Study V: Abundance and distribution of algal species on the island of Dominica, Lesser Antilles

James Ritzmann
Institute for Tropical Marine Ecology
P.O. Box 944, Roseau Commonwealth of Dominica

Abstract Many general surveys have been done in the waters of Dominica, West Indies in the past nine years. These studies have examined the general makeup of the benthic communities and species interactions. Despite this there has been no major record of what species of algae are found here since 1970. Thirty species were identified in three habitats (rock, coral reef, and seagrass).The algal presence was surveyed at twenty-one sites along the west coast ranging from 100 to 2100 squared meters, at depths of zero to fifteen meters. Rocky habitats and coral reefs were 51% similar in algal community structure and there was virtually none between hard substrates (rock and coral reef) and seagrass. This may be due to the fishing pressures and practices that are used and the addition of marine reserves may be beneficial to the marine environment in controlling algal overgrowth.

Keywords Dominica • Algae • Species inventory • West Indies • Habitat distribution

Introduction

Early surveys of algae in Dominica were carried out by Randolph and Rhyne (1970). More recently, there have been a few different types of algal and benthic surveys in the waters of Dominica. These surveys examined the make up the benthic communities (Lehman 2001; Wallover 2005), and the comparison between macro algal cover and the abundance of grazers in the reef ecosystem (Willette 2001; McKinney 2002; Alfsnes 2004). These studies showed the total algal cover was between 45-50% of the benthic community (Williams 2001; Alfsnes 2004), and that there was a negative correlation between macroalgal cover and grazer abundance (Steiner and Williams 2005). However, these studies did not include an inventory of algal.

Dominica is one of the youngest volcanic islands of the Lesser Antilles, with very steep mountain ranges that are covered in dense vegetation. The island shelf ranges from 0-1km from shores (Imray et al. 1995). The steep terrain makes it so that the majority of the population lives within close proximity of littoral and sublittoral habitats (Diamond 2001). This puts most

population centers near shore and puts anthropogenic disturbances close to near shore marine resources (Steiner 2003).

The main objective for this project was to compose a species inventory of algae in Dominica; what is the abundance of each species; and is there a difference in distribution of species and abundance between different habitat types (rock, coral reef, and seagrass beds). Based on previous studies of Lehman (2001), some common genera that are expected to be seen during the survey were: *Galaxaura*, *Porolithon*, *Acanthophora* (Rhodophyta), *Ventricaria*, *Halimeda*, *Caulerpa* (Chlorophyta), *Dictyota*, *Padina*, and *Sargassum* (Phaeophyta).

Creating an inventory will give a baseline as to what algae can be expected when visiting the island. Sea moss as a drink is popular in the Caribbean, and is exported though out the Americas and Europe. Sea moss is the colloquial term for marine algae that are commonly boiled down into a semi gelatinous state, agar. They are then processed, flavored, and packaged for export. Knowing what algal species are found and where they are found would be beneficial to persons interested in making sea moss.

Materials and methods

Data collection was conducted in October, November 2008. All of the sites were located on the west coast of Dominica. There were twenty-two sites that were surveyed with a range of areas (100-2100m^2). A majority of the sites surveyed were done using snorkel gear only, but SCUBA was used for depths of six meters or more. Species identification was in situ, and later confirmed using various identification books (Humann and Deloach 2002; Littler and Littler 2000; Littler et al. 1989).

The areas of survey at each site were estimated in the field and later confirmed using satellite imagery provided by Google Earth (Google). The surveyor swam the total area in a zigzag pattern over a twenty-minute period. This was the most efficient way to cover the entire area within the allotted time. These twenty minutes were broken into four continuous time blocks, five minutes each, and an "extra minutes" category, which was any time after the set twenty-minute survey, was over. Algal species were listed as they were seen in the field, and marked in the time block during which they were seen. Any species that were seen after the twenty minutes of the survey were then recorded in the extra minutes category.

