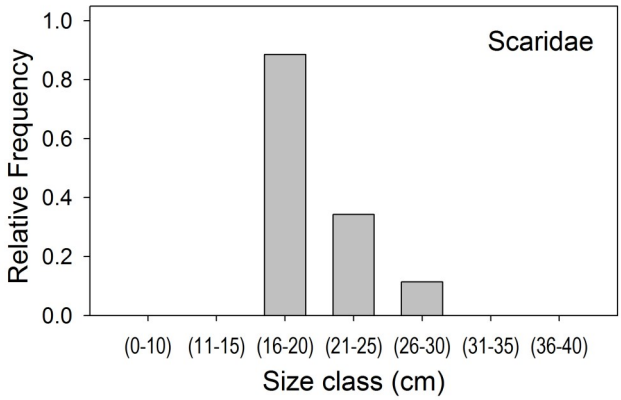


Figure 5. Size-class frequency distribution of Scaridae.

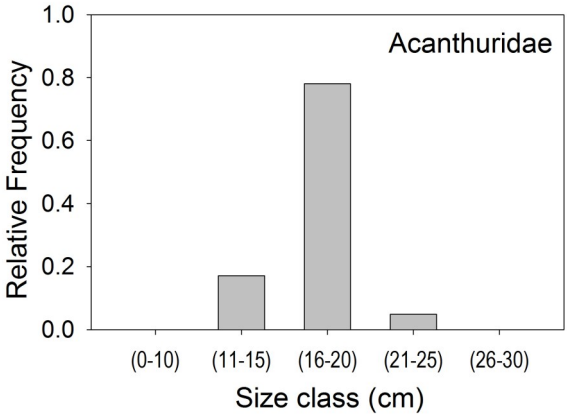
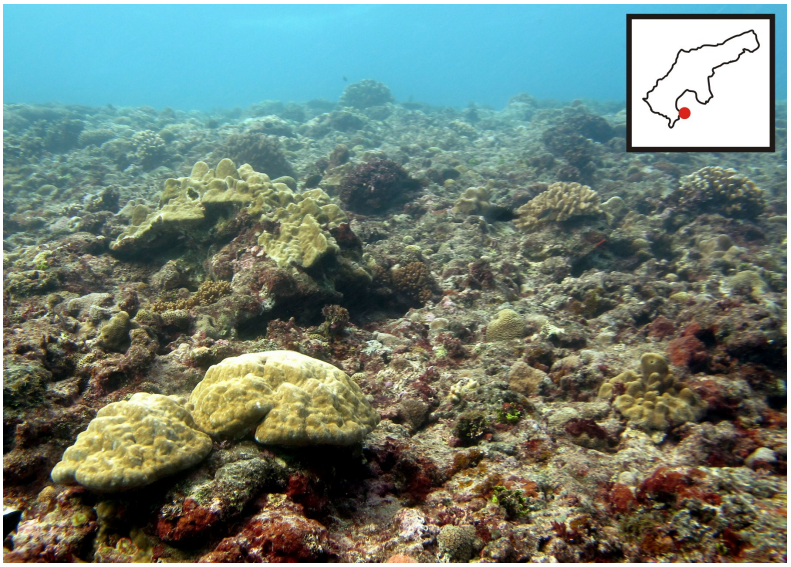


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 7/35: South Laolao



This is the most southerly site surveyed in Laolao Bay. The reef's location gives it unusually high wave exposure for sites within Laolao Bay. South Laolao is ranked 7/35 with a resilience score of 0.76 (anchored to 0.90) and is considered a high resilience site. Five of the nine variables: coral diversity, bleaching resistance, temperature variability, nutrient input, and fishing access received high scores (Table 1). Coral recruitment and macroalgae received medium scores with just herbivore biomass scoring low in the resilience assessment. Coral diversity is very high with a Simpson's Index of Diversity value of 0.95 (anchored score of 0.99), but coral cover is low (<15%, Fig. 1). Algae is the major component of the benthic environment at this site, covering 45.6% of the substrate (Fig. 1). Pavement (bare substrate), CCA, and sand were also observed at the site. One of the coral species originally petitioned in 2009 for endangered species status was observed during these surveys. The species observed was proposed in November 2012 as 'not warranted' (Table 2). Corals are mostly very small (<8 cm in diameter). A few larger corals with diameters 16-32 cm were also observed (Fig. 2). Herbivore biomass is low relative to the other sites at 0 .47 kg/100m^2 (28/35, Fig. 3) and the observed herbivore fish community was comprised of mostly grazers (Fig. 4). The Acanthurids observed at this site were 15 cm in length or smaller. Scarids were not observed at the site during these surveys (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.95	0.99
Recruitment	10.46	0.73
Bleaching Resistance	73.95	0.84
Temperature variability	0.95	0.96
Herbivore biomass	0.47	0.14
Macroalgae cover*	24.61	0.66
Nutrient input*	3.22	0.88
Sedimentation*	1.80	0.66
Fishing pressure	1671	0.94
Resilience score		0.76
Final anchored resilience score (**7**/35)		0.90

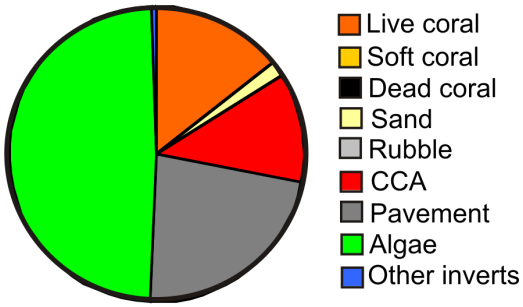


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (1/24)
Cyphastrea ocellina[NW]

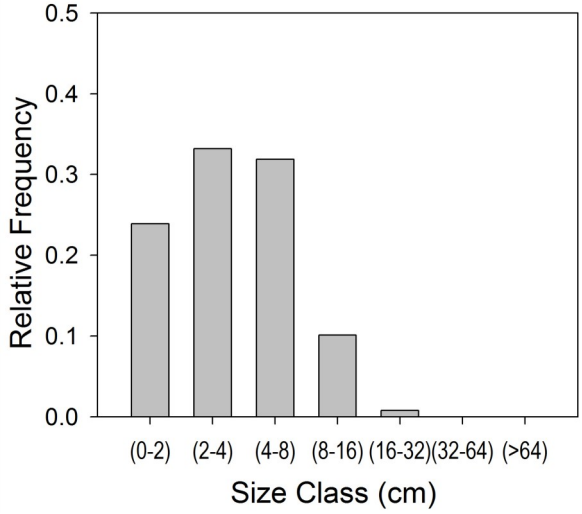


Figure 2. Size-class frequency distribution for stony corals.

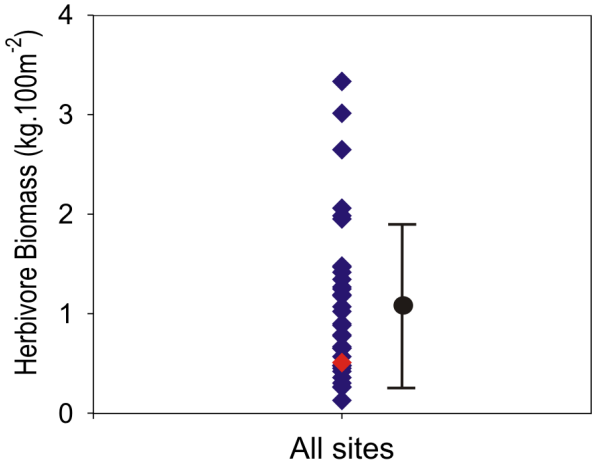


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

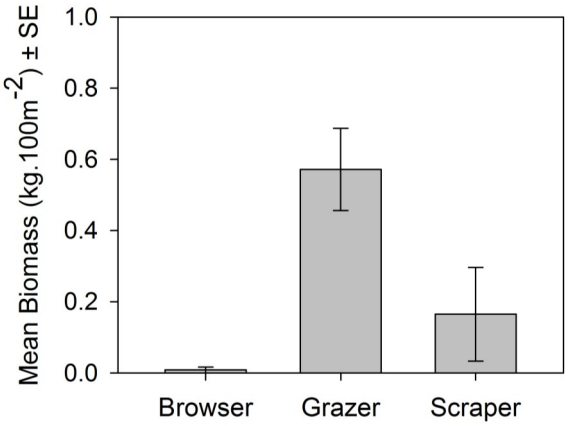


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

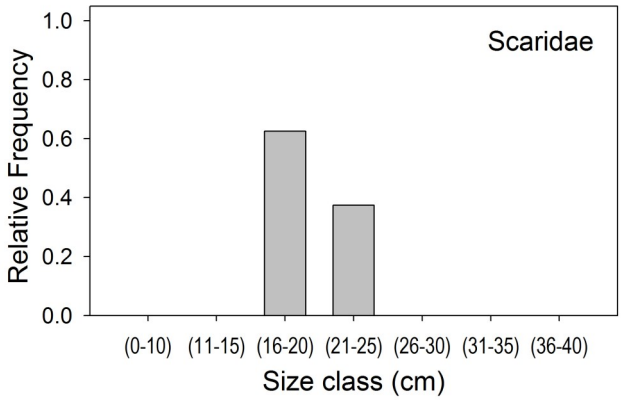


Figure 5. Size-class frequency distribution of Scaridae.

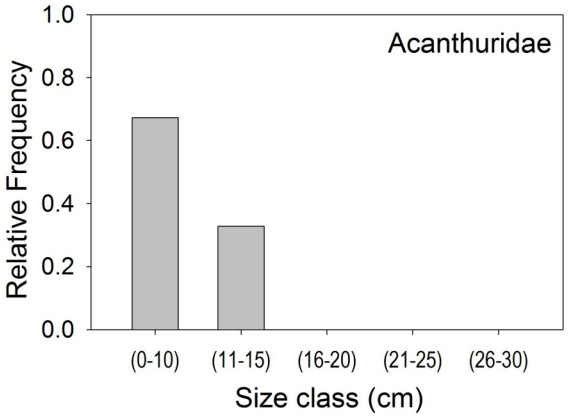
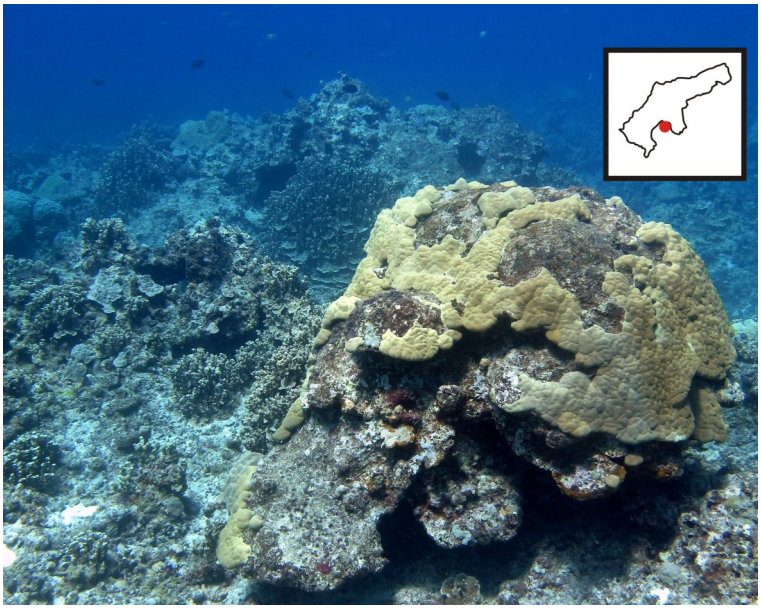


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 8/35: Laolao Bay East



Laolao Bay East is the easternmost site located in Laolao Bay. This site is one of the most popular fishing spots around Saipan. Laolao Bay East is ranked 8/35 with a resilience score of 0.75 (anchored to 0.89) and is classified as a high resilience site. Six of the nine variable included in the resilience analysis had high scores: coral diversity, coral recruitment, bleaching resistance, temperature variability, macroalgae cover, nutrient input (Table 1). Sedimentation was the only variable to receive a medium score, while herbivore biomass and fishing access received low scores. Coral assemblages at Laolao Bay East were highly diverse (0.93 for Simpson's Index of Diversity) and had one of the highest ('best') scores for bleaching susceptibility with less than 20% of the community susceptible to bleaching. Most of the substrate is made up of live coral (22.3%) and macroalgae (50.3%) (Fig. 1). Sand, rubble, CCA, pavement (bare substrate), and invertebrates are also present at the site in lesser amounts. Seven of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 7 species, 3 species were proposed in November 2012 as 'threatened' and 4 species were proposed as 'not warranted' (Table 2).Corals at this site are mostly very small (<8 cm in diameter), but a few larger corals were also observed (Fig. 2). Herbivore biomass is 1.25 kg/100m^2 (12/35, Fig. 3), and the observed herbivore fish community was mostly comprised of grazers (Fig. 4). The size-class frequencies for Scarids and Acanthurids differ: all Scarids were found to be <20 cm in length, and Acanthurids >11 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.93	0.96
Recruitment	14.31	1.00
Bleaching Resistance	81.79	0.92
Temperature variability	0.96	0.97
Herbivore biomass	1.25	0.37
Macroalgae cover*	1.00	0.99
Nutrient input*	3.67	0.87
Sedimentation*	1.92	0.64
Fishing pressure	20	0.01
Resilience score		0.75
Final anchored resilience score (**8**/35)		0.89

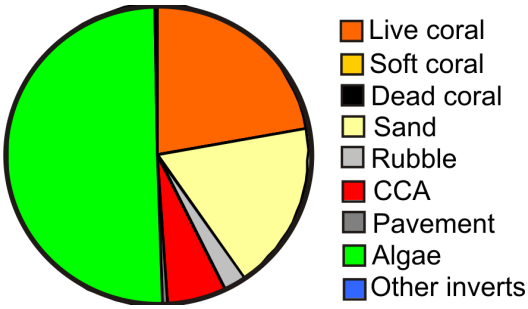


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (4/24)
Cyphastrea ocellina NW
Pavona bipartita NW
Pocillopora elegans T
Turbinaria reniformis NW

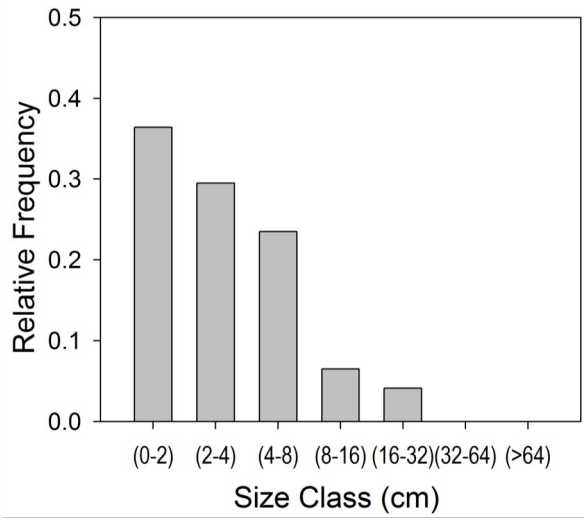


Figure 2. Size-class frequency distribution for stony corals.

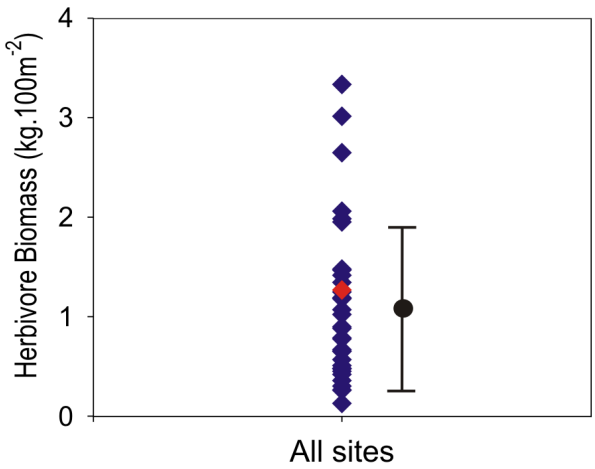


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

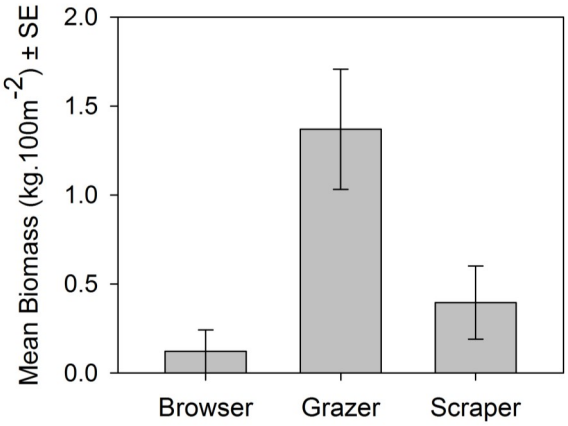


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

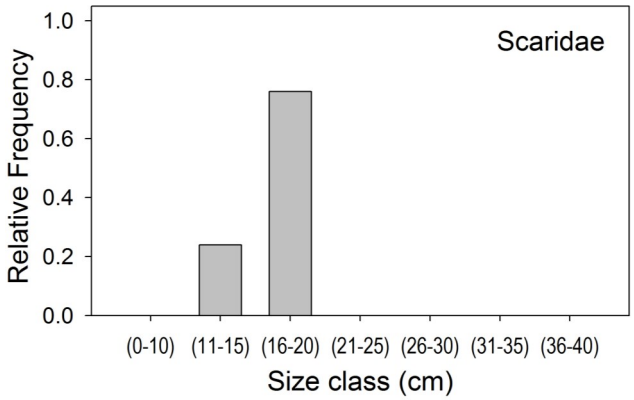


Figure 5. Size-class frequency distribution of Scaridae.

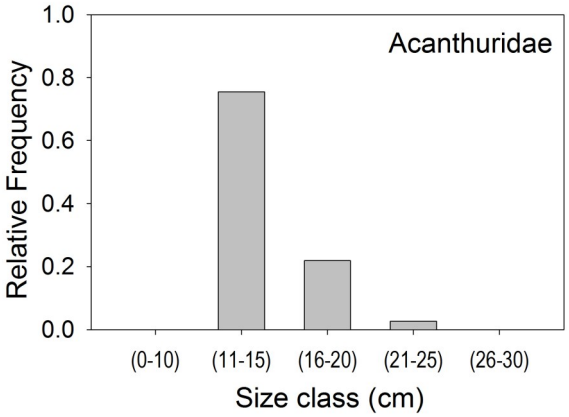
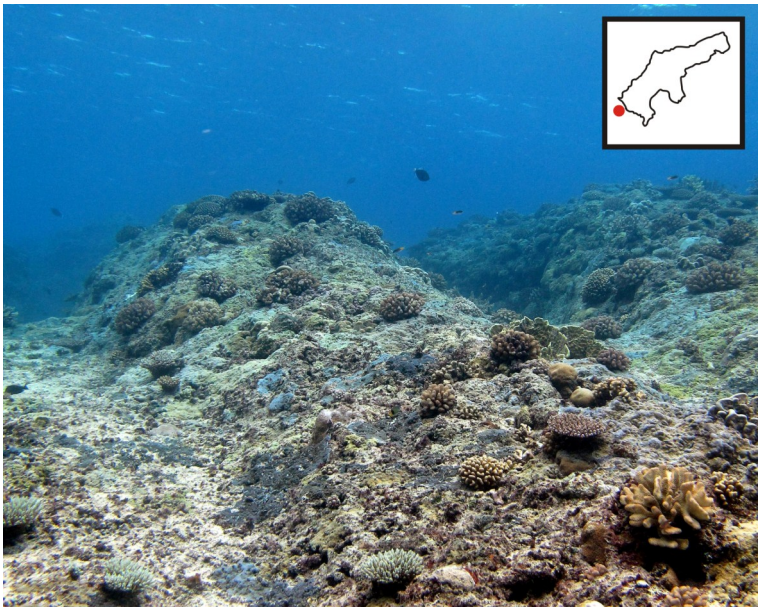


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 9/35: Agingan Point



Agingan Point is the southwestern most point on Saipan. An outfall pipe from a sewage treatment plant is located at the point, 90 feet deep and 90 feet away from the coast line. Despite proximity to the pipe, Agingan Point has the ninth highest resilience score (0.72, anchored to 0.86) and is classified as a high resilience site. Although the site received low scores for herbivore biomass and fishing access, the site scored high in five of the 9 variables used in the resilience analysis: coral diversity, coral recruitment, temperature variability, nutrient input, and macroalgae (Table 1). Bleaching resistance and sedimentation both received medium scores. The Simpson's Index of Diversity value for coral diversity is 0.91. Turfing algae covers much of the substrate at the site (46.7%), though coral cover is a close second with 35.3% (Fig. 1). Three of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. All 3 of these species were proposed in November 2012 as 'threatened' (Table 2). A few larger corals were found at this site, but most corals were very small (<8 cm in diameter) (Fig. 2). Herbivore biomass is low, 0.67 kg/100m^2 (anchored score of 0.20, 21/35, Fig. 3) and the majority of herbivorous fishes observed were grazers (Fig. 4). All Scarids and most Acanthurids were 11-15 cm in length, but some Acanthurids <11 cm were also observed (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.91	0.94
Recruitment	13.50	0.94
Bleaching Resistance	66.80	0.76
Temperature variability	0.97	0.98
Herbivore biomass	0.67	0.20
Macroalgae cover*	0.00	1.00
Nutrient input*	2.28	0.92
Sedimentation*	1.51	0.71
Fishing pressure	130	0.07
Resilience score		0.72
Final anchored resilience score (**9**/35)		0.86

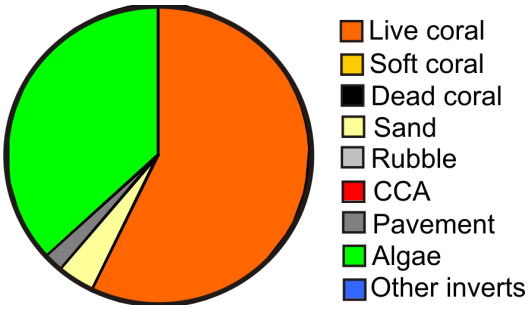


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (3/24)
Acropora verweyi[T]
Pocillopora danae[T]
Pocillopora elegans[T]

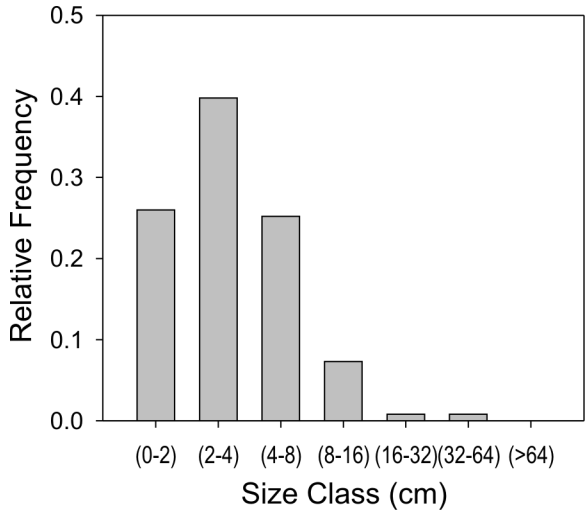


Figure 2. Size-class frequency distribution for stony corals.

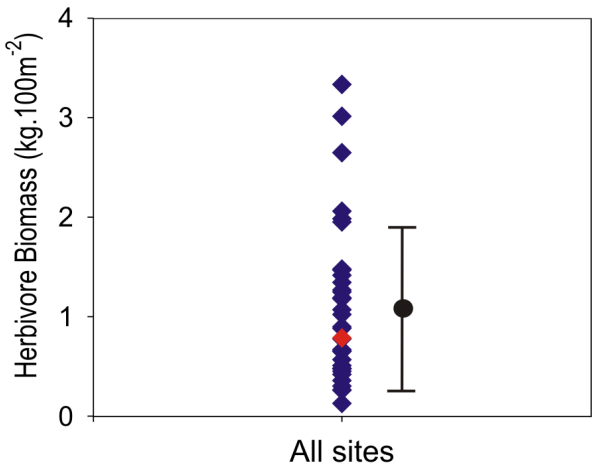


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

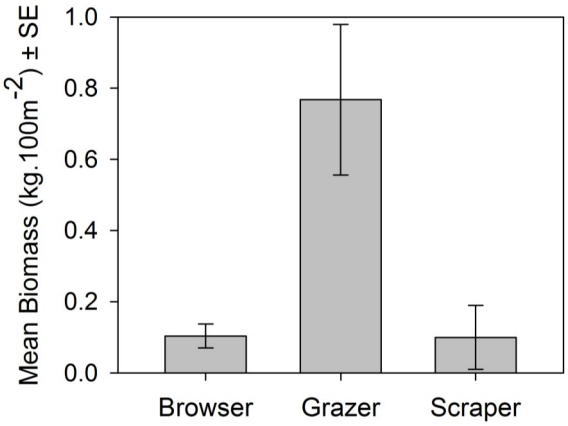


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

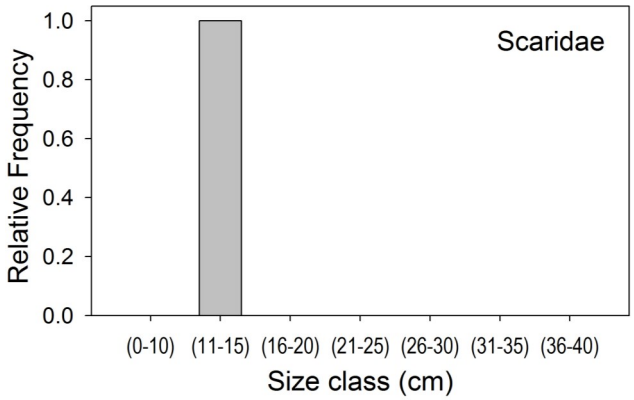


Figure 5. Size-class frequency distribution of Scaridae.

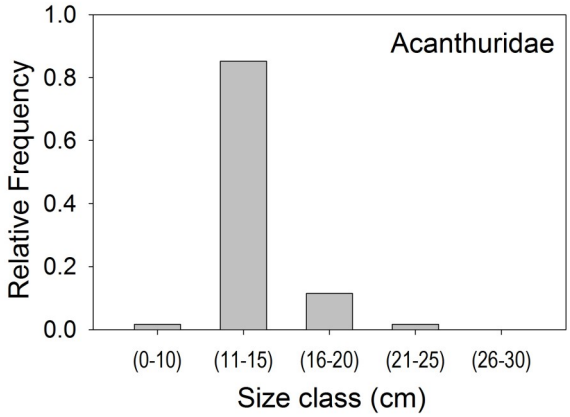
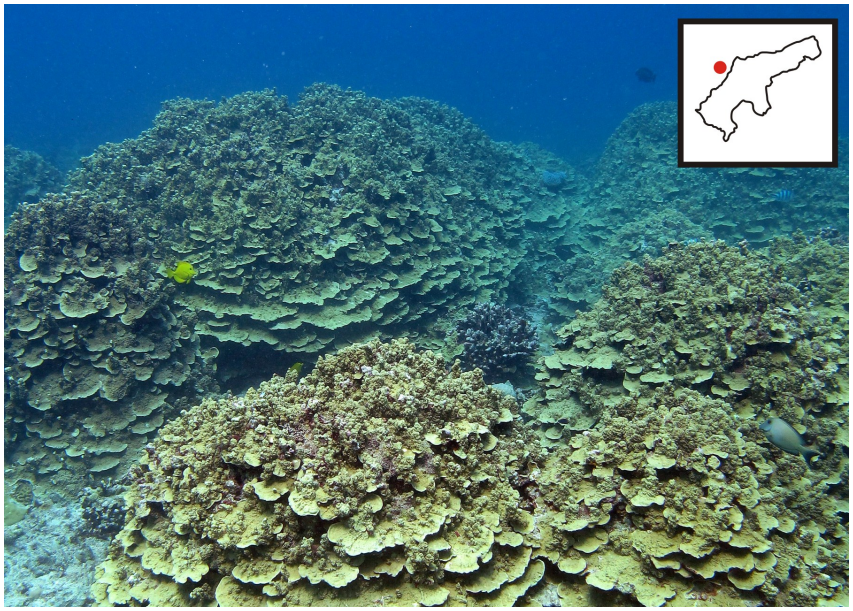


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 10/35: Oleai Rocks



Oleai Rocks is located on the western side of Saipan. Dive operators have been using this area as a back-up to more popular sites like Ice Cream or Dimple. Oleai Rocks is a high resilience site with a resilience score of 0.72 (anchored to 0.86). This site scored high for four of the 9 variables used in the resilience analysis: coral diversity, temperature variability, macroalgae cover, and nutrient input (Table 1). Coral recruitment, bleaching resistance, and sedimentation received medium scores while herbivore biomass and fishing access received low scores. Coral species diversity was high with a Simpsons Index of Diversity value of 0.92. The majority of the substrate at this site at the time of surveys is pavement (bare substrate) (42%), and coral cover (30.3%) (Fig. 1). One of the coral species originally petitioned in 2009 for endangered species status was observed during these surveys. This species was proposed in November 2012 as 'threatened' (Table 2). Corals observed ranged in diameter from <1 cm to 64 cm, but most were recruits (<4 cm in diameter) (Fig. 2). Herbivore biomass is 1.47 kg/100m^2 (anchored score of 0.44, 8/35, Fig. 3) and most herbivorous fish at the site are scrapers (Fig. 4). More than half of the Scarids and Acanthurids observed were 11-20 cm in length, but some larger and smaller Scarids were observed (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.92	0.96
Recruitment	10.69	0.75
Bleaching Resistance	58.52	0.66
Temperature variability	0.94	0.95
Herbivore biomass	1.47	0.44
Macroalgae cover*	0.00	1.00
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	100	0.06
Resilience score		0.72
Final anchored resilience score (**10**/35)		0.86

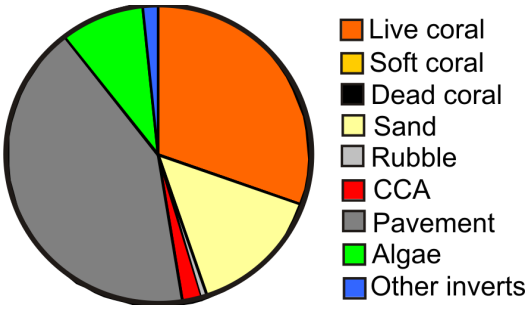


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (1/24)
Montipora caliculata[T]

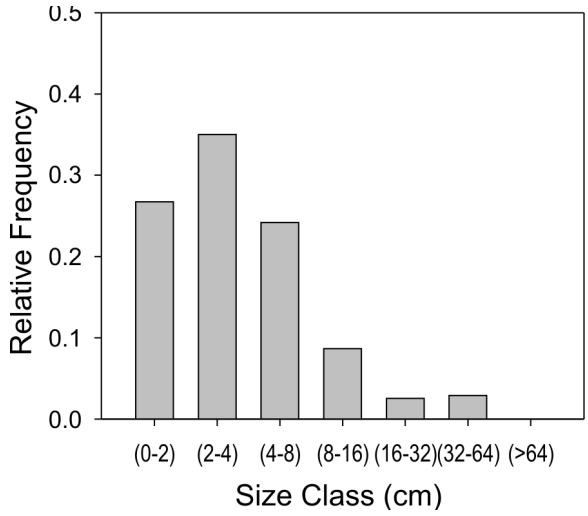


Figure 2. Size-class frequency distribution for stony corals.

