# An inventory of anolis lizards in Barra Del Colorado Wildlife Refuge

## Examining the species diversity, abundance, microhabitat associations and the effects of flooding on anolis lizards living near Caño Palma Biological Station.

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HAS University of Applied Sciences
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This study is conducted as part of an internship by a third year student, following an Applied Biology Bachelor course at the HAS University of Applied Sciences, Den Bosch, The Netherlands. The study is conducted at the Canadian Organization for Tropical Education and Rainforest Conservation (COTERC), Caño Palma Biological Station, Costa Rica.

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# Abstract

Among the wide variety of different families inhabiting Costa Rica are the *Dactyloidae*, more commonly known as Anoles or Anolis lizards. Relatively little is known about the ecology of anoles living on the mainland compared to island species. On different islands, anoles have radiated to better adapt to certain microhabitats and thus fill certain niches. Six so called 'ecomorph' classes have been defined in order to categorize these morphological adaptations. These ecomorph classes have been defined based on anoles from the Greater Antilles. Understanding what species of anoles utilize which microhabitat can be essential for further research, as microhabitat plays a role in many important ecological aspects. The aim of this project was to compile a list of the species diversity and abundance near Caño Palma Biological Station. Additionally, the microhabitat associations of each species were investigated in order to detect any evidence of ecomorph partitioning in mainland anoles. Furthermore, the effects of the flooding on the presence of the different species of anoles were researched. In order to do all this, 10 plots were set up. Every week these plots were canvassed and data on all caught species was gathered, including the microhabitat they were found in. The microhabitat and plot preference of all species was then analyzed using a generalized linear model. To detect any effect of flooding, data was gathered on habitat composition; the percentage of terrain that was dry, muddy and flooded. These variables were then transformed into one variable, which was then analyzed using a generalized linear model. In total, seven different species were found in the plots. The most prevalent species were *Anolis Limifrons* and *Anolis Lionotus*. The results suggest that there were signs of ecomorph partitioning. Habitat composition also seems to play a role on the presence or abundance of anoles, though in what way remains unknown and a topic for future study.

# Preface

This study was conducted by Robin van Iersel, a third year student from the HAS University of Applied Sciences, as part of a Bachelor Course Applied Biology. This study is part of an internship at the Caño Palma Biological Station. First of all, I would like to thank all the interns and volunteers for all their help with the fieldwork. I would also like to thank Osama Almalik for helping me with R. Furthermore, I would like to thank both Inés Quilez and Rene Quinten for their supervision and for their helpful feedback. Moreover, I would like to thank Molly McCargar for her amazing help, supervision, feedback and support during my internship. I would also like to thank Charlotte Foale for providing me with the amazing opportunity to conduct my internship at the Caño Palma Biological Station. And last of all, I would like to thank everybody at the Caño Palma Biological Station for the great time and fond memories.

# 1. Introduction

Costa Rica is a country known for its biodiversity and the study thereof (Nielsen-muñoz et al. 2012). Among the wide variety of different families are the *Dactyloidae*, more commonly known as anoles or anolis lizards. A diverse group of lizards, there are about 400 currently known species, with more species still being discovered (Savage 2002; Losos & Schneider 2009). Anoles are mainly found in the Caribbean islands and on the mainland from Mexico to Brazil (Velasco et al. 2015).

Relatively little is known about the ecology of anoles living on the mainland (Central and South America), compared to island species. This is likely due to the fact that there is a lower abundance and diversity of anoles on the mainland (Vitt et al. 2002). However, it has been shown that anoles that live on the mainland differ from those that live on islands in morphology, life history and behavior (Irschick et al. 1997; Macrini et al. 2003).

On different islands, anoles have radiated to better adapt to certain microhabitats and thus fill certain niches (Irschick et al. 1997). On most islands anoles have adapted to have similar morphological forms and fill similar niches. Phylogenetic studies have shown that this is due to convergent evolution (Losos & Thorpe 2004). Six so called 'ecomorph' classes have been defined in order to categorize these morphological adaptations: trunk-ground, trunk-crown, trunk, crown-giant, twig-dwarf and grass-bush (Williams 1983). Each group is named after the microhabitat the anoles inhabit. Aside from the microhabitat they utilize, species that form the same ecomorph have other characteristics in common: size, foraging behavior, defensive behavior, body-size, color and scales are all different between each and almost always equal within a given ecomorph (Appendix A) (Williams 1983). The diversity in microhabitat utilization the anoles show allows for them to live sympatrically (Losos & Thorpe 2004).

These ecomorph classes have been defined based on anoles from the Greater Antilles (Williams 1983). The same factors which played a big role in the classification of the ecomorphs for the anoles living in the Greater Antilles; the size of anoles, their perch and the climate they live in, are also important to anoles living on the mainland (Williams 1983). Additionally, it is known that anoles living on the mainland can also live sympatrically, though with a slightly smaller species diversity than is found on islands (Losos & Thorpe 2004). Yet it is expected that mainland anoles do not inhabit the (exact) same six ecomorph classes as island anoles (Williams 1983; Irschick et al. 1997; Savage 2002). The most likely reason for this is that island and mainland anoles live in different environmental conditions, causing them to develop in different ways (Williams 1983; Irschick et al. 1997; Savage 2002). Factors such as more predators and competition with other lizards on the mainland might play a part in this (Losos & Thorpe 2004).

