DISTRIBUTION AND ABUNDANCE OF SELECTED MARINE ORGANISMS IN DOMINICA, LESSER ANTILLES

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Introduction

Marine research in Dominica has received increased attention with the establishment of the Institute for Tropical Marine Ecology (ITME) in 1999. Since then studies have focused on coral reefs (Steiner 2001, 2003; Diamond 2001), coral diseases (Borger 2001; Borger and Steiner 2005), coral bleaching (Byrd et al. 2005, Steiner and Kerr 2008), *Diadema antillarum* (Steiner and Williams 2005, 2006), reef fishes (Green 2003; Mohan 2001; Willette 2001), and the implementation of the Atlantic and Gulf Rapid Reef Assessment (AGGRA) survey (Byrd et al. 2005). More recently, large scale habitat surveys (Price 2007, Macfarlane 2007) led to the first comprehensive overview and database (http://www.itme.org/marinehabitats) of Dominica's marine resources, including all earlier reports generated by ITME. Based on this frame of reference, surveys were conducted to build on existing marine species inventories. Semi-quantitative studies were carried out on the epibenthic species within Porifera, Malacostraca, Mollusca, Echinodermata, and Algae as follows:

Study I: Alexandra Clermont, Distribution and abundance of selected Demospongiae in Dominica. Pages 6-16.

Study II: Robert Brewer, The distribution of selected Malacostraca of Dominica, Lesser Antilles. Pages 17-30.

Study III: Lindsay Chapman, Species richness and abundance of Bivalvia, Cephlapoda, Gastropoda and Polyplacophora in shallow near shore environments in Dominica, Lesser Antilles. Pages 31-42.

Study IV: Ashley Walchuk, Distribution and abundance of Echinodermata in shallow near shore environments in Dominica, Lesser Antilles. Pages 43-51.

Study V: James Ritzmann, Abundance and distribution of algal species on the island of Dominica, Lesser Antilles. Pages 52-62.

A total of thirty five sites along the west coast were surveyed (Figure A) between October 20 and November 12, 2008. However, south-eastern wind bands of Hurricane Omar affected Dominica on October 15 and 16, 2008, causing coastal flooding and erosion. Following this event severe damage to benthic communities within 0-8 meters in depth could be seen throughout the west coast. Disturbances included sediment deposits, the uprooting and displacement of benthic organisms and consequently the alteration of habitats. It should therefore be noted that the findings on the distribution and abundance of organisms are possibly more conservative than if the study were carried out before Hurricane Omar.

The studies presented here will be included in the updated version (2008) of the ITME website (http://www.itme.org/marinehabitats). The publicly accessible site will provide useful information to teachers, researchers or nature lovers.

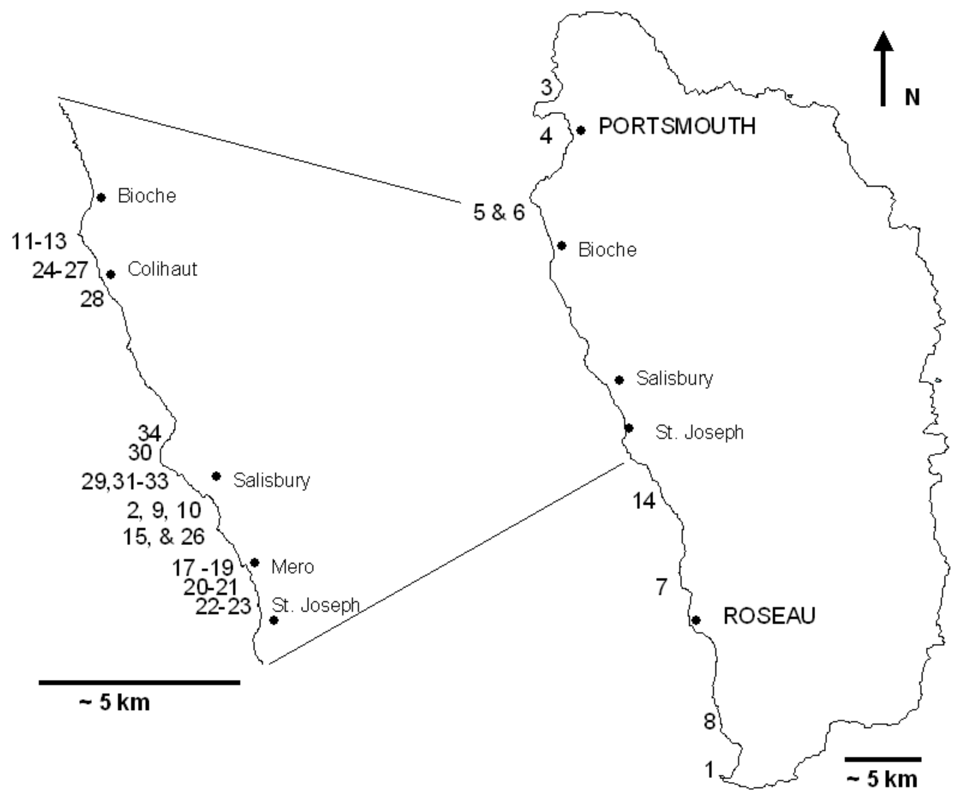

Figure A. Distribution of survey sites.

Table A. Survey sites and organism groups assessed.

