Herpetology Notes, volume 8: 141-148 (2015) (published online on 10 April 2015)

Testing sustainable forestry methods in Puerto Rico: Does the presence of the introduced timber tree Blue Mahoe, *Talipariti elatum*, affect the abundance of *Anolis gundlachi*?

Norman Greenhawk

Abstract. The island of Puerto Rico has one of the highest rates of regrowth of secondary forests largely due to abandonment of previously agricultural land. The study was aimed at determining the impact of the presence of *Talipariti elatum,* a timber species planted for forest enrichment, on the abundance of anoles at Las Casas de la Selva, a sustainable forestry project located in Patillas, Puerto Rico. The trees planted around 25 years ago are fast-growing and now dominate canopies where they were planted. Two areas, a control area of second-growth forest without *T. elatum* and an area within the *T. elatum* plantation, were surveyed over an 18 month period. The null hypothesis that anole abundance within the study areas is independent of the presence of *T. elatum* could not be rejected. The findings of this study may have implications when designing forest management practices where maintaining biodiversity is a goal.

Keywords. *Anolis gundlachi, Anolis stratulus*, Puerto Rican herpetofauna, introduced species, forestry

Introduction

At the time of Spanish colonization in 1508, nearly one hundred percent of Puerto Rico was covered in forest (Wadsworth, 1950). As a result of forest clearing for agricultural and pastureland, ship building, and fuel wood, approximately one percent of the land surface contained virgin forest by the early twentieth century (Little and Wadsworth, 1964). Beginning in the 1950s, the urbanization and industrialization of, and emigration from, the island resulted in the majority of farmland being abandoned. Since then ecological succession of native and introduced species of trees has resulted in Puerto Rico being one of the few places in the world that is showing an increase in forested land. By 2003, 57% of Puerto Rico's land surface was forested (Brandeis, 2007).

The secondary growth forest represents a significant resource base for the people of Puerto Rico, and, if managed properly, an increase in suitable habitat for forest-dwelling herpetofauna. Depending on the management methods used, human-altered agro-forestry plantations have potential conservation value (Wunderle, 1999). In Puerto Rico, the proper management of second-growth forests for habitat and ecosystem services is especially important; most of Puerto Rico's primary forests were destroyed before 1900, and of what remains, most has been heavily altered by human activity (Wadsworth, 1950).

Established in 1983, Las Casas de la Selva is a 404.68 hectare sustainable forestry project located in the mountains of Patillas, Puerto Rico. The property adjoins the southern border of the Carite State Forest; the entire area has been classified as subtropical wet forest in the Holdridge Life Zone system (Kumme and Briscoe, 1963). Las Casas de la Selva is an experimental laboratory testing sustainable forestry methods, such as line-planting of timber trees mixed with native trees and the removal of timber using alternatives to clear-cutting, with the goal of preserving the biodiversity of Puerto Rico and the ecosystem services of the forests.

Tropic Ventures Education and Research Foundation,
Las Casas de la Selva, HC-63, Buzon 3879, Rte 184, Km 15.9, Patillas, Puerto Rico, 00723
E-mail: greenhawk81@gmail.com

Part of its research program investigates whether timber production negatively affects overall biodiversity of the forest.

A previous biodiversity study showed that the line-planting of non-native trees at intervals in the secondary forest in approximately one-third of the property did not have a negative impact on floral and faunal biodiversity (Nelson et al., 2010). Nelson et al. (2010) focused mainly on the impact on abundance and diversity of frogs in the genus *Eleutherodactylus*. The extent to which the planting of non-native trees and the harvest of timber affects lizards of the genus *Anolis*, the most abundant vertebrate in Puerto Rico (Williams, 1969), remains largely unknown.

In the subtropical wet forests of Puerto Rico, anoles have been found to make up approximately 55.7 kg/ha of the biomass (Reagan, 1996[a]). Most anole species are dietary generalists, with smaller species tending to be predominantly insectivores and frugivores; larger species are able to consume larger prey items, feeding on small mice or fledgling birds when the opportunity arises (Rivero, 1998). Anoles are themselves prey for tertiary consumers, including lizard-eating birds and mammals (Losos, 2009[a]). In Puerto Rico, anoles are common prey for several species of birds, other anoles, snakes, whipscorpions, tarantulas, and centipedes (Reagan, 1996[b]).

