Orb-weaving spiders of the Eastern Caribbean

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ABSTRACT

The Eastern Caribbean represents a poorly studied region in terms of arthropod biodiversity, in particular spiders. This paper reviews studies on the biodiversity of orb-weaving spider families on seven islands in the Eastern Caribbean, sampled between January 2006 and August 2010. Specimens were collected using two main methods; visual search and sweep-netting, and supplemented by material collected from the nests of the spider hunting wasp *Sceliphron* sp. Sampling efforts yielded 33 species distributed among six families. Biodiversity was quantified by examining the observed species richness, diversity indices, species abundance models, and multidimensional scaling plots. Factors such as geographic location and habitat classification were also examined in this study as possible factors influencing orb-weaver biodiversity. No significant difference among the islands was found in terms of species richness, diversity, evenness and dominance. St. Lucia possessed the most distinct orb-weaver species composition, while the faunas of St. Kitts and Nevis and of Grenada and Montserrat were closely associated.

Key words: Anapidae, Araneidae, Mysmenidae, Symphytognathidae, Theridiosomatidae and Tetragnathidae, orb-webs

INTRODUCTION

Spiders are regarded as one of the most speciose animal orders on the planet (Coddington and Levi 1991; Foelix 1996; Nyffeler 2000) and high ranking predators in multiple habitat types (Cardoso *et al.* 2008; Oxbrough *et al.* 2005; Sharma *et al.* 2010; Stratton *et al.* 1979; Wise 1993). Spiders also make excellent candidates for biodiversity studies due to their abundance as well as relative ease to identify and be efficiently sampled compared to other invertebrates (Hsieh and Linsenmair 2011; Oxbrough *et al.* 2005). Finally they occupy middle trophic levels in terrestrial food webs acting as prey for organisms in higher tropic levels (Oxbrough e*t al.* 2005) as well as predators (Cardoso *et al.* 2008; Stratton *et al.* 1979; Wise 1993) which makes them highly regarded with respect to ecosystem stability (Coyle 1981) and arthropod control (Enders 1975; Moulder and Reichle 1972; Riechert 1974; Turnbull 1973).

The neotropics have long been declared a region rich in biodiversity but the literature contains scattered references to the spiders, particularly concerning the islands of the Lesser Antilles. Many islands in the region lack species lists and those lists that do exist tend to be based on surveys that were conducted 80 or more years ago, for example, the survey of Antigua by Bryant (1923). As a result, biodiversity data is either unavailable or unreliable for most islands and existing lists fail to document the relation of species composition and richness to the habitat from which it is recorded.

Habitat has been consistently cited as one of the most important factors affecting arthropod biodiversity influencing multiple facets including abundance, species richness (Halaj *et al.* 1998; Hatley and MacMahon 1980; Peres *et al.* 2007; Stratton *et al.* 1979) and species composition (Uetz 1991). This is achieved by the presence of more diverse microclimates (Uetz 1991) produced by the varying amounts of rain and light that reach the lower strata of forests (Loyola and Martins 2009). Web-building spiders in particular are highly dependent on the vegetation present in an area to provide them with suitable points of attachment for web construction (Riechert and Gillespie 1986) and for protection from the elements and predators (Enders 1974, 1976, 1977; Hodge 1988).

In the Eastern Caribbean there are 15 web-building spider families recorded, out of which six construct orb-webs; Anapidae, Araneidae, Mysmenidae, Symphytognathidae, Theridiosomatidae and Tetragnathidae. I chose to limit my study to orb-weaving spiders as their characteristic web design ensures they are relatively thoroughly sampled in each locality selected. They also have a uniform lifestyle and literature is available to identify them, which makes detection of new species and changes in the ecology between families and species and differences between habitat types easier and faster.

This paper focuses on the orb-weaving spider families collected on seven islands between January 2006 and February 2008. Sampling was conducted on the islands of Nevis (Sewlal and Starr 2007), St. Kitts (Sewlal 2008), Anguilla (Sewlal and Starr 2010), Antigua (Sewlal 2009a), Grenada (Sewlal 2009b), Montserrat (Sewlal 2010) and St. Lucia (Sewlal, 2011). Sampling on all of these islands was done with the aim of documenting the spider species found in as a broad variety of habitats as possible. This paper serves to collectively examine the results of the islands sampled, and looks at the relationship between habitat heterogeneity and species diversity with respect to orb-weaving spiders

METHODOLOGY

Across the seven islands in this study (Fig. 1), a total of 110 localities and 27 different habitats were sampled with some habitats not found on every island sampled (Table 1). Brief descriptions of the habitat types are given Table 2. Each island in this study was sampled for a uniform period of two weeks.