Ranks were then given to algal species for when they were seen; 5 – first five minutes, 4 – five to ten minutes, 3 – ten to fifteen minutes, 2 – fifteen to twenty minutes, and 1 – after survey. Abundance was also determined with a ranking system, where 1 – rare (1 sighting), 2 – occasional (2-10 sightings), 3 – common (>10 sightings). Sightings of species with prostrate or turf like growth forms (e.g. *Coelothrix irregularis*) were counted in units of "delineated" areas e.g. the rock on which it grows, or a patch with other organisms acting as "borders". Three habitat types were also noted (coral reef, rock, and seagrass). Coral reef was defined by actual reef formation. Rocks included habitats of consolidated rocks, rocky outcrops, and boulders. Seagrass was a bed of *Syringodium filiforme*.

A site specific abundance index then calculate by finding the product of the time of sighting and abundance ranking, and then dividing by the one one-hundredth of the area ((Time x Abundance)/(Area/100)).

Results

Thirty species were found including twelve Rhodophyta, eleven Chlorophyta, seven Pheaophyta, and one species that could not be identified (unknown A). Out of the twenty-two sites surveyed the five species that were repeatedly seen were *Dictyota sp., C. irregularis, Ventriaria ventricosa, Jania sp., Galaxaura sp.* (see Table 2). There was greater species richness on rock habitats with twenty-four species, followed by coral habitat with twenty, and then seagrass with two (Figure 2-4). The species that had the highest abundance were *Dictyota sp., Galaxaura sp., Coelothrix irregularis, Valonia macrophysa,* and *Hypnea spinella* (Figure 1). Coral and rock habitats were 51.44% similar to each other in average abundance of species across different habitats. However, the average abundance of species in seagrass beds showed very little similarity with the hard substrate (coral reef and rock), 2.78% (Figure 4).

Discussion

There were thirty algal species that were found in the three habitats surveyed (Table 2). Of these species there were ten species identified that had not been previously recorded, as well as five species that were previously seen but absent in the study. A possible explanation for the lack of certain algal species can be explained by their raised morphology above the substrate. Three

days before the survey began, Hurricane Omar had passed north of the island, but the effects of the storm had considerably damaged the benthic community. There was a lot of debris of large, soft organisms, e.g. sponges and macroalgae, as well as large coral heads that had been displaced (pers obs 2008).

Unlike algae with a prostrate morphology, *C. irregularis, Dictyota spp*., the storm would have affected large macroalgae more significantly due to their raised morphology. This is why a majority of the algae that were seen were in turf-like growth forms (*Gelidella acerosa*), or low lying to the substrate (*Caulerpa spp.*). More macroalgae were seen before the storm. For example, *Sargassun sp.* was seen at multiple sites before the storm and only few were seen after the storm when the survey was carried out. The reduction of algae is believed to be a directly influenced by the storm.

In the rock habitats *Chaetomorpha sp*. spread quickly near shore (0-10m) for three weeks after the storm. This alga is not regularly seen growing on the island. It is a green algae that grows after large storm systems pass though and was seen after a hurricane had passed the previous year (Steiner pers comm 2008). After Hurricane Omar this type of algal growth was also evident. As soon as the *Chaetomorpha sp*. starts to die off a second species, *Liagora sp*. starts grow taking over the substrate at a range of depths with more density closer to shore.. It was seen growing on top of other organisms, e.g. *Pseudoterogorgia sp*, and could potentially suffocate coral and algae species by blocking sunlight.

