

Distribution and abundance of *Montipora dilatata* in Kaneohe Bay, Oahu, Hawaii

Cover Photo—*Kappaphycus* spp. encroaching on *Montipora dilatata* on Reef 44 in Kaneohe Bay, Hawaii, in August 2008.



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Abstract:

The Hawaiian reef coral *Montipora dilatata*, described as one of the rarest coral species in the Pacific (Veron 2000; Maragos *et al.* 2004; Fenner 2005), has suffered a dramatic decline in the previous decades due to freshwater kills, invasive algae, and habitat degradation (NOAA 2007). In the summer of 2008, visual surveys were conducted in Kaneohe Bay, Oahu, Hawaii, in areas of historical *M. dilatata* presence, and in areas where the habitat was suspected to be suitable. Surveys were conducted at 24 sites, with 20 *M. dilatata* colonies found in clumped distributions at 5 of the sites. Invasive algae presence was quantitatively analyzed around each colony, and was found to be a threat to the continued health and survival for one of these colonies. Algal biomass extraction efforts were made around this colony to conserve the specimen and to assess the long-term effectiveness of selected algae removal. Based on the multitude of threats this species faces, including alien algae presence and the Allee effect, further monitoring of recorded colonies along with expanded conservation efforts is needed.

Introduction:

The Hawaiian reef coral *Montipora dilatata*, a Pacific Islands Region Species of Concern (SOC), has declined dramatically over the past few decades (NOAA 2007). There is a critical need for monitoring to assess population size and to improve our understanding of possible factors for any further decrease in population numbers for this species. Monitoring data will aid the National Marine Fisheries Service (NMFS) Pacific Islands Regional Office (PIRO) in determining whether on-the-ground conservation measures (e.g., continued removal of alien/invasive algae from SOC habitats; test

reintroductions of captively propagated individuals) are effective in protecting this species from further decline in Kaneohe Bay, Oahu, Hawaii.

In 2000, surveys of *M. dilatata* identified only three colonies in Kaneohe Bay, Oahu, Hawaii, where it formerly was more abundant (J.E. Maragos, pers. comm.). As part of the University of Hawaii-Manoa (UHM) field course surveys in 2007, students as well as coral experts again only positively identified three *M. dilatata* colonies in Kaneohe Bay (although not the same colonies originally identified in 2000, which have not been relocated), and were unsuccessful in clearly identifying it from other species within the same genus, particularly *M. incrassata* (Hunter *et al.* 2008). One *M. dilatata* colony that was positively identified in 2007 was found to have invasive *Eucheuma* spp. growing within centimeters of its perimeter in 2008, threatening to overgrow and kill the colony. Habitat degradation as a result of sedimentation, pollution, alien/invasive algae species, and a limited distribution may be contributing factors to the apparent decline of this species in Kaneohe Bay. Proper identification and monitoring of *M. dilatata* would ultimately provide insight into the actual endangerment of this species and to better inform management strategies. Due to the morphological plasticity of *M. dilatata* (incrusting to branching colony forms, with and without verrucae), a positive identification can be difficult in the field.

The goals of this study were to: 1) conduct surveys to map the current occurrences of *M. dilatata* throughout Kaneohe Bay and compare these results to 2007 and prior surveys to see if recent removal of invasive alien algae has aided recovery efforts; 2) collect and photograph three to five samples of the species and provide to Drs. Rob Toonen and Zac Forsman (UHM) for genetic and morphological analyses; 3) quantify the

current occurrence of alien/invasive algae in *M. dilatata* habitat; and 4) remove alien/invasive algae in proximity to *M. dilatata*.

Methods:

Field surveys of *Montipora dilatata* were conducted in July and August, 2008. Patch reefs throughout Kaneohe Bay were selected for surveying based on satellite imagery. Reefs that appeared to be suitable habitats were chosen. Specimens of *Montipora dilatata*, known from previous studies, were surveyed to examine their status. Ten student researchers were transported to the selected reefs and swimming surveys were conducted by snorkeling on the tops of the patch reefs in shallow water (<3 m). No specific search pattern was employed. Dr. J.E. Maragos, one of the world's foremost coral experts, joined one of the surveys and confirmed that the previously located specimens were *M. dilatata* based upon morphology. Individual specimens were photographed and marked with a GPS device.