Anoles are important species in the food web of Puerto Rican forests. Thus, it is important to determine if the forestry methods utilized at Las Casas de la Selva cause a reduced abundance of native anole species. Of the 404.68 ha of forest at Las Casas de la Selva, 121.4 ha were line-planted with tropical timber trees, including the non-native tree *Talipariti elatum*, in different areas of the forest. Thirty percent of the surface area of the property has non-native timber trees as the most abundant and canopy-dominating tree species.

The purpose of the study was to determine if the presence of *Talipariti elatum* affects abundance of anoles. Losos et al. (2001) found that, when introduced into a new habitat, the populations of two species of anoles that were not closely related developed similar limb length in several different habitats. The study concluded that, "Phenotypic flexibility provided by plasticity may allow anole populations to occupy novel habitats that would otherwise be inaccessible". If so, this same phenotypic flexibility might allow anoles to utilize introduced species of plants that might alter the structure, perch availability, and microhabitats of an ecosystem. Additionally, a significant number of non-native trees are already part of the secondary forests in Puerto Rico (Little and Wadsworth, 1989). The null hypothesis is that anole seasonal abundance is independent of the presence of *T. elatum*.

Figure 1. Control area.

Figure 2. Mahoe area.

Materials and Methods

a. Experimental Design

For this study, two study sites were chosen, a mahoe plantation area and a control area, which was not line-planted with mahoe or any other timber trees. The plots were chosen to be at the same elevation as this factor has an impact on both vegetation and faunal populations.

The control area (Figure 1) consists of second growth subtropical wet forest. The dominant canopy tree species is Guaraguao (*Guarea guidonia*), intermixed with Palma de Sierra (*Prestonea montana*). The understory consists of sapling trees, as well as shrubs of the family *Piperaceae*. The forest floor contains a thick layer of leaf litter.

The mahoe area (Figure 2) consists of a near-monoculture of *Talipariti elatum* as the top canopy species, with an understory of Camasey (*Miconia spp*.). The forest floor consisted of a thin layer of *T. elatum* leaf litter and ferns.

The two plots were chosen for ease of access, and because both areas contain a closed canopy with a shaded understory level. Both plots have relatively flat terrain. Both are approximately 800 m in elevation on the southern slope of the same mountain. Both are dominated by trees of approximately 25 years in age on land that previously was utilized as a coffee plantation.

Each area was divided into six 10 m^2 quadrants for ease of counting and homogenization of data. Plots were marked off using PVC pipes for plot corners and twine marked with florescent plastic flagging tape for plot borders.

b. Survey Methodology

The research protocols were standardized. All surveys were completed between 1000 h and 1400 h, and all surveys of each plot type were completed on the same day, unless inclement weather prevented such. In that case, one area was surveyed one day, the second area the next. Once a survey was started, all six quadrants were surveyed. If weather prevented the surveying of all six quadrants, then that survey was excluded from analyses.

Field data for this study were collected with the help of Earthwatch Institute volunteers. Training for anole identification was provided to all volunteers to ensure accurate identification and the principal investigator (NG) confirmed all field identifications. Individuals were sexed when possible. If the anole was old enough to show sexually dimorphic traits to distinguish it as male or female, then it was classified accordingly. If not, it was classified as a juvenile.

During each survey, the surveyors stood shoulder-to-shoulder in a line on all four sides of the quadrant to be surveyed. One volunteer served as data recorder and remained outside the plot at all times. The P.I. also remained outside to permit moving as needed to assist volunteers with anole identification without disturbing unsurveyed areas of the quadrant. When the start of the survey was announced, volunteers began visually surveying the area directly in front of their field of vision, including all tree trunks (as high as visual confirmation of species allowed), understory shrubs and seedlings, and the ground. The volunteers moved forward together, to hold a continuous front.

Table 1. List of anoles observed at Las Casas de la Selva^.

Species	Common Name Spanish	Common Name English	Ecomorph*	Observed at study
A. gundlachi	Lagartijo de Barba Amarilla	Yellow-Chinned Anole	Truck-ground	Yes
A. c. cristatellus	Lagartijo Común	Puerto Rican Crested Anole	Truck-ground	No
A. evermanni	Lagartijo Verde	Emerald Anole	Trunk-Crown	Yes
A. krugi	Lagartijo Jardinero de Montana	Krug's Anole	Grass	No
A. stratulus	Lagartijo Manchado	St. Thomas Anole	Trunk-Crown	Yes

^ As of 2/15/2014

* Ecomorph assignment from Losos 2009[b].

