

Herpetofauna of Iguala de la Independencia, Guerrero, Mexico: Species richness, diversity, and local patterns of community composition

Herpetofauna de Iguala de la Independencia, Guerrero, México: riqueza, diversidad y patrones de composición a escala local

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Abstract

Land-use change is a major driver of biodiversity loss in amphibians and reptiles, yet information on species richness and community structure at local spatial scales remains limited. This study assessed the diversity and composition of the herpetofauna in the municipality of Iguala de la Independencia, Guerrero, Mexico. Field surveys were conducted between 2022 and 2023 at four sites representing the municipality's main habitat types and were complemented by occurrence records from biodiversity databases. Inventory completeness was evaluated using rarefaction curves, and alpha and beta diversity were estimated to characterize community structure. A total of 40 species were recorded, including five amphibians and 35 reptiles. Rarefaction analyses indicated an inventory completeness greater than 98% and predicted a potential richness of approximately 44 species for the municipality. Only one habitat exhibited a Shannon diversity value above 2, corresponding to the highest effective number of species ($\exp(H')$ = 9.24). Species turnover was the main component of beta diversity among habitats. The deciduous low forest showed the highest richness and diversity, although it also exhibited lower evenness among species. These findings provide new information on local-scale patterns of herpetofaunal diversity and highlight the importance of conserving heterogeneous habitats within human-modified landscapes.

Keywords: beta diversity, habitat heterogeneity, biodiversity inventory, anthropogenic disturbance.

Resumen

El cambio de uso del suelo es uno de los principales motores de la pérdida de biodiversidad de anfibios y reptiles. Sin embargo, la información sobre la riqueza de especies y la estructura de las comunidades a escala espacial local sigue siendo limitada. En este estudio se evaluaron la diversidad y la composición de la herpetofauna en el municipio de Iguala de la Independencia, Guerrero, México. Los muestreos de campo se realizaron entre 2022 y 2023 en cuatro sitios que representan los principales tipos de hábitat del municipio y se complementaron con registros de ocurrencia provenientes de bases de datos de biodiversidad. La completitud del inventario se evaluó mediante curvas de rarefacción y se estimaron las diversidades alfa y beta para caracterizar la estructura de las comunidades. En total se registraron 40 especies, incluyendo cinco anfibios y 35 reptiles. Los análisis de rarefacción indicaron una completitud del inventario superior al 98 % y predijeron una riqueza potencial de aproximadamente 44 especies en el municipio. Solo un hábitat presentó un valor del índice de Shannon superior a 2, correspondiente al mayor número efectivo de especies ($\exp(H')$ = 9.24). El recambio de especies fue el principal componente de la diversidad beta entre hábitats. La selva baja caducifolia presentó la mayor riqueza y diversidad, aunque también mostró una menor equidad entre especies. Estos resultados aportan nueva información sobre los patrones de diversidad de la herpetofauna a escala local y resaltan la importancia de conservar hábitats heterogéneos en paisajes modificados por actividades humanas.

Palabras clave: diversidad beta, heterogeneidad del hábitat, inventario de biodiversidad, perturbación antropogénica.

Introduction

In Mexico, land-use change associated with agricultural, urban expansion, and commercial or industrial development has resulted in the degradation of approximately 44.9 % of the country's soils (SEMARNAT, 2013). These processes alter the structure and functioning of ecosystems, directly or indirectly affecting biodiversity (Juan, 2021). Amphibian and reptile communities are particularly sensitive to such disturbances because their physiology and life histories are closely linked to environmental conditions, including temperature, rainfall patterns, and habitat structure. Consequently, modifications in landscape configuration derived from land-use change can negatively affect their diversity and community composition (Wanger et al., 2010; Biaggini & Corti, 2015; Cruz-Elizalde et al., 2016; Cordier et al., 2021; Schivo et al., 2023). In turn, these pressures may contribute to increases in the number of species classified as threatened by the International Union for Conservation of Nature (Nowakowski et al., 2017; Balouch et al., 2022; Cox et al., 2022; IUCN, 2026).

Although the effects of anthropogenic disturbance on terrestrial vertebrates have been widely documented (Newbold, 2018), studies evaluating the responses of reptile and amphibian communities at a local scale remain comparatively scarce. This limitation is partly related to methodological challenges associated with the study of these groups, including the rarity and low detectability of some reptile species and the frequent underestimation of amphibian richness, which often requires intensive sampling effort to obtain reliable inventories even at local scales (Fouquet et al., 2007; Rotem et al., 2020; Barnagaud et al., 2021). As a result, important gaps persist in our understanding of how amphibian and reptile communities respond to land-use change. Generating information at local scales is therefore essential, as it can reveal patterns that are not detectable at broader scales and may refine interpretations of species' conservation status. For example, populations considered globally threatened may exhibit different risk levels under local ecological conditions, and conversely, locally vulnerable populations may not be reflected in global assessments (Sulis et al., 2021).

In Mexico, systematic documentation of amphibian and reptile diversity began with the foundational works of Smith and Taylor (1945, 1948, 1950). Subsequent efforts have progressively updated national inventories, including contributions by Flores-Villela & García-Vázquez (2014), Parra-Olea et al. (2014), Smith & Lemos-Espinal (2022), and Suazo-Ortuño et al. (2023), and Ramírez-Bautista et al. (2023). Currently, approximately 423 species of amphibians and 998 species of reptiles are recognized in the country (Balderas-Valdivia & González-Hernández, 2024 & 2025). These figures represent a substantial increase compared with the 290 amphibian species and 705 reptile species reported three decades ago by Flores-Villela (1993). Despite this progress, significant gaps remain in the documentation and understanding of the Mexican herpetofauna (Ochoa-Ochoa et al., 2014).

The state of Guerrero illustrates the complexity of this knowledge gap. Its rugged topography, prolonged geological history, and climatic heterogeneity have generated a wide diversity of ecosystems. Moreover, four major biogeographical regions converge in the state—the Trans-Mexican Volcanic Belt, the Pacific Coastal Plain, the Sierra Madre del Sur, and the Balsas Basin. The latter two regions, in particular, harbor a high number of endemic amphibian and reptilian species (Saavedra & Sissom, 2004; Almazán-Núñez & Navarro, 2006; Santiago-Alvarado et al., 2016; Estrada-Márquez et al., 2021). To date, 259 herpetofaunal species have been recorded in Guerrero, including 78 amphibians (13 families and 29 genera) and 181 reptiles (32 families and 80 genera). Of these, 180 species are endemic to Mexico and 55 are restricted to the state, highlighting the high conservation value of the region's herpetofauna (Palacios-Aguilar & Flores-Villela, 2018; Pérez-Ramos et al., 2000).

