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The herpetofauna of Cerro Jesús María (Cordillera Dipilto-Jalapa), the second highest mountain in Nicaragua

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RESUMEN: Realizamos un muestreo herpetológico en Cerro Jesús, la segunda montaña más alta de Nicaragua. En total, encontramos 14 especies de anfibios y 14 especies de reptiles de las cuales 19 de ellas son nuevos registros para el departamento de Nueva Segovia. Además, aumentamos el rango altitudinal previamente conocido en Nicaragua de *Pristimantis ridens*, *Craugastor lauraster* y *Geophis hoffmanni* y reportamos la presencia de especies con particular interés para la conservación como *Craugastor lauraster*, *Ptychohyala hypomykter*, *Sibon dimidiatus* y *Anolis wermuthi*. Estos hallazgos refuerzan la necesidad de llevar a cabo más investigaciones herpetológicas en regiones de alta montaña en Nicaragua.

With a surface area of about 130 370 km², Nicaragua is the largest and middlemost country in Central America, and the Nicaraguan Depression constitutes the transitional area between nuclear and lower Central America (Savage, 2002; Sunyer & Köhler, 2010). Except for the northern mountains and the line of isolated volcanoes located along the Pacific coast, this country is characterized by relatively uniform lowlands (94% of the country's surface is below 1000 masl, and only a negligible amount of land surpasses 1500 masl). The northern mountains are made up of four

primary mountain ranges that decrease in altitude from north to south: the Cordilleras Dipilto-Jalapa, Isabelia, Dariense, and Chontaleña (the northernmost area about twice as high as the southernmost area). On Nicaragua's northern border with Honduras, the Cordillera Dipilto-Jalapa Mountain range constitutes the geologically oldest (Paleozoic) and highest portion of the country, being Cerro Jesús María (commonly referred to as Cerro Jesús; 1801 masl) –after Cerro Mogotón (2107 masl)– the second highest mountain peak in the country (Elming *et al.*, 2001).

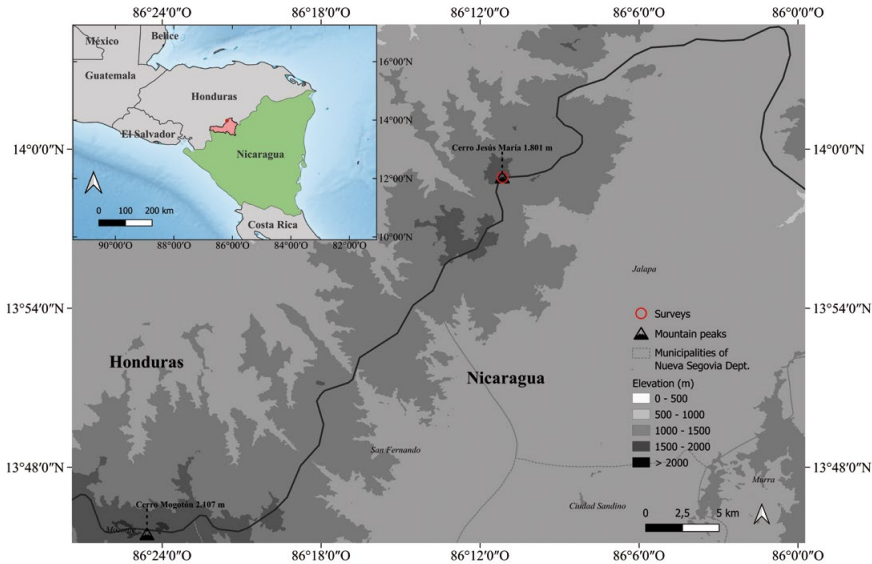


Figure 1: Location of Cerro Jesús (Cordillera Dipilto-Jalapa), Nueva Segovia Department, Nicaragua.

Figure 1: Localización del Cerro Jesús (Cordillera Dipilto-Jalapa), Departamento de Nueva Segovia, Nicaragua.