This process continued until the entire quadrant had been surveyed. Volunteers reported data in an orderly fashion, calling to the data recorder and then waiting for confirmation before reporting the species and gender of the anole. Attempts to capture anoles were only made after this data was recorded, and then only if the capture of the animal didn't disrupt the ordered movement of volunteers through the plot (e.g. "breaking the line"). This procedure helped to ensure that anoles were not counted more than once per survey.

Figure 3. Male *Anolis gundlachi.*

c. Statistical Analysis

A Wilcoxon Test was used to determine if anole seasonal abundance was independent of the presence of *Talipariti elatum;* a Wilcoxon Test was also used to compare age/sex differences (male, female, juvenile) between the control area and mahoe area.

Results

A total of six complete surveys were conducted in August 2009, December 2009, March 2010, June 2010, August 2010, and March of 2011. Of the five species of anoles observed at Las Casas de la Selva, three were observed in the study areas (Table 1). A total of 756 anoles were observed during this study (Table 2).

Anolis gundlachi (Figure 3) was the most commonly observed anole in both the control area and mahoe area with an average of 92.05% and 92.64%, respectively, of all anoles observed during the study. *Anolis stratulus* was the second most commonly observed anole. *A. stratulus* composed 6.28% of all anoles counted in the control area and 5.58% of all anoles counted in the mahoe area.

One other species of anole, *Anolis evermanni*, was observed infrequently. *A. cristatellus* and *A. krugi* were not observed in the study areas during any of the surveys.

Anolis gundlachi was the only anole observed with enough frequency to provide sufficient data for statistical analysis (Table 3). Both areas in the study

Table 2. Total observed anoles.

Date	*Anolis*	Mahoe Area	Mahoe Area Percentage of Observed Anoles	Control Area	Control Area Percentage of Observed Anoles
3.15.2011	Total	106	100	104	100
	A. gundlachi	22-46-38 (106)	100.00	22-33-48 (104)	99.04
	A. stratulus	-	-	-	-
	A. evermanni	-	-	0-0-1 (1)	0.06
8.1.2010	Total	79	100	58	100
	A. gundlachi	26-17-31 (74)	93.67	16-26-10 (52)	89.66
	A. stratulus	2-0-2 (4)	5.06	2-0-1 (3)	5.17
	A. evermanni	0-1-0 (1)	1.27	0-1-2 (3)	5.17
6.26.2010	Total	44	100	31	100
	A. gundlachi	10-26-6 (42)	95.45	9-17-5 (31)	100
	A. stratulus	1-0-1 (2)	4.54	-	-
	A. evermanni	-	-	-	-
3.18.2010	Total	41	100	78	100
	A. gundlachi	8-9-21 (38)	92.68	24-14-39 (77)	98.72
	A. stratulus	0-1-0 (1)	2.44	-	-
	A. evermanni	1-0-1 (2)	4.88	1-0-0 (1)	1.28
12.1.2009	Total	39	100	32	100
	A. gundlachi	6-10-17 (33)	84.62	5-6-11 (22)	68.75
	A. stratulus	4-2-0 (6)	15.38	2-6-2 (10)	31.25
	A. evermanni	-	-	-	-
8.1.2009	Total	66	100	78	78
	A. gundlachi	9-27-23 (59)	89.39	23-5-47 (75)	96.15
	A. stratulus	1-2-1 (4)	6.06	1-0-0 (1)	1.28
	A. evermanni	2-1-0 (3)	4.55	1-0-1 (2)	2.57
	Total	375		381	
	Average observed anoles	62.5		63.5	
	Anoles observed per $10m^2$	10.41666667		10.58333333	

Count data for each species reported as: Male-Female-Juvenile (Total).
- = No data/none observed.

Table 3. Mean number of *Anolis gundlachi* observed during the survey^.

	Mahoe	Control
Average Total	58.67	60.00
Standard Deviation ±	27.71	30.70
Average Males	13.50	17.33
Standard Deviation ±	8.34	10.69
Average Females	22.50	16.83
Standard Deviation ±	13.81	11.05
Average Juveniles	22.67	26.67
Standard Deviation ±	11.11	20.07

^Mean number of 6 counts for each total study area, $600m^2$.

yielded similar results of number of this species, with the control area having an average of 58.67 ±27.71, and the mahoe area having an average of 60.00 ±30.70.