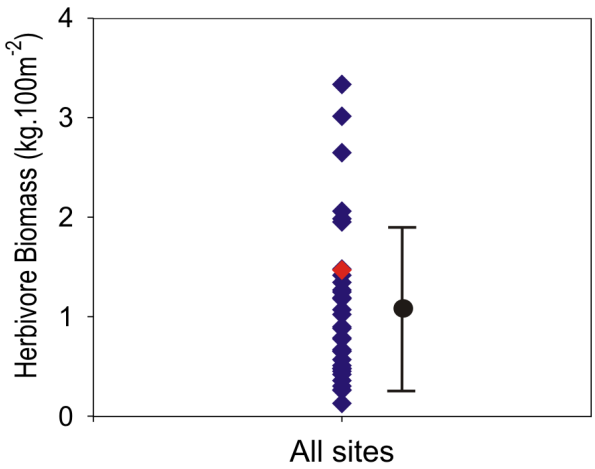


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

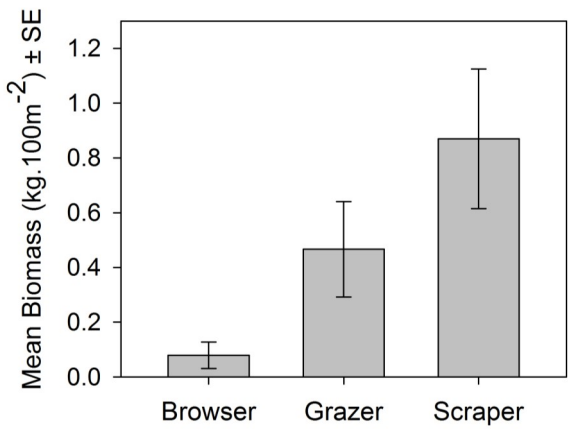


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

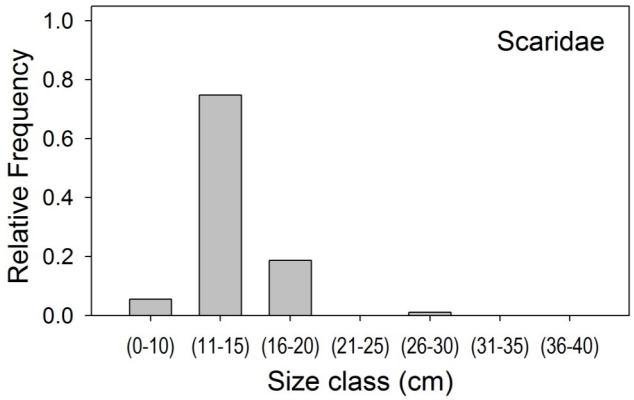


Figure 5. Size-class frequency distribution of Scaridae.

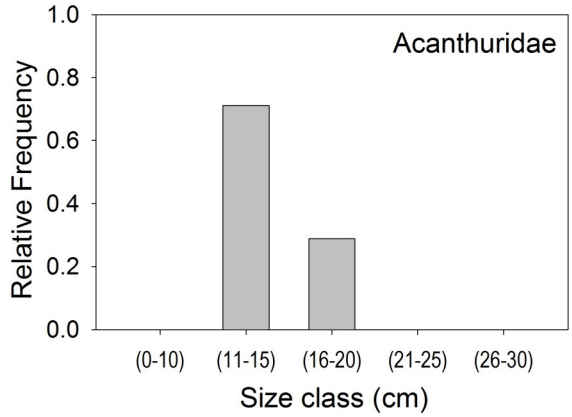
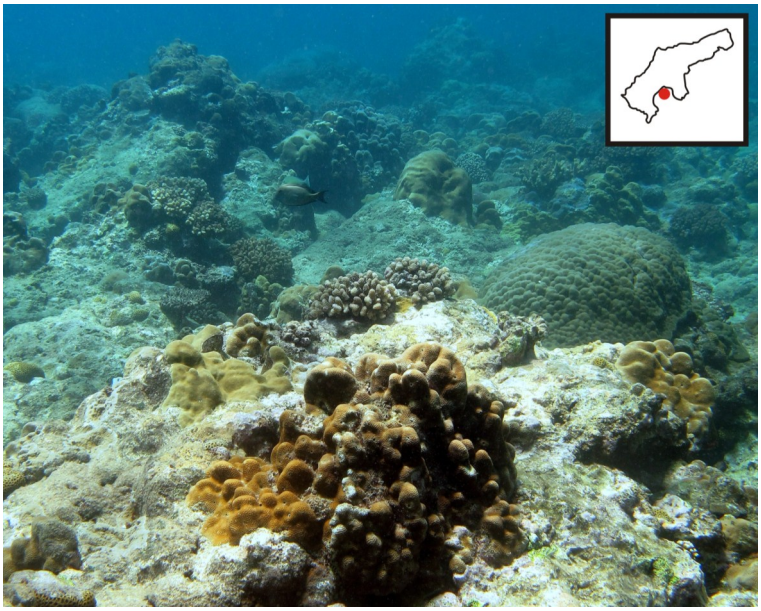


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 11/35: Laolao Bay Mids



Laolao Bay Mids is located within central Laolao Bay. This site lies within the Laolao Bay Sea Cucumber Sanctuary, which was established to address overharvesting issues. Laolao Bay Mids is ranked 11/35 with a resilience score of 0.72 (anchored to 0.85) and is classified as a high resilience site. Four of the nine variables included in the resilience analysis received high scores: coral diversity, temperature variability, macroalgae cover, and nutrient input (Table 1). Bleaching resistance, herbivore biomass, and sedimentation received medium scores, with just two variables (coral recruitment and fishing access) receiving low scores. More than a third of the coral community at Laolao Bay Mids is susceptible to bleaching, though as with most other surveyed sites coral diversity is high (0.91, Simpson's Index of Diversity). Algae covers 73% of the substrate at this site and live coral only 14.5% (Fig. 1). The rest of the substrate is covered by sand, rubble, CCA, and other invertebrates. Six of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 6 species, 3 species were proposed in November 2012 as 'threatened' and 3 species were proposed as 'not warranted' (Table 2). The majority of corals observed here were very small (<8 cm or less in diameter (Fig. 2). Laolao Bay Mids has the fifth highest concentration of herbivore biomass of all the sites observed: 1.98 kg/100m^2 (Fig. 3). Most herbivorous fish observed were browsers (Fig. 4). The majority of Scarids and Acanthurids observed were between 16 cm and 20 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.91	0.95
Recruitment	8.44	0.59
Bleaching Resistance	63.76	0.72
Temperature variability	0.96	0.97
Herbivore biomass	1.98	0.60
Macroalgae cover*	0.50	0.99
Nutrient input*	2.83	0.90
Sedimentation*	1.68	0.68
Fishing pressure	85	0.05
Resilience score		0.72
Final anchored resilience score (**11**/35)		0.85

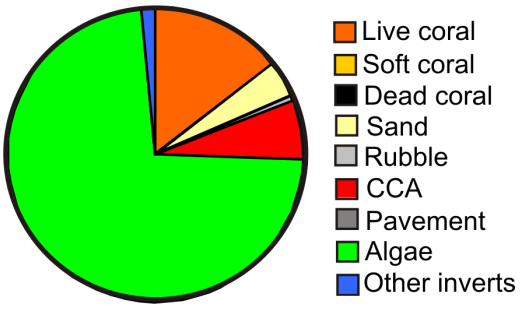


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (2/24)
Acanthastrea brevis[T]
Pocillopora danae[T]

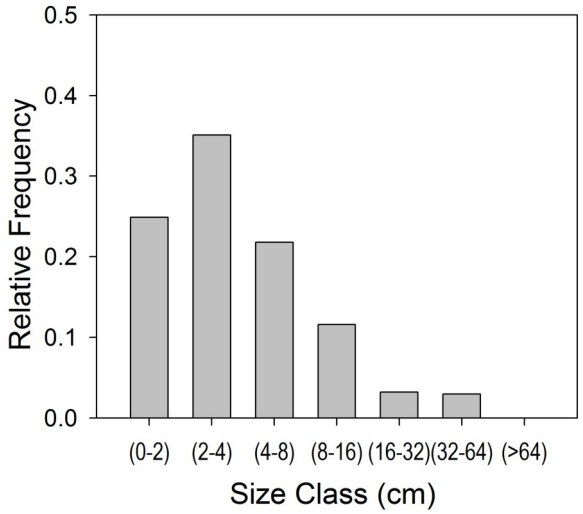


Figure 2. Size-class frequency distribution for stony corals.

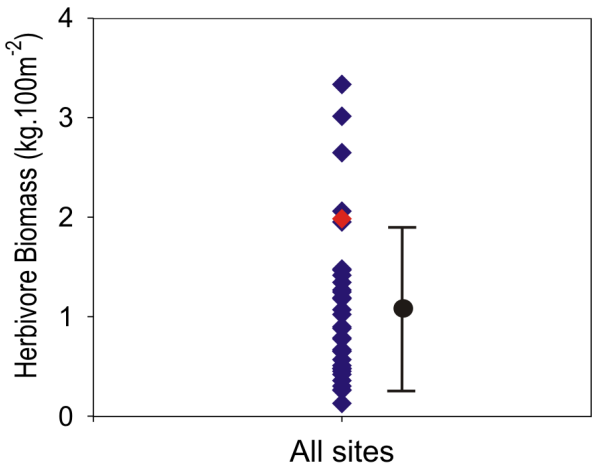


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

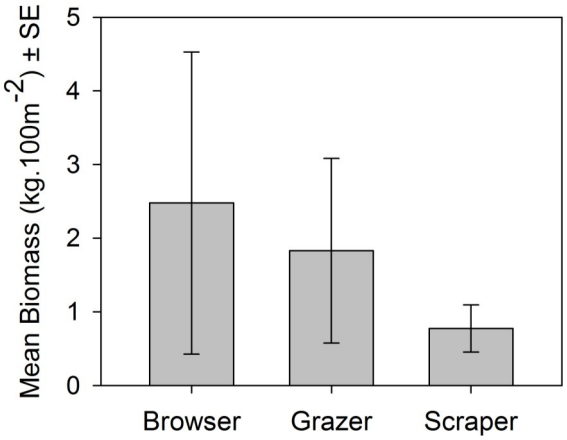


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

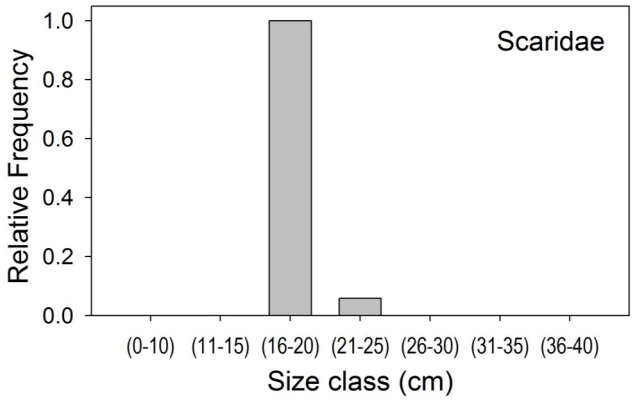


Figure 5. Size-class frequency distribution of Scaridae.

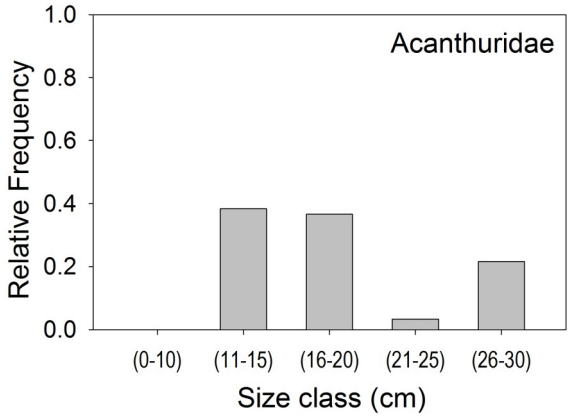
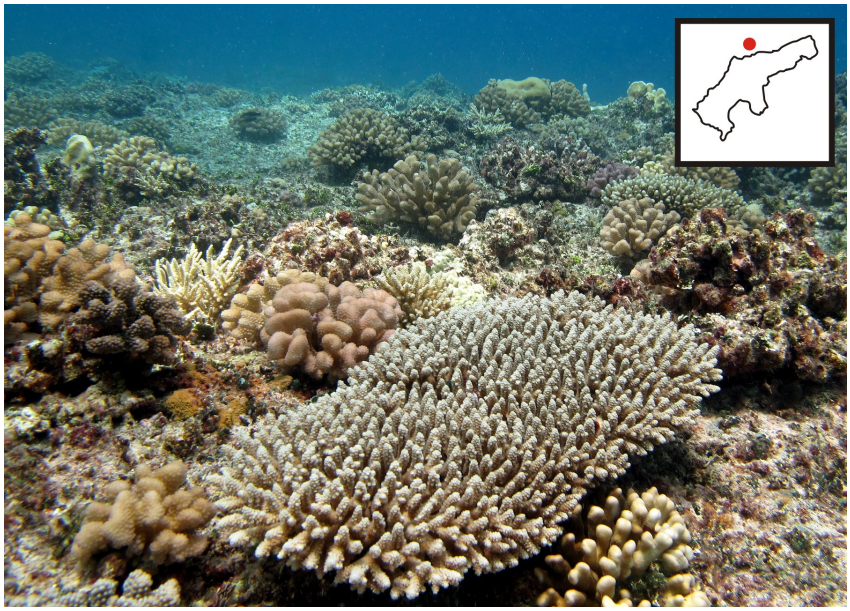


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 12/35: North Dakota



Dakota reef is located in the southern half of LaoLao Bay. North Dakota reef is located near the abandoned estate of Larry Hilbloom, the estranged millionaire who went missing in the 1980s. North Dakota is the twelfth ranked site and is considered a high resilience site with a resilience score of 0.71 (anchored to 0.86). This site received high scores for four of the 9 variables included in the resilience analysis; coral diversity, temperature variability, macroalgae cover, and nutrient input (Table 1). Coral recruitment, bleaching resistance, and sedimentation received medium scores, while just two variables, fishing access and herbivore biomass received low scores. About a third of the coral community at North Dakota is susceptible to bleaching. Coral diversity was high with a Simpson's Index of Diversity of 0 .94. The substrate is made up of roughly a third pavement (bare substrate), a third live coral, and a third made up of algae, sand and some CCA (Fig. 1). All of the algae present was turf algae with no recorded macroalgae. Four of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 4 species, 3 species were proposed in November 2012 as 'threatened' and 1 species was proposed as 'not warranted' (Table 2). Coral size at this site ranged from <1-32 cm with most corals recruit-size (<4 cm) (Fig. 2). Herbivore biomass concentration is 0.65 kg/100m^2 (22/35, Fig. 3), and most of the herbivorous fish observed are grazers or scrapers with only a few browsers observed (Fig. 4). Some large (36-40 cm) Scarids were observed (Fig. 5). More than 75% of the Acanthurids observed were <10 cm in length (Fig. 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.94	0.98
Recruitment	10.31	0.72
Bleaching Resistance	64.53	0.73
Temperature variability	0.96	0.97
Herbivore biomass	0.65	0.20
Macroalgae cover*	0.00	1.00
Nutrient input*	3.97	0.86
Sedimentation*	1.99	0.62
Fishing pressure	616	0.35
Resilience score		0.71
Final anchored resilience score (**12**/35)		0.85

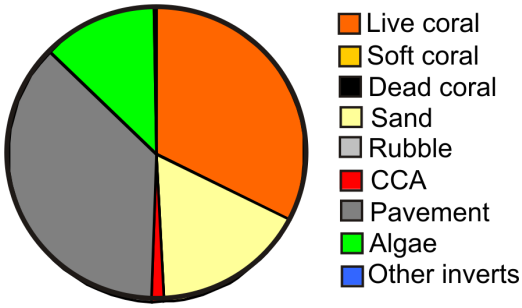


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (4/24)
Acropora vaughani[T]
Cyphastrea ocellina[NW]
Millepora tuberosa[T]
Montipora caliculata[T]

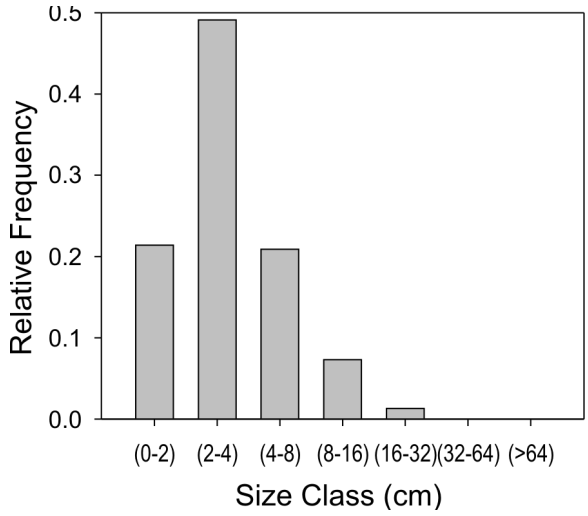


Figure 2. Size-class frequency distribution for stony corals.

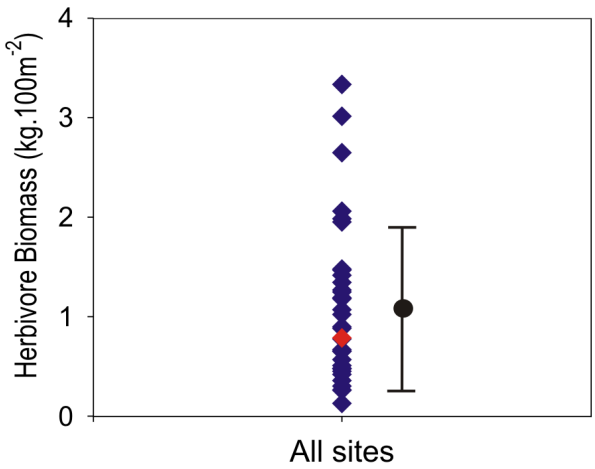


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

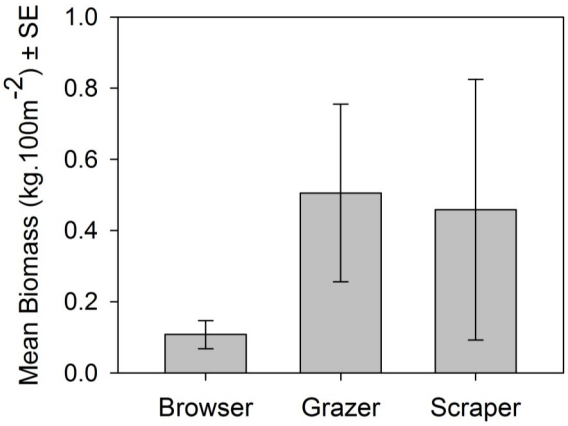


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

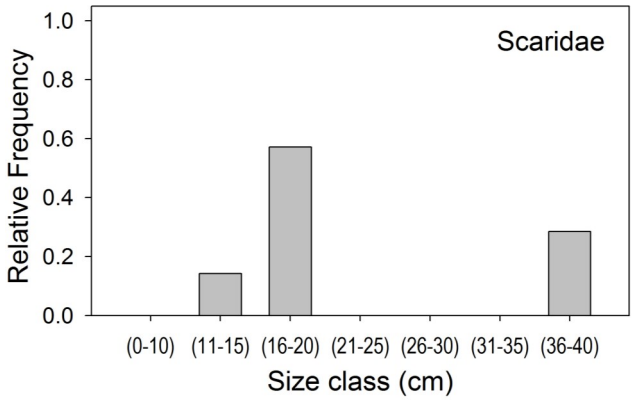


Figure 5. Size-class frequency distribution of Scaridae.

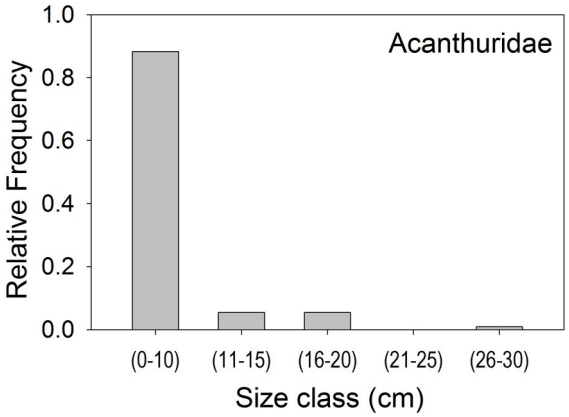
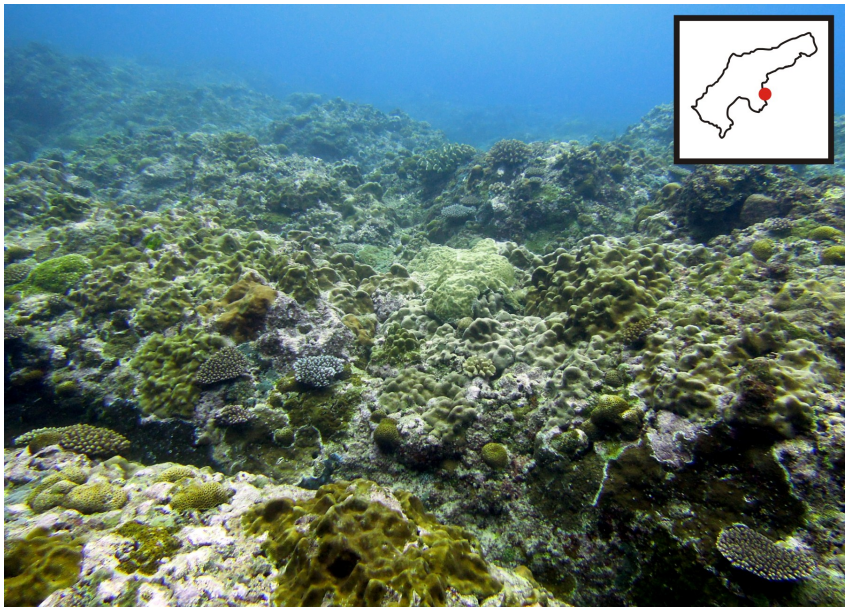


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 13/35: Old Man By the Sea



One of the secluded pocket beaches on Saipan's eastern coast, Old Man by the Sea is a popular site amongst both locals and visitors. A rock formation resembles the profile of a man when viewed at the proper angle. Ranked thirteenth, Old Man By the Sea has a resilience score of 0.71 (anchored to 0.84) and is classified as a high resilience site. Despite the high resilience of the site, just three variables received high scores: coral diversity, temperature variability and macroalgae cover (Table 1). Bleaching resistance, nutrient input, and fishing access received medium scores while coral recruitment, herbivore biomass, and sedimentation all scored low. Coral diversity is above average (0.85) with a Simpson's Index of Diversity of 0.94. Almost 50% (48.7%) of the substrate is covered by live coral (Fig. 1). Algae, pavement, rubble, sand, and invertebrates were also observed. Six of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 6 species, 5 species were proposed in November 2012 as 'threatened' and 1 species was proposed as 'not warranted' (Table 2). The size class frequency of coral diameter ranges from >1 cm to 64 cm, but most corals observed are small (<16 cm) (Fig. 2). Herbivore biomass is 1.27 kg/100m^2 (11/35, Fig. 3) and the herbivorous fish community is mostly comprised of grazers (Fig. 4). More than half of both Scarids and Acanthurids observed range from 11-20 cm in length (Figs. 5 & 6). Both fish families also had a few fish <10 cm in length and some Acanthurids larger than 20 cm were observed (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.94	0.97
Recruitment	4.75	0.33
Bleaching Resistance	69.79	0.79
Temperature variability	0.94	0.95
Herbivore biomass	1.27	0.38
Macroalgae cover*	6.00	0.92
Nutrient input*	7.16	0.74
Sedimentation*	2.68	0.49
Fishing pressure	1397	0.79
Resilience score		0.71
Final anchored resilience score (**13**/35)		0.84

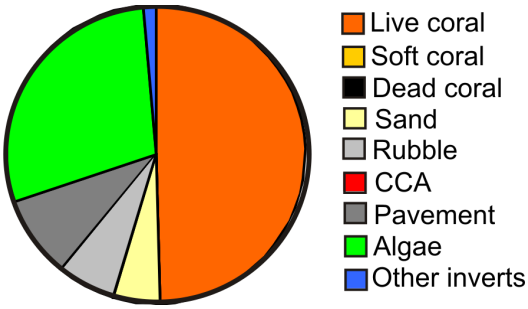


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (6/24)
Acropora vaughani[T]
Acropora verweyi[T]
Heliopora coerulea[NW]
Millepora tuberosa[T]
Pocillopora danae[T]
Pocillopora elegans[T]

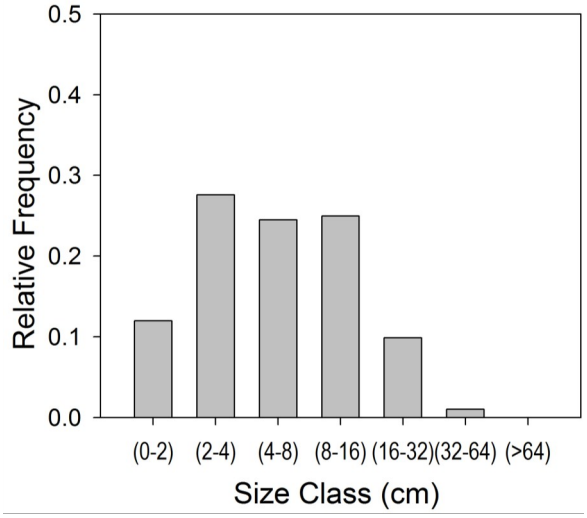


Figure 2. Size-class frequency distribution for stony corals.

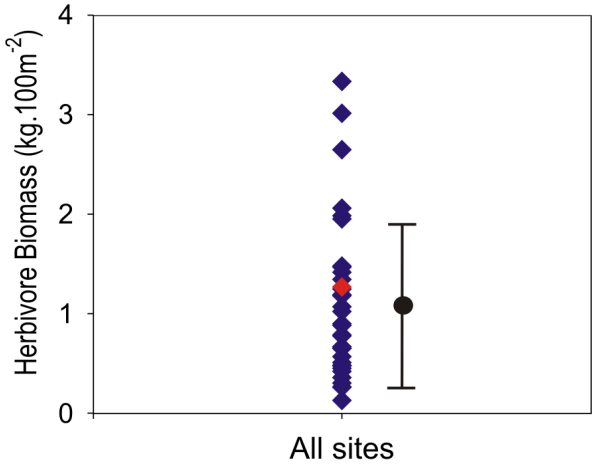


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

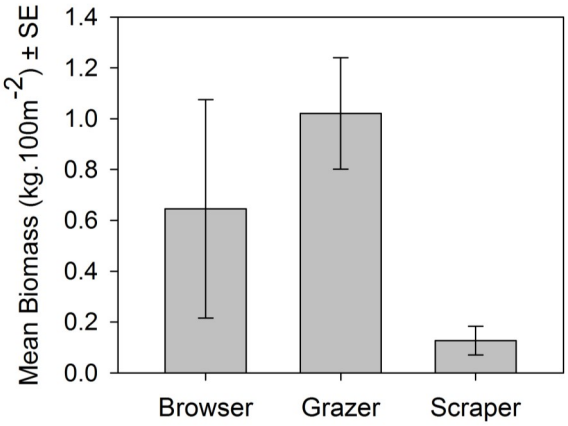


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

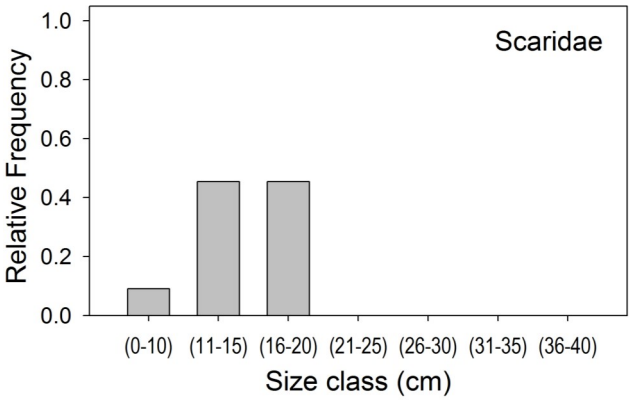


Figure 5. Size-class frequency distribution of Scaridae.

