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New occurrence records of *Lepidodactylus lugubris* (Duméril & Bibron, 1836) (Squamata: Gekkonidae) for the amazon and atlantic forest in Brazil

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Locality: Brazil, Pará, Capitão Poço, 1°45'7.1676" S; 47°3'50.5728" W. Annelise Batista D´Angiolella, 11/02/2018. MPEG 32963. Osvaldo Rodrigues da Cunha Herpetological Collection, Museu Paraense Emílio Goeldi (MPEG). Brazil, Pará, Breves, 1°40'56.222" S; 50°28'58.933" W. Lywouty Reymond, 06/24/2020. Specimen photographed and released. Brazil, Bahia, Salvador, 12°59'56.983" S; 38°31'4.969" W. Ben Phalan and Luciana Leite, March, and June 2019. Specimens were filmed, photographed and these observations were archived on the citizen science site iNaturalist.

Comments: The mourning gecko, *Lepidodactylus lugubris* (Duméril and Bibron, 1836), is native to southwest Pacific, and has been introduced to a range of tropical and subtropical localities from the Seychelles to Latin America (Bauer and Henle, 1994; Ineich, 1999; Uetz *et al*., 2016). It is a nocturnal species, with a generalist diet (e.g., Ota, 1994; Savage, 2002; Nafus, 2012) usually found near urban environments, inside houses or other buildings (e.g., Hoogmoed and Avila-Pires, 2015; Señaris *et al*., 2017; Behm *et al*., 2019). Its dispersal is likely to be related to human activities, such as transport of horticultural plants and cargoes on ships (Lever, 2003; Powell *et al*., 2011; Powell and Henderson, 2012; Krysko and Mackenzie-Krysko, 2016). Currently, it is known to have spread to Mexico, Central America, and parts of South America, besides some remote regions such as the Galapagos and Easter Islands (Hoogmoed and Avila-Pires, 2015).

In South America, there are records in Colombia (Moreno-Arias *et al.,* 2006; Daza *et al*., 2012; Giovanny Montes *et al*., 2012; Rubio-Rocha *et al*., 2012; Sierra *et al*., 2012), Ecuador (Fugler, 1966; Schauenberg, 1968; Torres-Carvajal, *et al*., 2014), Venezuela (Guerreiro and Graterol, 2011), Surinam (Bauer *et al*., 2007) and northern Brazil (Hoogmoed and Avila-Pires, 2015). For Brazil, seven published records are known, all from the city of Belém, State of Pará, in the Brazilian Amazon (Hoogmoed and Avila-Pires, 2015). The present note extends the known distribution of the introduced gecko *L. lugubris* in Brazil, presenting two other records for the Amazon region, including the first insular record in Brazil, and the first record for the species in the Atlantic Forest in Northeastern Brazil (Fig. 1 and Table 1).

In November 2nd, 2018, an individual of *L. lugubris* was collected by Annelise B. D'Angiolella, in Capitão Poço city, northeast mesoregion of the State of Pará. The capture occurred around 7 PM while the animal was feeding on leftover sugar-based candy inside a dumpster, in a tree of approximately two meters height, located in a residential neighborhood (1°45'7.1676" S; 47°3'50.5728" W). When it was captured, the specimen had its tail curled laterally, a behavior that has also been reported for other gekkos, such as *Hemidactylus frenatus* and *Hemidactylus garnotti* (Dame and Petren, 2006). After collected, the specimen was fixed in formaldehyde 10%, preserved in alcohol 70% and deposited at the Oswaldo Rodrigues da Cunha Herpetological Collection of the Museu Paraense Emilio Goeldi, under the voucher MPEG 32963.