In recent decades, there has been a growing interest in increasing knowledge on the Nicaraguan herpetofauna (e.g., Sunyer, 2009; Martínez-Fonseca *et al.*, 2015; Sunyer & Martínez-Fonseca, 2019; McCranie *et al.*, 2019). So far, there have been described 261 species (two classes, six orders, 49 families, 141 genera, three exotic species), including 76 amphibian and 185 reptile species; where seven amphibians and six reptiles' species are considered endemisms (Martínez-Fonseca *et al.*, 2015; Sunyer & Martínez-Fonseca, 2019). Still, the highlands' Nicaraguan herpetofauna –and their range of distribution– remains largely unknown. It is worth noting that highland areas such as Cerro Jesús are dangerous to explore because landmines planted during Nicaragua's civil war (1979-1990) remain in place.

We here present the first list of herpetofauna species in the mountain Cerro Jesús (Jalapa, Nueva Segovia Department). Cerro Jesús is located on the eastern slopes of the Cordillera Dipilto-Jalapa bordering northern Honduras (Figure 1). The lower portions of this mountain correspond to Premontane Moist Forest formation (PME, under 1200 masl) and is characterized by the

presence of extensive coffee plantations. The higher and steeper portions correspond to Lower Montane Moist Forest formation (LMF, above 1200 masl; Holdridge, 1967), characterized by the presence of patches of relatively well-preserved cloud forest. Only the southwestern section of the Cordillera Dipilto-Jalapa is under protection as Reserva Natural Dipilto y Jalapa.

We base this study on surveys we conducted (RGR and JS) at Cerro Jesús from 19-24 July 2011. More specifically, we explored an area that belongs to the *Jesús Mountain Coffee Company* (13°59'04,3"N / 86°11'24,1"W). The whole fieldwork was carried out at an altitude ranging from 1096 to 1801 masl. Due to the presence of unallocated landmines planted during the Civil War, our work was primarily conducted across the route that connected the workers house of the *Jesús Mountain Coffee Company* to a pathway made in the past to cross the country's border. This path, which culminated at the summit of Cerro Jesús, exhibited variations in its width, ranging from more than one and a half meters to around 60 centimetres. Along the route, there were

clearings that we used them both to search for new animals and as resting points. We also explored some of the smaller paths branching off from the main route when there were signs of have been recently crossed. We found the specimens by active visual searching during the day and night, typically between 11 am and 4 am, depending on the weather conditions.

Each individual identification was confirmed through taxonomic keys at laboratory (Köhler, 2001, 2008; Savage, 2002). We preserved voucher specimens and fresh tissue samples in 70% ethanol and were deposited in the Museo Herpetológico UNAN-León (MHUL), Universidad Nacional Autónoma de Nicaragua-León, Nicaragua.

LIST OF SPECIES

We report in this study a total of 28 species, 14 amphibians and 14 reptiles, for Cerro Jesús (Table 1; Figure 2). 22 of the total 28 species were found in the PMF near the coffee plantation area. Only six of 28 species were caught in LMF zone, probably because of the complexity of finding reptiles and amphibians in this type of ecosystem added to the fact of unlocated landmines.

The 14 amphibian species, belonging to the three orders (Anura, Caudata, Gymnophiona), represent 13 genera and eight families: Caeciliidae (1 sp.), Plethodontidae (1 sp.), Bufonidae (2 sp.), Centrolenidae (2 sp.), Craugastoridae (1 sp.), Hylidae (4 sp.), Ranidae (2 sp.) and Strabomantidae (1 sp.). Hylidae was the more



Figure 2: Some of the species found in Cerro Jesús, Nueva Segovia Department, Nicaragua. a) *Bolitoglossa striatula*, b) *Esparadana prosoblepon*, c) *Smilisca baudinii*, d) *Drymobiobius margaritiferus*, e) *Ninia maculata*, f) *Sibon nebulatus*, g) *Anolis capito*, h) *Ninia sebae*.

