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New distributional records of amphibians and reptiles from the Mixteca region of Oaxaca, Mexico

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Abstract. We report new distributional records for 16 species of amphibians and reptiles from the northern Mixteca region of Oaxaca, Mexico. Notable observations include the first state record of *Leptodeira splendida* (Squamata, Colubridae), a new locality for the endemic *Tantalophis discolor* (Squamata, Colubridae), the first record of *Barisia planifrons* (Squamata, Anguidae) in Mixteca. We comment on an issue with the identification of the tadpoles used to describe a new taxon, *Sarcohyla ameibothalame* (Anura, Hylidae) from the Mixteca (Canseco-Márquez et al. 2002). Additionally, we updated the regional checklist of 31 species (5 amphibians and 26 reptiles), of which more than 80% are Mexican endemics and 13% are state endemics.

Key words: herpetofauna, amphibians, reptiles, Sierra Madre del Sur, Mixteca, endemism.

The montane regions of southern Mexico harbor the greatest herpetological diversity and endemism in the country, despite being the least explored (Ochoa-Ochoa & Flores-Villela 2006, Ochoa-Ochoa et al. 2014). New distribution records and species descriptions are consistently published for these areas, and this trend will certainly continue with further surveying (Mata-Silva et al. 2015). The southern state of Oaxaca harbors the richest herpetofauna in Mexico, estimated at 149 amphibians and 293 reptile species (Mata-Silva et al. 2015). This mountainous state is composed of eight political regions partitioned largely by geographic features and indigenous cultural groups. The Mixteca region in northwestern Oaxaca is the second largest in the state (approximately 21,263 km^2) (Ortíz-Pérez et al. 2004), and is physiographically defined by a mosaic of mountain ranges separated by intermontane valleys. Despite its size and topological complexity, only two independent herpetological surveys have been published on the region, with similar results: 119 species (38 amphibians, 81 reptiles) by Castro-Gálvez (2011) and 117 species (33 amphibians, 84 reptiles) by Mata-Silva et al. (2015). Canseco-Márquez & Gutiérrez-Mayén (2010) provided scattered records from the mountain ranges adjacent to the Tehuacán-Cuicatlán Valley that represent the northern limit of the Mixteca. Here, we present findings from field surveys in the northern portion of Mixteca conducted in 2017–2018, adding to the scant herpetofaunal knowledge of the region.

Fieldwork was mainly conducted in the vicinities of the communities of Yosocuno (17.851667°N, 97.57944°W, datum: WGS-84) and El Zapote (17.8167428°N, 97.665227°W), within three municipalities (San Pedro Nopala, Santa María Camotlán, and Santiago Huajolotitlán) in Mixteca, northwestern Oaxaca, Mexico, at an elevation range of 1822–2700 m (see Table 1 for geographical coordinates of specific sampling sites). These localities lie in a north-south oriented mountain range bordered by the Zapotitlán Salinas Valley to the north, the dry intermontane valleys containing the city of Huajuapan de León to the west, and the lower elevations of the Río Hondo River drainage basin to the east and south. The vegetation mostly comprises perturbed oak forests and xerophytic vegetation in the surroundings of the Yosocuno Valley and the western Mixtecan mountains (Canseco-Márquez & Gutiérrez-Mayén 2010).

Two surveys were conducted on 8–19 June 2017 and 7–15 July 2018 during the rainy season, during which amphibians and reptiles were visually observed or captured opportunistically by hand during both day and night surveys, focusing on potentially suitable microhabitats for the herpetofauna (e.g. under stones and logs, leaf litter, etc.). Field surveys were conducted by three to five people, between 9:00–14:00h during the day and 20:00–00:00h during the night. Sampled habitats mainly consisted of disturbed oak forest, open shrubland, and riparian vegetation, we also recorded individuals spotted within water bodies. Most encountered individuals were collected for museum accession given the poorly documented biodiversity for the region. Specimens were euthanized humanely by pentobarbital overdose (Hubrecht & Kirkwood 2010). Tissue samples from the liver or muscle were extracted and stored in 96% ethanol before the specimens were prepared with a 10% formalin solution. All specimens were transferred to 70% ethanol for permanent storage, except tadpoles that were stored in 10% formalin, along with the associated tissue samples, specimens were deposited at the herpetological collection of the Museo de Zoología, "Alfonso L. Herrera", Facultad de Ciencias (MZFC), Universidad Nacional Autónoma de México in Mexico City (UNAM).

We performed selected measurements on the preserved snake specimens that represented new records (*Leptodeira splendida*, *Tantalophis discolor* and *Tantilla deppei*, Table 2). The total length and tail length were measured with a metal ruler and rounded to the nearest millimeter. Also, the following scale counts were scored under a stereoscopic microscope: dorsal scales at midbody, ventral scales and subcaudals. These characters have been selected as they are considered relevant and very useful to acknowledge geographic variation and identification to specific level in several ophidians.

