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Lepidoblepharis sanctaemartae, Sabanas de San Ángel, Magdalena, Colombia. *Photo by Juan Manuel Renjifo.*

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Amphibians and reptiles of an agroforestry system in the Colombian Caribbean

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***Abstract.*—Land-use change is a factor that may alter the assembly of herpetofaunal communities. To determine the effects of land use change, we characterized the herpetofaunal community of "La Gloria Project" in Magdalena, Colombia. Agroforestry crops (Red Gum, Pink Trumpet Tree, Beechwood, and Teak), native forest, wetlands, and built-up zones composing the site. From March to October 2012, we performed eleven field trips, of ten days (eight hours each) for a total sampling effort of 880 hours per observer. We implemented visual encounter surveys and pitfall traps for herpetofauna detection. We recorded 23 amphibian (3,555 individuals) and 37 reptile species (1,088 individuals); the highest diversity for both amphibians and reptiles were found in native forest. Comparing disturbed areas, Teak agroforest presented the highest diversity for both taxa relative to non-natural environments, by factors such as big leaf size, generating conditions to sustenance of some species. However, we demonstrated that short-term differences between natural and non-natural habitats are significant, since there has not been enough time for generalist species to displace the susceptible species and occupy their niches in all vegetation coverages in the study area.**

Key words. Agroforest, Caribbean lowlands, habitat fragmentation, herpetofaunal communities, tropical dry forest, lower Magdalena River

***Resumen.*—El cambio de usos del suelo es un factor que puede afectar el ensamblaje de las comunidades de herpetofauna. Para determinar los efectos del cambio del uso de suelo, caracterizamos la comunidad de herpetofauna del "Proyecto La Gloria" en el departamento del Magdalena, Colombia. Cultivos agroforestales (eucalipto rojo, roble rosado, melina y teca), bosques nativos, humedales y zonas con construcción constituyen el área de estudio. De marzo a octubre de 2012, desarrollamos once salidas de campo de diez días (cada uno de ocho horas) por un esfuerzo total de muestreo total de 880 horas × observador. Utilizamos búsqueda libre por encuentro casual y trampas de caída para la detección de herpetofauna. Registramos 23 anfibios (3,555 individuos) y 37 reptiles (1,088 individuos); La mayor diversidad tanto para anfibios como reptiles la encontramos en los bosques nativos. Comparando las áreas intervenidas, el agrobosque de teca presentó la mayor diversidad de ambos taxones con respecto a los otros ambientes no naturales, por factores como el gran tamaño de sus hojas, que generan condiciones para el sostenimiento de algunas especies. Empero, se demuestra que a corto plazo, las diferencias entre los hábitats naturales y no naturales son significativas, pues no ha pasado suficiente tiempo para que las especies generalistas desplacen a la especies sensibles y ocupen sus nichos.**

Palabras clave. Agrobosques, bajo río Magdalena, bosque seco tropical, comunidades de herpetofauna, fragmentación de hábitat, tierras bajas del Caribe

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Introduction

Colombia ranks second in taxonomic diversity of amphibians (785 species) and third in reptiles (593 species) (Acosta-Galvis 2014; Andrade-C. 2011). In the Caribbean lowlands 167 reptiles species and 55 amphibians are recorded (Romero-Martínez and Lynch 2012; Carvajal-Cogollo et al 2012). The low diversity of amphibians in the Colombian Caribbean is due to drier conditions of the region, however, the small number of species have morphological, physiological, and behavioral adaptations to tolerate drought (Cuentas et al. 2002). Existing surveys include checklists, inventories, and diversity of amphibians and reptiles for the entire region (Dugand 1975; Carvajal-Cogollo et al. 2012; Romero-Martínez and Lynch 2012); as well as the states of Córdoba (Renjifo and Lundberg 1999; Carvajal-Cogollo et al. 2007; Carvajal-Cogollo and Urbina-Cardona 2008; Romero-Martínez et al. 2008; Romero-Martínez and Lynch 2010), Sucre (Galván-Guevara and de la Ossa-Velásquez 2009; Acosta-Galvis 2012b), Bolivar and Atlántico (Cuentas et al. 2002), Cesar (Rueda-Almonacid et al 2008a; b; Medina-Rangel 2011; Medina-Rangel et al. 2011), La Guajira (Galvis et al. 2011; Blanco-Torres et al. 2013), and Magdalena (Ruthven 1922; Dueñez-Gómez et al. 2004; Rueda-Solano and Castellanos-Barliza 2010; Montes-Correa et al. 2015). Many studies were performed in natural areas with wetlands or native forests, with different levels of anthropogenic intervention. Nonetheless, the information on the herpetofauna of dry spots is scarce, and most of the available literature are species descriptions, taxonomic reviews of specific groups, or national lists (Acosta-Galvis, 2012a).

Deforestation and changes in land-use modify the assembly of amphibian and reptile communities (Castro and Kattan 1991; Garden et al, 2007). The physical transformation of natural environments can cause drastic changes in humidity and temperature, having significant effects in these organisms (Herrera et al. 2004). However, dryland amphibians have several adaptations to survive the lack of water, as the changes in activity patterns and development of wide ranges of dehydration (Thorson 1995; Cuentas et al. 2002).

Moreover, reptiles are more resistant to disturbance as their skin is covered by keratinized scales. Amniotic eggs make reptiles more tolerant to dehydration and sunstroke (Vargas-Salinas and Bolaños 1999). Even so, the canopy cover, leaf litter cover, and understory density are important factors for the establishment and distribution of both taxa, since it can determine the movement patterns of these ectothermic animals (Urbina-Cardona et al. 2006).

Our goal was to determine the diversity of herpetofauna in "La Gloria Project" (Sabanas de San Ángel, Magdalena, Colombia), and assess the characteristics and variations of herpetofaunal communities among the various vegetation coverages (Agroforestry crops—Red Gum, Pink Trumpet Tree, Beechwood, and Teak—native forest, wetlands, and built-up zones [any area inhabited by humans] composing the area).

Materials and Methods

Study site: "La Gloria project" is part of "Reforestadora de la Costa (REFOCOSTA S.A.S.)" organization, within the jurisdiction of the municipality of Sabanas de San Ángel, Magdalena department, 30 km from the county seat (10°10'29.2"N; 74°19'38.052"W) (Fig. 1). The study area includes 7,288 hectares, and corresponds to "zonobioma tropical alternohígrico" (tropical dry forest) proposed by Hernández-Camacho and Sánchez (1992). This locality has a unimodal biseasonal climate with an average annual rainfall of 1,157 mm (Rangel-Ch. and Carvajal-Cogollo 2012). The oldest agroforest is about about 20 years old. Timber is grown in the middle extension of the La Gloria project. The main crop is Teak (*Tectona grandis*) (21% of the total extent of study area), followed by Red Gum (*Eucalyptus tereticornis*) (18%). Also grown to a lesser extent is, Pink Trumpet Tree (*Tabebuia rosea*) (7%) and Beechwood (*Gmelina* sp.) (2%),

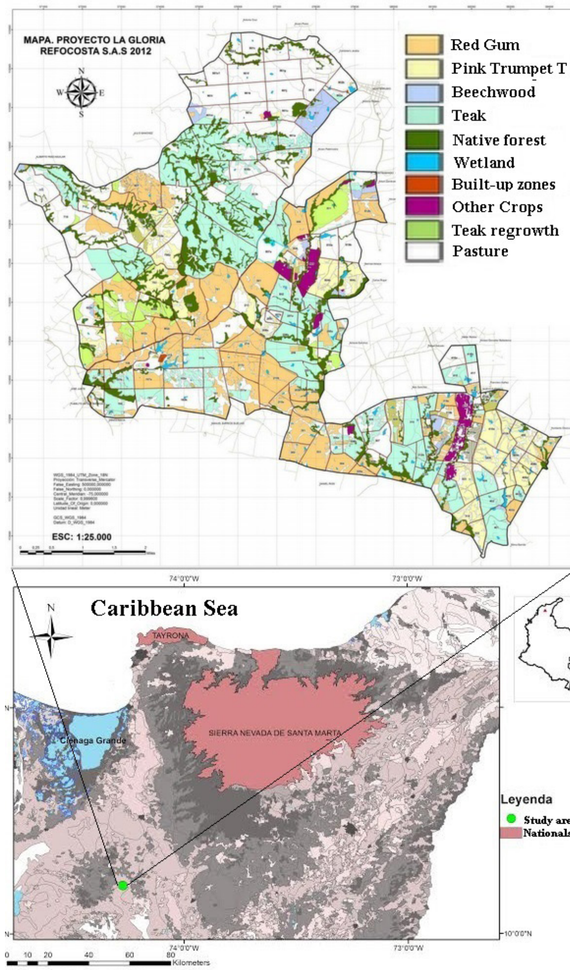

Fig. 1. Map of La Gloria Project (taken and modified from Refocosta 2012). *Map developed by HD Granda-Rodríguez.*

while the remaining 2% consists of other crops. In addition to agroforests, there is an area of regrowth of Teak (5%), pasture (34%), native forest (10%), and wetlands (1%) (Refocosta 2012). There are also small and scattered built-up zones within "La Gloria Project." Surveys for this study were carried out in areas with agroforest, native forests, wetlands, and urbanized sites.