Between March and June 2019, at least three individuals (distinguished by size and state of tail regeneration) of *L. lugubris* (Fig. 2a) were seen by Ben Phalan and Luciana Leite inside their fourth-floor apartment in the city of Salvador, Bahia (12°59'56.983" S 38°31'4.969" W). At least one of

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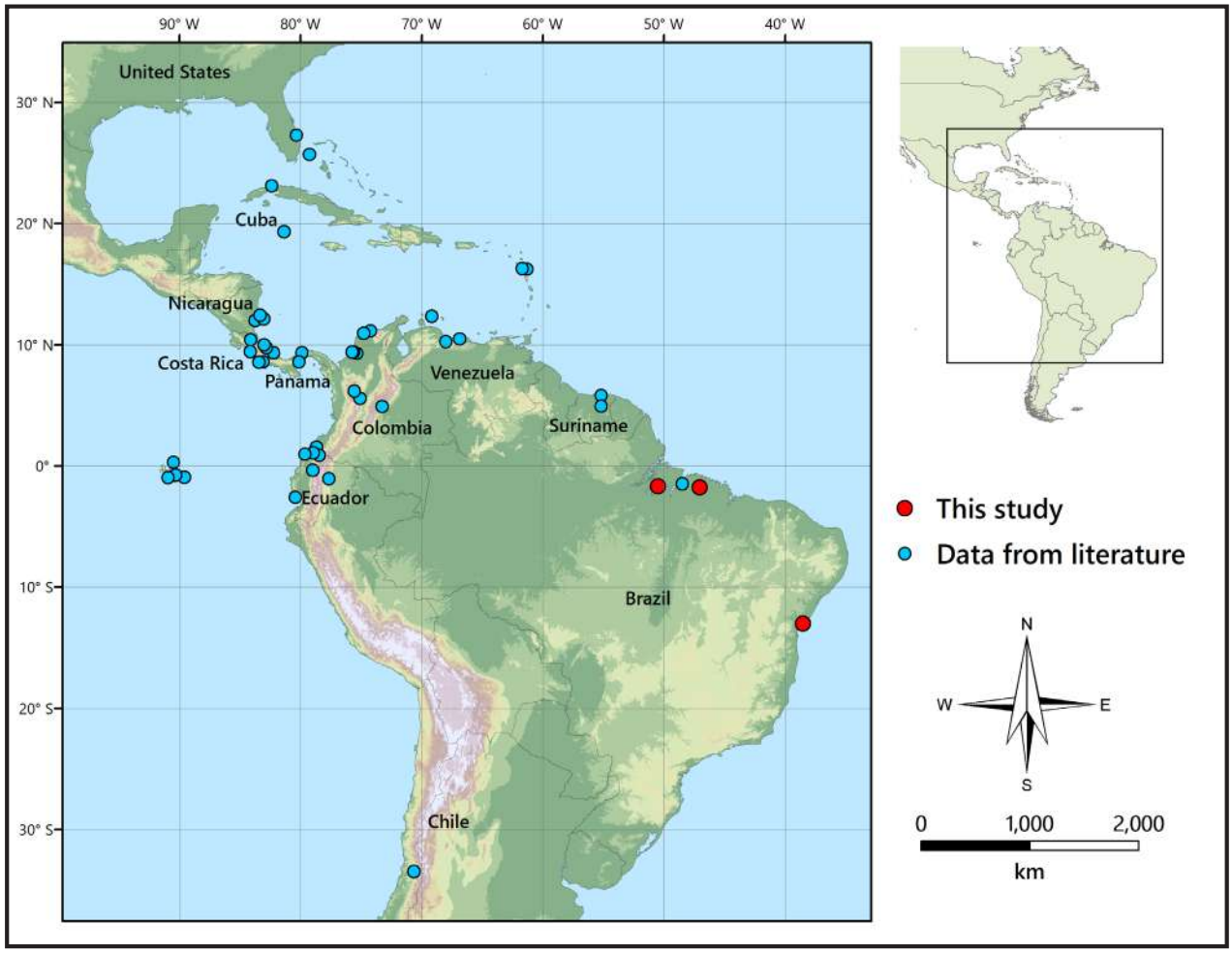

Figure 1. Map of distribution of the gecko *Lepidodactylus lugubris* in the New World. Blue circles represent previous records and red circles represent the new records of Capitão Poço and Breves (State of Pará) and Salvador (State of Bahia), in the Amazon and Atlantic Forest Biome, respectively.

