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Article in *Caribbean Journal of Science* · October 2019

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## The Arachnids (Arachnida) of Aruba, Bonaire, and Curaçao

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**ABSTRACT.**—Aruba, Bonaire, and Curaçao (ABC Islands) are located at the southern margin of the Caribbean Plate, just north of South America. Little is known of the arachnid fauna of these islands, and the only work on spiders was published over a century ago. Here we provide a list of arachnids opportunistically collected from the islands, including Klein Bonaire and Klein Curaçao, over approximately 2 months. More than 750 specimens from 4 arachnid orders, (Amblypygi, Pseudoscorpiones, Scorpiones, Araneae) were collected and identified. We recovered 1 species of amblypygid, 2 species of pseudoscorpions, 1 species of scorpion, and 76 species of spiders. Additionally, we compared species diversity between urban and natural areas. The number of species is relatively low given the proximity to South America, but this likely reflects that collecting only took place for a short time and was opportunistic as opposed to systematic. Nevertheless, we found 25 new records and >20 likely undescribed species for the islands, providing insights into the spider fauna of northern South America and indicating that additional surveys of the area are warranted.

**KEYWORDS.**— Amblypygid, ABC Islands, Caribbean, Lesser Antilles, Netherlands Antilles, pseudoscorpion, scorpion, spider

### INTRODUCTION

Aruba, Bonaire, and Curaçao, also called the ABC Islands, are relatively small (Aruba: 180 km<sup>2</sup>, Bonaire: 294 km<sup>2</sup>, Curaçao: 444 km<sup>2</sup>) and low-lying, with the highest point being Mt. Christoffel on Curaçao (375 m) (De Palm 1985). The climate on the islands is semi-arid to arid, and the vegetation is largely xeric, although Curaçao also has dense secondary woodland (Beers et al. 1997).

The ABC Islands are located in the Caribbean-South America plate boundary zone (Hippolyte and Mann 2011) and are all relatively near (no more than 100 km) the northern coast of Venezuela (Fig. 1). Whereas Bonaire and Curaçao are separated from the South American mainland by the Bonaire Trench, which at places exceeds 2000 m in depth (Beets 1972), Aruba lies on the continental shelf, and the maximum depth between the island and the mainland does not exceed 135 m. At least parts of the islands have been subaerial since the Middle Miocene (Stienstra 1991), and glacial and eustatic sea level fluctuations have caused

a series of transgressions and regressions (De Buissonjé 1974). Dating of the Higher Terrace limestones indicates a gradual sea level decline during the Pleistocene, from a maximum of approximately 175 m above the current level around 2.4 mya to approximately 100 m above the current level around 1.3 mya. This indicates that the islands have been continuously exposed for approximately 2.3 my. Aruba differs from Curaçao and Bonaire in that during the glacial sea level drop that occurred 19.5 kya, it was likely connected to the South American mainland or at most separated by only a narrow channel (Van Buurt 2005).

Arachnids are a very diverse group of predators, comprising both generalists and specialists, and play a huge role in controlling insect populations. Only a single paper has been published on the spiders of the ABC Islands, and it is over a century old (Van Hasselt 1887). The paper lists 19 valid species in 11 families, primarily from Curaçao, with fewer from Bonaire and Aruba, and also includes a record from Suriname. Since that time, there have been

papers describing individual species (Alayón 2005) or listing ranges (e.g., Chickering 1967) or providing lists that include the islands (Edwards and Wolff 2008), but no surveys or inventories examining the entire arachnid fauna have been published.

### MATERIALS AND METHODS

Arachnids were collected opportunistically by hand or by shaking vegetation over a butterfly net by 1 person, primarily during November and December 2004 and January 2005. Aruba collections were made opportunistically by hand for 2 days in October 2004; therefore while these collections are included in the counts and noted in the list, the habitats and results are not discussed in detail. Because only adults can be reliably identified to species in most cases, only adults are included in counts unless no adults of a single family/genus/species were found (e.g.,

Sparassidae was counted as a family, genus, and species although only a single juvenile was collected). Valid names of spiders were checked using the World Spider Catalog (2015). All specimens are deposited at the California Academy of Sciences.

### Study Sites

Arachnids were collected in both a variety of natural areas and urban habitats (Fig. 1, Table 1). Below is a brief description of the seven primary habitats in which collecting occurred.