Site Number, Name, Date of Survey, Coordinates	Porifera	Crustacea	Mollusca	Echinodermata	Algae
1 - Scotts Head (east rock wall) – 20.11.08 N15˚12’52” W61˚22’19”	●	●	●	●	●
2 – Lauro Shallows – 21.10.08 N15˚26’09” W61˚26’25”	●	●	●	●	●
3 – Douglas Bay South – 22.10.08 N15˚35’26” W61˚28’15”			●	●	●
4 – Cabrits Pier – 22.10.08 N15˚34’55” W61˚28’16”	●	●	●	●	●
5 – Espagnole Bay (Shallow) – 23.10.08 N15˚31’54” W61˚28’34”		●	●	●	●
6 – Espagnole Bay (Deep) – 23.10.08 N15˚31’52” W61˚28’36”	●	●	●		
7 – Fond Cole – 24.10.08 N15˚19’12” W61˚23’42”	●	●	●	●	●
8 – Champagne – 27.10.08 N15˚14’38” W61˚22’25”	●	●	●	●	●
9 – Dou Dou Reef #1 – 28.10.08 N15˚25’50” W61˚26’14”	●			●	●
10 – East Carib Dive Seagrass – 28.10.08 N15˚25’54” W61˚26’16”		●			●
11 – Anse Mulatre #1 – 30.10.08 N15˚30’08” W61˚28’07”	●		●	●	●
12 – Anse Mulatre #2 – 30.10.08 N15˚30’07” W61˚28’07”	●	●	●	●	●
13 – Anse Mulatre # 3 – 30.10.08 N15˚30’06” W61˚28’07”	●		●	●	●
14 – Rodney’s Rock – 31. 10.08 N15˚22’49” W61˚24’42”	●	●	●		
15 – Lauro Reef (SCUBA) – 03.11.08 N15˚26’17” W61˚26’38”	●	●			●
16 – Easy Street (SCUBA) – 03.11.08 N15˚26’12” W61˚26’32”	●	●			●
17 – Mero to East Carib Dive #1 – 03.11.08 N15˚25’26” W61˚26’02”					
18 – Mero to East Carib Dive #2 – 03.11.08 N15˚25’44” W61˚26’11”			●	●	
19 – Mero to East Carib Dive #3 – 03.11.08 N15˚25’49” W61˚26’11”			●	●	
20 – Barry’s Dream (SCUBA) – 04.11.08 N15˚25’00” W61˚26’00”	●	●			●
21 – Maggie’s Reef (SCUBA) – 04.11.08 N15˚24’55” W61˚25’55”	●	●			●

Site Number, Name, Date of Survey, Coordinates	Porifera	Crustacea	Mollusca	Echinodermata	Algae
22 – Mero to St. Joseph #1 – 04.11.08 N15˚24'31" W61˚25'38"			●	●	
23 – Mero to St. Joseph #2 – 04.11.08 N15˚24'32" W61˚25'36"			●	●	
24 – Anse à Liane #1 – 07.11.08 N15˚29'36" W61˚28'07"	●				
25 – Anse à Liane #2 – 07.11.08 N15˚29'26" W61˚27'59"				●	●
26 – Anse à Liane #3 – 07.11.08 N15˚29'24" W61˚27'59"		●		●	
27 – Anse à Liane #4 – 07.11.08 N15˚29'14" W61˚27'57"	●			●	●
28 – Colihaut South – 10.11.08 N15˚28'53" W61˚27'44"	●	●	●	●	●
29 – Nose Reef (SCUBA) – 11.11.08 N15˚26'18" W61˚27'09"	●	●			●
30 – Rena's Hole Reef (SCUBA) - 11.11.08 N15˚26'27" W61˚27'15"	●	●			●
31 - Grand Savanne to East Carib Dive #1 – 11.11.08 N15˚26'27" W61˚26'49"			●	●	
32 - Grand Savanne to East Carib Dive #2 – 11.11.08 N15˚26'23" W61˚26'47"			●	●	
33 - Grand Savanne to East Carib Dive #3 – 11.11.08 N15˚26'19" W61˚26'37"			●	●	
34 – Floral Gardens (SCUBA) – 12.11.08 N15˚26'49" W61˚27'03"	●	●			●
35 – Dou Dou Reef # 2 – 12.11.08 N15˚25'50" W61˚26'14"	●	●			

References

Borger JL (2001) Three scleractinian coral diseases in Dominica, West Indies: distribution, infection patterns and contribution to coral tissue mortality. Rev Biol Trop 51(4): 25-28

Borger JL, Steiner SCC (2005) The spatial and temporal dynamics of coral diseases in Dominica,West Indies. Bull Mar Sci 77(1): 137-154

Byrd K, Jordan M, Klarman M, Lowe A, McNeal J, Wallover N, Zuercher R (2005) Atlantic and Gulf Rapid Reef Assessment (AGGRA) protocol v. 4.0: First Implementation in the Commonwealth of Dominica, October – November 2005. ITME Research Reports 23 (I-VII): 1-91. Student Research Reports, Fall Semester 2005

Diamond A (2001) Species richness and frequency distribution of Scleractinia at Tarou Point, Dominica, West Indies. ITME Research Reports 6: 19-29

Green D (2003) Dominica reef fish status 2002: An assessment of the abundance and species composition of Dominican reef fishes. ITME Research Reports 13

Macfarlane, K (2007) Study II: Distribution of the benthic marine habitats in the northern region of the West Coast of Dominica, W.I., Institute of Tropical Marine Ecology Research Report – 26: 30-48

Mohan E (2001) Fish species composition and size class distribution in Dominica, West Indies ITME Research Reports 9: 10-18

Price L (2007) Study I: The distribution of benthic marine habitats in the central and southern regions of Dominica's West Coast, ITME Research Reports 26:4-29

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

Steiner SCC (2001) Scleractinian assemblages of Dominica, Lesser Antilles, West Coast, 28th AMLC Meeting Puerto Rico. ITME Research Reports 7

