

Survey of Necrophagous Diptera Species Abundance and Diversity at
Springfield Station, Commonwealth of Dominica

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Abstract

Fly species from the family Calliphoridae are one of the most significant insects used for determining time of death in forensic entomology. Species that are found in a specific area are dependent on what type of habitat is present and the adaptations that are best suited for that environment. Several studies have been conducted previously to monitor calliphorid activity in a variety of regions, however none have been conducted in Dominica. This survey was conducted in order to observe what calliphorid species are established in Dominica and what types of habitats they are most concentrated in. Necrophagous Diptera activity can be affected by several factors such as weather patterns, type of carrion, and the habitats present. Three environments: urban, rural, and riparian, were tested in this study. It was determined that the most prominent species of Calliphoridae present in this area was *Lucinia lucigerens*, which is significant because this species has never been recorded outside of Jamaica. It was also found that the majority of necrophagous fly activity was concentrated in riparian environments.

Keywords: Calliphoridae, Dominica, forensic entomology, necrophagous Diptera, carrion

The growth and activity of necrophagous insects are often used in forensic entomology as indicators for time of death in crime investigations. Of these, Diptera species in the family Calliphoridae are the most important (Brundage, 2011). Although some species of Calliphoridae present have been identified in general studies on the Caribbean as a whole, comprehensive research has never been conducted specifically in Dominica before. Species of forensic importance previously identified in Dominica include *Lucilia fayeae*, *Chrysomya albiceps*, *Chrysomya megacephala*, *Chrysomya rufifacies*, *Lucilia eximia*, and *Cochliomyia macellaria* (Whitworth 2010).

Distribution of calliphorid flies is heavily dependent upon habitat and climate (Hwang and Turner, 2005). Dominica, much like other islands of the Caribbean, has a wide variety of habitats hosting diverse flora and fauna. As elevation increases, the density and type of vegetation observed shifts. At lower elevations, coastal and dry scrub woodland dominate the island, while rainforests, elfin, and montane forests are found at higher elevations (Lack et al, 1997). In this study, traps were set in a variety of habitats in order to confirm the presence of known species and determine which habitats those species are most concentrated in.

Materials and Methods

Three types of habitats were focused on during this survey: riparian, urban, and rural. Traps in the riparian location were set at the lowest elevation, along the

Springfield River. The urban traps were set around the Springfield Plantation; an area characterized by seasonal forests and affected by anthropogenic activity. The rural traps were set at the top Mount Joy, in a rainforest habitat. Flies collected at each of the three locations were identified in order to observe species abundance and distribution in each habitat.

The Stamper traps, designed by Trevor Stamper, were used during this survey. Three packages of food grade bovine liver served as the bait to attract Diptera. The liver was cut and divided into nine amounts approximately equal in size and weight and placed into plastic bottles with screw-on lids. The blood from the liver packages was distributed among the nine containers, and water was then added to each container approximately matching the amount of liver and blood already present. Screw-on lids were placed on the containers in order to build up pressure of the decaying liver, maximizing the odor therefore increasing the effectiveness of the bait. The bait was left to rot for 24 hours before setting out the first set of traps.

The traps were set out a total of five days in each habitat and picked up at the end of each day to collect the caught specimens. Three traps were set in each habitat at based on locations likely to attract flies. Rope was used to hang and secure the traps from plant vegetation so that the bottom of the trap hovered about six inches above the ground. The bait containers were placed underneath the center of the trap so that the outer rim of the bottom edge of the trap hung about one inch over the top of the bait, ensuring when flies flew upwards from the bait they would enter the trap (see Figure 1). The screw on lids of each container were removed and replaced with window screen secured on to the bottles with rubber bands. The mesh allowed the flies to smell the bait, but prevented them from flying inside the container. Depending on the location of the trap, a hole was dug in the ground to place the bait container in or rocks were placed around the bottle to secure its position underneath the trap. Small rocks were also placed inside the trap in order to stabilize it over the bait.

Traps were left out 10-12 hours per day to attract flies, then collected in the evening, stored in gallon size Ziploc bags, and placed in the freezer to kill the specimens. All the insects not belonging to the order Diptera were discarded, and the rest were sorted by location of the trap and keyed out using Whitworth's Keys to the genera and species of blow flies (Diptera: Calliphoridae) of the West Indies (Whitworth, 2010).

Results

A total of 151 flies were collected and identified from the station traps, while 171 flies were collected and identified from the hill traps. A total of 1,954 flies were identified from the stream traps although there were 3,878 flies collected. The

remaining 1,924 specimens were left unidentified due to lack of time. Flies belonging to the family Calliphoridae were identified to species, while those belonging to Muscidae or Sarcophagidae were identified to family (Table 1).