Herpetological research in Guerrero has been concentrated in a limited number of municipalities. Early studies documented the fauna of specific regions, such as the work of Liner & Dundee (1969), who surveyed the area among Acapulco, Guerrero, and the Río Verde south of Pinotepa Nacional,

Oaxaca. Additional studies have focused on municipalities including Chilpancingo (Hall, 1951; Davis & Dixon, 1959, 1961, 1965; Flores-Villela & Muñoz-Alonso, 1993), Taxco (Flores-Villela & Hernández-García, 2006), Acapulco (Sánchez & López-Forment, 1987), and recently San Marcos (Ramírez-Ramírez et al., 2023). In contrast, many municipalities remain poorly explored, including Iguala de la Independencia, where current knowledge is limited to sporadic occurrence records (Bloom & Russel, 2026).

Given the limited information available for the Municipality of Iguala de la Independencia, this study aims to evaluate the distribution, richness, and diversity of amphibians and reptiles in the area by comparing representative environments differing in degree of anthropogenic alteration, particularly those affected by agricultural activities. By characterizing local patterns of community composition, this research seeks to contribute baseline information that may support future ecological and conservation studies in the region.

Materials and methods

Study area

The municipality of Iguala de la Independencia is located in the state of Guerrero, Mexico, between 18°19'42.16" and 18°20'56.59" N, and -99°25'54.65" and -99°39'4.93" W (WGS-84). It covers an area of 567.10 km², representing approximately 0.9 % of the state's territory, with elevations ranging from 500 to 1900 m a.s.l. (INEGI, 2010, 2021a).

The dominant vegetation types include induced grasslands, oak forests, low deciduous forests, palm, and reed vegetation (INEGI, 2001). Induced grasslands occur in areas where the original vegetation has been removed, particularly in zones affected by agricultural activities. The predominant soil types in the municipality include Leptosols—characterized by shallow depth, stony structure and limited development—as well as Luvisols, Phaeozems, Regosols, and Vertisols (INEGI, 2010; INEGI, 2021b).

The climate is predominantly warm subhumid with summer rainfall. The dry season runs from mid-October to mid-June, while the rainy season runs from mid-June to mid-October. The average annual temperature recorded in the municipality's center is 24.9 °C (INEGI, 2021a).

Fieldwork

The taxonomic list and associated data on the herpetofauna were obtained from sampling conducted at four sites representing different habitat types within the municipality (Figure 1):

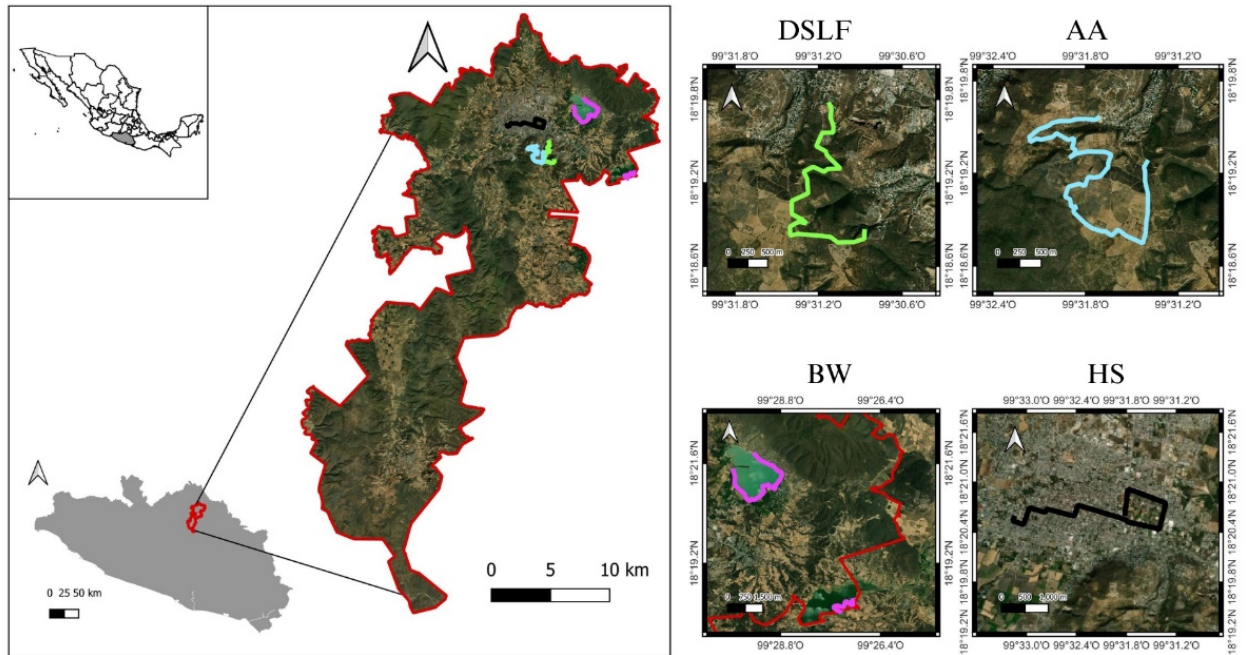
- 1) Deciduous low forest (DSLFL), located in Cerro de la Santa Cruz. This site represents the best-preserved environment among the four surveyed and is characterized by diverse plant assemblages dominated by species from the families Convolvulaceae, Asteraceae, Fabaceae, and Verbenaceae. The average annual temperature is 33.8 °C (Conagua, 2024).
- 2) Bodies of water and riparian vegetation (BW), represented by the Laguna de Tuxpan and the Valerio

Trujano dam. In recent years, the original vegetation in this area has been partially replaced by agricultural fields and commercial settlements; however, representative vegetation such as *Typha* spp. and remnant patches of deciduous low forest persist. The average temperature is 24 °C (Ortega, 2015; Mijangos & González, 2016).

3) Semi-intensive corn agricultural areas (AA) located adjacent to Cerro de la Santa Cruz. This site exhibits a high degree of anthropogenic disturbance due to extensive agricultural activity. The landscape consists of maize field with patches of induced grassland and remnants of deciduous and subdeciduous forests along field margins. The area lies below 1000 m a.s.l. and has an average temperature of 28.3 °C.

4) Human settlements (HS), located in the urban area of the city of Iguala de la Independencia. This site represents one of the most disturbed environments in the study area and consists primarily of residential areas with scattered patches of non-native ornamental vegetation. The average annual temperature is approximately 33.3 °C (Conagua, 2024).

Figure 1. Study sites showing the sampling routes in the municipality of Iguala de la Independencia.



Note. The gray figure represents the state of Guerrero, Mexico. The red line represents the municipality of Iguala de la Independencia. DSLF = deciduous low forest; AA = agricultural areas; BW = bodies of water; HS = human settlements.