Understanding what species utilize which microhabitat can be essential for further research, as microhabitat plays a role in many important ecological aspects such as foraging (Barragán-Contreras & Calderón-Espinosa 2013). On top of that, microhabitat partitioning is also one of the key mechanics that allow anoles to live sympatrically, and thus important when looking at species diversity (Losos & Thorpe 2004).

Little is known about the role of flooding on the utilization of microhabitats, yet it is expected that it will play an important role in species diversity. It is known that the onset of rainfall causes a variety of changes in the behavior of anoles such as changes in foraging locations and display levels (Stamps 1976). This insinuates that flooding may indeed be important when looking at the presence of certain species. Additionally, due to changes in habitat composition, microhabitats near ground-level will no longer be accessible when flooded, forcing any anoles that live there to either move to higher terrain or leave the area, thus impacting microhabitat utilization.

The aim of this project was to compile a list of the species diversity and abundance near Caño Palma Biological Station. Additionally, the microhabitat associations of each species were investigated in order to detect any evidence of ecomorph partitioning in mainland anoles, either within the same classifications used for island anoles, or within novel ecomorph categories. It was expected that anoles on the mainland utilize different microhabitats, specific to each species found, as this would explain the presence of sympatric communities. The effect of flooding was also taken into account when looking at species diversity and abundance. The effect this climate factor has on anoles and their community structure was unknown. Yet this might be an important factor concerning the presence or absence of certain species, as this changes the habitat composition and anoles near ground-level will have to adapt to the sudden loss of their usual microhabitat. It was therefore expected that in the research areas which are most susceptible to floods, fewer species with an association to microhabitats near ground-level would be found.

# 2. Materials and methods

## 2.1 Area description and setup

The research area is located in the Barra Del Colorado wildlife refuge at Caño Palma Biological Station, Costa Rica (Figure 1). There were 10 plots set up, each with a size of 10x15 meters. Through each plot there is a small path, where little vegetation grows. This path and the area beyond it were included to maximize diversity of habitat type, and were always located in the last 5 meters of the 15m sides (Figure 2). The 10 plots were chosen because they vary in vegetation type and cover, potentially increasing species diversity. There are 5 plots with a lower elevation and 5 plots with a higher elevation. This lower elevation causes some parts to flood more easily and is most likely one of the main reasons for the variation in vegetation. However, there are still parts within the high elevation plots that flood on regular basis, as well as parts in the low elevation that remain dry, especially in periods of intense rainfall or drought respectively. Different vegetation was chosen in order to get as complete of a view of the local species diversity as possible. The different plots were located in a loop close to the biological station with ± 50 meters between each plot.

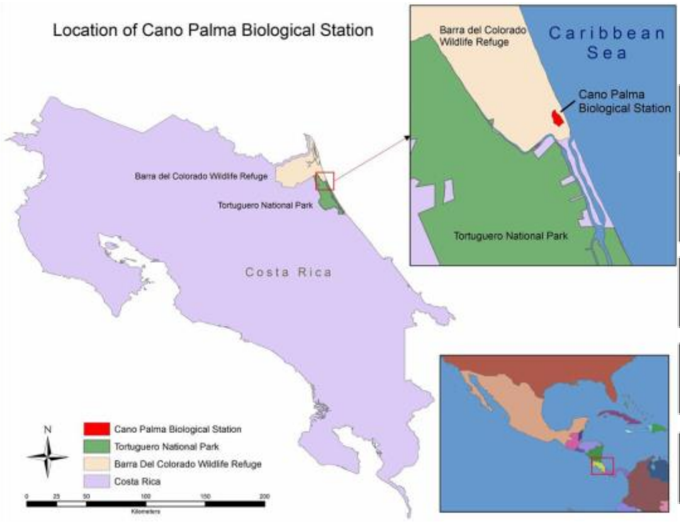


*Figure 1*: The location of the station in Barra Del Colorado Wildlife Refuge, adjacent to Tortuguero National Park, in Limon, Costa Rica.

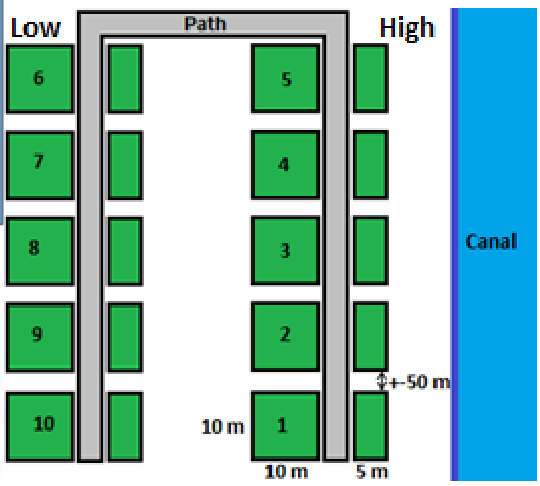


*Figure 2*: Lay-out of the plots, their location and elevation, including the path and the area beyond the path that was included in order to increase the variation in vegetation. As well as the canal located next to the first five plots (Gray=Path, Blue=Canal, Green=Plots). The plots on the left-hand side were of a lower elevation. The plots on the right-hand side were of a higher elevation.

