Biodiversity along a Altitudinal Gradient at SPECTRE

Celia Montes
Lauren Johnican
Samara Ferrara
Thomas Decker

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Abstract

The biodiversity of selected plant and animal groups was assessed along an altitudinal transect on the island of Dominica. Certain species of trees, herbaceous plants, vertebrates, and insects were surveyed at several sites from the Check Hall River to the top of Fifi and Mt. Joy trails at the Archbold Tropical Research Center, Springfield. In general, biodiversity decreased with the increase in altitude.

Introduction

The various types of forest on the island of Dominica are tiered on its mountains. From the top down precipitation decreases, species composition varies, and possibly even soil pH varies. Clinal changes in species composition are well known on large mountains, but can they be measured on Dominica? Based on background information available on Dominica (Lack ey al. 1997), we hypothesize that the density of the selected plant species, trees, vertebrates, and beetles will increase with altitude, with its highest density being at the highest altitude.

Materials and Methods

We measured/surveyed easily recognizable understory trees and bushes, herbaceous plants, vertebrates, and beetles at five sites within the Archbold Tropical Research Center (ARTC), Springfield, The five sites extended from the Check Hall river, up the Fifi and Mt. Joy trails to the top of the ARTC property line. Location of all five sites is shown in Fig. 1. A compass was used to determine direction of slopes and associated transects and an altimeter was used to record altitude at each site. An attempt was made to maintain direction of slope as a constant against which changes in altitude could be measured.

<u>Beetles</u>

For this part of the study, one flight intercept trap was set at each site. The flight-intercept traps were constructed from screen door mesh tied or stapled between two trees. Three aluminum pans 16 cm by 12.5 cm filled with soapy water and preservative were placed under the mesh for each trap to collect the insects that hit the net and fall. For this study, two sites out of a series of five were examined. The sites were also equipped with a

Malaise trap and six yellow pan traps. The traps were assembled at different times due to time and logistical constraints: the Site 1 and Site 2 traps were constructed on 23 May 2003, Site 3 on 25 May 2003, Site 4 on 24 May 2003, and Site 5 on 28 May 2003, and cleaned periodically until 4 June 2003.

Vertebrates

At each site a 50 m radial transect was conducted five times for a period of 30 minutes each. With the help of binoculars, all of the species of vertebrates (birds, mammals and reptiles) were recorded in a draft notebook and with a waterproof pen.

Herbaceous Plants

Six line-transects where set out at each of the 5 different sites at the ATRC. A tape measure was used to measure the line transects which varied from 16 m to 12 m. An effort was made to align all transects in the same direction at each site, terrain permitting. The sites varied slightly, from 300° NW to 320° NW. At every 4m along the transects, a 2m radius was made and the percent coverage of the herbaceous plants was recorded. A magnifying glass was used to help identify the plants. The unidentifiable plants where placed in a plastic bag with some water and brought back to the Steven Hill Herbarium to identify.

Trees

Preliminary samples of trees and understory plants were taken along both Mount Joy trail and Fifi Trail. Samples of trees and understory plants were taken. Keeping in mind that these plants would have to be identified many times, each plant and its cuttings were examined for easily observable distinguishing characteristics. Easily identifiable plants that were fairly common on the two trails were then selected from the preliminary collections for use in the altitudinal surveys. The following species were selected:

Family	Genus and species	Description
Fabaceae	Inga ingoides	. . . . . .smaller leaf “wings” on stem
Rubiaceae	Faramea occidentalis	. .opposite leaf arrangement and 1 cm long stipules
Myrtaceae	Eugenia spp.	. . . . . pink new growth
Spiney Acacia		. . . . . small thorns on trunk and deltoid-like leaves in groups of 3
Laureaceae	Ocotea spp.	. . . . . alternate leaf arrangement and dark green, straight trunks

After selecting 5 easily identifiable plants, west or southwest facing plateaus with at least two-tiered canopy structures were chosen along each trail. Three plateaus were found on the Fifi trail for the preliminary samples, but only two of these were eventually used for establishing the transects. Additionally, there were two plateaus on the Mount Joy trail, and one plateau on the Check Hall River. Disregarding the size of the plateau, a grid was sectioned off using string and tent stakes (or sticks when there was a shortage of tent stakes) into 5m x 5m squares. Squares were made by staking an axis down the middle of the plateau and centering adjacent squares off of the axis.

Grids were numbered on each plateau, starting with the first square approached by the trail. Each sample consisted of two grids selectred from each plateau, with grids selected using a random number generator provided by Microsoft Excel. During each sampling period, the identifiable species of understory trees were counted in each of the two grids . The number of each species found in the random grids with pen and paper was then recorded. Means were calculated for each site.