Field sampling was conducted between 2022 and 2023. Each site was surveyed for approximately 6 hours per sampling event, with 3 surveys conducted during the dry season and 3 during the rainy season, resulting in a total of 24 sampling events.

Herpetofauna were recorded using the Visual Encounter Survey (VES) method with manual capture (Doan, 2003). This method consists of actively searching for individuals along pre-established routes and recording all encountered organisms (MINAM, 2015; Pereyra et al., 2021). The protocol was modified to increase the time dedicated to inspecting potential shelters for reptiles and amphibians along the sampling routes (Doan, 2003). Surveys were conducted between 09:00 and 15:00 h; nocturnal surveys were not carried out due to safety constraints. Considering the combined length of all routes across the four sites, a total of 22.71 km was surveyed during each sampling visit.

Most individuals encountered were captured for taxonomic identification and subsequently released at the site of capture. Specimens that could not be reliably identified in the field were collected and prepared as voucher specimens. All voucher material is deposited in the Amphibian and Reptile Collection of the Universidad Autónoma Metropolitana Unidad Iztapalapa (CAR-I). Field collections were conducted under SEMARNAT permit number SPARN/DGVS/00962/23 issued to Luis E. Galeana-Barrera.

Individuals that were not collected were documented photographically using a Canon T3i and T5 cameras equipped with a Canon 70–300 mm telephoto lens. These images are deposited in the Photographic Collection of Amphibians and Reptiles of the Universidad Autónoma Metropolitana Unidad Iztapalapa (CFAR-I). Each photographic record includes the specimen number, date, and the locality's geographic coordinates. Species identification was conducted using dichotomous keys and specialized literature, including Köhler & Heimes (2002), Köhler (2003), Köhler et al. (2014), Ramírez-Bautista et al. (2023), Heimes (2016), and González-Hernández et al. (2021).

The species list for the municipality of Iguala was complemented with records obtained from the public databases VertNet (Bloom & Russel, 2026), the Global Biodiversity Information Facility (<https://www.gbif.org/>), and the National Biodiversity Information System of Mexico (<https://www.snib.mx/>), which compile records from national and international scientific collections (Appendix 1). Only records located within the municipal boundaries of Iguala and corresponding to the period 1900–2023 were included. This temporal range was selected to incorporate the most recent available records, while accounting for the limited number of historical occurrences. Records lacking precise location information or with coordinates outside the municipality were excluded.

Taxonomic nomenclature and species arrangement follow Balderas-Valdivia & González-Hernández (2024, 2025) and were corroborated, when necessary, using Frost (2026) for amphibians and Uetz et al. (2026) for reptiles. Conservation status and endemism were determined according to the categories established by NOM-059 (SEMARNAT, 2019) and the IUCN Red List (IUCN, 2026).

Statistical analysis

Inventory completeness was evaluated using a rarefaction curve generated from field-sampling abundance with the iNEXT Online program (Chao et al., 2022). A sample-based rarefaction curve with 100 randomizations was generated and extrapolated to 1500 individuals. The same program was used to estimate Hill numbers for orders 0, 1, and 2 to characterize community structure (Colwell et al., 2012; Chao & Jost, 2012; Chao et al., 2014). In this framework, q_0 represents species richness (total number of observed species); q_1 weights species by their abundance without bias toward abundant or rare species, and can be interpreted as the effective number of abundant or typical species; and q_2 mainly represents dominant species, as its estimator is sensitive to species abundance (Chao et al., 2020).

Alpha diversity was estimated from field data by habitat type and for the entire study area using the

Shannon-Wiener index in PAST version 4.12b (Cruz et al., 2017). These values were subsequently transformed into true diversity following the approach proposed by Jost (2007) to facilitate comparison with the diversity estimated obtained from iNEXT.

Beta diversity among habitat types was estimated using the Sørensen dissimilarity index (β_{SOR}) following the formulation proposed by Baselga (2009). This index allows the partitioning of beta diversity into components associated with species turnover and nestedness. To quantify species turnover, Simpson's pairwise dissimilarity index (β_{SIM}) was calculated (Baselga, 2009). The nestedness component (β_{NES}) was obtained by subtraction using the relationship $\beta_{NES} = \beta_{SOR} - \beta_{SIM}$. In this framework, higher β_{SOR} values indicate greater similarity among communities (lower beta diversity), whereas lower values indicate greater compositional differentiation (Koleff et al., 2003).

Results

Based on field sampling and database records, a total of 910 herpetofauna records for 40 species were documented for the municipality of Iguala de la Independencia. These records include 5 amphibian species and 35 reptile species, representing 30 genera, 19 families, and 3 orders. One amphibian species and 16 reptile species constitute new records for the municipality (Table 1).

All recorded taxa are currently classified as Least Concern (LC) by the IUCN. However, 14 species (35%) are included in risk categories under NOM-059 (SEMARNAT, 2019), of which 10 are listed as Subject to Special Protection (Pr) and 4 as Threatened (A). Additionally, 13 species are endemic to Mexico and 2 correspond to invasive species.

Databases searches yielded 116 records representing 19 species (3 amphibians and 16 reptiles). Field sampling yielded 794 records representing 32 species (4 amphibians and 28 reptiles). Among the sampled habitats, 23 species were recorded in deciduous forest (DSLFL), 11 in agricultural areas (AA), 12 in bodies of water and riparian vegetation (BW), and 9

in human settlements (HS). According to the field data, *Sceloporus horridus* was the most abundant species in DSLFL and AA, whereas *Rhinella horribilis* dominated in BW and *Hemidactylus frenatus* in HS.

Rarefaction analyses indicated an inventory completeness greater than 95 % across all sampled habitats. The estimated species richness was 29.86 species for DSLFL, 11.86 for AA, 9.85 for HS, and 14.91 for BW. At the municipal scale (MT), the expected richness was 44.05 species (Figure 2).

Alpha diversity for the entire municipality was $H' = 2.41$. Among the sampled habitats, the highest value was recorded in DSLFL ($H' = 2.23$), whereas the remaining environments presented values lower than 2. Hill numbers indicated that DSLFL was the most diverse habitat, with $q_0 = 23$ species, of which 9 were common (q_1) and 6 were dominant (q_2). In contrast, both q_1 and q_2 values were lower in the remaining habitats (Table 2).

Table 1. Amphibian and reptile species recorded in the municipality of Iguala de la Independencia, Guerrero, Mexico. The table includes taxonomic classification (order, family, genus, species), conservation status according to NOM-059 (PR = subject to special protection, A = threatened) (SEMARNAT, 2019), distribution status (E = endemic, I = invasive), and source of the record (FW = fieldwork, DB = databases).