Conservation

When algal growth gets out of control it can be devastating. Over-fishing in Dominica greatly affects the algal community. Many algae species' only form of predation is either herbivorous fishes or urchins. With over-fishing causing a lack of predation on algae, they are able to grow much faster and in more places, giving greater competition to Porifera and Cnidaria. Due to the make up of the island most of the rock habitat is located close to shore and thus easily accessible by many fishermen, with a variety of methods able to be used (fish pots, seine nets, speargun,

and hook and line). This may be why the greatest number of algae species were found on the rock substrate (as well as a high cover of unidentifiable turf algae (pers obs 2008)). The coral reef habitats had a lower species richness, but did possess fifteen out of the twenty-four present on rocks making the two sites similar in species composition. The most noticeable difference between the two habitats was the low coverage of turf algae on coral reefs and the abundance difference of present algae. For example, *C. irregularis* and *H. spinella* were found in high abundance in the rocky habitats, but had low abundance in the coral reefs. These species were weedy, fast growing algae like *C. irregeularis* and *H. spinella*, which make up the food source of herbivorous fishes (Williams 2001). While species like *Dictyota sp.*, *V. macrophysa*, and *Galaxaura sp.* were abundant in both sites. These species are not targets of these fishes and that is why they are abundant in both habitats. This may be because the reef locations were further off shore and thus harder to reach by fisherman, though fishing pressure is still high.

It was found that there was no similarity between seagrass and hard substrates (coral and rock). This was expected to be seen due to substrate preference (Littler and Littler 2000). There were only two species found in a seagrass bed and of those only one was found elsewhere, *Avrainvillea sp. Halimeda* sp. was seen in the sand portion of the coral reefs. Although there was only one seagrass bed in the survey, *Halimeda* sp. was expected to be seen throughout the bed and was not. There were however, many broken and dead pieces of *Halimeda* sp. of unknown origin seen in the seagrass bed (pers obs 2008).

The species richness of algae on coral and rock are similar, yet there were differences in species abundance between the two. The rock is overgrown with algae, while the coral reefs are not. Due to the island's narrow shelf, coral and rock habitats are exposed to many of the same disturbances, natural or human. Control of algal growth is important to the reef because algae can out compete other organisms on the reef. Since many of the rocky habitats also harbour coral colonies, controlling algal growth in these habitats would be vital to conservation. The rocky habitats cover a larger area than true coral reefs and this is where many coral larvae are produced that repopulate and help maintain reef health throughout the island's west coast. It is important

that more effort must be put into regulating anthropogenic impacts such as over-fishing, sediment input, waste, etc. The establishment of marine reserves will limit these effects and allow herbivorous fishes to sustain higher numbers. This will help to limit algal growth and allow for new coral recruits to establish making more vibrant and healthy marine communities.

Seamoss

Algae are consumed all over the world and are believed to contain many health benefits, and the Caribbean is no different. They consume a drink called sea moss that is very popular in the region. The species of preferred use in the general Caribbean (*Eucheuma isiforme*) was not found on the island. This makes it so that the product must be imported onto the island. Though the preferred species is not present, it is uncertain if other species would produce the same agar that is desired. A more common species *Dictyota spp.* is found in great numbers all over the island. This species shares the same characteristics as *E. isiforme* (tough, fleshy, large), and may be a suitable alternative. This would be beneficial because it is locally found, and would be easily grown and harvested.

Acknowledgements

I would like to thank Sasha Steiner for his support and guidance through the project. Thank you to Keira Macfarlane and Lori Price for their support as well as their assistance in the field. I also would like to thank, Lindsay Chapman, Alexandra Clermont, Ashley Walchuk, and Robert Brewer for their help, and input during the research.

References

Alfsnes K (2004) *Diadema antillarum* and its grazing effects of algal richness and cover on coral habitats in Dominica. ITME Research Reports 21: 20-26Diamond A (2001) Species richness and frequency distribution of Scleractinia at Tarou Point Dominica, West Indies. ITME Research Reports 6: 19-29

Humann P, Deloach N (2002) Reef Coral Identification; Florida, Caribbean, and Bahamas. New World Publications, Inc. Jacksonville, FL

Imray, Laurie, Norie, Wilson (1995) Map of Leeward Islands, Dominica. Imray, Laurie, Norie, Wilson Ltd. Cambridgeshire, England

Lehman W (2001) The benthic community at Tarou Point, Dominica, organisms and percent cover of sessile organisms; composition of substrate; abundance of *Diadema antillarum*. ITME Research Reports 6: 13-18

Littler DS, Littler MM (2000) Caribbean Reef Plants. Offshore Graphics Inc. Washington D.C.