## 2.2 Research methods

Data collection took place from 05-03-2015 until 19-06-2016. The plots were canvassed three times a week. For each day of data collection, 5 plots were canvassed, either the high or low elevation set of plots. Additionally, on 27-06-2016 and 28-06-2016, a large open area near the standard area was also canvassed. This was done to see if this area possibly contained species that weren't found in the denser research plots.

To determine the effect of flooding, habitat composition was recorded, as the percentage of dry, muddy and flooded terrain in each plot. This was done each time data was collected, because the amount of rainfall heavily fluctuated and periods of intense rainfall or drought occurred. Whenever a plot was canvassed, the date, plot number and start time were recorded. Weather was recorded as well, classified as: 1 (dry), 2 (fog), 3 (drizzle) or 4 (rain). The abundance of a species was based on the total number of anoles found throughout the 10 plots. To canvas a certain plot, two (or three) people would enter the plot, each covering 50% (or 33% in the case of three people) of the plot per person. All anoles found were captured if possible. This was done either by hand or with an adjustable noose made of thin wire, which can be made smaller and bigger as necessary, attached to the end of a small fishing rod (95 cm), which tightens around their neck. Once captured, the species, sex, microhabitat in which the anole was found and whether the area there was flooded, muddy or dry, and the GPS coordinates and GPS accuracy were recorded (Appendix B). Species were identified using the field guides; Amphibians and Reptiles of Costa Rica and Reptiles of Central America (Köhler 2008; Chacón & Johnston 2013). The microhabitat classifications are largely equal to the six ecomorph classifications made for the anoles found on the Greater Antilles (Appendix A). However, during the work in the field it became apparent that just these six ecomorph classifications would not suffice to categorize the microhabitats in which the anoles were found accurately enough. Thus four extra microhabitat classifications were used. These four extra classifications were chosen as they were also used in several other studies: Leaf-litter, Fallen log, Dead hanging palm frond and Palm branch (Talbot 1979; Vitt et al. 2002). Pictures were taken for future species confirmation (Figure 3). If an anole could not be captured, the GPS coordinates and accuracy were taken regardless, to get an estimate of anole activity and abundance in each plot.


*Figure 3*: An anole (*Anolis lionotus*), which has been captured and is photographed for future species confirmation.

## 2.3 Statistical analysis

The microhabitat preference of all species was determined by using a generalized linear model with poisson error distribution (glm function, *stats* package, R software version 3.2.3). The alpha value for this test, and all following tests was 0,05. A poisson distribution was used because the data was count data. The response variable was the number of anoles found and the explanatory variable was the microhabitat each anole was found in. If microhabitat was found to have an effect on the number of anoles found then a subsequent Tukey’s test was used (glht function, *multcomp* package, R software version 1.4-2), to find in which microhabitat the most anoles were found. A difference between the microhabitats would mean that one or multiple microhabitats were preferred over other microhabitats. The microhabitat preference for individual species was determined in the same way.

The overall plot preference for all species was determined in the same manner, using a generalized linear model with a poisson error distribution (glm function, *stats* package, R software version 3.2.3). The number of anoles found in each plot was the response variable and the plot itself was the explanatory variable. If plot was found to have an effect on the number of anoles found, then a subsequent Tukey’s test was used (glht function, *multcomp* package, R software version 1.4-2). This was done to find in which plot most anoles were found. A difference between the number of anoles per plot would mean that one or more plots were preferred over other plots. The plot preference per species was determined in the same way.

The three variables collected on habitat composition, the percentages of dry, muddy and flooded terrain, couldn’t be analyzed by a generalized linear model as they were perfectly collinear. However, in order to still see if habitat composition plays a role in the number of anoles found, a principal component analysis was used (prcomp function, *stats* package, R software version 3.2.3). This way a variable which explained 84% of all variation could be computed, rather than analyzing the three variables for habitat composition. This computed variable was then used as an explanatory variable in a generalized linear model (glm function, *stats* package, R software version 3.2.3), where the number of anoles found was the response variable. If the habitat composition had an effect on the number of anoles found in a certain plot, then this shows that anoles have a preference for certain habitat compositions. This was then repeated for each individual species.

# 3. Results

In total, seven different species were found in the plots around the station (Table 1). The most prevalent species in the plots were *Anolis Limifrons* (Slender Brown Anole) and *Anolis Lionotus* (Stream Anole). In the sampling of the open area near the standard research area, only three species were found; *Anolis Limifrons, Anolis Lemurinus* and *Anolis Lionotus*.