Steiner SCC, Kerr JM (2008) Stony corals in Dominica during the 2005 bleaching episode and one year later. Rev Biol Trop 56:139-148

Steiner SCC, Williams SM (2005) The density and size distribution of *Diadema antillarum* in Dominica (Lesser Antilles): 2001-2004. Marine Biology 149: 1071-1078

Steiner SCC, Williams SM (2006) A recent increase in the abundance of the echinoid *Diadema antillarum* in Dominica (Lesser Antilles): 2001-2005. Rev Biol Trop 54: 97-103

Willette DAS (2001) Algal cover versus grazing fish abundance of shallow and mid-depth coral reefs in Dominica, West Indies. ITME Research Reports 9:19-25

Study I: Distribution and abundance of selected Demospongiae in Dominica

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Abstract The coastal waters of Dominica have been the object of consistent ecological research since the inauguration of the Institute for Tropical Marine Ecology (ITME) in 1999. Sponges are noticeably one of the dominant groups of benthic organisms in the island's marine ecosystems, but they have not been extensively catalogued. The objective of this survey was to contribute an inventory of Dominican sponge species, along with their distribution across 22 sites on the West coast, to ITME's growing online public-access database (http://www.itme.org/marinehabitats). Depth and surface inclination were found to be an important factor in the richness and abundance of sponges. However, a range of ecological parameters affecting the local distribution across microhabitats warrants further research.

Keywords Porifera • Species Inventory • Distribution • Abundance • Dominica

Introduction

Sponges are sessile, simple multi-cellular animals that constitute the phylum Porifera. They are active suspension feeders with distinct ostia, and occupy a wide variety of benthic habitats including, but not limited to: boulders, caves, sea grass beds, coral reefs, pier pillars and sand. Sponges display a great morphological diversity, and certain species may grow in an assortment of these forms: encrusting, barrel, vase, tube, ball, and rope shapes (Humann and Deloach 2002). Marine sponges reproduce either by spawning or asexual regeneration after fragmentation. Of the classes relevant to neritic research around the island of Dominica in the West Indies, the class Demospongiae contains 95% of all sponge species and is prevalent in the island's marine environments. Sponges in the Calcarea class are far more infrequent and cryptic (Macfarlane pers comm 2008). Large-scale sponge industries are virtually a thing of the past, as the once-high commercial demand for natural sponges as cleaning implements has been substituted by the mass-production of artificial sponges. Artisanal sponge fishing practices survive in the Florida Keys, the Caribbean, and the Mediterranean (Shubow 1969). Though also traditionally collected for use in homeopathic remedies, sponges are now being targeted, through the advancement of modern bio-medical research, as an important source of chemical compounds in the development of pharmaceuticals (Bull 2004). Expanding sponge-related research is becoming an increasingly invaluable investment.

Sponges play many functional roles in marine ecosystems, namely, reinforcing substratum, filtering water, recycling nutrients, and providing habitats for micro- and macro-organisms. Some encrusting sponge species, such as *Mycale laevis*, protect the coral colonies they grow on from bioerosion caused by boring sponges. Species such as *Agelas clathrodes* commonly host tunicates, hydroids, and other organisms on their surface, while a variety of rope and massive sponges have associations with zoanthids (Humann and Deloach 2002). Large barrel sponges such as *Xestospongia muta* offer protection to small invertebrates like echinoderms, crustaceans, and juvenile fish, while many sponges are known to maintain mutualistic relationships with bacteria and micro-algae (Brusca and Brusca 1990). Sponges filter a remarkable volume of water: a complex leuconoid sponge 10 cm in height and 1 cm in diameter can pump 22.5 L per day (Barnes 1987). Though sponges are considered an integral component of benthic ecosystems, the extent of their ecological importance has yet to be fully understood. Some unanswered questions remain: How indispensable are they in helping to sustain balanced nutrient levels in the community's water system? What effects would the loss of sponge habitats have on the organisms that rely on them?

The sponges of Dominica's coastal marine environment have not been significantly investigated. Species-specific studies have been conducted (Rützler 1971) as well as quantitative research to determine species abundance at four select sites (Lestrade 2001). However, this larger-scope study aimed to catalog sponge richness, abundance and distribution primarily in Dominica's western coastal zones, adding to the basic inventory available online (ITME website: http://www.itme.org/marinehabitats). Additional questions considered were: Does the richness and abundance of sponges vary with depth? Do sponges display particular habitat preferences?

Materials and methods

This study was conducted in October and November 2008 at 22 select sites along the West coast of Dominica (Fig. A). Using snorkel or SCUBA gear, coral reef and rock habitats were surveyed to determine the presence and abundance of sponge species, in depths of 0 to 18 meters.

The survey areas ranged from 160 m^2 to 1300 m^2 and were on specific substrata. The dimensions were estimated in the field and later adjusted through Google Maps (2008). In cases where homogeneous habitats spread over too large an area to cover at once, terrestrial landmarks were noted to delineate the survey zone's parameters.

A 20-minute roaming technique was employed at each site: swimming in a zig-zag pattern and free-diving underwater when necessary enabled identification of sponges, which were recorded and ranked according to time sighted: within 5, 10, 15, 20, and 20+ minutes using the ranks 5, 4, 3, 2, and 1 respectively. In addition, abundance rankings were assigned: 1 for Rare (single sighting), 2 for Occasional (2 to 10 sightings), and 3 for Common (11+ sightings). The species recorded at each site were then given an index value representing abundance per m^2, expressed as the product of time of sighting and abundance rankings, divided by one hundredth of the area surveyed. All species identified outside of the 20-minute survey were noted, but not quantified.