Fieldwork: from March to October of 2012, we made 11 field trips, each one lasting ten days. We used Visual Encounter Surveys (VES) (Crump and Scott 1994). Daily, a single person did random walks for eight hours (09:00–12:00, 14:00–17:00, and 19:00–22:00 h), for a total sampling effort of 880 hours × observer. In addition, we captured cryptic species with terrestrial, semifosorial, and fossorial habits with pitfall traps (Vogt and Hine 1982), eight trap systems per habitat during each survey (56 in total). These traps system consist of two 3.78 liters buckets, and a two m interception net between them. Traps remained open for ten days.

We used a 10% chlorobutanol solution to euthanize all amphibians captured and intrathoracic lidocaine injections for euthanizing reptiles. No turtles or crocodilians were sacrificed for this study. All vouchered specimens were deposited in the Centro de Colecciones Biológicas de la Universidad del Magdalena (CBUMAG:REP and CBUMAG:ANF acronym). The scientific nomenclature used in this contribution is that accepted by Uetz et al. (2014) and Frost (2014).

Data analysis: Relative abundance was calculated as the number of individuals in each sample relative to capture effort, expressed in individuals/hours × observer (RA= Ind/h × obs.) (Lips 1999). Species were qualified according to their relative abundance in "very rare" (VR) if it was observed between 0.1–0.24 individuals per hour × observer; "rare" (R) if it was observed between 0.25–0.49; "common" (C) if it was observed between 0.50–0.74; "abundant" if it was observed between 0.75–0.99; and "very abundant" if it was observed between 1.0 or more (Rueda-Solano and Castellanos-Barliza 2010). Using PRIMER 6 (v 6.1.11) (Clarke and Gorley 2001) we calculated Margalef Richness Index (d), Pielou Uniformity Index (J'), Shannon-Wiener Diversity Index (H'), and Simpson Dominance Index (λ) for each vegetal coverage. We built a Bray-Curtis Similarity Matrix of non-transformed amphibian and reptile abundance data, to generate a nonparametric one-way similarity analysis (ANOSIM) (999 permutations), in order to refute a null hypothesis when there were no significant differences between diversity of amphibians and reptiles among sites. We made dendrograms with the same Bray-Curtis Matrix, to evaluate the similarity among vegetal coverages within the study area; likewise, the similarity between La Gloria project and other localities with published inventories of amphibians and reptiles in the Colombian Caribbean. It should be noted that if the similarity was greater than 50%, it was considered a homogenous cluster. We used the software EstimateS (v 9.1.0) (Coldwell 2013) to create a species accumulation curve from non-parametric qualitative estimators Chao 2, Bootstraps, Jacknife 1, and Jacknife 2 (randomized 999 times for each case) to quantify the representativeness of the sample. We also calculated the unique and duplicates species.

Results and Discussion

Representativeness of survey: Bootstraps, Chao 2, Jacknife 1, and Jacknife 2 estimators show that amphibian survey had representativeness among 24.83% to 28.95%. The Chao 2 curve was only one who got stabilization. The unique and duplicated species were not reduced during the survey (Fig. 2a). Furthermore, the reptile surveys had more representativeness, since the estimators reached among 39.79% to 45.94%. The Chao 2 and Jacknife 2 curve obtained asymptote. In this case, unique and duplicates species neither decreased (Fig. 2b). Jacknife 1 and Jacknife 2 estimators have higher values, suggesting that surveys had a low representativeness in both taxa (Carvajal-Cogollo and Urbina-Cardona 2008). Bootstraps estimator obtained close values with observed species. Taking this as a reliable algorithm to estimate total richness, amphibian and reptile surveys reached a representativeness of 24.83% and 39.79% respectively. A comparison of survey methods used (observational surveys [VES] and trapping) results in a greater number of species and abundance being obtained through VES. (Fig. 3a, b). Using this technique, we detected 92.31%

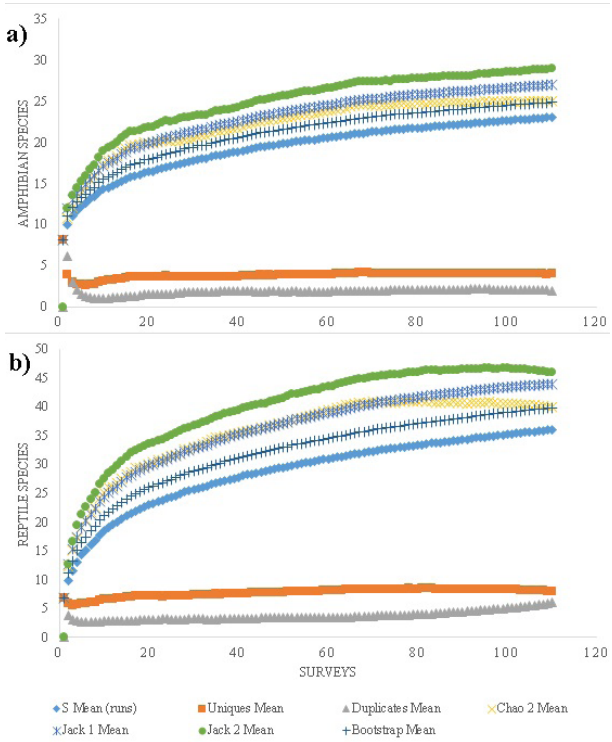

Fig. 2. Cumulative curve species of la Gloria project.

Table 1. Relative abundance = RA, VA = very abundant, A = abundant, C = common, R = rare, VR= very rare, NA = not available, and vegetation coverage, RG = Red Gum, PTT = Pink Trumpet Tree, BW= Beechwood, T = Teak, NF = native forest, WL = wetland, BZ = built-up zones. CBUMAG = Centro de Colecciones Biológicas de la Universidad del Magdalena (ANF = amphibian; REP = reptile).

TAXA	GT	PTT	BW	T	NF	WL	BZ	RA	Voucher
CLASS AMPHIBIA									CBUMAG:ANF
Order Anura									
Family Bufonidae									
Rhinella marina (Linnaeus 1758)	X		X	X	X	X	X	R	699
Rhinella humboldti (Gallardo 1965)	X		X		X	X	X	VR	701
Family Ceratophrydae									
Ceratophrys calcarata (Boulenger 1890)					X			VR	672
Family Hylidae									
Dendropsophus microcephalus (Cope 1886)					X	X		VA	713
Dendropsophus ebraccatus (Cope 1874)						X		VR	00666-67
Hypsiboas pugnax (Schmidt 1857)	X	X			X			VA	00697-8
Hypsiboas crepitans (Wied-Neuwied 1824)					X			VR	30
Scarthyla vigilans (Solano 1971)					X	X		VA	718
Scinax rostratus (Peters 1863)					X	X		VR	00031-32, 49
Scinax "x-signatus" (Spix 1824)	X	X		X	X	X		R	15
Trachycephalus typhonius (Linnaeus 1758)					X	X		VR	696
Phyllomedusa venusta Duellman and Trueb 1967					X			VR	676
Pseudis paradoxa (Linnaeus 1758)						X		VR	
Family Leptodactylidae									
Leptodactylus fuscus (Schneider 1799)	X		X	X	X	X		R	00703-4
Leptodactylus insularum Barbour 1906	X		X		X	X		R	00693, 695, 700
Leptodactylus poecilochilus (Cope 1862)					X	X		VR	348
Leptodactylus fragilis (Brocchi 1877)						X		VR	
Engystomops pustulosus (Cope 1864)	X	X		X	X	X		R	00708, 711, 716
Pleurodema brachyops (Cope 1869)		X		X	X	X		C	00702, 705
Pseudopaludicola pusilla (Ruthven 1916)	X			X	X	X		C	00709, 717
Family Microhylidae									
Elachistocleis panamensis (Dunn, Trapido, and Evans 1948)	X					X		VR	719
Elachistocleis pearsei (Ruthven 1914)	X	X		X	X			VR	00710, 720
Order Gymnophiona									
Family Caecilidae									
Caecilia subnigricans Dunn 1942							X	VR	634
CLASS REPTILIA									CBUMAG:REP
Order Squamata									
Family Sphaerodactylidae									
Gonatodes albogularis (Duméril and Bibron 1836)	X	X	X	X	X			VR	236
Lepidoblepharis sanctaemartae (Ruthven, 1916)				X	X			VR	
Family Gekkonidae									
Hemidactylus frenatus (Duméril and Bibron 1836)							X	VR	237
Family Phyllodactylidae									
Thecadactylus rapicauda (Houttuyn 1782)	X				X			VR	
Family Iguanidae									
Iguana iguana (Linnaeus 1758)					X			VR	
Family Dactyloidae									
Anolis auratus Daudin 1802					X			VR	231

