





# Significant distribution extension and first verified record of Chiapan Beaded Lizard, *Heloderma alvarezii* (Bogert & Martin del Campo, 1956) (Squamata, Helodermatidae), in southeastern Guerrero, Mexico

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## Abstract

We document the first verifiable records of *Heloderma alvarezii* (Bogert & del Campo, 1956) in southeastern Guerrero, Mexico. We recorded seven individuals of *H. alvarezii* near the village of Cihuapoloya, municipality of Cuauhtepic. These are the westernmost records of the species, extending its distribution by approximately 149 km from the nearest previously known occurrences in Oaxaca. With these records, the number of reptile species in Guerrero increases to 182.

## Keywords

Extent distribution, Helodermatidae, melanism, southern Guerrero, tropical dry forest

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## Introduction

Chiapan Beaded Lizard, *Heloderma alvarezii* (Bogert & Martin del Campo, 1956), is one of the five species of the family Helodermatidae recorded in Mexico (Campbell and Lamar 2004; Beck 2005). *Heloderma alvarezii* unique among the beaded lizards because it undergoes an ontogenetic increase in melanism, and the distinctive yellow banding on the tail—which is typical of other

species of beaded lizards—is essentially absent in the juveniles and adults of this species (Bogert and Martin del Campo 1956; Beck 2005). Its reported geographic range the central coast of Oaxaca (García-Grajales et al. 2020), Central Depression (Río Grijalva Depression) of central Chiapas, and the Río Lagartero Depression in extreme western Guatemala (Campbell and Lamar 2004;

Beck 2005; Köhler 2008; Johnson et al. 2010; Wilson and Johnson 2010).

*Heloderma alvarezii* is a venomous lizard which inhabits seasonally dry tropical deciduous forests (Domínguez-Vega et al. 2012), one of the most threatened ecosystems in the world (Janzen 1988). This species is known colloquially as “escorpión” and is considered extremely dangerous by the local inhabitants. Its natural history is surrounded by mystery, notoriety, and misconception (Reiserer et al. 2013; Domínguez-Vega et al. 2017, 2018), principally because these animals can spend up to 95% of their lives hidden in shelters underground, which makes detection difficult. Furthermore, studies of population levels are limited. Despite this, it is clear that habitat loss and fragmentation are the main threats to this species because most of its distribution is outside of the well-conserved designated areas where protection is afforded to it (Beck 2005; Domínguez-Vega et al., 2012).

The Mexican state of Guerrero harbors a rich flora and fauna and is considered the fourth most diverse state in the country (Flores-Villela and Gerez 1994; Palacios-Aguilar and Flores-Villela 2018). The most recent checklist of the herpetofauna of Guerrero reported 181 reptile species, with only one representative of the family Helodermatidae (*Heloderma horridum*; Wiegmann, 1829; Palacios-Aguilar and Flores-Villela 2018).

Guerrero has been studied by many researchers, who have reported new species, new state records, and taxonomic changes in the last decades. According to previous studies, the possibility for many other, unreported species in Guerrero exists (Flores-Villela and García-Vázquez 2014; Palacios-Aguilar and Flores-Villela 2018). In this study, we provide the first verifiable records of Chiapan Beaded Lizard, *H. alvarezii* in southeastern Guerrero, Mexico. Our new records come from Cihua-poloya, municipality of Cuau-tepec, which is an unprotected area in the state.

## Methods

Guerrero is in southern Mexico, and the state has an area of 63,620 km<sup>2</sup>, which represents 3.2% of the national territory and makes it the fourteenth largest state in the country (INEGI 2012). There are four biogeographic regions in Guerrero which, from north to south, are Trans-Mexican Volcanic Belt, Balsas Depression, Sierra Madre del Sur, and Pacific Coast (CONABIO 1997).