Localities for sampling were selected through consulting with government ministries and obtaining maps or reports done that contained vegetation classifications. The classification from the first island to be sampled - Nevis – was used as a guide to maintain consistency in habitat descriptions and thus the selection of habitats for sampling in subsequent islands that were sampled. Care was taken not to damage produce or flowers when sampling some habitats such as farmland used for cultivation of crops or ornamental plants. Precautions included questioning owners about the period between the last treatments with pesticides, and in determining if the habitat in some localities were to be classified as natural or disturbed such as secondary forests, in terms of when was it last used for commercial purpose.

Data from each island were collected using a combination of the visual search and sweep-netting methods, both of which are effective with respect to rapid collection of the species present in an area. Visual search involved walking around in the selected habitat and collecting what was seen from ground level to arm's length above the collector's head. Microhabitats most likely to yield cryptic species were searched using this method, such as under logs, inside rotting logs, inside holes, under bark and rocks. Sweep-netting involved sweeping the vegetation with a tough canvas insect net. This method collected diurnal and nocturnal species in retreats or resting in the vegetation. Sampling concluded if no individuals of new species were found after 15 minutes of the last new species recorded for that locality. The main goal of this study was to survey a single locality of each of the major vegetation types on each island sampled, but where time and resources permitted up to four localities in each major vegetation type was sampled (Table 2). After identifying specimens down to species level, they were transferred and stored in glass vials in 96% alcohol.

There are many different ways to separate organisms into categories to allow for easier study. One such method is by placing them into what are known as what are known as functional guilds. These are defined by Whitmore *et al.* (2002) as groups that contain species that "potentially compete for jointly limited resources". In this study web-building spiders, specifically orb-weaving species, were collected. Spiders are generally separated into web-builders, plant wanderers and ground wanderers. As their name suggests, the web-builders depend on their webs to capture prey whereas with the other two functional groups the spiders do not construct webs, but stalk and ambush their prey. The difference between the last two groups is that one is predominantly found wandering on the vegetation, hence the term plant wanderers, while members of the other group walks on the forest floor thereby referred to as ground wanderers. The use of functional groups can allow