Table 1 (Continued). Relative abundance = RA, VA = very abundant, A = abundant, C = common, R = rare, VR = very rare, NA = not available), and vegetation coverage, RG = Red Gum, PTT = Pink Trumpet Tree, BW = Beechwood, T = Teak, NF = native forest, WL = wetland, BZ = built-up zones. CBUMAG = Centro de Colecciones Biológicas de la Universidad del Magdalena.

TAXA	GT	PTT	BW	T	NF	WL	BZ	RA	Voucher
Family Corytophanidae									
Basiliscus basilicus (Linnaeus 1758)						X		VR	
Family Scincidae									
Maracaiba zuliae (Miralles, Rivas, Bonillo, Schargel, Barros, García-Pérez, and Barrio-Amorós 2009)		X	X	X	X			VR	235
Family Gymnophthalmidae									
Leposoma rugiceps (Cope 1869)		X		X	X			VR	239
Tretioscincus bifasciatus (Duméril 1851)		X	X	X	X			VR	00232-33
Family Teiidae									
Cnemidophorus gaigei Ruthven 1915				X	X			R	
Ameiva praesignis (Baird and Girard 1852)				X	X			R	
Ameiva bifrontata Cope 1862					X			R	
Family Anomalepididae									
Liotyphlops albirostris (Peters 1857)							X	VR	194
Family Boidae									
Boa constrictor Linnaeus 1758					X			VR	
Epicrates maurus Gray 1849					X			VR	234
Family Colubridae									
Chironius spixii (Hallowell 1845)				X	X			VR	120
Tantilla melanocephala (Linnaeus 1758)				X				VR	00208, 210
Leptophis ahaetulla (Linnaeus 1758)					X			VR	10
Family Dipsadidae									
Leptodeira annulata (Linnaeus 1758)				X	X			VR	34
Leptodeira septentrionalis (Kennicott 1859)		X		X	X			VR	
Lygophis lineatus (Linnaeus 1758)	X				X			VR	
Pseudoboa neuwiedii (Duméril, Bibron, and Duméril 1854)				X	X			VR	91
Imantodes cenchoa (Linnaeus 1758)				X	X			VR	16
Thamnodynastes gambotensis Pérez-Santos and Moreno 1989					X	X		NA	232
Thamnodynastes paraguanae Bailey and Thomas 2007					X	X		NA	38
Helicops danieli Amaral 1938						X		VR	128
Oxyrhopus petolarius (Linnaeus 1758)					X			VR	238
Xenodon rabdocephalus (Wied 1824)					X			VR	00170-71
Family Viperidae									
Crotalus durissus Linnaeus 1758					X			VR	
Porthidium lansbergii (Schlegel 1841)				X				VR	74
Bothrops asper (Garman 1883)				X	X			VR	165
Family Elapidae									
Micrurus dissoleucus (Cope 1860)				X				VR	
Order Testudines									
Family Chelidae									
Mesoclemmys dahli (Zangerl and Medem 1957)						X		VR	
Family Emydidae									
Trachemys callirostris (Gray 1855)						X		VR	
Family Testudinidae									
Chelonoidis carbonarius (Spix 1824)		X			X			VR	
Order Crocodylia									
Family Alligatoridae									
Caiman crocodilus (Linnaeus 1758)						X		A	

of amphibian and 68.48% of reptile individuals, respectively. With VES, we recorded 21 amphibian species and 35 reptile species. With this method we recorded 25 exclusive species (10 amphibians and 15 reptiles), that are strictly arboreal or aquatic. Conversely, we captured 7.69% and 31.52% of amphibian and reptile individuals respectively, using pitfall traps. This method recorded 12 amphibian species and 19 reptile species. We only found two fossorial species (*Elachistocleis pearsei* and *Micrurus dissoleucus*) with pitfall traps.

Amphibians: A total of 3,555 individuals, corresponding to two orders, six families, and 23 species (Table 1), were recorded. Anurans found represented five families and 22 species (37% of the total herpetofauna of the area) (Fig 4); a single caecilian specie was encountered (Fig. 4). Forty-two percent (41.8%) of lowland amphibian species occurring in the Colombian Caribbean were observed at La Gloria Project. The absence of expected species is due to a lack of specialized capture methods. For example, *Typhlonectes natans* is rarely observed due to its cryptic aquatic habits despite being distributed throughout the Caribbean region of the upper Magdalena-Cauca River (Tapley and Acosta-Galvis 2010). However, in this study we report the first record of the Clown Treefrog (*Dendropsophus ebraccatus*) in the lower Magdalena River, for which the nearest known distribution is in Rio Manso, Cordoba (Cochran and Goin 1970). In this contribution, we prefer to name *Scinax* "*x-signatus*" instead *Scinax* "*ruber*" (as was known previously Renjifo and Lundberg 1999; Cuentas et al. 2002). This is due to unresolved controversy regarding its taxonomy and biogeography (Barrio-Amorós 2004; Acosta-Galvis et al. 2006; Barrio-Amorós et al. 2011; Acosta-Galvis et al. 2012a). Following Rivero's (1969) criteria, the absence of dark dorsolateral lines and head equally long as wide place the collected specimens within the *x-signatus* and *ruber* groups.

Reptiles: We recorded 1,088 specimens corresponding to three orders, 19 families, and 37 species (Table 1). The most diverse order was Squamata with 15 families and 32 species, the suborder Lacertilia was the richest with nine families and 13 species, 20% of the total herpetofauna of the area. The suborder Serpentes represented six families and 20 species (34%). We observed three families and three species of turtles (5%) and recorded one crocodilian species (2%) (Fig. 3). La Gloria Project harbors 21.8% of lowlands reptile species of the Colombian Caribbean. We found three endemic species from Colombia, *Helicops danieli*, *Thamnodynastes gambotensis*, and *M. dahli*, the latter with restricted distribution in the Colombian Caribbean (Rossman 2002; Bailey and Thomas, 2007; Carvajal-Cogollo et al. 2012; Forero-Medina et al. 2013). The presence of *M. dahli* in the study area was unexpected, as species distribution models by Forero-Medina et al. (2012) propose a low probability of occurrence within this region. However, this area has many first-order streams with abundant riverine vegetation, throughout native forests and agroforests, habitat characteristics of this species (Forero-Medina et al. 2011; Montes-Correa et al. 2014).

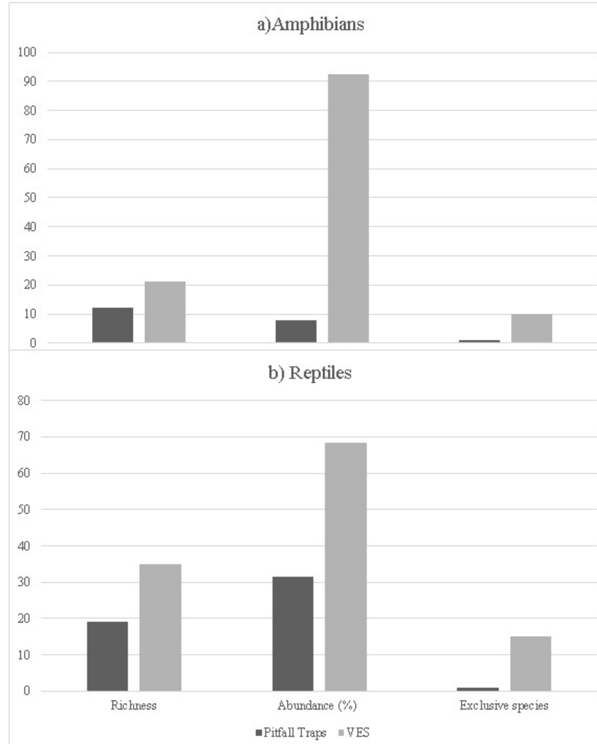

Fig. 3. Comparisons between the methods used for herpetofauna recording and capturing.