them inhabited a crevice underneath a wooden table during the day, moving in the evenings to a fruit bowl where she was recorded feeding from ripe bananas (available online at https://youtu.be/IJC2RXnNUf0). Individuals were also observed capturing and eating a moth-fly (Diptera: Psychodinae - image available on inaturalist at the link below). and licking condensed droplets of water from a glass bottle. Vocalizations were heard (and recorded) on one occasion, when one called intermittently from a potted bromeliad. This recording and documentation of all other observations are archived on the citizen science site iNaturalist (available online at https://www.inaturalist.org/observations?d1=2019-03-01&d2=2019-06-30&place_id=20640&subview=table&taxon_id=104226).

The third report was performed on June 24th of 2020 by Lywouty Reymond Nascimento in Breves, southwest of Marajó Island, in Pará State. The specimen was seen around 5 PM while initiating its foraging activity inside a room in the residence (1°40'56.222" S; 50°28'58.933" W). When captured, the lizard performed the classical agonistic vocalization and jumping behavior (Señaris *et al.*, 2017). This specimen was photographed (Fig. 2b) and released.

Individuals from Capitão Poço, Breves and Salvador are in accordance with the morphological description of the species made by Hoogmoed and Avila-Pires (2015) and Señaris *et al.* (2017).

Our records expand the distribution of *L. lugubris* in Brazil by 162 km (Capitão Poço), 221.36 km (Breves) and 1,780 km (Salvador) from the first record (Belém). Breves, in Marajó Island, represents the first insular record for the species in Brazil and Salvador is the first record of this species in the Atlantic Forest biome.

The abundance of *L. lugubris* in gardens and houses was suggested to be related to the availability

Table 1. List of records of the gecko *Lepidodactylus lugubris* showed in Figure 1, including location, georeference, and source.