In addition, habitat types were recorded. Macrohabitats were defined by the general substratum composition: most sites were either rock or coral reef, with the exception of the Cabrits Pier which consisted of smooth cylindrical metal pillars. Microhabitats were distinguished by the inclination of the surface on which each sponge was growing: a "flat" surface encompassing horizontal boulder tops, level reef sections or sandy areas was easily observable from a planar perspective and was exposed to full light. A "slope" was defined as any incline, usually in the form of rock walls or the sides of boulders, in full or partial light. A "recess" was any hollow cavity completely protected from direct light exposure. Finally, "coral" was registered as a fourth type of surface, since boring sponges were only present on coral colonies.

In situ visual identification of sponges was based on Humann and Deloach (2002), the Coralpedia web-based sponge guide (Sheppard 2007), the Smithsonian Tropical Research Institute's online database (2008) and the *Photographic Identification Guide to Some Common Marine Invertebrates of Bocas Del Toro, Panama* (Collin et al. 2005). Photographs were taken of the more frequent sponge species that remained unidentified and, along with detailed descriptions, were sent to Dr. Sven Zea of the National University of Panama for identification[*].

Results

Thirty-nine sponge species were identified. Between 12 (at Anse Mulatre 2) and 37 (at Rena's Reef) of these species were present at each of the 22 sites surveyed. The average species richness for shallow sites (0-5 m) was 17.7, and 25.2 for deep sites (6-18 m). Most of the species present in the largest range of sites varied evenly between Common and Occasional occurrence, except for *X. muta*, which was Common at 18 of the 22 sites. Species present at the least number of sites were either Occasional or Rare in abundance. Of the 39 species, seven were present at deep sites

[*] These species were: *Ircinia felix*, *Niphates erecta* and *Xestospongia rosariensis*.

only (Table 1). With the exception of *Amphimedon compressa*, the species present at 20 sites or more also had the highest mean abundance (Fig. 1). The majority of species had a greater mean abundance at a depth of 6-18 m than at 0-5 m; however, five species were more abundant across the shallow sites. Of the remaining 27 species present at both shallow and deep sites, approximately half had a significantly higher average abundance at depth (Fig. 2).

The majority of sponges were found to inhabit both flat and sloping surfaces, but a variety of morphologies displayed preferential patterns: ball, tube, vase, barrel and rope sponges occurred more commonly on a flat substratum, while ropey-encrusting and encrusting sponges occurred more commonly on slopes. For some massive sponges, the predisposition to a specific microhabitat was species-dependent: *Agelas dispar* showed a distinct tendency towards inhabiting flat surfaces, whereas *Agelas clathrodes* was more prevalent on vertical inclines. Some sponges appeared on both microhabitat types within the same survey site. The sponges that were found solely on flat surfaces included barrel, branching, vase, rope and small massive shapes. The sponges occurring exclusively on sloped surfaces were all encrusting. No sponges were identified in recesses (Table 2). *Cliona laticavicola* and *Siphonodictyon coralliphagum*, the boring sponges, were seen most frequently on the coral hosts *Montastraea faveolata* and *Siderastrea siderea*.

Discussion

Definitive identification of sponges requires the use of a microscope, and since sampling specimens for spicule observation did not occur during this study, accurate visual identification was limited. Some species were identified late in the study, while others, occurring sporadically and not clearly matching anything in the identification resources, were overlooked. Perhaps even more significant in the effects on the results was the event of Hurricane Omar (Oct. 15-16 2008), which caused considerable damage to shallow regions between 0-8 m. Some beaches at survey sites were littered with hundreds of washed up sponges (pers obs 2008), displaying the consequential impacts of the storm on sponge community structure.

It was difficult to ascertain whether the macrohabitats had any influence on distribution because all of the shallow surveys were on rock habitats, and all of the coral reef sites were deep; based on the similar results of both rock and reef surveys within the same depth range, it is likely that depth was the more important factor. Species richness and abundance were greater at deep sites: the direct effects of river run-off and sediment deposit (from coastal terrestrial environments) are less pronounced, and the protection from turbulent waters creates stable benthic conditions that encourage higher diversity and growth rates (Carballo 2006; Maldonado et al. 2008).

The microhabitats found within each site proved to be more significant than the types of substratum in determining trends in species distribution. Though some sponges grew evenly in both conditions (i.e. on flat surfaces exposed to light and stronger currents, and on protected walls in partial light), most showed strong tendencies toward one or the other. The species that occurred exclusively on one type of inclination may be considered microhabitat specialists. For example, *Ircinia campana*, a large barrel sponge and *Ptilocaulis sp.*, an erect branching sponge, were always found rooted on flat surfaces, exploiting the space of the water column to grow upright. *Halisarca sp.*, an encrusting sponge requiring more surface area for attachment, was only ever seen growing on vertical slopes (Table 2). Barnes (1987) states: "[t]he great variation in the shapes of the Demospongiae reflects, in part, adaptations to limitations of space, inclination of substratum, and current velocity."