Order						
Family						
Genus	Species	IUCN	CR	DT	TC	BD
Squamata						
Teiidae						
<i>Aspidoscelis</i>	<i>Aspidoscelis costatus</i> (Cope, 1878)	LC	Pr	E	x	x
	<i>Aspidoscelis communis</i> (Cope, 1878)	LC	Pr	E	x	
	<i>Aspidoscelis deppii</i> (Wiegmann, 1834)	LC			x	x
	<i>Aspidoscelis sackii</i> (Wiegmann, 1834)	LC	Pr	E	x	x
Phrynosomatidae						
<i>Sceloporus</i>	<i>Sceloporus gadoviae</i> (Boulenger, 1905)	LC		E		x
	<i>Sceloporus horridus</i> (Wiegmann, 1834)	LC			x	x
	<i>Sceloporus melanorhinus</i> (Bocourt, 1876)	LC			x	x
	<i>Sceloporus ochoterena</i> (Smith, 1934)	LC			x	
	<i>Sceloporus pyrocephalus</i> (Cope, 1864)	LC			x	x
<i>Urosaurus</i>	<i>Urosaurus bicarinatus</i> (Duméril, 1856)	LC			x	
Gekkonidae						
<i>Phyllodactylus</i>	<i>Phyllodactylus delcampoi</i> (Mosauer, 1936)	LC			x	
<i>Hemidactylus</i>	<i>Hemidactylus frenatus</i> (Duméril & Bibron, 1836)	LC		I	x	x
Eublepharidae						
<i>Coleonyx</i>	<i>Coleonyx nemoralis</i> (Gray, 1845)	LC			x	
Iguanidae						
<i>Ctenosaura</i>	<i>Ctenosaura pectinata</i> (Wiegmann, 1834)	LC	A	E	x	x
	<i>Ctenosaura similis</i> (Gray, 1831)	LC	A			x
<i>Iguana</i>	<i>Iguana iguana</i> (Linnaeus, 1758)	LC	Pr			x
Helodermatidae						
<i>Heloderma</i>	<i>Heloderma horridum</i> (Wiegmann, 1829)	LC	A	E	x	
Dactyloidae						
<i>Anolis</i>	<i>Anolis quercorum</i> (Fitch, 1978)	LC			x	
	<i>Anolis nebulosus</i> (Wiegmann, 1834)	LC			x	
Scincidae						
<i>Marisora</i>	<i>Marisora aquilonaria</i> (Matthews & Hedges, 2020)	LC		E	x	
Typhlopidae						
<i>Indotyphlops</i>	<i>Indotyphlops braminus</i> (Daudin, 1803)	LC			x	

Order						
Family						
Genus	Species	IUCN	CR	DT	TC	BD
Bipedidae						
<i>Bipes</i>	<i>Bipes canaliculatus</i> (Latreille, 1801)	LC	Pr	E		x
Colubridae						
<i>Salvadora</i>	<i>Salvadora mexicana</i> (Duméril, Bribón & Duméril, 1854)	LC	Pr	E	x	x
<i>Drymarchon</i>	<i>Drymarchon melanurus</i> (Duméril, Bribón & Duméril, 1854)	LC			x	
<i>Senticolis</i>	<i>Senticolis triaspis</i> (Cope, 1866)	LC			x	
<i>Pseudoficimia</i>	<i>Pseudoficimia frontalis</i> (Cope, 1864)	LC			x	
<i>Drymobius</i>	<i>Drymobius margaritiferus</i> (Schlegel, 1837)	LC			x	
<i>Masticophis</i>	<i>Masticophis mentovarius</i> (Duméril, Bribón & Duméril, 1854)	LC				x
	<i>Masticophis flagellum</i> (Shaw, 1802)	LC	A			x
<i>Trimorphodon</i>	<i>Trimorphodon biscutatus</i> (Duméril, Bribón & Duméril, 1854)	LC			x	
Viperidae						
<i>Crotalus</i>	<i>Crotalus culminates</i> (Klauber, 1952)	LC	Pr		x	
Loxocemidae						
<i>Loxocemus</i>	<i>Loxocemus bicolor</i> (Cope, 1861)	LC	Pr			x
Dipsadidae						
<i>Leptodeira</i>	<i>Leptodeira maculata</i> (Hallowell, 1861)	LC	Pr	E	x	
Testudines						
Kinosternidae						
<i>Kinosternon</i>	<i>Kinosternon integrum</i> (Le Conte, 1854)	LC	Pr	E	x	
Emydidae						
<i>Trachemys</i>	<i>Trachemys scripta</i> (Thunberg In Schoepff, 1792)	LC		I	x	
Anura						
Bufonidae						
<i>Rhinella</i>	<i>Rhinella horribilis</i> (Wiegmann, 1833)				x	
<i>Incilius</i>	<i>Incilius perplexus</i> (Taylor, 1943)	LC		E		x
Leptodactylidae						
<i>Leptodactylus</i>	<i>Leptodactylus melanonotus</i> (Hallowell, 1861)	LC			x	x
Hylidae						
<i>Smilisca</i>	<i>Smilisca baudinii</i> (Duméril & Bibron, 1841)	LC			x	
<i>Agalychnis</i>	<i>Agalychnis dacnicolor</i> (Cope, 1864)	LC		E	x	x

Table 2. Hill numbers and sampling completeness for each study site and the entire municipality.

Site	q0 observed	q0 extrapolated	q1 observed	q1 extrapolated	q2 observed	q2 extrapolated	Completeness (%)
DSLFL	23	29.86	8.85	9.30	6.04	6.11	95.57
AA	11	11.86	5.40	5.50	4.06	4.08	99.07
HS	9	9.86	4.13	4.23	3.14	3.17	98.53
BW	12	14.91	6.23	6.37	4.80	4.84	98.20
MT	32	44.05	10.98	11.21	7.56	7.59	98.36

Note. q0 = observed species richness; q1 = effective number of common species; q2 = effective number of dominant species. Extrapolated values were estimated using rarefaction–extrapolation analyses. DSLFL = deciduous low forest; AA = agricultural areas; HS = human settlements; BW = bodies of water; MT = entire municipality.