The southeastern section of the Pacific Coast region is characterized by its forest cover, which is mainly dry forest; however, most areas are highly deforested, and only 2% of the cover is undisturbed (García 2006). In this region, dry forest has been removed for crops and grasslands, which is one of the principal reasons why this area has been severely affected by anthropogenic change (Trejo 2010). As with most regions of the world, the two main agents of anthropogenic changes are the expansion of large-scale commercial agriculture and increased urbanization (Trejo 2010).

In this region, tropical dry forest is the most extensive forest cover in the state; however, this is found in patches, and the matrix surrounding the forest patches is highly heterogeneous, being composed of secondary forests, annual crops, cattle pastures, and human settlements, as well as rubber, cocoa and oil palm plantations (Torres-Colín 2004). According to the Köppen climatic classification, Cuau-tepec is within the Tropical Equatorial Climate, with a mean annual temperature of 24–28 °C, a mean rainfall of 2245 mm (García 1973), and a long period of drought that lasts from November to May (Trejo 2010).

We recorded seven *Heloderma alvarezii* near the village of Cihua-poloya, Cuau-tepec municipality, Guerrero, where they were encountered by humans during 2020. We captured each individual and photographed them with an Iphone XR, measured the total length (TL) with a plastic ruler, and weighed each lizard using a 5-kg Pesola handy spring scale balance. The photographs of the captured individuals were deposited in the photographic digital collection of the Colección Nacional de Anfibios y Reptiles in the Instituto de Biología at the Universidad Nacional Autónoma de México (CNAR-IBH-RF).

We used information from scientific collections (e.g., Instituto de Biología, El Colegio de la Frontera Sur) and data available in published literature to determine the currently known distribution of *H. alvarezii* in Mexico. Only reliable information and accurate coordinates from scientific institutions and scientific literature was considered and summarized in a table (Table 1) and a map (Fig. 1), which was prepared using QGIS3.16.

## Results

Our review of collections and literature revealed 30 records of *Heloderma alvarezii* (Table 1), including our records; 66.6% were from Chiapas, 23.4% from Guerrero, and the remaining 10% from Oaxaca. Our new records (Fig. 1) increase the distribution of the species by 149 km from the nearest records in Oaxaca. All individuals photographed were encountered between July and September 2020.

**New records. MEXICO – Guerrero •** 3.02 km SE of Cihua-poloya, Cuau-tepec municipality; 16°42'10.93"N, 098°50'30.30"W; 180 m a.s.l.; 21.VII.2020; A. Ventura-Carmona & C. Casiano-González leg.; between stacked rocks (1146 h); 1 adult female, CNAR-IBH-RF 639 • 2.08 km SE of Cihua-poloya, Cuau-tepec municipality; 16°42'27.17"N, 098°53'13.09"W; 181 m a.s.l.; 21.VII.2020; A. Ventura-Carmona & C. Casiano-González leg.; near a cattle pasture (1245h); 1 adult female, CNAR-IBH-RF 640 • 3.04 km SW of Cihua-poloya, Cuau-tepec municipality; 16°42'13.46"N, 098°53'02.91"W; 180 m a.s.l.; 22.VII.2020; A. Ventura-Carmona & C. Casiano-González leg.; near a cattle pasture (1030 h); 1 adult female, CNAR-IBH-RF 641 • 2.62 km SW of Cihua-poloya, Cuau-tepec municipality; 16°43'00.32"N,

**Table 1.** Locality records of *Heloderma alvarezii* from Mexico, derived from literature records, official institutions and the present study. Coordinates and localities from only reliable sources are shown. Abbreviations: CHIS = Chiapas; OAX = Oaxaca; GRO = Guerrero. AMNH = American Museum of Natural History; TNHC = Texas Natural History Collection; ECO-SCH = El Colegio de la Frontera Sur- Unidad San Cristobal; UIMNH = Illinois University, Museum of Natural History; UTA-R = University of Texas at Arlington, Collection of Vertebrates; IBUNAM = Instituto de Biología, Universidad Nacional Autónoma de México; MCZ = Harvard University Museum of Comparative Zoology; MZFC = Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México; USNM = United State National Museum of Natural History; UTEP = University of Texas at El Paso, Laboratory of Environmental Biology.