The researchers returned to the located specimens and performed four 10 meter transect surveys in the north, south, east, and west directions from the coral colonies. Percent cover of algae was recorded per square meter of transect. Invasive algae including *Gracilaria salicornia*, *Kappaphycus/Eucheuma* spp., and *Acanthophora spicifera* located along these transects were noted and removed.

Results:

Out of 24 surveys conducted, 20 *M. dilatata* colonies were found on 5 different reefs in Kaneohe Bay, Hawaii (Figure 1). Another six possible colonies were found

around Kaneohe Bay but could not be confidently identified due to the varied morphological differences in this species. Six colonies were found on Patch Reef 44. Of these six colonies, only Colony #5 was surrounded by *Kappaphycus* spp. Four transects were conducted along north, south, east, and west radii from Colony #5 to measure percent abundance of *Kappaphycus* spp. The south transect contained 20% *Kappaphycus* spp. The north transect had less than 20% *Kappaphycus* spp., although the majority of the area immediately next to the colony contained as much as 40%. The east transect averaged 20% *Kappaphycus* spp. with one square meter of the transect containing 60% *Kappaphycus* spp. The west transect ranged from 10% to 65% *Kappaphycus* spp. abundance (Figure 2).

Four transects were examined to assess the percent abundance of *Kappaphycus* spp. around Colony #5 after the alien algal removal on August 5, 2008. The north, west and east transects were reduced to less than 10% *Kappaphycus* spp. The south transect showed a reduction in *Kappaphycus* spp., however the abundance still ranged from 20% or greater. All other colonies found on Reef 44 had no *Kappaphycus* spp. within a 20 meter diameter (Figure 3). Five mesh bags of *Kappaphycus* spp. weighing approximately 75 pounds each (375 pounds total) were removed from Reef 44 by eight snorkelers in one hour.

The colony found at Reef 20 had *G. salicornia*, *A. spicifera*, and *Kappaphycus* spp. present around the colony. The north, west, and south transects had 10% *Kappaphycus* spp. or less throughout the 10 meter transect. These transects also had 5% or less of *G. salicornia*, and *A. spicifera* was present in ranges of 3% to 60% along the west transect and 25% or less on the north transect. There was no alien algae on the east

transect (Figure 4). Eleven colonies were found on Patch Reef 47, of which three were relatively larger in size, estimated at 1 m in diameter, and the remaining eight colonies were of relatively smaller size. Colonies on Reef 47 did not show any immediate threats from alien algae over-growth.

The *M. dilatata* colony located on Checker Reef was found by J.E. Maragos down the reef slope where alien algae were not present. Also, the colony on the fringing reef next to Sampan Channel was not threatened by alien algae.

Discussion:

Montipora dilatata only occurs in Hawaii and is becoming increasingly rare (Maragos 1977; NOAA Fisheries 2007). In 2004, NOAA declared *M. dilatata* a species of concern. Due to increasing habitat degradation, invasive algae overgrowth, and pollution (NOAA Fisheries 2007) extensive surveys have been conducted to quantify the abundance and possible threats to the species. Surveys conducted in previous years were unsuccessful in properly identifying *M. dilatata* in the field making it difficult to locate and compare to previous surveys. During this survey, proper identification was conducted with the help of J.E. Maragos, an expert in coral biology and morphology.

Of the 20 colonies found, Colony #5 from Reef 44 was the most threatened by *Kappaphycus* spp. over-growth. The results indicated a significant change in the abundance from transects taken before and after manual removal of *Kappaphycus* spp. (Figures 2 and 3). The south transect had a small change in abundance because of the difficulties in removing the clumps of *Kappaphycus* spp. growing within the coral branches and multiple holdfasts that anchor the mats.

The colonies that were found on Reef 44 were clustered towards the center and eastern half of the reef. This is north of the area where there has been some previous removal of *Kappaphycus* spp. by the “Super Sucker,” a device used by the State of Hawaii to manually remove alien algae. The western half of the reef has a substantially greater amount of *Kappaphycus* spp. cover.

