



Updated Distribution Range of two Worm Lizard Species (*Amphisbaena alba* and *A. fuliginosa*) Based on Citizen Science and Literature Review

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Citizen Science (CS) refers to the participation of the public in the collection and processing of scientific data, often in collaboration with professional scientists (Kullenberg and Kasperowski 2016; Strasser et al. 2019). The term encompasses various forms of partnership between scientists and individuals interested in science, ranging from structured initiatives with standardized protocols to unstructured initiatives, such as iNaturalist, in which sampling sites and targets are not predefined and participants autonomously choose what and where to record observations (Bonney et al. 2009; Welvaert and Caley 2016; Mandeville et al. 2022). The combination of academic and CS data contributes to a better understanding of biodiversity, as they are generally complementary, mitigating different limitations related to the collection of biodiversity data (Díaz-Calafat et al. 2024; Zani 2024). Furthermore, CS has emerged as a promising approach to fill gaps in knowledge about biodiversity, particularly in understanding the geographic distribution of species, which is essential for reducing gaps in our knowledge,

which is known as the Wallacean shortfall (Hortal et al. 2015; Santos et al. 2023).

With the advent of online CS platforms, especially iNaturalist, which receives thousands of photographic records daily (Maritz and Maritz 2020; Dimson and Gillespie 2023), the knowledge about various species, particularly regarding their natural history and geographical distribution, has expanded substantially (e.g., Oliveira and Costa 2022; Cacciali and Maneyro 2024; Lacerda et al. 2024). The integration of CS data with scientific collections and literature is particularly important for reptiles (Forti et al. 2024), especially for wormlizards (Amphisbaenia), a poorly known group of legless squamates (Colli et al. 2016; Guedes et al. 2023).

Many amphisbaenian species are rarely observed due to their fossorial habits; however, *A. alba* and *A. fuliginosa* are more frequently encountered, not only because of their larger size, but also because they often forage above ground, usually during the day (e.g., Gorzula et al. 1977; Gorzula and Señaris 1998; Lemos and Facure 2007; Ray et al. 2015). *Amphisbaena*



Figure 1. A Red Wormlizard (*Amphisbaena alba*; ZRC: IMG 2.714) from Feijó, Acre, Brazil (left) and a Speckled Wormlizard (*Amphisbaena fuliginosa*; ZRC: IMG 2.715) from Palmas, Tocantins, Brazil (right). Photographs via iNaturalist (CC BY-NC 4.0) by Catia Furtado and Tulio Dornas. Photographic vouchers deposited at the Lee Kong Chian Natural History Museum, National University of Singapore.

fuliginosa and *A. alba* are, respectively, the two species most frequently recorded on iNaturalist, with 687 records for the former and 556 for the latter (as of 5 January 2026). They stand out for their large body sizes (810 mm and 555 mm, respectively) (Colli and Zamboni 1999; Vanzolini 2002a) and wide geographic distributions (Ibáñez et al. 2019; Hladki et al. 2019; Colli et al. 2016).

Amphisbaena alba is likely the most widely distributed species within the genus, with a range that extends from northern Colombia to southern Brazil in all South American countries except Argentina, Chile, Ecuador, and Uruguay. Records from Panama are questionable (Jaramillo et al. 2010). In Brazil, it has been recorded in all federal units except Acre and Rio Grande do Sul (Colli et al. 2016; Guedes et al. 2023). Although many species of wormlizards are difficult to identify without close examination of annuli and preloacal pore counts, adult *A. alba* can be readily identified by their large size, short tail lacking an autotomy site, and a uniformly yellowish to tan dorsum (Gans 1962; Vanzolini 2002b).

The geographic range of *A. fuliginosa* extends from Panama¹ to central-western Brazil, with isolated records in eastern Brazil (Roberto et al. 2021). It is a polytypic species with five subspecies based mostly on differences in color patterns (*A. f. fuliginosa*, *A. f. amazonica*, *A. f. bassleri*, *A. f. varia*, and *A. f. wiedi*) (Vanzolini 2002a), sometimes considered different species (e.g., Gans 2005; Muñoz et al. 2023). Individuals of *A. fuliginosa* (sensu lato) are easily identified by their size, longer tail (with an autotomy site) and pattern (black with white blotches or white with black blotches) (Vanzolini 2002a).