**Strand vegetation** in the Leeward Islands occurs in both sandy and rubble beach areas along the open coasts. This habitat is greatly affected by salt spray, wind, and sun exposure caused by the absence of tree cover. The vegetation is dominated by *Suriana maritima* and *Scaevola plumieri* (e.g., site 37) scrub growth, whereas *Batis maritima*, *Sesuvium portulacastrum*, and

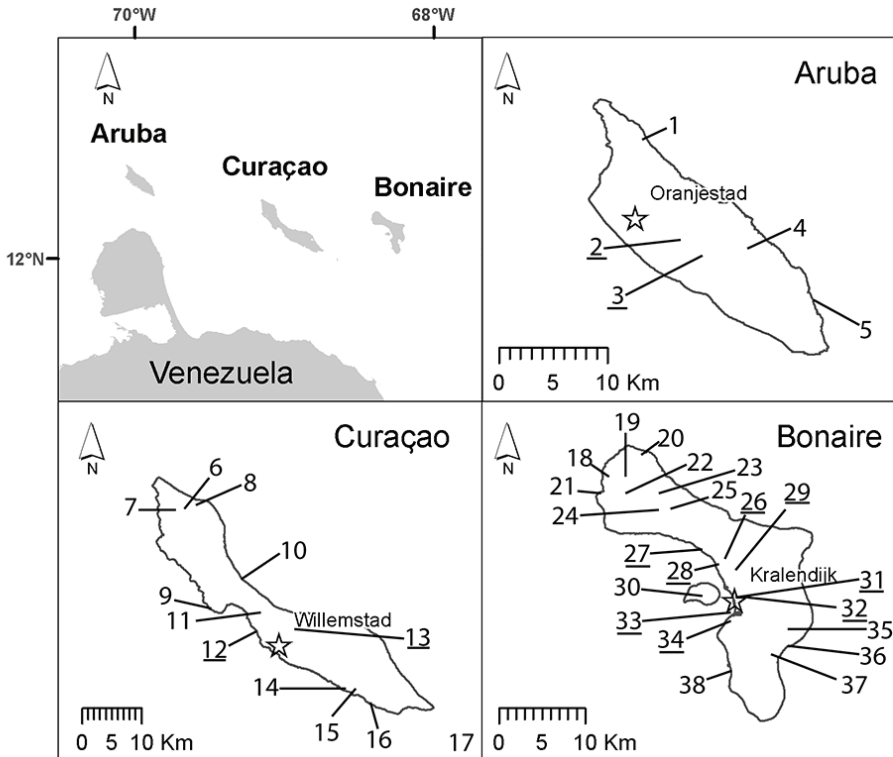


FIG. 1. Map showing the location of Aruba, Bonaire, and Curaçao, with a star indicating the capital of each island, showing collecting localities indicated by numbers. These numbers correspond to those given in Table 1. An underlined number indicates that it is an urban collection site rather than a natural collection site.

TABLE 1. The locality numbers correspond to those given in Figure 1. If a number is underlined, it indicates that the area is an urban area vs. a natural area.

Locality number	Locality	General habitat type
1	Aruba: Alto Vista Chapel	Dry-deciduous
<u>2</u>	Aruba: Bringamosa	Urban/Dry-deciduous
<u>3</u>	Aruba: vic. Wela Shooting Range	Urban/Dry-deciduous
4	Aruba: Arikok National Park	Dry-deciduous
5	Aruba: Boca Grandi Beach	Strand vegetation
6	Curaçao: vic. Seru Christoffel, Christoffel National Park	Dry-evergreen
7	Curaçao: Seru Gracia, Christoffel National Park	Dry-evergreen
8	Curaçao: Pos Monton, Christoffel National Park	Dry-deciduous
9	Curaçao: Rif St. Marie	Saline lagoon
10	Curaçao: Hato Plain	Coastal dry-evergreen
11	Curaçao: Malpais	Freshwater spring
<u>12</u>	Curaçao: Carmabi Institute	Urban
<u>13</u>	Curaçao: Girouette Plantation	Urban
14	Curaçao: Janthiel	Coastal dry-evergreen
15	Curaçao: Caracasbaai	Coastal dry-evergreen
16	Curaçao: Fuikbaai	Coastal dry-evergreen
17	Curaçao: Klein Curaçao	Strand vegetation
18	Bonaire: Bronswinkel	Freshwater spring
19	Bonaire: Brandaris	Dry-evergreen
20	Bonaire: Saliña Matijs	Saline lagoon
21	Bonaire: Saliña Slagbaai	Saline lagoon
22	Bonaire: Slagbaai	Dry-deciduous
23	Bonaire: Landhuis Washington	Dry-deciduous
24	Bonaire: Dos Pos	Freshwater spring
25	Bonaire: Altamira Ungu	Coastal dry-evergreen
<u>26</u>	Bonaire: Republiek	Urban
<u>27</u>	Bonaire: Sabadeco	Urban
<u>28</u>	Bonaire: DROB	Urban
<u>29</u>	Bonaire: Kaya Otomac	Urban
30	Bonaire: Klein Bonaire	Coastal dry-evergreen
<u>31</u>	Bonaire: Flor di Kuba	Urban

TABLE 1. Cont..

Locality number	Locality	General habitat type
<u>32</u>	Bonaire: Nikibobo	Urban
<u>33</u>	Bonaire: Plaza Marina	Urban
<u>34</u>	Bonaire: Lima	Urban/Coastal dry-evergreen
35	Bonaire: Bakuna	Coastal dry-evergreen
36	Bonaire: Lac Bonaire	Saline lagoon
37	Bonaire: Kontiki/Sorobon	Strand vegetation
38	Bonaire: Pink Beach	Strand vegetation

*Heliotropium curassavicum* are common herbs (De Freitas et al. 2005).