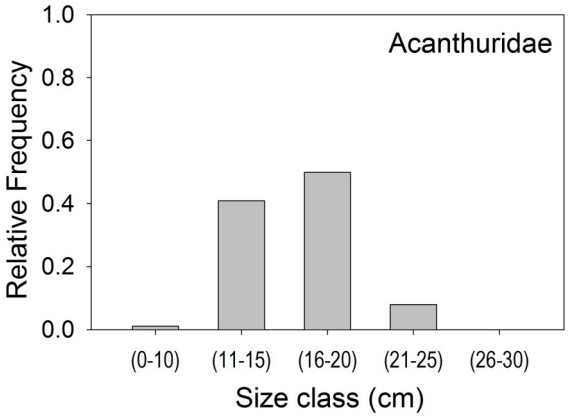
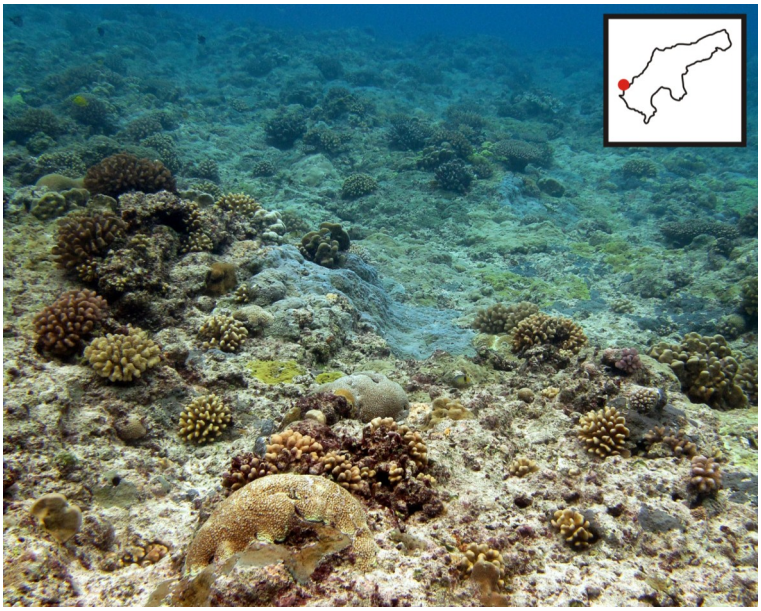


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 14/35: Point Break Reef



Point Break Reef is one of the southeastern reefs of Saipan. The reef here is adjacent to Saipan's most consistently breaking 'wave' – the Point Break flowrider mechanical wave at the Pacific Islands Resort. Ranked 14/35, Point Break Reef has a resilience score of 0.71 (anchored to 0.84) and is classified as a high resilience site. Coral diversity, temperature variability, macroalgae cover, and nutrient input, all received high scores, while coral recruitment, bleaching resistance, and sedimentation received medium scores (Table 1). Fishing access and herbivore biomass both received low scores. Coral assemblages at Point Break Reef are diverse and have a Simpson's Index of Diversity of 0.92, though 38.02% of the coral community was found to be susceptible to bleaching. The substrate at Point Break Reef consists of turf algae (41.3%) and live coral (24%) with sand, rubble, CCA, and pavement making up the remaining area (Fig. 1). Two of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Both of these coral species were proposed in November 2012 as 'threatened' (Table 2). Almost all corals observed were very small (<8 cm) (Fig. 2). The overall herbivore biomass concentration of the site is 0.90 kg/100m^2 (17/35) (Fig. 3). More than half of the herbivorous fish observed were grazers (Fig. 4). All Scarids and more than half of the Acanthurids observed ranged from 11-15 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.92	0.95
Recruitment	10.92	0.76
Bleaching Resistance	61.98	0.70
Temperature variability	0.95	0.96
Herbivore biomass	0.90	0.27
Macroalgae cover*	0.00	1.00
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	119	0.07
Resilience score		0.75
Final anchored resilience score (**14**/35)		0.84

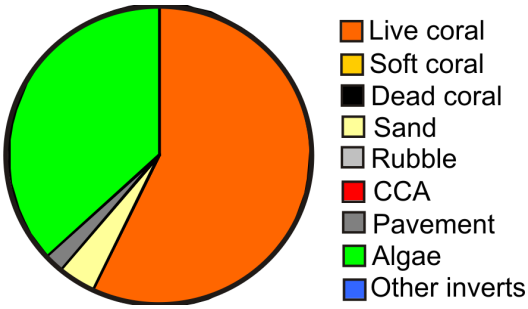


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (8/24)
Acropora verweyi [T]
Cyphastrea ocellina [NW]
Leptoseris incrustans [NW]
Montipora caliculata [T]
Pocillopora danae [T]
Pocillopora elegans [T]
Turbinaria reniformis [NW]
Turbinaria stellulata [NW]

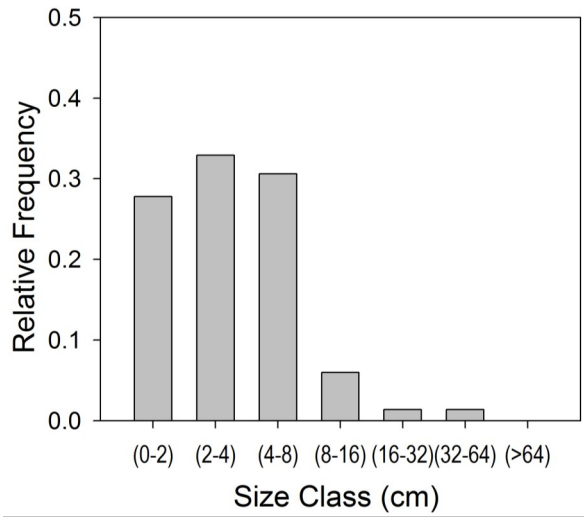


Figure 2. Size-class frequency distribution for stony corals.

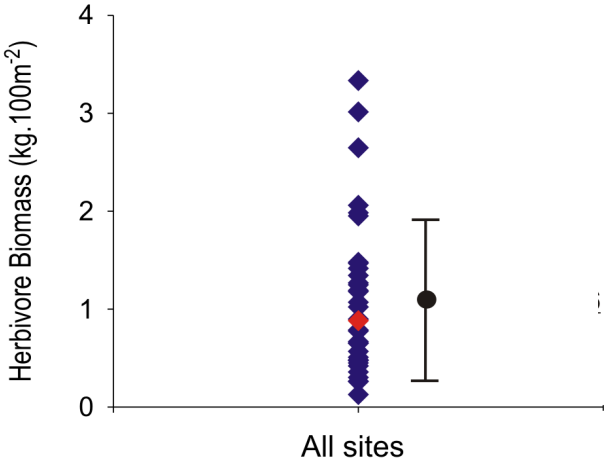


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

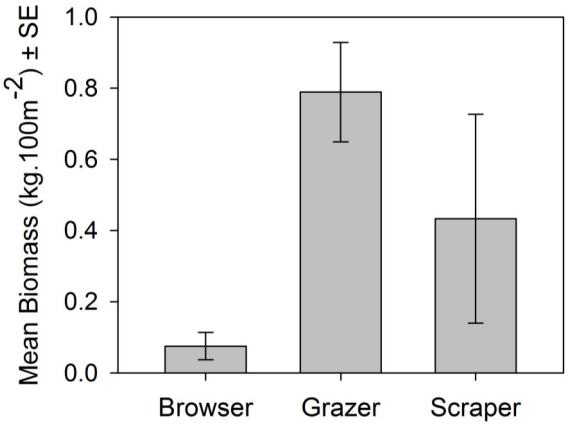


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

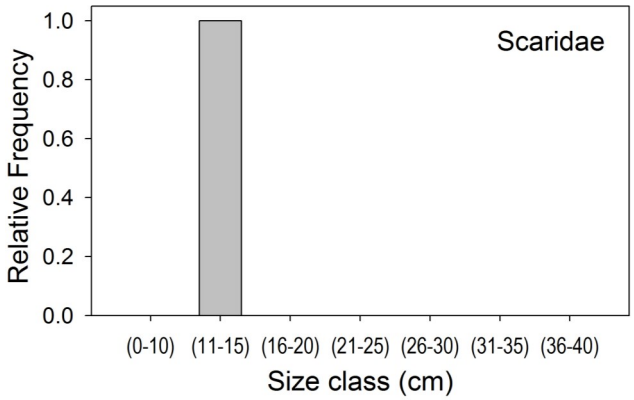


Figure 5. Size-class frequency distribution of Scaridae.

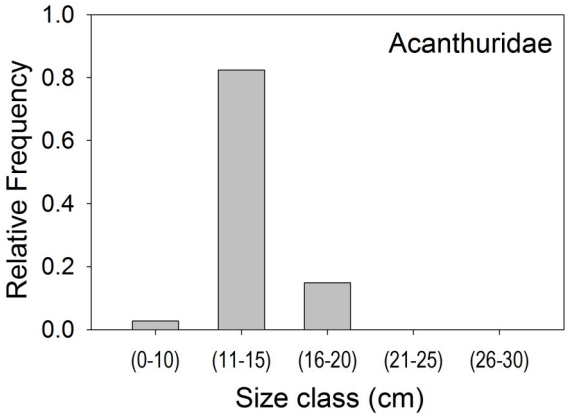
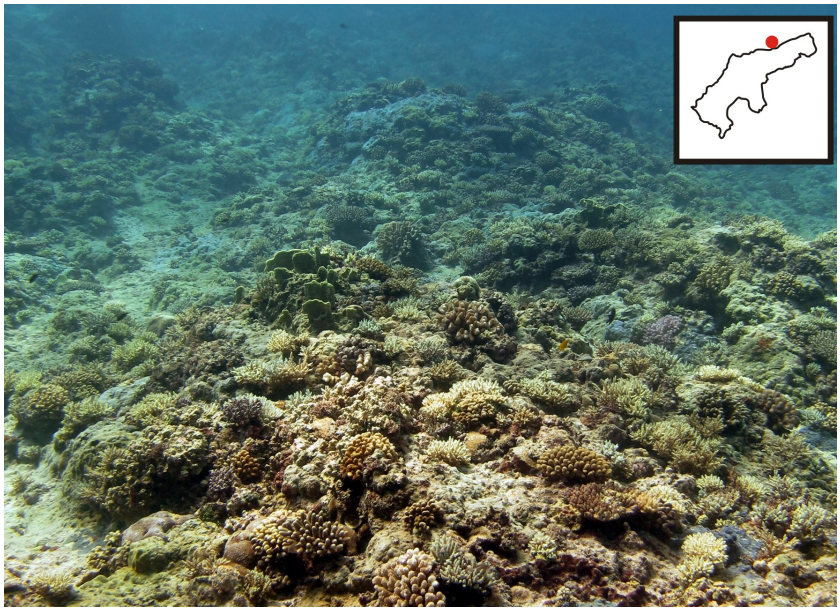


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 15/35: Pau Pau



Pau Pau is located on the north-eastern portion of Saipan's barrier reef. The lagoon area within the site is a common site to see black-tip shark pups. Pau Pau has a resilience score of 0.71 (anchored to 0.84) and is considered a high resilience site. Coral diversity, temperature variability, macroalgae cover, and nutrient input all received high scores, while coral recruitment, bleaching resistance, and sedimentation received medium scores (Table 1). The only two variables to receive low scores were herbivore biomass and fishing access. Coral diversity was relatively high with a Simpson's Index of Diversity of 0.94, above the survey average (0.85). The substrate at this site is mostly pavement (bare substrate) (76.7%) with 20% live coral and 1% or less of sand, algae, and invertebrates (Fig. 1). Three of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. All 3 of these were proposed in November 2012 as 'threatened' (Table 2). The majority of corals observed were very small (<8 cm) (Fig. 2). Herbivore biomass was 1.07 kg/100m^2 (15/35, Fig. 3) and most of the herbivorous fish community observed were grazers (Fig. 4). Most Scarids and Acthurids observed were 11-15 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.94	0.97
Recruitment	11.06	0.77
Bleaching Resistance	54.07	0.61
Temperature variability	0.96	0.97
Herbivore biomass	1.07	0.32
Macroalgae cover*	0.00	1.00
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	107	0.06
Resilience score		0.71
Final anchored resilience score (**15**/35)		0.84

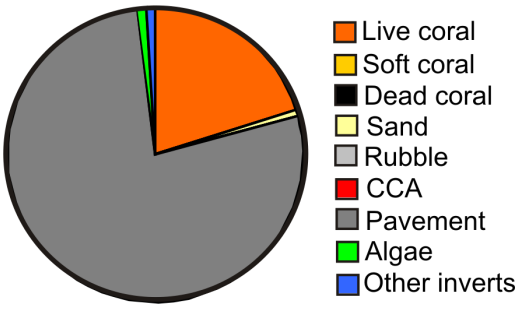


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (3/24)
Acropora verweyi[T]
Millepora tuberosa[T]
Pocillopora danae[T]

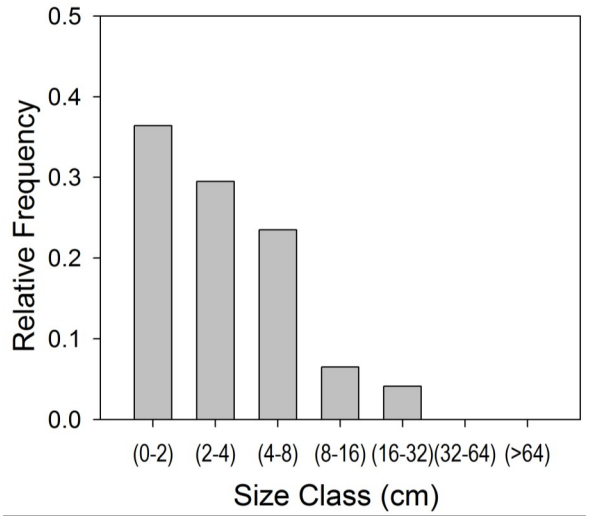


Figure 2. Size-class frequency distribution for stony corals.

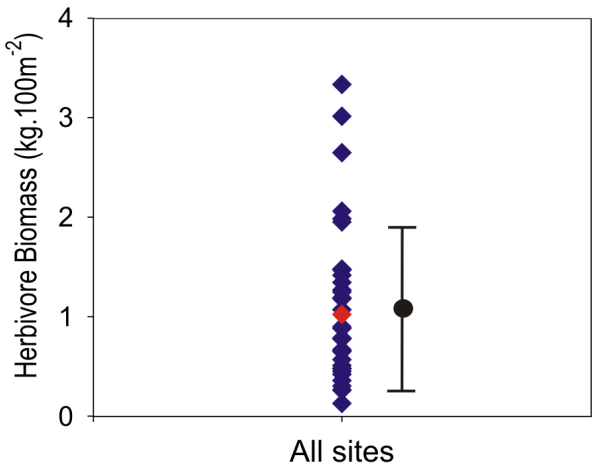


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

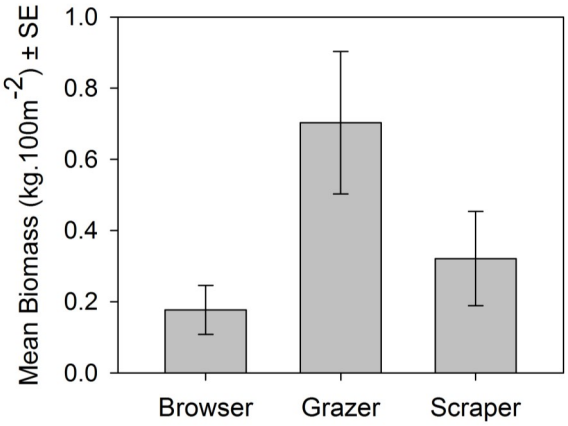


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

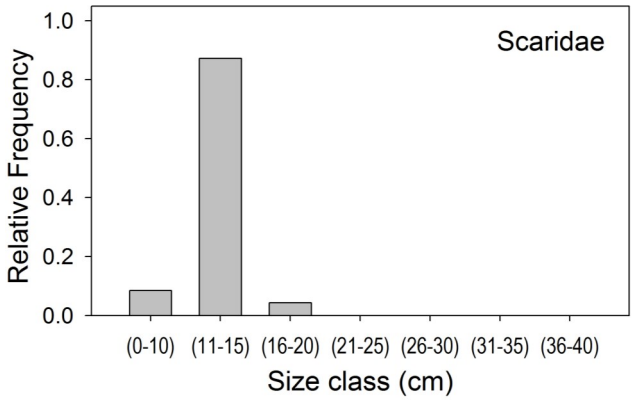


Figure 5. Size-class frequency distribution of Scaridae.

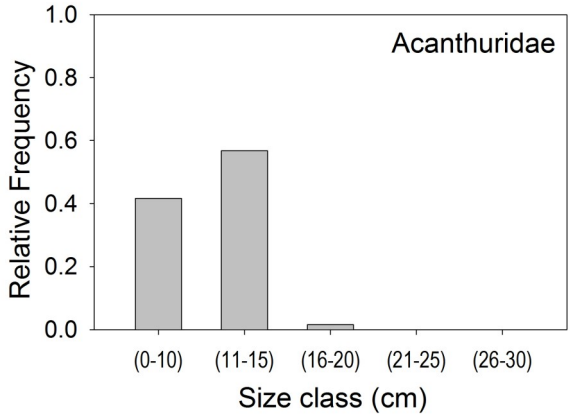
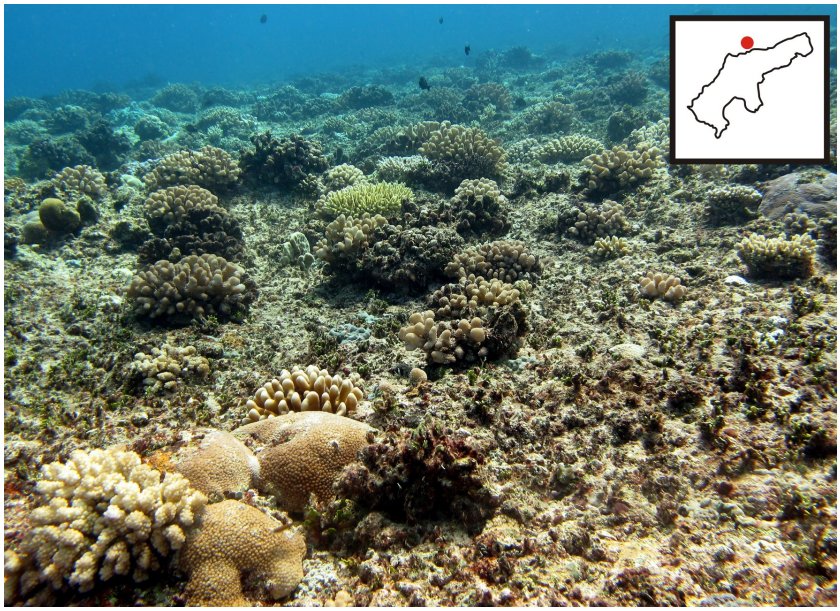


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 16/35: Achu Dangkulu



Achu Dangkulu is located on the northwestern portion of Saipan's barrier reef. The dominant feature – a rock formation exposed at low tide – is a traditional fishing spot for the community of Tanapag village. Achu Dangkulu has a resilience score of 0.70 (anchored to 0.84) and this 16th ranked site is considered a high resilience site. High coral diversity and temperature variability contributed to the overall high resilience score (Table 1). Coral recruitment, bleaching resistance, and sedimentation received medium scores, while fishing access and herbivore biomass received low scores. Achu Dangkulu has high coral diversity surveyed with a Simpson's Index of Diversity of 0.94. The substrate is comprised of almost equal parts live coral (26%), sand (27.3%), and algae (27%); CCA and pavement account for the remaining area (Fig. 1) Four of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. All 4 of these species were proposed in November 2012 as 'threatened' (Table 2). The majority of corals observed at the site are very small (<8 cm) in diameter (Fig. 2). Herbivore biomass at the site is amongst the lowest of all the surveyed sites at 0.30 kg/100m^2 (32/35, Fig. 3). Most of the herbivorous fish observed were scrapers (Fig. 4). Scarids were not observed during the surveys. Almost all of the Acanthurids observed were <15 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.94	0.98
Recruitment	8.94	0.62
Bleaching Resistance	67.74	0.77
Temperature variability	0.96	0.97
Herbivore biomass	0.30	0.09
Macroalgae cover*	0.00	1.00
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	443	0.25
Resilience score		0.70
Final anchored resilience score (**16**/35)		0.84

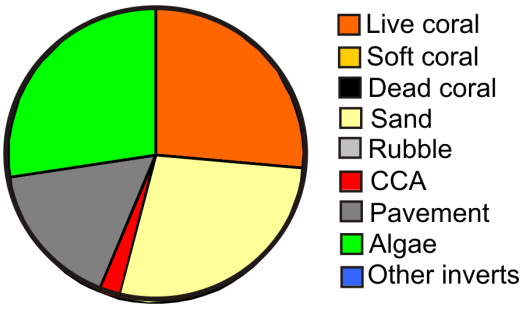


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (4/24)
Acropora vaughani[T]
Acropora verweyi[T]
Montipora caliculata[T]
Pocillopora danae[T]

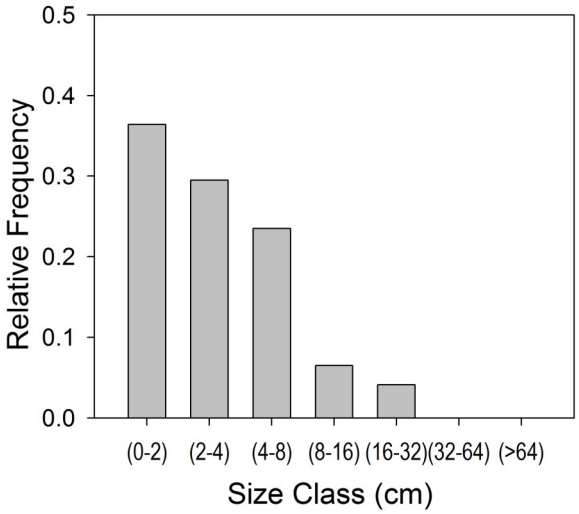


Figure 2. Size-class frequency distribution for stony corals.

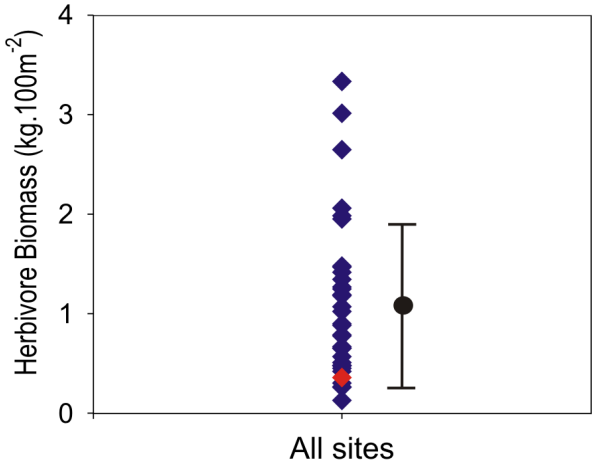


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

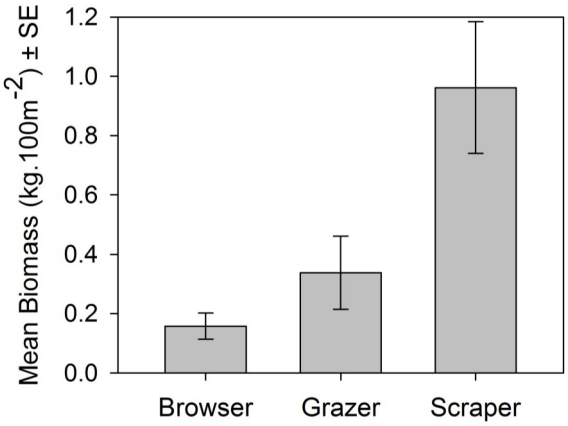


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

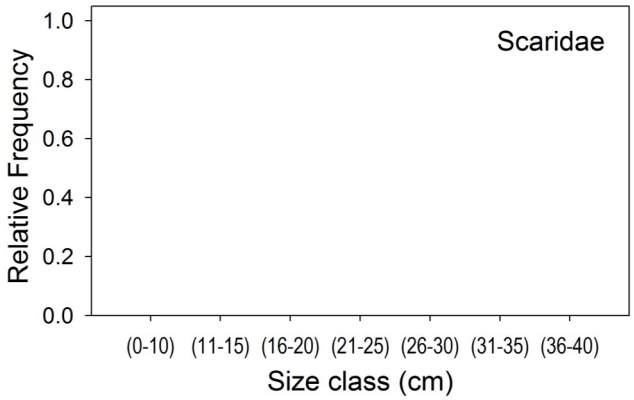


Figure 5. Size-class frequency distribution of Scaridae.

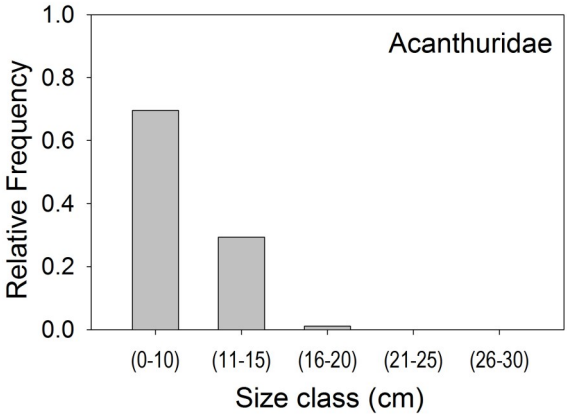
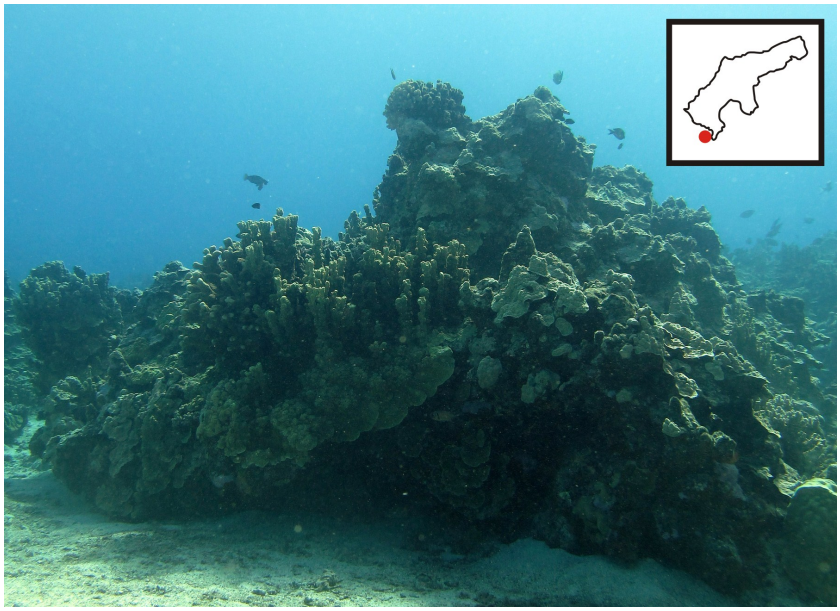


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 17/35: Boy Scout



Boy Scout is located on the southern coast of Saipan. This site is a Marine Monitoring Team survey site. Boy Scout is a popular dive site and is named for the annual trip that the local Boy Scout troops take to visit the beach. This high resilience site is ranked 17/35 and has a resilience score of 0.70 (anchored to 0.83). Five variables received high scores: coral diversity, bleaching resistance, temperature variability, macroalgae cover, and nutrient input (Table 1). Coral recruitment and sedimentation had medium scores and herbivore biomass and fishing access received low scores. Coral diversity is above average (0.85) with a Simpson's Index of Diversity value of 0.94. The substrate is made up of live coral (25%), sand (20.5%), CCA (23.2%), and rubble (14.8%) (Fig. 1). Turf algae (1.3%) and invertebrates (1.5%) were also observed. Nine of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 9 species, 7 species were proposed in November 2012 as 'threatened' and 2 species were proposed as 'not warranted' (Table 2). Most corals observed are very small (<8 cm), but some corals larger than 16 cm in diameter were observed (Fig. 2). Herbivore biomass at Boy Scout is 1.19 kg/100m^2 (13/35, Fig. 3). Grazers, scrapers and browsers were all observed at the site (Fig. 4). All Scarids and most Acanthurids observed were 16-20 cm in length, but a few Acanthurids <15 cm were observed as well (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.94	0.98
Recruitment	10.06	0.70
Bleaching Resistance	70.68	0.80
Temperature variability	0.95	0.96
Herbivore biomass	1.19	0.36
Macroalgae cover*	0.00	1.00
Nutrient input*	4.20	0.85
Sedimentation*	2.05	0.61
Fishing pressure	57	0.03
Resilience score		0.70
Final anchored resilience score (**17**/35)		0.83

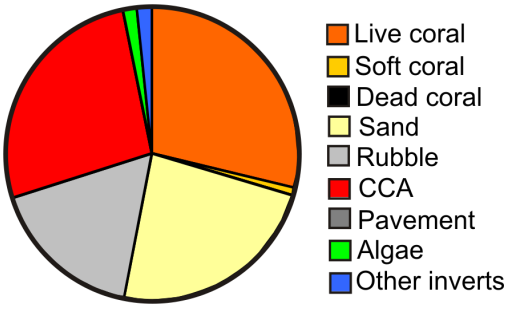


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (11/24)
Acropora aculeus [T]
Acropora vaughani [T]
Acropora verweyi [T]
Cyphastrea ocellina [NW]
Heliopora coerulea [NW]
Leptoseris incrustans [NW]
Millepora tuberosa [T]
Montipora lobulata [T]
Pocillopora danae [T]
Pocillopora elegans [T]
Turbinaria reniformis [NW]

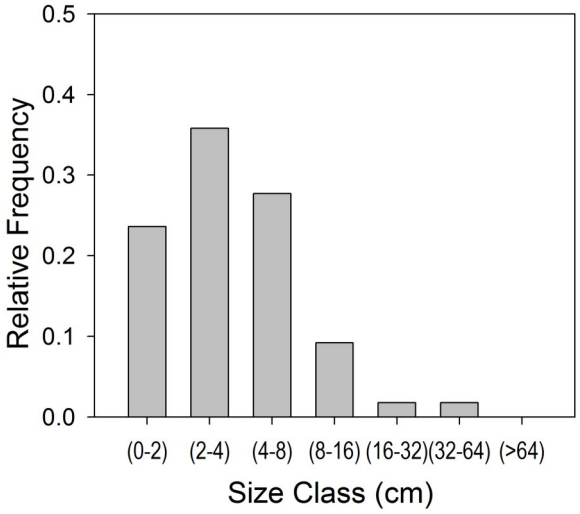


Figure 2. Size-class frequency distribution for stony corals.

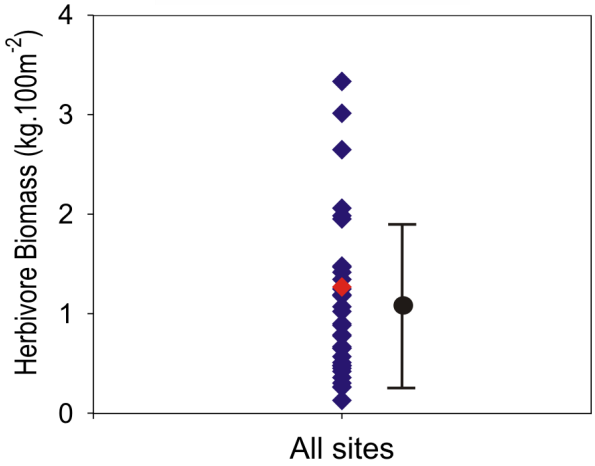


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

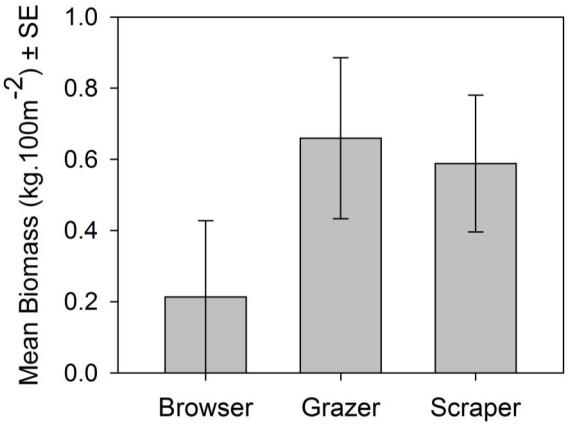


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

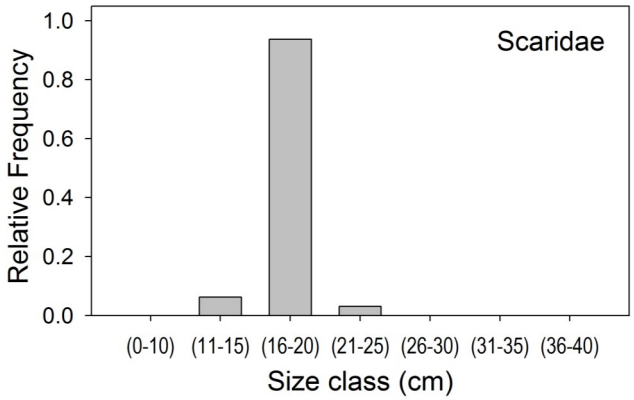


Figure 5. Size-class frequency distribution of Scaridae.