The ten most abundant sponges (Fig. 1) each possessed distinct morphological characteristics, leading to ideas on hierarchies of competitive ability: each of the species corresponding to a particular morphology may be dominant, consistently outcompeting similarly-shaped sponges for the specific habitat best suited to their structure. Species-specific mechanisms contributing to successful competition may be higher reproductive output, faster growth rate, and stronger resistance to physical disturbances. Chemical warfare is also a key element in sponge community structures, as evidence suggests "allelochemical interactions provide a widespread, specific, and complex mechanism for interference competition for space among natural populations of coral reef organisms" (Jackson and Buss 1975). Distribution of reef sponges may also be influenced by predation: parrotfish are known to limit certain sponges to protected habitats (Wulff 1997), and the sea-star species *Oreaster reticulatus* is considered to be a factor in delineating sponges' viable habitat range through its own feeding and habitat preferences (Wulff 1995). Competition with other benthic organisms for substratum space may also affect dispersal patterns, but some recent studies have shown otherwise (Preciado and

Maldonado 2005). Though sponges have the ability to draw in water for feeding through the beating of choanocyte cells (Macfarlane pers comm 2008) and can therefore inhabit recesses and habitats protected from currents, the majority of species seen in this study were found in positions strategically exposed to external water currents. Furthermore, sponges do not rely on light for survival; however, the micro-algal organisms that may live symbiotically within them (commonly cyanobacteria) produce nutrients that the host sponge consumes directly, thus contributing to higher net primary production and growth rates (Brusca and Brusca 1990), and prompting a greater species presence in euphotic zones (see Wilkinson and Evans 1989).

Sponges have adapted to and integrated themselves in a wide range of habitat zones; they occurred in almost all of the marine environments investigated in the course of this study and displayed patterns in microhabitat preferences and comparisons at depth. Though no single factor has been recognized as dominant, this study showed that depth, surface inclination, morphology, internal biological mechanisms and external ecological circumstances all influenced the distribution, richness and abundance of sponge species in Dominica.

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References

Barnes RD (1987) The Sponges. In: Hicks-Courant M, Atwater S (eds) Invertebrate zoology. 5th ed. Saunders College Publishing, Chicago, pp 71-90

Bull AT (2004) Microbial Diversity and Bioprospecting. ASM Press, Washington D.C.

Brusca RC, Brusca GJ (1990) Phylum Porifera: The Sponges. In: Sinauer AD, Simpson J (eds) Invertebrates. Sinauer Associates Inc., Massachusetts, pp 181-207

Carballo JL (2006) Effect of natural sedimentation on the structure of tropical rocky sponge assemblages. Ecoscience 13:119–130

Collin R, Díaz MC, Norenburg J, Rocha RM, Sánchez JA, Schulze A, Schwartz M, Valdés A (2005) Photographic Identification Guide to Some Common Marine Invertebrates of Bocas del Toro, Panama. Caribbean Journal of Science 41 (3):638-662

Google (2008) Google Maps. http://www.maps.google.com

Humann P, Deloach N (2002) Reef Creature Identification: Florida, Caribbean, Bahamas. 2nd ed. New World Publications, Inc., Florida

Jackson JBC, Buss L (1975) Allelopathy and spatial competition among coral reef invertebrates. Proceedings of the National Academy of Sciences 72 (12):5160-5163

Lestrade N (2001) Common sponges and percent cover at four locations on the west coast of Dominica. ITME Research Reports 9:26-30

Maldonado M, Giraud K, Carmona C (2008) Effects of sediment on the survival of asexually produced sponge recruits. Marine Biology 154 (4):631-641

Preciado I, Maldonado M (2005) Reassessing the spatial relationship between sponges and macroalgae in sublittoral rocky bottoms: a descriptive approach. Helgoland Marine Research 59 (2):141-150

Rützler K (1971) Bredin-Archbold-Smithsonian biological survey of Dominica: burrowing sponges, genus Siphonodictyon Bergquist, from the Caribbean. Smithsonian Contributions to Zoology 77:1-37

Sheppard C (2007) Coralpedia v.1.0: your guide to Caribbean corals and sponges. http://coralpedia.bio.warwick.ac.uk

Shubow D (1969) Sponge fishing on Florida's East Coast. Tequesta 1 (29): 3-15

Smithsonian Tropical Research Institute (2008) Bocas del Toro species database: Porifera. Smithsonian Institute. http://biogeodb.stri.si.edu/bocas_database/search/phylum/1/

Van Soest R (gen. Ed.) (2008) World Porifera Database. World Register of Marine Species (WoRMS). http://www.marinespecies.org/porifera/

Wilkinson CR, Evans E (1989) Sponge distribution across Davies Reef, Great Barrier Reef, relative to location, depth, and water movement. Coral Reefs 8 (1):1-7

Wulff JL (1995) Sponge-feeding by the Caribbean starfish *Oreaster reticulatus*. Marine Biology 123 (2):313-325

Wulff JL (1997) Parrotfish predation on cryptic sponges of Caribbean coral reefs. Marine Biology 129 (1):41-52

Table 1 Distribution, richness and abundance of 39 sponge species across 22 sites; (●) represents Rare (single sighting), (⊙) represents Occasional (2-10 sightings) and (O) represents Common (11+ sightings). Depth listed for each site: (S) Shallow 0-5 m, (D) Deep 6-18 m.