Results

There was a 203 m difference from lowest point at Check Hall River to highest point on Mt. Joy Trail. Due to variation in GPS readings at the ARTC laboratory throughout the

course of this study, we were unable to calibrate the altimeter at the research station. Daily readings at a single spot varied by several hundred feet in altitude.
For the most part, biodiversity was the greatest on site 1 (lowest point on Fifi), with the exception of trees, which had the greatest biodiversity on site 5. In general (with the exception of trees) biodiversity was the lowest at site 5 and site 4 (stream). Specifically, herbaceous plants and vertebrates were the lowest at the creek, highest at the bottom of Fifi and decreased as the altitude increased. Species richness of the beetles was the highest at the two lowest altitudes, dropped at the middle altitude and remained relatively low as altitude increased. The trees had the lowest amount of species at the lowest altitudes and the highest number of species at the highest altitude.

Discussion

Beetles - Beetle biodiversity measurements are based on morphospecies. There appears to be a loss of biodiversity in beetles as the altitude increases. This is consistent with the loss of biodiversity in vertebrates and herbaceous plants also observed. Site 4, the lowest site, had the most familial diversity, with members of the Scarabaeidae, Bostrichidae, Staphylinidae, Histeridae, and at least one unidentified family. Staphylinids were found at all sites except site 5, and scarabs were found at all sites except site 3. Curculionids were found only at sites 2, 3, and 5, and bostrichids were only found at site 4. It is, however, not clear whether or not these differences are due to the altitude or to differences in the habitats at the trap sites.

Vertebrates - Different birds were spotted at various altitudes. The Great Blue Heron was only found on site 1(lowest point on Fifi). The Smooth-billed Ani was found only on site 3 (lowest point on Mt. Joy). The Yellow-crowned Night Heron was only found on site 4 (the Check Hall river). The Lesser Antillean Swifts and Streaked Saltator were only found at site 5 (highest point on Mt. Joy). Bananaquits, Tremblers, Bullfinches, Yellow Warbler and, Hummingbirds (Purple-Throated Carib and Green- Throated Carib) were observed on all sites. The Peter G.H. Evans Field Guide ranged the Great Blue Heron by Cabrits and Roseau Valley, so it was actually out of its range. The rest of the birds were

found in the Field Guide's indicated habitats. The Tink frogs were only spotted at site 2 and 3, but were expected to be found at site 4 (Checkhall River) because of the amount in humidity.

The largest biodiversity was found at site 1 and 3 (12 and 11 species respectively) and the lowest biodiversity was found at site 4 (5 species). The lowest biodivesity was found at the lowest altitude. Site 1, 2, 3 and 5 ranged from 10 to 12 different species observed. As opposed to site 4, there was a larger viewing range to watch flying birds at all the other sites. Sites 1 and 3 were also the closest to the Bee House, the largest clearing we encountered.

Herbaceous Plants – Two species occurred across all the altitudial gradients lemon grass (*Cymbopogon citratus)* and vine #2 . Each transects was on a slight slope so each transect had to be adjusted either by changing the degrees or by reducing its size. Two transects increased (1 and 4) with biodiversity as you went from the top of the transect to the bottom of it while one stayed the same (2) and two went down (3 and 5). From observation of data, none of the grasses where at all of the sampled areas with the exception of the lemon grass. The only flowering herbaceous plant that was common along the altitudial gradient and each habitat was the *Rubus rosifolia* minus the top of Mt. Joy. The least amount of plant diversity occurred at the lowest elevation which is near Checkhall River, which was covered in a dense canopy of dead debri. At site #5 the gradient is mostly dominated by vines. The greatest amount of biodiversity occurred at 60m and 86m in the middle of our gradient. The data is accurate because they are closest to the most disturbed cultivated land. So the hypothesis is not supported because the mass amount of diversity occurred in the middle not at the top of our gradient.

Trees – Spiney Acacia was found at only the top of Mt. Joy and at the creek with higher concentrations at the creek. Laurels were found throughout the altitudes with its increase in density found in higher elevations (one genus of Lauraceae). The Faramea, Eugenia, and Inga increased in density as the altitude increased. The biodiversity of the selected understory species increases with altitude. Although this is just a sample of the understory biodiversity could be a reference the whole understory diversity. A

correlation between the number of species at each site versus the altitude reveals an increase in diversity with the increase in altitude. However, according to the standard deviation, the data collected is marginal to produce more credible results. Site 3 provided the most variance among all of the trials, which could mean that it was a different habitat than the other sites.

Group Correlation

For the most part, there was a correlation between altitude and the herbaceous plants, vertebrates, under story trees, and beetles. With the exception of the trees, biodiversity significantly increases from the stream to the bottom of Fifi trail, site 1. From Site 1 (60m) to site 2 (104m) the biodiversity started to ebb with herbaceous plants and vertebrates. There was an outlier with the number of beetle species at 86m because the trap was placed in a more open area that is clear secondary growth.

The idea that the increase in biodiversity increases with altitude did not happen along each facet experimented. This only occurred with the trees. The reason for this result largely stems from habitat control. Even with the transects and traps taken and set up at the edge, the size of the edge can determine if the edge is a corridor or a field. The observation of site 1 being the closest to the Bee House rendered the results of the largest biodiversity with herbaceous plants, vertebrates, and beetles. The occurrence of the most biodiversity at the top of Mt Joy, site 5, for the trees may be the result of more rainfall or more grids to produce a less variable testing.