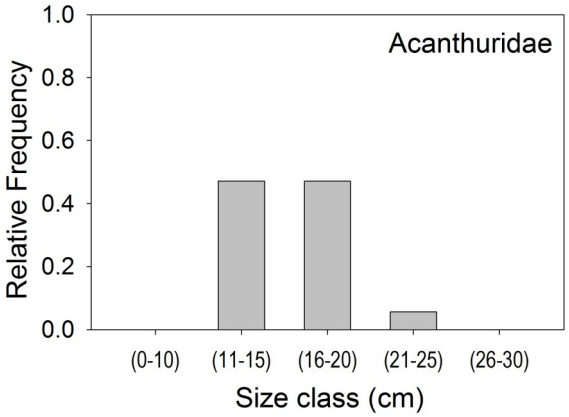
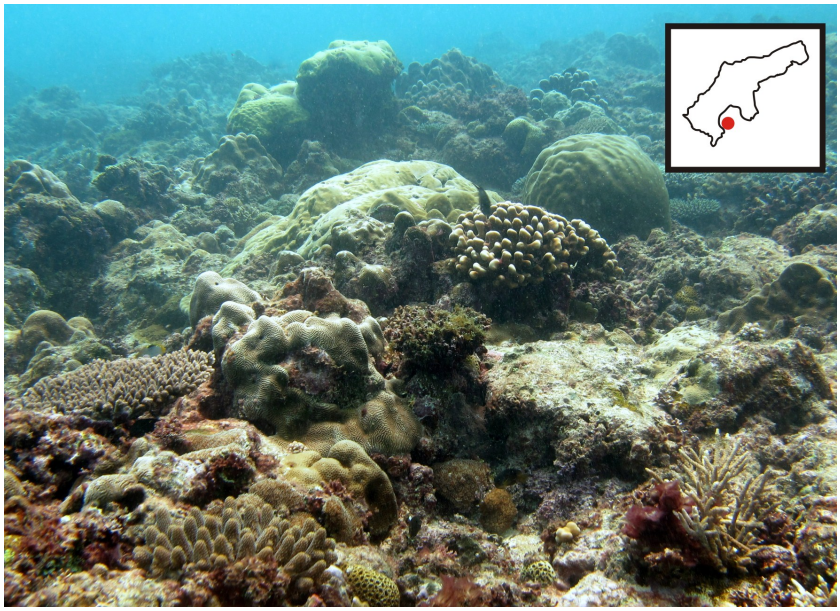


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 18/35: South Dakota



The South Dakota reef is located within Laolao Bay, in the DanDan watershed. The survey site was affectionately named South Dakota due to its resemblance to the rolling hills of the state. South Dakota is the 18th ranked site and is classified as a high resilience site (0.69, anchored to 0.82). Of the nine variables used in the resilience analysis, five of the variables received high scores: coral diversity, bleaching resistance, temperature variability, nutrient input, and fishing access (Table 1). Sedimentation was the only variable to receive a medium score, while coral recruitment and herbivore biomass received low scores. Coral diversity at this site is above average (0.85); the Simpson's Index of Diversity value is 0.95. South Dakota received the fourth highest score for bleaching resistance with less than 20% of the coral community susceptible to bleaching. The substrate at the site is covered mostly by algae (48.7%) and corals (31.3%) (Fig. 1). Three of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 3 species, 2 species were proposed in November 2012 as 'threatened' and 1 species was proposed as 'not warranted' (Table 2). Most corals at the site are small (<16 cm in diameter) though some corals larger than 16cm were observed (Fig. 2). Herbivore biomass at the time of surveys is 0 .51 kg/100m^2 (25/35. Fig. 3) and most herbivorous fish observed were grazers (Fig. 4). The majority of Scarids and Acanthurids observed were 15 cm in length or smaller. A few Acanthurids larger than 16 cm in length were observed (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.95	0.98
Recruitment	4.81	0.34
Bleaching Resistance	80.95	0.92
Temperature variability	0.95	0.96
Herbivore biomass	0.51	0.15
Macroalgae cover*	33.67	0.54
Nutrient input*	3.25	0.88
Sedimentation*	1.80	0.66
Fishing pressure	1405	0.79
Resilience score		0.69
Final anchored resilience score (**18**/35)		0.82

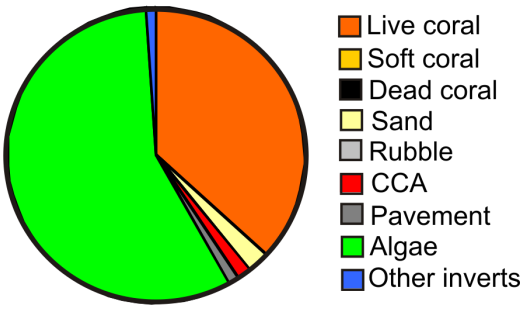


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (3/24)
Acropora verweyi[T]
Cyphastrea ocellina[NW]
Pocillopora danae[T]

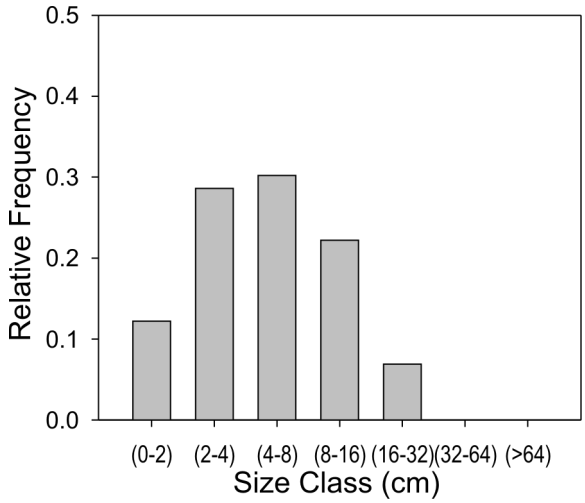


Figure 2. Size-class frequency distribution for stony corals.

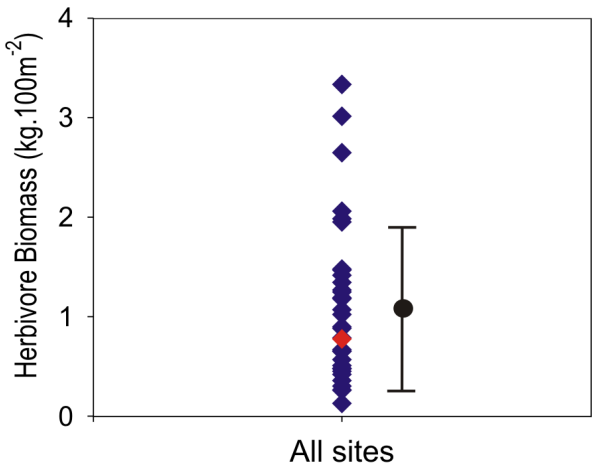


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

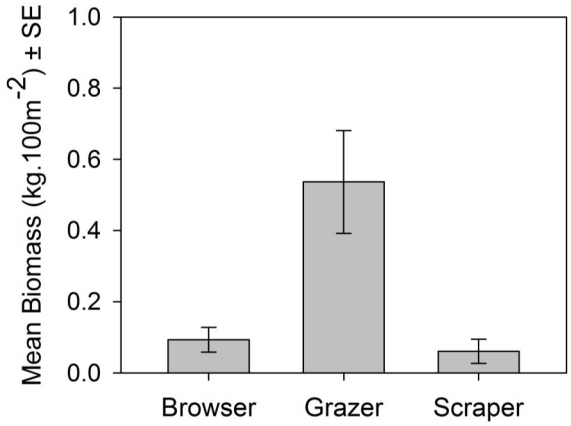


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

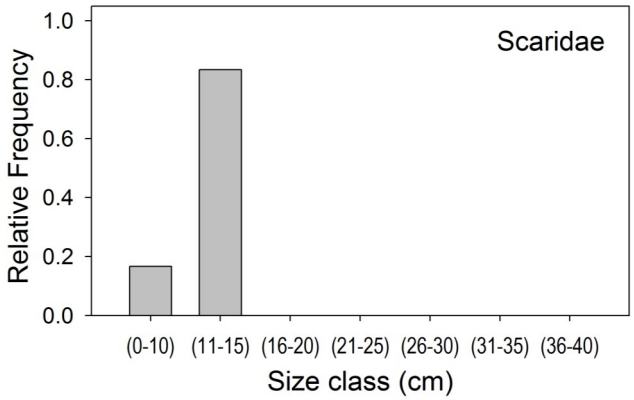


Figure 5. Size-class frequency distribution of Scaridae.

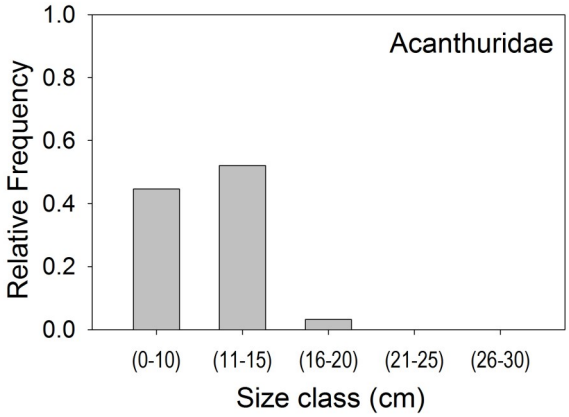
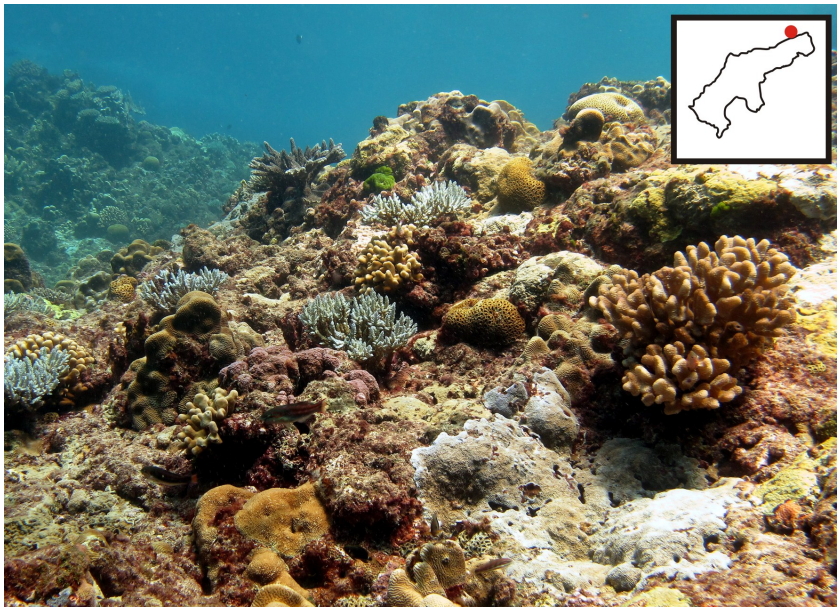


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 19/35: Wing Beach



Wing Beach is located on the northwest side of Saipan and is a Marine Monitoring Team survey site. On calm days, divers often see turtles and a humpback whale was seen from the surface during these surveys. Wing Beach is ranked nineteenth overall with a resilience score of 0.69 (anchored to 0.82) and is classified as a high resilience site. Coral diversity, temperature variability, macroalgae cover, and nutrient input all received high scores (Table 1). Coral recruitment and sedimentation received medium scores while bleaching resistance, herbivore biomass, and fishing access all received low scores. Coral diversity is high at the site; the Simpson's Index of Diversity value is 0.84 (anchored to 0.98). More than half of the substrate (54%) was covered by live coral. Roughly a third of the remaining substrate was covered by pavement (bare substrate). The remaining substrate was made up by soft corals, rubble, CCA, algae and other invertebrates (Fig. 1). Nine of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 9 species, 6 species were proposed in November 2012 as 'threatened' and 3 species were proposed as 'not warranted' (Table 2). More than half of the corals observed at this site were recruits (<4 cm in diameter) (Fig. 2). A few corals >16 cm in mean diameter were also observed as well (Fig. 2). Herbivore biomass is 0.57 kg/100m^2 (24/35, Fig. 3). Most herbivorous fish observed were grazers (Fig. 4). Most Scarids observed were 16-20 cm in length. Most Acanthurids ranged from 11-15 cm (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.94	0.98
Recruitment	10.88	0.76
Bleaching Resistance	50.59	0.57
Temperature variability	0.98	0.99
Herbivore biomass	0.57	0.17
Macroalgae cover*	0.00	1.00
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	139	0.08
Resilience score		0.69
Final anchored resilience score (**19**/35)		0.82

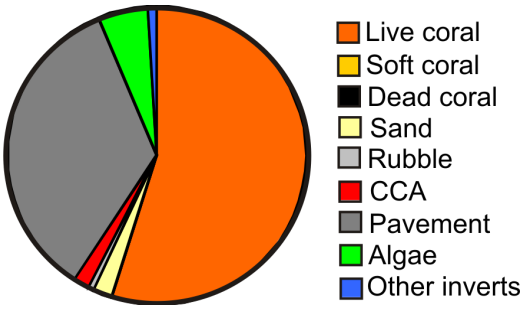


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (9/24)
Acropora aculeus [T]
Acropora vaughani [T]
Acropora verweyi [T]
Cyphastrea ocellina [NW]
Millepora tuberosa [T]
Pavona venosa [NW]
Pocillopora danae [T]
Pocillopora elegans [T]
Turbinaria reniformis [NW]

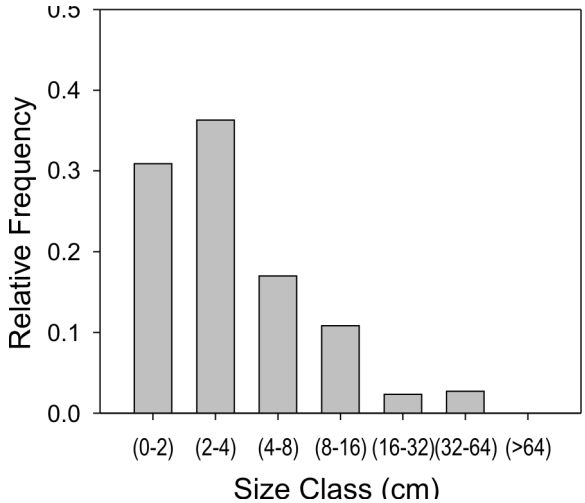


Figure 2. Size-class frequency distribution for stony corals.

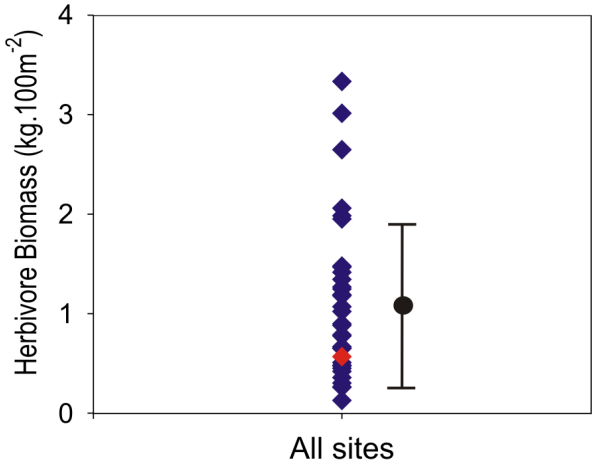


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

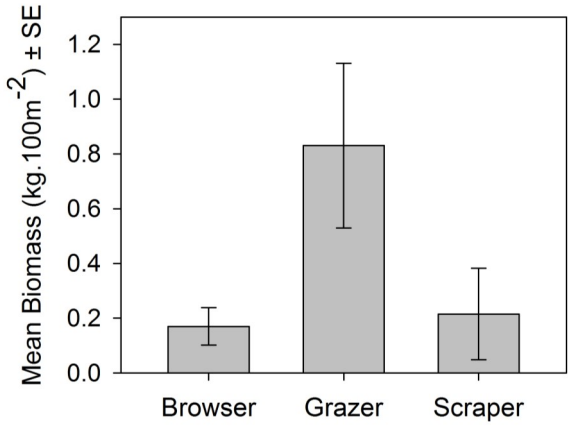


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

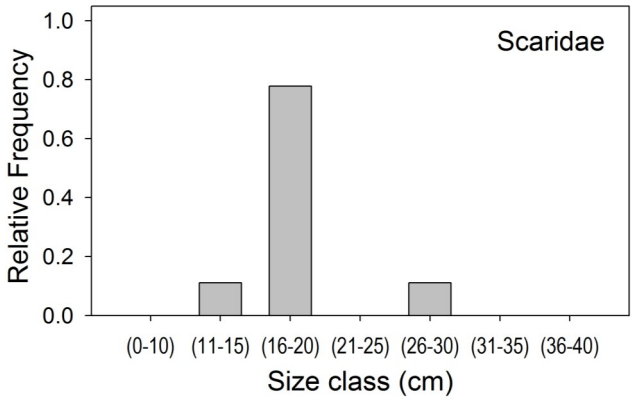


Figure 5. Size-class frequency distribution of Scaridae.

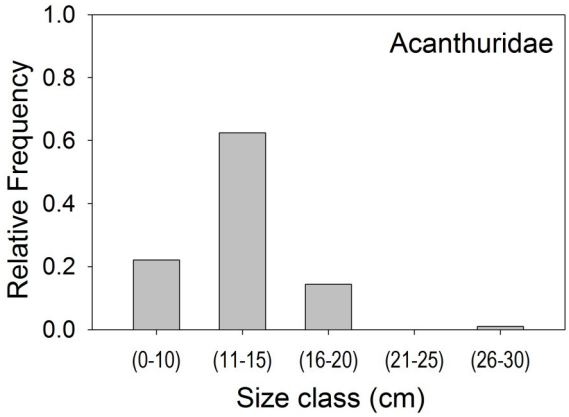
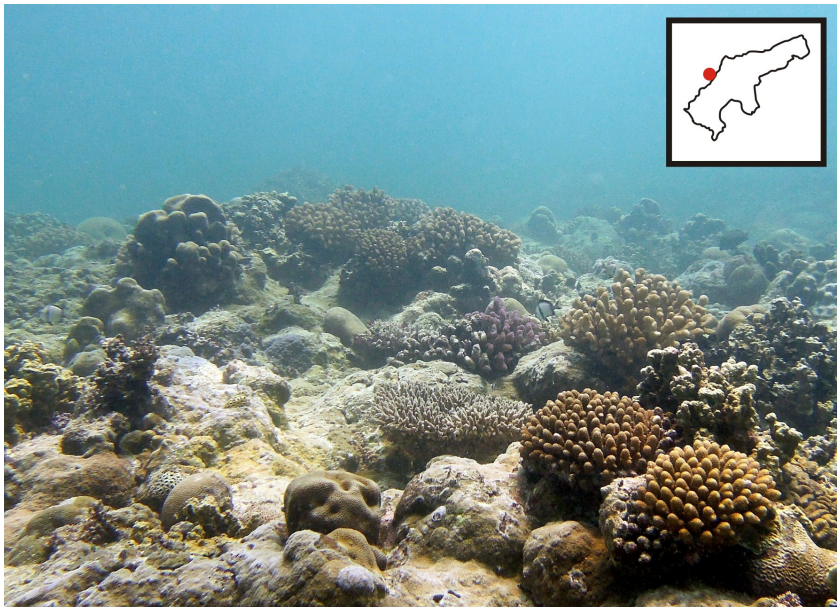


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 20/35: Lighthouse Reef



The Lighthouse Reef is located within the Lighthouse Reef Trochus Santuary, which was established in 1981 to create a reservoir of high level trochus productivity. Trochus are now protected throughout the CNMI. With a resilience score of 0.69 (anchored to 0.82), Lighthouse reef is the 20th ranked site but is considered to be a high resilience site. This site received high scores for coral diversity, bleaching resistance, temperature variability, macroalgae cover, and nutrient input (Table 1). Sedimentation was the only factor to receive a medium score, while coral recruitment, herbivore biomass, and fishing access all received low scores. Coral diversity is extremely high with a Simpson's Index of Diversity of 0.99, the third highest of all sites. The substrate is made up of 72% live coral (Fig. 1). Six of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. All 6 of these species were proposed in November 2012 as 'threatened' (Table 2). A few larger corals ranging in diameter from 16-64 cm were observed at this site, but most corals were very small (<8 cm) (Fig. 2). The herbivore biomass concentration at this site was 1.02 kg/100m^2 (16/35, Fig. 3) and most herbivorous fish present were grazers; only a few scrapers and browsers were observed (Fig. 4). The size-class frequency distributions were similar for Scaridae and Acanthuridae; for both families more than half of the fish observed were 11-15 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.95	0.99
Recruitment	6.42	0.45
Bleaching Resistance	71.85	0.81
Temperature variability	0.94	0.95
Herbivore biomass	1.02	0.31
Macroalgae cover*	0.00	1.00
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	38	0.02
Resilience score		0.69
Final anchored resilience score (**20**/35)		0.82

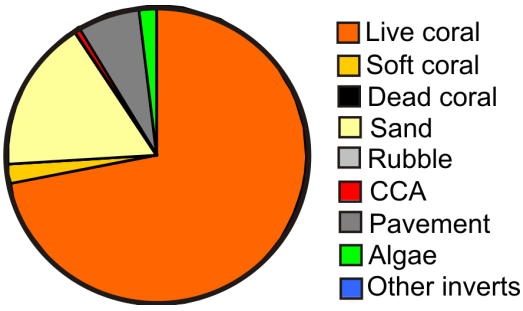


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (6/24)
Acropora vaughani[T]
Acropora verweyi[T]
Millepora tuberosa[T]
Montipora caliculata[T]
Pocillopora danae[T]
Pocillopora elegans[T]

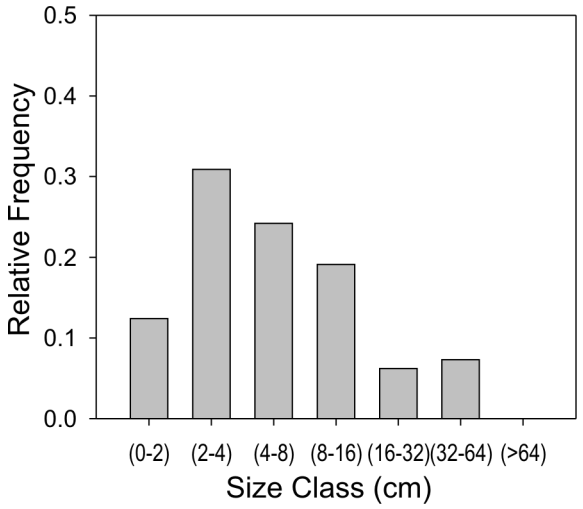


Figure 2. Size-class frequency distribution for stony corals.

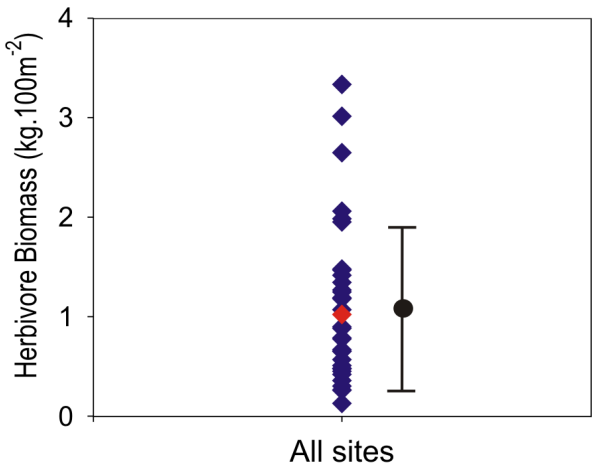


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

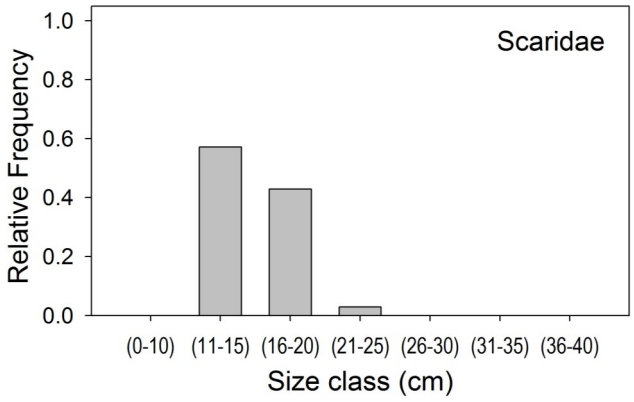


Figure 5. Size-class frequency distribution of Scaridae.

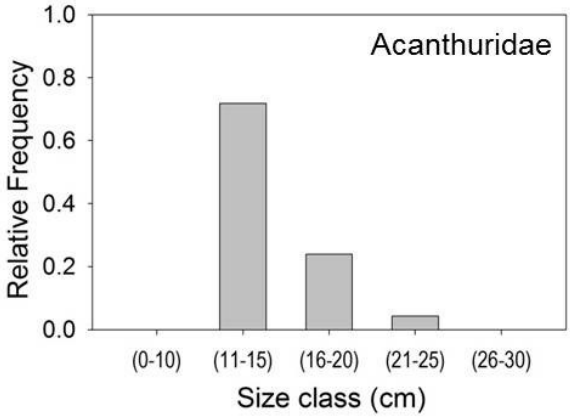
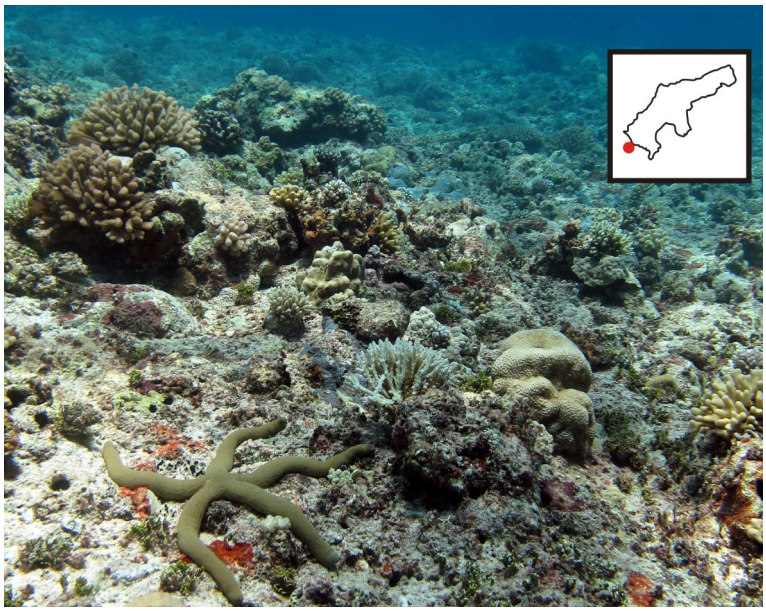


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 21/35: Ladder Beach



Ladder Beach is located on the southern coast of Saipan. Ladder Beach is a popular beach for campers. Ladder Beach, ranked 21/35, has a resilience score of 0.69 (anchored to 0.82) and is classified as a high resilience site (Table 1). A sleeping white tip reef shark was seen at the site during these surveys. Coral diversity and temperature variability received high scores. Coral recruitment, bleaching resistance, and sedimentation all received medium scores. Herbivore biomass, fishing access, macroalgae cover and nutrient input received low scores. Ladder Beach has the highest coral diversity of all the sites surveyed (Simpson's Index of Diversity value of 0.96). The benthos is mostly comprised of live coral (34%) and sand (34%), but CCA, pavement, and algae are also present (Fig. 1). Six of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 6 species, 5species were proposed in November 2012 as 'threatened' and 1 species was proposed as 'not warranted' (Table 2).Corals at this site are mostly very small with more than half <8 cm in diameter, but a few large (>16 cm diameter) corals were also seen (Fig. 2). The herbivore biomass at Ladder Beach is 0.48 kg/100m^2 (27/35, Fig. 3). Browsers, grazers and scrapers were seen, albeit in low densities (Fig. 4). Scarids observed ranged from 11-20 cm in length and Acanthurids ranged from 16-200 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.96	1.00
Recruitment	10.19	0.71
Bleaching Resistance	54.15	0.61
Temperature variability	0.95	0.96
Herbivore biomass	0.48	0.14
Macroalgae cover*	0.00	1.00
Nutrient input*	2.34	0.92
Sedimentation*	1.53	0.71
Fishing pressure	223	0.13
Resilience score		0.69
Final anchored resilience score (**21**/35)		0.82

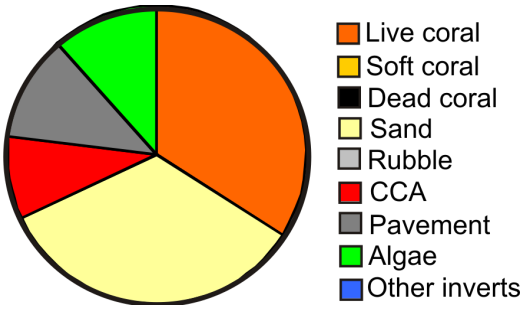


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (6/24)
Acropora vaughani[T]
Acropora verweyi[T]
Cyphastrea ocellina[NW]
Millepora tuberosa[T]
Montipora caliculata[T]
Pocillopora danae[T]

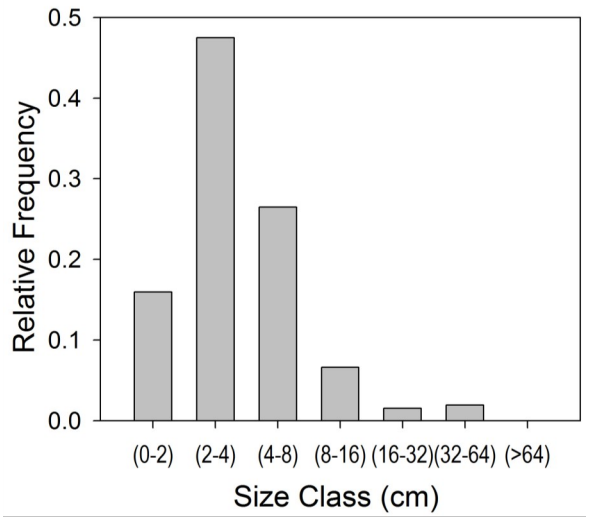


Figure 2. Size-class frequency distribution for stony corals.