**Salina vegetation** is identified as a separate landscape type in the Leeward Islands that typically occurs around saline lagoons or inland waters (Beers et al. 1997). Typical trees found there are *Conocarpus erectus*, *Hippomane mancinella*, *Prosopis juliflora*, and the mangrove *Rhizophora mangle* (e.g., site 36). These areas also share many plant species with the coastal dry-evergreen scrublands, and species such as *Capraria biflora*, *Corchorus hirsutus*, *Croton flavens*, *Jatropha gossypifolia*, and *Opuntia wentiana* are common.

**Coastal dry-evergreen** woodlands occur principally on Pleistocene carbonate reef terraces that are found along the coasts of the islands and are largely dominated by *Haematoxylon brasiletto* and *Casearia tremulans* trees, as well as *Antirhea acutata*, *Croton* sp., *Erithalis fruticosa*, *Jatropha gossypifolia*, and *Lantana involucrata* bushes. The occasional *Guaiacum officinale*, *G. sanctum*, and *Jacquinia armillaris* are typical trees found in dry-evergreen scrubland vegetation (De Freitas et al. 2005).

**Freshwater lake and pond habitat** in these islands is rare and ecologically important. It is typically dominated by *Stemodia maritima*, *Ammannia coccinea*, *Echinodorus berteroi*, and several rushes (*Cyperus* spp.) and usually surrounded by dry-deciduous *Prosopis* and *Opuntia* woodlands.

**Dry-deciduous woodland vegetation** is principally found on igneous-derived soils

and dominated by *Bourreria succulenta* and *Haematoxylon brasiletto* trees, *Cereus repandus* columnar cacti, and *Melochia tomentosa* and *Cordia curassavica* scrub. More degraded forms of this vegetation may be dominated by thorny scrub of *Vachellia tortuosa* and *Prosopis juliflora* trees, along with *Croton* sp. and *Opuntia* sp. (De Freitas et al. 2005).

**Urban areas** have intensely disturbed vegetation in which native species have largely been replaced by many typical hardy tropical ornamental and invasive weedy species. Early successional *Vachellia tortuosa* and the invasive grass *Cenchrus ciliaris* are common weeds, as are the invasive vines *Antigonon leptopus* and *Cryptostegia grandiflora*.

**Inland dry-evergreen vegetation** is typically found on igneous (or, in the case of Curaçao, on non-calcareous sedimentary rock) deposits at elevations of 150 m or higher. The least disturbed examples of such vegetation are found in Curaçao where it is typically dominated by a variety of evergreen trees and shrubs, such as *Gundlachia corymbosa*, *Antirhea acutata*, and *Erithalis fruticosa*. The occurrence of bromeliads and epiphytes such as orchids and ferns, along with some of the rarest evergreen tree species of the islands, typifies this type of vegetation (Beers et al. 1997).

## RESULTS

Over 750 specimens were collected from the arachnid orders Scorpiones, Amblypygi,

Pseudoscorpiones, and Araneae (Table 2). In total, 1 species of scorpion, 1 species of amblypygid, 2 species of pseudoscorpions, and 76 species of spiders belonging to 63 genera in 23 families were recovered (Tables 3 and 4). The two species of pseudoscorpion, *Aphelolpium scitulum* and *Pachyolpium arubense*, were previously recorded from the islands (Hoff 1964; Van den Tooren 1995), as were the scorpion and amblypygid species (Fet et al. 2000; Harvey 2003).

Although only a few specimens were collected from Aruba, they do not entirely overlap with species collected in Bonaire and Curaçao and include 2 species that are apparently undescribed. The families with the most species were Salticidae (17), Theridiidae (12), and Araneidae (10) (Table 3). Undescribed species (22) were found on all of the islands. Between Bonaire and Curaçao, at least 18 species overlap. On Bonaire, 33 species from 32 genera of 16 families were collected, and 59 species from 54 genera of 21 families were collected in Curaçao. Overall, more species were collected in natural areas (56) than in urban areas (35). The same pattern is seen per island, with 21 species collected in natural areas and 19 species collected in urban areas in Bonaire, and 48 species collected in natural areas and 22 species collected in urban areas in Curaçao.

## DISCUSSION

Similar to survey results of other Caribbean islands, the families with the most species were Salticidae, Theridiidae, and Araneidae (Table 4) (e.g., Jamaica; Crews et al. 2015). Additionally, a pattern of more species found in natural areas over urban areas is similar to results of surveys conducted in Antigua (Sewlal 2009a) and Grenada (2009b) (but see Sewlal 2007; 2008).

