Survey of pest arthropods in and around urban structures in Roseau, Dominica, and IPM strategies to control pest arthropods

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Abstract

The island of Dominica has a rich arthropod fauna, members of which may be pests of businesses and dwelling structures used by humans, if not properly monitored. Previous surveys of arthropods in Dominica have focused exclusively on species interacting in their natural environment from a behavioral or ecological standpoint. To date, no studies have been conducted on the relative abundance of arthropods considered pests in urban settings around Roseau, Dominica. This project was structured to identify arthropod pests in urban localities in Roseau, assess pest prevalence, and offer suggestions modeled after integrated pest management (IPM) practices, when applicable.

Introduction

By far the most diversified and abundant group of animals on Earth and within human structures are arthropods (Bertone, 2016). Since humans have established fixed residents, there has been a plethora of arthropods that share these structures with humans (Martin, et al. 2015). This remains to be the case in multiple environments conducive to human and arthropod co-habitation. A potential trait that may have facilitated arthropods to be able to live successfully within man-made structures is their ability to use the human body as a resource of food and water (Bertone, 2016). Multiple authors have proposed that lineages of arthropods that are currently associated with human dwellings were once inhabitants of caves and coevolved along with humans (see Balvin, et al. 2012). It follows that those arthropods that once inhabited primitive human homes have since evolved to better live alongside humans in their modern structures. The development of human dwellings, the domestication of animals, and the ability to stockpile food have all contributed to the increased diversity of arthropod species in human residencies (Bertone, 2016). Previous research concerning indoor arthropod pests has mainly focused on those with a medical and economic importance, like bed bugs or mosquitoes (Robinson, 2005).

The working definition of a pest in this study is defined as any animal in a location that is not wanted in that area. The scope of this study was directed to surveying arthropod pests in various urban environments throughout Roseau, Dominica. Since there

has been no previous documentation of such pests in this tropical city, it is the intention of this field survey to establish a basal understanding of the urban arthropod fauna in hopes of providing information for further studies to build upon.

Materials and Methods

Locations surveyed in Roseau included four buildings at the Botanical Gardens (two office buildings, the library, and a laboratory), the Forestry Division building, the football federation (FIFA) building, and a small residence across the street from the FIFA structure. A numerical catalogue system was put into place to associate the correct data with the corresponding localities. Locations one through four were assigned to the structures surveyed in respective order.

Trapper Max glue boards (Bell Laboratories, Madison, WI) were placed behind exit doors of rooms and structures, behind toilets, under large sinks, behind appliances (e.g., refrigerators and washing machines), and under shelving that appeared to be a high traffic area for pests. In addition, 288i glue boards (AP & G Co., Brooklyn, NY) were placed in narrow spaces between plumbing fixtures and walls, and also in windowsills where pest activity was suspected. Table 1 indicates the number and type of traps placed at each location. The glue boards were left for a period of three days before being collected for assessment. Each of the four locations was surveyed twice with the exception of the residence, which was surveyed only once. When the glue boards were retrieved, they were marked with the appropriate catalogue number and transported back to the laboratory at the Springfield Station for taxonomic identification.

Yellow pan traps (SOLO Cup Co., Lake Forest, IL) were used to capture flying arthropods in all structures except for the private residence. Pan traps were placed near windows and partially filled with an orange-scented soap (Colgate-Palmolive Co., New York, NY) and water mixture. The pan traps were set at the same time as the second round of glue boards and were not employed during the first round of data collection. When the contents of the pan traps were gathered, the mixture was poured into catalogued Nalgene bottles (Thermo-Fischer Scientific Inc., Waltham, IL) and transported back to the laboratory for arthropod identification.

Once all data had been compiled at the station, each glue board and pan trap was assessed by sight identification as well as using a dichotomous key and a tally of specimens identified to the level of family was recorded. When sight identification was not possible, Crisco vegetable oil (The J.M. Smucker Company Orrville, OH) droplets were placed with a pipette over the trapped specimens (BioQuip Inc. Rancho Dominguez, CA). The contents from each pan trap and glue board were examined individually by means of a dissecting microscope. All specimen identifications were done by using the dichotomous keys in Borror and Delong's *Introduction to the Study of Insects* (2005).