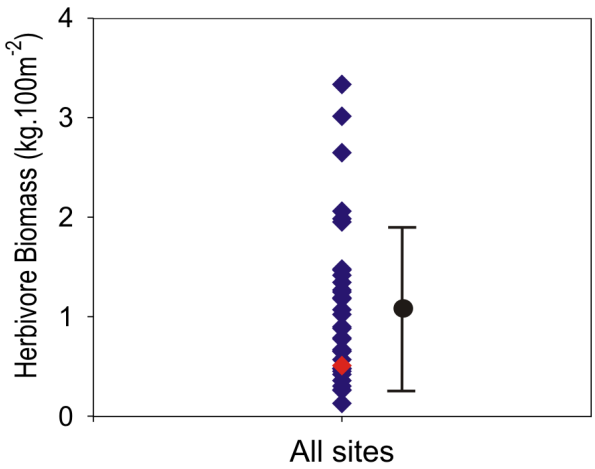


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

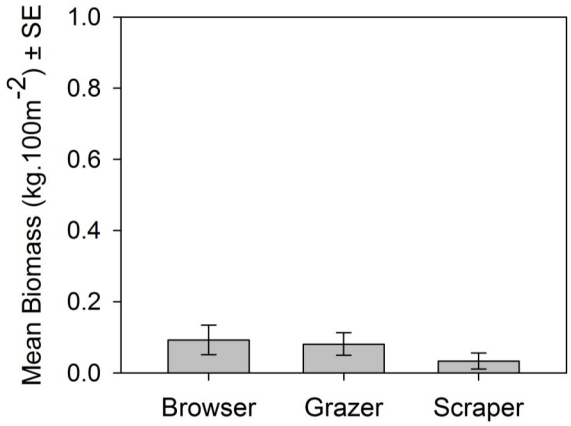


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

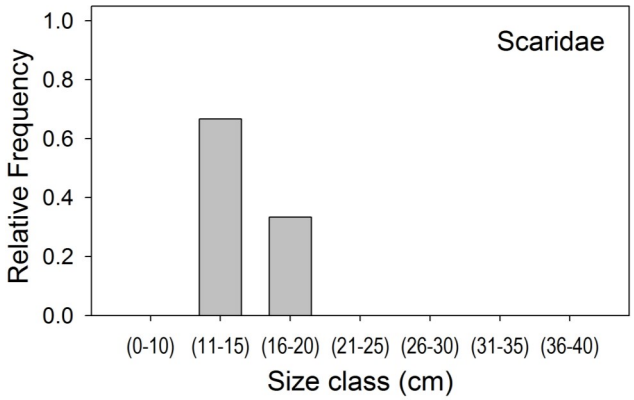


Figure 5. Size-class frequency distribution of Scaridae.

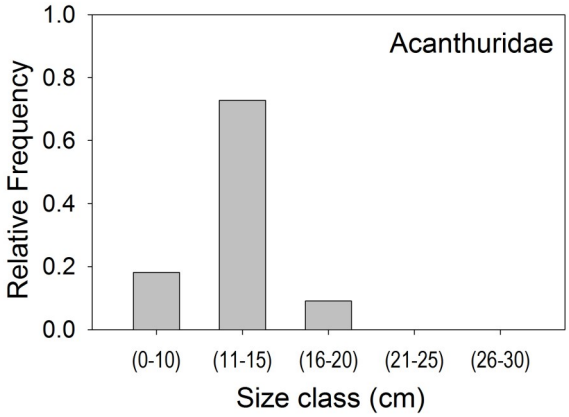
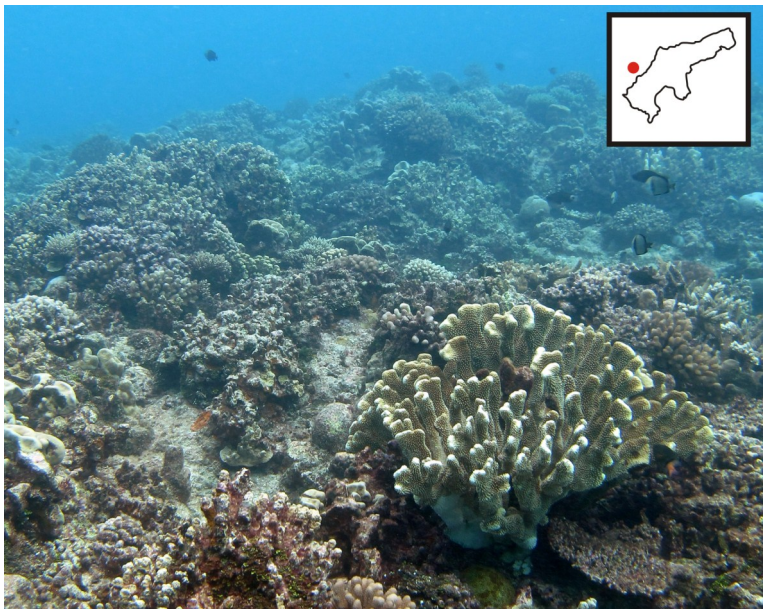


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 22/35: MMT Outside Grand Hotel



The MMT Outside Grand Hotel is ranked 22nd overall with a resilience score (0.68, anchored to 0.82) that just classifies it as a high resilience site. This site is a Marine Monitoring Team survey site. Five of the nine variables used in the resilience analysis received high scores; coral diversity, temperature variability, macroalgae cover, and nutrient input (Table 1). Bleaching resistance and sedimentation received medium scores, while coral recruitment, herbivore biomass, and fishing access all received low scores. About a third of the coral community found at the site is susceptible to bleaching. Coral diversity was high with a Simpson's Index of Diversity value of 0.95. No macroalgae were observed on the substrate, which was comprised of mostly live coral and pavement with less than a third of the site covered with turf algae, other invertebrates, sand, rubble, and CCA (Fig. 1). Seven of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 7 species, 5 species were proposed in November 2012 as 'threatened' and 2 species were proposed as 'not warranted' (Table 2). A few larger corals, 16-64 cm, were observed at this site. Most corals were very small (<8 cm in diameter) (Fig. 2). Herbivorous biomass concentration is 0.77 kg/100m^2 (20/35, Fig. 3) and most herbivorous fishes observed were grazers (Fig. 4). Most Scarids and Acanthurids ranged in length from 11-20 cm, but a few smaller (<11 cm) Acanthurids were observed as well (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.95	0.98
Recruitment	6.93	0.48
Bleaching Resistance	69.66	0.79
Temperature variability	0.95	0.96
Herbivore biomass	0.77	0.23
Macroalgae cover*	0.00	1.00
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	113	0.06
Resilience score		0.68
Final anchored resilience score (**22**/35)		0.82

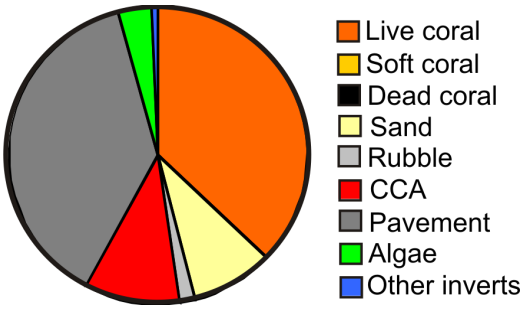


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (7/24)
Acropora aculeus [T]
Acropora verweyi [T]
Cyphastrea ocellina [NW]
Millepora tuberosa [T]
Pocillopora danae [T]
Pocillopora elegans [T]

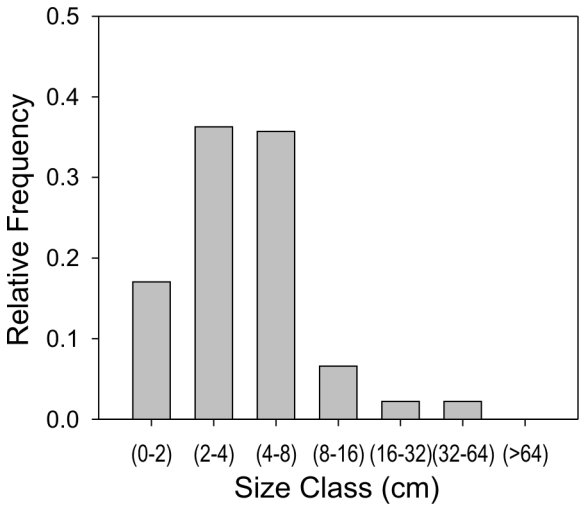


Figure 2. Size-class frequency distribution for stony corals.

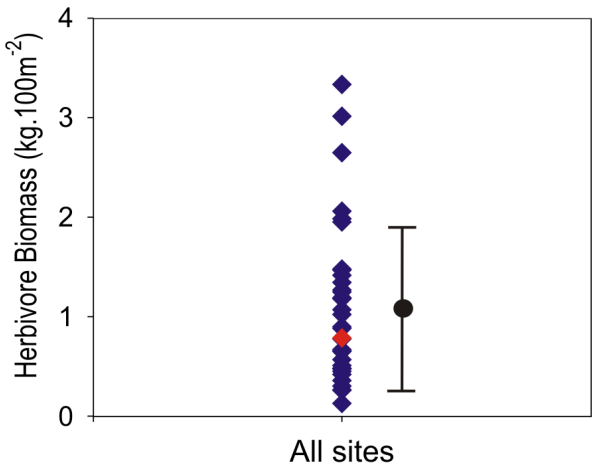


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

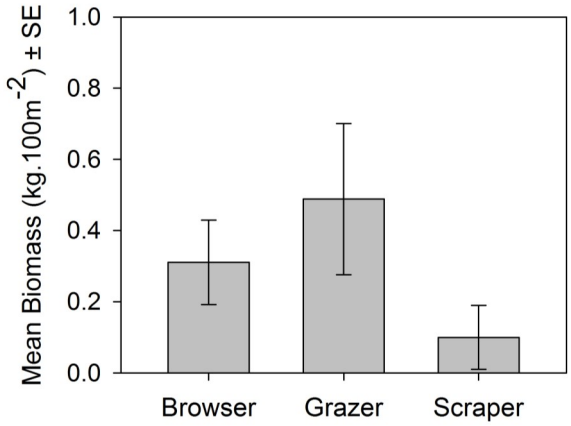


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

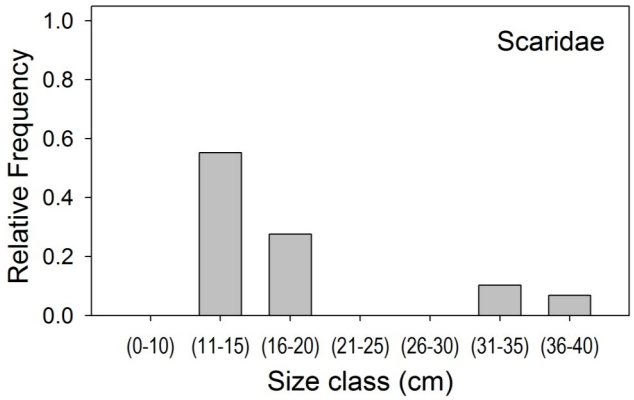


Figure 5. Size-class frequency distribution of Scaridae.

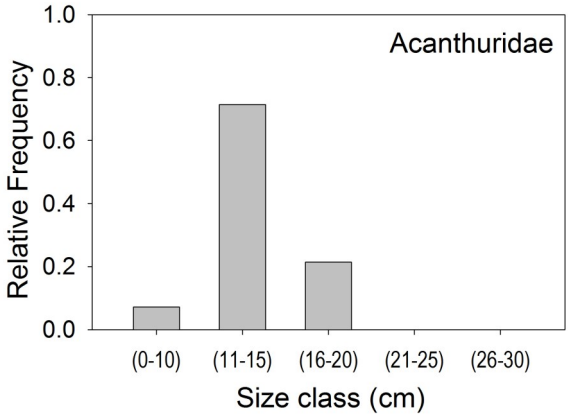
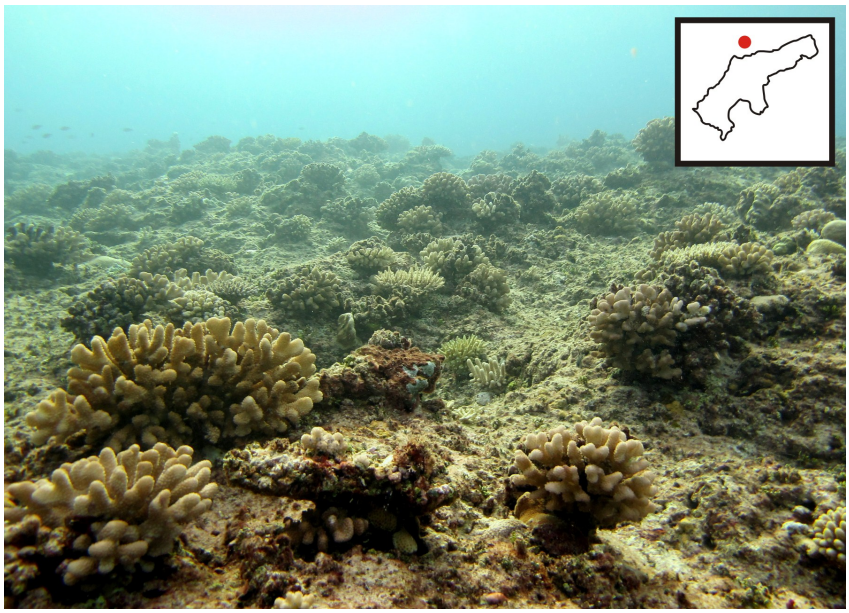


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 23/35: Elbow Reef



The Elbow Reef survey site is located just outside the the Managaha Marine Conservation Area. This part of the barrier reef surrounding the Saipan lagoon has high wave exposure and is home to very strong currents. Elbow Reef has the 23rd highest resilience score, 0.68 (anchored to 0.82), and is the lowest ranked of the sites considered to have high resilience. Temperature variability, nutrient input, coral diversity and macroalgae cover all received high scores (Table 1). Bleaching resistance and sedimentation both received medium scores, while coral recruitment, herbivore biomass, and fishing access scored low at this site. Coral diversity is high at the site with a Simpson's Index of Diversity value of 0.96. The substrate was comprised of turf algae (64.3%) and live coral (23.7%) (Fig. 1). Three of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. All 3 of these species were proposed in November 2012 as 'threatened' (Table 2).The majority of corals seen are recruits (<4 cm) (Fig. 2). Herbivore biomass at the site is 0.36 kg/100m^2 (31/35, Fig. 3). Most of the herbivorous fish observed were grazers and scrapers (Fig. 4). Scarids were not observed during these surveys and almost all Acanthurids observed were <15cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.96	1.00
Recruitment	6.69	0.47
Bleaching Resistance	62.98	0.71
Temperature variability	0.96	0.97
Herbivore biomass	0.36	0.11
Macroalgae cover*	0.00	1.00
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	448	0.25
Resilience score		0.68
Final anchored resilience score (**23**/35)		0.82

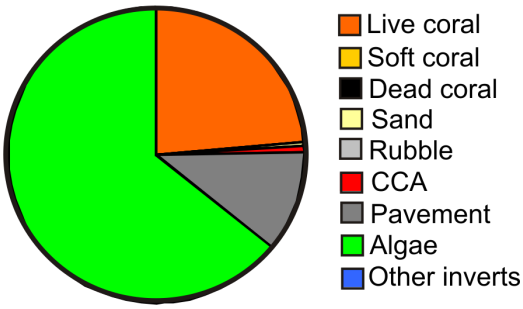


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (3/24)
Acropora verweyi[T]
Millepora tuberosa[T]
Montipora caliculata[T]

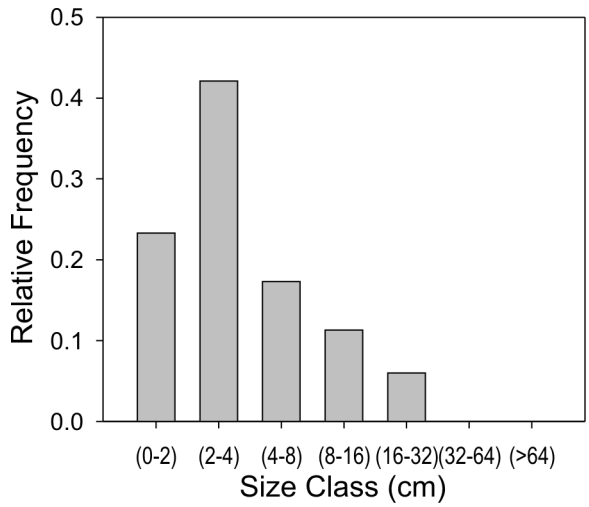


Figure 2. Size-class frequency distribution for stony corals.

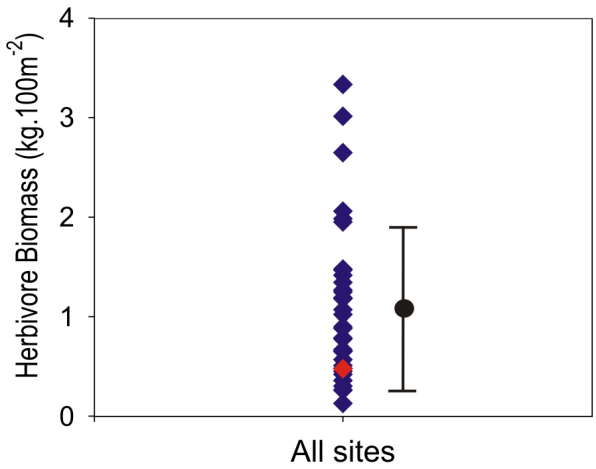


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

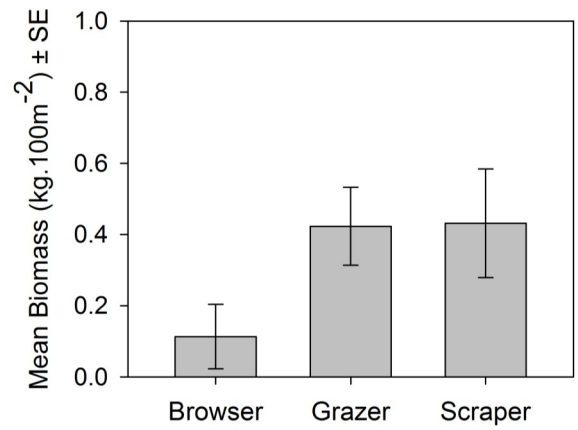


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

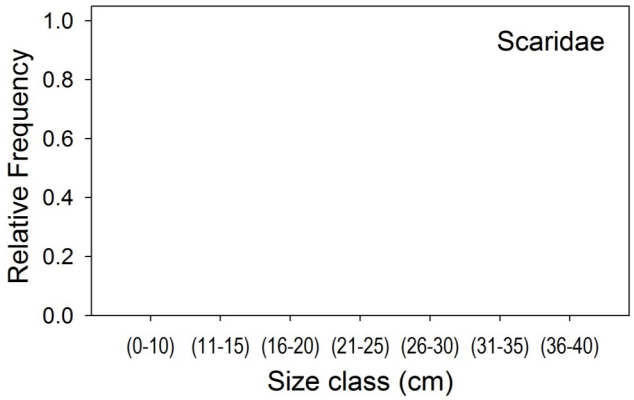


Figure 5. Size-class frequency distribution of Scaridae.

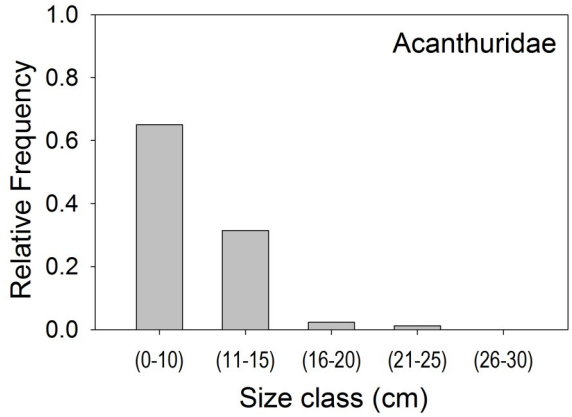
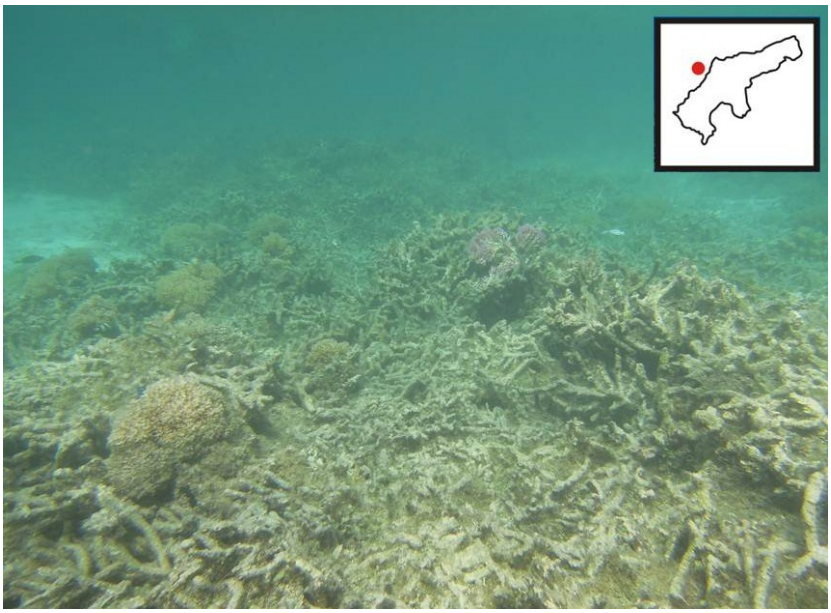


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 24/35: Oleai Staghorn



Oleai Staghorn is located in the central part of the Saipan lagoon. The site was severely devastated by a bleaching event in 2000. The resilience score at Oleai Staghorn is 0.66 (anchored to 0.79) and is the highest scoring medium resilience site. Bleaching resistance, temperature variability, macroalgae cover, and nutrient input, all received high scores (Table 1). Coral diversity, herbivore biomass, and sedimentation all received medium scores. Coral recruitment and fishing access received low scores. This site is one of the least diverse in terms of coral species, though it actually has the highest possible score for bleaching resistance with just over 10% of the coral assemblage susceptible to bleaching. Coral cover at the site though is very low (3.3%); most of the substrate is made up of pavement (bare substrate) (Fig. 1). Algae, sand, and invertebrates were also observed but made up less than 15% of the substrate. One of the coral species originally petitioned in 2009 for endangered species status was observed during these surveys. This species was proposed in November 2012 as 'threatened' (Table 2). More than three-quarters of corals observed were recruits (<4 cm in diameter). A few corals >32 cm in diameter were observed (Fig. 2). Though this site experiences the highest fishing access, Oleai Staghorn had the fourth greatest herbivore biomass (2.06 kg/100m^2, Fig. 3). The herbivore fish community was mainly comprised of scrapers (Fig. 4). Scarids and Acanthurids have similar size-class frequencies. Most of the individuals in these families were 15 cm or smaller, but a few Scarids 16-20 cm were also observed (Figs. 5 & 6). This area appeared to be a nursery for many of the lagoon fish species.

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.69	0.72
Recruitment	2.50	0.17
Bleaching Resistance	88.46	1.00
Temperature variability	0.94	0.95
Herbivore biomass	2.06	0.62
Macroalgae cover*	11.33	0.84
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	7	0.00
Resilience score		0.66
Final anchored resilience score (**24**/35)		0.79

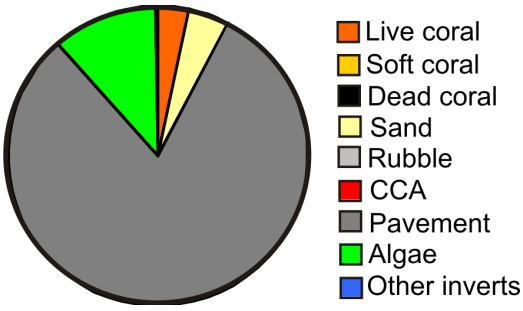


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (1/24)
Acropora aspera[T]

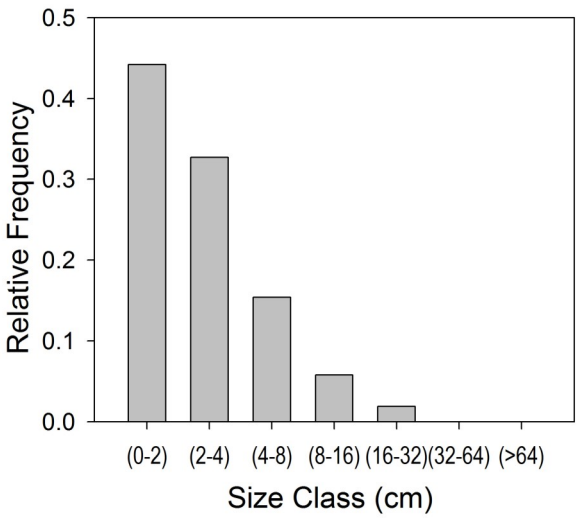


Figure 2. Size-class frequency distribution for stony corals.

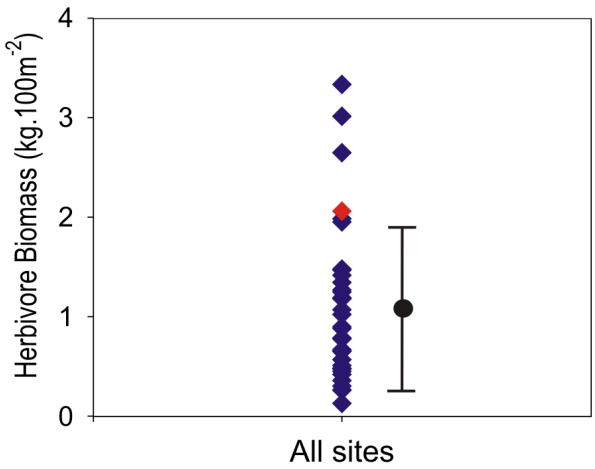


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

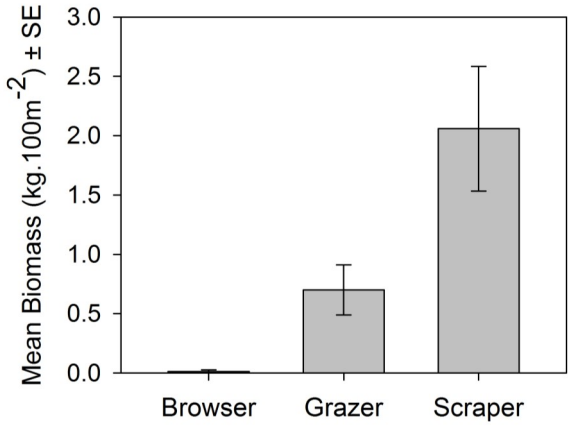


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

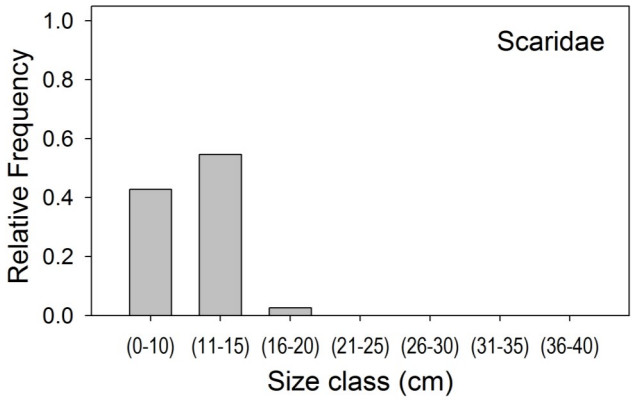


Figure 5. Size-class frequency distribution of Scaridae.