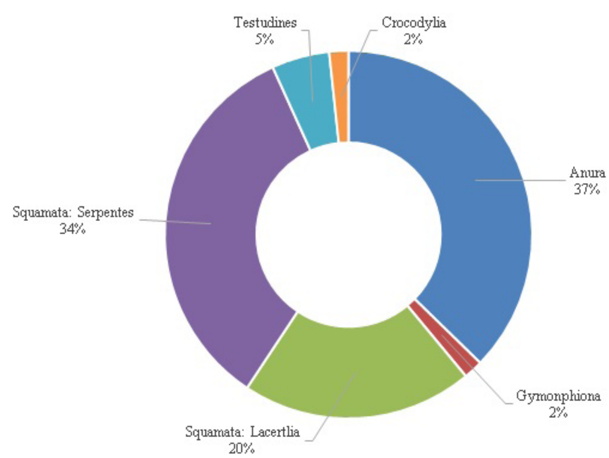

Fig. 4. Herpetofauna composition percentage in la Gloria Project.

In addition, we report the first record of *Maracaiba zuliae* in the lower Magdalena River, an expansion of its currently known distribution. This species was recently reported in Colombia in Reserva Forestal Protectora Montes de Oca, La Guajira state (Galvis et al. 2011). Several records by Ruthven (1922) in the Barbacoas River, the Arenas Stream, and Las Pavas must correspond with this recently described species. Likewise, we report the first record of *Thamnodynastes paraguanae* in the region. In Colombia, this snake is only known from La Gu-

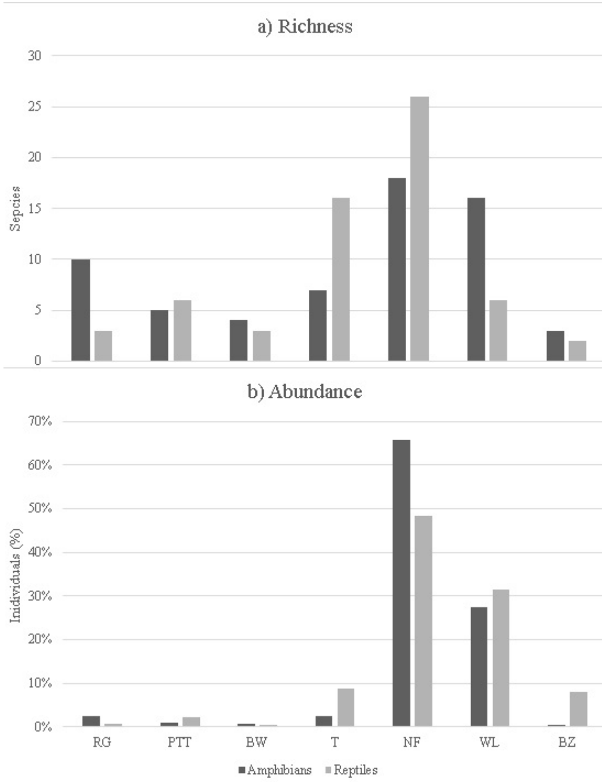

Fig. 5. Richness (a) and abundance (b) of amphibians and reptiles between habitats (RG = Red Gum, PTT = Pink Trumpet Tree, BW = Beechwood, T = Teak, NF = native forest, WL = wetland; BZ = built-up zones).

ajira: Uribia, Riohacha, and Reserva Forestal Protectora Montes de Oca (Bailey and Thomas 2007; Galvis et al. 2011). We must clarify that while the fieldwork was developed, snakes of *Thamnodynastes* genus were treated as one species, and they are not included in this analysis because their relative abundance is not available.

Richness and abundance patterns: in La Gloria Project, the native forest was the habitat that hosted the greatest number of species (Fig. 5a), 18 amphibians and 26 reptiles. The wetlands were the second habitat in amphibian composition, while the Teak agroforest was second in number of reptiles. Remaining habitats had less or equal to 10 species, both for amphibians and reptiles. We verified the greatest abundance in native forest (Fig. 5b), as 65.63% of amphibians and 48.35% of reptiles were detected in this habitat. All non-natural habitats scored an abundance below 10%. Some studies show that abundance patterns of natural and non-natural environments are similar (Gardner et al. 2007; Carvajal-Cogollo and Urbina-Cardona et al. 2008). Over time, composition and abundance tend to homogenize by dominance of the generalist species that displace more sensitive species for their lower habitat requirements and increased tolerance to disturbance (Offerman et al, 1995; Laurance et al. 2002). Surely, La Gloria Project does not present homogenization because agroforests are very recent. Regarding the qualitative relative abundance in amphibians, we observed three very abundant species, two common, five rare, and 13 very rare. *Dendropsophus microcephalus*, *Scarthyla vigilans*, and *Hypsiboas pugnax* were the most abundant amphibians, while *Caecilia subnigricans* is represented by a single individual. Moreover, in reptiles we observed one abundant species, three rare, 31 very rare, and two not available. The most abundant species of reptiles were *Caiman crocodilus*, *Ameiva bifrontata*, and *Ameiva praesignis*. Furthermore, *Mesoclemmys dahli* and *Micrurus dissoleucus* were observed for a single individual. Similarly, other studies of tropical dry forest herpetofauna, found over half species had low relative abundance (Rueda-Solano and Castellanos-Barliza 2010; Pedroza-Banda and Angarita-Sierra 2011). In addition, snakes present a lower detection, possibly due to their cryptic habits or low abundance. *Leptodeira annulata* and *Leptodeira septentrionalis* were the most common snakes throughout the study area, supporting Scott and Seigel (1992) and Dodd (1993) hypotheses, where small sized snakes are more tolerant to disturbance, therefore, possibly more abundant. As to the community attributes (Table 2), native forest had the highest Margalef Richness and Shannon-Wiener Diversity for amphibians and reptiles and Beechwood agroforest had the greatest Pielou Uniformity Value. For these three attributes, built-up areas showed the lower values, however, this habitat had dominance for the highest values. In this study, the higher value of Margalef Richness, Shannon-Wiener Diversity, and Pielou Uniformity created higher values obtained for the coverage of floristic and structural complexity. A similar pattern was observed in Zapatosa region by Medina-Rangel (2011).

Habitat comparisons and herpetofaunal autoecology: ANOSIM determined there are global composition and abundance differences between seven evaluated habitats (p-value = 0.502). However, there are specific differences between Red Gum agroforest and Pink Trumpet Tree agroforest (*p*-value = 0.006), Red Gum and Beechwood (*p*-value = 0.038), Red Gum and Teak (*p*-value = 0.161), Pink Trumpet Tree and Beechwood (*p*-value = 0.068), Pink Trumpet Tree and Teak (*p*-value = 0.012), and Beechwood and Teak (*p*-value = 0.357). These similarities among agroforests are due to sharing among pioneer and generalist species that are able to tolerate conditions imposed by the new environment (Luja et al. 2008), e.g., Nest-building Frogs (*Leptodactylus*) (Heyer 1969). Some of these can be considered as common colonizers (see also, Dueñez-Gómez et al. 2004).