Figura 2: Algunas de las especies encontradas en Cerro Jesús, Departamento de Nueva Segovia, Nicaragua. a) *Bolitoglossa striatula*, b) *Esparadana prosoblepon*, c) *Smilisca baudinii*, d) *Drymobiobius margaritiferus*, e) *Ninia maculata*, f) *Sibon nebulatus*, g) *Anolis capito*, h) *Ninia sebae*.

Table 1: Summary of amphibian and reptile species found in Cerro Jesús, North Nicaragua. * New departmental record for Nueva Segovia Department. ⁽¹⁾ Premontane Moist Forest formation (PMF, under 1200 masl). ⁽²⁾ Lower Moist Forest formation (LMF, above 1200 masl). ⁽³⁾ IUCN (2023) conservation status. ⁽⁴⁾ The Red Book of Amphibians and Reptiles of Nicaragua conservation status (Robleto-Hernández *et al.*, 2019).

Tabla 1: Listado de las especies de reptiles y anfibios encontradas en Cerro Jesús, en el norte de Nicaragua. * Nuevos registros para el Departamento de Nueva Segovia. ⁽¹⁾ Bosque Húmedo Premontano (PMF, por debajo de 1200 msnm). ⁽²⁾ Bosque Húmedo Inferior (LMF, por encima de 1200 msnm). ⁽³⁾ Estatus de conservación en IUCN (2023). ⁽⁴⁾ Estatus de conservación en The Red Book of Amphibians and Reptiles of Nicaragua (Robleto-Hernández *et al.*, 2019).

	Nº of individuals	Altitude (masl)	Habitat	Conservation Status
AMPHIBIA				
<u>Gymnophiona</u>				
Caeciliidae				
<i>Gymnopsis multiplicata</i> Peters, 1874	1*	1080	1	LC ⁽³⁾⁽³⁾
<u>Caudata</u>				
Plethodontidae				
<i>Bolitoglossa striatula</i> (Noble, 1918)	1*	1095	1	LC ⁽³⁾
<u>Anura</u>				
Bufonidae				
<i>Incilius valliceps</i> (Wiegmann, 1833)	4	1080 – 1290	1	LC ⁽³⁾
<i>Rhinella horribilis</i> (Wiegmann, 1833)	1*	1080	1	LC ⁽³⁾
Centrolenidae				
<i>Espadarana prosoblepon</i> (Boettger, 1892)	1*	1382	2	LC ⁽³⁾
<i>Hyalinobatrachium fleischmanni</i> (Boettger, 1893)	1*	1080	1	LC ⁽³⁾
Craugastoridae				
<i>Craugastor lauraster</i> (Savage, McCranie, & Espinal, 1996) ⁽¹⁾	1*	1380	2	LC ⁽³⁾ / EN ⁽⁴⁾
Hylidae				
<i>Agalychnis callidryas</i> (Cope, 1862)	2*	1080	1	LC ⁽³⁾
<i>Dendropsophus microcephalus</i> (Cope, 1886)	5	1080	1	LC ⁽³⁾
<i>Ptychohyla hypomykter</i> McCranie & Wilson, 1993	4*	1080 – 1337	1, 2	VU ⁽³⁾
<i>Smilisca baudinii</i> (Duméril & Bibron, 1841)	1	1080	1	LC ⁽³⁾
Ranidae				
<i>Lithobates maculata</i> (Brocchi, 1877)	2*	1080	1	LC ⁽³⁾
<i>Lithobates brownorum</i> (Sanders, 1973)	2	1072 – 1080	1	LC ⁽³⁾
Strabomantidae				
<i>Pristimantis ridens</i> (Cope, 1866)	4*	1472	2	LC ⁽³⁾
REPTILIA				
<u>Squamata / "Sauria"</u>				
Dactyloidae				
<i>Anolis capito</i> Peters, 1863	1*	-	-	LC ⁽³⁾
<i>Anolis dariense</i> (Fitch & Siegel, 1984)	2*	1080	1	LC ⁽³⁾
<i>Anolis wermuthi</i> (Köhler & Obermeier, 1998)	7*	1745 – 1802	2	EN ⁽³⁾
Scincidae				
<i>Scincella cherriei</i> (Cope, 1893)	1*	1080	1	LC ⁽³⁾
<u>Serpentes</u>				
Colubridae				
<i>Dendrophidion aphaocybe</i> Cadle, 2012	1	1080	1	LC ⁽³⁾
<i>Drymobius margaritiferus</i> (Schlegel, 1837)	3*	1080 – 1100		LC ⁽³⁾
<i>Geophis hoffmanni</i> (Peters, 1859)	2	1080 – 1334	1, 2	LC ⁽³⁾
<i>Mastigodryas alternatus</i> (Bocourt, 1884)	1	1090	1	LC ⁽³⁾
<i>Ninia maculata</i> (Peters, 1861)	1*	1080	1	LC ⁽³⁾
<i>Ninia sebae</i> (Duméril, Bibron & Duméril, 1854)	4*	1090 – 1240	1, 2	LC ⁽³⁾
<i>Spilotes pullatus</i> (Linnaeus, 1758)	1*	1200	1	LC ⁽³⁾
Dipsadidae				
<i>Sibon nebulatus</i> (Linnaeus, 1758)	1	1090	1	LC ⁽³⁾
<i>Sibon dimidiatus</i> (Günther, 1872)	1*	1080	1	LC ⁽³⁾ / VU ⁽⁴⁾
Elapidae				
<i>Micrurus nigrocinctus</i> (Girard, 1854)	1	1023	1	LC ⁽³⁾