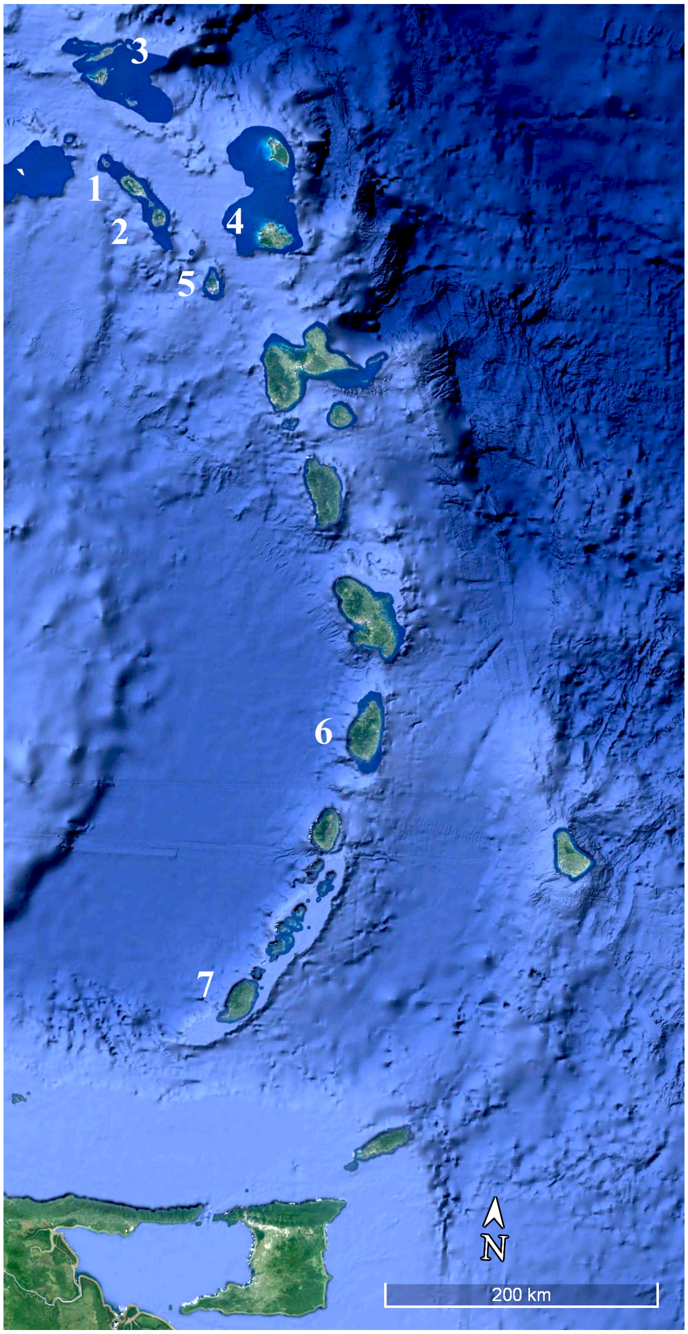

Fig. 1. Map of Eastern Caribbean showing islands sampled; St Kitts (1), Nevis (2), Anguilla (3), Antigua (4), Montserrat (5), St. Lucia (6) and Grenada (7).

Table 1. Number of localities sampled in each habitat according to island for spider surveys of Eastern Caribbean. Shaded sites are human-influenced habitats.

Island	Garden	In and on buildings	Abandoned buildings	Farmland	Roadside	Pastureland	Sec forest	Deciduous forest	Lower montane	Montane	Palm brake	Humid Valley Forest	Dry Forest	Vegetation around salt ponds	Mangrove	Littoral Woodland	Elfin woodland	Riparian Vegetation	Semi-evergreen forest	Evergreen woodland	Inland scrub	Rainforest	Dry evergreen forest	*Scelphron* nests	Coastal veg	Cactus scrub
St. Kitts	2	2	2	2	4	1	1	0	0	0	1	0	1	1	0	1	1	0	0	0	0	1	2	1	0	0
Nevis	4	3	0	1	2	0	3	0	0	1	1	0	0	0	0	2	1	0	0	0	3	0	0	0	0	0
Anguilla	1	2	3	0	2	0	0	0	0	0	0	0	2	1	0	0	0	0	0	1	0	0	0	2	0	1
Antigua	3	4	3	0	4	2	0	0	0	0	0	2	3	3	0	0	0	3	0	0	0	0	0	0	3	0
Montserrat	3	2	1	2	3	0	0	0	0	1	1	0	2	0	3	2	1	0	1	0	0	0	0	0	1	0
St. Lucia	3	1	0	2	2	0	3	2	2	0	0	0	0	0	1	2	0	1	1	0	0	0	0	0	1	0
Grenada	1	2	3	2	2	0	1	0	0	2	1	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0

one to gain valuable insight into the microhabitat, vegetation preferences as well as responses to habitat change of each group (Haddad *et al.* 2009; Hsieh *et al.* 2003).

Trends in biodiversity in this study were limited to web-building species and determined by examining species richness, diversity indices and species composition, and calculating the three main diversity indices; Shannon-Weiner Index (*H')*, reciprocal of the Simpson Index (1/*D*) and Berger-Parker (*d*) which looked at species diversity, evenness and dominance respectively (Magurran 2004), using the following formulas; $H' = -\Sigma p_i \ln p_i,$ where $p_i = n_i / N$ (the abundance of species *i* at a site as a proportion of the total sample at that site), 2. $D = 1/\mathrm{y}$, where $\mathrm{y} = \Sigma(n_i(n_i-1) / N(N-1))$ and $d = n_{\max} / N$, where $n_{\max}$ represents the number of individuals of the most common species. The Shannon index has been used in numerous biodiversity studies (Begossi1996) giving it the reputation as a benchmark measure for biological diversity (Magurran 2004), allowing the comparison of diversity with other studies. The Shannon index is sensitive to sample size (Magurran 2004) and to changes in the importance of rare species (Peet 1974). Much ecological information can be obtained from the value of the Shannon index. High Shannon values indicate high species richness and thus the presence of diverse communities and species that are evenly distributed (Hsieh *et al.* 2003; Peet 1974), while a zero value indicates the presence of a single species (Peet 1974). Therefore Shannon gives information on the distribution of species abundance in the community or sample (Peet 1974). The interpretation of the results of the Shannon index with respect to comparing sites is tricky due to sources of error as it is sensitive to relative species abundance and richness (Magurran 2004). Multiple diversity indices were used to better describe the differences in diversity between habitats.