In La Gloria Project, the herpetofauna composition was quite heterogeneous, thus, all clusters were below 50% similarity (Fig 6). The more similar habitats were the Teak and Pink Trumpet Tree (48.5% similarity). Likewise, native forests and wetlands have a cluster (42.6%) and Beechwood and Red Gum agroforest an-

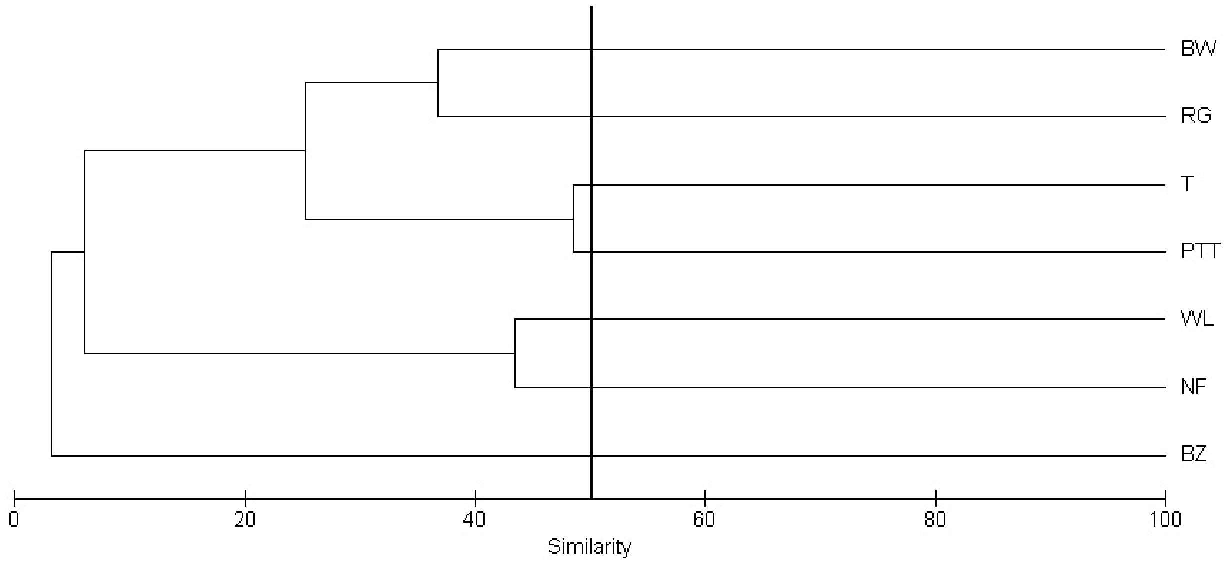

Fig. 6. Bray-Curtis similarity dendrogram between habitats in la Gloria Project (RG = Red Gum, PTT = Pink Trumpet Tree, BW = Beechwood, T = Teak, NF = native forest, WL = wetland; BZ = built-up zones).

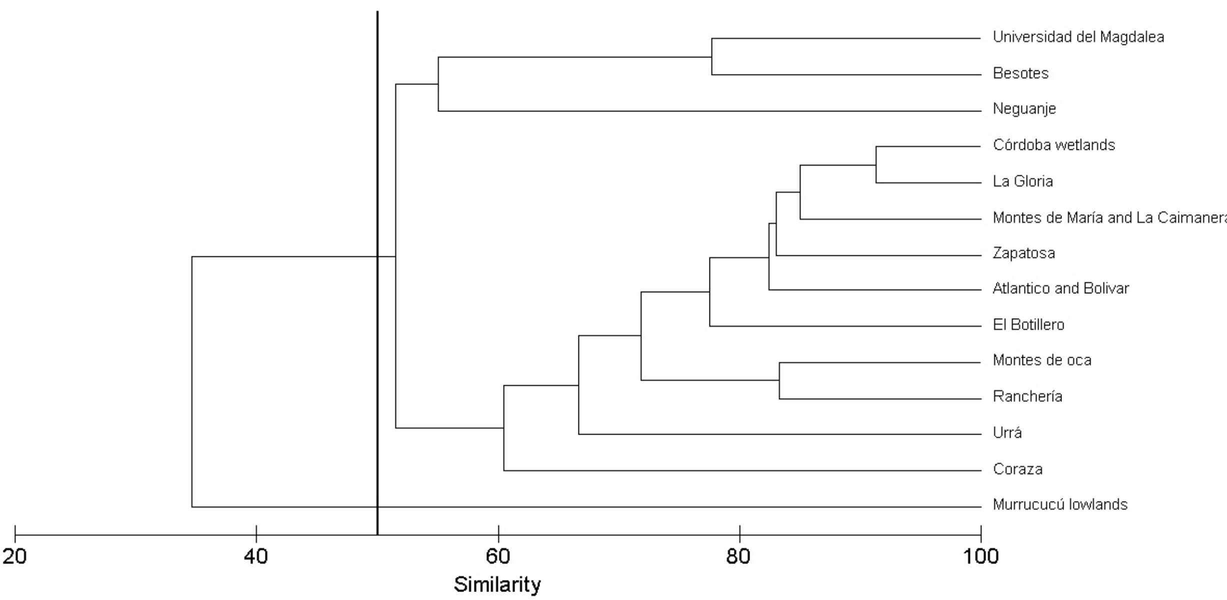

Fig. 7. Similarity of amphibian richness between La Gloria project and others inventories in Caribbean lowlands. Humedales del Córdoba (Romero-Martínez and Lynch 2010); Montes de María and Ciénaga la Caimanera (Acosta-Galvis 2012b); El Botillero (Dueñez-Gómez et al. 2004); Ciénaga del Zapatosa (Medina-Rangel et al. 2011); Atlántico and north Bolivar (Cuentas et al. 2002); Montes de Oca (Galvis et al. 2011); Ranchería (Blanco-Torres et al. 2013); Urrá (Renjifo and Lundberg 1999); Los Besotes (Rueda-Almonacid et al. 2011a); Serranía de Coraza (Galván-Guevara and de la Ossa-Velásquez 2009); Universidad del Magdalena (Montes-Correa et al. 2015); Ensenada Neguanje (Rueda-Solano and Castellanos-Barliza 2010); Cerro de Murrucucú lowlands (Romero-Martínez et al. 2008).

other (36.8%). The more dissimilar habitat is the built-up zone with 3.1% similarity with respect to other habitats.

The species with greater frequency of occurrence was *Rhinella marina*, which was present in six of the seven evaluated habitats. This species has ecological plasticity and is able to tolerate highly degraded environments, including benefiting from human activities (Zug and Zug 1979). On the other hand, we found 28 exclusive species from a single cover. For example, *Pseudis paradoxa*, *Caiman crocodilus*, and *Trachemys callirostris* are strictly aquatic species and only found in wetlands. The exclusivity of *Hemidactylus frenatus* is due to its strong synanthropy (Caicedo-Portilla and Dulcey-Cala 2011). *Phyllomedusa venusta* and *Trachycephalus typhonius* were exclusive of native forests, since these organisms have behavioral adaptations to tolerate prolonged drought in these habitats (Cuentas et al. 2002).

The richness and abundance of amphibians in La Gloria project was higher in native forests and their nearby wetlands. Moreover, in the Red Gum agroforest, amphibian richness and abundance was lower due to the sparse canopy of this tree which allows more sunlight to reach the forest floor, similar to what Gardner et al. (2007) reported for Brazil. In Indonesia, Wanger et al. (2009)