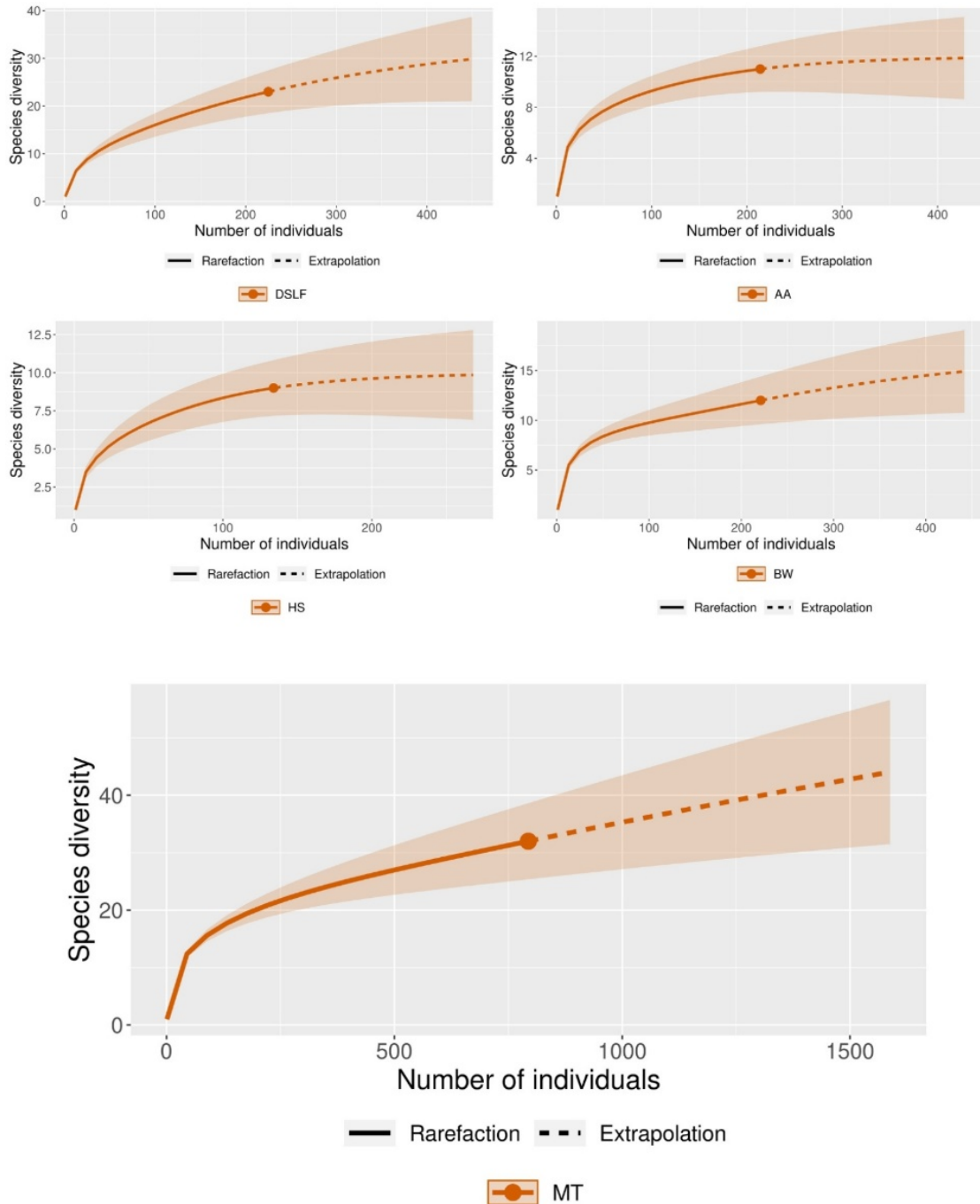
Table 3. Pairwise Sørensen dissimilarity and its components among study sites.

Comparison	β_{SOR}	β_{SIM}	β_{NES}
DSLFL – AA	0.47	0.18	0.29
DSLFL – BW	0.71	0.58	0.13
DSLFL – HS	0.50	0.11	0.39
AA – BW	0.47	0.45	0.02
AA – HS	0.60	0.55	0.05
BW – HS	0.71	0.66	0.05

Note. β_{SOR} = Sørensen dissimilarity; β_{SIM} = Simpson dissimilarity (species turnover component); β_{NES} = nestedness-resultant component of beta diversity. DSLFL = deciduous low forest; AA = agricultural areas; HS = human settlements; BW = bodies of water.

Regarding beta diversity, BW showed the highest similarity with DSLFL and HS, whereas the lowest similarity values were observed between AA–DSLFL and AA–BW (Table 3). Accordingly, the highest compositional dissimilarity occurred between AA— one of the most disturbed sites and the most conserved sites— and the more conserved habitats (DSLFL and BW).

Figure 2. Rarefaction curves (95% confidence intervals) of estimated species richness for the four sampled sites and the entire municipality.



Note. DSLF = deciduous-subdeciduous low forest; AA = agricultural areas; HS = human settlements; BW = bodies of water.

Discussion

The results of this study indicate that the herpetofauna of the municipality of Iguala de la Independencia comprises 40 species of amphibians and reptiles, representing 15.44% of the herpetofaunal diversity reported for the State of Guerrero (Palacios-Aguilar & Flores-Villela, 2018). This richness is lower than that documented for other municipalities such as Acapulco, where Sánchez & López-Forment (1987) reported 61 taxa based on four years of field sampling. A similar richness (43 species) has been reported for the Sierra de Taxco, despite the fact that this region encompasses a larger area—including several municipalities in Guerrero (Alpoyeca, Tetipac, Pilcaya, and Taxco de Alarcón) and localities in the State of Mexico—and was surveyed with greater sampling effort than in the present study (Flores-Villela & Hernández-García, 2006). In contrast, the number of species recorded in Iguala slightly exceeds that reported for the municipality of Chilpancingo, where 39 species have been documented (Flores-Villela & Muñoz-Alonso, 1993). Considering that sampling in the present study was conducted over a single year, restricted to four sites, and consisted of six surveys per site, it is likely that documented richness underestimates the total herpetofaunal diversity of the municipality. This expectation is supported by the rarefaction analyses, which predict a potential richness of approximately 44 species.

The thirteen endemic species recorded in Iguala represent 30% of the municipality's herpetofauna, a notable proportion given that 180 endemic taxa occur in the state, representing approximately 20% of the reptile and amphibian species endemic to Mexico (Palacios-Aguilar & Flores-Villela, 2018; Ramírez-Bautista et al., 2023). This relatively high level of endemism is likely associated with the environmental conditions characteristic of the Balsas Basin, including the geographic isolation of tropical dry ecosystems, altitudes gradients ranging from 300 to 2000 m a.s.l., and temperatures between 28 and 30°C. These conditions promote environmental heterogeneity and the formation of microhabitats

that may facilitate local adaptation and speciation processes in both plant and animal taxa (Saavedra & Sissom, 2004; Almazán-Núñez & Navarro, 2006; Estrada-Márquez et al., 2021).

In contrast, the climatic conditions prevailing in the municipality—particularly high temperatures and low soil moisture—may limit amphibian diversity (Tsianou et al., 2021), potentially increasing their vulnerability to local extinction if their thermal limits are exceeded (Duarte et al., 2011). Additionally, the limited representation of amphibians in this study may partly reflect methodological constraints, as sampling was conducted exclusively during daylight hours and did not include twilight or nocturnal surveys, periods during which many amphibian species are more active.