Incomplete overlap of taxa from Aruba with taxa from Bonaire and Curaçao may result from having fewer specimens from Aruba or could be historical. Whereas all three islands have generally been subaerial since the Mid-Miocene and have become continuously exposed since approximately 2.3 mya, the fauna of Aruba differs from the other islands likely because it may have been connected to mainland South America during the a glacial sea-level drop 19.5 kya (Stienstra 1991). Despite this, Aruba is home to several endemic plants and many endemic animal species (Arends and Boersma 2000; Debrot 2006; Crews 2011).

Because collection efforts were not uniform across the islands, we are unable to determine whether the arachnid fauna of Curaçao is actually more species rich than that of Bonaire or whether it only appears that way. More collections were made for a longer time in Curaçao. Additionally, Curaçao is larger than Bonaire, with more vegetation types and plant species (De Freitas et

TABLE 2. Orders, families, and species of Arachnida, excluding Araneae, collected in 2004 and 2005 in Bonaire and Curaçao. Numbers refer to localities shown in Figure 1 and detailed in Table 1. Underlined numbers indicate urban areas (vs. natural areas).

Order	Family	Species	Bonaire	Curaçao
Amblypygi	Phryniidae	<i>Phrynus pulchripes</i> (Pocock 1894)	<u>27</u>	<u>12</u>
Pseudoscorpiones	Olpiidae	<i>Aphelolpium scitulum</i> Hoff 1964		17
		<i>Pachyolpium arubense</i> Beier 1936		6
Scorpiones	Buthidae	<i>Centruroides testaceus</i> (De Geer, 1778)		<u>12</u>

TABLE 3. All families, genera, species and individual counts of Araneae collected in Aruba, Bonaire, and Curaçao during 2004–2005. Species are arranged alphabetically. Numbers refer to localities shown in Figure 1 and detailed in Table 1. A pound sign (#) next to the name indicates the species is apparently undescribed. An asterisk (\*) next to the name indicates the species is a new record for the islands. Underlined numbers indicate urban areas (vs. natural areas). imm(s). = immature(s).

	Localities	Total number of individuals	Known distribution
<b>Anyphaenid+A1+A3:D112</b>			
imms.	7, 8, 11, <u>12</u> , <u>13</u> , 15, 16, 18, <u>28</u> , <u>31</u> , <u>34</u> , 36, 38	31	
<i>Anyphaenoides irusa</i> Brescovit	7, 22, <u>28</u>	5	Venezuela, Suriname, Dutch West Indies
* <i>Wulfila modestus</i> Chickering	8, 11	4	Panama
<b>Araneidae</b>			
imms.	7, 8, 11, <u>13</u> , 15, 16, 18, <u>28</u> , <u>31</u> , <u>35</u> , 36, 38	72	
* <i>Acacesia tenella</i> (L. Koch)	8, <u>13</u>	2	Mexico to Brazil, French Guiana, Guyana
<i>Argiope argentata</i> (Fabricius)	7, 9, <u>13</u> , <u>28</u>	6	USA to Chile
<i>Argiope</i> sp. imms.	7, 8, 14	3	
<i>Cyclosa</i> sp. imm.	8	1	
* <i>Eriophora edax</i> (Blackwall)	11, 16, 22	3	USA to Brazil
* <i>Eriophora fulginea</i> (C.L. Koch)	<u>13</u>	1	Honduras to Brazil
* <i>Eustala guttata</i> F.O. Pickard-Cambridge	8, 11, 14, 16, 18, <u>28</u> ,	31	Mexico to Brazil
* <i>Larinia directa</i> (Hentz)	36	1	USA to Brazil

TABLE 3. Continued.

	Localities	Total number of individuals	Known distribution
<i>Larinia</i> sp. imm.	<u>13</u>	1	
<i>Mecynogea lemniscata</i> (Walckenaer)	16	2	USA to Argentina
<i>Metepeira compsa</i> (Chamberlin)	4, 10, 16, 21, 22, 23, <u>26</u> , <u>28</u> , 29, <u>31</u> , 35, 36, 38	60	Puerto Rico to Argentina
<i>Metepeira</i> sp. imms.	8, 11, 15, 16, <u>31</u> , <u>34</u> , 35, 37	38	
* <i>Tatepeira tatarendensis</i> (Tullgren)	16	1	Colombia to Bolivia
Corinnidae			
* <i>Creugas gulosus</i> Thorell	<u>32</u>	1	Cosmopolitan
* <i>Falconina melloi</i> (Schenkel)	18	2	Colombia, Venezuela
<i>Falconina</i> sp. imm.	29	1	
<i>Xeropigo tridentiger</i> (O. Pickard-Cambridge)	<u>13</u>	1	USA to Brazil, West Indies, St. Helena
Ctenidae sp.			
imm.	<u>13</u>	1	
Dictynidae sp.			
imms.	16, <u>33</u>	2	
<i>Dictyna</i> cf. <i>meditata</i>	11, 14, <u>13</u> , 15, 16, <u>28</u>	21	<i>D. meditata</i> has been found from Mexico to Panama, Cuba
Gnaphosidae			
imm.	<u>13</u>	1	
* <i>Australoechemus celer</i> Schmidt & Piepho	<u>12</u>	1	Cape Verde Islands



TABLE 3. Continued.