Species	Scottshead	Lauro Shallows	Cabrits Pier	Espagnole Bay	Fond Cole	Champagne	Dou Dou Reef 1	Anse Mulatre 1	Anse Mulatre 2	Anse Mulatre 3	Rodney's Rock	Lauro Reef	Easy Street	Barry's Dream	Maggie's Reef	Anse Liane 1	Anse Liane 4	Colihaut Quarry	Nose Reef	Rena's Reef	Floral Gardens	Dou Dou Reef 2	# Sites present
Agelas clathrodes	⊙	●	●		⊙	⊙	⊙	⊙	⊙		⊙	⊙		⊙	⊙	⊙			⊙	⊙	O		16
Agelas conifera									⊙				⊙	O	O				O	⊙	O		7
Agelas dispar		⊙		O	⊙	⊙	⊙	O	⊙	⊙	⊙	O	O	O	O	⊙	⊙	O	O	O	⊙	O	20
*Geodia neptuni**																				⊙		⊙	2
Ircinia campana	O					O			⊙			⊙	●	⊙	⊙			⊙	O	⊙	⊙	⊙	12
Ircinia felix	O	O			O	⊙		O		O	⊙	⊙		⊙		⊙	⊙	O	⊙	O	⊙	⊙	16
Ircinia strobilina	⊙	⊙	⊙	⊙	O	⊙	⊙	⊙	O	⊙	⊙	O	⊙	⊙	O	O	O	⊙	O	O	O	O	22
Cliona laticavicola							⊙	⊙			⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	●	⊙	⊙	⊙	14
*Diplastrella megastellata**	⊙	⊙	⊙		⊙									⊙	⊙					⊙	⊙		8
Spirastrella coccinea							O			⊙		⊙	O	⊙	⊙	●	⊙	⊙	O	O	⊙	⊙	13
*Spirastrella mollis**											⊙		⊙										2
Ptilocaulis sp.		⊙		⊙		⊙	⊙	●				O	O	⊙		⊙	●	⊙	O	O	⊙	O	15
Ulosa ruetzleri			O		●		⊙					●	O	⊙	⊙		⊙		O	⊙	⊙	⊙	12
Svenzea zeai	O					⊙			⊙	●	O	⊙	⊙	⊙		O			O	⊙	⊙	●	13
Halisarca sp.		⊙	O	⊙	⊙	⊙	O	O	●	O	⊙	●	⊙	⊙	⊙	⊙		⊙		⊙	⊙	⊙	19
Callyspongia plicifera															●				⊙	⊙			3
Callyspongia vaginalis	O	⊙	⊙	⊙	⊙	⊙	⊙	⊙		O	⊙	⊙	⊙	⊙	⊙	O	●	⊙	O	O	⊙	⊙	21
Amphimedon complanata						⊙						⊙				⊙				⊙	●		5
Amphimedon compressa	O		●	⊙	⊙	⊙	●	⊙	⊙		⊙	O	⊙	O	O	⊙	●	⊙	O	O	⊙	⊙	20
Niphates digitalis	⊙					O							⊙	⊙	⊙				O	⊙	O	●	9
Niphates erecta	O	⊙	O	⊙	⊙	⊙	O	⊙	⊙	⊙	O	O	O	O	O	⊙	O	⊙	O	O	O	O	22
Xestospongia muta	⊙	⊙	●	O	O	O	O	O	O	⊙	O	O	O	O	O	O	O	O	O	O	O	O	22
Xestospongia rosariensis				●	⊙			⊙	⊙	⊙	⊙	O	⊙	⊙	⊙	O	⊙	O	O	⊙	⊙	⊙	17
Siphonodictyon coralliphagum	O			⊙			O	⊙			⊙	O		⊙	⊙	⊙		O	⊙	⊙	⊙	⊙	14
Plakortis sp.																				⊙	⊙	⊙	3
Monanchora arbuscula							●						●	●		●	⊙					●	6
Monanchora barbadensis	⊙		●				⊙		⊙				⊙	⊙	⊙					⊙	⊙		9
*Clathria sp.**			●			●							●							⊙	●		5
Holopsamma helwigi	O											⊙	⊙	⊙			●		⊙	O	O	O	9
Ectyoplasia ferox															⊙				⊙	●	⊙	⊙	5
Mycale laevis	⊙	●	O		⊙	⊙	O			⊙	⊙	⊙	O	⊙	O	⊙	O	⊙	⊙	O	O	⊙	19
Mycale laxissima			O									⊙	⊙	●	⊙				⊙	⊙	O	⊙	9
Iotrochota birotulata	●	⊙	O	O		⊙	⊙	O		⊙	O	O	O	O	O	⊙	O	O	⊙	O	⊙	O	20
Cinachryella sp.											⊙	●		●	⊙				⊙	⊙		⊙	7
Aiolochroia crassa	O	⊙	⊙	⊙		●		⊙			⊙	⊙	O	⊙	O	●	●	⊙	⊙	⊙	⊙	O	18
Aplysina cauliformis															⊙					⊙			2
Aplysina fistularis		O	⊙	⊙	O	O	●	⊙		O		O	●			O	O	⊙	⊙	O	⊙	O	17
Verongula reiswigi	●					⊙		⊙			⊙			⊙			●	●	⊙	⊙			9
Verongula rigida		●			⊙	⊙				⊙	⊙					O	⊙	⊙	●	⊙			10
Species richness (# spp./site):	18	15	16	13	15	21	18	17	12	14	20	25	26	29	26	22	20	20	29	37	31	28	
Depth:	S	S	D	S	S	S	D	S	D	S	S	D	D	D	D	S	S	S	D	D	D	D	
Site Area (m^2):	500	1150	150	1050	250	1000	450	160	500	300	210	900	750	300	300	1225	480	1300	500	800	235	400	

(* indicates species for which visual identification is uncertain and would require microscopic examination)