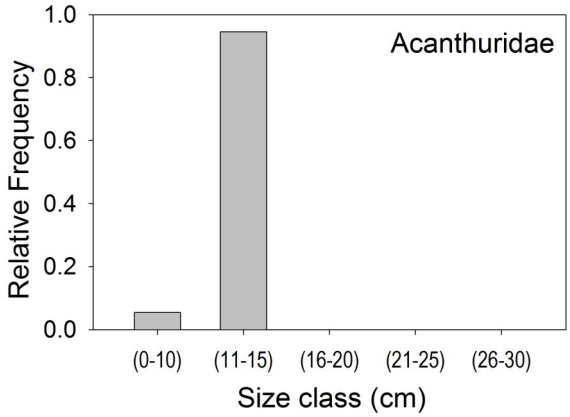
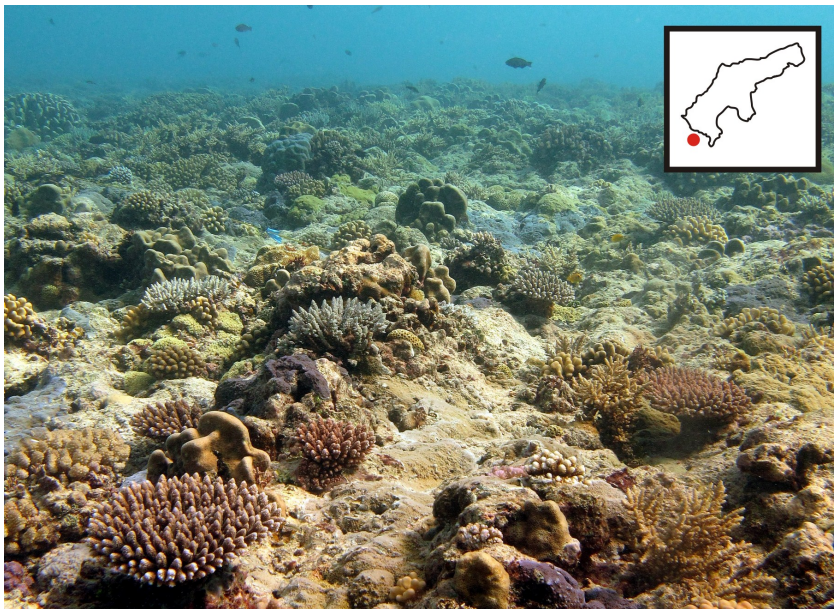


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 25/35: Coral Ocean Point



Coral Ocean Point is located on the southern shores of Saipan. This site is a Marine Monitoring Team survey site. This site, named for the golf course resort adjacent to the reef, is ranked 25/35, has a resilience score of 0.65 (anchored to 0.77) and is classified as a medium resilience site. Four of the nine variables used in the resilience analysis scored high in the resilience assessment: coral diversity, temperature variability, macroalgae cover, and nutrient input (Table 1). Coral recruitment was the only variable to receive a medium score, while bleaching resistance, herbivore biomass, sedimentation, and fishing access all received low scores. Coral Ocean Point had the second highest coral diversity (Simpsons Index of Diversity value of 0.96) of the sites surveyed. The substrate is made up primarily of corals (57.3%) and algae (36.7%) (Fig. 1). Lesser amount of sand and pavement are present. Thirteen of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 13 species, 9 species were proposed in November 2012 as 'threatened' and 4 species were proposed as 'not warranted' (Table 2). This site has a wide distribution of coral size with diameter measurements ranging from less than 1 cm to 64 cm, but most corals are recruits (<4cm) (Fig. 2). Herbivore biomass is 0.65 kg/100m^2 (23/35, Fig. 3) and the herbivorous fish community is dominated by grazers (Fig. 4). At this site Scarids were found to be mostly larger than Acanthurids; the majority of Scarids were 16-20 cm in length, and almost all of the Acanthurids observed were 11-15 cm (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.96	1.00
Recruitment	9.50	0.66
Bleaching Resistance	51.36	0.58
Temperature variability	0.95	0.96
Herbivore biomass	0.65	0.20
Macroalgae cover*	0.00	1.00
Nutrient input*	5.30	0.81
Sedimentation*	2.30	0.56
Fishing pressure	103	0.06
Resilience score		0.65
Final anchored resilience score (**25**/35)		0.77

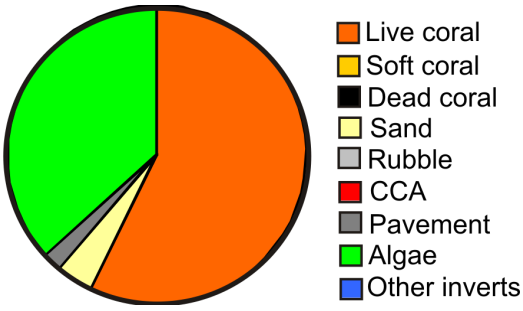


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (13/24)
Acropora aculeus [T]
Acropora paniculata [T]
Acropora verweyi [T]
Alveopora fenestrata [T]
Heliopora coerulea [NW]
Leptoseris incrustans [NW]
Millepora tuberosa [T]
Montipora caliculata [T]
Montipora lobulata [T]
Pavona venosa [NW]
Pocillopora danae [T]
Pocillopora elegans [T]
Turbinaria reniformis [NW]

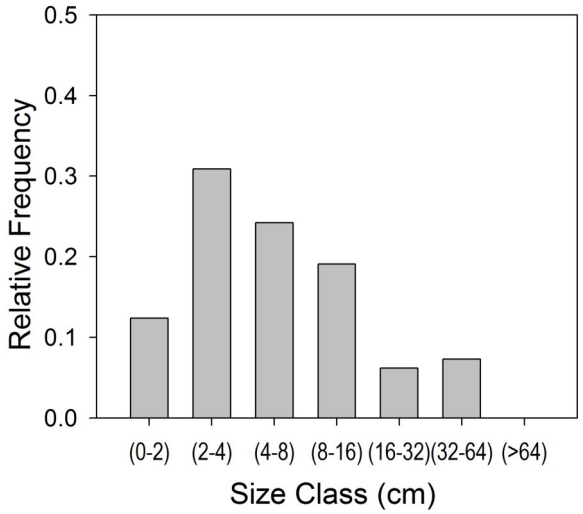


Figure 2. Size-class frequency distribution for stony corals.

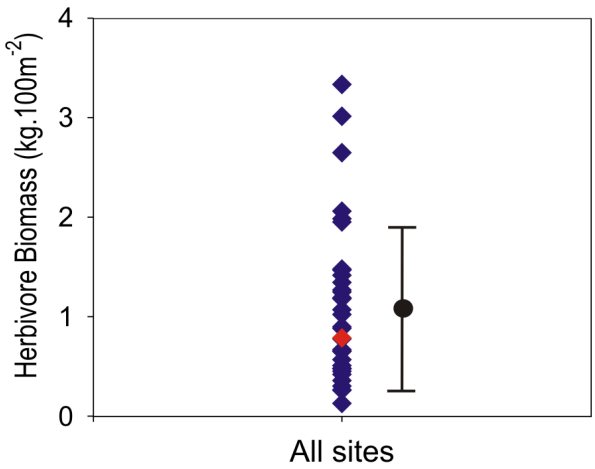


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

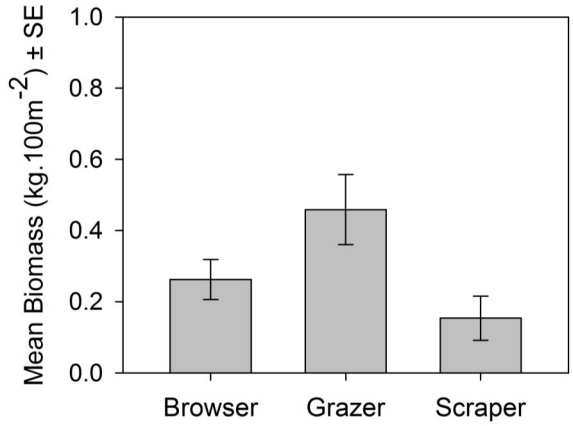


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

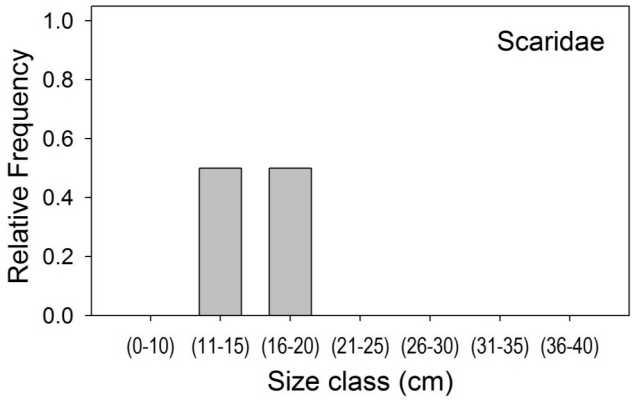


Figure 5. Size-class frequency distribution of Scaridae.

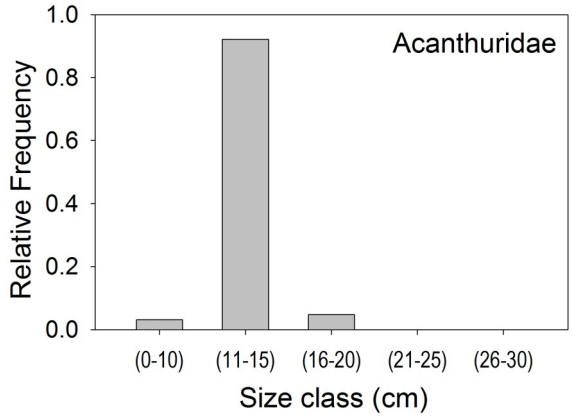
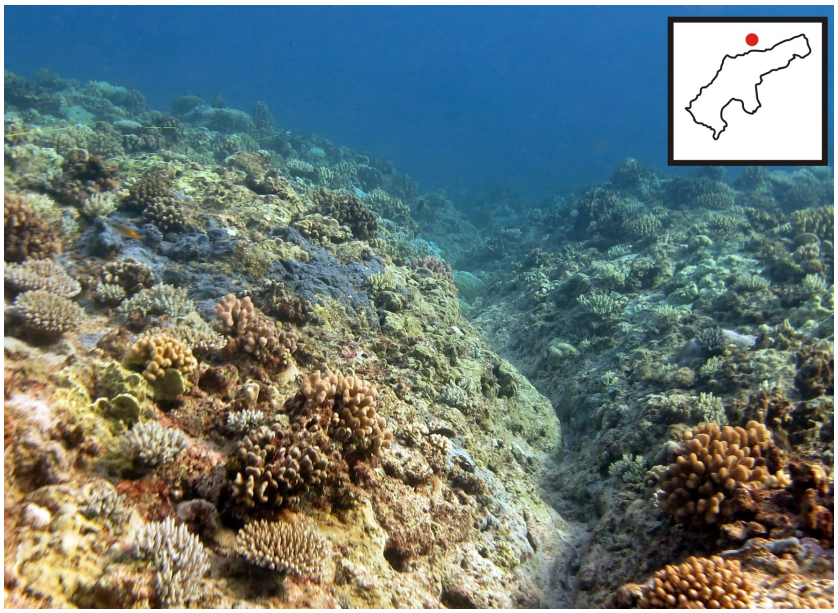


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 26/35: Achugao



Achugao is located on the northeast side of Saipan. Achugao is ranked 26/35 with a resilience score of 0.65 (anchored to 0.77) and is classified as a medium resilience site. Four of the nine variables used in the resilience analysis received high scores: coral diversity, temperature variability, macroalgae cover, and sedimentation (Table 1). Coral recruitment and sedimentation received medium scores, while bleaching resistance, herbivore biomass, and fishing access all received low scores. Coral diversity is high at the site with a Simpson's Index of Diversity value of 0.94. In addition, the site has the coral community most susceptible to bleaching of all the sites with 59.93% found to be susceptible. The substrate is made up of live coral (54.7%), pavement (bare substrate, 27.7%), and lesser amounts of algae, sand, rubble, and invertebrates (Fig. 1). Three of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 3 species, 2 species were proposed in November 2012 as 'threatened' and 1 species was proposed as 'not warranted' (Table 2). Most of the corals at this site are larger than 16cm; a characteristic unique to this site (Fig. 2). Herbivore biomass is 0.26 kg/100m^2 (34/35, Fig. 3) and grazers make up the majority of the observed herbivorous fish community (Fig. 4). All of the Scarids observed were 16-20 cm in length. Acanthurids observed ranged from >5-20cm (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.94	0.97
Recruitment	9.06	0.63
Bleaching Resistance	40.07	0.45
Temperature variability	0.95	0.96
Herbivore biomass	0.26	0.08
Macroalgae cover*	0.00	1.00
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	107	0.06
Resilience score		0.65
Final anchored resilience score (**26**/35)		0.77

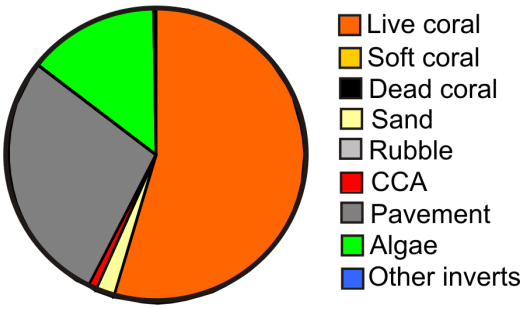


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (3/24)
Acropora vaughani[T]
Acropora verweyi[T]
Heliopora coerulea[NW]

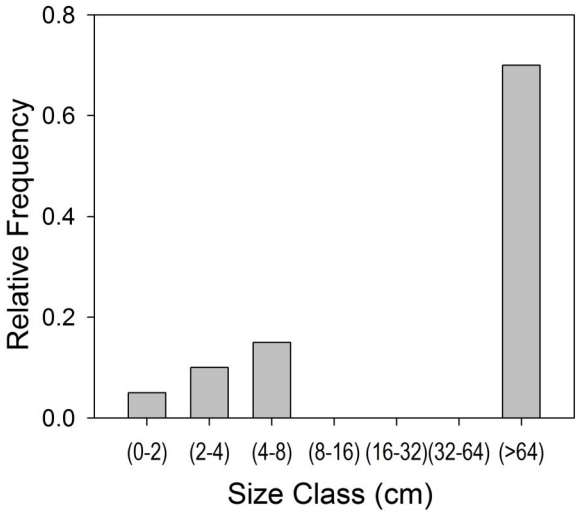


Figure 2. Size-class frequency distribution for stony corals.

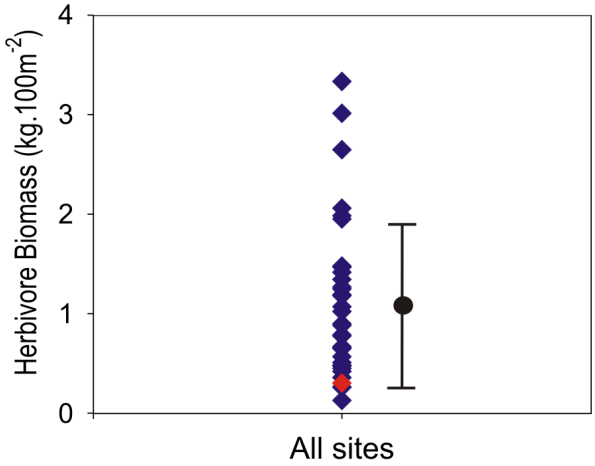


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

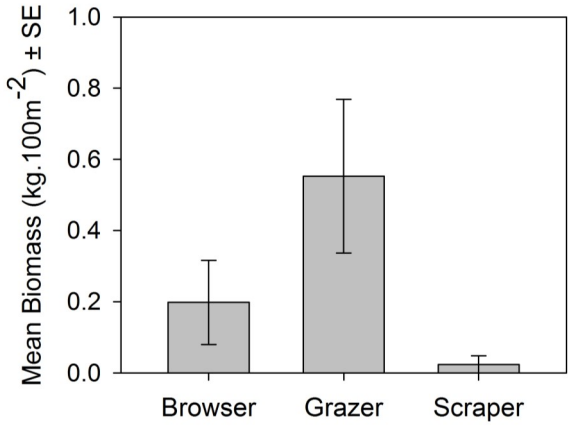


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

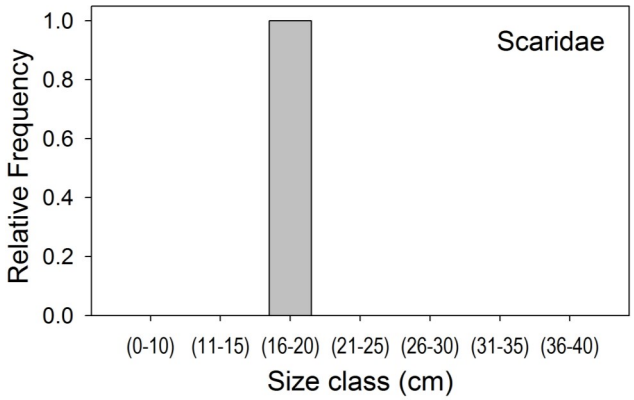


Figure 5. Size-class frequency distribution of Scaridae.

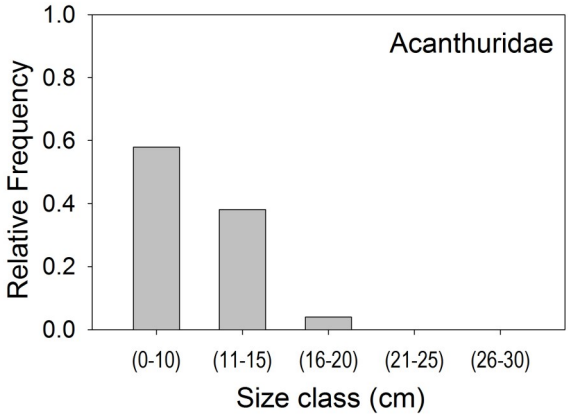
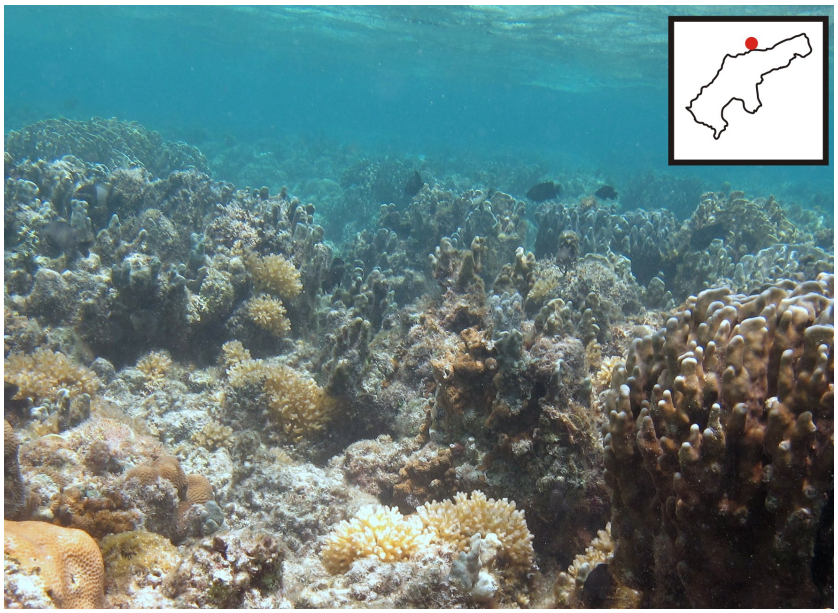


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 27/35: Tanapag Staghorn



Tanapag Staghorn is located in the northern part of the Saipan Lagoon. This reef is a common fishing area for the community of the Tanapag village and has a resident nurse shark. Tanapag Staghorn, ranked 27/35, has a resilience score of 0.60 (anchored to 0.72) and is classified as a medium resilience site. Coral diversity, bleaching resistance, temperature variability, and macroalgae cover received high scores (Table 1). Nutrient input was the only variable to receive a medium score, while coral recruitment, herbivore biomass, sedimentation, and fishing access all received low scores. Diversity of corals is below average (0.85) at this site (Simpson's Index of Diversity value of 0.78). The substrate is made up of live coral (48.3%) and algae (45.3%). The remaining <10% is made up by sand, rubble, and pavement (Fig. 1). Four of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 4 species, 2 species were proposed in November 2012 as 'threatened' and 2 species were proposed as 'not warranted' (Table 2). Corals range in diameter from less than 1 cm to 64 cm, but most corals are small (<8 cm in diameter) (Fig. 2). Herbivore biomass is 0.78 kg/100m^2 (19/35, Fig. 3). Most of the herbivorous fish community observed were grazers (Fig. 4). All Scarids observed were less than 15 cm in length (Fig. 5). Acanthurids have a wider size-class distribution and ranged in length from 5-20 cm (Fig. 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.78	0.80
Recruitment	4.88	0.34
Bleaching Resistance	82.67	0.93
Temperature variability	0.96	0.97
Herbivore biomass	0.78	0.24
Macroalgae cover*	10.67	0.85
Nutrient input*	6.59	0.76
Sedimentation*	2.57	0.51
Fishing pressure	7	0.00
Resilience score		0.60
Final anchored resilience score (**27**/35)		0.72

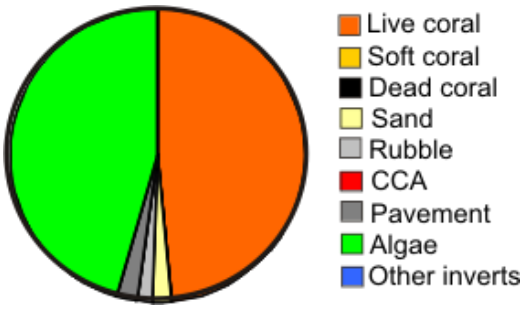


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (4/24)
Acanthastrea brevis [T]
Acropora aspera [T]
Heliopora coerulea [NW]
Pavona cactus [NW]

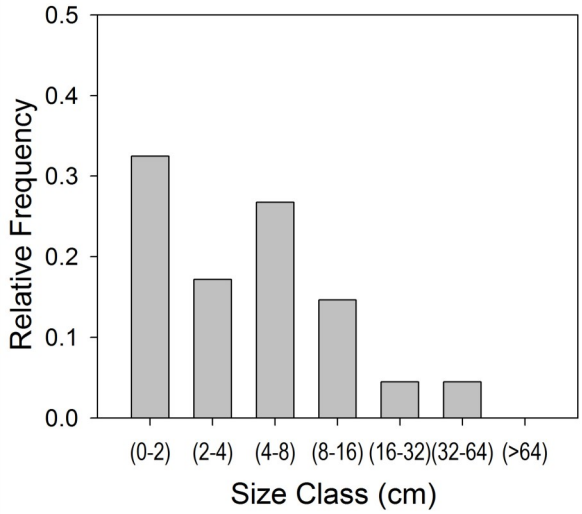


Figure 2. Size-class frequency distribution for stony corals.

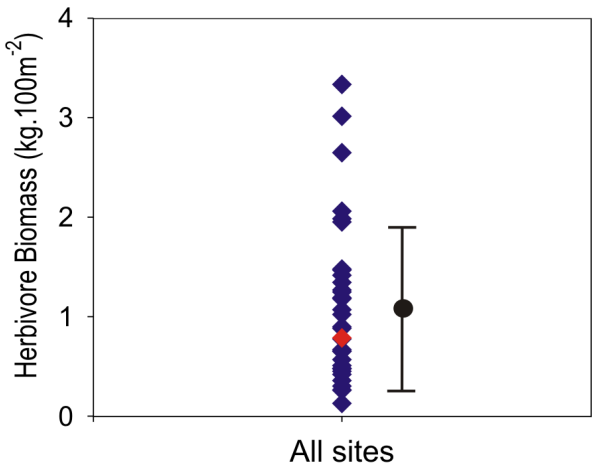


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

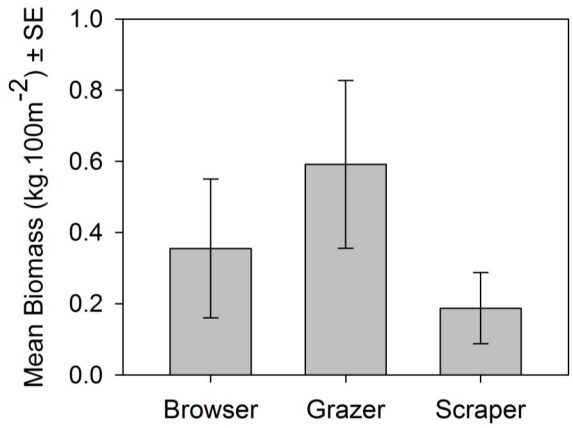


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

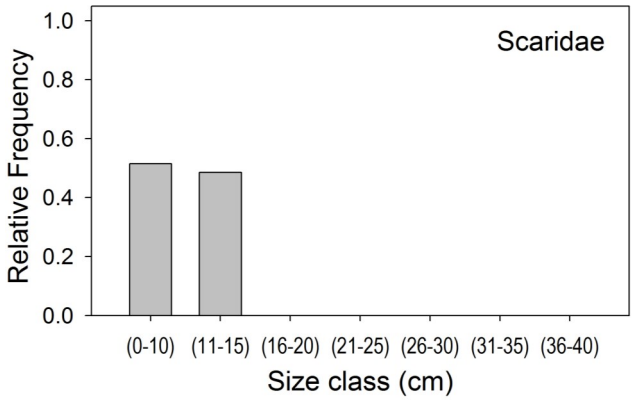


Figure 5. Size-class frequency distribution of Scaridae.

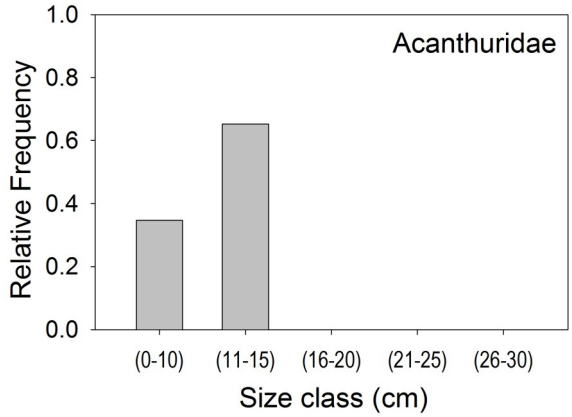
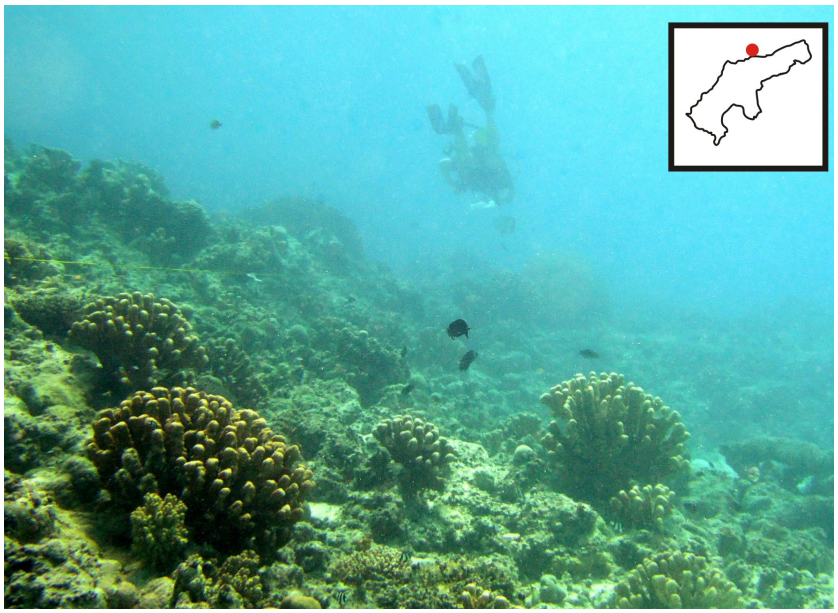


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 28/35: MMT Managaha Patch Reef



This site is located within the Managaha Marine Conservation Area. This is one of three sites established by the CNMI MMP. The multiple sites were chosen to replicate the wide range of habitats found in the MMCA. The MMT Managaha Patch Reef is the 28th ranked site and is classified as a medium resilience site with a resilience score of 0.60 (anchored to 0.71). Four of the 9 variables used in the resilience analysis had high scores: coral diversity, temperature variability macroalgae cover, and fishing access. One variable, bleaching resistance, received a medium score (Table 1). Four variables received low scores: coral recruitment, herbivore biomass, sedimentation, and nutrient input. Despite the lowest score for sedimentation and one of the lowest scores for nutrient input, coral species diversity at this site was high with a Simpson's Index of Diversity value of 0.94. Turf algae makes up much of the substrate (45.3%). Live coral; sand, rubble, CCA, and pavement (bare substrate) make up 22.7%. Other invertebrates make up the remaining area (Fig. 1). Five of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 5 species, 4 species were proposed in November 2012 as 'threatened' and 1 species was proposed as 'not warranted' (Table 2). Most corals observed were small (<8 cm in diameter). A few corals with diameters larger than 32 cm were observed as well (Fig. 2). Managaha Patch Reef has a herbivore biomass concentration of 1.34 kg/100m^2 (10/35, Fig. 3) and a herbivorous fish community dominated by scrapers (Fig. 4). The size-class frequency of observed Scarids was much wider than that of Acanthurids (Figs. 5 & 6). Some Scarids were observed to be as large as 21-25 cm in length. All Acanthurids observed were <15 cm in length.

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.94	0.95
Recruitment	8.94	0.36
Bleaching Resistance	67.74	0.73
Temperature variability	0.96	0.96
Herbivore biomass	0.30	0.40
Macroalgae cover*	0.00	0.94
Nutrient input*	2.04	0.01
Sedimentation*	1.43	0.00
Fishing pressure	443	1.00
Resilience score		0.60
Final anchored resilience score (**28**/35)		0.71

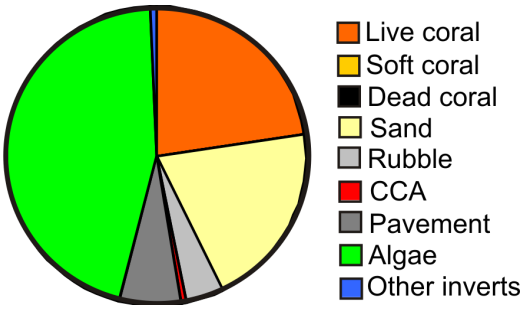


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (5/24)
Acropora verweyi[T]
Heliopora coerulea[NW]
Millepora tuberosa[T]
Montipora lobulata[T]
Pocillopora elegans[T]

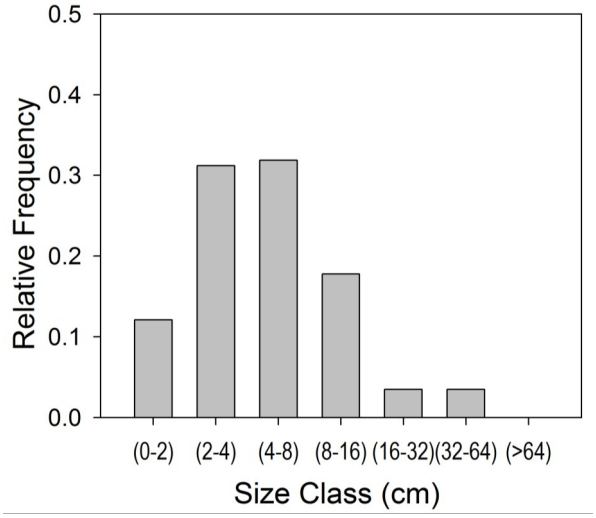


Figure 2. Size-class frequency distribution for stony corals.

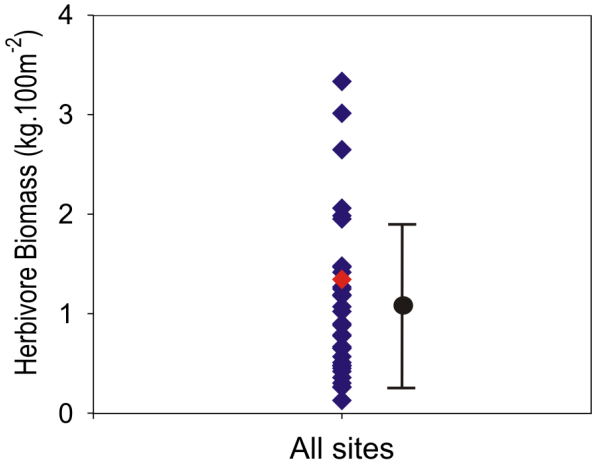


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

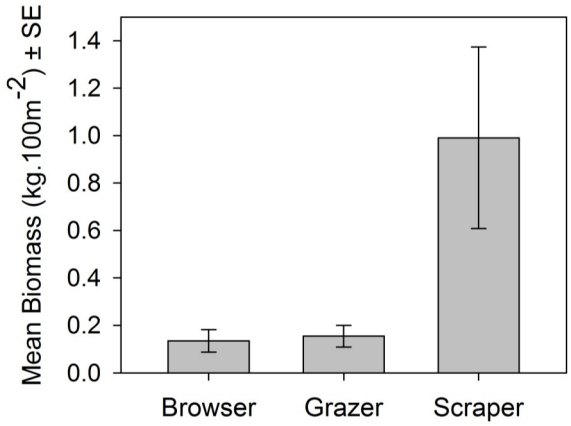


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

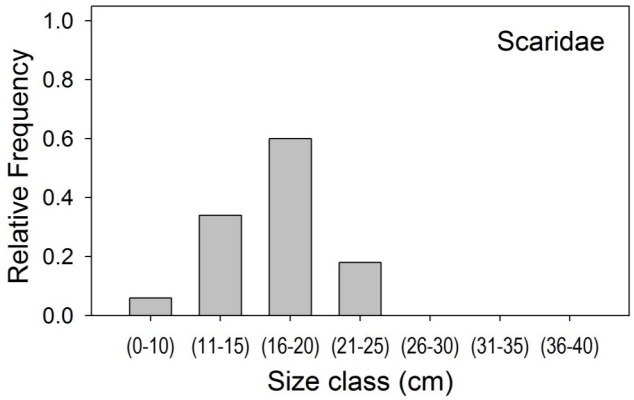


Figure 5. Size-class frequency distribution of Scaridae.