Among the recorded taxa, the presence of the exotic gecko *Hemidactylus frenatus* is noteworthy. This species was recorded primarily in HS, one of the most disturbed environments, although two observations were also obtained in DSLF. *H. frenatus* is commonly associated with urban environments, where it exploits artificial lighting to prey upon insects attracted to light sources (Díaz-Pérez et al., 2017). Although only two records were obtained in DSLF, its occurrence in this habitat suggests the possibility of expansion into more natural environments. This could represent a potential threat to native gecko species such as *Phyllodactylus delcampoi*, as *H. frenatus* has been reported to exhibit more aggressive and territorial behavior than native geckos and may compete for food resources (Bolger & Case, 1992). Continued expansion into natural habitats could therefore lead to competitive displacement or local declines of native species (Bolger & Case, 1992; Case et al., 1994; Dame & Petren, 2006).

In the diurnal assemblage, the dominance of *S. horridus* in DSLF and AA is consistent with previous reports describing the species as associated to arboreal and rocky substrates (Bustos-Zagal et al., 2013). It has also been documented as abundant in grasslands and agricultural landscapes (Téllez, 2005), which corresponds with the patterns observed in AA. In DSLF, its abundance may be related to the presence

of trees approximately 7–8 m in height, which provide suitable substrates for basking and thermoregulation (Trejo, 1999). Similarly, the dominance of *R. horribilis* in BW likely reflects its frequent use of temporary aquatic environments and its preference for humid areas, open habitats, and anthropogenic grasslands (Cortés-Suárez, 2017; Bolívar, 2021; Rosas-Espinoza et al., 2022). Its relatively large body size may also confer greater resistance to desiccation compared with smaller anuran species (Tracy et al., 2010), which could contribute to its higher abundance.

Following Margalef (1972) interpretation of Shannon-Wiener index values, diversity values below 2 indicate low diversity, values between 2 and 3.5 correspond to intermediate diversity, and values above 3.5 indicate high diversity. Based on this classification, the overall herpetofaunal diversity of Iguala de la Independencia can be considered intermediate ($H' = 2.41$). Among the sampled habitats, DSLF exhibited intermediate diversity ($H' = 2.23$), whereas the remaining environments showed values below 2, indicating lower diversity. This pattern may reflect the greater representation of tropical dry forest within the municipality (35.83%) and throughout the Balsas Basin (INEGI, 2001), ecosystems that have been recognized for supporting relatively high faunal diversity compared with other vegetation types in the region (Challenger, 1998; Trejo & Dirzo, 2002; Trejo, 1998).

Although DSLF exhibited the highest species richness and the highest values of true diversity value among the sampled sites, the community structure suggests relatively low evenness. As noted by Pla (2006), the greater the difference between the observed number of species and the effective number of species, the lower the evenness of the community. Additionally, a greater reduction in diversity signifies less equity in the community structure (Zelený, 2026). In DSLF, richness decreased from 23 observed species (q_0) to 8.85 effective species (q_1), representing a reduction of 61.52%. A similar pattern is reflected in the diversity of order 2 (q_2), which indicates the presence of 6.04 dominant species (Hsieh et al., 2016). Comparable patterns were observed in the remaining

habitats. In contrast, BW exhibited the smallest reduction between observed and effective richness (48.08%), suggesting a more even distribution of individuals among species.

Despite its higher richness, DSLF therefore appears to contain a greater number of poorly represented species. Reduced evenness may result from the increasing dominance of generalist taxa, a pattern frequently associated with anthropogenic disturbance and habitat modification (Hillebrand et al., 2008; Bastazini et al., 2021). Such shifts in species dominance can alter both intra- and interspecific interactions and increase disparities in species abundances within communities (Hillebrand et al., 2008). This pattern is also evident when considering the municipality as a whole (MT), where effective diversity represents a reduction of 65.68% relative to the total number of species recorded ($n = 32$). These results are consistent with the proposition by Hillebrand et al. (2008) that anthropogenic disturbances can modify dominance patterns, reduce habitat heterogeneity, and consequently influence beta diversity patterns.

Pairwise comparisons using the Sørensen dissimilarity index revealed relatively high beta diversity between DSLF-AA and DSLF-HS. In both cases, the dissimilarity is largely explained by the nestedness component, indicating that communities in more disturbed habitats represent subsets of those occurring in better-preserved environments, likely reflecting species loss associated with habitat degradation (Baselga, 2009). Similar patterns have been widely documented in agricultural landscapes (Glor et al., 2001; Trimble & Aarde, 2014; Biaggini & Corti, 2015; Fulgence et al., 2021) and urban environments (Hamer & McDonnell, 2009; Semple et al., 2021; Marsh et al., 2023), where increasing disturbance is typically associated with reductions in species richness and abundance.

In contrast, beta diversity patterns among BW-DSLF, BW-AA, BW-HS, and AA-HS were primarily driven by species turnover, species replacements along environmental gradients (Baselga, 2009; Qian et al., 2009). These differences are expected given the

contrasting environmental characteristics of BW—represented by the Laguna de Tuxpan—relative to the other habitats. For instance, BW has a mean annual temperature of approximately 24°C, whereas DSLF and AA range between 26 and 31 °C. Additionally, soils surrounding BW consist primarily of clay-rich pelic Vertisols and chromic Cambisols, whereas the other sampled sites are dominated by Leptosols (INEGI, 2010; Ortega, 2015; Mijangos & González, 2016). Such environmental differences likely contribute to the observed variation in species composition among habitats.

Conclusions

The herpetofaunal community of the municipality of Iguala de la Independencia comprises 40 species of amphibians and reptiles. Of these, 14 species are included in risk categories under NOM-059, 13 are endemic to Mexico, and two correspond to exotic species. According to the Shannon-Wiener index, the overall ecological diversity of the municipality can be classified as intermediate.

Rarefaction analyses suggest that the expected richness may reach approximately 44 species, indicating that additional sampling efforts would likely increase the number of recorded taxa and contribute to a more complete inventory of the local herpetofauna. Despite the limited spatial coverage and sampling duration of this study, the species richness documented for Iguala is comparable to that reported in other nearby localities.

The beta diversity analyses highlight the influence that anthropogenic disturbance on the ecosystems within the municipality, affecting both the composition and structure of amphibian and reptile communities. Future research should therefore incorporate ecological attributes at the species level—such as diet, reproductive strategies, and behavioral traits— to better evaluate functional diversity, sensitivity to environmental disturbance, and potential conservation risks.