Group Suggestions

The idea of the experiment was a good one. However, the complications of the experiment came with its various methods. If all four experiments had been conducted at the same location, a better correlation between biodiversity and altitude may have been more apparent. Instead some variables that should have been controlled (such as habitat, slope, and direction) influenced the results of the experiment. Habitat was a major factor due to edge effect along the trails and the river. Naturally, more insects, flowering plants,

and vertebrates would be found along the edge. With understory trees, the same is not true.

To reduce the time of research and identification, either more picture books should be available or better understanding of how plants, insects, and vertebrate fit into families. If families were identified more easily, using a key could have been a more feasible possibility, which would have made a more thorough report/ experiment. With the plant and insect experiments, narrowing down to a few easily identifiable species helped out immensely. Too much time was taken strictly for identification. Luckily, Nancy was a valuable and quick resource in plant identification. Unfortunately, narrowing down the insect species was not done. At least only the family names were give rather than meticulously looking up genus and species names.

For transects in general, either making more trails or having more grids would have helped to provide more sound data.

Time spent building and maintaining the insect traps, the lack of a field guide comparable to those available for plants and vertebrates, and the sheer amount of specimens collected resulted in an insect biodiversity study that was crude in comparison to the others in this experiment. The decision to focus on Coleoptera captured by the flight intercept traps specifically, rather than all insects from all the traps, was made very late in the timeframe of the project, so proper identification was unable to be completed. Future studies of a similar nature should take into account the impracticality of attempting to identify all insects, and should, from the beginning, focus on one or two orders of insects.

A larger range in altitude may have also given more credible results. There was only a total of 203 m difference. Expanding the experiment to 500m may render less sketchy results.

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Observed Vertebrates in Correlation to Altitude

Location # 4- Checkhall River Total # of Species = 5

Common Name	***Scientific Name***	**Total # Observed**
Yellow-crowned Night Heron	***Nycticorax violaceus***	**3**
Bananaquit	*Coereba flaveola*	27
Green-throated Carib	*Sericotes holosericeus*	6
Purple-throated Carib	*Eulampis jugularis*	2
Zenaida Dove	*Zenaida aurita*	3

Location # 1- Lowest point on Fifi Total # of species = 12

Common Name	***Scientific Name***	**Total # Observed**
Blackface Grassquit	*Tiaris bicolor*	1
Trembler	*Cinclocerthia ruficauda*	13
Yellow Warbler	*Dendroica petechia*	7
Anole	*Anolis Oculatus*	14
Lesser Antillean Bullfinch	*Loxigilla noctis*	15
Great Blue Heron	***Ardea herodias***	**1**
Bananaquit	*Coereba flaveola*	30
Broad-winged Hawk	*Buteo platypterus*	5
Blue-headed Hummingbird	*Cyanophaia bicolor*	2
Zenaida Dove	*Zenaida aurita*	12
Purple-throated Carib	*Eulampis jugularis*	3
Green-throated Carib	*Sericotes holosericeus*	1

Location # 3- Lowest point on Mt. Joy Total # of Species = 11

Common Name	***Scientific Name***	**Total # Observed**
Blue-headed Hummingbird	*Cyanophaia bicolor*	1
Trembler	*Cinclocerthia ruficauda*	9
Broad-winged Hawk	*Buteo platypterus*	6
Yellow Warbler	*Dendroica petechia*	4
Bananaquit	*Coereba flaveola*	27
Zenaida Dove	*Zenaida aurita*	7
Green-throated Carib	*Sericotes holosericeus*	6
Smooth-billed Ani	***Crotophaga ani***	**3**
Lesser Antillean Bullfinch	*Loxigilla noctis*	2
Anole	*Anolis oculatus*	3
Tink Frog	*Eleutherodactylus martinincensis*	2

Location # 2 – Highest point on Fifi Total # of Species = 10

Common Name	***Scientific Name***	**Total # Observed**
Green-throated Carib	*Sericotes holosericeus*	6
Bananaquit	*Coereba flaveola*	26
Lesser Antillean Bullfinch	*Loxigilla noctis*	9
Anole	*Anolis oculatus*	11
Yellow Warbler	*Dendroica petechia*	2
Broad-winged Hawk	*Buteo platypterus*	3
Trembler	*Cinclocerthia ruficauda*	6
Zenaida Dove	*Zenaida aurita*	10
Purple-throated Carib	*Eulampis jugularis*	6
Tink Frog	*Eleutherodactylus martinincensis*	1

Location # 5 – Highest point on Mt. Joy Total # of Species = 10

Common Name	***Scientific Name***	**Total # Observed**
Lesser Antillean Swifts	***Chaetura martinica***	**103**
Bananaquit	*Coereba flaveola*	14
Purple-throated Carib	*Eulampis jugularis*	5
Black-face Grassquit	*Tiaris bicolor*	2
Streaked Saltator	***Saltator albicollis***	**1**
Trembler	*Cinclocerthia ruficauda*	8
Yellow Warbler	*Dendroica patechia*	8
Zenaida Dove	*Zenaida aurita*	6
Broad-winged Hawk	*Buteo platypterus*	4
Green-throated Carib	*Sericotes holosericeus*	2