The colony found on Reef 20 was located on the edge of the reef slope and showed less of a threat from algal over-growth with no algae directly in contact with the coral (Figure 4). There was no removal of algae at this site due to time constraints and the threat was less immediate than the colony on Reef 44. Careful monitoring at this site should be maintained none the less to prevent a future loss of this colony to algal over-growth.

Ten of the colonies found on Reef 47 were found on the northern side of the reef (Figure 1) within three meters of each other, possibly indicating fragmentation of the original colony (Jokiel *et al.* 1983; Heyward and Stoddart 1985; Cox 1992). Another colony was found on the western side of the reef and is less likely to be from fragmentation of the northern colonies. More genetic testing needs to be done in order to genetically identify these colonies. Even though these colonies have no immediate threat from algal over-growth, possible reproductive isolation (Allee effect) should be considered a possible threat to the species in the future. Colonies on Checker Reef and fringing reef next to Channel Marker 23 were in no immediate threat from algal over-growth, but monitoring should be continued to ensure the existence and health of these colonies.

The threat posed to *Montipora dilatata* is a unique case of a possible loss in coral biodiversity from stressors on a local scale verses the global threat of warming ocean water. Alien algae over-growth is a form of habitat destruction that contributes to the stressors already in place from global climate change. The “Super Sucker” is an innovative and non-destructive way to remove alien algae from the reefs. Introducing biological control (e.g., the native sea urchin, *Tripneustes gratilla*) can potentially prevent algal over-growth from returning, but further research is needed to understand the full potential of this option (Conklin and Smith 2005). *M. dilatata* is possibly one of the rarest and endemic species of coral in Hawaii--maybe even in the United States (J.E. Maragos, pers. comm.), and needs to be continually monitored and actively protected to ensure its survival in the wild.

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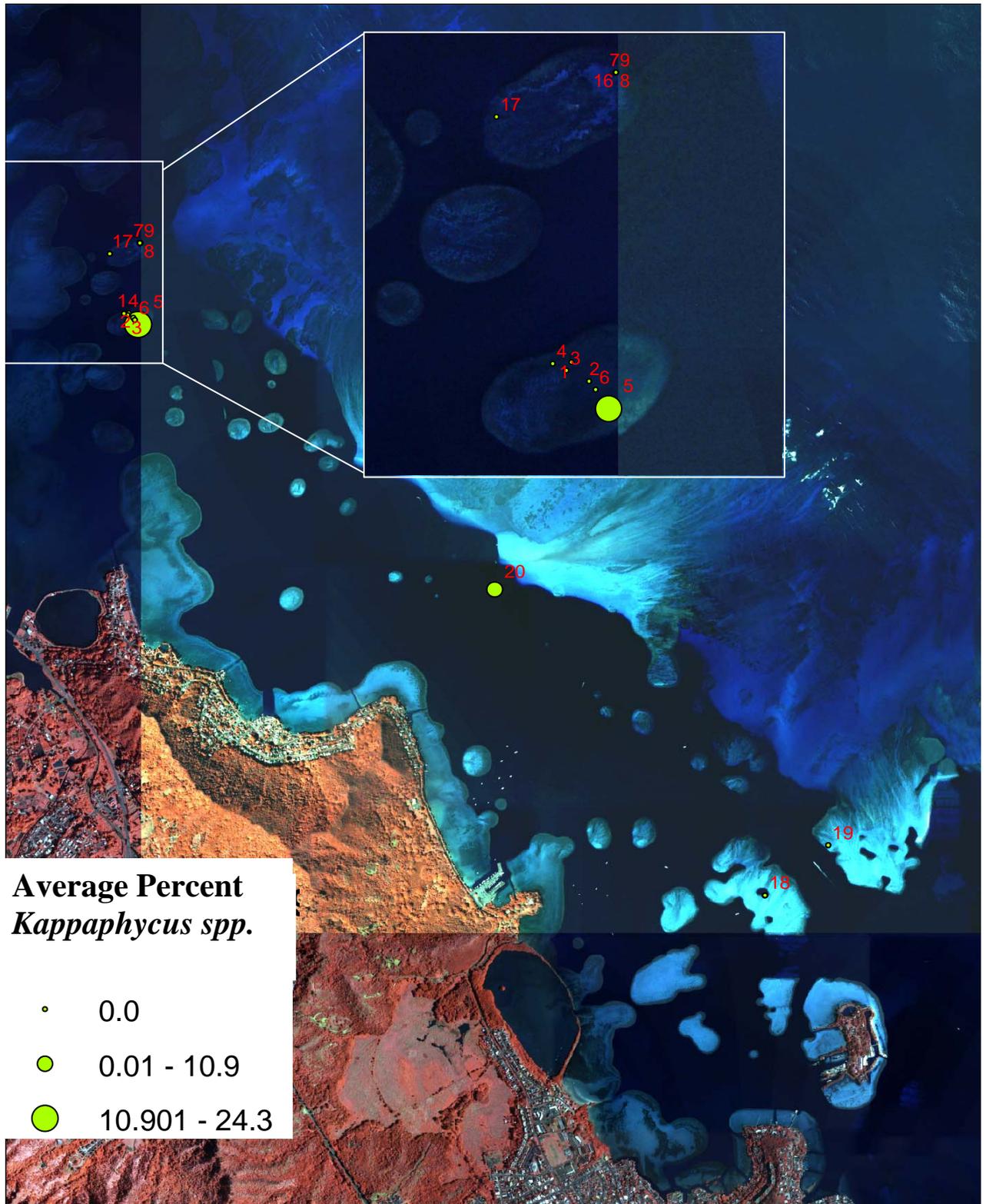