Locality	State	Latitude	Longitude	Reference
Cintalapa municipality	CHIS	16.4140	-093.4330	AMNH-65863
Cintalapa municipality	CHIS	16.4140	-093.4330	AMNH-70538
Cintalapa municipality	CHIS	16.4216	-093.4813	AMNH-70540
Cintalapa municipality	CHIS	16.4216	-093.4813	TNHC-23714
Osumacinta municipality	CHIS	16.5040	-093.0435	AMNH-70539
Ocozacoautla de Espinosa municipality	CHIS	16.4615	-093.2613	AMNH-71081
Ocozacoautla de Espinosa municipality	CHIS	16.3702	-093.2545	ECO-SCH-1548
Cintalapa municipality	CHIS	16.3436	-093.5533	UIMNH-7029
Cintalapa municipality	CHIS	16.2840	-094.0450	UTA-R-5715
Cintalapa municipality	CHIS	16.2840	-094.0450	UTA-R-18694
Puerto Arista, Tonala municipality	CHIS	15.5601	-093.4837	IBUNAM-3654
Tonala municipality	CHIS	16.0530	-093.4510	MCZ
Tonala municipality	CHIS	15.5634	-093.3807	MZFC-5011
Tonala municipality	CHIS	15.5104	-093.2845	USNM-192535
Tonala municipality	CHIS	15.5100	-093.2630	LACM-38214
Tuxtla Gutiérrez municipality	CHIS	16.4502	-093.0703	IBUNAM-763
Tuxtla Gutiérrez municipality	CHIS	16 45 02	-093 07 03	IBUNAM-764
Tuxtla Gutiérrez municipality	CHIS	16.4745	-093.0540	
				UTEP-4622
Chiapa de Corzo municipality	CHIS	16.4354	-093.0200	UTA-R
Jiquipilas municipality	CHIS	16.2355	-093.4911	ECO-SCH-3275
Santa Rosa de Lima, Villa de Tututepec municipality	OAX	16.0642	-097.3745	García-Grajales et al. 2020
El Porvenir, Santa María Colotepec municipality	OAX	15.4944	-096.5829	García-Grajales et al. 2020
Santa María Huatulco municipality	OAX	15.4638	-096.0934	García-Grajales et al. 2020
Cihuapoloya, Cuauhtepec municipality	GRO	16.4300	-098.5311	IBH-RF 639, CNAR/this study
Cihuapoloya, Cuauhtepec municipality	GRO	16.4210	-098.5030	IBH-RF 640, CNAR/this study
Cihuapoloya, Cuauhtepec municipality	GRO	16.4227	-098.5313	IBH-RF 641, CNAR/this study
Cihuapoloya, Cuauhtepec municipality	GRO	16.4251	-098.5259	IBH-RF 642, CNAR/this study
Cihuapoloya, Cuauhtepec municipality	GRO	16.4157	-098.5039	IBH-RF 643, CNAR/this study
Cihuapoloya, Cuauhtepec municipality	GRO	16.4213	-098.5102	IBH-RF 644, CNAR/this study
Cihuapoloya, Cuauhtepec municipality	GRO	16.3909	-098.5249	IBH-RF 645, CNAR/this study