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Authors' contributions

Luis Enrique Galeana Barrera collected field data and conducted analyses that served as the basis for this study. Matías Martínez Coronel contributed by revising the manuscript for style and structure, performing complementary diversity analyses, providing relevant literature, and assisting with the taxonomic identification of collected specimens. Aarón García Rosales contributed to the revision of the manuscript and assisted in the identification of the collected taxa. Raciél Cruz Elizalde reviewed the manuscript, provided relevant literature, and contributed to the interpretation and presentation of the results.

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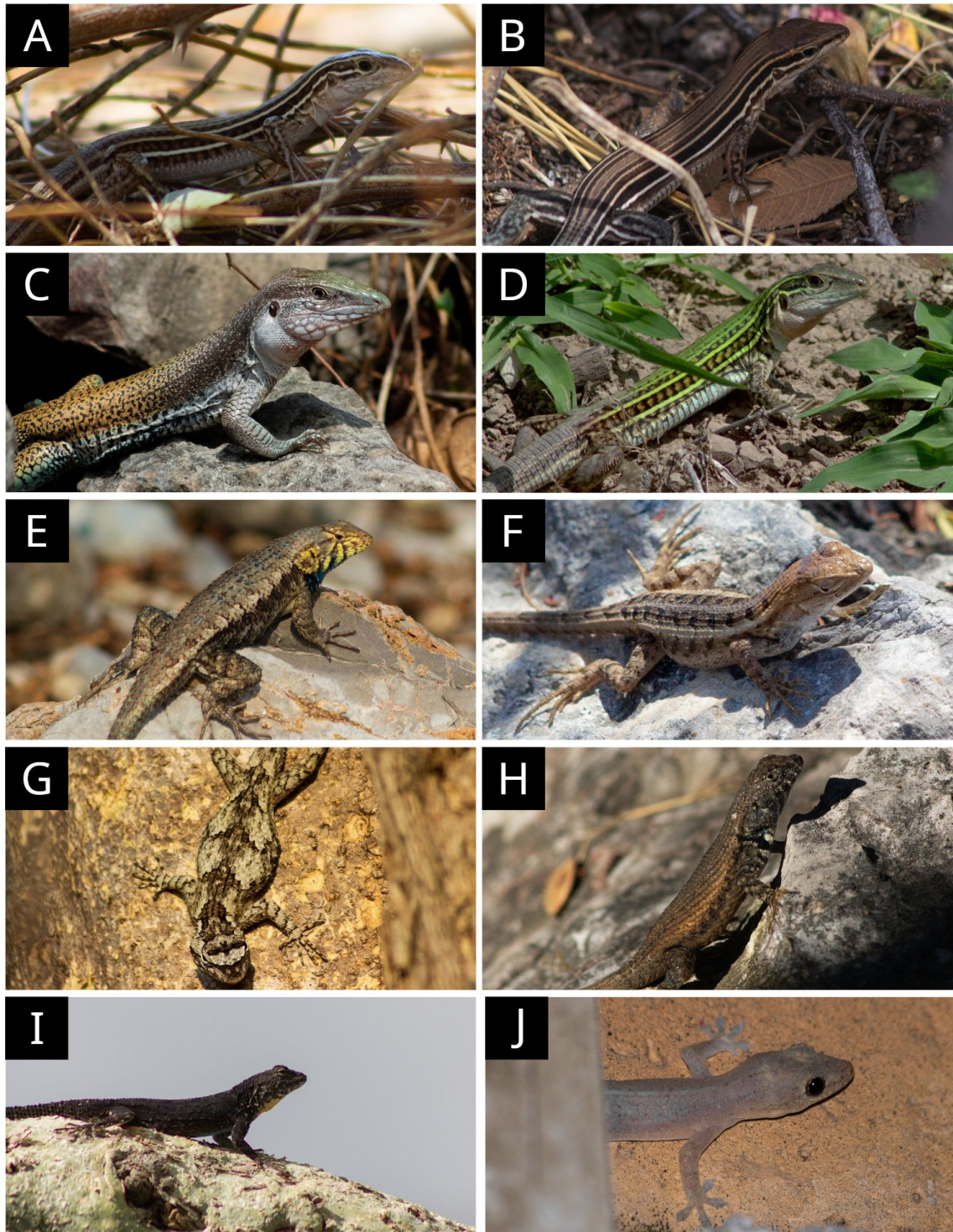
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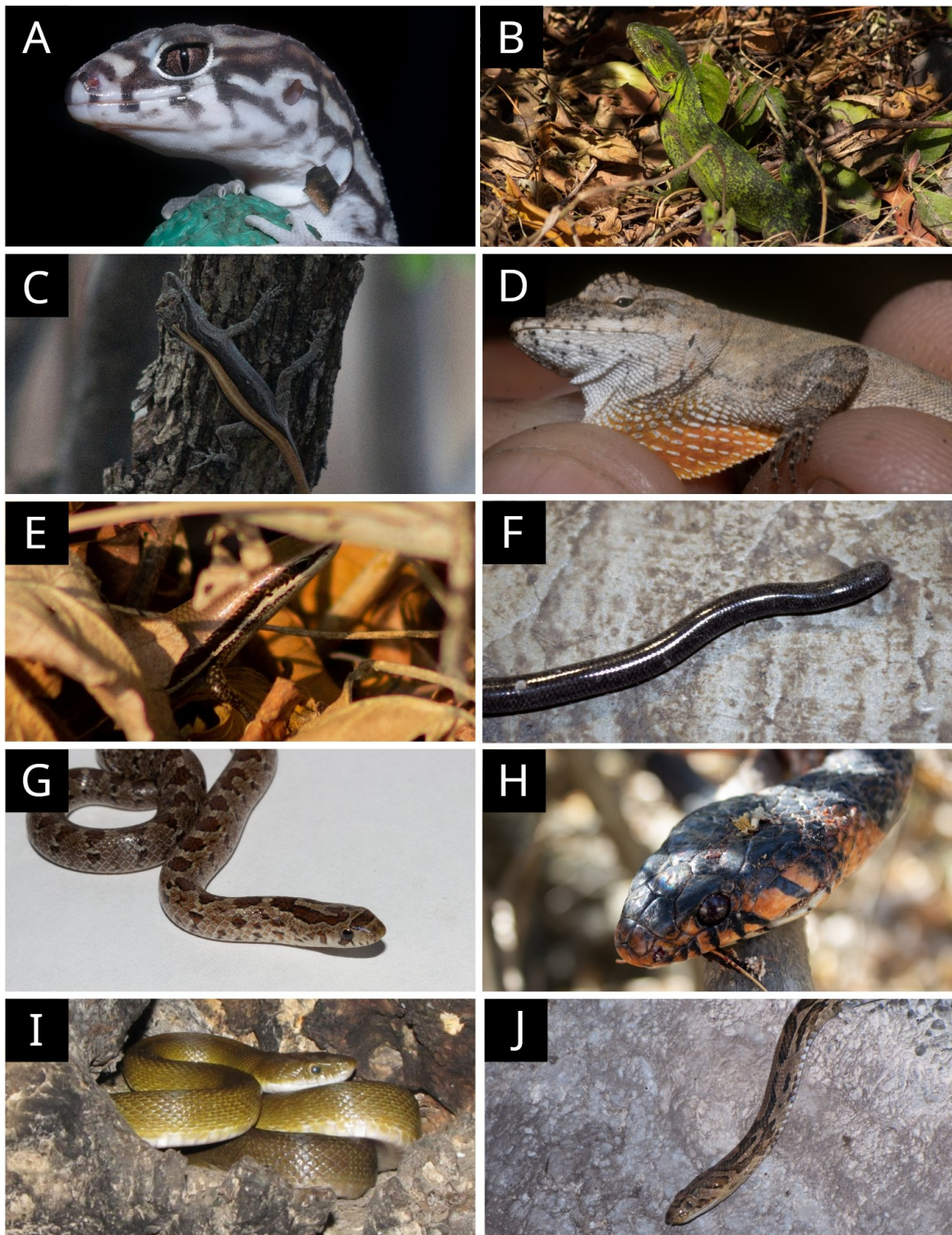
Appendix