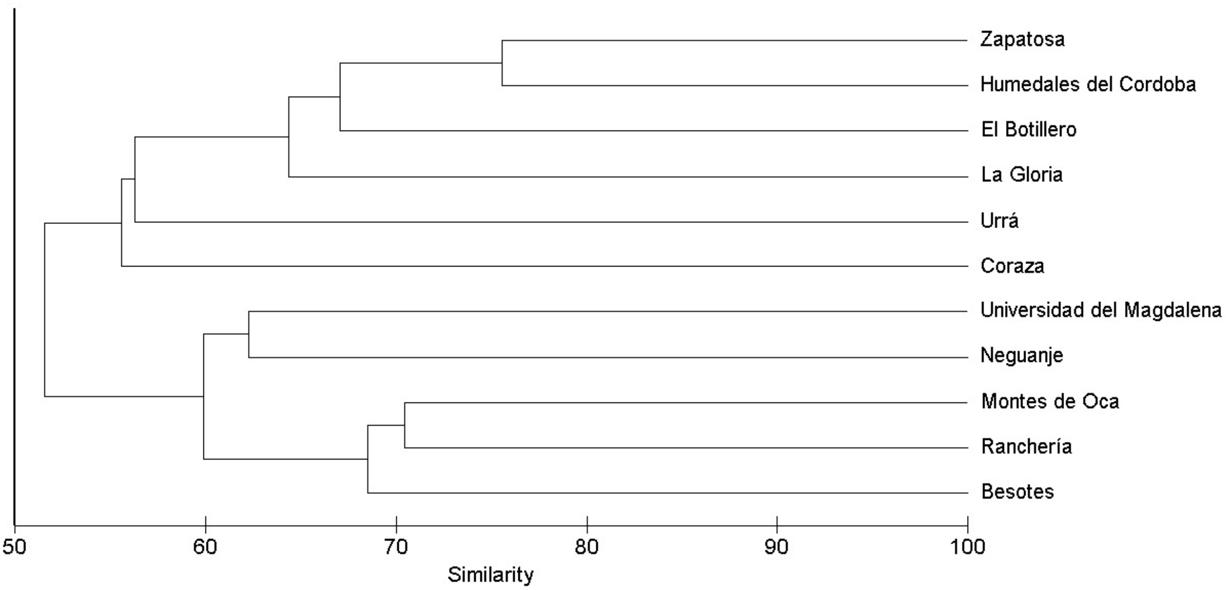

Fig. 8. Similarity of reptile richness between La Gloria project and others inventories in Caribbean lowlands. Humedales del Córdoba (Carvajal-Cogollo et al. 2); El Botillero (Dueñez-Gómez et al. 2004); Ciénaga del Zapatosa (Medina-Rangel et al. 2011); Montes de Oca (Galvis et al. 2011); Ranchería (Blanco-Torres et al. 2013); Urrá (Renjifo and Lundberg 1999); Los Besotes (Rueda-Almonacid et al. 2011b); Serranía de Coraza (Galván-Guevara and de la Ossa-Velásquez 2009); Universidad del Magdalena (Montes-Correa et al. 2015); Ensenada Neguanje (Rueda-Solano and Castellanos-Barliza 2010).

found that amphibians are more abundant in native rainforests than in Cacao Tree agroforest. In Gorgona Island, amphibians were more abundant in little disturbed rainforests than in palm cultivation (Urbina-Cardona and Londoño-Murcia 2003). On the other hand, in mountain rainforest, amphibian composition and abundance were higher in open areas that agroforest and native forests (Hoyos-Hoyos et al. 2012).

Canopy coverage may not be as important to some reptiles. Wanger et al. (2009) found that reptile richness and abundance was similar in Cacao Tree agroforest, native rainforests and open areas, and even these showed greater richness in open areas than in native rainforests. In Gorgona Island, reptile richness was higher in secondary forests; nevertheless, were more abundant in disturbed areas than in primary forests (Urbina-Cardona and Londoño 2003). In La Gloria project, the reptile richness was higher in native forests, although we recorded several species in agroforests, mainly in Teak; this because large leaves of this tree generate heavy shade and leaf-litter layers able to generate favorable microclimatic conditions for herpetofaunal establishment. In other agroforest reptile composition and abundance was low due to thin canopy cover and insufficient leaf-litter depth. In the case of Red Gum agroforest, the leaf-litter layer is very poor, as this tree is perennial. Changes of leaf-litter dynamics can alter amphibian and reptile assembly (Whitfield et al. 2014).

In La Gloria project, there are typical species of forest formations, but not necessarily exclusive of native forest. For example, *Lepidoblepharis sanctaemartae* occurred in native forest and Teak agroforest, being slightly more abundant in the native forest; *L. sanctaemartae*, as other small leaf-litter geckos, requires a leaf-litter layer containing humidity and little light penetration through the canopy, because of their passive thermoregulatory strategy (Vitt et al. 2005). Because of this aspect, *L. sanctaemartae* was not present in Red Gum agroforest. This species is a good model of Garden et al. (2007) hypotheses, since a dense canopy and a humid leaf-litter layer are more important for this species persistence than forest vegetation composition. Therefore, *L. sanctaemartae* is abundant both in preserved native forests as agroforest with sufficient coverage canopy and leaf-litter humidity (Montes-Correa pers. obs.).

The tortoise *Chelonoidis carbonarius* was present almost exclusively in native forest, where there is available fruit, which makes up much of their diet (Rueda-Almonacid et al. 2007). A single individual was recorded in Pink Trumpet Tree agroforest, feeding on flowers of this tree in breeding season, which are also an important part of their diet (Moskovits and Bjorndal 1990). We did not find this species in other agroforests since the timber cultivation does not offer alimentary resources. The slider turtle *Trachemys callirostris* was more abundant in wetlands with open areas on its banks, as these offered sites for nesting (Moll and Legler 1971).

The Spectacled caiman (*C. crocodilus*) was very abundant, being present in all wetlands in the zone. The low metabolic rate and generalist feeding habits allow them to maintain populations in areas with small and disperse wetlands (Castro-Herrera et al. 2013). Likewise, it is possible that the extermination of *Crocodylus acutus* in the lower Magdalena River has favored the increasing

Table 2. Attributes of amphibians and reptiles communities in the habitats of La Gloria project (d = Margalef richness, J' = Pielou Uniformity, H' = Shannon-Wiener Diversity, λ = Simpson Dominance).

		Red Gum	Pink Trumpet Tree	Beechwood	Teak	Native Forest	Wetlands	Built-up Zone
Amphibians	d	2.03	1.11	0.92	1.33	2.19	2.18	0.8
	J'	0.85	0.81	0.93	0.77	0.68	0.55	0.75
	H'	0.85	0.57	0.56	0.65	0.85	0.67	0.36
	λ	0.17	0.31	0.3	0.27	0.2	0.32	0.51
Reptiles	d	0.96	1.55	1.12	3.3	3.83	0.69	0.22
	J'	0.82	0.92	0.92	0.84	0.7	0.23	0.31
	H'	0.39	0.72	0.44	1.01	0.98	0.16	0.09
	λ	0.47	0.21	0.39	0.12	0.17	0.85	0.89

populations of *C. crocodilus*. A similar situation occurred in Venezuelan Llanos with *Crocodylus intermedius* extermination (Medem 1981).

Compared to other inventory studies in the Colombian Caribbean lowlands. La Gloria project presented similarity in richness of amphibians with other inventory studies in areas with abundant wetlands (Fig. 6); it showed the highest similarity with the Humedales del Córdoba (Romero and Lynch 2010) (85.7% similarity). Although they agreed in many lowlands species, forest formations are scarce in Córdoba Wetlands, thus, in La Gloria project forest species such as *Phyllomedusa venusta* were present, while in Córdoba Wetlands it was not reported. There is another great cluster with the localities of La Guajira. Studies made in Urrá (Renjifo and Lundberg, 1999), Coraza (Galván-Guevara and de la Ossa-Velásquez 2009), and Murrucucú (Romero et al. 2008) suggest the area of influence of the Sinú River has many common elements with the Cordillera Occidental, biogeographic Chocó, and Central America. (v. gr. *Colostethus pratti*, *Strabomantis bufoniformis*, *Bolitoglossa biseriata*, and *Oscaecilia polizona*). Clustering between Neguanje (Rueda-Solano and Castellanos-Barliza 2010), and Universidad del Magdalena (Montes-Correa et al. 2015) and Besotes (Rueda-Almonacid et al. 2008a) is due to the typical elements of tropical dry forest and the Sierra Nevada de Santa Marta (as *Colostethus ruthveni*, *Cryptobatrachus boulengeri*, and *Allobates* sp.).

In reptiles, La Gloria project is very similar to other areas of lowlands with wetlands, presenting the most similarity between Humedales del Córdoba (Carvajal-Cogollo et al. 2007) and Ciénaga del Zapatosa (Medina-Rangel et al. 2011) (69.8% similarity) (Fig. 7). This evident clustering of the lowlands is very similar to the localities in La Guajira but differs from typical elements from northeastern Caribbean, as *Gonatodes vittatus*, *Bachia talpa*, and *Thamnodynastes paraguanae*. The western regions are very dissimilar to La Gloria project by having typical elements of biogeographic Chocó, as *Chelydra acutirostris* and *Anolis vittigerus* (Medem 1977; Castro-Herrera and Vargas-Salinas 2008).

Conclusions

This study shows that communities of amphibians and reptiles are affected by structural changes in forests, since cultivated timber does not provide the necessary microhabitats to sustain many elements of herpetofauna species. The introduction of agroforests results in alterations of the spatial distribution of species, restricting them to small remnants of native forest.

A greater problem of studies of amphibians and reptiles in the Colombian Caribbean is that the predominant information is unpublished literature and the methodologies unclear (Blanco-Torres et al. 2013). This study contributes to the state of knowledge of amphibian and reptile richness in the lower Magdalena River, providing three new records for the region and establishes a list from a standardized inventory.