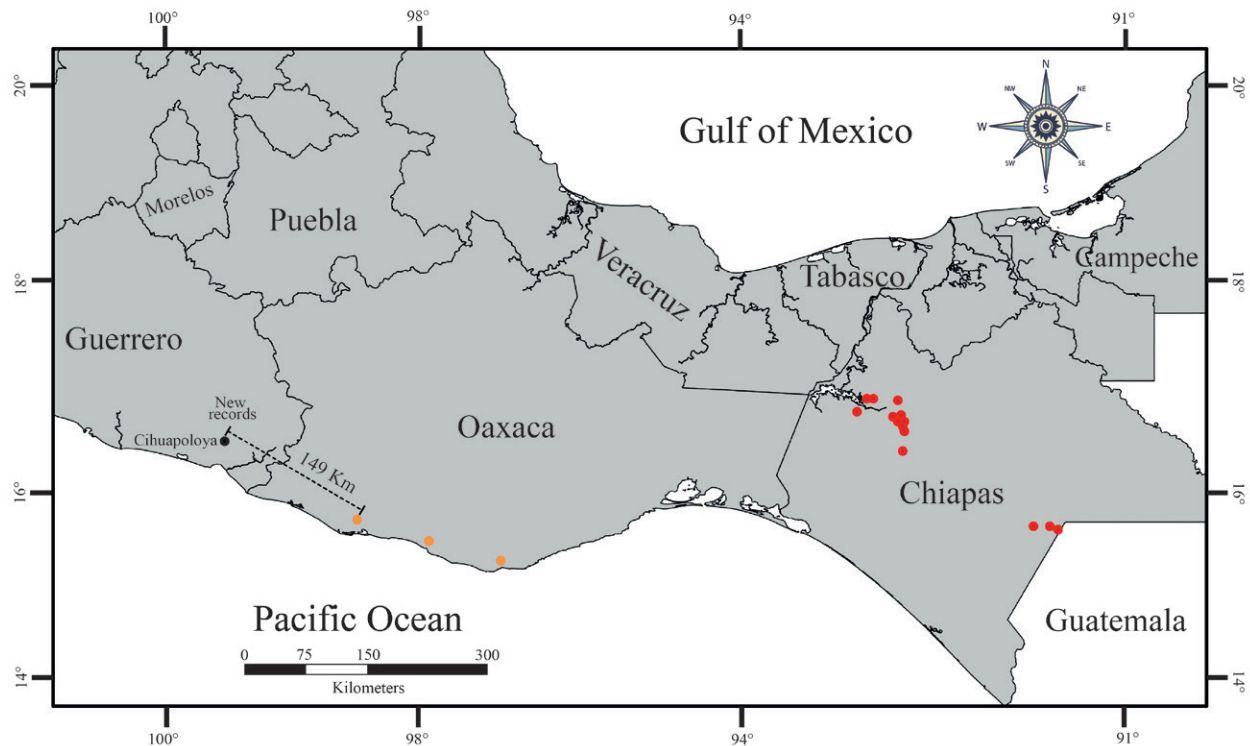
098°53'11.88"W; 178 m a.s.l.; 24.VII.2020; A. Ventura-Carmona & C. Casiano-González leg.; on a tree (1830 h); 1 adult female, CNAR-IBH-RF 642 • 2.11 km SW of Cihuapoloya, Cuauhtepec municipality; 16°39'09.40"N, 098°52'49.36"W; 168 m a.s.l.; 24.VII.2020; A. Ventura-Carmona & C. Casiano-González leg.; under a dry tree (1145 h); 1 adult female, CNAR-IBH-RF 643 • 2.11 km SW of Cihuapoloya, Cuauhtepec municipality; 16°42'51.19"N, 098°52'59.92"W; 180 m a.s.l.; 30.VII.2020; A. Ventura-Carmona & C. Casiano-González leg.; near a ranch (0915 h); 1 adult female, CNAR-IBH-RF 644 • 7.5 km S of Cihuapoloya, Cuauhtepec municipality; 16°41'57.89"N, 098°50'39.12"W; 180 m a.s.l.; 26.IX.2020; A. Ventura-Carmona & C. Casiano-González leg.; near a ranch (0800 h); 1 adult female, CNAR-IBH-RF 644.