	Stream	Field Station	Mount Joy
<i>L. lucigerens</i>	692	76	105
<i>L. exenia</i>	51	8	0
<i>C. rufifaces</i>	84	27	6
<i>C. macellaria</i>	13	13	0
<i>C. megacephala</i>	29	2	0
Muscidae	1,074	24	6
Sarcophagidae	11	1	0
Total	1,954	151	117

Table 1: Totals of Diptera specimens of each species and family collected and identified from traps at stream, station, and hill locations.

Discussion

Dominica is home to a wide variety of vegetation and wildlife, enabling many diverse habitats to flourish. Therefore, many different Calliphoridae species should theoretically be present in high quantities on the island. A total of five species in Calliphoridae were collected during this survey, along with flies from the families Muscidae and Sarcophagidae. Out of the 4,096 flies collected (not including those in poor condition), 3,878 were found in the traps set along the stream. Although effectiveness of the traps and bait do play a role in the quantity of caught specimens, a capacity this significant is more likely due to environmental factors such as weather conditions, anthropogenic activity, and wildlife present (Hwang and Turner, 2005).

The environment at the stream provided a variety and excess of resources not offered at the other two locations. Unlike the habitats found near Springfield station, the stream had minimal human impact on its flora and fauna. It also had an abundance of both moving and standing water, which both other locations lack. This created an aquatic ecosystem with different wildlife in addition to the ecosystem already present in the surrounding terrain. Twenty crab species and 11 shrimp species have been reported in Dominica, and are typically concentrated in rivers and streams from sea level up to 1000 meters elevation, like the stream chosen for this study (Evans and James, 1997). These animals, along with other organisms found in the stream, provide an alternative source of food for carrion feeding flies not found at the other two trap locations.

These traps also had significantly more diversity than those found at Mount Joy, which only had two of the five species of Calliphoridae seen during this study,

and also lacked the family Sarcophagidae. This was unexpected because Mount Joy lies in an area dominated by mature primary and secondary forests, which is home to the majority of bird and mammal diversity on the island (Lack et al. 1997; Evans and James, 1997). In theory, the abundance and variety of carrion to feed on in this habitat should yield a high capacity of flies obtained, however they caught the least number of specimens out of all three locations. This could be due to height and position of the traps, the intensity of the bait odor, or weather conditions present only at higher elevations. Further studies should be done in order to explain this phenomenon.

The traps set at Springfield Plantation, while they did not collect high quantities as seen at the stream, did have at least one specimen in each species and family of Diptera observed. Therefore, while Diptera species are not as abundant at this location, the species found and recorded are diverse. Both the field station and Mount Joy locations caught approximately the same quantity of flies total, so it cannot be determined if human activity affects Diptera distribution without further observation.

An unexpected outcome of this study was the abundance of *Lucilia lucigerens* found in the traps. It was the most common species of Calliphoridae collected and identified, however it had only previously been found in Jamaica (Whitworth, 2010; Whitworth, 2014). Due to the lack of research on this species, there is no clear explanation for how this species has made its way from Jamaica to Dominica. It could have been carried over on boats or other means of transportation throughout the Caribbean Islands to settle in Dominica, or have previously been present but never identified.

If this survey were to be repeated, taking further measures to increase stability of the traps would assist in yielding higher numbers of flies collected. Stakes secured in the sides of the traps would greatly increase stability, which is important when weather conditions are not ideal. Several times when the traps were collected, particularly after windy or rainy days, the bait containers had fallen over or the traps had been knocked to one side, rendering the trap ineffective. This will aid in preventing animals and other wildlife from disturbing the trap as well.

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Resources

Brundage, Adrienne, Shannon Bros, and Jeffrey Y. Honda. "Seasonal and habitat abundance and distribution of some forensically important blow flies (Diptera: Calliphoridae) in Central California." *Forensic Science International* 212.1 (2011): 115-120.

Evans, Peter G.H., and Arlington James. "Wildlife Checklists." *Dominica Nature Island of the Caribbean*. Vol. 2. Brussels: Ecosystems, 1997. 5-9. Print.

Hwang, C., and B. D. Turner. "Spatial and temporal variability of necrophagous Diptera from urban to rural areas." *Medical and veterinary entomology* 19.4 (2005): 379-391.

Hwang, C., and B. D. Turner. "Spatial and temporal variability of necrophagous Diptera from urban to rural areas." *Medical and veterinary entomology* 19.4 (2005): 379-391.

Lack, Andrew J., Whitefoord, Caroline, Evans, Peter G.H., and Arlington James. "Illustrated Flora." *Dominica Nature Island of the Caribbean*. Vol. 5. Brussels: Ecosystems, 1997. 4-16. Print.

Whitworth, Terry. "Keys to the genera and species of blow flies (Diptera: Calliphoridae) of the West Indies and description of a new species of *Lucilia* Robineau-Desvoidy." *Zootaxa* 2663 (2010): 1-35.

Whitworth, Terry. "A revision of the neotropical species of *Lucilia* Robineau-Desvoidy (Diptera: Calliphoridae)." *Zootaxa* 3810.1 (2014): 1-76.