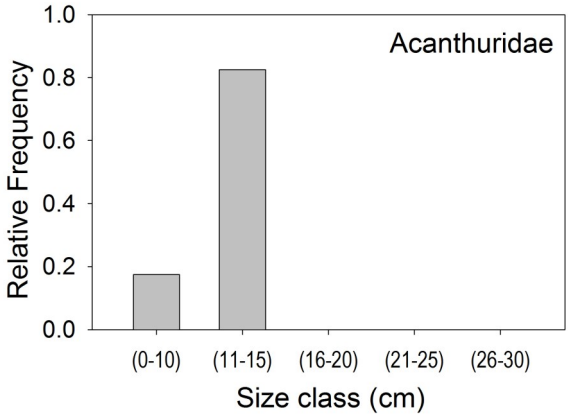
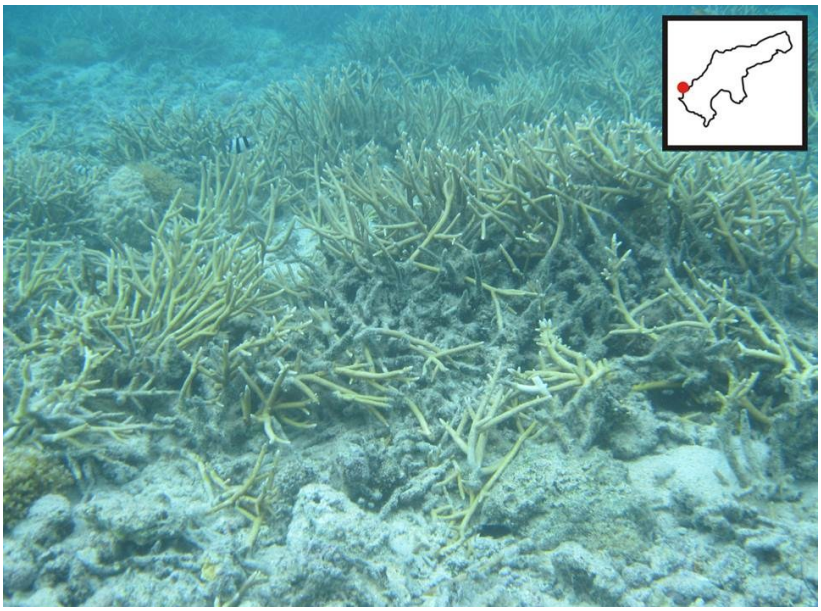


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 29/35: Pak Pak Beach



Pak Pak Beach is located in the southern portion of the Saipan lagoon. Pak Pak Beach is a popular swimming beach as it is adjacent to the Pacific Islands Club Resort. Pak Pak Beach has a resilience score of 0.59 (anchored to 0.70) and is a medium resilience site. This 29th ranked site has just four variables that received high scores: coral diversity, temperature variability, macroalgae cover, and nutrient input (Table 1). Sedimentation was the only variable to receive a medium score, while coral recruitment, bleaching resistance, herbivore biomass, and fishing access all received low scores. Coral diversity at Pak Pak beach is just above the average (0.85) for the surveyed sites (Simpson's Index of Diversity value of 0.90). Live corals make up almost 50% of the benthos at this site; algae, sand, rubble, and CCA make up the remaining area (Fig. 1). Nine of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 9 species, 6 species were proposed in November 2012 as 'threatened' and 3 species were proposed as 'not warranted' (Table 2). Most corals ob served at the site are small (<16 cm in diameter) (Fig. 2). Pak Pak Beach had the lowest herbivore biomass of all the sites, 0.13 kg/100m^2 (Fig. 3). Most of the herbivorous fish community observed at the site were grazers (Fig. 4). Scarids and Acanthurids have similar size-class frequencies with most fish <10 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.90	0.93
Recruitment	3.38	0.24
Bleaching Resistance	45.45	0.51
Temperature variability	0.95	0.96
Herbivore biomass	0.13	0.04
Macroalgae cover*	3.00	0.96
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	16	0.01
Resilience score		0.59
Final anchored resilience score (**29**/35)		0.70

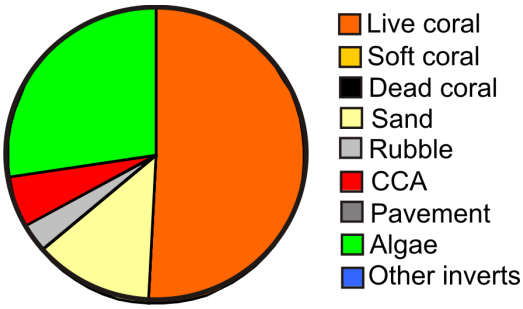


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (9/24)
Acanthastrea brevis[T]
Acropora aspera[T]
Acropora vaughani[T]
Cyphastrea agassizi[NW]
Cyphastrea ocellina[NW]
Heliopora coerulea[NW]
Millepora tuberosa[T]
Pocillopora danae[T]
Pocillopora elegans[T]

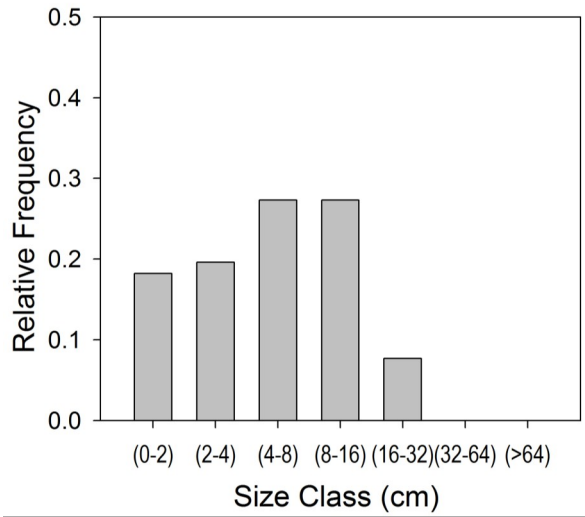


Figure 2. Size-class frequency distribution for stony corals.

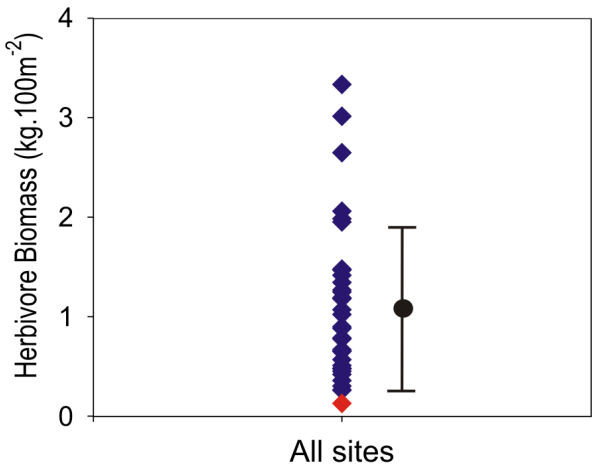


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

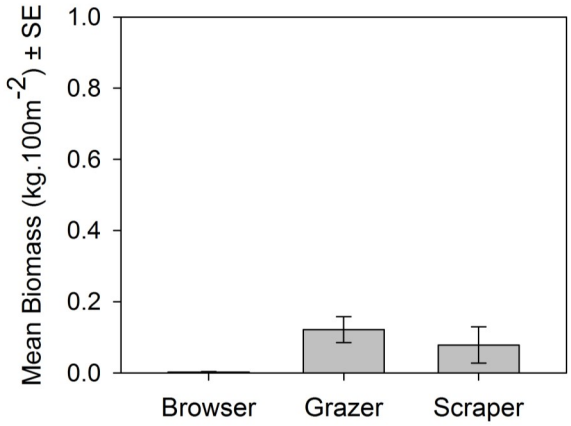


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

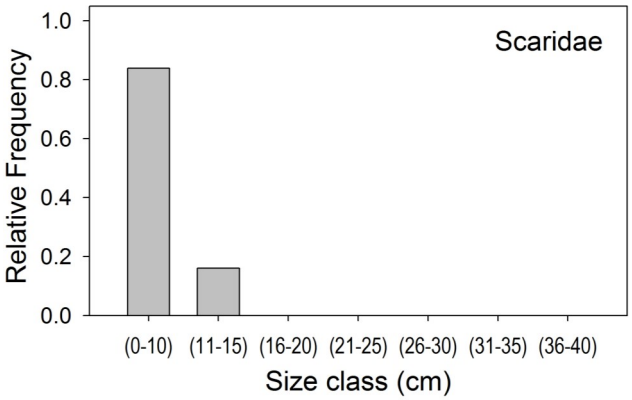


Figure 5. Size-class frequency distribution of Scaridae.

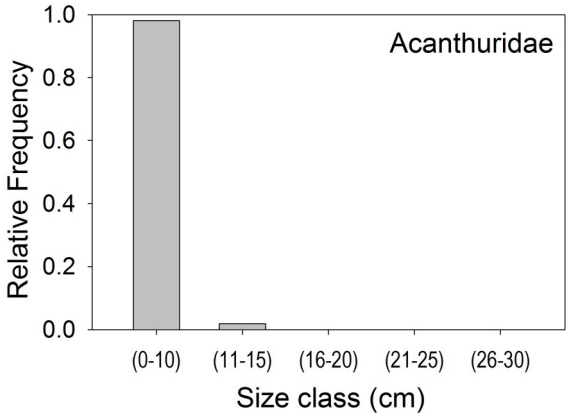
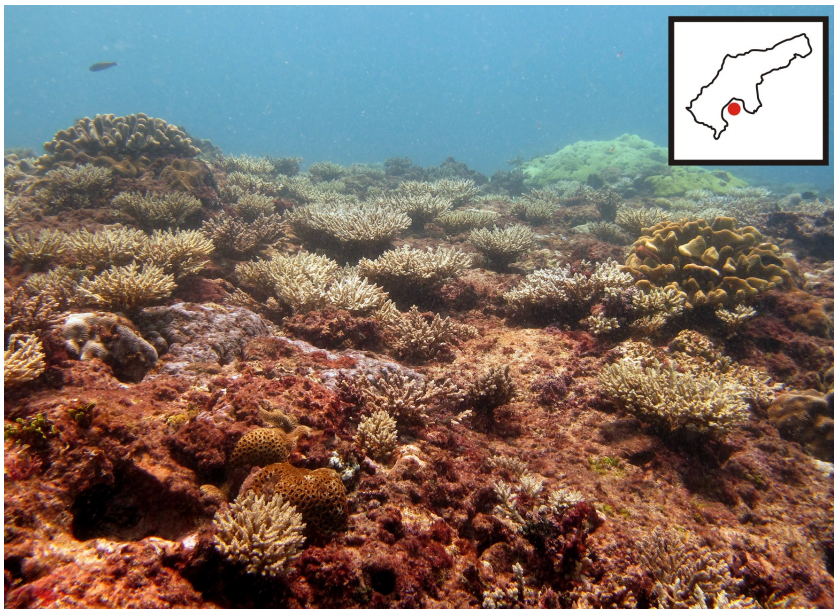


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 30/35: Tuturam



Tuturam is located in Laolao Bay. A natural stream drainage once flowed right through the reef, but construction of an access road changed this, causing heavy sedimentation issues for this and other parts of the Bay. Recent road and drainage improvements have been made and the natural stream has been realigned. Tuturam has a resilience score of 0.58 (anchored to 0.70) and is classified as a medium resilience site. Four of the nine variables used in the resilience analysis have high scores: coral diversity, bleaching resistance, temperature variability, and nutrient input (Table 1). No variables fell within the medium range; the rest of the variables: coral recruitment, herbivore biomass, macroalgae cover, sedimentation, and fishing access all received low scores. Coral diversity is high at the site (Simpson's Index of Diversity value of 0.95) but this site had the highest macroalgae cover of all the sites surveyed. The substrate is made up almost entirely of algae – 82.3%, with only 8.8% live coral and lesser amounts of sand, CCA, and pavement (Fig. 1). One of the coral species originally petitioned in 2009 for endangered species status was observed during these surveys. This species was proposed as 'not warranted' (Table 2). Most of the corals at this site are recruits (<4 cm in diameter) (Fig. 2). Herbivore biomass at the site is 0.45 kg/100m^2 (29/35, Fig. 3) and the herbivorous fish community is dominated by grazers (Fig. 4). Acanthurids have a wider size-class frequency than Scarids, ranging from 5-20 cm (Figs. 5 & 6). All of the Scarids observed were <15 cm in length.

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.95	0.98
Recruitment	8.38	0.59
Bleaching Resistance	72.17	0.82
Temperature variability	0.95	0.96
Herbivore biomass	0.45	0.13
Macroalgae cover*	72.44	0.00
Nutrient input*	4.57	0.84
Sedimentation*	2.14	0.59
Fishing pressure	614	0.35
Resilience score		0.58
Final anchored resilience score (**30**/35)		0.70

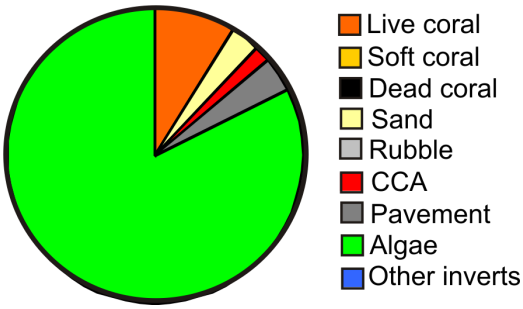


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (1/24)
Cyphastrea ocellina[NW]

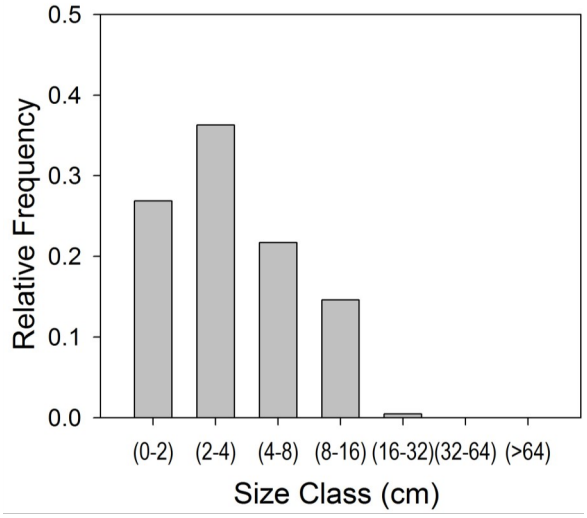


Figure 2. Size-class frequency distribution for stony corals.

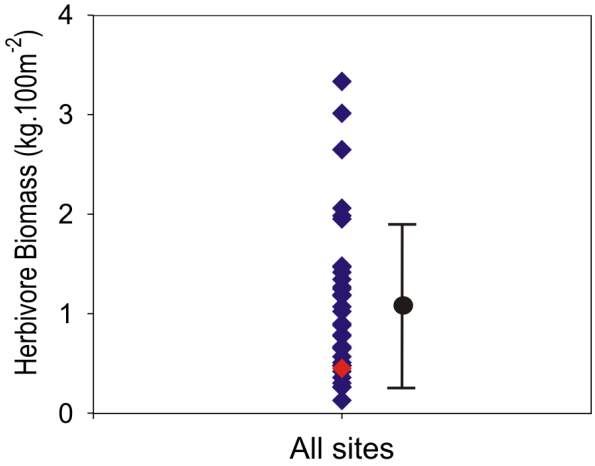


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

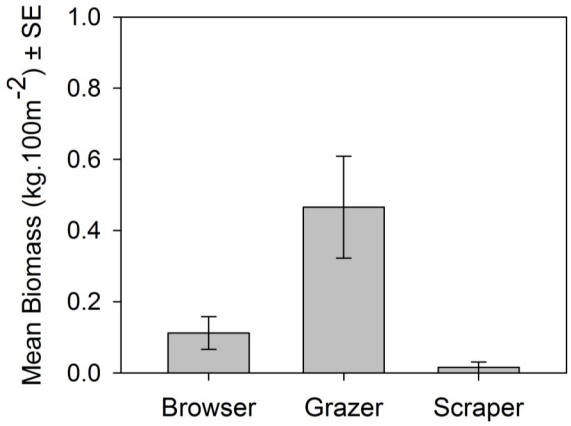


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

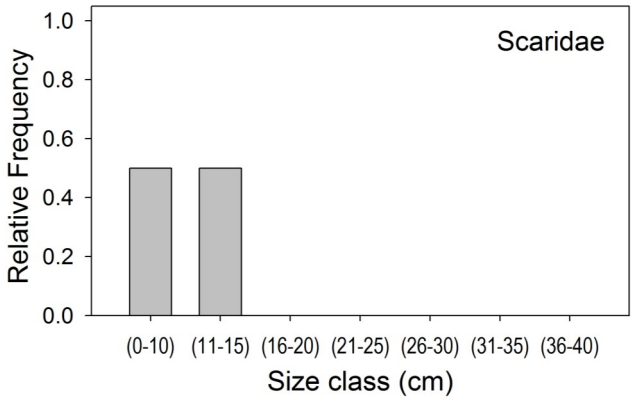


Figure 5. Size-class frequency distribution of Scaridae.

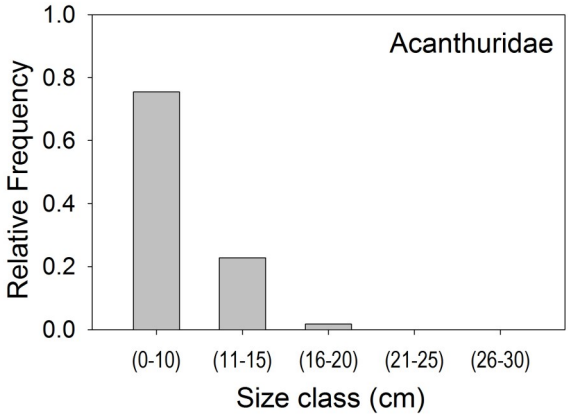
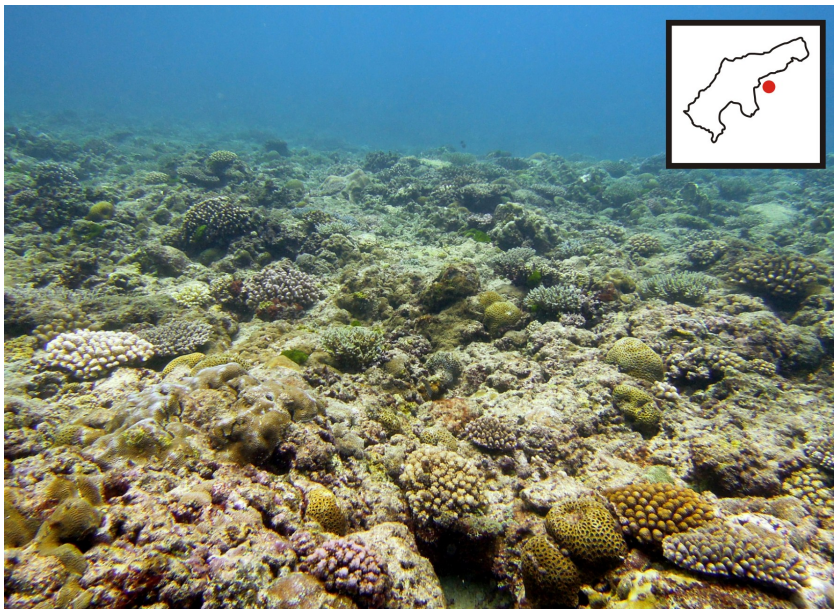


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 31/35: Tank Beach



Tank Beach is located within in the Forbidden Island Marine Sanctuary, on the exposed northeastern boundary. Tank Beach is a well documented turtle nesting site. This site is a Marine Monitoring Team survey site. Ranked 31st overall, Tank Beach has a resilience score of 0.58 (anchored to 0.69) and is classified as a medium resilience site. Coral diversity, bleaching resistance, temperature variability, macroalgae cover, and fishing access all received high scores (Table 1). Bleaching resistance was the only variable to receive a medium score. Coral recruitment, herbivore biomass, nutrient input, and sedimentation all received low scores. Coral diversity was high with a Simpson's Index of Diversity value of 0.96. The substrate at the site is made up by mostly live coral (43.3%) and turf algae (27%) (Fig. 1). Pavement (bare substrate), sand, rubble, and invertebrates make up the remaining area. Tank beach has the lowest scores of all surveyed sites for both nutrient input and sedimentation. Nine of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. Of these 9 species, 7 species were proposed in November 2012 as 'threatened' and 2 species were proposed as 'not warranted' (Table 2). More than half of the corals were very small (<8 cm in diameter) (Fig. 2). Herbivore biomass at the site is 0.26 kg/100m^2 (33/35, Fig. 3) and most herbivorous fish observed were scrapers (Fig. 4). All Scarids observed were 11-15 cm in length (Fig. 5). Acanthurids ranged in length from 5-30 cm with most species 11-20 cm (Fig. 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.96	0.99
Recruitment	6.13	0.43
Bleaching Resistance	68.75	0.78
Temperature variability	0.95	0.96
Herbivore biomass	0.26	0.08
Macroalgae cover*	0.35	1.00
Nutrient input*	27.72	0.00
Sedimentation*	5.26	0.00
Fishing pressure	1771	1.00
Resilience score		0.58
Final anchored resilience score (**31**/35)		0.69

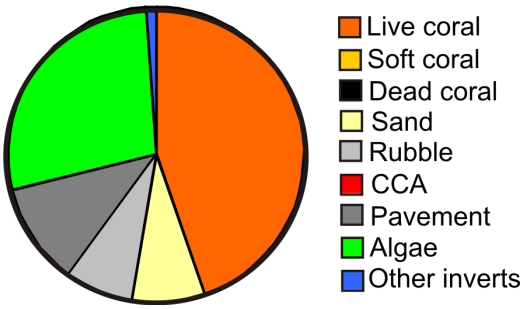


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (9/24)
Acropora aculeus[T]
Acropora vaughani[T]
Acropora verweyi[T]
Cyphastrea ocellina[NW]
Heliopora coerulea[NW]
Millepora tuberosa[T]
Montipora caliculata[T]
Pocillopora danae[T]
Pocillopora elegans[T]

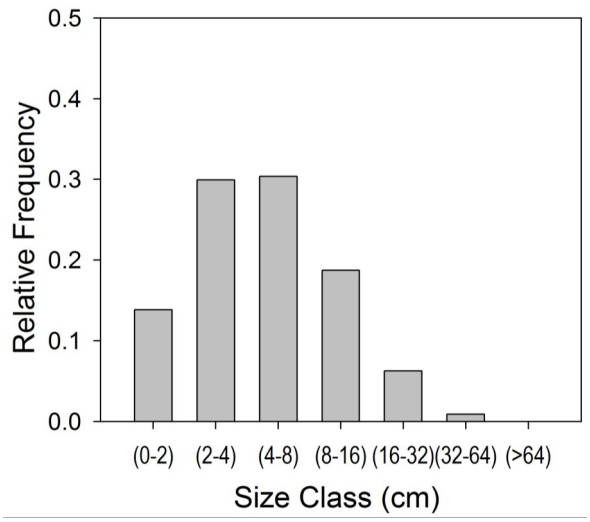


Figure 2. Size-class frequency distribution for stony corals.

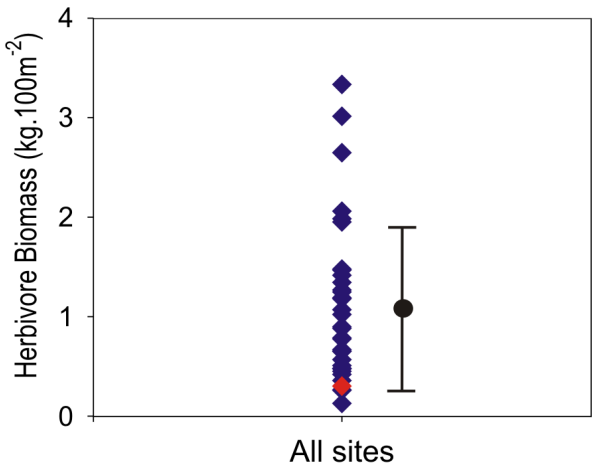


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

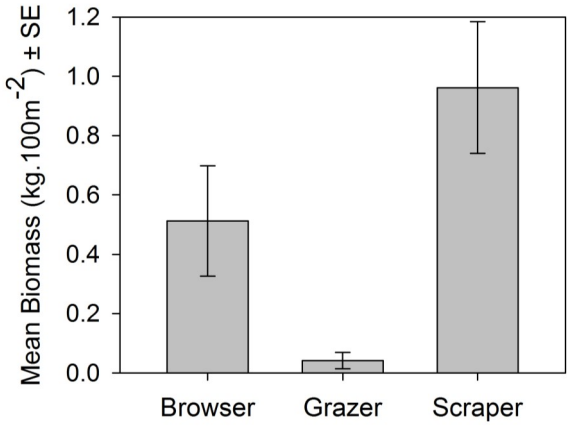


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

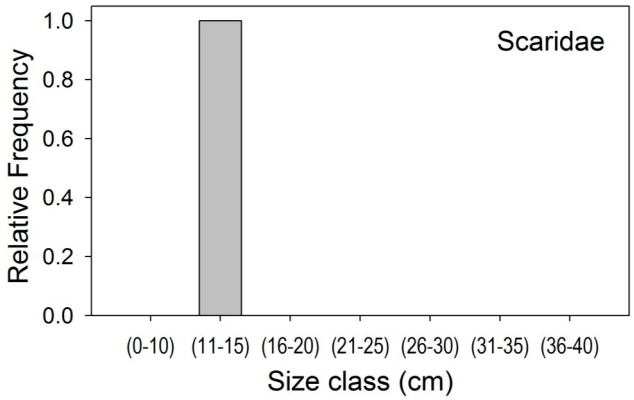


Figure 5. Size-class frequency distribution of Scaridae.

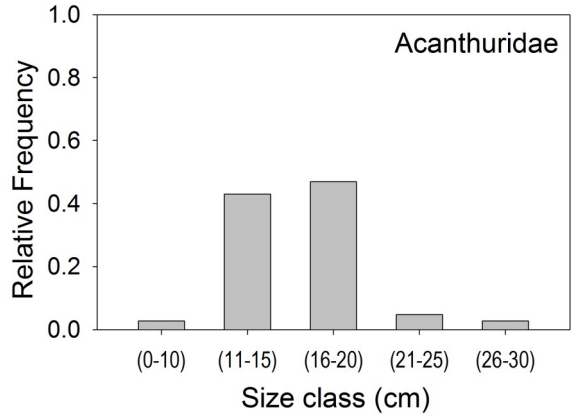
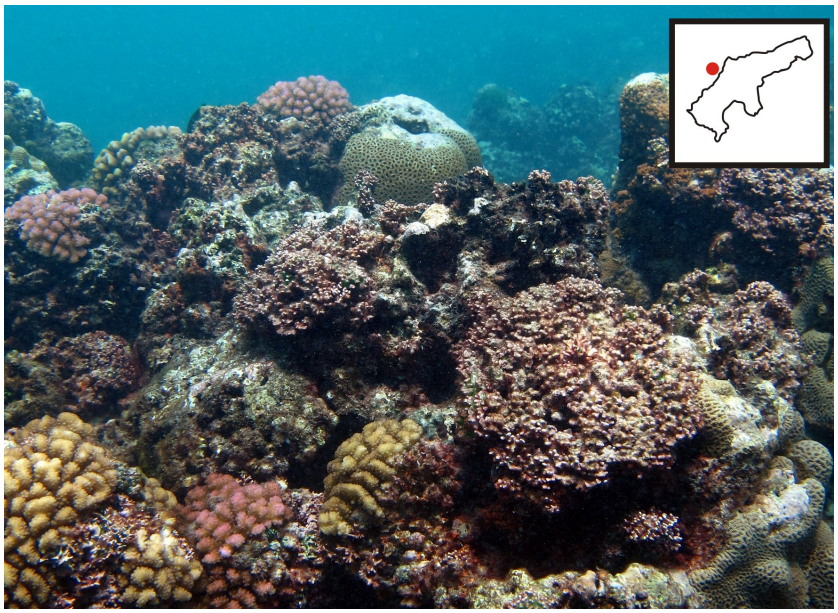


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 32/35: Peysonnelia Reef



This site is one of the CNMI Marine Monitoring Program's long-term survey sites. This site has been affectionately called the 'Peysonnelia Sanctuary' due to the high cover of Peysonnelia, a fleshy red algae. Peysonnelia Reef is the lowest-ranked site (32/35) considered to be a medium resilience site (0.55, anchored to 0.66). Coral diversity, bleaching resistance, temperature variability, and macroalgae cover all received high scores. Herbivore biomass, nutrient input, sedimentation, and fishing access all received low scores (Table 1). The Simpson's Index of Diversity value is 0.79. Algae covers 71.7% of the substrate, though only 0.33% of this is macroalgae (Fig. 1). One of the coral species originally petitioned in 2009 for endangered species status was observed during these surveys. This species was proposed in November 2012 as 'threatened' (Table 2). Most corals observed at the site were very small (<8 cm in diameter) (Fig. 2). Herbivore biomass is 0 .48 kg/100m^2 (26/35, Fig. 3). The herbivorous fish community observed was made up in nearly equal parts of browsers, grazers, and scrapers (Fig. 4). About half of the Scarids observed and almost all Acanthurids observed were less than 15cm in length; the other half of the Scarids were 16-25 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.79	0.82
Recruitment	8.56	0.60
Bleaching Resistance	85.95	0.97
Temperature variability	0.94	0.95
Herbivore biomass	0.48	0.14
Macroalgae cover*	0.33	1.00
Nutrient input*	19.95	0.28
Sedimentation*	4.47	0.15
Fishing pressure	137	0.08
Resilience score		0.55
Final anchored resilience score (**32**/35)		0.66

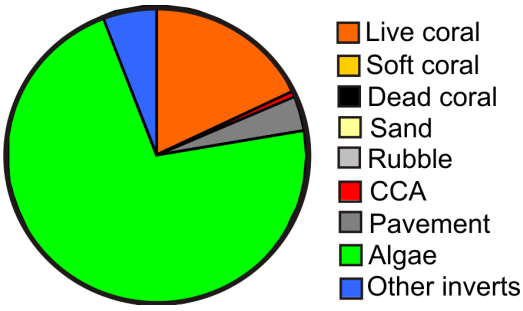


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (1/24)
Acropora vaughani[T]

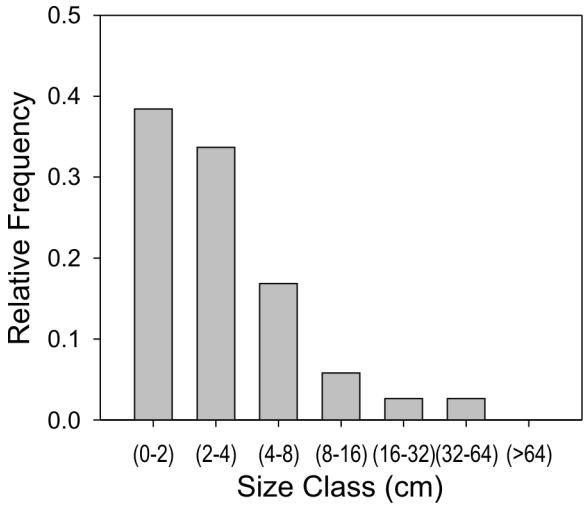


Figure 2. Size-class frequency distribution for stony corals.