Figure 1: Locations and average percent abundance of alien algae found around each *Montipora dilatata* colony in Kaneohe Bay, Hawaii.

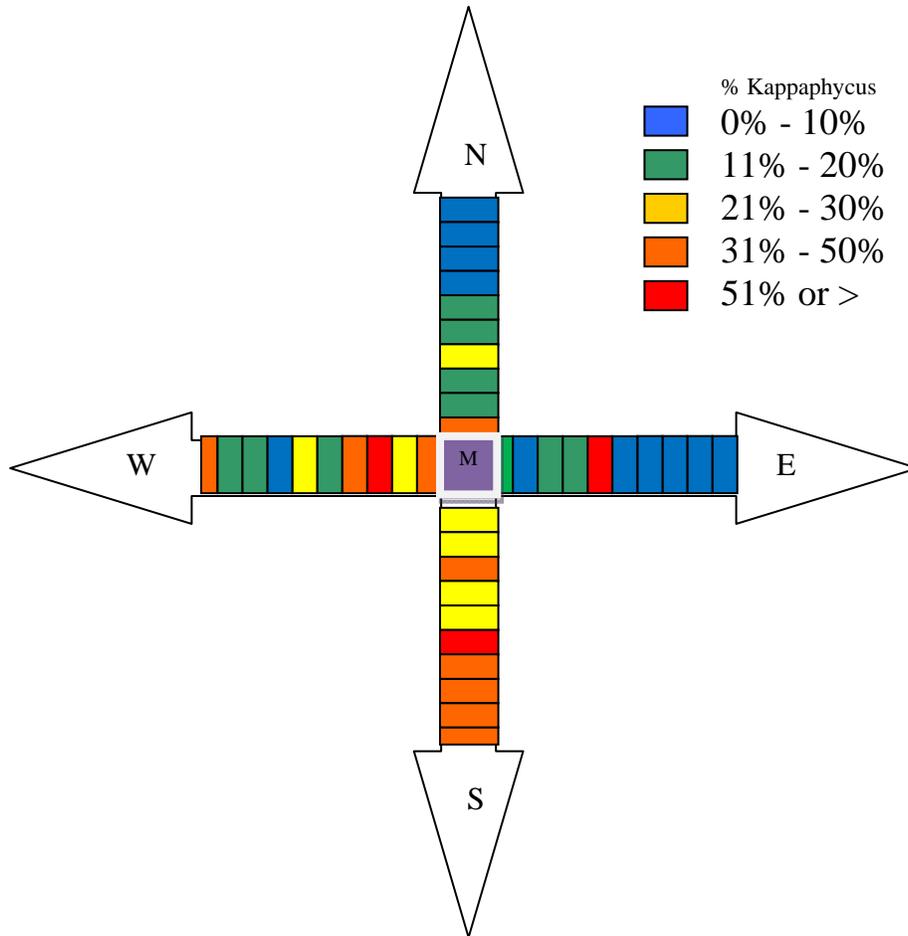


Figure 2: Depiction of four transects conducted on Colony 5 from Reef 44 before *Kappaphycus spp.* removal. Each colored block represents one square meter.