*Table 1*: The species and their abundance as found during the surveys.

| Scientific name | Common name | Number |
|---|---|---|
| *Anolis Cupreus* | Dry Forest Anole | 3 |
| *Anolis Limifrons* | Slender Brown Anole | 94 |
| *Anolis Lemurinus* | Ghost Anole | 24 |
| *Anolis Lionotus* | Stream Anole | 47 |
| *Anolis Humilis* | Ground Anole | 18 |
| *Anolis Biporcatus* | Green Tree Anole | 1 |
| *Anolis Carpenteri* | Little Green Anole | 1 |

Overall, the most anoles were found in the trunk-ground microhabitat ($p<0{,}001$) (Figure 4). More anoles were found in the twigs microhabitat than in the dead hanging palm frond and leaf-litter microhabitat ($p<0{,}05$). Additionally, more anoles were found in the twigs, palm branch, trunk and trunk-crown microhabitat than the fallen log microhabitat ($p<0{,}05$).

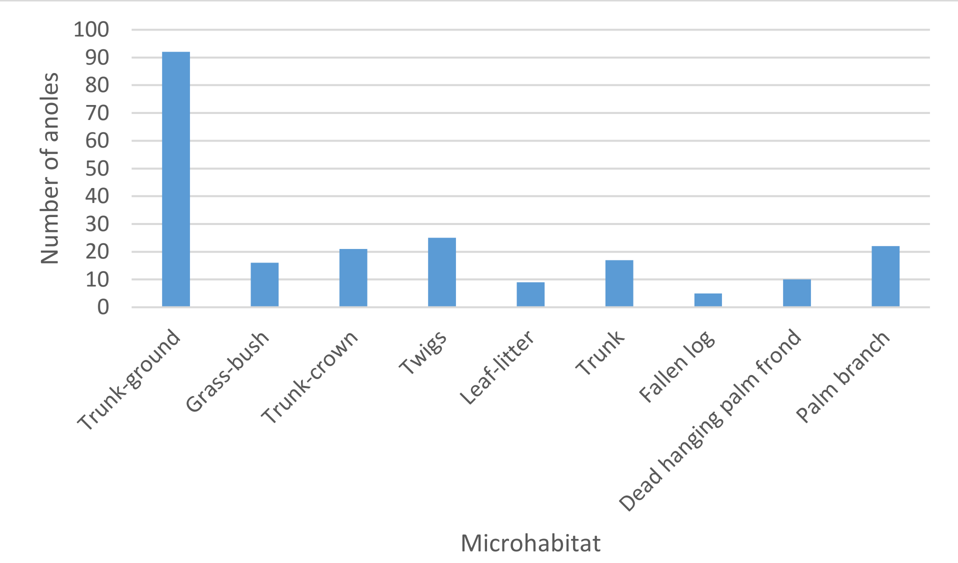


*Figure 4*: The total number of anoles found per microhabitat for all species.

Significant differences per species for the number of anoles found per microhabitat were only found for *Anolis Limifrons* and *Anolis Lionotus* (Figure 5 & 6). Where of both species, there were significantly more anoles found in the trunk-ground microhabitat than the other microhabitats ($p<0{,}05$), with the exception of the number of *Anolis Limifrons* found in the twig microhabitat ($p=0{,}10$). Additionally, for *Anolis Limifrons*, more anoles were found in the palm branch and twig microhabitats compared to the dead hanging palm frond, fallen log and leaf-litter microhabitats ($p<0{,}05$). There were also more anoles found in the twig microhabitat than the grass-bush microhabitat ($p=0{,}04$). For the full list of all significant results with p-values see appendix C.

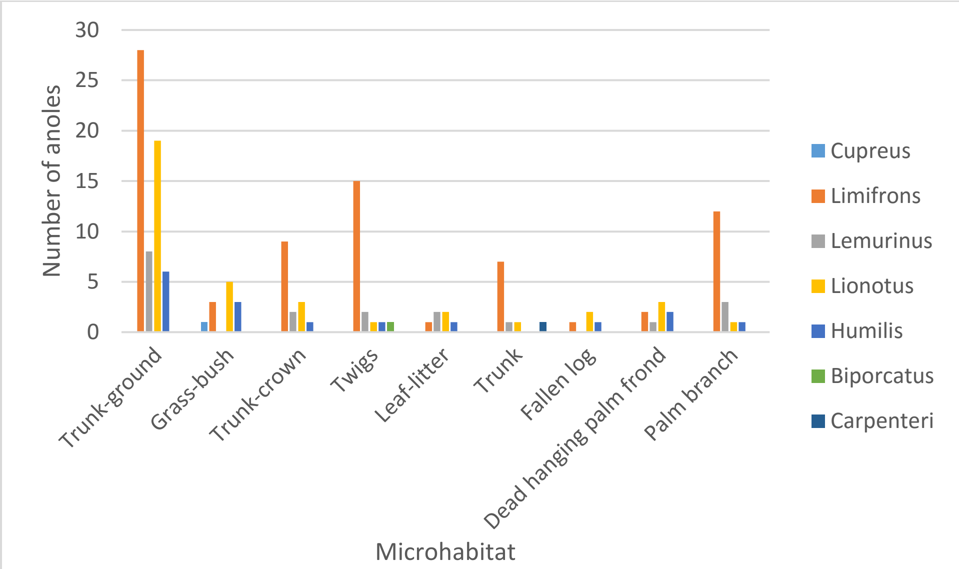


*Figure 5*: The total number of anoles found per microhabitat per species.