The reciprocal of the Simpson index was calculated as recommended by Downie *et al.* (1995) and Magurran (2004) to obtain a measure expressing diversity in addition to evenness. Data analysis involved determining the abundance, observed species richness, species diversity, evenness and dominance for each island as a whole and per habitat. However, because of the lack of independence among these indices an ANOVA using Statistix was only conducted on observed species richness to determine if this varied significantly among habitats on the islands sampled.

The community structure of the spider fauna was determined by fitting the rank-abundance curve generated for all the islands as a whole, to four main species abundance models given in Magurran (2004) which give additional information on the communities in question such as main ecological trends. Lastly species composition was analysed through the use of a MDS (multidimensional scaling) plot generated using Primer 5 software (Clarke and Warwick 2001).

RESULTS

One way of examining the results is to split the habitats found in more than one island into 'naturally occurring habitats' and 'habitats that have developed as a result of human activities'. Overall, the two most speciose habitat types are roadside and garden vegetation containing 17 and 15 species respectively, with both being considered to belong to the latter mentioned group. Pastureland was the least speciose with five species. Within natural habitats, the most species-rich were littoral woodland the vegetation surrounding salt ponds with 11 species each. The lowest species richness found in palmbrake and elfin woodland

Table 2. Habitat types sampled during the course of this study and their descriptions.