**Identification.** The specimens were identified following Beck's (2005) procedure, mainly because this taxon is unique among beaded lizards by undergoing an ontogenetic increase in melanism (Bogert and Martin del Campo 1956; Beck 2005). Our photographic evidence

was corroborated by Victor Hugo Reynoso Rosales from the National Collection of Amphibians and Reptiles (CNAR-IBH-RF). All specimens were adult black females (Fig. 2) of different lengths. Although Bogert and Martin del Campo (1956) and Beck (2005) explained that black specimens are uncommon, there is recent photographic evidence (García-Grajales et al. 2020), such our new records here, that proves otherwise.

## Discussion

Our new records of *Heloderma alvarezii* extend the range by 149 km to the western of the nearest previously known occurrence at San Pedro Tututepec in the state of Oaxaca (García-Grajales et al. 2020). These new records thus represent the westernmost occurrences of this species in Mexico. The discovery of this species in the municipality of Cuauhtepec, Guerrero, increases the distribution northwest from the nearest populations in Oaxaca and Chiapas. Although *H. alvarezii* was thought to be restricted to the Mexican state of Chiapas and adjacent



**Figure 1.** Geographic distribution of *Heloderma alvarezii* in Mexico. Red dots: historical records; orange dots: literature records; black dots: new records (this study).

western Guatemala, recent evidence has shown it to have a coastal distribution in the state of Oaxaca (García-Grajales et al. 2020). Reiserer et al. (2013) reported an isolated population resembling *H. alvarezii* from San Pedro Tututepec, Oaxaca, but they refrained from calling it this species until the possibility of human displacement could be ruled out.

Our new data are the first verifiable records of *H. alvarezii* from the state of Guerrero and increase the number of reptile species to 182 (Palacios-Aguilar and Flores-Villela 2018). We identified the species using photographic evidence, and this was confirmed by a specialist at CNAR-IBH-RF. Photographic-records are an important tool for documenting the reptiles' presence in a given location (Nguyen et al. 2020), and their scientific significance is increased when they are accompanied with geographic coordinates, habitat characteristics, and other data and deposited into a scientific collection (Casper et al. 2015).

Due to taxonomic changes in the family Helodermatidae in the last decade, *H. alvarezii* is not listed in Mexico (NOM-059-SEMARNAT-2010; SEMARNAT 2010), and in the International Union for Conservation of Nature Red List. In both cases, this is due to the outdated taxonomy of the *H. horridum* complex. The main threat to beaded lizard populations is deforestation of dry tropical forests for agriculture, cattle ranching, and the burgeoning human population (Beck and Lowe 1991; Domínguez-Vega et al. 2012), but the escalation of droughts and fires is also a threat (Beck 2005; Domínguez-Vega et al. 2012; Ariano et al. 2020).