Results

The first sampling bout using glue boards was done on 10-14 June 2016 and the second sampling bout occurred on 14-17 June 2016. In the first sampling using glue boards, 24 different arthropod taxonomic groups were found (Figure 1), while only 17 taxonomic groups were found on the second sampling bout (Figure 2). Of the 17 taxonomic groups caught during the second sampling, 11 taxonomic groups overlapped with the first sampling bout. Thus, a total of 30 different taxonomic groups were found overall during the two separate 3-day intervals of the survey. The pan traps collected 15 separate families of flying insects, as well as a few crawling insects, including common ants in the family Formicidae.

The most abundant taxonomic group found in both surveys using glue boards was the ant family Formicidae, while the least abundant was the beetle family Tenebrionidae (Figures 1 and 2). The most abundant families captured with pan traps were Phoridae and Isotomidae, while the least abundant family was Diapriidae (Figure 3). Lastly, the percentage and abundance of families for both samplings using glue boards and pan traps was varied based on where the building was located (Figures 1-3). For example, there was a high concentration of fruit flies (Drosophiladae) that were recorded at the FIFA building at almost 90%, however at most other buildings ants (Formicidae) were recorded as the most abundant arthropods (Figure 2). Also, there were not large amounts of various collembolans found at both the Ministry of Forestry and the Ministry of Agriculture, but at low levels at the FIFA building (Figure 3).

Discussion

The aim of this survey was to assess the arthropod pests inside urban structures in Roseau, Dominica, as well as try and provide some suggestions on how to control the pests inside the surveyed structures. At first, it was assumed that there would be more cockroaches (Blattidae) than ants (Formicidae) because of the previous surveys that have been done on the island of different insect orders. However, after the survey was completed, there was a significantly higher concentration of formicids than blattids. This is probably due to the accidental capture of a few invasive geckos on the traps. Once the geckos were caught, the formicids started to eat and decompose their bodies. If the geckos were not caught, there would have been only slightly fewer formicids present, because of the multiple trails of formicids that were seen while placing traps.

Additionally, we only obtained American cockroaches (*Periplanea americana)* on the traps, and did not record any German cockroaches (*Blatella germaninca*). American cockroaches do not stay together in small areas, and their sighting is normally of only one or two individuals. The American cockroach is not associated with sanitation issues. Therefore, it was likely present because of the large amount of rainfall and the soil that is present in Dominica, which helps harbor this cockroach and make it easy for it to survive. Once inside a dwelling, it is only looking for a way to go back outside, thus not being considered a pest associated with sanitation issues.

Another point of interest was the lack of mosquitoes in all surveyed areas. This may be due the heavy focus by public health officials to eliminate standing puddles of water, which are optimal mosquito breeding sites. There has been a clear focus on eliminating these sites throughout the entire island to reduce the potential for transmission of deadly mosquito-borne viruses to humans. The lack of mosquitoes in our survey is positive news, because health officials in Roseau are already implementing an important part of IPM.

One anomaly that was noticed was the high concentration of fruit flies in the genus *Drosophila* on the second floor of the FIFA building. This was likely due to the leaking faucet that was under the sink in the kitchen. Also, there was a large amount of arthropods found throughout the FIFA building due to the variety of insect food sources

available. There was food left out on the counters as well as various water sources and shelter areas, which are the three main sources that arthropods need in order to survive.

Another thing that was noticed was the large amount of collembolans that were caught in the pan traps at both the Ministry of Agriculture and the FIFA building. This could be due to collembolans attaching themselves to humans or equipment that is brought into a structure. Once inside, the collembolans try to find a habitat they are familiar with, thus falling into the pan traps that were placed in various locations throughout the surveyed buildings. Based on these key points found, the next step is to control these arthropods from entering structures by using IPM.

As stated previously, a pest is any animal that is in a structure or area frequented by humans where they are unwanted (University of California, 2016a). Defining what constitutes an arthropod pest in Dominica is quite difficult due to the nature of the environment on the island. The climate and latitude of Dominica is conducive to having large amounts of arthropod diversity and numerous amounts of arthropods due to the fact that shelter, water, and food is not scarce.

