Sampling the Beetle Fauna of Dominica in 2011

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Abstract

A study was conducted to find and identify as many beetle families and species as possible in Dominica using different trap techniques. Methods used in this project: soil washing, leaf litter sifting, malaise traps, UV light traps, flight intercept traps, canopy traps, yellow pan traps, Lindgren Funnel and personal collecting. Malaise traps provided the most new records, 19 new families were recorded for the beetle fauna of Dominica, making a total of 55.

Introduction

Coleoptera are the most diverse and abundant animal order on the planet, with a total of 165 recognized families and ca. 300,000 described species. Of the 165 families, 98 are known to occur in the West Indies. On neighboring islands, St. Lucia has 69 families with 817 species (M. Ivie, pers com.), Montserrat has 64 families with 718 species (Ivie et al. 2008) and Guadalupe has 70 families and 1,366 recorded species (Peck, 2009) (Table 1). On Dominica, an island of comparable size and diversity to these, and where our project took place, only 44 families and 550 species of Coleoptera have been recorded (Peck 2006, O'Brien and Turnbow 2011). This is surprising given the major work done by the Smithsonian Archbold-Breden survey in the 1960s, with several prominent beetle systematists involved in field work on the island (Spilman, 1971). In a review of the region's beetle fauna, Peck (2009) predicted an actual total of 1,500 species for Dominica.

The primary objective of this project was to find and identify as many beetle families and species as possible in three weeks using various types of collecting strategies. Trapping types would include passive and active trapping. Passive trapping would include traps such as yellow pan and flight intercept traps, and active would include litter sifting, soil washing and hand

collecting. Soil washing is a new technique that was recently used in St. Lucia where it produced a new suite of beetles but is very strenuous and time consuming.

Table 1: Number of beetle families in Dominica (before and after our study) and the surrounding islands.

	Beetle Species Counts Before Study				
Family	Montserrat (Ivie et al. 2008)	Guadeloupe	St. Lucia (Ivie et al. 2009)	Dominica (Peck 2006 & O'Brien 2011)	Species Collected (this study)
Gyrinidae	0	x	0	1	0
Haliplidae	0	x	1	0	0
Noteridae	0	x	3	0	0
Dytiscidae	8	x	6	6	2
Rhysodidae	1	x	1	1	0
Carabidae	29	x	46	40	10
Hydrophilidae	13	x	17	12	3
Histeridae	10	x	13	1	2
Hydraenidae	1	x	1	1	0
Ptiliidae	6	x	4	0	3
Leiodidae	3	x	9	3	3
Scydmaenidae	3	x	8	2	4
Staphylinidae	125	x	103	31	40
Passalidae	1	x	2	2	2
Trogidae	1	x	1	1	1
Hybosoridae	0	x	2	2	1
Geotrupidae	0	0	1	0	0
Scarabaeidae	24	x	29	37	15
Scirtidae	2	x	6	2	3
Buprestidae	7	x	7	7	1

	Beetle Species Counts Before Study				
Family	Montserrat (Ivie et al. 2008)	Guadeloupe	St. Lucia (Ivie et al. 2009)	Dominica (Peck 2006 & O'Brien 2011)	Species Collected (this study)
Elmidae	0	x	3	1	1
Dryopidae	0	0	0	1	0
Limnichidae	0	x	1	0	0
Heteroceridae	0	x	1	0	0
Cneoglossidae	0	x	1	0	0
Ptilodactylidae	1	x	11	0	1
Chelonariidae	0	0	1	0	0
Callirhipidae	0	x	1	1	1
Eucnemidae	5	x	6	0	2
Elateridae	11	x	16	3	8
Lycidae	2	x	1	0	0
Lampyridae	1	x	7	7	4
Cantharidae	3	x	4	3	3
Dermestidae	2	x	1	0	1
Bostrichidae	8	x	7	6	5
Ptinidae	32	x	12	3	6
Jacobsoniidae	1	0	0	0	0
Lymexylidae	1	x	1	1	1
Trogositidae	6	x	4	0	1
Cleridae	3	x	2	0	0
Melyridae	2	x	4	0	1
Sphindidae	1	0	0	0	0
Nitidulidae	12	x	10	4	8
Cybocephalidae	0	0	0	0	1
Smicripidae	1	x	1	0	1
Monotomidae	5	x	3	0	2
Silvanidae	3	x	5	1	2
Laemophloeidae	11	x	10	0	1
Phalacridae	3	x	4	0	1
Cryptophagidae	1	x	0	0	0
Erotylidae	8	x	6	1	1
Bothrideridae	2	x	2	0	0
Cerylonidae	6	x	5	0	3