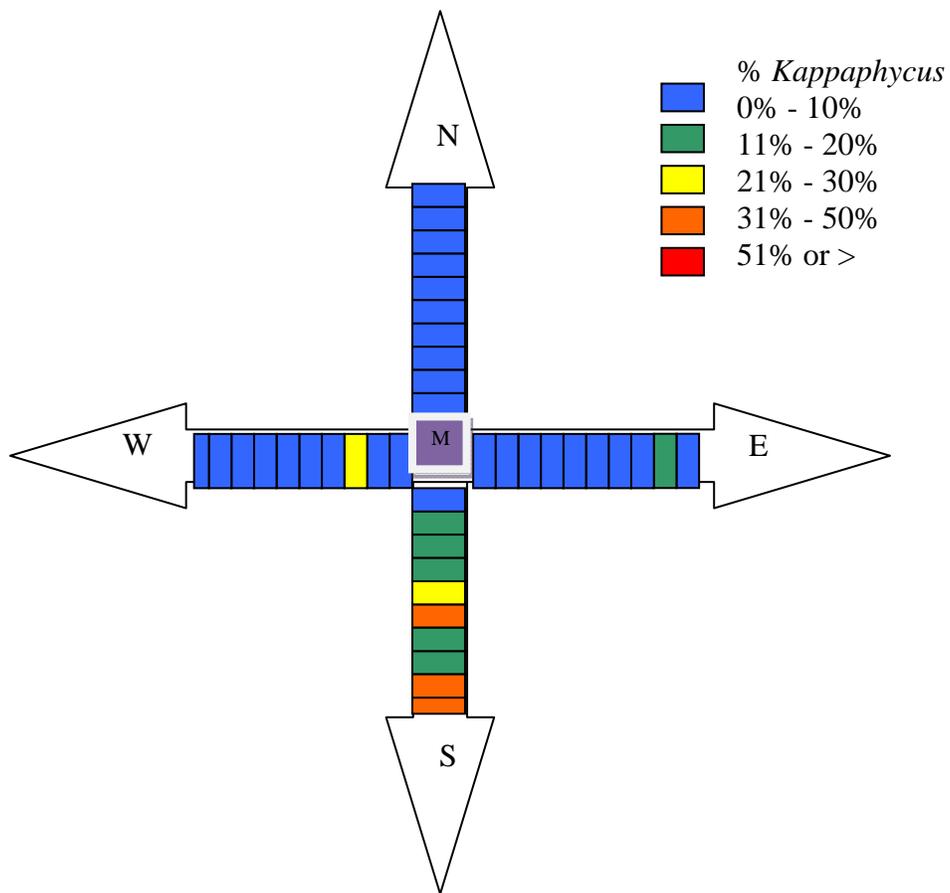


Figure 3: Depiction of four transects on colony 5 from Reef 44 after *Kappaphycus spp.* removal. Each colored block represents one square meter.