abundant amphibian family in relation to the number of species and individuals (21.4% and 33.3% respectively). The second most common amphibian families were Bufonidae and Craugastoridae, with both the 14.3% for the total of species and 16.7% for the total of individuals found in our surveys (Table 1).

We found 14 species of reptiles along the transect with 10 genera and five families, including sauria and snakes: Dactyloidae (3 sp.), Scincidae (1 sp.), Colubridae (7 sp.), Dipsadidae (2 sp.), and Elapidae (1 sp.) (Table 1; Figure 2). The family with the highest number of species was Colubridae (50%), followed by Dactyloidae (21.4%). These also were the families with the highest number of individuals for the total reptiles found in our surveys (46.6% and 33.3% respectively).

All in all, 67.8% of species are new departmental records for Nueva Segovia – specifically, 71.4% of the amphibian species and 64.2% of the reptile species. In particular, it is the first time that the orders Gymnophyona (*Gymnopsis multiplicata*) and Caudata (*Bolitoglossa striatula*) have been reported in Nueva Segovia. In the order Anura, the families Centrolenidae (*Espadarana prosoblepon* and *Hyalinobatrachium fleischmanni*), Craugastoridae (*Craugastor lauraster*) and Strabomantidae (*Pristimantis ridens*) had not been previously reported either. This also happens with Squamata families such as Dactyloidae (*Anolis capito*, *A. dariense* and *A. wermuthi*) and Scincidae (*Scincella cherriei*). We also found the following new departmental records: *Rhinella horribilis* (Bufonidae), *Agalychnis callidryas* and *Ptychohyla hypomykter* (Hylidae), *Lithobates maculate* (Ranidae), *Drymobius margaritiferus*, *Ninia maculata*, *N. sebae* and *Spilotes pullatus* (Colubridae) and *Sibon dimidiatus* (Dipsadidae).