	Beetle Species Counts Before Study				
Family	Montserrat (Ivie et al. 2008)	Guadeloupe	St. Lucia (Ivie et al. 2009)	Dominica (Peck 2006 & O'Brien 2011)	Species Collected (this study)
Endomychidae	4	x	3	0	1
Coccinellidae	24	x	21	2	9
Corylophidae	9	x	7	0	3
Latridiidae	2	x	2	0	0
Mycetophagidae	3	x	2	0	1
Ciidae	9	x	14	0	1
Melandryidae	1	0	0	1	0
Mordellidae	5	x	7	0	3
Rhipiphoridae	1	x	2	2	0
Colydiidae	10	x	9	6	3
Zopheridae	3	x	4	4	0
Tenebrionidae	29	x	38	23	10
Oedemeridae	4	x	7	0	3
Meloidae	3	x	2	2	2
Mycteridae	1	x	0	0	1
Salpingidae	5	x	7	1	5
Anthicidae	1	x	2	1	3
Aderidae	8	x	6	0	5
Cerambycidae	33	x	51	34	16
Chrysomelidae	36	x	51	51	11
Anthribidae	11	x	6	9	3
Attelabidae	1	x	1	1	1
Brentidae	4	x	6	5	0
Curculionidae	145	x	112	200	25
Curcul.Scolytinae		x	64	22	13
Platypodidae	1	x	3	1	2
Families Total	64	70	69	43	55
Species Total	718	1366	817	546	266
Area (km2)	104	1510	616	751	

Materials and Methods

For this project, six different types of traps were used in order to obtain beetles on the island. Table 2 provides the information regarding the type, when and where each trap was set. The traps were placed in areas where there was a clear, natural flyway for beetles. Some of these areas were in dry forests, while others were wet forests.

We set a total of 9 Malaise traps, 3 canopy traps, 5 Lindgren funnels, 320-350 yellow pan traps, 1 flight intercept trap, 1 Malaise trap across a stream and 1 UV light trap. Table 3 provides the GPS locations for each of the traps. The killing solution used in the Malaise traps and Lindgren funnels was either propylene glycol or ethanol. For the yellow pan traps, water and hand soap were used. The samples were sorted under a Leica® EZ4 microscope and transferred to ethanol for preservation. Each sample was placed in Whirl-Packs® containing ethanol. The Springfield traps were set up and collected daily by Mrs. LaDonna Ivie. The traps placed in areas located outside Springfield Station were collected after approximately a week had passed.

Leaf litter sifting involved placing material from dense layers of forest detritus into a sifter and shaking it in order to separate the small fraction of leaf litter. Each sample was stored in a cloth bag until it was placed in Berleses and/or Winkler Funnels to extract any insects. A total of 3 Berlese and 2 Winkler funnels were set up at Springfield Station. At bottom of these funnels was a Whirl-Pack® containing propylene glycol as the killing solution, as well as a label containing collection data.

The process for soil washing is to shovel soil into a bucket with water, and then agitate the water and soil by hand. Any floating material was skimmed with a fine aquarium net and placed on a pad of newspaper to soak up the remaining water. The process is repeated five times and then the other newspaper encased samples were placed in a cloth bag. The resulting samples

were then extracted in Berlese or Winkler funnels, as for leaf litter. All samples were checked and identified by Dr. Michael Ivie from Montana State University.

*Table 2: Data locations and trap types used in this project. *=Number of sample bags, **=Number of newspaper rolls, X=Hand collecting*

	Localities								
Traps	Middleham Falls	Emerald Pool	Cabrits	Springfield Station	Waitukabuli Trail	Batalie Beach	Syndicate Trail	Boeri Lake	Mount Joy
Malaise	27 May-5 Jun (2)	1 Jun-5 Jun (2)	30 May-7 Jun (2)	26 May-8 Jun (1)	31 May-5 Jun (2)				
Canopy			30 May-7 Jun (2)	26 May-8 Jun (1)					
Malaise over stream				2 Jun- 7 Jun (1)					
Lindgren Funnel			30 May-7 Jun (1)	26 May-8 Jun (4)					
Yellow Pan Traps				26 May-8 Jun (320-350)					
Soil washing		1 Jun (5)**				30May (2)**			
Leaf Litter Sifting	5 Jun (1)*	5 Jun (3)*	7 Jun (1)*						4 Jun (3)*
Flight Intercept Traps				30 May-8 Jun(1)					
UV Light				26 May-5 Jun (1)					
Personal/ By hand	X	X	X	X	X	X	X	X	X