Campbell and Vannini (1988) indicated the probability

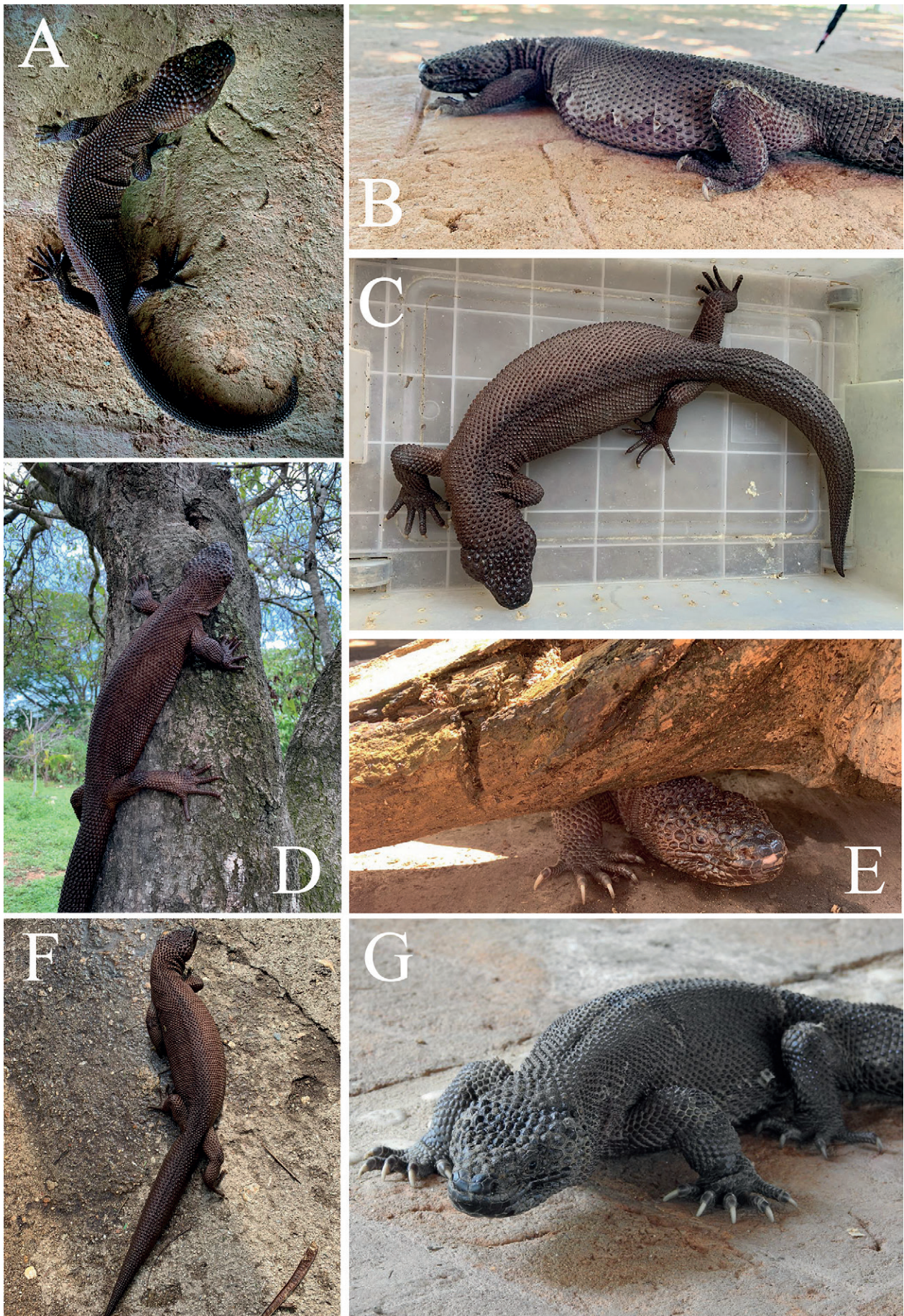
of areas of intergradation between *H. horridum* and *H. alvarezii* in the region between the Isthmus of Tehuantepec (Oaxaca) and Cintalapa (Chiapas). In an unpublished thesis, Hernández-Jiménez (2011) reported black individuals of *Heloderma* from Copala, Guerrero, and some localities on the western coast of Oaxaca. In that work, Hernández-Jiménez (2011) found low genetic divergence and geographic structure in these populations and considers that they might represent an undescribed species. Taking this into account, we hypothesize the probable existence of hybridization among wild populations between *H. horridum* and *H. alvarezii*, and we note that additional studies to clarify the extent of hybridization and the forces driving hybridization in southern of Mexico are warranted.

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**Figure 2.** *Heloderma alvarezii* from municipality of Cihupoloya, Cuautepec, southeastern Guerrero, Mexico. **A.** Dorsal view of IBH-RF 639. **B.** Lateral view of IBH-RF 640. **C.** Dorsal view IBH-RF 641. **D.** Lateral view of IBH-RF 642. **E.** Head of IBH-RF 643. **F.** Dorsal view of IBH-RF 644. **G.** Frontal view of IBH-RF 645.

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