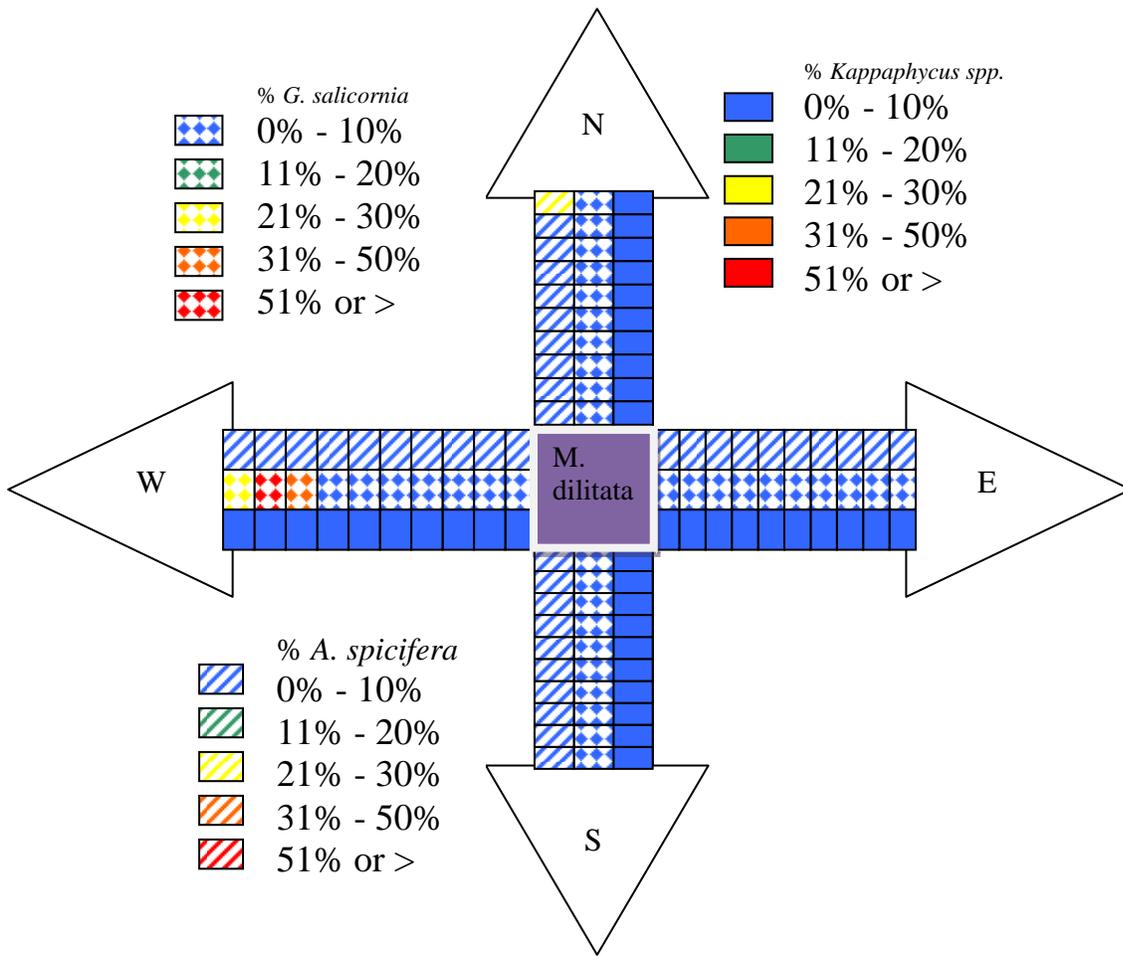


Figure 4: Depiction of four transects conducted over *Montipora dilatata* colony on Reef 20. Each colored block represents one square meter.



Figure 5: *Montipora dilatata* colony (Colony #5) at Reef 44 being overgrown by *Kappaphycus spp.* prior to algal removal (Photo by: J.E. Maragos)

Appendix A. GPS coordinates (decimal degrees) for *Montipora dilatata* colonies located in Kaneohe Bay, Oahu, Hawaii; July-August, 2008.

Reef #	Colony	Long	Lat	Depth (cm)	Diam. (cm)	Mean % Kap
44	1	-157.83217	21.47768	60	150	0
44	2	-157.8319	21.4774	100	60	0
44	3	-157.83225	21.47756	80	100	0
44	4	-157.83246	21.47766	200	60	0
44	5	-157.8316	21.477	130	60	24.3
44	6	-157.8318	21.47728	n/a	n/a	0
47	7	-157.83145	21.48187	n/a	n/a	0
47	8	-157.83145	21.48187	n/a	n/a	0
47	9	-157.83145	21.48187	n/a	n/a	0
47	10	-157.83145	21.48187	n/a	n/a	0
47	11	-157.83145	21.48187	n/a	n/a	0
47	12	-157.83145	21.48187	n/a	n/a	0
47	13	-157.83145	21.48187	n/a	n/a	0
47	14	-157.83145	21.48187	n/a	n/a	0
47	15	-157.83145	21.48187	n/a	n/a	0
47	16	-157.83145	21.48187	n/a	n/a	0
47	17	-157.8333	21.48124	n/a	n/a	0
Across (N)	18	-157.79367	21.44258	n/a	n/a	0
from 8	19	-157.7898	21.44555	n/a	n/a	0
20	20	-157.81	21.461	n/a	n/a	10.9