	Localities	Total number of individuals	Known distribution
<i>Camillina jeris</i> Platnick & Shadab	17	2	Curaçao
Echeminae sp.#	<u>27</u>	1	
Linyphiidae			
imm.	<u>13</u>	1	
* <i>Mermessus bryantae</i> (Ivie & Barrows)	14	1	North America, Cuba, Venezuela, Azores
* <i>Tutaibo velox</i> (Keyserling)	11	1	Brazil
Lycosidae			
imm.	36	2	
cf. <i>Trochosa arctosina</i>	5, 14, 17, 36	27	<i>T. arctosina</i> has been found in Venezuela and Guyana
Mimetidae			
imm.	11	3	
<i>Mimetus</i> sp.#	11, <u>13</u>	2	
Miturgidae			
<i>Odo</i> sp.#	23	1	
<i>Odo</i> sp. imm.	<u>13</u> , 16	5	
Oxyopidae			
<i>Oxyopes</i> sp. imm.	14, 16	2	
Philodromidae			
<i>Philodromus traviatus</i> Banks	<u>28</u> , <u>34</u>	2	Panama, Aruba, Curaçao, Venezuela
Pholcidae			
<i>Modisimus</i> sp.#	6, 8, <u>13</u>	13	

TABLE 3. Continued.

	Localities	Total number of individuals	Known distribution
<i>Papiamenta</i> sp. 1#	1, 5	2	
<i>Papiamenta</i> sp. 2#	10, 17, 23	7	
<i>Physocyclus globosus</i> (Taczanowski)	<u>13</u>	2	Cosmopolitan
Phrurolithidae			
imms.	6, 10	2	
Salticidae			
imms.	7, 8, 11, <u>13</u> , 14, 15, 16, <u>28</u> , <u>31</u> , <u>34</u> , 36, 37	38	
<i>Chira</i> sp. nov. <i>trivittata</i> gp.	8, 11, <u>13</u>	5	
cf. <i>Naubolus</i> sp.#	11	1	
Dendryphantinae <i>Gastromicans</i> group sp. 1#	38	1	
Dendryphantinae <i>Gastromicans</i> group sp. 2 #	8, 11	2	
Dendryphantinae <i>Gastromicans</i> group sp. 3#	8, <u>28</u>	2	
Dendryphantinae <i>Gastromicans</i> group sp. 4#	7, 16, 22, 35	5	
<i>Gastromicans</i> cf. <i>levispina</i>	7	1	
Euophryinae sp.#	11, <u>13</u> , <u>28</u>	4	
Freyinae – cf. <i>Triggella</i> sp. 1#	<u>28</u>	2	
Freyinae – cf. <i>Triggella</i> sp. 2#	11	1	
* <i>Helvetia albovittata</i> Simon	7, 16	2	Brazil, Paraguay, Argentina, Galapagos Islands
<i>Hentzia</i> sp.#	<u>34</u>	1	

TABLE 3. Continued.

	Localities	Total number of individuals	Known distribution
<i>*Nycerella decorata</i> (Peckham & Peckham)	11, <u>13</u>	2	Panama, Colombia, St. Vincent
<i>Pseudattulus</i> sp.#	7, 11, 14, 21, 30	12	
<i>Saitidops</i> sp.#	17, <u>28</u>	3	
Salticidae sp. 1#	5	1	
Salticidae sp. 2#	6	1	
Salticidae sp. 3#	17	1	
Scytodidae			
<i>Scytodes</i> imms.	4, 8, 16	4	
<i>*Scytodes lineatipes</i> Taczanowski	<u>31</u>	1	Venezuela to Paraguay
Segestriidae			
<i>Ariadna</i> sp.	4	2	
Selenopidae			
<i>Selenops arikok</i> Crews	<u>2</u> , 3, 4	4	Aruba
<i>Selenops curazao</i> Alayón	<u>12</u> , <u>13</u> , 14, 23, 24, <u>25</u> , <u>28</u>	22	Curaçao and Bonaire
Sparassidae			
imm.	8	1	
Tetragnathidae			
<i>Leucauge</i> imms.	7, 8, 11, <u>13</u> , 14, 16, <u>26</u> , 29	13	
<i>*Leucauge argyra</i> (Walckenaer)	<u>28</u>	1	USA to Brazil

TABLE 3. Continued.