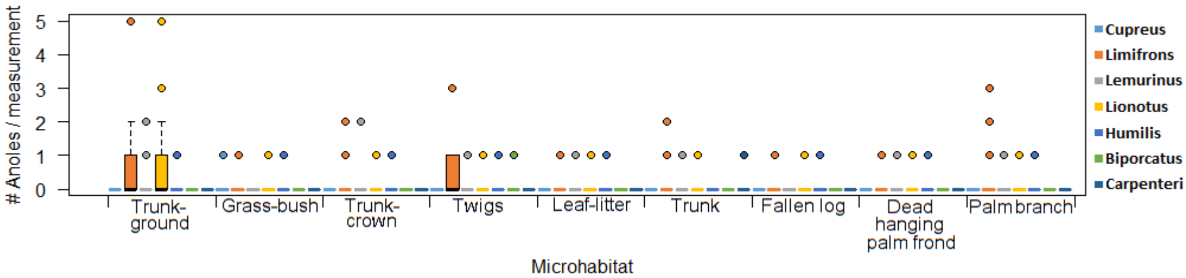


*Figure 6*: A boxplot showing the number of anoles found per microhabitat & species, per measurement.

Overall, more anoles were found in plot 1 than in plots 2, 3, 6, 7 and 9 ($p<0,05$) (Figure 7). Additionally, more anoles were found in plot 4 than in plots 6, 7 and 9 ($p<0,05$). And more anoles were found in plot 5 than in plots 7 and 9 ($p<0,05$). The species diversity varied slightly per plot (Table 2).

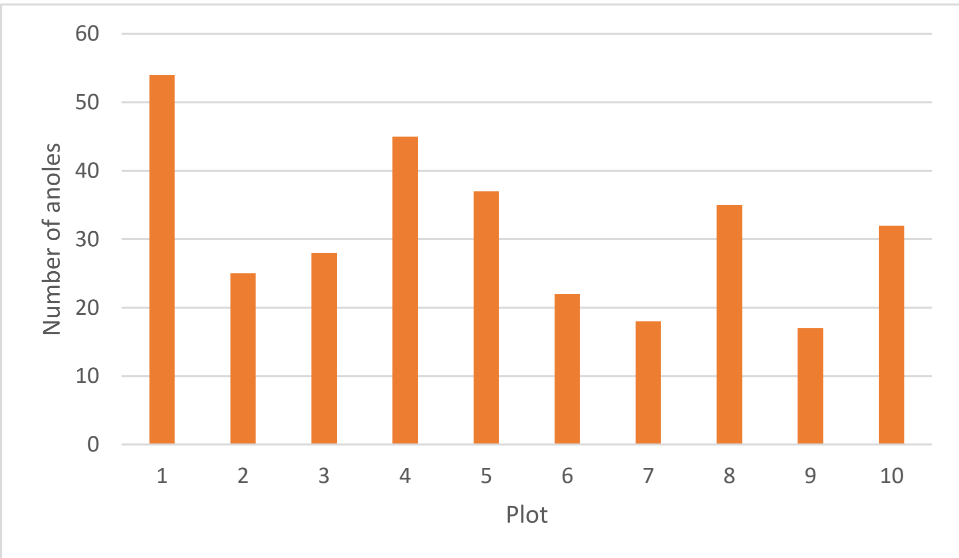


*Figure 7*: The total number of anoles found per plot for all species.

*Table 2*: The number of different species per plot.

| Plot | Species diversity |
|---|---|
| **1** | 5 |
| **2** | 5 |
| **3** | 3 |
| **4** | 3 |
| **5** | 4 |
| **6** | 4 |
| **7** | 5 |
| **8** | 4 |
| **9** | 3 |
| **10** | 4 |

The only significant difference per species found for the plots was for *Anolis Limifrons*. Where in plot 1 more anoles were found than in plots 2, 5, 6, 7, 8, 9 and 10 (p<0,05) (Figure 8 & 9). Additionally, more anoles were found in plot 3 than in 7, 8, 9, 10 (p<0,05) and more anoles were found in plot 4 than in plots 7 and 10 (p<0,05). For the full list of all significant results with p-values see appendix D.