Littler DS, Little MM, Bucher KE, Norris JN (1989) Marine Plants of the Caribbean. Smithsonian Institution Press, USA

McKinney J (2002) Algal cover versus *Diadema antillarum* abundance along the west coast of Dominican reefs. ITME Research Reports 12: 10-14.

Randolph T, Rhyne C (1970) Marine algae of Dominica. Smithsonian Contrib. to Botany 3: 1-16

Steiner SCC (2003) Stony corals and reefs of Dominica. Atoll Research Bulletin 498: 1-15

Steiner SCC, Williams SM (2005) A recent increase in the echinoid *Diadema antillarum* in Dominica (Lesser Antilles): 2001-2005 ITME Research Reports 22

Wallover N (2005) Study III: Rapid benthic assessment of reefs in Dominica, West Indies. ITME Student Research Reports 23(I-VII): 32-42 Student Research Reports, Fall semester 2005

Willette DA (2001) Algal cover versus grazing fish abundance of shallow and midrange coral reefs of Dominica, West Indies. ITME Research Report 9: 19-25

Williams ID, Palunin NVC (2001) Large-scale association between macroalgal cover and grazer biomass on mid-depth reefs in the Caribbean. Coral Reefs, 19: 358-366

Williams SM (2001) Abundance and size distribution of *Diadema antillarum* on the west coast of Dominica, West Indies. ITME Research Reports 9: 3-9

Table 1 Site names and their corresponding numbers found on the west coast, area surveyed at each site, and habitat type. Site 9- Dou Dou Reef has no area because there was not a survey conducted there but some species were reported.

Site Number/Name	Area Surveyed, m^2	Habitat Type
1 - Scott's Head (east rock wall)	450	Rock
2 - Lauro shallows	900	Rock
3 - Douglas Bay South	750	Rock
4 - Cabrits Pier	1200	Rock
5 - Espagnole Bay (Shallow)	750	Rock
7 - Fond Cole	100	Rock
8 – Champagne	2100	Rock
9 - Dou Dou Reef	N/A	Coral Reef
10 – East Carib Dive Seagrass	700	Seagrass
11 - Anse Mulatre #1	300	Rock
12 - Anse Mulatre #2	1400	Rock
13 - Anse Mulatre #3	750	Rock
15 - Lauro Reef (SCUBA)	1200	Coral Reef
16- Easy Street (SCUBA)	1600	Rock
20 - Barry's Dream (SCUBA)	300	Rock
21 - Maggie's Reef (SCUBA)	1200	Coral reef
25- Anse liane #2	900	Rock
27- Anse liane #4	600	Rock
28 - Colihaut S (Quarry)	1600	Rock
29 - Nose Reef (SCUBA)	800	Coral Reef
30 - Rena's Hole Reef (SCUBA)	800	Coral Reef
34 - Floral Gardens (SCUBA)	200	Coral Reef

Table 2 Algal species inventory across 22 sites, with abundance represented at each site and the number of sites each species was present, ●● - Common, ● - occasional, and ○ – rare.