	Localities	Total number of individuals	Known distribution
* <i>Leucauge venusta</i> (Walckenaer)	7, 8, 11, <u>13</u> , 19, 22, <u>26</u> , <u>28</u> , <u>31</u>	21	Canada to Brazil
<i>Tetragnatha</i> sp. imm.	15, 36	2	
* <i>Tetragnatha nitens</i> (Audouin)	15	1	Circumtropical
<i>Tetragnatha</i> sp.#	15	1	
Theridiidae			
imms.	11, 16, <u>13</u>	6	
<i>Anelosimus studiosus</i> (Hentz)	18	7	USA to Argentina
* <i>Coleosoma floridanum</i> Banks	11	1	Pantropical, greenhouses in Europe
* <i>Cryptachaea hirta</i> (Taczanowski)	7,8, 11, 16, 14, 22, <u>28</u> , <u>33</u> ,	39	Panama to Argentina
<i>Faiditus caudatus</i> (Taczanowski)	8, 11, 16, 18	5	USA, West Indies to Argentina
<i>Latrodectus curacaviensis</i> (Müller)	20	1	Lesser Antilles, South America
<i>Latrodectus geometricus</i> (C.L. Koch)	<u>12</u>	1	Cosmopolitan
* <i>Steatoda ancorata</i> (Holmberg)	<u>3</u> , 4	3	Mexico to Chile
<i>Steatoda erigoniformis</i> (O. Pickard-Cambridge)	<u>13</u>	1	Pantropical
<i>Steatoda</i> cf. <i>quadrifaculata</i> #	10	1	<i>S. quadrifaculata</i> has been found from the USA
<i>Steatoda</i> sp. imm.	21	1	
* <i>Theridion dilucidum</i> Simon	14	1	Costa Rica to Venezuela, West Indies
* <i>Wamba crispulus</i> (Simon)	8, 16	2	Canada to Brazil, West Indies

TABLE 3. Continued.

	Localities	Total number of individuals	Known distribution
Thomisidae			
* <i>Misumenops maculissparsus</i> (Keyserling)	7, 8, 9, 11, <u>13</u> , 14, 15, 16, 18, 22, 24, <u>26</u> , <u>28</u> , <u>34</u> , <u>35</u> , 36	148	Brazil, Argentina
* <i>Tmarus ineptus</i> (O. Pickard-Cambridge)	8, 11	9	Panama
Zodariidae			
imm.	10	1	
<i>Antillorena</i> sp. imm.	<u>31</u>	1	

al 2005), greater elevational differences, higher rainfall, and less habitat degradation. Greater species abundance in Curaçao has been observed for other arthropod groups, such as butterflies (Miller et al. 2003).

Due to the islands' proximity to the mainland (MacArthur and Wilson 1967), it is likely that additional, focused searching rather than opportunistic collection would reveal more species. Nearly as many species were found in the Turks and Caicos Islands, another group of low-lying, arid, Caribbean/Atlantic islands, which is surprising given their small size (Crews and Yang 2016).

There were several adult specimens (>20) collected that could not be identified to species even with the help of experts on the group. Most of these occur in the family Salticidae. Salticids are the most species rich family of spiders, and they are more diverse in the tropics than anywhere else (World Spider Catalog 2019). Additionally, northeastern Colombia and northwestern Venezuela are relatively poorly known regarding spider fauna, with the most recent comprehensive work on Venezuelan spider fauna from 1955 (Caporiacco 1955).

A few species mentioned in Van Hasselt (1887) were not recovered in this study (Table 5). This is likely only coincidental because

many of these species are widespread (e.g., *Nephila clavipes*, *Gasteracantha cancriformis*) throughout the tropics and therefore likely occur on the islands. Additionally, some of Van Hasselt's species are now considered *nomen dubia*, and some of them may have been misidentified because they are not known to occur outside of the United States (e.g., *Ctenus hibernalis*).

Many of the species identified have widespread distributions (Table 3), occurring throughout North and South America, with a few being Circumtropical or Cosmopolitan, and only a few endemics or seemingly endemic species. Again, this may be due to opportunistic collections rather than active searching for more cryptic species. Many aerial-web-building spiders have broader distributions due to their excellent dispersal capabilities. Additionally, the potential undescribed species may be endemic to the islands or they may also be found on the mainland; this can only be revealed by more systematic survey efforts in both areas. Of the spiders that are considered endemic (Gnaphosidae: *Camillina jeris*; Selenopidae: *Selenops arikok* and *S. curazao*; Pholcidae: *Papiamenta* sp.), it may be that these have not yet been collected on the mainland. The former two families are non-web-building and live

TABLE 4. Table showing the number of genera, species and individuals collected per family for all three islands. Families are arranged by the number of species, followed by the number of genera.

Family	Number of Genera	Number of Species	Number of Individuals
Salticidae	13	17	85
Theridiidae	9	12	68
Araneidae	9	10	221
Gnaphosidae	4	4	5
Pholcidae	3	4	24
Tetragnathidae	2	4	39
Corinnidae	3	3	5
Linyphiidae	3	3	3
Thomisidae	2	2	158
Anyphaenidae	2	2	40
Selenopidae	1	2	26
Scytodidae	1	2	3
Lycosidae	1	1	29
Dictynidae	1	1	23
Xenoctenidae	1	1	6
Mimetidae	1	1	5
Oxyopidae	1	1	2
Phrurolithidae	1	1	2
Segestriidae	1	1	2
Zodariidae	1	1	2
Ctenidae	1	1	1
Philodromidae	1	1	1
Sparassidae	1	1	1
Total	63	76	751

TABLE 5. Species that are listed in Van Hasselt 1887 that were not collected in our study.