Habitat	**Description**
Garden	Lands landscaped and maintained at private residences, hotels or for public viewing.
Inside and around dwellings	Inside and around buildings occupied by humans
Abandoned buildings	Stone and wooden structures that have not been occupied or used for a minimum of two years
Farmland	Land that is utilised for cultivation of crops
Roadside	Vegetation up to 30m from either side of the road
Pasture land	This habitat exists in areas once cleared for cultivation and have been abandoned. Current use of this habitat may be as pasture land for grazing livestock.
Secondary vegetation	Lands once cleared for agriculture disturbed for firewood or timber extraction
Deciduous Seasonal Forest	This vegetation type experiences the same conditions as semi-evergreen seasonal forest. The canopy layer reaching 3-9 m in height with an emergent layer 12-18 m. Buttressing is again not a feature of the trees in this vegetation type. Palms are absent while lianes and epiphytes are rare.
Lower Montane Rainforest	This habitat type experiences a high evaporation rate. The canopy is closed and reaches heights up to 21-30 m. The lower level consists of small tree ferns while the ground cover is extremely sparse. Again buttressing is not exhibited by the trees. Palms, lianes and epiphytes are rare in this vegetation type.
Montane Forest	Land has steep topography, with shallow, leached and often water-logged soils. High precipitation is characteristic of this habitat (200-254cm per annum).
Palm brake	This habitat type is comprised almost entirely of *Prestoea montana*, with a lower stratum of immature trees and palms, with ferns and heliconias comprising the understory vegetation. The palms vary from 3 m in exposed areas to 12 m in sheltered areas.
Humid Valley forest	This habitat type is found in small areas in the south-western volcanic regions of the island of Antigua. The dominant species in this habitat type consist of *Ceiba pentandir*, *Ficus* spp., and *Delonix regia*. There is a low concentration of vines, epiphytes and palms.
Dry Forest	Vegetation is of moderate height, with many shrubs and vines. Trees such as *Ceiba pentandra* and *Ficus citrifolia* may exceed 9 m.
Vegetation around salt ponds	This includes Red Mangrove (*Rhizophora mangle*).
Mangrove	Mangrove and vegetation under its canopy found along the banks of rivers or lakes or in dry coastal areas.
Littoral woodland	These areas are near the sea and confined to the north and east coasts of the island. They are exposed to sea-blast which refers to the fine salt spray deposited on the vegetation. They seldom extend inland from the coast for more than approximately 60 m. The vegetation also exhibits the mechanical effect of the wind, where they are streamlined into tables and domes.
Elfin Woodland	Characterised by small trees and shrubs stunted by constant wind exposure. The high humidity is ideal for epiphytes, like bromeliads, orchids, ferns and mosses.
Riparian Vegetation	Vegetation found along the banks of rivers or lakes
Semi-evergreen seasonal forest	This vegetation type is not exposed to violent winds. However, it does experience a drought period of five months. The canopy layer occurs at a height of 6-12 m, with a discontinuous emergent layer reaching 18-24 m. The lower level is dominated by palms. Buttress roots are not common in this habitat but, lianes and epiphytes are frequent.
Evergreen woodland	The vegetation in this habitat type seldom exceed 9m in height and consist of trees and shrubs with small leathern leaves. Native species include *Pisonia fragrans*, *P. subcordata Burgera simaruba* and *Tabebuia pallida*. Non-native species include *Haematoxylum campechianum*, *Leucaena leucocephala* syn. *L. glauca* and *Acacia* spp. succulent species such as *Agave karatto*, *Cephalocereus royeni* and *Opuntia* spp. are also found.
Inland scrub	This exists in areas once cleared for cultivation and have been abandoned. The areas around many of the abandoned sugar plantations exhibit this habitat. Patches of scrub vegetation usually spiny, are found dispersed in the grassland.
Rainforest	This vegetation type usually consists of broad-leaved trees and has a continuous canopy, commonly 30–36 m in height as well as emergent trees, 60 m or taller. The canopy layer comprises of trees of many different sizes, including pygmies, which reach only a metre.
Dry Evergreen forest	Bushes and gnarled little trees with hard evergreen leaves that form low woodland 3-9 m in height.
Sclephron sp. nests	Cells of the solitary mud wasp *Sceliphron* sp.
Coastal Vegetation	Vegetation comprises mainly of sea grapes (*Coccoloba uvifera*). Most vegetation is stunted and wind sculpted where wind exposure is high.
Coastal/Cactus Scrub	Found in areas of shallow and stony soil with an average annual rain-fall of 76 to 102 cm. Besides cacti, trees which grow in this habitat are stunted and wind sculpted if wind exposure is high.

Table 3. Showing species composition for the orb-weaving families, according to habitat for spider surveys of Eastern Caribbean. Key: 1 – St. Kitts; 2 – Nevis; 3 – Anguilla; 4 – Antigua; 5 – Montserrat; 6 – St. Lucia 7 – Grenada.