We routinely identify records of *Amphisbaena* on iNaturalist, which already has led to some interesting results that include range extensions and natural history novelties (e.g., Oliveira et al. 2023; Paiva et al. 2022, 2023, 2025). While reviewing records assigned to *A. alba* and *A. fuliginosa*, four cases caught our attention for having been recorded in Brazilian states where the presence of these species had not been previously confirmed (Guedes et al. 2023). The first record (Furtado 2024) for *A. alba* (Fig. 1) was on 9 December 2023 in Feijó, Acre, Brazil (-8.17720, -70.33554; elev. 167 m asl). The nearest literature record is approximately 284 km to the southwest in Alto Purus National Park, Peru (Padial et al. 2016). The second record by Lusvardi (2023) of *A. alba* on 25 February 2023 in Rio Branco, Acre (-9.98397, -67.86207; elev. 172 m asl), approximately 144 km southeast of the nearest record, in Guayaramerín, Bolivia (Dirksen and De la Riva 1999). The third record of *A. alba* (Serrano 2025) in the state of Acre was in the municipality of Epitaciolândia

on 26 November 2021 (-10.89091, -68.31313; elev. 240 m asl), approximately 160 km east of the nearest record in Guayaramerín, Bolivia (Dirksen and De la Riva 1999). These new records of *A. alba* from Acre fill a gap of about 690 km between Alto Purus National Park (Peru) (Padial et al. 2016) and Benjamin Constant (Amazonas, Brazil) (Vanzolini 1968) and 690 km between Alto Purus National Park and Fazenda Sheffer (Amazonas, Brazil) (Avila-Pires et al. 2009). The fourth record (Dornas 2024) is of an *A. fuliginosa* (Fig. 1) on 8 February 2024 in Palmas, Tocantins, Brazil (-10.22703, -48.15065; elev. 645 m asl). The nearest literature record is approximately 348 km to the south in Cavalcante, Goiás (Moreira et al. 2009), and the new record fills a gap of approximately 840 km in a straight line between Cavalcante (Moreira et al. 2009) and Paragominas (Pará, Brazil) (Vanzolini 2002a).

Methods

These findings prompted a review and revision of the geographic distribution of these two species. We searched for records of *Amphisbaena alba* and *A. fuliginosa* on Google Scholar, issues of *Herpetological Review* (which are not always indexed by Google Scholar), and consulted our personal libraries. We did not consult the gray literature (e.g., academic dissertations, theses, and reports) as such sources are often not considered formal publications and may lack rigorous peer-review. For records without precise coordinates, we georeferenced the localities using gazetteers (e.g., IBGE 2011; Paynter 1982, 1992) and Google Earth v.7.3 (Google 2024). We discarded imprecise records, such as state or national centroids, as well as dubious and duplicate records. In addition, we downloaded and confirmed the identification of all records classified as Research Grade on iNaturalist through 5 January 2026. By combining both sources, we obtained a total of 1,498 occurrence records for *A. alba* and 1,196 for *A. fuliginosa* (Table S1; <https://doi.org/10.5281/zenodo.18162937>). Based on these data, using QGIS v.3.38 (QGIS Development Team 2026), we created a map (Fig. 2) including all currently known localities for each species. Finally, we classified the species occurrence points into biomes according to Dinerstein et al. (2017). Our updated database and maps recorded an increase of over 781% in records for *A. alba* and over 1,070% for *A. fuliginosa* when compared to the databases by Colli et al. (2016) and Roberto et al. (2021), highlighting the importance of these types of data.

Results and Discussion

For *Amphisbaena alba* (Fig. 2; Table S1), the northernmost record is from the municipality of Gómez, Margarita Island, Nueva Esparta, Venezuela, based on CS data via iNaturalist (Taranenko 2024). Previously, the northernmost known occurrence was in the Los Besotes Wildlife Sanctuary, Colombia (Medina-Rangel 2011). The southernmost limit

¹ After this work was accepted for publication, Sosa-Bartuano et al. (2016) published a review of records of *Amphisbaena fuliginosa* in Panama, including new reports and corrections.

of the species' distribution is in Joinville, Santa Catarina, Brazil (Vanzolini 1955). The easternmost record is from João Pessoa, Paraíba, Brazil, also documented via CS (da Rocha 2024). Prior to this, the easternmost known limit was Recife, Pernambuco (Vanzolini 1968). Finally, the westernmost record is from Rioja, San Martín, Peru, likewise obtained through CS (Schulte 2011); until then, the west-

ernmost known locality was Moyobamba, in the same region (Boulenger 1885).

For *A. fuliginosa* (Fig. 2; Table S1), the northernmost record is from Santa Marta, Magdalena Department, Colombia, based on a CS observation by Minca (2019). Previously, the northernmost known locality was Las Lapas, Acosta, Falcón, Venezuela (Mijares-Urrutia and Arends