This study expands the altitudinal range known of some species in Nicaragua. In amphibians, we collected *P. ridens* at 1472 masl;

increasing ~122 m its altitudinal range (Sunyer, 2009; Martínez-Fonseca *et al.*, 2015). We also found *C. lauraster*, whose distribution range is limited to several few points in the north of Nicaragua, at 1380 masl, increasing its altitudinal range in ~130 m (Martínez-Fonseca *et al.*, 2015). In reptiles, we found *Geophis hoffmanni* at 1080 m and 1334 masl, being over the altitudinal range reached in the country until now (960 masl; Sunyer, 2009; McCranie *et al.*, 2019). We also discovered *A. wermuthi* specimens at 1745 and 1802 masl, extending the species altitudinal range by ~144 masl. This finding—the same as described by Sunyer *et al.* (2013)—is the highest reptile record in the herpetofauna of Nicaragua. It also extends the species' distributional range about 70 km northwest from its closest locality, Reserva Natural Cerro Kilambé, dept. Jinotega, Nicaragua. Furthermore, during the same surveys as this study, Sunyer *et al.* (2013) collected specimens on Honduran territory, hence confirming the presence of *A. wermuthi* for the first time in Honduras.

It was particularly encouraging to find species that are of particular interest for conservation (Robleto-Hernández *et al.*, 2019; Vásquez-Almazán *et al.*, 2020). At a country level, *C. lauraster* is categorized by The Red Book of Amphibians and Reptiles of Nicaragua as “Endangered” (EN). Their populations are experiencing sharp declines in higher elevation areas of Nicaragua (Robleto-Hernández *et al.*, 2019; Wilson *et al.*, 2020). *Ptychohyla hypomykter*, which seems to be distributed in very few locations from Guatemala to Nicaragua, is categorized globally as “Vulnerable” (Vu C2a) (Vásquez-Almazán *et al.*, 2020) and as EN at country level (Robleto-Hernández *et al.*, 2019). In reptiles, *A. wermuthi* is categorized by the IUCN as EN B1ab (Sunyer *et al.*, 2019). Before Sunyer *et al.* (2013), only five Nicaraguan population of *A. wermuthi* were known; in which at least three of these are subjected to an ongoing habitat destruction (Sunyer *et al.*, 2019). We highli-

ght that this record –described also in Sunyer *et al.* (2013)–, represents the sixth Nicaraguan population currently known for *A. wermuthi* (Sunyer *et al.*, 2013; 2019). Finally, *S. dimidiatus* is classified at country level as VU according to The Red Book of Amphibians and Reptiles of Nicaragua (Robleto-Hernández *et al.*, 2019).

The present research provides the first list of amphibian and reptile records in Cerro Jesús, Nueva Segovia Department, North Nicaragua. With 28 species reported, we provide new departmental records and the presence of endangered species. Therefore, we believe that Cerro Jesus, as well as other highland territories in Nicaragua, are promising ecosystems for further herpetological research.

VOUCHER SPECIMENS

AMPHIBIA.

Anura:

- Bufonidae: *Incilius valliceps* JS 2259-60, JS 2263, JS 2279.
- Centrolenidae: *Esparadana prosoblepon* JS 2291; *Hyalinobatrachium fleischmanni* JS 2291.
- Craugastoridae: *Craugastor lauraster* JS 2296.
- Hylidae: *Agalychnis callidryas* JS 2280, JS 2283; *Dendropsophus microcephalus* JS 2285-

88; *Ptychohyala hypomykter* JS 2294-95, JS 2263, JS 2279; *Smilisca baudinii* JS 2284.

- Ranidae: *Lithobates brownorum* JS 2301-02; *Lithobates maculata* JS 2289-90.
- Strabomantidae: *Pristimantis ridens* JS 2297-99, JS 2305.

Caudata:

- Plethodontidae: *Bolitoglossa striatula* JS 2319.

Gymnophyona:

Caeciliidae: *Gymnopsis multiplicata* JS 2310.

REPTILIA.

Sauria:

- Phrynosomatidae: *Sceloporus malachiticus* JS 2303-04.
- Dactyloidae: *Anolis capito* JS 2306; *Anolis dariense* 2311-12; *Anolis intermedius* JS 2277-78; *Anolis wermuthi* JS 2265, JS 2267-70.
- Scincidae: *Scincella cherriei* JS 2313.

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EL PROBLEMA DE LAS ENFERMEDADES EMERGENTES

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