

Population density study of *Dendrobates pumilio* at La Selva Verde, Costa Rica

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Abstract

La Selva Verde offers various microhabitats on its grounds. A population study of Dendrobates pumilio was taken in order to understand habitat preferences of the species. Frogs were caught along a secondary rainforest trail on the La Selva Verde grounds. The trail consisted of four microhabitats including: secondary forest, edge farm, river trail, and a recently disturbed area. Surveying was done in the morning and SVL and mass were taken. A SVL/g relationship was determined for the populations as a whole and for identifiable males. A chi square test was used to determine random distribution over all four locations. Both SVL/g fits had poor r values and were not well representative of the data. It was determined that frogs would need to be sexed to conclude a SVL/g relationship for the population. Pumilio distribution along the river and the farm sites were significantly different from the expected random distribution. Further analysis is needed to determine whether the results are due to an increased visual exposure of one site over another.

Introduction

The lizard and frog populations of the Central American rainforests are, perhaps, one of the least studied areas of tropical biology. Reptiles and amphibians are susceptible to environmental changes, especially edge effects and the destruction of specific microhabitats related to their niche (Bell 2006, Schlaepfer 2000).

La Selva Biological Research Station in Costa Rica is one of the natural wildlife preserves that have appeared in order to help stop continued fragmentation of the primary tropical rainforests of Costa Rica. Ecotourism in the Sarapiquí county of Costa Rica is generated by the close proximity to the OTS research station. There are several environmentally friendly lodges available for ecotourists to stay at.

La Selva Verde is one ecotourist venue. It has trails through secondary rainforest and a stretch of primary and secondary rainforest across the river. It allows visitors to come into close contact

with the naturally occurring flora and fauna of the rainforest.

The environment of La Selva Verde is unique in that it provides researchers access to several different microhabitats without the need to travel a great distance. The presence of these microhabitats, combined with edge effects on frog populations, would allow researchers to identify the specific sites that frogs prefer.

Dendrobates pumilio is a small poison dart frog common throughout Costa Rica (Gardner 2005). They prefer *D. pumilio* displays territoriality with other males of the same species (Gardner 2005) and will protect any area that is important to their foraging or tadpole rearing needs (Gardner 2005). They call actively during the morning hours and are easy to find along in both secondary and primary forest (Gardner 2005).

Since *D. pumilio* is a common, territorial frog of Costa Rica it is important to understand what types of habitat they prefer. Population density

studies of the different microhabitats located throughout the habitats is crucial to determining the effect that fragmentation and the presence of different environments has on the presence of the *pumilio* population at La Selva Verde.

Materials and Methods

Location:

The chosen area of study was La Selva Verde resort in the Sarapiquí county of Costa Rica. The surrounding area hosts several prominent research stations including La Selva OTS and Timbarina preserve. La Selva Verde resort has several self-guided trails through secondary rainforest and a stretch of primary rainforest located across the Sarapiquí River. The reserve is bordered by several farms.

One of the self-guided trails located on La Selva Verde was chosen for a concentration analysis for *Dendrobates pumilio*. This trail was ideal because it presented a variety of microhabitats for study including secondary rainforest, forest bordered by a major water source, secondary forest bordered by a farm, and a recently disturbed section of forest (Figure 1).