Table 3: Trap location coordinates

Location	Trap	GPS coordinates
Middleham Falls	Malaise	15.49387° N, 61.25362° W
	Leaf Litter	15.2056° N, 61.5049° W
Emerald Pool	Soil washing & Leaf litter sifting	15.3990° N, 61.31209° W
	Malaise	15.398899° N, 61.311736° W
Cabrits	Malaise 1	15.58619° N, 61.47263° W
	Malaise 2	15.58564° N, 61.47210° W
	Canopies	15.58452° N, 61.47247° W
	Lindgren Funnel	15.58452° N, 61.47247° W
	Leaf Litter	15.58452° N, 61.47247° W
Springfield Station	Malaise across stream	15.34566° N, 61.36951° W
	Additional Traps	15.34644° N, 61.36892° W
Waitukabuli Trail	Malaise	15.38149° N, 61.340138° W
Syndicate Trail		15.52399° N, 61.42014° W
Batalie Beach	Soil washing	15.45354° N, 61.44674° W
Mount Joy	Soil washing	15.35159° N, 61.36324° W
Boeri Lake	Personal	15.34810° N, 61.31301° W
	Personal	15.35172° N, 61.32001° W

Results

We recovered 36 of the 43 previously recorded beetle families, as well as collecting an additional 19 previously unrecorded families. The eight previously recorded families that were not found during this collection period are Brentidae, Dryopidae, Gyrinidae, Hydraenidae, Melandryidae, Rhipiphoridae, Rhysodidae, and Zopheridae. These eight families represent only 16 species in the published fauna (Tables 1, 4).

We collected an estimated 266 beetle species, a little over half total number of the beetle species recorded for the island. Yet, many of these are known to not be represented in the reported fauna, increasing the total species known considerably. However, it will require a great deal of further work to verify identifications and species counts, as well as the degree of independence or overlap between the lists, especially in those families estimated to have more

than 10 species. The final number of species collected could go down slightly, or rise considerably from the estimate, but the total fauna will certainly increase.

The relative yield of each type of trap or collecting method for each family collected during our stay is shown in Table 4. The number of specimens collected is ranked as 0 (not collected), 1 (detected) or 2 (optimal). The number of families taken by each method is summed at the bottom.

*Table 4: List of the different traps used during our study in Dominica. *New record 0=not collected. 1=detected. 2= optimal.*

	Collecting Method/Trap Type								
RECORDED FAMILIES	Malaise	Canopy	Lindgren Funnel	Yellow Pan	Soil Washing	Leaf Litter Sifting	Flight Intercept	UV Light	Personal/ By Hand
Gyrinidae	-	-	-	-	-	-	-	-	-
Dytiscidae	1	0	0	1	0	0	0	0	0
Rhysodidae	-	-	-	-	-	-	-	-	-
Carabidae	1	0	0	1	0	1	1	1	2
Hydrophilidae	0	0	0	1	0	1	0	0	0
Histeridae	0	0	0	0	0	1	1	0	0
Hydraenidae	-	-	-	-	-	-	-	-	-
Ptiliidae*	1	0	1	2	0	2	2	0	0
Leiodidae	0	0	0	1	0	1	1	0	0
Scydmaenidae	1	1	1	1	0	1	2	1	0
Staphylinidae	2	1	1	2	0	2	2	1	1
Passalidae	0	0	0	0	0	0	0	0	2
Trogidae	0	0	0	0	0	0	0	1	0
Hybosoridae	1	0	0	0	0	1	0	0	0
Scarabaeidae	0	0	0	1	0	1	1	2	1
Scirtidae	2	1	1	1	0	0	1	1	0
Buprestidae	0	0	0	1	0	0	0	0	0
Elmidae	0	0	0	0	0	0	1	1	2
Dryopidae	-	-	-	-	-	-	-	-	-
Ptilodactylidae*	2	1	1	2	0	0	1	1	0
Callirhipidae	1	0	0	0	0	0	0	0	1
Eucnemidae*	2	1	1	0	0	0	0	0	0
Elateridae	2	1	2	1	0	0	1	2	1
Lampyridae	2	1	1	0	0	0	0	1	0
Cantharidae	2	1	1	1	0	0	1	2	0
Dermestidae	0	0	0	0	0	0	0	1	1
Bostrichidae	0	0	1	0	0	0	0	2	0
Ptinidae	2	0	1	0	0	0	1	1	0
Lymexylidae	0	0	0	0	0	0	0	1	0
Trogositidae*	1	0	1	0	0	0	0	0	0
Melyridae*	1	0	0	0	0	0	0	0	0
Nitidulidae	1	1	2	2	0	1	2	1	1