Location	Country	Longitude	Latitude	Reference
Capitão Poço	Brazil	-1.751.991	-47.064.048	This study
Salvador	Brazil	-1.299.916	-38.518.047	This study
Breves	Brazil	-1.682.284	-50.483.037	This study
Belém	Brazil	-1.457.069	-48.496.061	Hoogmoed & Avila-Pires (2015)
Paramaribo	Suriname	5.828.789	-55.180.914	Bauer *et al.* (2007)
Brownsberg plateau	Suriname	494.405	-55.170.631	Hoogmoed & Avila-Pires (2015)
South of El Rodadero	Colombia	11.167.658	-74.230.444	Hoogmoed & Avila-Pires (2015)
Barranquilla	Colombia	10.983.333	-74.816.667	Palacio Sierra *et al.* (2012)
Sincelejo	Colombia	93.025	-75.383.889	Montes *et al.* (2012)
Coveñas	Colombia	9.425.278	-756.225	Montes *et al.* (2012)
Cispata Bay	Colombia	940.355	-75.763.211	Moreno-Arias *et al.* (2007)
Santa Maria	Colombia	4.893.517	-73.282.033	Moreno-Arias *et al.* (2006)
Vereda Puente Lindo	Colombia	5.571.889	-75.123.778	Rubio-Rocha *et al.* (2012)
Medellin	Colombia	6.190.167	-75.581.778	Rubio-Rocha *et al.* (2013)
Tumaco	Colombia	1.544.167	-78.698.056	Pinto-Erazo (2020)
Puerto Misahualli	Ecuador	-1.032.967	-77.669.347	Torres-Carvajal *et al.* (2014)
Alluriquin	Ecuador	-0.322908	-78.995.275	Torres-Carvajal *et al.* (2014)
Lita	Ecuador	0.879125	-78.471.439	Torres-Carvajal *et al.* (2014)
Esmeraldas	Ecuador	1.089.333	-78.989.878	Fugler (1966)
Borbon	Ecuador	0.968917	-7.965.165	Schauenberg (1968)
Puerto Baquerizo Moreno	Ecuador	-0.901119	-89.611.003	Olmedo & Cayot (1992)
Puerto Ayora	Ecuador	-0.743539	-9.031.075	Olmedo & Cayot (1991)
Marchena	Ecuador	0.291483	-90.492.992	Jiménez-Uzcátegui (2014)
Puerto Villamil	Ecuador	-0.957153	-90.967.003	Olmedo & Cayot (1990)
Playas Canton	Ecuador	-2.600.000	-80.433.333	Cuadrado *et al.* (2020)
Colón	Panama	9.353.014	-79.903.719	Fugler (1966)
El Valle de Antón	Panama	8.600.903	-80.129.619	Köhler (2002)
Bocas del Torro	Panama	9.340.692	-82.240.606	Lotzkat (2010)
Golfito	Costa Rica	8.604.261	-83.113.378	Savage (2003)
Osa Peninsula	Costa Rica	8.564.414	-83.465.369	Savage (2004)
Cahuita	Costa Rica	9.738.306	-82.840.839	Mayer (2010)
Quepos	Costa Rica	9.432.039	-84.161.181	Savage (2002)
Limón	Costa Rica	9.991.139	-83.035.489	Hoogmoed & Avila-Pires (2015)
La Virgen of Sarapiquí	Costa Rica	1.041.691	-8.412.477	Jiménez & Abarca (2014)
Bluefields	Nicaragua	12.015.267	-83.760.161	Henderson *et al.* (1976)
Great Corn Island	Nicaragua	12.173.253	-83.052.247	Henderson *et al.* (1977)
Pearl Key	Nicaragua	12.471.406	-83.381.392	Villa (1993)
Port St Lucie	U.S.A.	27.289.111	-8.036.475	Krysko *et al.* (2011)
Grande-Terre	French West Indies	1.624.545	-6.129.411	Lorvelec *et al.* (2011)
Basse-Terre	French West Indies	1.631.739	-6.169.778	Parmentier *et al.* (2013)
Havana	Cuba	23.117.056	-82.402.278	Bosch & Paéz (2017)
Caracas	Venezuela	10.488.694	-66.880.889	Señaris *et al.* (2017)
Carabobo	Venezuela	10.270.972	-68.001.556	Guerrero & Graterol (2011)
Curaçao	Antilhas Holandesas	123.632	-691.547	Behm *et al.* (2018)

Cayman islands	Mar das Caraíbas	19.352.306	-81.381.111	Goetz & Burton (2018)
Santiago	Chile	-33.444.683	-70.648.408	Urra *et al.* (2020)
Sapodilla Bay	Bahamas	2.174.089	-7.228.417	Ruhe & Ruhe (2019)
Marsh Harbour	Bahamas	26.544.272	-77.049.793	Giery *et al.* (2019)
Island of North Bimini	Bahamas	25.727.001	-79.295.807	Krysko & Krysko (2016)