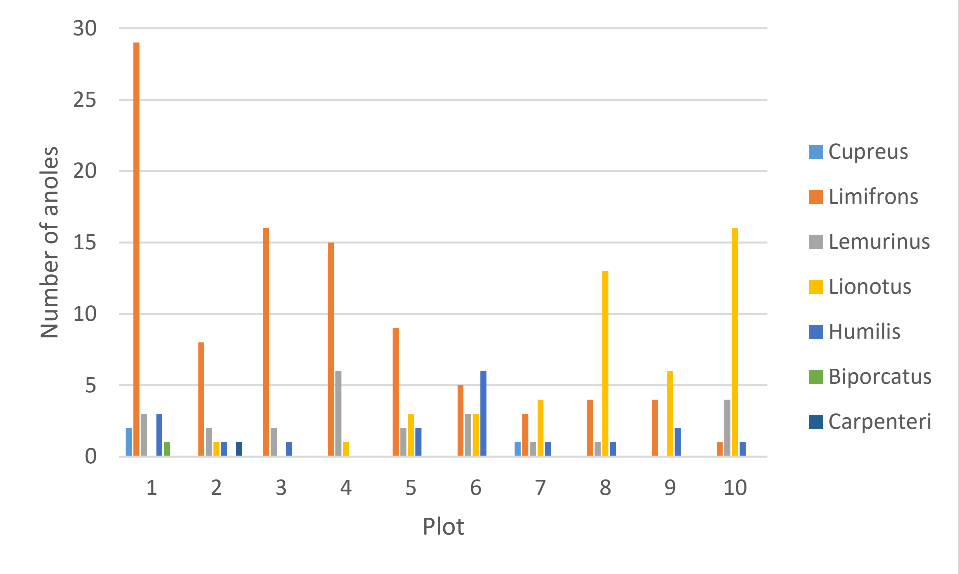


*Figure 8*: The total number of anoles found per plot per species.

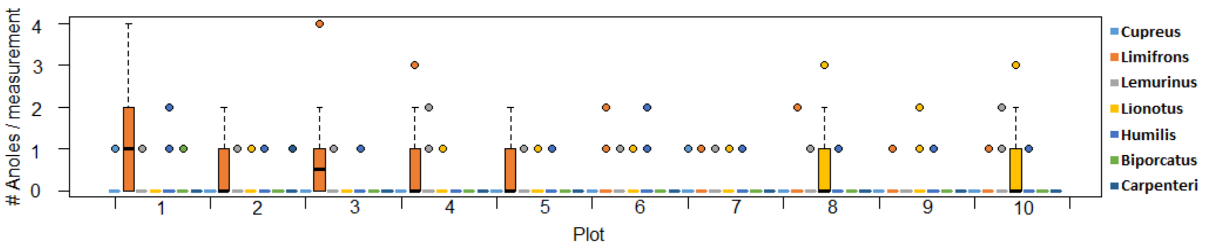


*Figure 9*: A boxplot showing the number of anoles found per plot & species, per measurement.

The effect of habitat composition on the presence of anoles was found to be significant for *Anolis Limifrons* (p<0,001) and *Anolis Lionotus* (p=0,013). No reliable test could be run for *Anolis Cupreus, Anolis Biporcatus* and *Anolis Carpenteri* due to the small sample size (n=3, n=1 and n=1 respectively). Due to a more severe dry season than usual, most of the data was collected on dry or mostly dry plots. In total over the entirety of the measurement period, 91,4% of the plots was dry, 5,4% was muddy and 3,1% was flooded, with flooding being observed in a plot 33 times.

## 4. Discussion

Only 7 species were found within the plots, of which the most common species were *Anolis Limifrons* and *Anolis Lionotus*, with the most common microhabitat for both species being trunk-ground. These findings are contrary to previous research showing that *Anolis Limifrons* is considered a grass-bush ecomorph (Vitt et al. 2002), although it is known to also be able to inhabit microhabitats 1-2 meters off of the ground (Talbot 1979). The relatively low availability of grass-bush microhabitat in the plots used for this study might cause *Anolis Limifrons* to use more available microhabitats, such as trunk-ground. *Anolis Lionotus* is not considered as one of the standard ecomorphs, but rather considered an aquatic anole (Muñoz et al. 2015; Leal et al. 2002). However, it has been shown that *Anolis Lionotus* is morphologically similar to the trunk-ground ecomorph type, which could explain why many anoles of this species were found in the trunk-ground microhabitat (Leal et al. 2002).

*Anolis Humilis* is of the trunk-ground ecomorph, and while this is not significant, the data does show a trend for preference of the trunk-ground microhabitat (Huyghe et al. 2007). *Anolis Lemurinus,* while again not significant, was also found more often on trunk-ground, rather than its previously described trunk ecomorph (Huyghe et al. 2007). Of *Anolis Cupreus, Anolis Biporcatus* and *Anolis Carpenteri* only a few individuals were caught (n=3, n=1 and n=1 respectively), and thus there are no particular trends evident.

There are several possible reasons why trunk-ground was the microhabitat in which most anoles were found. One potential reason is that it is easier to spot anoles in this microhabitat than several other microhabitats. Anoles in microhabitats such as trunk-crown or crown-giant are much less visible than anoles in microhabitats such as trunk-ground. This could explain why only one *Anolis Biporcatus* was found, as these usually live higher up in the trunk-crown microhabitat (Huyghe et al. 2007). However, this does not explain why other microhabitats easily accessible, such as leaf-litter, fallen log, trunk or grass-bush, had lower abundances of anoles.