	Garden	**In and on Buildings**	**Abandoned buildings**	**Farmland**	**Roadside**	**Pastureland**	**Secondary Forest**	**Deciduous forest**	**Lower montane**	**Montane**	**Palm brake**	**Humid Valley Forest**	**Dry Forest**	**Vegetation around salt ponds**	**Mangrove**	**Littoral Woodland**	**Elfin woodland**	**Riparian Vegetation**	**Semi-evergreen**	**Evergreen woodland**	**Inland scrub**	**Rainforest**	***Scelphron* nests**	**Coastal veg**	**Cactus scrub**
Anapidae																									
Sp. A					6																				
Araneidae																									
Acacesia cf *hamata*																			6						
nr *Alpaida* sp.																							3		
Araneus sp. A																				3					
Araneus sp. B																				3					
Araneus sp. C														4											
Araneus sp. D	5															5								5	
Argiope argentata	3;4;5;6	1;2;6;7	1;3;7	6;7	1;3;4;5;6;7	4	2;6	6		7			3;4;7	3;4	5;6	1;2;4;5;7		4;6;7	5	3	2		3	5;6	3
Argiope trifasciata														4		1									
Chrysometa sp A				1							2											1			
Cyclosa caroli	6						6		6			4						6	6						
Cyclosa walkenari	4;2;5	4	3	2	1;2;3;5								4							3	2				
Eriophora sp.					2																				
Eustala anastera	4;5;2;1	7	4;1		5		2	6		5		4	5		5;6	7			5;6				3	6	
Eustala fuscovittata				1;6		4																			
Gasteracanta cancriformis	1;2;4	1;4	1;4;5	1;2;5	1;2;3;7		2;6			5	2		1;3;4;5;7	1	5	5;7		4;6	5	3	1;2		3	5	
Kapogea sp.					1																				
Mangora sp.	2																								
Metepeira compsa	1;2;3;4;6	1;2;6	1	1;2	1;2;3;7								4	1;3;4	5	1;4;5;6	7	4	5	3	2		3	5;6	3
Neoscona neothesis				6	6																				
Neoscona cf oaxcensis	2;4	2		5	1;3;4	4								4	5	1;5					2		3		
Spilasma sp.										5															
Wagneriana sp.																	7								
Mysmenidae																									
Sp A																			6						
Symphytognathidae																									
Sp A															6										
Tetragnathidae																									
Alcimosphenus lincinus					6		2	6	6			4													
Leucauge argyra	2;4;5;6	2;4;7	5;7	1;5;6	1;2;3;4;5;6;7	1	2;6			5;7	5			1;3;4		4	5	4;6;7			2				
Leucauge regnyi	1;2;3;7	2;7	1;7	1;5;7	2;3;5;6	1	1;2;6;7	6	6	5;7	1	4	1;3;4;7		5;6	1;5;7	1;7	4;6	5;6	3	2	1		5	
Tetragnatha nitidens					4;5									3;4;5			1	4;5;6	6						
Tetragnathid sp A																			5						
Theridiosomatidae																									
Sp A.					6		6																		
Sp B.														4				4							

Table 4. Showing the total island sample and mean per site for; abundance (N), observed species richness (S), species diversity (*H′*), species evenness (1/*D*) and dominance (*d*) per habitat for Grenada, Montserrat, Nevis, St. Kitts, St. Lucia Antigua and Anguilla sampled between January 2006 and August 2010.

Island	$N_{(Act.)}$	$N_{(Mean)}$	$S_{(Act.)}$	$S_{(Mean)}$	$H'_{(Act.)}$	$H'_{(Mean)}$	$1/D_{(Act.)}$	$1/D_{(Mean)}$	$d_{(Act.)}$	$d_{(Mean)}$
Grenada	110	13.8	8	2.5	1.98	0.8	5.59	3.04	0.39	0.06
Montserrat	313	24.1	13	3.3	2.38	0.9	10.67	2.9	0.35	0.06
Nevis	311	25.5	12	4.1	1.87	1	5.61	2.9	0.34	0.05
St. Kitts	380	31.7	12	3.4	2.32	0.8	7.89	2.5	0.28	0.04
St. Lucia	358	22.4	16	4.3	2.06	1	6.41	4.1	0.45	0.05
Antigua	220	14.7	15	4.5	2.09	1	7.55	3.3	0.15	0.05
Anguilla	258	21.5	12	4.1	1.48	1	3.19	3.9	0.25	0.05

habitats with four and five species respectively (Table 3).

Sampling yielded a total of 33 species from six families for this region. Grenada was found to contain the lowest species richness (Table 4) while St Lucia and Antigua had the highest and second highest values. Notably Nevis, St. Kitts and Anguilla have the same species richness values. However, single factor ANOVA test observed species richness ($F_{6,72} = 1.47$; $P = 0.201$), was not significantly different among the islands included in this study.

The rank-abundance curve produced (Fig. 2) fitted only the log series model ($D = 0.151$; $D_{0.05} = 0.154$).

In terms of the similarity of species composition among the islands, analysis (Fig. 3) showed three distinct groups. Antigua, St Kitts and Nevis formed one cluster with Montserrat, Anguilla and Grenada forming a second cluster with Montserrat, with Montserrat and Anguilla being more similar to each other than either to Grenada. St. Lucia contained the most distinct assemblage of species.