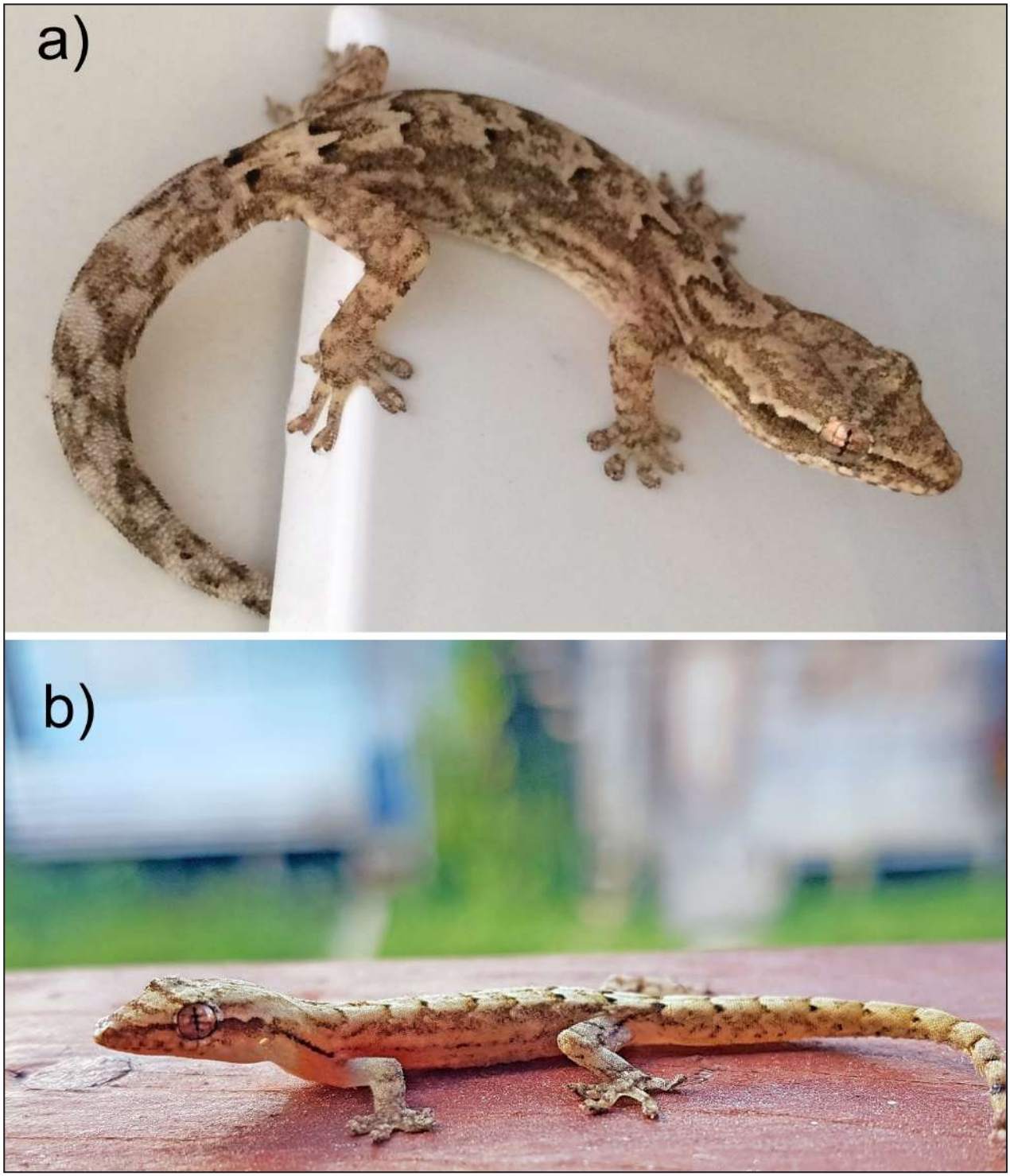

Figure 2. Individuals of *Lepidodactylus lugubris* collected in the present study. a) in the municipality of Salvador, Bahia State, Brazil, photographed by Ben Phalan and b) in the municipality of Breves, Marajó Island, Pará State, Brazil, photographed by Lywouty Reymond Nascimento.

of food resources, especially fruit flies (*Drosophila* spp.) and ripe fruits (Señaris *et a*., 2017). Our observations corroborate the consumption of both insect prey and sugary substances by this species, with its generalist diet as a possible cause for the species' success in colonizing new areas.

We believe our records represent independent colonizations, with specimens arriving in Capitão Poço in auto-vehicles coming from Belém, while the colonization of Breves and Salvador may have occurred by ships, since both represent port cities, similar to others already colonized by the species. Breves is the capital of Marajó Island and the access to the city is primarily made by ships or by planes (least frequent and inaccessible for most people), with no roads connecting the city to the continent. This record reinforces our hypothesis of ship colonization, with the most likely vector for arrival of these individuals being potted plants or soil. Introductions of *L. lugubris* have been described as accidental or as a consequence of the pet trade, so the latter alternative cannot be discarded for the new records presented here.

The fast expansion experienced by this species across the Brazilian territory, leads us to believe that *L. lugubris* has already spread to other states, or even biomes, across north and northeast of Brazil, even though its occurrence is yet to be documented in these regions.

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