A more severe dry season than in previous years may have resulted in fewer anoles being found. It is known that drought can influence behavior (Stamps 1976). It can alter display levels for both females and juveniles, and for both males and females, the location where they forage shifts from more exposed locations to higher places in the canopy or in leaf-litter. Additionally, general locomotor activity is reduced (Stamps 1976). This would make it harder to spot anoles thus reducing the number of anoles found.

Another thing to take into consideration is that the anoles couldn't be marked and weren't individually recognizable. Which means that it is possible, as the same plots were surveyed multiple times, that the data can include recaptures and the actual abundance of a certain species could have been lower than observed.

While this is likely to have lowered the abundance of anoles in general, it does not explain why there is a relatively small diversity in species diversity. Several other species are known to live in the area (Köhler 2008; Chacón & Johnston 2013). In addition, the open area that was also canvassed near the standard research area, did not contain any additional species. While this might be due to the shorter sampling period, it is likely that this is not the case as anoles were relatively easy to spot in the open area. Once again, the low species diversity could be attributable to the fact that certain species, like *Anolis Biporcatus,* live higher up and are therefore less likely to be spotted. This applies to many more anole species. Additionally, it is possible that the 10 plots researched in this study simply did not contain the necessary microhabitat requirements for certain species.

Requirements like habitat composition, for example, do seem to play a role in the presence of certain species. While the exact preference could not be tested, both the presence of *Anolis Limifrons* and *Anolis Lionotus* were influenced by habitat composition. Whether the preferred composition between species differs or not is uncertain, though one would expect so when looking at the plots in which both species were found. Though this has not been statistically tested, visual observation of the data shows that *Anolis Limifrons* are more frequent in the higher elevated plots (plots 1 through 5) and *Anolis Lionotus* seems to prefer the lower elevated plots (plots 6 through 10) (Figure 8 & 9). As one of the main differences between the two elevations is the amount of water, one would expect that *Anolis Limifrons* prefers dryer plots than *Anolis Lionotus*. This insinuates that different species do indeed have different preferences for habitat composition.

Furthermore, it is highly unusual to find *Anolis Lionotus* more than 5 meters away from a water source (Leal et al. 2002), yet most *Anolis Lionotus* were found in the plots with lower elevation, which are more than 5 meters removed from the nearby canal (Figure 2 & 8). Visual observation of the data reveals that *Anolis Lionotus* was found in these plots throughout the entirety of the measurement period, even during the dry season when water was scarce. The few times that plots were flooded, it was in the plots which had a lower elevation. However, it seems unlikely that the small amount of flooding and the few times that it was occured would be enough to allow *Anolis Lionotus* to live in the plots during the rest of the measurement period. How then it is possible for *Anolis Lionotus* to remain present in these plots, when there is not a high abundance of water present remains unknown and could be a topic for further study.

## 5. Conclusion

Of the 7 species found, two show a correlation to a certain microhabitat: *Anolis Limifrons* and *Anolis Lionotus* with their preference for the trunk-ground microhabitat. While unexpected, this can be explained, as *Anolis Limifrons* is known to inhabit low microhabitats. And *Anolis Lionotus* is morphologically similar to the trunk-ground ecomorph. For the other species not much can be said with certainty. It could be that they do have a correlation with a certain microhabitat but were simply found in too low an abundance to determine which. This is supported by the fact that for both *Anolis Humilis* and *Anolis Lemurinus* a trend was found for a particular microhabitat; trunk-ground. The remaining three species, *Anolis cupreus, Anolis Biporcatus* and *Anolis Carpenteri*, were found in such low abundances that not much can be said (n=3, n=1 and n=1 respectively). It would seem that there is in fact some ecomorph partitioning, as was expected. However, it does seem to be a lot more flexible in comparison to island anoles, as *Anolis Limifrons* does show ecomorph partitioning, but not for the ecomorph which was attributed to this species.

Habitat composition does play a role on the presence or abundance of anoles, but what species prefers what habitat composition remains unknown. It also remains unknown whether anoles which are usually found lower to the ground, are the only ones affected, as was hypothesized, or if this is simply due to the fact that more data was gathered on *Anolis Limifrons* and *Anolis Lionotus*. This remains a subject for future study. Furthermore, the fact that *Anolis Lionotus* has been found to live further away from a water source than expected warrants future study.