Family	Species	Where collected
Araneidae	<i>Gasteracantha cancriformis</i> (Linnaeus)	Suriname
	<i>Neoscona arabesca</i> (Walckenaer)	Curaçao
	<i>Metazygia pallidula</i> (Keyserling)	Curaçao
Caponiidae	<i>Nops glaucus</i> Hasselt	Bonaire
Ctenidae	<i>Ctenus hibernalis</i> Hentz	Curaçao
Nephilidae	<i>Nephila clavipes</i> (Linnaeus)	Curaçao
Pholcidae	<i>Psilochorus pullulus</i> (Hentz)	Curaçao
Salticidae	<i>Metacryba taeniola</i> (Hentz)	Bonaire
	<i>Pelegrina galathea</i> (Walckenaer)	Curaçao
	<i>Salticus bonaerensis</i> Holmberg	Bonaire
Sparassidae	<i>Heteropoda</i> sp.	Curaçao
Thomisidae	<i>Misumenops croceus</i> (Keyserling)	Curaçao
Zodariidae	<i>Antillorena polli</i> (Simon)	Bonaire, Curaçao

under bark or beneath rocks, and although the selenopids are similar to spiders on the mainland, they do not require synonymization (re Galvis and Flórez 2015) and can be considered endemic.

One species of note, the gnaphosid *Australochemus celer*, was previously known only from the Cape Verde Islands. This species was collected at the CARMABI biological research station in Curaçao. It is unknown whether this is an introduced species because it could also be a native species that was transferred to the Cape Verde Islands. The Cape Verde Islands played a large role in the Caribbean slave trade, and people taken for slavery from their homes in Africa had to wait several years on the Cape Verde Islands before being sent off to Curaçao (Brokken 2015). It has been theorized that the Papiamentu language spoken in the ABC Islands originated in the Cape Verde Islands.

The relatively quick survey of arachnids

from the ABC Islands revealed several likely undescribed species and expanded the range of at least 25 species, providing a basic knowledge of the arachnids occurring on these islands. Further systematic surveys would be useful to provide a more thorough knowledge of the arachnid fauna here and would likely provide information regarding the arachnid fauna of northwestern Venezuela and northeastern Colombia.

*Acknowledgements.*—The authors would like to thank Nadine Dupérré, Facundo Labarque, Alex Valdez Mondragón, Ricardo Ott, Cristina Rheims, Adalberto Santos, Bárbara Faleiro, and Diana Silva for help obtaining publications or with identifications. SCC would like to thank Facundo Franken and Roy Croes with help collecting spiders in Aruba. Field work by AOD on Curaçao and Bonaire was supported by the Carmabi Foundation thanks to annual general subsidies from the former

Government of the Netherlands Antilles and the Island Government of Curaçao. Captain Don's Habitat, Bonaire, is gratefully acknowledged for providing a free hotel room, and Stinapa Bonaire is acknowledged for providing a vehicle to AOD. Finally, we thank Alexander Sánchez-Ruiz and an anonymous reviewer for comments that greatly improved this paper.