While the total number of *Anolis gundlachi* observed in both areas is similar, there were slight differences with gender composition. The average number of males observed in the control area was 17.33 ±10.69, compared to 13.50 ±8.34 males in the mahoe area. While the number of females observed in the control area was comparable to the males at 16.83 ±11.05, the number of observed females in the mahoe area, 22.50 ±13.81, was much higher than the number of males observed, 17.33 ±10.69. In the control area, 26.67 ±20.07 juvenile *A. gundlachi* were observed compared to 22.67 ±11.11 juveniles in the mahoe area.

Table 4. Wilcoxon Test results for control area vs. mahoe area

	***A. gundlachi* control vs. *A. gundlachi* mahoe**	**Total anole control vs. total anole mahoe**
Z	-.105[a]	-.314[a]
Asymp. Sig. (2-tailed)	0,916	0,753

Data was analyzed using a Wilcoxon test to evaluate whether the presence of mahoe trees had an impact of the abundance of anoles (Table 4). Two Wilcoxon tests were run; one for total observed anoles and one exclusively for *Anolis gundlachi*. Individual tests were not run for *A. stratulus* or *A. evermanni* as too few observations were made to make statistically valid arguments. The results of the total anole Wilcoxon test indicated no significant difference, $z= -.314$, $p > 0.01$. The mean rank of anoles in the control area was 3.00, while the mean in the mahoe area was 4.50. For the *A. gunlachi* Wilcoxon test, $z=-.105$, $p > 0.01$. The mean rank for *A. gundlach*i in the control area was 2.75 and in the mahoe area was 5. Based on these results, the null hypothesis that the abundance of anoles is independent of the presence of mahoe trees cannot be rejected.

A Wilcoxon test was also utilized to conduct a general comparison of age and sex composition between the two populations of *Anolis gundlachi* (Table 5). For males in the control area vs. males in the mahoe area, $z = -.406$. For females in the control area vs. females in the mahoe area, $z = -1.051$, and for juveniles in the control area vs. juveniles in the mahoe area, $z = -.524$. For all three comparisons, $p > 0.01$, showing no significant difference in the number of anoles of each age/sex between the two areas.

Discussion

Two of the five species of anoles occurring at Las Casas de la Selva (Table 1) were regularly observed in the study areas: *Anolis gundlachi* and, with lesser frequency, *A. stratulus*. One species, *Anolis evermanni*, was only occasionally observed.

Anolis evermanni is classified as a trunk-crown anole; therefore it is not surprising that few individuals were observed during the surveys. Whereas *A. evermanni* has been observed in abundance at Las Casas de la Selva at ground level around areas of high human impact on the environment (Greenhawk, unpubl. data), it rarely was encountered in forested areas of deep shade. Access to the canopy level of the forest is likely to yield more observations of *A. evermanni*.

Anolis stratulus also is classified as a trunk-crown anole, and like *A. evermanni*, it is not unusual that few individuals were observed during the surveys. Reagan (1992) found that in El Yunque, *A. stratulus* was the most abundant anole in the forest, but inhabited the canopy. At Las Casas de la Selva *A. stratulus* has been found to be more abundant at ground level in areas where trees are plentiful but the canopy is open (Greenhawk, unpubl. data), an observation supported by Reagan (1991), who found *A. stratulus* inhabiting lower levels of forest after a hurricane destroyed (opened) the canopy; when it regenerated, *A. stratulus* quickly colonized the canopy again.

Anolis krugi is a grass-bush anole that is most often encountered at Las Casas de la Selva along the forest trails and within areas of the forest where the canopy has been opened by falling trees and the forest floor has been colonized by grass and shrubs, and seems to prefer a habitat of tall grass, low shrubs, and somewhat open canopy cover (pers. Obs.). Robles et al. (2010) describes *A. krugi* as being a species found in the shade. However, Rand (1964) found that *A. krugi*, while found in habitats with low to medium shade levels, was not often associated with heavily-shaded areas, and out of 112 observed individuals, only 11 were found on

Table 5. Wilcoxon Test results for *Anolis gundlachi* by age/sex.

	Males in control area vs. males in mahoe area	Females in control area vs. females in mahoe area	Juveniles in control area vs. juveniles in mahoe area
Z	-.406[a]	-1.051[b]	-.524[a]
Asymp. Sig. (2-tailed)	0.684	0.293	0.6

tree perches with a diameter greater than three inches. As such, it is expected that *A. krugi* would not be encountered in the study area.

Anolis cristatellus was not observed in either study location. While *A. cristatellus* has been observed inhabiting shade at lower elevations, previous research has shown that when *A. cristatellus* and *A. gundlachi* overlap in range, the former remains in open habitat and the latter species is found in forests (Hess & Losos, 1991; Rand, 1964; Schoener and Schoener, 1971).