The first step in trying to control the arthropods from entering a human-frequented structure is to determine if an arthropod is in fact a pest. If so, then IPM strategies are a very good option to help control the arthropods in question. A very easy way to control flying pests is to install screens on windows and doors where possible. There is still an ability to have airflow, and it also keeps the flying pests from entering because they cannot fit through the mesh (University of California, 2016b).

An easy way to control crawling insects is to find where they are coming from and then sealing that entry point with caulk or any another form of sealant (University of California, 2016b). Another way to keep crawling pests out of structures is to make sure that doors close all the way and that only the absolutely necessary doors are kept open. However, as a cheap remedy, pan traps and glue boards can be used to help catch some pests but they should be more used as an indication of how many arthropods are present in an area. The final way to help control most arthropod pests is to make sure that there is not easy food and water sources for them to exploit (University of California, 2016b). If any or all of these suggestions are implemented, then there will be a reduction of pest arthropods seen inside urban structures.

Future studies should include more urban sampling areas throughout Dominica as well as a more comprehensive way to capture arthropods. Since there was a large time constraint, only glue boards and pan traps were used. Future studies should use various insect collecting equipment like aspirators, sweep nets, vacuums, etc., to capture a larger diversity of pest arthropods. Another future study should try to incorporate some restaurants as well as other places of business inside of downtown Roseau to have a wider range of structure types. Lastly, future studies should be completed inside more residential buildings in the capital city and other villages around the island. This study focused on commercial buildings, and only one home was sampled. If it is possible to survey more homes, then more knowledge of what pest arthropods are present in Dominica would be achievable, thus making it easier to help provide IPM strategies tailored to a certain structure type. This would ultimately help the citizens of Dominica with controlling pests in around where they work and live.