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# Appendices

## Appendix A: An overview of all ecomorphs found on the Greater Antilles, and their descriptive characteristics

The ecomorph definitions, as defined for the anoles found on the Greater Antilles (Adapted from Williams 1983).

| | **Trunk-ground** | **Trunk-crown** | **Trunk** | **Crown-giant** | **Twig-dwarf** | **Grass-bush** |
|---|---|---|---|---|---|---|
| **Size** | > 60 mm | > 70 mm | < 50 mm | > 100 mm | < 50 mm | Usually < 50 mm |
| **Color** | Brown with a variable pattern, sometimes green | Green, some gray | Variable (green, gray or brown) | Green, patterned or not | Gray | Distinct lateral or dorsal stripe in both sexes |
| **Typical perch** | On lower trunk | Canopy and upper trunk | On trunk between trunk-crown and trunk-ground | High in the crown | Twigs of canopy | On grasses or bushes |
| **Body proportions** | Head relatively short, body short and stocky, limbs long | Large head, body tending to be long, short legs | Head and body short | Head large, massive, often casqued | Long head, short body, short legs | Head moderately long, body slender, tail long |
| **Scales** | Middorsal scales abruptly (in 2 rows) or gradually enlarged | Uniform dorsal scales | Dorsal scales, usually uniform | A vertebral crest present | Uniform dorsal scales | A zone of few to many rows of dorsal scales |
| **Foraging behavior** | Sit-and-wait predator on ground prey | A searcher on leaves and branches | Primarily a forager on its trunk perch | Primarily a canopy forager | A slow searcher on twigs | Primarily a grass-bush forager |
| **Defensive behavior** | Flight downward | Flight upward | Run to opposite side of trunk | Primarily aggressive | Primarily crypsis | Flight downward |

## Appendix B: The datasheets used in the field

The datasheets used in the field, the top row was used to enter all data regarding date and time, the plot and environmental conditions. The rest was used to notate data regarding captures (or sightings in the case of an anole that can't be caught).

| **Date:** ……….. | **Plot:** …… | **Weather:** ……. | **Time:** ……… | **Dry:** …..% | **Muddy:** …..% | **Flooded:** …..% | | |
|---|---|---|---|---|---|---|---|---|
| **NR** | **Species** | **Sex** | **Microhabitat** | **Flooded/muddy/dry** | **GPS X** | **GPS Y** | **GPS Acc.** | **Remarks** |
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## Appendix C: A full overview of all significant results for the species specific Tukey test's for microhabitat preference

All significant microhabitat comparisons and their P-values from the Tukey test's.

| **Species** | **Comparison** | **P-value** |
|---|---|---|
| *Anolis Limifrons* | Palm branch > Dead hanging palm frond | 0,04880 |
| *Anolis Limifrons* | Trunk-ground > Dead hanging palm frond | 0,00560 |
| *Anolis Limifrons* | Twigs > Dead hanging palm frond | 0,03496 |
| *Anolis Limifrons* | Palm branch > Fallen log | 0,04699 |
| *Anolis Limifrons* | Trunk-ground > Fallen log | 0,00763 |
| *Anolis Limifrons* | Twigs > Fallen log | 0,03496 |
| *Anolis Limifrons* | Trunk-ground > Grass-bush | 0,00560 |
| *Anolis Limifrons* | Twigs > Grass-bush | 0,03937 |
| *Anolis Limifrons* | Palm branch > Leaf-litter | 0,04699 |
| *Anolis Limifrons* | Trunk-ground > Leaf-litter | 0,00763 |
| *Anolis Limifrons* | Twigs > Leaf-litter | 0,03496 |
| *Anolis Limifrons* | Trunk-ground > Palm branch | 0,04602 |
| *Anolis Limifrons* | Trunk-ground > Trunk | 0,00763 |
| *Anolis Limifrons* | Trunk-ground > Trunk-crown | 0,01834 |
| *Anolis Lionotus* | Trunk-ground > Dead hanging palm frond | 0,0211 |
| *Anolis Lionotus* | Trunk-ground > Fallen log | 0,0211 |
| *Anolis Lionotus* | Trunk-ground > grass bush | 0,0356 |
| *Anolis Lionotus* | Trunk-ground > Leaf-litter | 0,0211 |
| *Anolis Lionotus* | Trunk-ground > Palm branch | 0,0211 |
| *Anolis Lionotus* | Trunk-ground > Trunk | 0,0211 |
| *Anolis Lionotus* | Trunk-ground > Trunk-crown | 0,0211 |
| *Anolis Lionotus* | Trunk-ground > Twigs | 0,0211 |

## Appendix D: A full overview of all significant results for the species specific Tukey test’s for plot preference

All significant plot comparisons and their P-values from the Tukey test's.

| **Species** | **Comparison** | **P-value** |
|---|---|---|
| *Anolis Limifrons* | 1 > 2 | 0,00945 |
| *Anolis Limifrons* | 1 > 5 | 0,02079 |
| *Anolis Limifrons* | 1 > 6 | 0,00319 |
| *Anolis Limifrons* | 1 > 7 | 0,00306 |
| *Anolis Limifrons* | 1 > 8 | 0,00306 |
| *Anolis Limifrons* | 1 > 9 | 0,00306 |
| *Anolis Limifrons* | 1 > 10 | 0,00838 |
| *Anolis Limifrons* | 3 > 7 | 0,03899 |
| *Anolis Limifrons* | 3 > 8 | 0,04549 |
| *Anolis Limifrons* | 3 > 9 | 0,04549 |
| *Anolis Limifrons* | 3 > 10 | 0,03899 |
| *Anolis Limifrons* | 4 > 7 | 0,04474 |
| *Anolis Limifrons* | 4 > 10 | 0,03933 |