	Collecting Method/Trap Type								
RECORDED FAMILIES	Malaise	Canopy	Lindgren Funnel	Yellow Pan	Soil Washing	Leaf Litter Sifting	Flight Intercept	UV Light	Personal/ By Hand
Cybocephalidae*	0	0	0	0	0	0	0	1	0
Smicripidae*	0	0	2	1	0	0	1	0	0
Monotomidae*	0	0	1	0	0	0	1	1	0
Silvanidae	0	0	1	0	0	0	1	2	0
Laemophloeidae*	1	0	1	0	0	0	0	0	0
Phalacridae*	0	0	0	0	0	0	0	1	0
Erotylidae	1	0	1	1	0	1	1	0	0
Cerylonidae*	0	0	0	1	0	1	1	0	0
Endomycidae*	0	0	0	1	0	0	0	0	0
Coccinellidae	1	0	0	2	0	0	1	0	0
Corylophidae*	1	1	1	2	0	1	2	1	0
Mycetophagidae*	1	0	0	1	0	0	1	0	0
Ciidae*	0	0	0	0	0	0	1	0	0
Melandryidae	-	-	-	-	-	-	-	-	-
Mordellidae*	2	2	1	1	0	0	1	0	0
Rhipiphoridae	-	-	-	-	-	-	-	-	-
Colydiidae	1	1	1	0	0	1	1	0	0
Zopheridae	-	-	-	-	-	-	-	-	-
Tenebrionidae	1	0	1	0	0	1	1	2	0
Oedemeridae*	2	1	1	1	0	0	1	2	0
Meloidae	1	0	0	0	0	0	0	2	0
Mycteridae*	1	0	0	0	0	0	0	0	0
Salpingidae	1	1	1	1	0	0	1	1	0
Anthicidae	1	0	1	1	0	0	0	1	0
Aderidae*	1	1	1	1	0	0	1	0	0
Cerambycidae	1	0	1	1	0	0	0	2	1
Chrysomelidae	1	1	0	2	0	0	1	1	1
Anthribidae	2	1	1	1	0	0	1	0	0
Attelabidae	0	0	0	1	0	0	0	0	0
Brentidae	-	-	-	-	-	-	-	-	-
Curculionidae	2	1	1	1	1	2	1	2	1
Scolytinae	1	1	2	1	0	1	1	1	1
Platypodinae	1	0	1	0	0	0	1	2	0
Total Families	37	18	31	32	1	17	34	31	13
Total New Families	15	9	12	11	1	4	11	10	4

Discussion

When comparing previously published records for Dominica to what was collected during this study, we found that, numerically, we collected approximately 4/5 of the known families for the island as well as ½ of the known species. These numbers were gathered based on data that was previously known for the island through the collection by Peck (2006) and O'Brien and Turbow (2011). With the added families found we are getting much closer in number of families known for of the surrounding islands.

When it comes to the species totals, we were unable to compare which species are recorded or unrecorded from the surrounding islands, limiting us to compare them on a numerical level. In this area the number of beetle species for Dominica is nowhere near the totals of the other islands. One reason why Dominica might be low in family numbers is that collecting beforehand was poor or some material could have remained unpublished.

By analyzing the different set of traps used in this project, Malaise traps had the highest yield in both overall families found, as well as number of newly recorded families. This could be because these traps were set up in 5 different forest locations. The second best method of collecting beetle families was the flight interception trap. This is interesting because this trap was only set up in one location throughout the entire stay and was able to contribute the second largest number of beetle families. Another trap type that stands out is the soil washing technique; this was done in one location and resulted in a single new and undescribed beetle species. Given that a recent flood had affected the area, a better site choice could increase yield of this technique.

One of the reasons for our success is possibly due to the seasonality in Dominica, these temporal changes may have allowed for more diversity in the beetle specimens. Another

alternative explanation for the success of certain traps versus others is due to the number of each trap that was placed. If the number of traps is considered in this study, it can be seen that traps worked better when found in quantities, rather than having a single trap. Moreover, sampling in different locations and ecosystems produced different families. Taking into consideration, that there are still more beetles to be found in the future, full inventory will require much more time and increased effort. For instance soil washing could be done in more areas of the island and with better site choice and equipment. Also, adding more flight interception traps to other locations should increase the beetle diversity collected.

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