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Figures and Tables

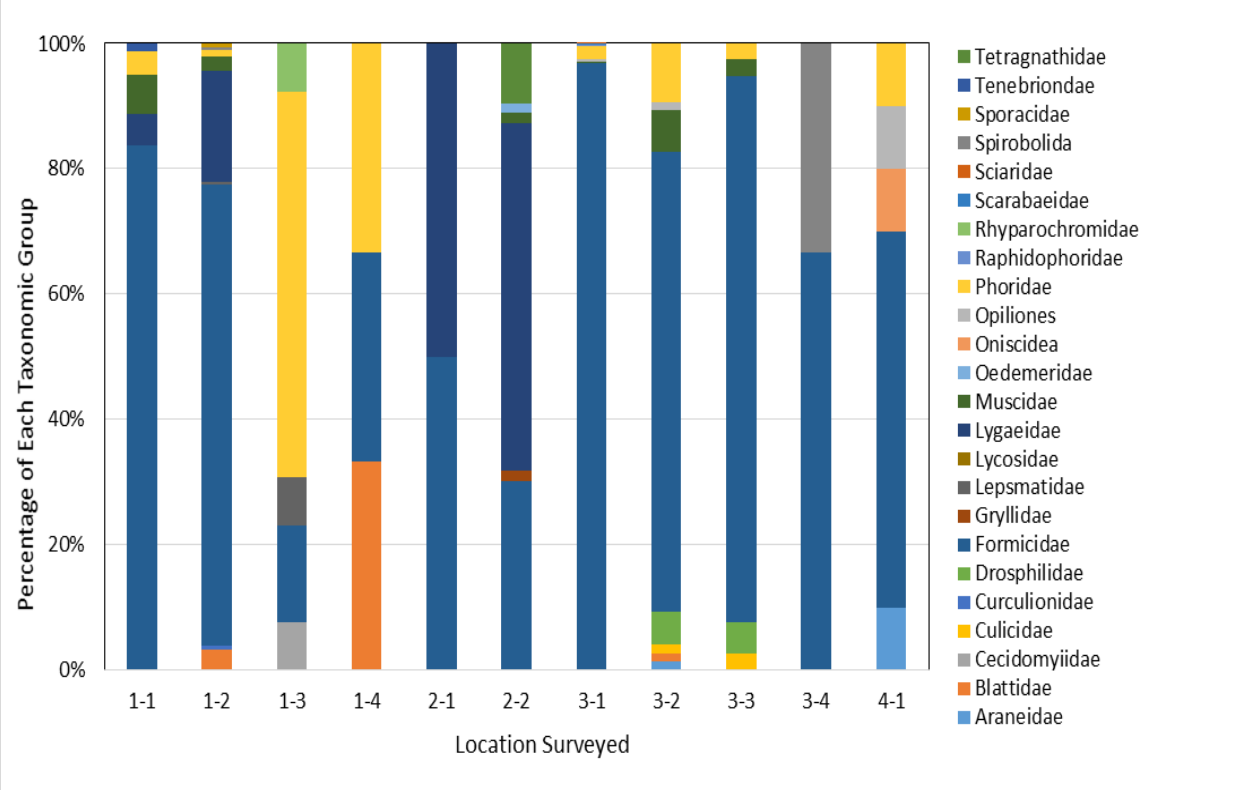

Figure 1. Relative abundance of each arthropod taxonomic group found in each location of urban structures using glue boards at various locations from 10 to 14 June 2016 (first sampling bout).

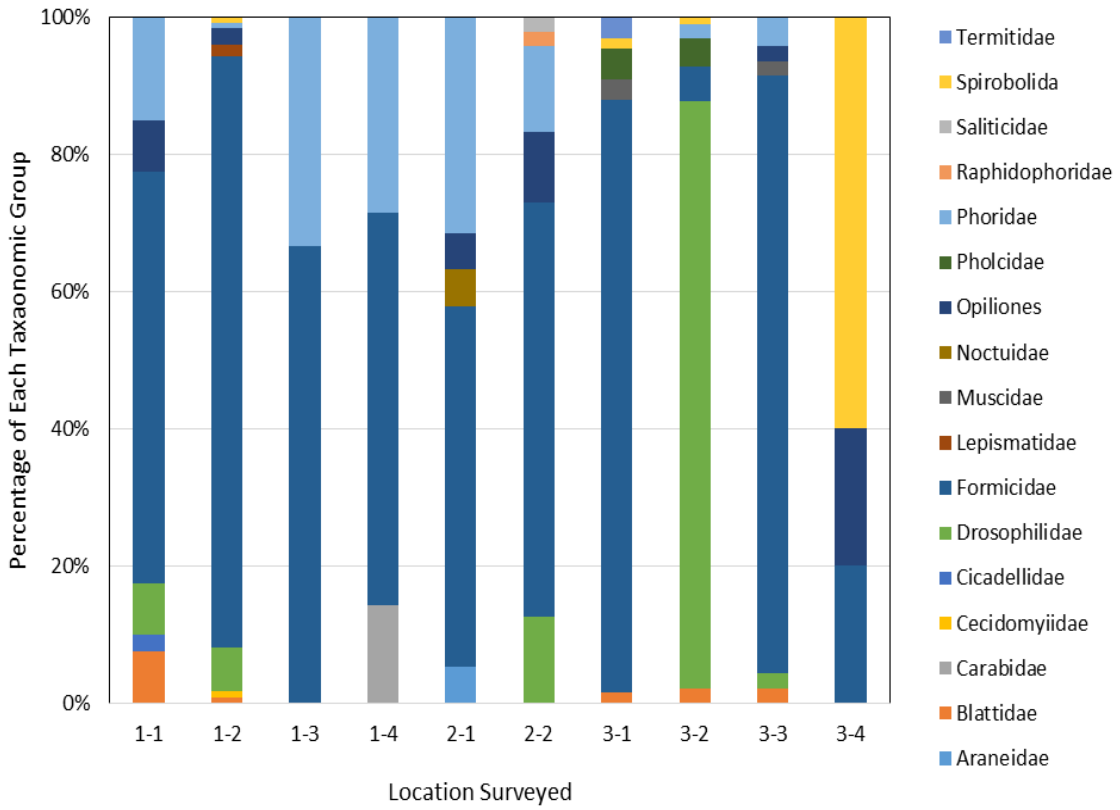

Figure 2. Relative abundance of each arthropod taxonomic group found in each location of urban structures using glue boards at various locations from 14 to 17 June 2016 (second sampling bout).