Figure 3. Amphibian and reptile species recorded in the municipality of Iguala de la Independencia, Guerrero, Mexico.



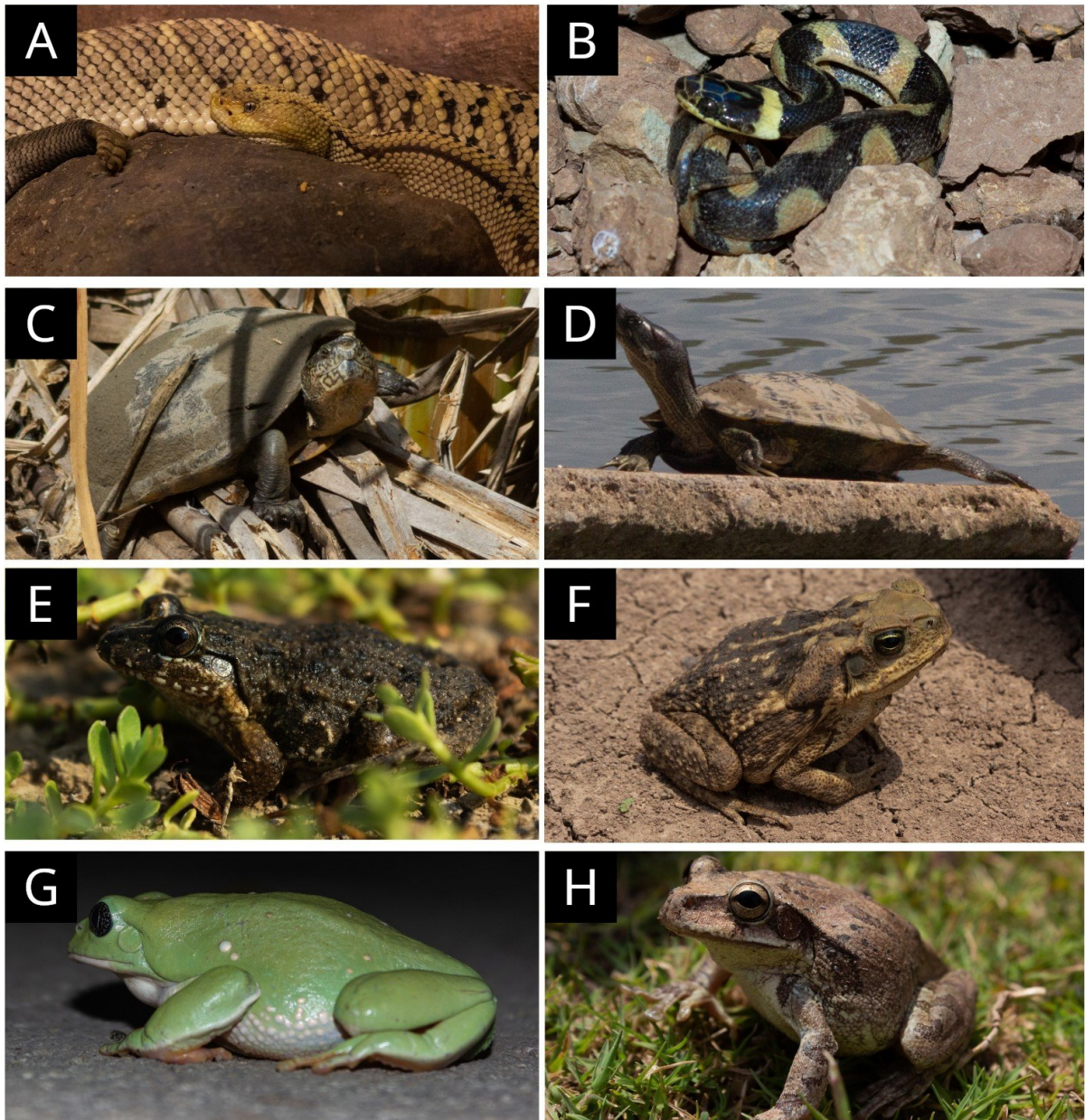
Note. A) *Aspidoscelis costatus*; B) *Aspidoscelis deppii*; C) *Aspidoscelis sackii*; D) *Aspidoscelis communis*; E) *Sceloporus horridus*; F) *Sceloporus ochotorenae*; G) *Sceloporus melanorhinus*; H) *Sceloporus pyrocephalus*; I) *Urosaurus bicarinatus*; J) *Hemidactylus frenatus*.

Figure 4. Amphibian and reptile species recorded in the municipality of Iguala de la Independencia, Guerrero, Mexico.



Note. A) *Coleonyx nemoralis*; B) *Ctenosaura pectinata* (juvenile); C) *Anolis quercorum*; D) *Anolis nebulosus*; E) *Marisora aquilonaria*; F) *Indotyphlops braminus*; G) *Pseudoficimia frontalis*; H) *Drymarchon melanurus*; I) *Senticolis triaspis*; J) *Trimorphodon biscutatus*.

Figure 5. Amphibian and reptile species recorded in the municipality of Iguala de la Independencia, Guerrero, Mexico.



Note. A) *Crotalus culminatus*; B) *Leptodeira maculata*; C) *Kinosternon integrum*; D) *Trachemys scripta*; E) *Leptodactylus melanonotus*; F) *Rhinella horribilis*; G) *Agalychnis dacnicolor*; H) *Smilisca baudinii*.