SPECIES	1	2	3	4	5	7	8	9	10	11	12	13	15	16	20	21	25	27	28	29	30	34	# Sites
Chlorophyta																							
Avrainvillea sp.									●							●●							2
Caulerpa serrulata																			●				1
Caulerpa sertularioides	●			○	●									●●	●●	●●			○			●	7
Chaetomorpha sp.											●						●●		●●				3
Codium isthmocladum	●						●																2
Dictyosphaeria sp.						○								●					○				3
Halimeda sp.														●		●●							2
Neomeris annulata														●		○	●	●					4
Penicillus sp.									●●														1
Valonia macrophysa					○			●		●	●			●●	○	●			●			●●	9
Ventricaria ventricosa	●	●	●		●			●		●	●●		●	●		●	●		●●	○		○	14
Phaeophyta																							
Dictyota bartaynesii							●			●			●		●		●	●			●●		7
Dictyota ciliolata	●●																	○					2
Dictyota sp.	●●	●	●	●						●●	●	●●	●●	●●	●	●●	●	●●	●	●●	●	●●	17
Lobophora variegata																●●						●●	2
Padina jamaicensis	○													●				○					3
Sargassum hystrix																		○					1
Sargassum sp.																●●							1
Rhodophyta																							
Acanthophora sp.	●●	○								●							○	●					5
Amphiroa fragilissima													●										1
Coelothrix irregularis		●●	○	○	●	○	●●			●	●●	●●		○			●	●	●●		○		14
Galaxaura sp.	●●				●●	●	●			●	●	●	●	●				●		●		●	12
Gelidella acerosa							●				●	●		●			●	●●	●●		●		8
Gelidium sp.															●●		●			●	●	●	5
Halymenia floresia																						○	1
Hypnea "spinella"						●	●●			●	●	●				●		●●	●●				8
Jania sp.										●	●	○	●	●	●		●	●	●●	●	●●		11
Laurencia sp.						●	●●			●●	●	●	●	●			●						8
Liagora sp.																	●		●●		●●	●●	4
Dasya sp.								●															1

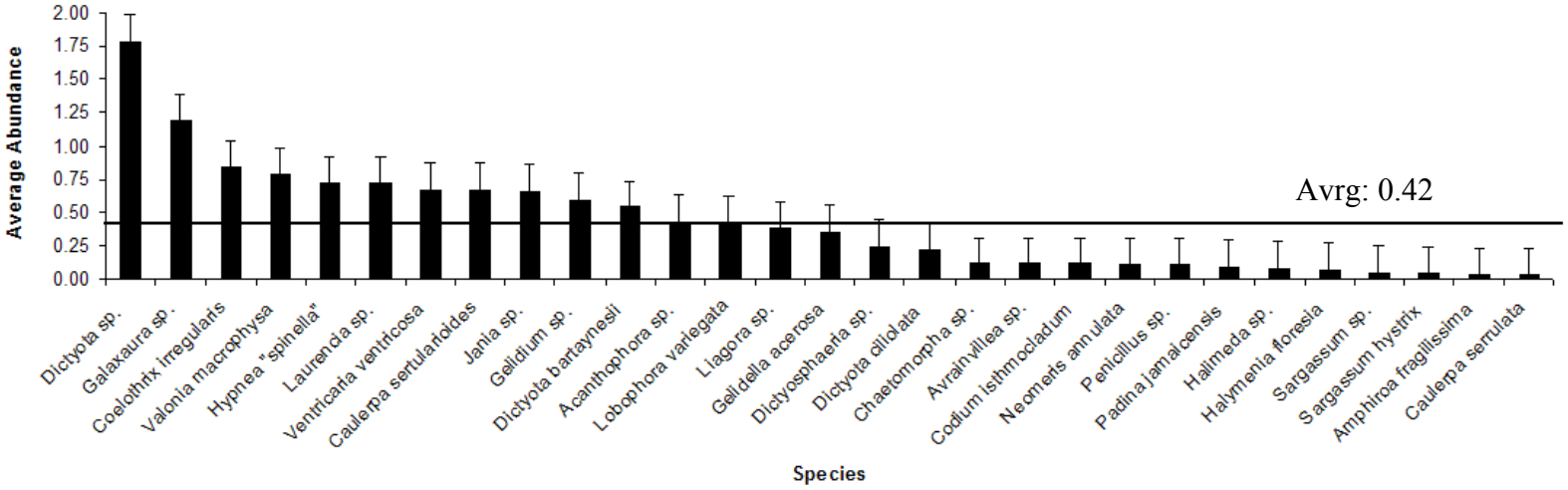

Figure 1 Average abundance ± S.E. of species at all sites surveyed (21), the average abundance of all species is 0.42