The prevalence of *Anolis gundlachi* was expected, as this species is a trunk-ground anole that inhabits the ground, small shrubs, and the trunks of trees up to two meters in height (Rodríguez-Robles, 2005) and is associated with heavily-shaded habitat (Rand 1964). Both study areas were deeply shaded, and although *Anolis cristatellus* is also a trunk-ground anole, it usually inhabits areas of open forest. The two species are very similar in appearance, and from a distance can be difficult to tell apart- both are generally colored various shades of brown, and both have the medium-sized, "stocky" build of a trunk-ground anole.

However, *Anolis gundlachi* possesses blue sclera, whereas *A. cristatellus* does not. Most individuals of *A. gundlachi* also possess yellow coloration on the bottom of the jaw, hence the common name "Yellow-chinned Anole". The possibility of misidentification cannot be fully ruled out. However, although not all anoles were captured during the study, over 95% were (the majority, but not all, of those not captured were skittish juveniles that fled researchers, or adults that had perched beyond reach) and never was an anole identified as *A. gundlachi* before capture found to be *A. cristatellus* after capture. When the findings of Rand (1964) and Hess & Losos (1991) are weighed with these observations, it is unlikely that significant misidentification occurred within the study area.

The lower average number of males observed in the mahoe area (13.50 ±8.34) as opposed to the control area (17.33 ±10.69) (Table 3) might be explained by a lack of appropriate perches and/or visual barriers in the mahoe plantations. Male anoles are territorial, and will make territorial displays towards other males they encounter. In sexually dimorphic species such as *Anolis gundlachi,* this behavioral display often escalates to physical fights (Lailvaux and Irschick, 2007). The majority of the trees in the control area have some buttressing, and the understory is slightly denser than that of the mahoe area. In contrast, the *Talipariti elatum* trees in the mahoe area are not buttressed. Therefore, while the two study areas were the same size, it is possible that the control area contained more suitable perching space and visibility barriers, allowing more male *A. gundlachi* to establish territories.

The lack of available perches for males may help account for the increased number of female anoles in the mahoe area (22.50 ±13.81) vs. the control area (16.83 ±11.05). If the mahoe area contained less available territory for male anoles than the control area, then it is possible that young males have a higher mortality rate than females in the mahoe area, allowing for more of the adult population to be comprised of females; additional research needs to be conducted to see if such a correlation exists.

The null hypothesis of no difference between sites could not be rejected using the data gathered from our study areas. Therefore, the results of this study are compatible with the hypothesis that anole abundance is independent of the presence of the introduced *Talipariti elatum* in our study sites. The two study sites were chosen to be as similar as possible in regards to canopy cover, slope, elevation, and location on the mountainside. However, since these study areas comprise a total of 1,200 m^2 on the property of 409 hectares, it is premature to conclude that this study is representative of all subtropical wet forest ecosystems in Puerto Rico in regards to anole abundance. It is possible that if other factors were included, the presence of *T. elatum* might affect seasonal abundance of anoles.

Future Research

This study is a baseline effort in regards to comparing abundance of Puerto Rican anoles in plantation vs. non-plantation forests. No studies on anoles had been conducted at Las Casas de la Selva before this one; the intention is that this data will be built upon with future research. There is potential for this study to be expanded to include different physical levels of the forest. It is possible that *Talipariti elatum* creates a canopy cover that is different enough in composition, perch structure, and thermal gradient that it might affect the abundance of trunk-crown species such as *Anolis evermanni* and *A. stratulus*. Replications of this research should be conducted, and expanded to include factors such as various canopy cover densities, various elevations, understory composition, predator/prey relationships, prey availability, perch availability, and microhabitat differences. Perhaps when these factors are examined, the presence of *Talipariti elatum* would affect anole abundance. This study did not focus on detailed age composition of the anoles; more focused research may yield findings that the introduction of *T. elatum* impacts this aspect of *A. gundlachi* populations. Monitoring should be conducted to observe the short-term and long-term effects of timber removal on anole population density, reproduction, and species richness. Research also should be conducted to determine if the perch availability in areas of the forest with and without *T. elatum* is a factor in anole species richness, population size, and gender composition.