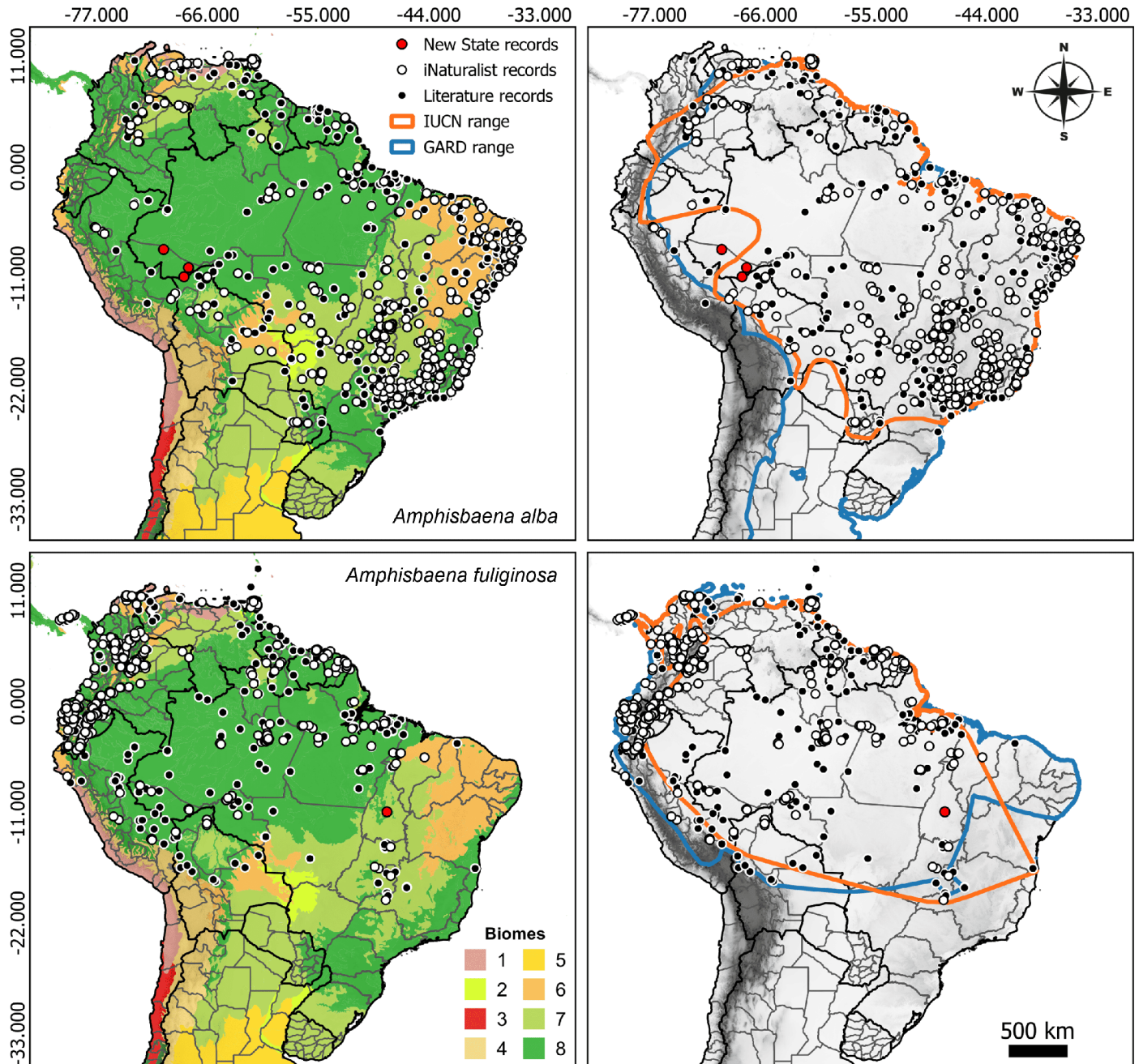


Figure 2. Updated distribution maps for the Red Wormlizard (*Amphisbaena alba*) (top) and the Speckled Wormlizard (*Amphisbaena fuliginosa*) (bottom). Red dots = new state records.; black dots = literature records; white dots = iNaturalist records. For details on literature and citizen science records, refer to Table S1 (<https://doi.org/10.5281/zenodo.18162937>). Orange outlines mark the ranges illustrated in the most recent IUCN assessments by Hladik et al. (2019) and Ibáñez et al. (2019) and blue outlines those in the Global Assessment of Reptile Distributions (GARD) by Roll et al. (2017) and Caetano et al. (2022). Biomes follow Dinerstein et al. (2017): 1 = deserts and xeric shrublands; 2 = flooded grasslands and savannas; 3 = Mediterranean forests, woodlands, and scrub; 4 = montane grasslands and shrublands; 5 = temperate grasslands, savannas, and shrublands; 6 = tropical and subtropical dry broadleaf forests; 7 = tropical and subtropical grasslands, savannas, and shrublands; 8 = tropical and subtropical moist broadleaf forests.