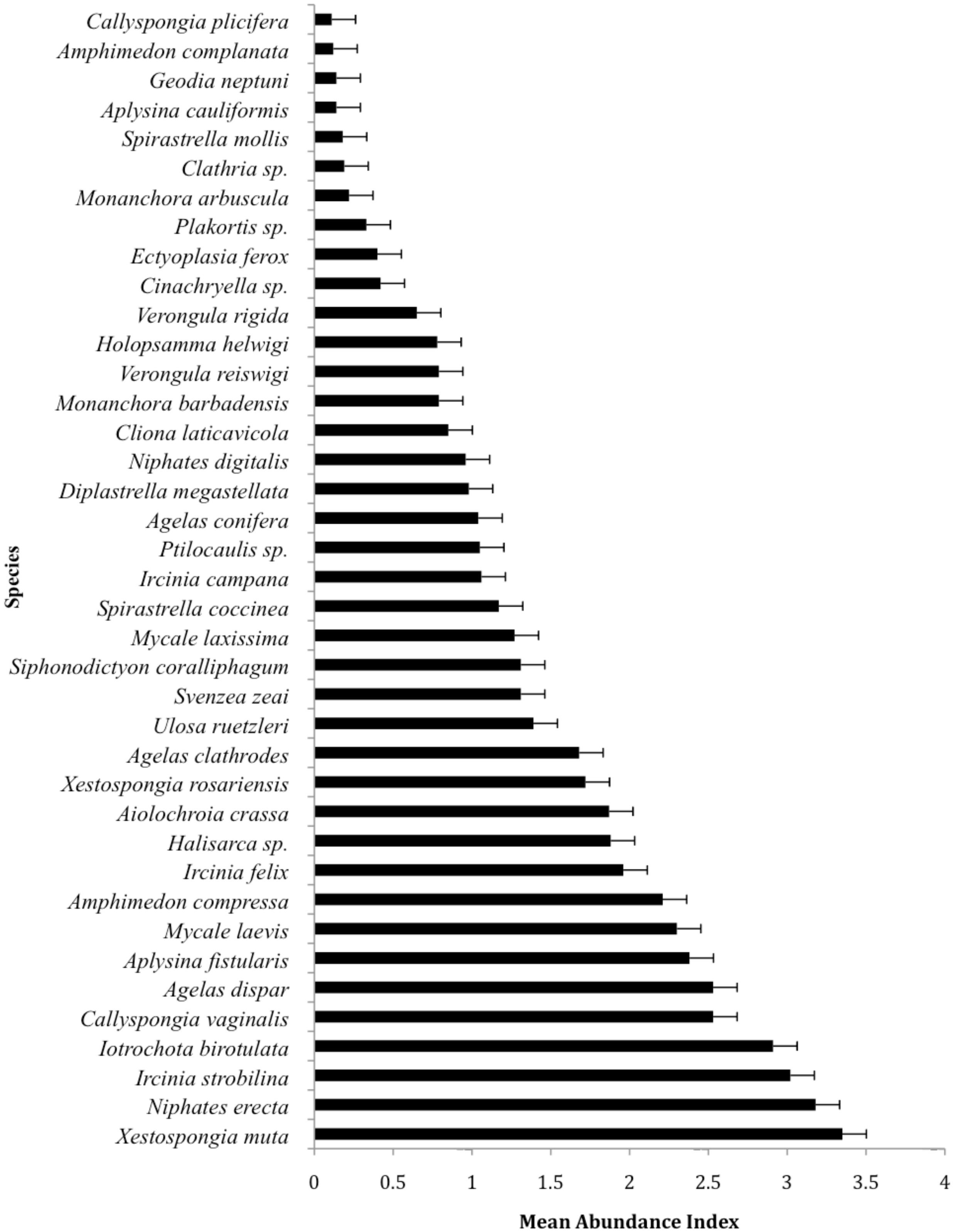

Fig. 1 Average abundance ± S.E. of 39 sponge species across 22 sites

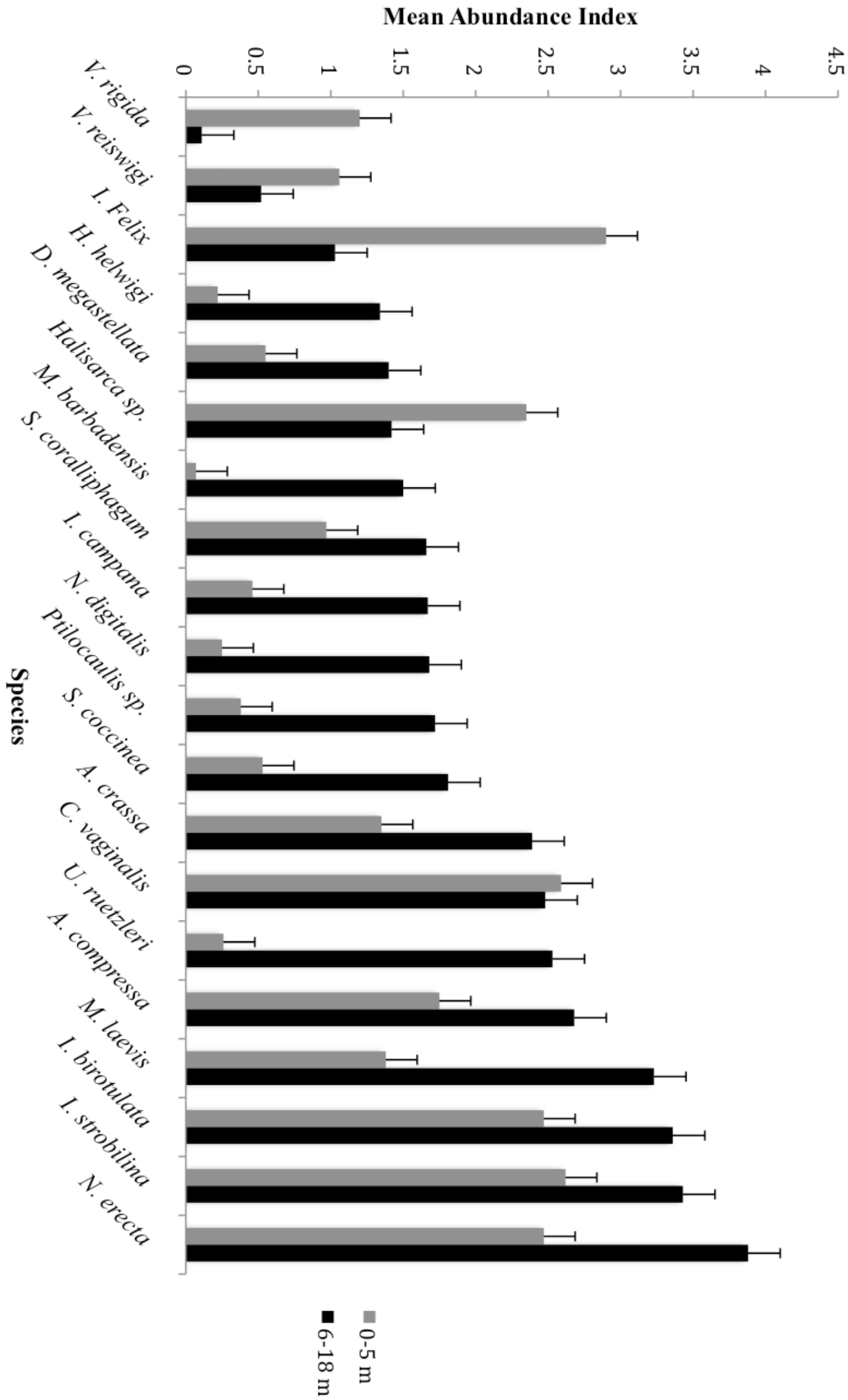

Fig 2. Comparison of average abundance ± S.E. of 20 select sponges at depth ranges of 0-5 m and 6-18 m

Table 2 Microhabitat preferences of 39 sponge species across 22 sites; (■) represents a flat substrate, (/) represents a sloping substrate, and (◆) represents an individual coral colony as substrate.

Species	Cabrits Pier	Fond Cole	Champagne	Dou Dou Reef 1	Anse Mulatre 1	Anse Mulatre 2	Anse Mulatre 3	Rodney's Rock	Lauro Reef	Easy Street	Barry's Dream	Maggie's Reef	Anse Liane 1	Anse Liane 4	Colihaut Quarry	Nose Reef	Rena's Reef	Floral Gardens	Dou Dou Reef 2
Agelas clathrodes	/	/	/	/	/	■		/	■		■	■	/			/	■	■	
Agelas conifera						■				/	■	/				■	■	■	
Agelas dispar		/	■	■	■	■	■ /	/	■	■	■	■	■	■	■	■	■	■	■
*Geodia neptuni**																	■		■
Ircinia campana			■			■			■	■	■	■			■	■	■	■	■
Ircinia felix		/	■		■		■	/	■		■		■	■	■	■	■	■	■
Ircinia strobilina	/	■	■ /	■	■	■	■	/	■	■ /	■	■	■	■	■	■	■	■	■
Cliona laticavicola				◆	◆			◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
*Diplastrella megastellata**	/	/									/	/					/	/	
Spirastrella coccinea				/			/		■	/	/	/	/	/	/	■	/	/	/
*Spirastrella mollis**								/		/									
Ptilocaulis sp.			■	■	■				■	■	■		■	■	■	■	■	■	■
Ulosa ruetzleri	/	/		/					/	/	■	/		■		■	/	/	/