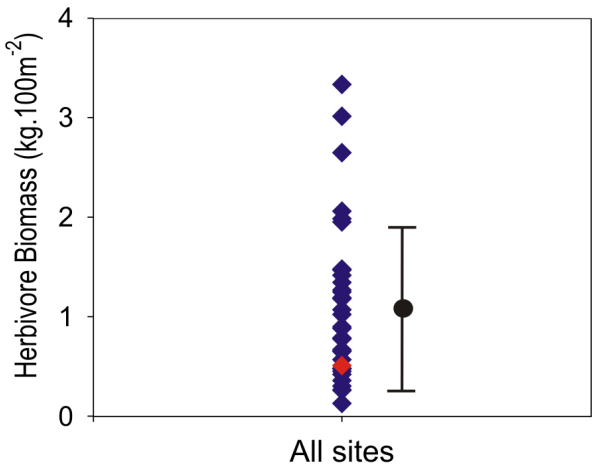


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

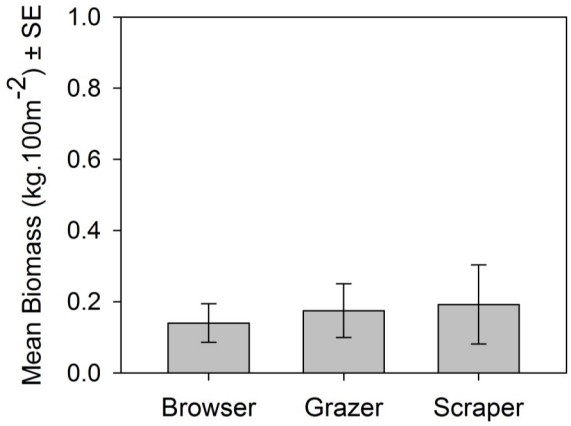


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

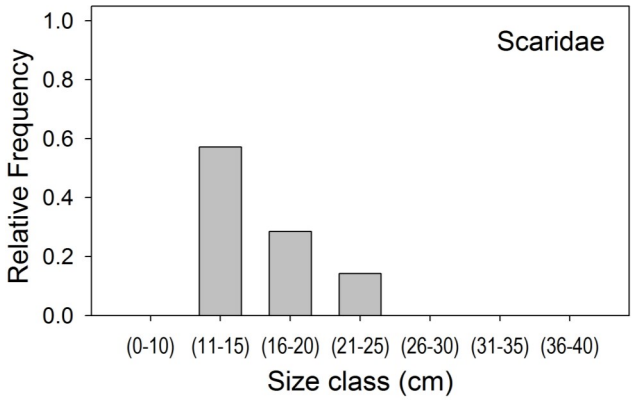


Figure 5. Size-class frequency distribution of Scaridae.

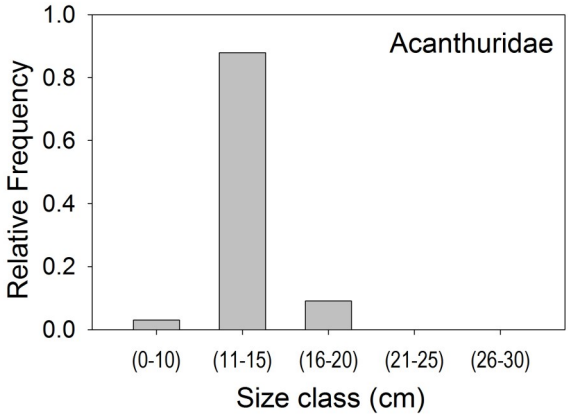
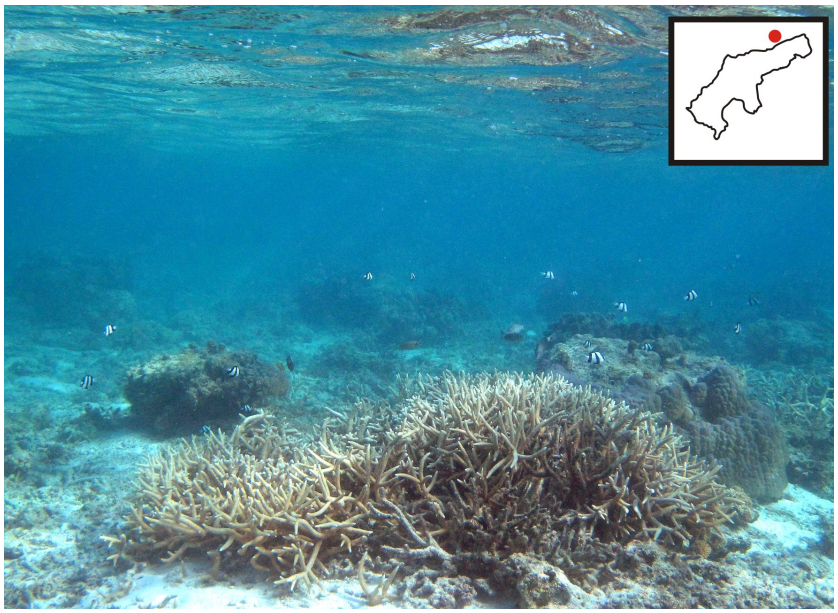


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 33/35: Marianas Resort



Marianas Resort is located within the northern portion of the Saipan Lagoon. The quaint, secluded beach has only one access point – a path from the Marianas Resort & Spa. This is a popular site with snorkelers and during our surveys a black tip reef shark was seen passing through. Marianas Resort is a lagoon site with a resilience score of 0.48 (anchored to 0.57) and is ranked 33/35. This is one of three sites considered to be low resilience sites. Only two variables received high scores: temperature variability and nutrient input (Table 1). Macroalgae cover and sedimentation received medium scores; the remaining five variables used in the resilience analysis received low scores: coral diversity, coral recruitment, bleaching resistance, herbivore biomass, and fishing access. Coral diversity was well below the average (0.85) with a Simpson's Index of Diversity value of 0.48 and about 80% of the coral community is susceptible to bleaching. Live coral and algae each account for 43% of the substrate while sand, rubble, CCA, and pavement can be found in lesser amounts (Fig. 1). One of the coral species originally petitioned in 2009 for endangered species status was observed during these surveys. This species was proposed in November 2012 as 'threatened' (Table 2). Coral recruitment was the second lowest of all the sites surveyed and most corals observed at this site were small (<16 cm in diameter) (Fig. 2). Herbivore biomass was 0.88 kg/100m^2 (18/35, Fig. 3) and the herbivorous fish community observed was mostly comprised of scrapers (Fig. 4). Size-class frequencies for Scarids and Acanthurids are similar; most fish observed in these families were <15 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.43	0.45
Recruitment	0.94	0.07
Bleaching Resistance	20.00	0.23
Temperature variability	0.96	0.97
Herbivore biomass	0.88	0.26
Macroalgae cover*	22.33	0.69
Nutrient input*	2.34	0.92
Sedimentation*	1.53	0.71
Fishing pressure	7	0.00
Resilience score		0.48
Final anchored resilience score (**33**/35)		0.57

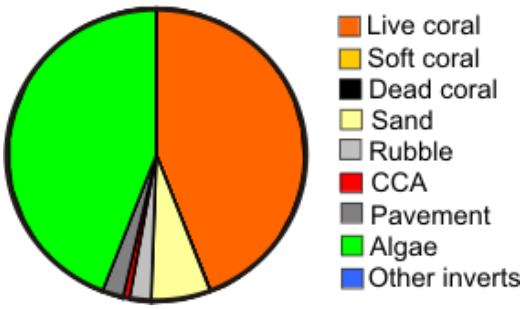


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (1/24)
Acropora aspera[T]

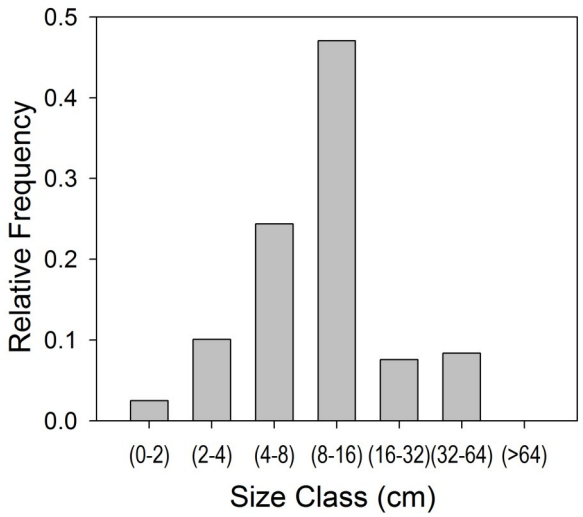


Figure 2. Size-class frequency distribution for stony corals.

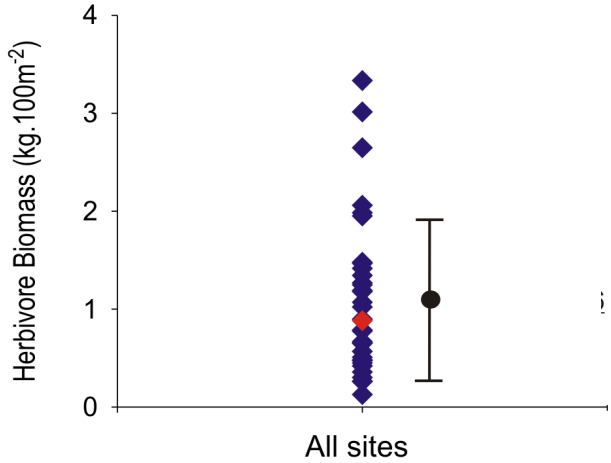


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

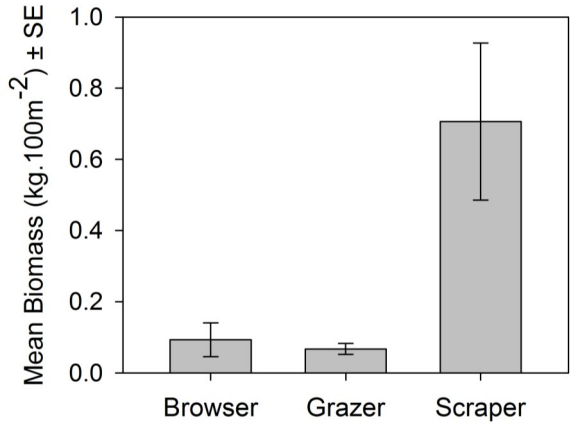


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

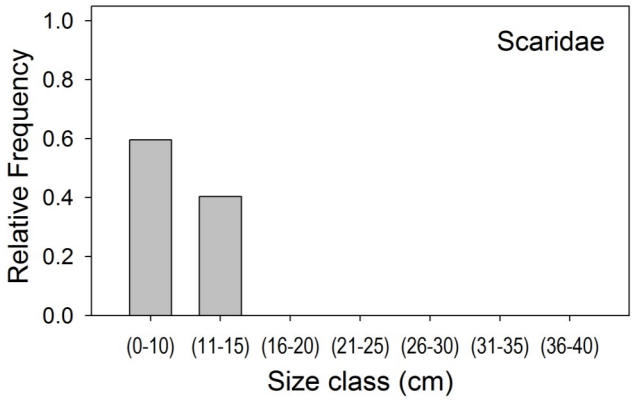


Figure 5. Size-class frequency distribution of Scaridae.

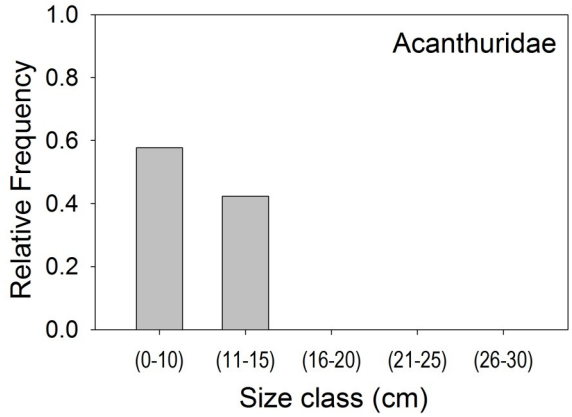
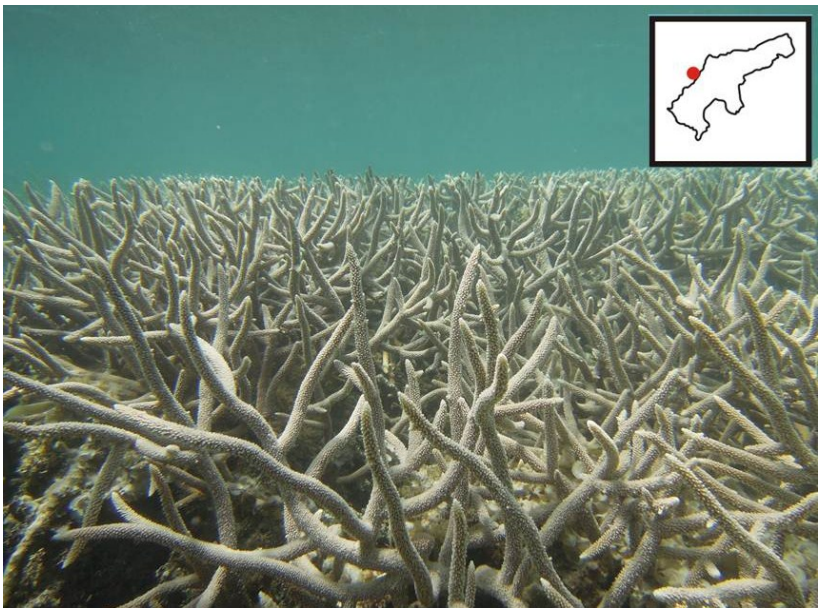


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 34/35: Quartermaster Staghorn



Quartermaster Staghorn is located in the central portion of the Saipan Lagoon. The survey site falls just within the Lighthouse Reef Trochus Sanctuary. Quartermaster Staghorn is ranked 34th overall and with a resilience score of 0.44 (anchored to 0.53) is classified as a low resilience site. Temperature variability and nutrient input are the only variables to have received high scores with just sedimentation receiving a medium score (Table 1). Six of the nine variables used in the resilience assessment received low scores: coral diversity, coral recruitment, bleaching resistance, herbivore biomass, macroalgae cover, and fishing access. Coral diversity is very low at this site with a Simpson's Index of Diversity value of 0.10. In addition, 80% of the coral community is susceptible to bleaching, resulting the second lowest score of all sites for this variable. Live corals account for 63% of the substrate and algae for 32.3%; 3% or less of sand and rubble make up the remaining area (Fig. 1). One of the coral species originally petitioned in 2009 for endangered species status was observed during these surveys. This species was proposed in November 2012 as 'threatened' (Table 2). Most corals observed are small (<16 cm in diameter) Quartermaster Staghorn has mostly large corals with diameters >64 cm (Fig. 2). Herbivore biomass at the site is 1.42 kg/100m^2 (9/35, Fig. 3). The herbivorous fish observed were mostly scrapers (Fig. 4). The size-class frequencies for Scarids and Acanthurids are similar; most fish in these families observed are 11-15 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.10	0.10
Recruitment	1.06	0.07
Bleaching Resistance	20.00	0.23
Temperature variability	0.94	0.95
Herbivore biomass	1.42	0.42
Macroalgae cover*	32.33	0.55
Nutrient input*	2.04	0.93
Sedimentation*	1.43	0.73
Fishing pressure	10	0.01
Resilience score		0.44
Final anchored resilience score (**34**/35)		0.53

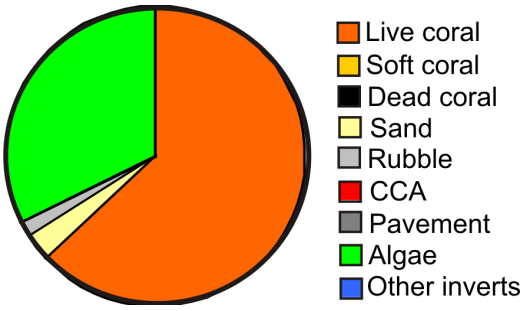


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (1/24)
Acropora aspera[T]

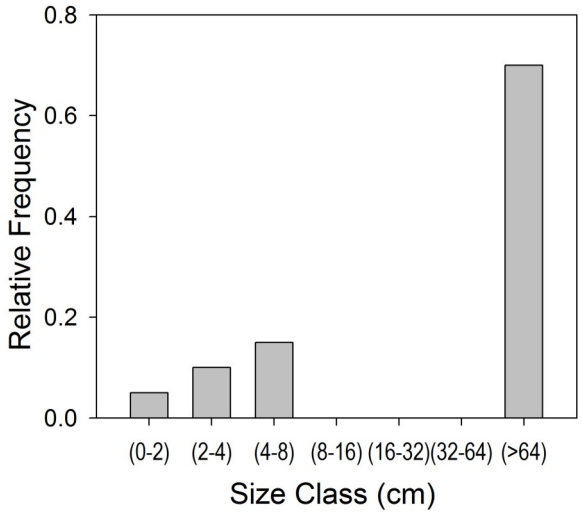


Figure 2. Size-class frequency distribution for stony corals.

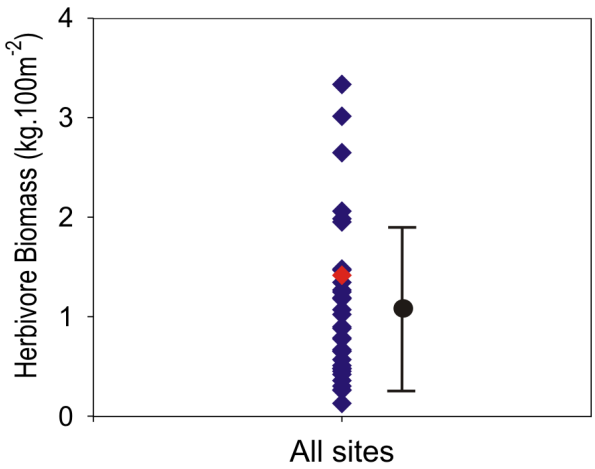


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

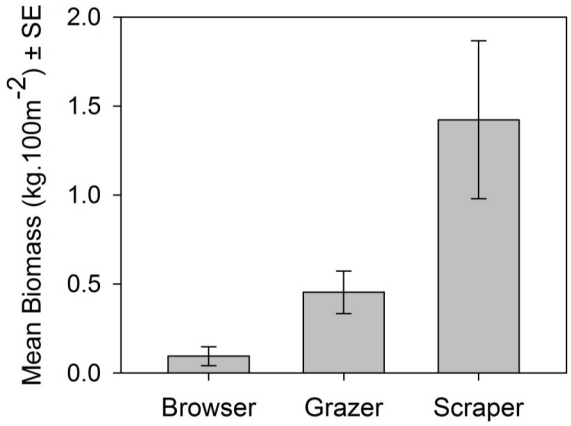


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

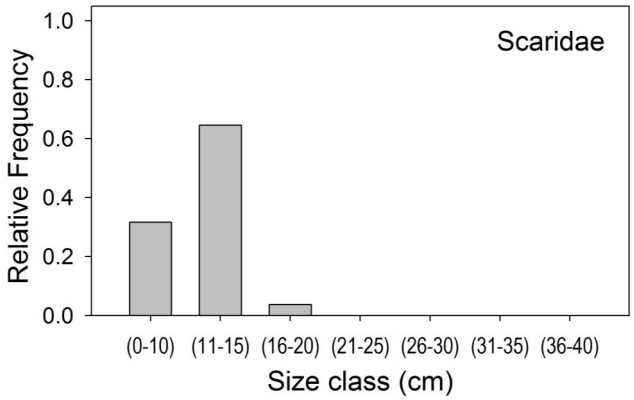


Figure 5. Size-class frequency distribution of Scaridae.

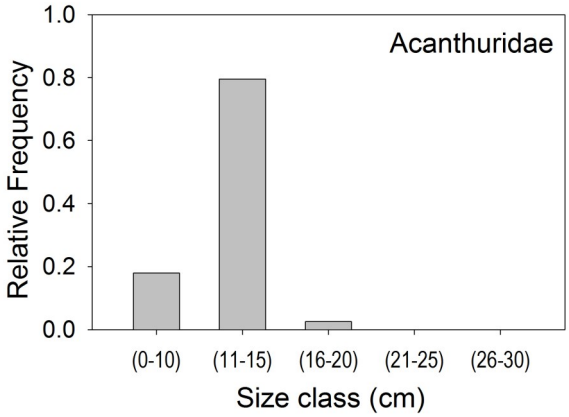
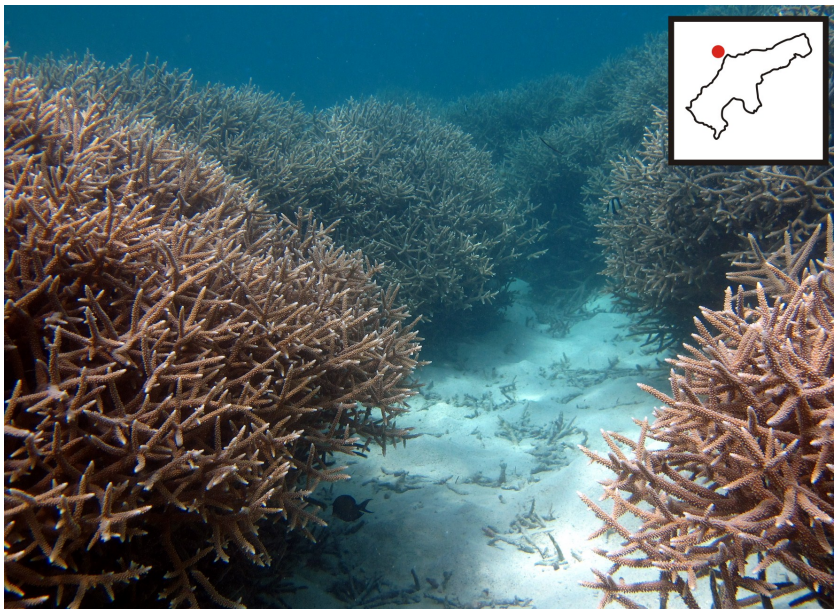


Figure 6. Size-class frequency distribution of Acanthuridae.

Rank 35/35: Fishing Base Staghorn



Fishing Base Staghorn is located within the Saipan Lagoon. This extensive patch of *Acropora* aspera is found just off of the Garapan Fishing Base dock, where an old fisherman's co-op was once located. Fishing Base Staghorn is the lowest ranking site with a resilience score of 0.41 (anchored to 0.49), and is considered a low resilience site (Table 1). Temperature variability, macroalgae cover, and nutrient input all received high scores while sedimentation received a medium score. Five of the variables used in the resilience analysis received low scores: coral diversity, coral recruitment, bleaching resistance, herbivore biomass, and fishing access. Other sites may have more had more variables with low scores, however, three of these variables at this site received anchored scores of 0.00, the lowest score possible. Though coral cover at this site is 100% (Fig. 1), there is no diversity (Simpsons Index of Diversity value is 0). One of the coral species originally petitioned in 2009 for endangered species status were observed during these surveys. This species was proposed in November 2012 as 'threatened' (Table 2). This coral species is highly susceptible to bleaching. All corals observed at Fishing Base Staghorn were >64 cm in diameter (Fig. 2). Herbivore biomass is 0.42 kg/100m^2 (30/35, Fig. 3) and most of the herbivorous fish community observed were scrapers (Fig. 4). Most Scarids and Acanthurids observed were <15 cm in length (Figs. 5 & 6).

Table 1. Raw and anchored scores for all resilience variables, and the final resilience score and ranking for this site out of 35.

Variable	Raw Value	Anchored Score
Coral Diversity	0.00	0.00
Recruitment	0.00	0.00
Bleaching Resistance	0.00	0.00
Temperature variability	0.95	0.96
Herbivore biomass	0.42	0.13
Macroalgae cover*	0.00	1.00
Nutrient input*	2.62	0.91
Sedimentation*	1.62	0.69
Fishing pressure	13	0.01
Resilience score		0.41
Final anchored resilience score (**35**/35)		0.49

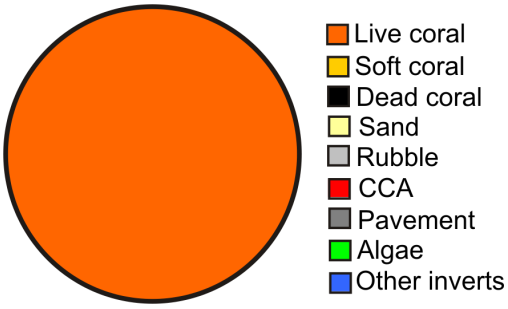


Figure 1. Proportion of the substrate covered by 9 groups.

Table 2. Coral species observed originally petitioned in 2009 for endangered species status by the NMFS. Proposed classifications were released in November 2012—T= Threatened, and NW = Not Warranted.

Species observed (1/24)
Acropora aspera[T]

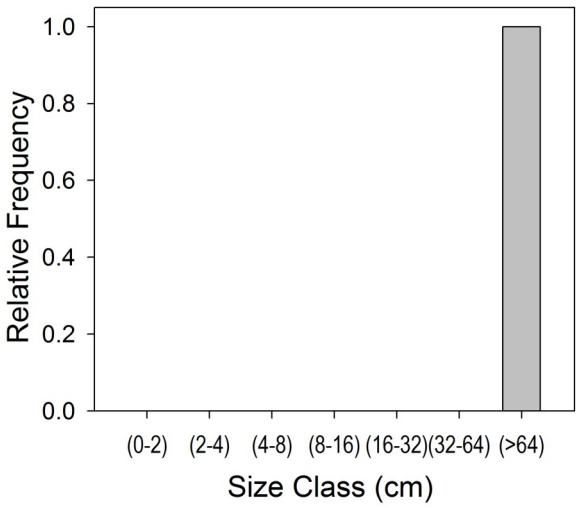


Figure 2. Size-class frequency distribution for stony corals.

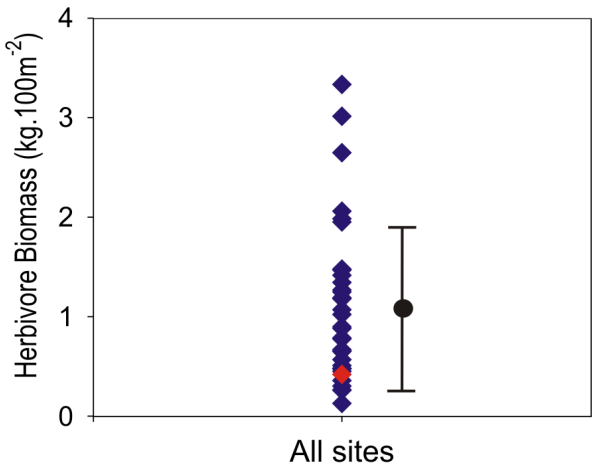


Figure 3. Herbivore biomass for the site (in red) amongst all sites surveyed.

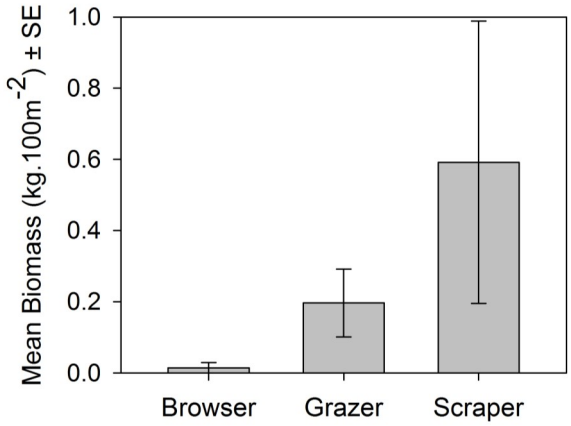


Figure 4. Proportion of the observed herbivorous fish community made up by three IUCN functional group classifications.

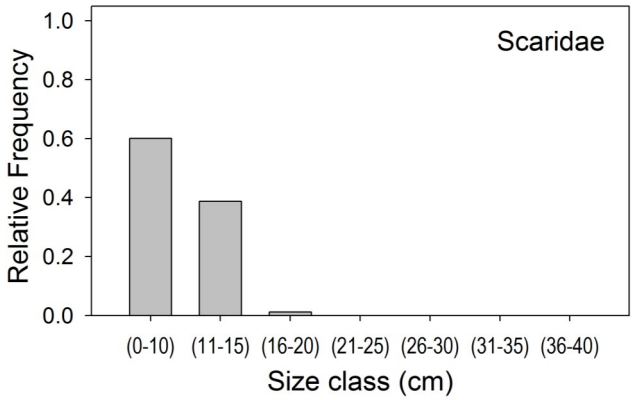


Figure 5. Size-class frequency distribution of Scaridae.

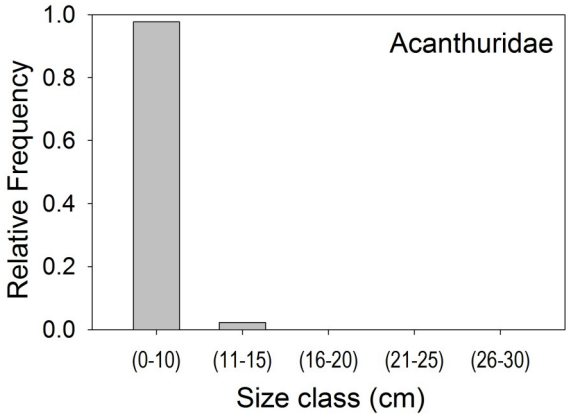


Figure 6. Size-class frequency distribution of Acanthuridae.