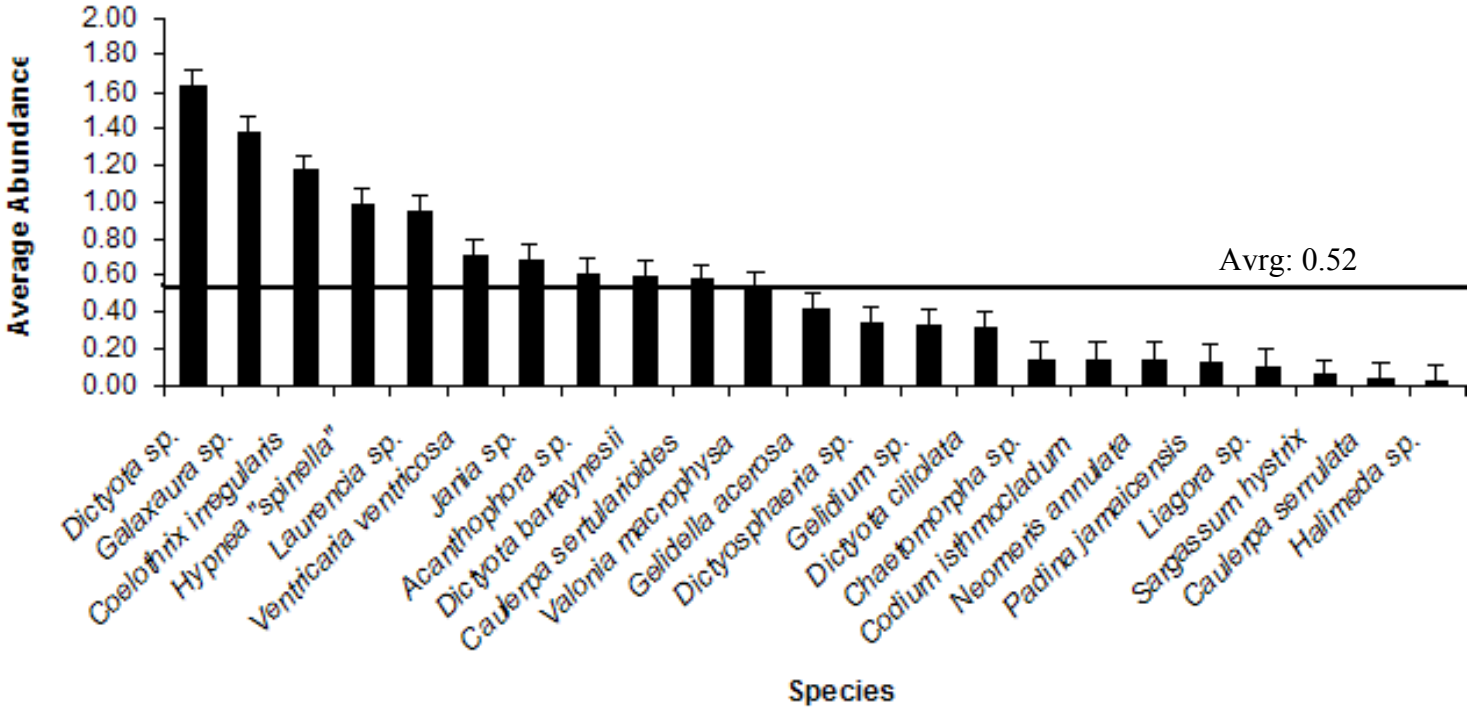

Figure 2 Average abundance ± S.E. of species found in rock habitat (15 sites), the average abundance of all species is 0.52