DISCUSSION

The results revealed that in natural habitats, highest species richness was found in littoral woodland and the vegetation around salt ponds, while lower species richness was exhibited in high altitude habitats such as, palmbrake and elfin woodland. This result was not surprising since these low diversity habitats are found at very high altitudes for example in in Nevis (Sewlal and Starr 2007), St. Kitts (Sewlal 2008), Montserrat (Sewlal 2010) and Grenada (Sewlal 2009b). Few species can withstand the harsh conditions present such as sea blast, salt and hurricanes. Although both littoral woodland and coastal vegetation experience similar conditions, the coastal habitat contains fewer species than littoral woodland with 11 and six species respectively. This is possibly due to the lack of study vegetation in coastal habitat which does not provide adequate support for webs. Most of the individuals present were found on the side facing inland, rather than that facing the ocean, indicating that this location provided the spiders with protection from elements such as wind.

The high species richness exhibited by both garden and roadside habitats is not consistent with previous studies, which indicate that both of these habitats provide ideal conditions for spiders. For example, they contain gaps in the vegetation for flying prey which can be blown into or fly into the webs of orb-weavers. The variety of vegetation means many suitable points of attachment for web construction. Also the presence of artificial lighting attracts

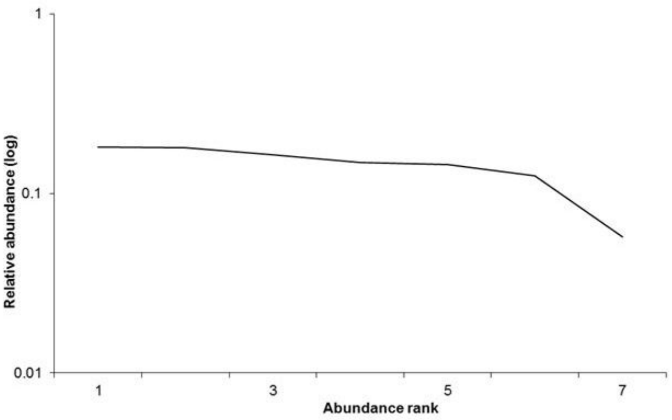

Fig. 2. Rank abundance curves for average abundances of all islands sampled (Montserrat, Nevis, St. Kitts, St. Lucia Antigua and Anguilla).

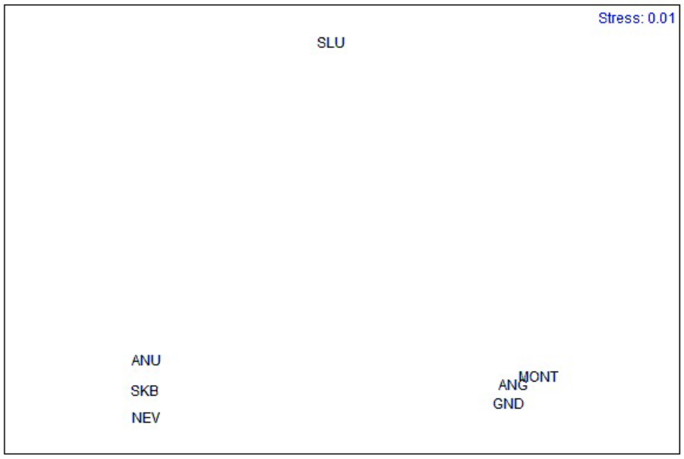

Fig. 3. Multidimensional scaling plot showing the species composition similarity for Anguilla (ANG), Grenada (GRN), Montserrat (MONT), Nevis (NEV), St. Kitts (SKB), St. Lucia (SLU) and Antigua (ANU).

flying insects thus providing a relatively steady food supply to nocturnal as well as diurnal species.

The low level of species richness exhibited by altered habitats such as pastureland can also be explained by the high level of disturbance caused by grazing, little protection from the elements and lack of stable structures for web construction. Although farmland is considered disturbed habitat, like the pastureland it exhibited a higher species richness, most likely as it provides a good food source for spiders since many agricultural pests are insects. It is important to note that the low species richness in certain habitats, such as dry evergreen forest, cactus scrub, low montane forest and rainforest, were most likely a by-product of these habitats only being present on a single or few islands.

Few species were also found on buildings (both occupied and abandoned). This is expected since most of the species found here were also found in the neighbouring garden habitat (Table 1). As with the garden habitat, these area often have artificial light, which will attract a relatively constant supply of insects thus providing a stable source of food. However, the exterior of these manmade structures did not provide many suitable points of attachment for web placement.