Svenzea zeai			■			■	/	/	■	/	■		/			/	■	■	■
Halisarca sp.	/	/	/	/	/	/	/	/	/	/	/	/	/		/		/	/	/
Callyspongia plicifera												■				■	■		
Callyspongia vaginalis	/	■	■	■	■		■ /	/	■	■	■	■	/	■	■	■	■	/	■
Amphimedon complanata			■						■				■				■	■	
Amphimedon compressa	/	/	■	■	■	■		/	■	■	■	■	■	■	■	■	■	■	■
Niphates digitalis			■							■	■	■				■	■	■	■
Niphates erecta	/	/	/	■ /	■	■	/	/	■	■ /	■	■ /	/	■ /	■ /	■	■ /	■ /	■
Xestospongia muta	■	■	■ /	■	■	■	/	/	■	■ /	■	■	■	■	■	■	■	■	■
Xestospongia rosariensis		/			■	■	■	/	■	■	■	■	■	■	■	■	/	■	■
Siphonodictyon coralliphagum				◆	◆			◆	◆		◆	◆	◆		◆	◆	◆	◆	◆
Plakortis sp.																	■	■	■
Monanchora arbuscula				/						/	/		/	/					/
Monanchora barbadensis	/			/		■				/	/	/					/	/	
*Clathria sp.**	/		/							/							/	/	
Holopsamma helwigi									■	■	■			/		■	■	■	■
Ectyoplasia ferox												/				■	■	■	■
Mycale laevis	/	/	/	/			/	/	/	/	/	/	/	/	■	/	/	■ /	■
Mycale laxissima	/								■	■	■	■				■	■	■	■
Iotrochota birotulata	/		■	■	■		/	/	■	■	■	■	■	■	■	■	■	/	■
Cinachryella sp.								/	■		■	■				■	■		■
Aiolochroia crassa	/		/		■			/	■	/	■	■	/	■	■	■	■	■	■
Aplysina cauliformis												■					■		
Aplysina fistularis	■	■	■	■	/		■		■	■			■	■	■	■	■	■	■
Verongula reiswigi			■		■			/			■			/	■	■	■		
Verongula rigida		/	■				/	/					■	■	■	■	■		

(* indicates species for which identification is uncertain and would require microscopic examination)