We observed 5 amphibian species (1 salamander, 4 anurans) and 26 reptile species (14 lizards, 12 snakes) (Table 1). Of these, 14 species (2 amphibians, 12 reptiles) were reported previously for the mountain range we sampled by the only other study specifically at this location (Canseco-Márquez & Gutiérrez-Mayén 2010). We recorded 17 previously unreported species for the studied portion of Mixteca (4 anurans, 1 salamander, 4 lizards and 8 snakes, Table 1). Twenty-five of the recorded species are Mexican endemics (80.6%, 5/5

Table 1. Herpetofauna species recorded in the Mixteca region, Mexico. * = endemic to Mexico; ** – endemic to Oaxaca. Hab. = O: Disturbed oak forest; S: Shrubland; R: Riparian vegetation; W: Water body. N = number of collected specimens, P (previously published); MZFC = voucher numbers in the Museo de Zoología, "Alfonso L. Herrera", Facultad de Ciencias; Cons. = Conservation designations: Pr (Special Protection) & A (Threatened), according to Mexican conservation law NOM-059; DD (Data Deficient), LC (Least concern), VU (Vulnerable), EN (Endangered) & NE (Not Evaluated), according to IUCN assessments 2020; L (Low), M (Medium) & H (High), according to the Environmental Vulnerability Score (Wilson et al. 2013a, b).

Species	Hab.	Coordinates	Date	N	MZFC	Cons.
AMPHIBIA						
Anura						
Bufonidae						
Incilius occidentalis (Camerano, 1879) *	S, R	17.81894°, -97.65976° 17.82071°, -97.56701° 17.81613°, -97.53115°	8.07.18	3	33761; 33793; 33794	LC, M
Hylidae						
Sarcohyla ameibothalame (Canseco-Márquez, Mendelson & Gutiérrez-Mayén, 2002) **	O			P		DD, H
Sarcohyla bistincta (Cope, 1877) *	R, W	17.84996°, -97.58051° 17.85263°, -97.58005° 17.85767°, -97.58113° 17.85271°, -97.58027° 17.82324°, -97.56865°	10.07.18	9	33787–33789; 33791; 33795; 33796; 33799; 33800; 33819	Pr, LC, L
Ranidae						
Lithobates zweifeli (Hillis, Frost & Webb, 1984) *	R, W	17.82358°, -97.65206° 17.82358°, -97.65392° 17.82503°, -97.65908° 17.82506°, -97.65397° 17.82056°, -97.55076° 17.82056°, -97.56639° 17.82448°, -97.65353°	7.07.18	10	33750–33755; 33760; 33779; 33790; 33823	LC, M
CAUDATA						
Plethodontidae						
Pseudoerycea mixteca (Canseco-Marquez & Gutiérrez-Mayén, 2005) *	O	17.839444°, -97.5497° 17.839145°, -97.5537°	12.06.17; 13.07.18	2	33743; 33821	LC, H
REPTILIA						
Squamata						
Anguidae						
Abronia mixteca (Bogert & Porter, 1967) *	O			P		A, VU, H
Barisia planifrons (Bocourt, 1878) **	O, S	17.80611°, -97.54111° 17.84453°, -97.55096°	15.06.17; 11.07.18	2	33746; 33806	NE, H
Dactyloidae						
Anolis quercorum (Fitch, 1978) *	O, S	17.83944°, -97.54972° 17.84383°, -97.55178° 17.83634°, -97.54756° 17.83946°, -97.55194° 17.84036°, -97.58963°	6.06.17; 9.07.18	7	33744; 33745; 33766; 33767; 33776; 33777; 33813	LC, H
Phrynosomatidae						
*Phrynosoma braconnieri (*Dumèril & Bocourt, 1870) *	O			P		Pr, LC, H
Sceloporus aureolus (Smith, 1942) *	O	17.82615°, -97.54713° 17.83545°, -97.54942° 17.83907°, -97.55067° 17.83854°, -97.55213° 17.85608°, -97.56756° 17.83977°, -97.58909°	11.07.18	7	33771–33774; 33797; 33801; 33802	LC, M
Sceloporus formosus (Weigmann, 1834) *	O, R			P		LC, H
Sceloporus grammicus (Wiegmann, 1828)	O	17.85342°, -97.57987° 17.85289°, -97.57718° 17.83607°, -97.64732°	10.07.18	4	33781; 33782; 33785; 33810	Pr, LC, L
Sceloporus horridus (Wiegmann, 1834) *	S, R	17.82385°, -97.65304°	9.07.18	1	33758	LC, M
Sceloporus jalapae (Günther, 1890) *	O	17.83889°, -97.68907°	13.07.18	1	33825	LC, M