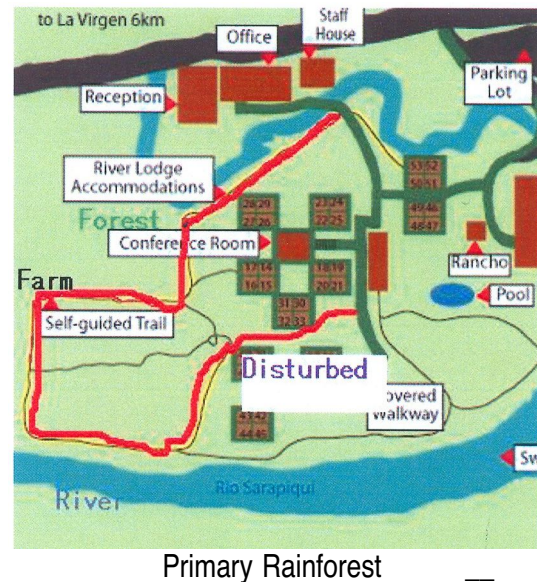


Figure 1. The test trail used at La Selva Verde, Costa Rica. The trail includes secondary forest and is approximately 24.4 meters long. There are four habitats located along the trail including a section of secondary forest, a portion of the trail bordered by farm land, a river section and a recently disturbed location.

Two additional trails were also looked at: a trail of primary forest in the property across the Sarapiquí River and a cloud forest. Time was spent looking for frogs in both locations but repeated visits were not made because of time constraints.

Length for the trail was calculated by counting steps. An average step length was calculated and the trail length was converted into meters. Each section was individually measured so that a density per area could be determined for frogs in a specific section.

Capture Method:

Walkthroughs were performed every morning between 0530 and 0930. Male *pumilio* actively call during this time period and so are easier to locate them along the trail. This time period

also allowed for gender identification of male *Dendrobates pumilio*.

Trail start positions were alternated daily to prevent collection bias. *Dendrobates pumilio* were counted along the trail. The number of frogs in a location was recorded along with their activity: moving, sitting, foraging, and calling. Gender for was indicated for male frogs displaying vocalizations.

Any frogs caught had a snout-vent length (SVL) measurement taken using a Tajima 150mm caliber and weights measured using a Pesola 30g spring scale. These calculations were used to generate a SVL by mass graph.

Morning, afternoon, and evening observations were also taken daily for five days. Frogs were observed for simple behavioral patterns including foraging, calling, and remaining still.

Weather conditions were recorded at the start and finish of every trial run. Also, notes were taken on rainfall prior to, during, or at the conclusion of every trial. Other factors including human presences on the trails and natural disasters were also recorded.

Calculations:

The trail lengths for each site were not even so the data was adjusted to represent the null hypothesis. First the trail length of each sight was calculated into meters. Each trail length was divided by the lowest form to convert it into a proportion. Each trail length was calculated from the total trail length and this percentage was multiplied by the total amount of frogs to determine the number of frogs that should be located in each environment if they are distributed randomly throughout the microhabitats.

Data was analyzed using Microsoft Excel and JMP statistical software.

Results

The SVL for all of the frogs was compiled and a scatter plot was made using all of the data. A linear regression and a formula were generated from the plot (Figure 2). The program was unable to create a strong equation to fit the data (linear regression, $r^2=0.017$).

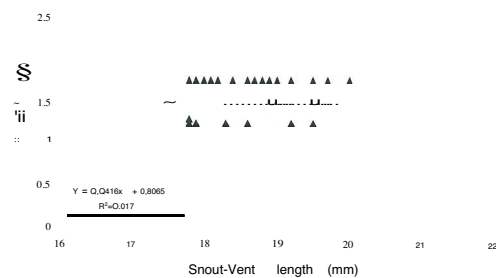
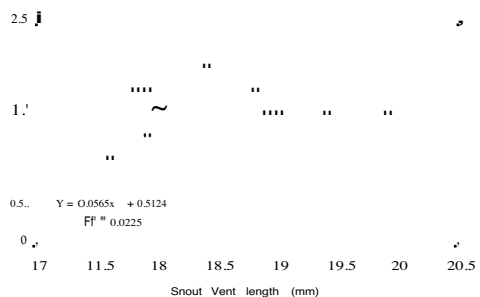


Figure 2. SVL weight graph of *D. pumilio* including both sexes. SVL was taken with a caliber to the nearest 10th of a mm and weight was taken with a spring scale to the nearest 100th of a gram.