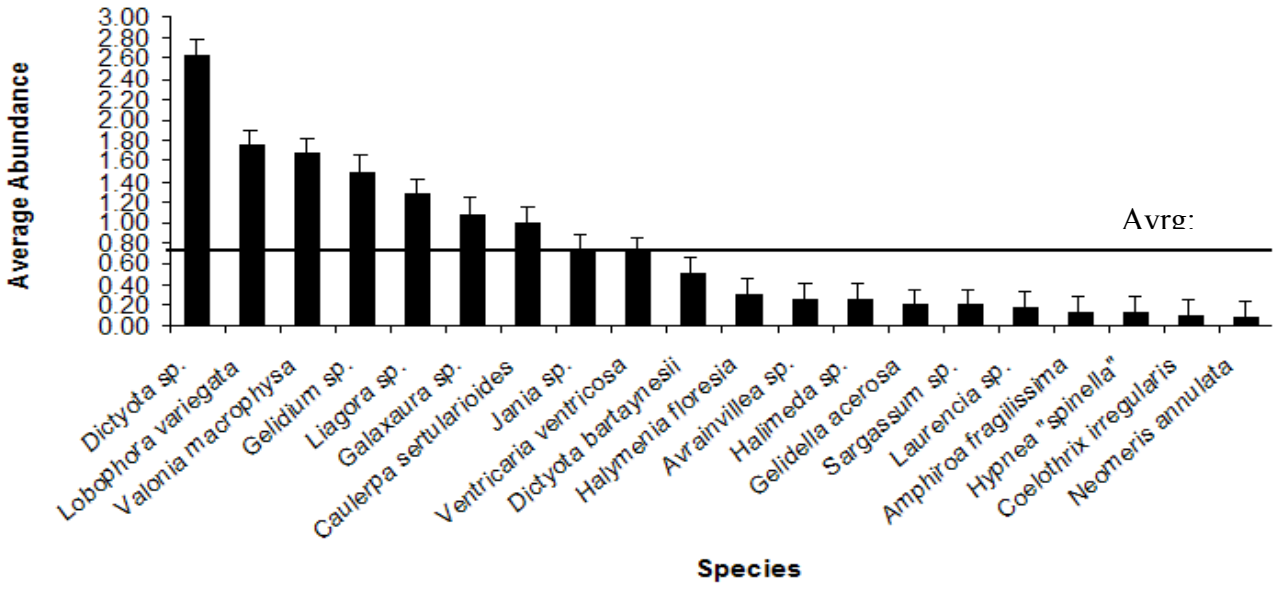

Figure 3 Average abundance ± S.E. of species found in coral reef habitat (5 sites), the average abundance of all species is 0.73

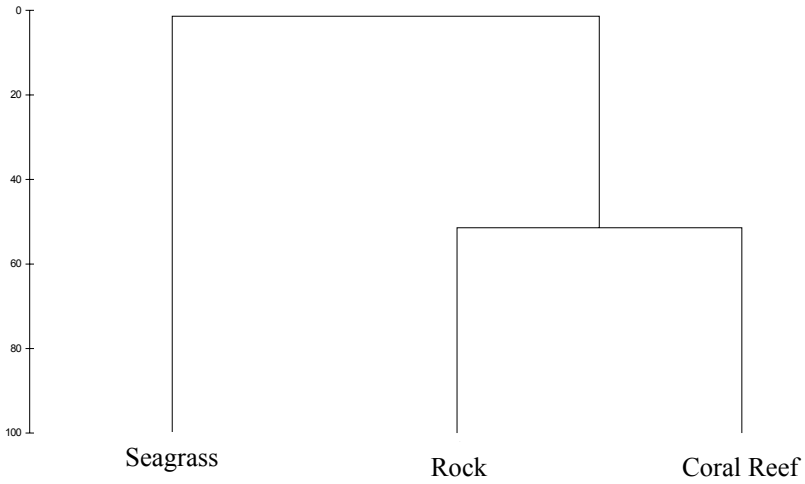

Figure 4 Similarity between habitat types based on the average abundance index depicting 51.44% similarity between rock and coral reef habitats.