Continued on the next page

Table 1. (continued)

Species	Hab.	Coordinates	Date	N	MZFC	Cons.
Sceloporus megalepidurus (Smith, 1934) *	O, S	17.83944°, -97.54972° 17.83621°, -97.54144° 17.83854°, -97.55213° 17.83784°, -97.55312° 17.83908°, -97.55075° 17.83857°, -97.58969°	14.06.17; 8.07.18	7	33742; 33768–33770; 33775; 33778; 33784	Pr, VU, H
Sceloporus spinosus (Wiegmann, 1828) *	O, S	17.84183°, -97.58937°	13.07.18	1	33814	LC, M
Sceloporus subpictus (Lynch & Smith, 1965) **	O, R			P		A, DD, H
Scincidae						
Plestiodon brevirostris (Günther, 1860) *	O, S	17.83911°, -97.55095° 17.84453°, -97.55096°	12.07.18	2	33792; 33817	LC, M
Teiidae						
Aspidocelis sackii (Zweifel, 1960) *	S	17.82106°, -97.65256°	7.07.18	1	33756	LC, H
Dipsadidae						
Leptodeira splendida (Günther, 1895) *	R	17.82448°, -97.65353°	13.07.18	1	33824	LC, H
Tantalophis discolor (Günther, 1860) **	O	17.84379°, -97.55076°	12.07.18	1	33815	A, VU, H
Colubridae						
Conopsis acuta (Cope, 1886) *	O, S	17.83621°, -97.54144° 17.83604°, -97.61164° 17.83917°, -97.57553° 17.84453°, -97.55096° 17.84013°, -97.55067° 17.84388°, -97.55053°	11.07.18	8	33759; 33762; 33763; 33765; 33783; 33786; 33807; 33808	NE, H
Conopsis lineata (Kennicot, 1859) *	O, S	17.83944°, -97.54972° 17.85568°, -97.56803° 17.85061°, -97.58086° 17.84012°, -97.55067° 17.84028°, -97.55074°	13.06.17; 11.07.18	6	33748; 33764; 33780; 33809; 33811; 33812	LC, M
Tantilla deppei (Bocourt, 1883) *	O	17.80611°, -97.54111° 17.83735°, -97.59155°	13.06.17; 14.07.18	3	33747; 33820; 33822	A, LC, M
Trimorphodon tau (Cope, 1870) *	S	17.82087°, -97.64295°	7.07.18	1	33757	LC, M
Natricidae						
Thamnophis chrysocephalus (Cope, 1885) *	R					A, LC, H
Thamnophis cyrtopsis (Kennicott, 1860)	R	17.85267°, -97.58013°	15.07.18	1	Photography record	A, LC, L
Viperidae						
Crotalus intermedius (Troschel, 1865) *	S			P		A, LC, H
Crotalus molossus (Baird & Girard, 1853)	S	17.82087°, -97.64295°	8.07.18	1	34507	Pr, LC, L
Crotalus ravus (Cope, 1865) *	O, S	17.83723°, -97.59191° 17.84071°, -97.55167° 17.84083°, -97.55223°	12.07.18	3	33798; 33816; 33818	A, LC, H
Mixcoatlus melanurus (Müller, 1923) *	S	17.830581°, -97.5314°	13.07.18	1	Photography record	Pr, EN, H

amphibians, 23/26 reptiles), five are state endemics (12.9%, 1/5 amphibians, 4/26 reptiles), and two (*Leptodeira splendida* and *B. planifrons*) are reported for the first time for Mixteca. Notable observations and an updated checklist (Table 1) are provided below.

Our record of *L. splendida* from El Zapote (Table 1) is the first for the state of Oaxaca, extending the known range by ~120 km SW from the type locality at Izúcar de Matamoros, Puebla (Duellman 1958a). The snake was collected close to a water body at night (Fig. 1A, Table 2).

Our observations of *Barisia planifrons* from the vicinity of Maguey Verde are the first for the Mixteca region, they also represent the northernmost localities for the species, extending the known distribution 88 km WNW from the nearest published records ("Sierra de Monteflor, highlands of San Juan Bautista Atlahuaca", Zaldívar-Riverón & Nieto-Montes de Oca 2002). All individuals were found active during the day between agave plants (Fig. 1B).

Pseudoeurycea mixteca is a Mexican endemic salamander restricted geographically to the Mixteca region of Oaxaca and the arid Tehuacán Valley in Puebla (Windfield-Pérez et al. 2007). Two individuals were found under agave debris 3 km E of San Pedro Nopala near Maguey Verde (Fig. 1C, Table 1).