## LITERATURE CITED

- Alayón, G. A. 2005. La familia Selenopidae en Cuba. *Solenodon*. 5:10–52.
- Arends, R. and F. Boersma. 2000. *Parke Nacional Arikok Guide*. Hong Kong: South Sea International Press Ltd.
- Beers, C. E., J. A. de Freitas and P. Ketner. 1997. *Landscape ecological vegetation map of the island of Curaçao, Netherlands Antilles*. Publication no. 138. Amsterdam: Foundation for Scientific Research in the Caribbean Region.
- Beets, D. J. 1972. *Lithology and stratigraphy of the Cretaceous and Danian succession of Curaçao*. *Uitgaven Natuurwetenschappelijk Studiekring voor Suriname en de Nederlandse Antillen* 70. Utrecht: The Netherlands.
- Brokken, J. 2015. *The Music of the Netherlands Antilles: Why Eleven Antilleans Knelt before Chopin's Heart*. USA: University Press of Mississippi.
- Caporiacco, L. di. 1955. Estudios sobre los arácnidos de Venezuela. 2a parte: Araneae. *Acta Biol. Venez.* 1:265–448.
- Chickering, A. M. 1967. The genus *Nops* (Araneae, Caponiidae) in Panama and the West Indies. *Brevoria*. 274:1–19.
- Crews, S. C. 2011. A revision of the spider genus *Selenops* Latreille, 1819 (Arachnida, Araneae, Selenopidae) in North America, Central America and the Caribbean. *ZooKeys*. 105:1–182.
- Crews, S. C. and A. Yang. 2016. Notes on the spiders (Arachnida, Araneae) of the Turks and Caicos Islands. *Caribb. J. Sci.* 49(1):83-90.
- Crews, S. C., L. A. Esposito, and F. Cala-Riquelme. 2015. The Arachnids of Hellshire Hills, Jamaica. *Caribb. Natur.* 28:1–14.
- Debrot, A. O. 2006. Preliminary checklist of extant endemic taxa of Aruba, Bonaire and Curaçao, Leeward Antilles. Carmabi Report, Carmabi, Curaçao. 28 pp.
- De Buissonjé, P. H. 1974. Neogene and Quarternary geology of Aruba, Curaçao and Bonaire. *Uitgaven Natuurwetenschappelijk Studiekring voor Suriname en de Nederlandse Antillen* 78. Utrecht: The Netherlands.
- De Freitas, J. A. de, B. S. J. Nijhof, A. C. Rojer and A. O. Debrot. 2005. *Landscape Ecological Vegetation Map of the Island of Bonaire (Southern Caribbean)*. Amsterdam: Royal Netherlands Academy of Arts and Sciences.
- De Palm, J. P. H. 1985. (ed), *Encyclopedie van de Nederlandse Antillen*. 2<sup>nd</sup> ed. Walburg Pers, Zutphen, The Netherlands.
- Edwards, G. B. and R. J. Wolff. 2008. A list of the jumping spiders (Salticidae) of the islands of the Caribbean region. *Peckhamia*. 3:27–60.
- Fet, V., W. D. Sissom, G. Lowe and M. E. Braunwalder. 2000. *Catalog of the Scorpions of the World (1758-1998)*. New York: New York Entomological Society.
- Galvis, W. and D.E. Flórez. 2015. New records of the flatie spider genus *Selenops* Latreille, 1819 (Araneae: Selenopidae) from Colombia. *Rev. Ibérica Aracnol.* 27: in press.
- Harvey, M. S. 2003. *Catalogue of the Smaller Arachnid Orders of the World: Amblypygi, Uropygi, Schizomida, Palpigradi, Ricinulei and Solifugae*. Australia: CSIRO Publishing.
- Hippolyte, J.-C. and P. Mann. 2011. Neogene-Quaternary tectonic evolution of the Leeward Antilles islands (Aruba, Bonaire, Curaçao) from fault kinematic analysis. *Mar. Petrol. Geol.* 28:259–277.
- Hoff, C. C. 1964. The Psuedoscorpions of Jamaica: Part 3. The Suborder *Diplosphyronida*. *Bull. Inst. Jamaica*. 10:5–47.
- MacArthur, R. H. and E. O. Wilson. 1967. *The Theory of Island Biogeography*. USA: Princeton University Press.
- Miller, J. Y., A. O. Debrot and L. D. Miller. 2003. A Survey of Butterflies from Aruba and Bonaire and New Records for Curaçao. *Caribb. J. Sci.* 39:170–175.
- Sewlal, J. N. 2007. Preliminary survey for spiders on Nevis, West Indies. *The Living World, J. of Trinidad and Tobago Field Naturalists' Club*. 2007:86–87.
- Sewlal, J. N. 2008. A preliminary survey for spiders on St. Kitts, West Indies, with comparative notes on Nevis. *The Living World, J. of Trinidad and Tobago Field Naturalists' Club*. 2008:66–69.
- Sewlal, J. N. 2009a. Preliminary survey for spiders on Antigua, West Indies. *Coll. of the Bahamas Res. J.* 15:8–11.
- Sewlal, J. N. 2009b. A preliminary survey for spiders on Grenada, West Indies. *The Living World, J. of Trinidad and Tobago Field Naturalists' Club*. 2009:37–39.
- Stienstra, P. 1991. *Sedimentary petrology, origin and mining history of the phosphate rocks of Klein Curaçao, Curaçao and Aruba, Netherlands*



- West Indies. Uitgaven Natuurwetenschappelijk Studiekring voor Suriname en de Nederlandse Antillen 130.* Amsterdam, The Netherlands.
- Van Buurt, G. 2005. *Field guide to the amphibians and reptiles of Aruba, Bonaire and Curacao.* Frankfurt am Main: Chimaira.
- Van den Tooren, D. 1995. Pseudoscorpions (Pseudoscorpiones; Ophiidae) of the genus *Apolpium* from Venezuela, and the genera *Pachyolpium*, *Leptolpium* gen. nov. and *Serianus* from Curaçao, Aruba and Bonaire. *Zool. Med. Leiden.* 76:141–192.
- Van Hasselt, W. M. 1887. Araneae exoticae, quas collegit, pro Museo Lugdunesi, J. R. H. Neervoort Van De Poll, insulis Curaçao, Bonaire et Aruba. *Tijds. voor Entomol.* 227–244.
- World Spider Catalog v. 16.5. 2019. <http://www.wsc.nmbe.ch/> accessed June 2019.