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Appendix I. Amphibian Caribbean lowlands inventories used for Bray-Curtis Similarity Analyses. A = La Gloria Project; B = El Botillero (Dueñez-Gómez et al. 2004); C = Ensenada Neguanje (Rueda-Solano and Castellanos-Barliza 2010); D = Medio Ranchería (Blanco-Torres et al. 2013); E = Reserva Forestal Protectora Montes de Oca (Galvis et al. 2011); F = Serranía de Coraza (Galván-Guevara and De la Ossa-Velásquez 2011); G = los Montes de María y la Ciénaga La Caimanera (Acosta-Galvis 2012b); H = Represa de Urrá (Renjifo and Lundberg 1999); I = Murrucucú lowlands (sensu Romero-Martínez et al. 2008); J = Humedales del Córdoba (Romero-Martínez and Lynch 2010); K = Atlántico and North Bolívar (Cuentas et al. 2002); L = Santuario de Vida Silvestre Los Besotes (Rueda-Almonacid et al. 2008a); M = Ciénaga del Zapatosa (Medina-Rangel et al. 2011); N = Universidad del Magdalena (Montes-Correa et al. 2015).

Species	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Rhinella humboldti	1	1	0	1	1	1	1	1	0	1	1	1	1	1
Rhinella margaritifera	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Rhinella marina	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rhinella sternosignata	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Rhaebo haematiticus	0	0	0	0	0	1	0	1	0	0	0	0	0	0
Hyalinobatrachium collymbiphyllum	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Hyalinobatrachium fleischmanni	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Ceratophrys calcarata	1	1	0	1	1	1	1	1	0	1	1	1	1	0
Craugastor raniformis	0	0	0	0	0	0	1	1	1	1	1	0	1	0
Pristimantis taeniatus	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Pristimantis viejas	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Strabomantis bufoniformis	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Eleutherodactylus johnstonei	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Colostethus pratti	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Colostethus ruthveni	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Dendrobates truncatus	0	0	1	0	0	1	1	1	1	1	1	0	1	0
Cryptobatrachus boulengeri	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Dendropsophus ebraccatus	1	0	0	0	0	0	0	1	0	1	0	0	0	0
Dendropsophus microcephalus	1	1	0	1	1	1	1	1	0	1	1	0	1	0
Hypsiboas boans	0	0	0	0	0	1	0	1	1	0	1	0	1	0
Hypsiboas crepitans	1	1	1	0	1	0	1	0	0	1	1	1	1	0
Hypsiboas pugnax	1	0	1	1	1	1	1	1	1	1	1	1	1	1
Hypsiboas rosenbergi	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Phyllomedusa venusta	1	1	0	0	0	0	1	1	1	0	1	1	0	0
Pseudis paradoxa	1	1	0	0	0	0	1	1	0	1	1	0	0	0
Scarthyla vigilans	1	1	0	1	0	1	1	1	0	1	1	0	0	0
Scinax boulengeri	0	0	0	0	0	0	0	1	0	0	1	0	0	0
Scinax elaeochrous	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Scinax rostratus	1	1	0	0	0	0	1	0	0	1	0	0	1	0
Scinax ruber	0	1	0	1	1	1	1	1	1	1	1	0	0	0
Scinax x-signatus	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Smilisca phaeota	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Smilisca sila	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Trachycephalus typhonius	1	0	0	1	1	1	1	1	0	1	1	0	1	0
Engystomops pustulosus	1	1	1	1	1	0	1	1	1	1	1	1	1	1
Pleurodema brachyops	1	1	1	1	1	0	1	1	0	1	1	1	1	1
Pseudopaludicola pusilla	1	1	0	1	1	0	1	1	0	1	1	0	1	0
Leptodactylus colombiensis	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Leptodactylus fragilis	1	1	1	1	0	0	1	1	0	1	1	0	1	0
Leptodactylus fuscus	1	1	0	1	1	1	1	1	0	1	1	1	1	1
Leptodactylus insularum	1	1	1	1	1	1	1	1	0	1	1	1	1	1
Leptodactylus poecilochilus	1	1	0	1	1	0	1	0	1	1	1	1	1	0

Appendix I (Continued). Amphibian Caribbean lowlands inventories used for Bray-Curtis Similarity Analyses. A = La Gloria Project; B = El Botillero (Dueñez-Gómez et al. 2004); C = Ensenada Neguanje (Rueda-Solano and Castellanos-Barliza 2010); D = Medio Ranchería (Blanco-Torres et al. 2013); E = Reserva Forestal Protectora Montes de Oca (Galvis et al. 2011); F = Serranía de Coraza (Galván-Guevara and De la Ossa-Velásquez 2011); G = los Montes de María y la Ciénaga La Caimanera (Acosta-Galvis 2012b); H = Represa de Urrá (Renjifo and Lundberg 1999); I = Murrucucú lowlands (sensu Romero-Martínez et al. 2008); J = Humedales del Córdoba (Romero-Martínez and Lynch 2010); K = Atlántico and North Bolívar (Cuentas et al. 2002); L = Santuario de Vida Silvestre Los Besotes (Rueda-Almonacid et al. 2008a); M = Ciénaga del Zapatosa (Medina-Rangel et al. 2011); N = Universidad del Magdalena (Montes-Correa et al. 2015).

Species	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Leptodactylus savagei	0	0	0	0	0	0	0	1	1	0	1	0	0	0
Lithodites lineatus	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Elachistocleis panamensis	1	0	1	1	1	0	0	1	0	1	1	0	1	0
Elachistocleis pearsei	1	0	0	0	0	1	1	1	0	1	1	0	1	0
Pipa parva	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Lithobates vaillanti	0	0	0	0	1	0	0	1	0	0	1	1	1	0
Caecilia isthmica	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Caecilia caribea	1	0	0	0	0	0	0	0	0	0	1	0	0	0
Caecilia subnigricans	0	0	0	0	0	0	0	1	0	1	0	0	0	0
Oscaecilia polyzona	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Typhlonectes natans	0	1	0	0	0	1	1	1	0	1	0	0	0	0
Bolitoglossa biseriata	0	0	0	0	0	1	0	1	1	0	0	0	0	0

Appendix II. Reptile Caribbean lowlands inventories used for Bray-Curtis Similarity Analyses. A = La Gloria Project; B = El Botillero (Dueñez-Gómez et al. 2004); C = Ensenada Neguanje (Rueda-Solano and Castellanos-Barliza 2010); D = Medio Ranchería (Blanco-Torres et al. 2013); E = Reserva Forestal Protectora Montes de Oca (Galvis et al. 2011); F = Serranía de Coraza (Galván-Guevara and De la Ossa-Velásquez 2011); G = Represa de Urrá (Renjifo and Lundberg 1999); H = Humedales del Córdoba (Carvajal-Cogollo et al. 2007); I = Santuario de Vida Silvestre Los Besotes (Rueda-Almonacid et al. 2008b); J = Ciénaga del Zapatosa (Medina-Rangel et al. 2011); K = Universidad del Magdalena (Montes-Correa et al. 2015).