Acknowledgments. This research was conducted at Las Casas de la Selva, certified as an auxiliary forest by the Puerto Rico Departamento de Recursos Naturales y Ambientales. Thanks to P. Calligari and P. Burrowes at UPRRP, F.B-Pico at UPRM, M. Nelson of the Institute of Ecotechnics, Tropic Ventures Education and Research Foundation, the Earthwatch Institute, J.M. Ray of La MICA Biological Station, J. Zeggara, and R.Y. Haddock.

Literature Cited

Brandeis, T. H. (2007): The status of Puerto Rico's forests 2003. *USDA Forest Service Resource Bulletin SRS-119*. Asheville, N.C.

Hess, N.E., J.B. Losos, J.B. (1991): Interspecific aggression between *Anolis cristatellus* and *A. gundlachi*: comparisons of sympatric and allopatric populations. Journal of Herpetology **25**: 256-259.

Kumme, K.W.O, Briscoe, C.B. (1963): Forest formations of Puerto Rico. Caribbean Forester **24**(2): 57-68.

Lailvaux, S.P.,Irschick, D.J. (2007): The evolution of performance-based male fighting ability in Caribbean *Anolis* lizards. The American Naturalist. **170**(4):573-586.

Little, E., Wadsworth, F. (1964): The Forests of Today. In: Common Trees of Puerto Rico and the Virgin Islands. pp. 14-15. Dogwood Printing, Ozark, MO.

Losos, J.B., Jackman, T.R., Larson, A., de Queiroz,K., Rodriguez-Schettin, L. (1998): Historical contingency and determinism in replicated adaptive radiations of island lizards. Science **279**: 2115-2117.

Losos, J.B., Schoener, T.W., Warheit, K.I., Creer, D. (2001): Experimental studies of adaptive differentiation in Bahamian *Anolis* lizards. Genetica **112–113**: 399–415.

Losos, J. B. (2009[a]): Meet the Anoles. In: Lizards in an Evolutionary Tree: Ecology and Adaptive Radiation of Anoles. p. 12. University of California Press, Berkeley, CA.

Losos, J. B. (2009[b]): Afterward: An Anole Bestiary. In: Lizards in an Evolutionary Tree: Ecology and Adaptive Radiation of Anoles. pp. 411-420. University of California Press, Berkeley, CA.

Nelson, M., Silverstone, S., Burrowes, P., Joglar, R., Robertson, M.,Vakil, T., (2010):
The impact of hardwood line-planting on tree and amphibian biodiversity in a
secondary wet tropical forest, southeast Puerto Rico. Journal of Sustainable Forestry **29**(5): 503-516.

Rand, A.S. (1964) "Ecological distribution in anoline lizards of Puerto Rico." Ecology **(45)**4: 745-752.

Reagan, D. (1991): The response of *Anolis* lizards to hurricane-induced habitat changes in a Puerto Rican rain forest. Biotropica **23**: 468-474.

Reagan, D. (1992): Congeneric species distribution and abundance in a three- dimensional habitat: the rain forest anoles of Puerto Rico. Copeia: 392-403.

Reagan, D., Waide, R.(1996[a]). Anole Biomass. In: The Food Web of a Tropical Rain Forest pp. 332-333. The University of Chicago Press. Chicago, IL.

Reagan, D., Waide, R.(1996[b]). Predators. In:The Food Web of a Tropical Rain Forest p. 343, The University of Chicago Press. Chicago, IL.

Rivero, Juan. (1998) The Lizards and Snakes. In: Los Anfibios y Reptiles de Puerto Rico. pp 401. La Editorial de Universidad de Puerto Rico, San Juan, P.R.

Rodríguez-Robles, J.A., Leal, M., Losos, J.B.. (2005): Habitat selection by the Puerto Rican yellow-chinned anole, *Anolis gundlachi*. Canada Journal of Zoology **83**: 983-988.

Schoener T.W., Shoener,A. (1971): Structural habitats of West Indian *Anolis* lizards II. Puerto Rican up-lands. Breviora **375**: 1-39.

Wadsworth, F. (1950): Notes on the climax forests of Puerto Rico and their destruction and conservation prior to 1900. The Caribbean Forester **11**(1): 38-47.

Williams, E. E. (1969): The Ecology of colonization as seen in the zoogeography of anoline lizards on small islands. Quarterly Review of Biology **44**(4): 345-389.

Wunderle, J.M. (1999): Conservation of Caribbean wildlife diversity: The role of agroforestry plantations. Biodiversity in the Caribbean: Management and Benefits. pp. 115-119.

Accepted by Mirco Solé