

Investigation of *Dendrobates granuliferus*: Territory in Relation to Gender and Size.

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Discussion

Conclusion

## Acknowledgments

## Literature Cited

### Abstract

Poison dart frogs are known to have defined territories and homelands in the jungles of South and Central America. While male frogs compete for and defend bordering plots of territory, female frogs have broad and often overlapping home territories. Because of their different activities concerning the land they inhabit, we hypothesized that both the size and gender of a given frog would be related to their location in a given section of forest. Using a 10x10 meter plot of rainforest, we used Bailey's method of mark and recapture to examine the relationship between the frog's size and gender in correlation with its location. The frogs were marked, measured and sexed for an hour over two days. Using statistical tests we determined that there is no correlation between the size of a frog and its gender, all frogs were approximately the same size. Location also had no correlation with the gender of the frog. The forest floor or an elevated perch were equally popular frog locations. This suggests that though male and female frogs have different activities concerning the land they inhabit, the frog's gender is not a factor when choosing their location within that territory.

### Introduction

The poison dart frogs of the ITEC station in Panama are a member of the *Dendrobates pumilio* group of frogs, specifically they are *Dendrobates granuliferus*. *Dendrobates pumilio* usually have a bright red body and jade legs with black dots on their back, but at the ITEC station, this group of frogs color morphed to have a body that is green on top with a yellow belly. The black dots on their backs are different for every frog, marking them as individuals. The toxins that they get their colloquial name from, are acolytes, the same acolytes found in coffee. While poisonous to predators if eaten, they are not toxic to healthy skin but can cause an irritating sensation to broken skin. *Dendrobates granuliferus* are diurnal and are most active during the wet season. Adults grow to 19-24 mm in length, about two thirds the length of most other *Dendrobates pumilio* frogs. These frogs are found on many different surfaces of wet lowland forests including leaf litter, vegetation, tree trunks, rock faces, and moss banks. Mating and reproduction happen on the ground between May and November. Female frogs tend to have a much larger territory than males do because the females transport the eggs they lay from the

ground to the canopies of different trees, placing one egg in each tree. Males have smaller territories which they fight other males to claim. Females can cross each other's paths without fighting while males patrol a smaller area and call for females to come to them. *Dendrobates granuliferus* are commonly found in southwestern Costa Rica and Panama. It is important to conduct population studies like this one in order to see how climate change and development are impacting *Dendrobates granuliferus* populations. Slash and burn deforestation in both of these countries could endanger this species of frog in the future. The null hypothesis for this study was the gender and size of frogs is unrelated to their capture location while our hypothesis was that the gender and size of the frogs is related to their capture location.

### Materials and Methods

To accurately assess the correlation between gender, size and location, we utilized Bailey's method of mark and recapture. In a 10x10 meter plot, marked A1-F6 with flags in a grid, allowed for precise marking of frog sighting and capture locations. Each marker had a spacing of two meters in-between, these markers covering a diverse terrain encompassing patches of ground and many large trees. Using flag tape, we created initial markers to signal the location of found frogs, to remember their original location after they were caught. Gallon bags were used to contain the captured frogs in between processing and capture. Processing began by sexing the frogs; determined by the appearance of a green stripe in between the hind legs of the frog to indicate maleness. With a Caliper we determined whether the frog was an Adult or Pre-reproductive, also taking note to recorded whether the frog was found on the ground or in an elevated position in the forest. We took a photo of every frog captured on an iPhone 7 camera, which on the second day was a reference to determine which of the frogs had been recaptured. The frogs were put back into the gallon bags, and returned to the original location as marked by

flag tape. The frogs remained unreleased from the bags until the hour of capture was over. This data collection took place for one hour between 3 and 4pm for two days.

## Results

On the first day, 13 frogs were captured in a 10 by 10 meter square. Of those 13 frogs, 9 were female and 4 were males. This was a male to female ratio of 4:9, or 1:2.25. On the second day we captured 15 frogs, 4 of which were recaptured from the previous day. There were 10 new females and 5 new males who were all captured on the second day. The male:female ratio for the second day was 5:10, or 1:2. To estimate the population of the 10 by 10 meter area, we used Bailey's method of mark and recapture ( $N_B = r(n + 1)/(m + 1)$ ). Utilizing this formula, we estimated the population of poison dart frogs in the 10 by 10 meter area consisted of 52 individuals. Using Bailey's method to calculate the number of female individuals, we estimated that there were 27 females and 25 male individuals in the area. This was a male:female ratio of 25:27, or 1:1.08. To calculate which ratio was more significant, we used the chi-squared test on the 9:17 sex ratio, which is the total male to female ratio. We found the p value to be 1.23. 100% percent of the frogs we captured were adults. 39% percent of the frogs that we processed were captured on the ground, while 61% percent of the frogs we processed were captured on an elevated position such as a log, branch, or buttress. The average length of a captured frog was 18.48 centimeters. We conducted a t-test on the values of the lengths of the different populations of males and females. We calculated a p-value of 0.279.

To determine the statistical significance of the capture location of the frogs, we analyzed the two populations, male and female, in a 2 by 2 contingency table. Our data only allowed for one degree of freedom, and we found that the chi-squared p-value was 0.16.

Bailey's Method:

$$NB = r(n + 1)$$

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$$m + 1$$

Frog Total:

$$NB = 13 (19 + 1)$$

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$$4 + 1$$

$$= 52 \text{ total}$$

$$\text{Females Only: } 9 (14 + 1)$$

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$$4 + 1$$

$$= 27$$

Sex Ratio: 9:17 (Male:Female)

$$X^2 = (o - e)^2$$

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$$e$$

$$(17 - 13) = 1111, 2, 3 < 3.841$$

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$$(1) \quad \text{NS}$$

$$13$$

According to the results of the chi-squared test, the male to female *Dendrobates granuliferus* ratio was statistically insignificant, with a value of 1.23. This means that there are no more female than male frogs in the 10 x 10 meter plot, despite us having caught more female

frogs than male. We believe that there is no significant reason that we caught more females than males other than the fact that females travel through a larger territory than males do, in order to tend to their young. We had numerous sources of error including changing weather conditions between days and a possible change in frog capturing skill. We also did not venture into the canopy to catch frogs, meaning many frogs were left unaccounted for.

From our contingency table, we found that the chi-squared p-value from comparing capture location across gender populations was 0.16. We determined this to be statistically insignificant. From this we can conclude that the capture location of frogs is not dependent on gender. Regardless of their gender, frogs do not appear to have a preference of location.

#### Literature Cited

Savage, Jay M. *The Amphibians and Reptiles of Costa Rica*. N.p.: University of Chicago, 2002.