The similarity among St. Kitts, Nevis and Antigua in terms of species composition (Fig. 3) is expected as they are relatively close to each other (Fig. 1) (Sewlal and Starr 2010), of similar size and share similar habitats. Montserrat, Anguilla and Grenada also have similar species compositions (Fig. 3). Although these islands are fairly far apart geographically (Fig. 1), they have all experienced high disturbance events. Hurricanes have profound effects on web-building spiders, for example causing a decrease in population densities (Spiller and Schoener 2007). Grenada has experienced two hurricanes successively in recent years; Hurricanes Ivan and Emily hit the island in 2005 and 2006 respectively resulting in a change in the understory vegetation structure. For example, in the montane forest on Mount Qua Qua the natural vegetation has been replaced with dense stands of razor grass (*Scleria secans*). This indicates that this habitat is going through primary succession, providing a habitat for generalist species (Sewlal 2009b), which may explain the lowest observed species richness here (Table 4). Hurricane damage to vegetation is a major influence on the orb-weaver fauna of this island, as indicated by the high species richness found in the dry forest habitat which exhibited little damage from the hurricanes (Sewlal 2009b). Anguilla has also experienced hurricane damage with the most recent being Hurricane Lenny in 1999. This island is also quite flat with a maximum elevation of 65m (Sewlal and Starr 2010); most of the vegetation is short and subject to disturbance by wind and rain. However, it has more time to recover in terms of its biodiversity. Montserrat has also experienced disturbance but in this case due to the constant activity of the Soufriere Hills volcano which has rendered approximately two-thirds of the island uninhabitable by people and explaining why it yielded the second lowest observed species richness (Table 4).

Sampling in St. Lucia was concentrated in the South and East of the island as they had the largest areas of natural habitats to sample (Sewlal 2011). Also some of the forested habitat sampled comprised of secondary vegetation which accounted for the high species richness. The disturbance in this habitat caused by commercial logging has created new niches, therefore possibly containing both specialist and generalist species (Sewlal 2011). St. Lucia is also the largest of the seven islands sampled, so this coupled with the mixture of natural and disturbed habitats could account for the more habitats and microhabitats and, in turn, the distinct species composition found on this island.

The community structure of spiders on these islands was found to fit the log series abundance model indicating that the species that make up this community arrived at random intervals (May 1975), which makes sense as these are oceanic islands. Oceanic islands have volcanic origins therefore all of the fauna found there was brought over by humans or naturally, such as on floating mats of vegetation or migration from continental land masses, depending on their distance from the island or nearby islands. It also implies that the community has a simple ecology (May 1975) dominated by a few factors (Magurran 2004; May 1975). Some of the advantages of this model are that it is not influenced by sample size or the abundance of the most common species (Taylor 1978).

Orb-weavers occupy a wide range of habitats, and Araneidae was consistently the most ecologically diverse family in all islands sampled (Sewlal and Starr 2007; Sewlal 2008, 2009a, 2009b, 2010, 2011). It was followed by Tetragnathidae in terms of family diversity, except when it was replaced by Oxyopidae in St Lucia (Sewlal 2011) and Salticidae in Montserrat (Sewlal 2010). However, the preference of certain species for specific habitats is not unusual especially with respect to orb-weavers.

Two big orb-weaver species (*Araneus* and *Eriophora*) were recorded from the islands. However, *Nephila clavipes* belonging to Nephilidae was absent from despite being present on nearby islands like Trinidad and Tobago (Sewlal 2013) and the Greater Antilles (World Spider Catalogue 2016). For future work, continental islands like Trinidad and Tobago can be compared with that of the females of this species are quite large, measuring between 24 to 40 mm in length, producing webs often spanning a metre in width. In the available habitats it was observed that members of *Leucauge* constructed web up to a metre in width so that they vegetation can support and facilitate webs of this size. Therefore the noted absence of very large orb-weaving species on the islands of the Eastern Caribbean may be related to their size in that the habitats available on these islands cannot facilitate webs of that size and provide enough prey to sustain spiders of this size.

For future work, I would recommend that similar studies be carried out on other spider groups, such as plant and ground wandering species. Also the results from these studies can be compared with continental islands such as Trinidad and Tobago.

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