1993). Additionally, more northerly records of possibly introduced individuals exist for the Barre de L'Isle Forest Reserve, Saint Lucia (Murphy et al. 2010). The southernmost limit of the species' distribution is in Uberlândia, Minas Gerais, Brazil, also based on CS data (Venancio 2018). Prior to this, the southernmost known locality was Araguari, Minas Gerais (Nogueira-Costa et al. 2013). The easternmost record is from Belmonte, Bahia (Vanzolini 1951), whereas the westernmost is in the city of Colón, Colón Province, Panama (Ray et al. 2015).

Both species occur across a range of tropical and subtropical biomes (sensu Dinerstein et al. 2017), although with notable differences. *Amphisbaena alba* has been recorded in tropical and subtropical dry broadleaf forests (e.g., Caatinga and Chiquitano dry forests); tropical and subtropical grasslands, savannas, and shrublands (e.g., Cerrado, Chaco, Beni savanna, and Llanos); tropical and subtropical moist broadleaf forests (e.g., Amazonia and especially the Atlantic Forest); and flooded grasslands and savannas (Pantanal). *Amphisbaena fuliginosa* has been recorded primarily in tropical and subtropical moist broadleaf forests (e.g., Amazonia and Chocó-Darién forests) and in tropical and subtropical grasslands, savannas, and shrublands (e.g., Cerrado and Guiana savannas); it also occurs in tropical and subtropical dry broadleaf forests (e.g., Chiquitano and Venezuelan dry forests), and a few records are within or adjacent to deserts and xeric shrublands (e.g., Guajira–Barranquilla xeric scrub) and montane grasslands and shrublands (e.g., Andean puna and páramo).

Amphisbaena alba and *A. fuliginosa* occur on both sides of the Andes, but trans-Andean records are much more common for *A. fuliginosa* (Fig. 2). Despite their broad distributions in tropical forests, few records for either species exist in southeastern and western Amazonia, which could be more reflective of sampling bias than true absence (Lima Moraes et al. 2022; Carvalho et al. 2023; Penhacek et al. 2025). Although *A. fuliginosa* occupies a broad range of environments, in contrast to *A. alba*, it has not yet been recorded in flooded grasslands and savannas (Pantanal ecoregion). Conversely, although *A. alba* is common throughout much of the Brazilian Atlantic Forest, *A. fuliginosa* (subspecies *A. f. wiedi*) is represented by few records in that region (Vanzolini 2022a). Finally, an “isolated” record of *A. fuliginosa* in the Caatinga region of northeastern Brazil (Fig. 2) is associated with moist forest enclaves, locally known as brejos de altitude (Roberto et al. 2021; Loebmann and Haddad 2010).

Amphisbaena alba exhibits high genetic diversity, suggesting that it might constitute a species complex (Mott and Vieites 2009), whereas *A. fuliginosa*, although also widely distributed, shows molecular evidence of gene flow between disjunct populations, indicating greater genetic cohesion (Mott and Vieites 2009). In any case, a formal taxonomic

analysis is needed to clarify the status of the “subspecies” of *A. fuliginosa*.

The distributions of both species as presented in the most recent IUCN Red List assessments (Ibáñez et al. 2019; Hladki et al. 2019) are outdated. For *A. alba*, records from Peru, Venezuela, and the municipality of Feijó, Acre, Brazil (including one of the new records reported in this study) fall outside the IUCN's current distribution polygon. In the case of *A. fuliginosa*, occurrences outside the polygon are documented in Bolivia, Peru, Ecuador, Colombia, Venezuela, and northeastern Brazil (Fig. 2). Furthermore, *A. fuliginosa* should not be expected in the area within the IUCN polygon between the known records from the Atlantic Forest and the Cerrado. The Atlantic Forest records likely represent a population once connected to Amazonia (Prates et al. 2016).

Comparisons with polygons in the Global Assessment of Reptile Distributions (GARD) (Roll et al. 2017; Caetano et al. 2022) and the known distributions of the species reveal substantial inconsistencies, suggesting the need for a revision of the range maps. For *A. alba*, the polygon extends into central Argentina, well beyond the southern limit documented in the literature. For *A. fuliginosa*, although the general outline resembles the expected distribution, the polygon encompasses almost the entirety of northeastern Brazil (where no records exist) and places the isolated population in the state of Bahia north of its actual location (Fig. 2).

These results underscore the key role of citizen-science platforms in bridging knowledge gaps about wormlizards and in addressing the Wallacean shortfall. The growing number of reliable records on platforms such as iNaturalist not only expands our understanding of species distributions but also highlights regions where sampling remains scarce. We therefore stress the importance of academic engagement with these tools and encourage their wider use by the community (Callaghan et al. 2022). However, we recognize that for many taxa, image-based identification can be misleading, thereby limiting the applicability of CS platforms. Nevertheless, when viable, such collaborative efforts are essential for improving biodiversity data, updating species assessments, and informing conservation strategies for poorly known taxa such as amphisbaenians.

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