A second regression was performed using only data from frogs with identifiable genders. Twelve male *pumilio* were plotted for their SVL and their weight (Figure 3). A regression analysis was performed and an equation was found to fit the data (linear regression, $r^2=0.0225$).

Figure 3. SVL weight graph of *D. pumilio* males. SVL was taken with a caliber to the nearest 10th of a mm and weight was taken with a spring scale to the nearest 100th of a gram.

According to a Chi Square test performed on the transformed data for



each location the frogs were not randomly distributed over all four habitats ($\chi^2 = 72.36$, $df = 3$, $p < 0.0001$).

There were more frogs located near the river than the expected. Also, there were fewer frogs near the farm land part of the trail (Table 1).

	Prop, Area	Exp,# Froas	Number Found
Disturbed	0.267	55,269	54
Woods	0.211	43,677	48
Farm	0.362	74,934	32
River	0.161	33,327	73

Table 1. Expected and Actual number of frogs found for each site. The proportions of each site were taken against the total length of the site in order to account for uneven trail lengths.

Discussion

We were unable to find a strong relationship between SVL and weight for the *pumilio* population we surveyed. I believe that this is mostly due to our inability to sex the frogs in the field. There was an increase in the tightness of the fit when we looked at only the male frogs. In order to have a valid regression line from the data, the frogs would have needed to be sexed during capture.

Dendrobates pumilio were easily found in the secondary forest trail that was chosen for the study. It was easier to find *pumilio* in the secondary forest trail than it was to find them in both the primary rainforest and the cloud forest. While there are established populations of *pumilio* in the primary rainforest there were very few sighted during the trial. The steep trail and the dense undergrowth made it more difficult to find frogs, although many males were heard calling. No frogs were seen or heard in the cloud forest which indicates

that perhaps this particular environment is not suited to the needs of the population. Gardner (2005) reasserts that the *pumilio* population prefers tropical rainforests at lower elevations which may explain the lack of *pumilio* populations at the cloud forest.

There were statistically significant differences found between some of the microhabitats of the secondary forest trail. More specifically, more frogs were found on the river trail and fewer frogs were found by the farm the farm trail than expected.

The low encounter rate of frogs along the farm trail is consistent with Schlaepfer's (2000) and Bell's (2006) observations that frogs tend to do poorly in areas with an edge effect. Increased sunlight in a particular area may have lead to desiccation, driving the frog populations further into the secondary forest. Furthermore, because the site is lined by farmland, the presence of pesticides or other chemicals employed by the farm may be responsible for the reduced population.

One other point to consider is the nature of the site itself. The secondary forest edging the farm site consists of very dense leaf litter and tightly packed trees and shrubs. It was very hard to locate frogs because of the condition of the trail. The farm property was also edged with a barbed wire fence, making it impossible for us to look for frogs closer to the farm edge.

The lack of access to this area may have impeded the gathering of a realistic representation of the population in this area. In a further study more time will need to be spent moving into the thick understory near the farm and looking for individuals.

Conversely, more frogs were found near the river than we expected.

The understory near the river was not dense and it was much easier to spot *pumilio* in this location. The capture and sight rates were much higher in this area because of the ability of the researchers to examine a majority of the area without being impeded by dense understory. Similar to Allmon's (1991) analysis of leaf litter frogs, many problems were encountered with the collection of data.

In order to validate these results further study will need to be conducted in the area, including refined search and capture methods.

Works Cited

- Allmon, W. D. 1991. A plot study of forest floor litter frogs, Central Amazon, Brazil. *Journal of Tropical Ecology*. 503-522.
- Bell, K. E., and M. A. Donnelly. 2006. Influence of forest fragmentation on community structure of frogs and lizards in northeastern Costa Rica. *Conservation Biology*, 1750-1760.
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Additional studies should also be conducted to map the territory of the *pumilio* populations. If researchers can identify the limits of a male *pumilio*'s territory then it would give added insight to the nature of habitat selection among *pumilio*.