Species	A	B	C	D	E	F	G	H	I	J	K
Amphisbaena alba	0	0	0	0	1	0	0	0	1	0	0
Amphisbaena fuliginosa	0	0	0	0	1	0	0	0	1	0	0
Amphisbaena medemi	0	0	0	1	0	0	0	0	1	0	0
Gonatodes albogularis	1	1	1	1	1	1	1	1	1	1	1
Gonatodes vittatus	0	0	0	1	1	0	0	0	0	0	0
Lepidoblepharis sanctaemartae	1	0	1	1	1	0	0	1	1	1	1
Sphaerodactylus heliconiae	0	0	0	0	0	0	0	0	0	1	0
Phyllodactylus ventralis	0	0	1	1	1	0	0	0	2	0	1
Thecadactylus rapicauda	1	1	1	1	1	0	1	1	0	1	1
Hemidactylus brookii	0	0	1	1	1	1	1	1	1	0	1
Hemidactylus frenatus	1	0	0	0	1	0	0	0	0	1	1
Basiliscus basilicus	1	1	0	1	1	1	1	1	0	1	0
Basiliscus galeritus	0	0	0	0	0	0	0	1	0	0	0
Corytophanes cristatus	0	0	0	0	0	0	1	0	0	0	0
Anolis auratus	1	1	1	1	1	1	1	1	1	1	1
Anolis biporcatus	0	0	0	0	1	0	0	0	0	0	0
Anolis pentaprion	0	0	0	0	0	0	1	0	0	0	0
Anolis onca	0	0	0	0	1	0	0	0	0	0	0
Anolis tropidogaster	0	0	0	0	1	0	1	1	0	1	0
Anolis vittigerus	0	0	0	0	0	1	0	1	0	0	0
Iguana iguana	1	1	1	1	1	1	1	1	1	1	1
Polychrus marmoratus	0	0	1	1	1	0	0	0	1	1	0
Stenocercus erythrogaster	0	0	1	0	1	0	0	0	1	1	0
Maracaiba zuliae	1	0	0	0	1	0	0	0	0	0	0
Mabuya sp.	0	1	1	1	0	1	1	1	1	1	0
Bachia bicolor	0	0	1	0	0	0	0	0	0	1	1
Bachia talpa	0	0	0	1	1	0	0	0	1	0	0
Gymnophthalmus speciosus	0	0	0	1	1	0	0	1	1	1	1
Leposomoma rugiceps	1	1	1	0	0	0	1	1	0	1	0
Tretioscincus bifasciatus	1	1	1	1	1	0	0	1	1	1	1
Ameiva praesignis	1	1	1	1	1	1	1	1	1	1	1
Ameiva bifrontata	1	0	1	1	1	0	0	0	0	0	1
Cnemidophorus lemniscatus	1	1	1	1	1	1	1	1	1	1	1
Holcosus festivus	0	0	0	0	0	1	1	1	0	1	0
Tupinambis teguixin	0	1	0	1	1	1	1	1	1	1	0
Liotyphlops albirostris	1	0	1	1	1	1	1	1	0	0	1
Epictia goudotii	0	0	0	1	0	0	0	0	1	0	1
Trilepida macrolepis	0	0	0	0	0	0	1	0	0	0	0
Trilepida dugandi	0	0	0	0	0	0	0	0	1	0	0
Boa constrictor	1	1	1	1	1	1	1	1	1	1	1
Corallus batesi	0	0	0	0	0	0	1	1	0	0	0
Corallus ruschenbergerii	0	0	1	1	1	1	1	1	0	1	0
Epicrates maurus	1	1	0	1	1	1	1	1	0	1	0
Chironius carinatus	1	0	0	0	1	1	1	1	0	1	0

Appendix II (continued). Reptile Caribbean lowlands inventories used for Bray-Curtis Similarity Analyses. A = La Gloria Project; B = El Botillero (Dueñez-Gómez et al. 2004); C = Ensenada Neguanje (Rueda-Solano and Castellanos-Barliza 2010); D = Medio Ranchería (Blanco-Torres et al. 2013); E = Reserva Forestal Protectora Montes de Oca (Galvis et al. 2011); F = Serranía de Coraza (Galván-Guevara and De la Ossa-Velásquez 2011); G = Represa de Urrá (Renjifo and Lundberg 1999); H = Humedales del Córdoba (Carvajal-Cogollo et al. 2007); I = Santuario de Vida Silvestre Los Besotes (Rueda-Almonacid et al. 2008b); J = Ciénaga del Zapatosa (Medina-Rangel et al. 2011); K = Universidad del Magdalena (Montes-Correa et al. 2015).

Species	A	B	C	D	E	F	G	H	I	J	K
Coluber mentovarius	0	0	0	0	1	0	0	0	0	0	0
Dendrophidion bivittatus	0	0	0	0	0	1	1	0	0	0	0
Dendrophidion percarinatus	0	0	0	0	0	0	1	0	0	0	0
Drymarchon caudomaculatus	0	0	0	1	0	0	0	0	0	0	0
Drymarchon melanurus	0	0	0	0	1	0	0	0	1	0	0
Leptophis ahaetulla	1	0	0	1	1	1	0	1	1	1	0
Mastigodryas boddaertii	0	0	0	1	1	0	1	0	1	0	1
Mastigodryas pleei	0	1	1	1	1	0	1	1	1	1	0
Oxybelis aeneus	0	1	1	1	1	1	1	0	0	1	1
Oxybelis fulgidus	0	0	1	0	1	0	0	0	1	0	0
Pliocercus euryzonus	0	0	0	0	0	0	1	0	0	0	0
Pseustes poecilonotus	0	0	0	0	0	0	1	0	0	0	0
Pseustes shropshieri	0	0	0	0	0	0	1	0	0	0	0
Spillotes pullatus	0	1	0	1	0	1	1	1	1	1	0
Stenorrhina degenhardtii	0	0	0	0	0	0	1	0	0	0	0
Tantilla melanocephala	1	0	0	0	1	0	0	1	1	0	1
Tantilla semicincta	0	0	0	1	1	0	0	0	1	0	1
Clelia Clelia	0	0	0	0	1	1	1	1	1	0	0
Enulius flavitorques	0	0	0	0	1	0	0	1	1	1	1
Erythrolamprus melanotus	0	0	0	1	1	0	1	1	1	0	0
Erythrolamprus bizona	0	0	0	0	0	0	0	0	1	0	0
Helicops danieli	1	1	1	0	0	1	1	1	0	1	0
Imantodes cenchoa	1	0	0	0	1	1	1	0	1	1	0
Leptodeira annulata	1	0	1	1	1	0	0	1	1	0	1
Leptodeira septentrionalis	1	1	0	0	0	1	0	0	0	1	1
Lygophis lineatus	1	0	0	0	1	1	1	1	1	1	0
Ninia atrata	0	0	0	0	0	0	1	0	0	0	0
Oxyrhopus petolarius	1	0	0	0	1	0	1	0	0	0	0
Phimophis guianensis	0	1	1	1	1	0	0	0	1	1	1
Pseudoboa neuwiedii	1	1	1	1	1	0	1	1	0	1	0
Sibon nebulatus	0	0	0	0	1	0	1	0	0	0	0
Thamnodynastes paraguanae	1	0	0	1	1	0	0	0	0	0	0
Thamnodynastes gambotensis	1	1	0	0	0	0	1	1	0	1	0
Xenodon severus	0	0	0	1	1	0	0	0	0	0	0
Xenodon rabdocephalus	1	0	0	0	1	0	0	0	0	0	0
Micrurus camilae	0	0	0	0	0	0	1	0	0	0	0
Micrurus dissoleucus	1	0	0	1	1	0	1	0	1	0	1
Micrurus dumerili	0	0	0	0	1	0	0	1	1	0	0
Bothriechis schlegelii	0	0	0	0	0	0	1	0	0	0	0
Bothrops asper	1	1	1	0	1	0	1	1	1	1	0
Crotalus durissus	1	0	1	1	1	0	0	0	1	1	1
Porthidium lansbergii	1	1	1	1	1	0	0	1	1	1	1
Porthidium nasutum	0	0	0	0	0	0	1	0	0	0	0
Mesoclemmys dahli	1	0	0	0	0	0	0	1	0	1	0

Appendix II (continued). Reptile Caribbean lowlands inventories used for Bray-Curtis Similarity Analyses. A = La Gloria Project; B = El Botillero (Dueñez-Gómez et al. 2004); C = Ensenada Neguanje (Rueda-Solano and Castellanos-Barliza 2010); D = Medio Ranchería (Blanco-Torres et al. 2013); E = Reserva Forestal Protectora Montes de Oca (Galvis et al. 2011); F = Serranía de Coraza (Galván-Guevara and De la Ossa-Velásquez 2011); G = Represa de Urrá (Renjifo and Lundberg 1999); H = Humedales del Córdoba (Carvajal-Cogollo et al. 2007); I = Santuario de Vida Silvestre Los Besotes (Rueda-Almonacid et al. 2008b); J = Ciénaga del Zapatosa (Medina-Rangel et al. 2011); K = Universidad del Magdalena (Montes-Correa et al. 2015).

Species	A	B	C	D	E	F	G	H	I	J	K
Podocnemis lewyana	0	0	0	0	0	0	1	0	0	1	1
Chelydra acutirostris	0	0	0	0	0	0	1	0	0	0	0
Cryptochelys leucostomum	0	0	0	0	1	0	1	0	0	0	0
Kinosternon scorpioides	0	0	0	0	1	0	1	1	1	1	1
Rhinoclemmys melanosterna	0	0	0	0	1	0	0	1	0	1	0
Trachemys callirostris	1	1	0	1	1	0	1	1	0	1	1
Chelonoidis carbonaria	1	1	0	1	1	0	1	1	1	1	1
Crocodylus acutus	0	0	0	0	1	0	1	0	0	1	0