Tantalophis discolor, the only representative of its genus, is restricted to the Oaxacan highlands between 2400–2800 m, within pine-oak forests (Myers & Campbell 1981). Our record from Maguey Verde between Yosocuno and San Pedro Nopala (Table 1) slightly extends the known distribution of the species by 21.3 km NE of the nearest reported locality

Figure 1. Noteworthy records, reported in this study. A: *Leptodeira splendida* (MZFC 33824); B: *Barisia planifrons* (MZFC 33806); C: *Pseudoeurycea mixteca* (MZFC 33821); D: *Sarcohyla bistincta* (MZFC 33791); E: *Tantalophis discolor* (MZFC 33815); F: *Tantilla deppei* (MZFC 33820).

Table 2. Select morphological measurements of new snake records reported in this study. MZFC = voucher numbers in the Museo de Zoología, "Alfonso L. Herrera", Facultad de Ciencias; L = total length (mm); TL = tail length (mm); D = Dorsal rows at midbody; V = number of ventrals; S = number of subcaudals. All individuals were adult males, except for *T. discolor* that was a juvenile male, and *Tantilla deppei* (MZFC 33820) that was an adult female.

Species	MZFC	L	TL	D	V	S
Tantilla deppei	33822	207	51	15	153	60
Tantilla deppei	33747	279	65	14	154	59
Tantilla deppei	33820	242	61	15	148	58
Leptodeira splendida	33824	412	71	20	158	42
Tantalophis discolor	33815	291	64	21	192	68

("6 mi SE Tamazulapam", Duellman 1958b). The species is considered rare and is poorly represented in scientific collections. The snake was found hidden under a decaying tree stump (Fig. 1E, Table 2).

Our observations of *Tantilla deppei* from Maguey Verde and 3.2 km SW of Yosocuno (Table 1) are only the second locality records for the state, and extend the species distribution 23.7 km NW from the only other record in Oaxaca ("12 km N intersection with road to Tlaxiaco on Rt. 190 [17.659428°N, 97.475871°W]", Wilson & Mata-Silva 2014). Three individuals were collected under dead agave debris (Fig. 1F, Table 2).

The mountain ranges discussed here have localized

regions that, due their complex physiography, climate and variety of habitats, harbor a large amount of vertebrate diversity with a high proportion of endemism. Specifically, the Mixteca region harbors at least 102 endemic herpetofauna species (35 amphibians, 67 reptiles), representing over 60% of the species of Oaxaca (Castro-Gálvez 2011, Mata-Silva et al. 2015). Multiple species we observed are of conservation importance: 14 are listed under conservation threat by Mexican law, and 23 species are designated as Least Concern, 2 as Vulnerable, 1 as Endangered, and 2 as Data Deficient by IUCN (2020). Based on the Environmental Vulnerability Score (EVS) assessment in Wilson et al. (2013a, b), four species have low (3–9), ten – medium (10–13), and sixteen – high (14–20) vulnerability (Table 1). This highlights the importance of the new records we present here. Although some species have not been placed yet in a category requiring immediate conservation actions, we observed natural habitat rapidly being converted into livestock and agricultural areas, which fragments habitats and puts the populations of these taxa at risk of extinction (Newman & Tallmon 2001). In addition, for some species we do not have sufficient data to carry out conservation assessments and take corresponding actions (e. g. *Sceloporus subpictus* and *Sarcohyla ameibothalame*), potentially meaning a loss of diversity before it can be properly documented.

An important finding of our study are the records of *Sarcohyla bistincta* (Fig. 1D, Table 1), a series of adult individuals and tadpoles mostly collected in a stream near the entrance to the town of Yosocuno. This is noteworthy because Canseco-Márquez et al. (2002, pp. 64–66) described a new species, *S. ameibothalame*, from this same locality and noted that they "refer these tadpoles to *H. ameibothalame* because they are the only hylid tadpoles that [they] found at the type locality, both the adults and tadpoles appear to be referable to the *H. bistincta* group". The tadpole described by them is clearly referable to the *S. bistincta* species group, but the presence of two taxa of this group in the region necessitates further assessments on the proper identification of these tadpoles since the larval stages of *S. bistincta sensu stricto* is currently unknown due to the hectic taxonomic changes made on this species complex in recent years (see Campbell et al. 2018, Kaplan et al. 2020 for a review on these changes).

Despite Oaxaca being one of the most explored states in Mexico (Ochoa-Ochoa & Flores-Villela 2006), recent surveys on that state continue to result in new records (Calzada-Arciniega et al. 2017, Martín-Regalado et al. 2016), and new species descriptions (Jiménez-Arcos et al. 2019). We consider that it is worthy to highlight the importance of regional surveys as these studies aid to gather information on wider distributional patterns and valuable data on the conservation of several poorly known taxa.

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