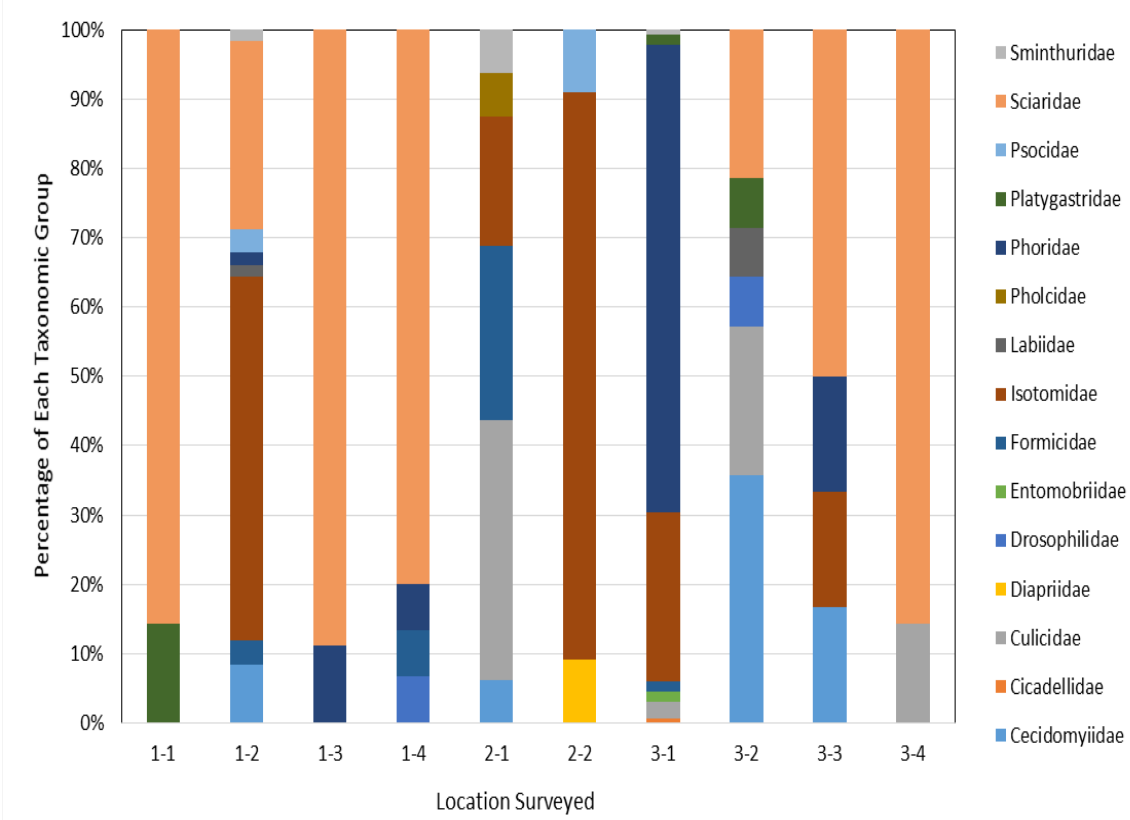

Figure 3. Relative abundance of each arthropod taxonomic group found in each location of urban structures pan traps at various locations from 14 to 17 June 2016.

Table 1. Description of room locations, sampling dates, and type of trap used to collect arthropods in building structures around Roseau, Dominica. Check marks indicate the dates and traps used per site, while an "x" indicates that a trap type was not used on a given date.

Site Number	Room ID	Type and number of trap used			Sampling dates	
		Trapper Max glue boards	Catchmaster 288i glue boards	Pan Traps	10-14 June 2016	14-17 June 2016
1-1	Administration Building at Department of Agriculture	8	4	2	✓	✓
1-2	Laboratory at Department of Agriculture	12	4	2	✓	✓
1-3	Library at Department of Agriculture	8	2	2	✓	✓
1-4	Main Office at Department of Agriculture	8	1	2	✓	✓
2-1	Upper Level of Department of Forestry	7	4	2	✓	✓
2-2	Lower Level of Department of Agriculture	8	5	2	✓	✓
3-1	First Level at FIFA Building	7	4	2	✓	✓
3-2	Second Level at FIFA Building	6	1	2	✓	✓
3-3	Third Level at FIFA Building	4	0	2	✓	✓
3-4	Fourth Level at FIFA Building	1	1	1	✓	✓
4-1	Home Surveyed	3	0	0	**X**	✓

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