

SHORT COMMUNICATION

# New record size, increased distribution range, and threat category reassessment proposal for *Tropidophis morenoi* (Serpentes: Tropidophiidae)

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**Keywords:** Central Cuba, Cuban dwarf boa, Extent of occurrence, IUCN, Threat category, Trope Zebra.

**Palavras-chave:** Boa-cubana-anã, Categoria de ameaça, Cuba central, Extensão de ocorrência, IUCN.

The Zebra Trope, *Tropidophis morenoi* Hedges, Garrido and Díaz, 2001, is one of 17 currently recognized species of Cuban dwarf boa (Díaz and Cádiz 2020), with a north central Cuba distribution (Henderson and Powell 2009, Rodríguez-Schettino *et al.* 2013; Figure 1A). This snake was previously placed in the *T. maculatus* species group by Hedges (2002), but Díaz and Cádiz (2020) transferred it to the *T. pardalis* species group. It is not well represented in museum collections and was described on the basis of two specimens (CZACC 4.5492-93) from Dolinas de Cueva de Humboldt, Caguanes, Sancti Spíritus province (Hedges *et al.* 2001). A third specimen (CZACC 4.12052) was reported from the type locality, which was a size record

for species (Domínguez *et al.* 2006). Later, Domínguez and Parada (2009) reported new localities for this species including Loma de Cunagua, Bolivia municipality and Alevinaje, Morón municipality, both from Ciego de Ávila province; and Coco Key from Sabana-Camagüey archipelago (specimens CIEC 66-67; CIEC 150, respectively). That provided the first records for Ciego Ávila province on the main island and Sabana-Camagüey archipelago, extending the distribution range 75.6 km E from the type locality at Caguanes. With that addition, Coco Key was shown to harbor the highest number of *Tropidophis* species among Cuban keys (Domínguez and Parada 2009, Rodríguez-Schettino *et al.* 2013). Additionally, a specimen (MNHNCu 5088) from Jobo Rosado, Jatibonico municipality, Sancti Spíritus province was reported by Díaz and Cádiz (2020), extending the distribution range 17.4 km SW from Caguanes.

Received 18 August 2022

Accepted 23 November 2022

Distributed December 2022

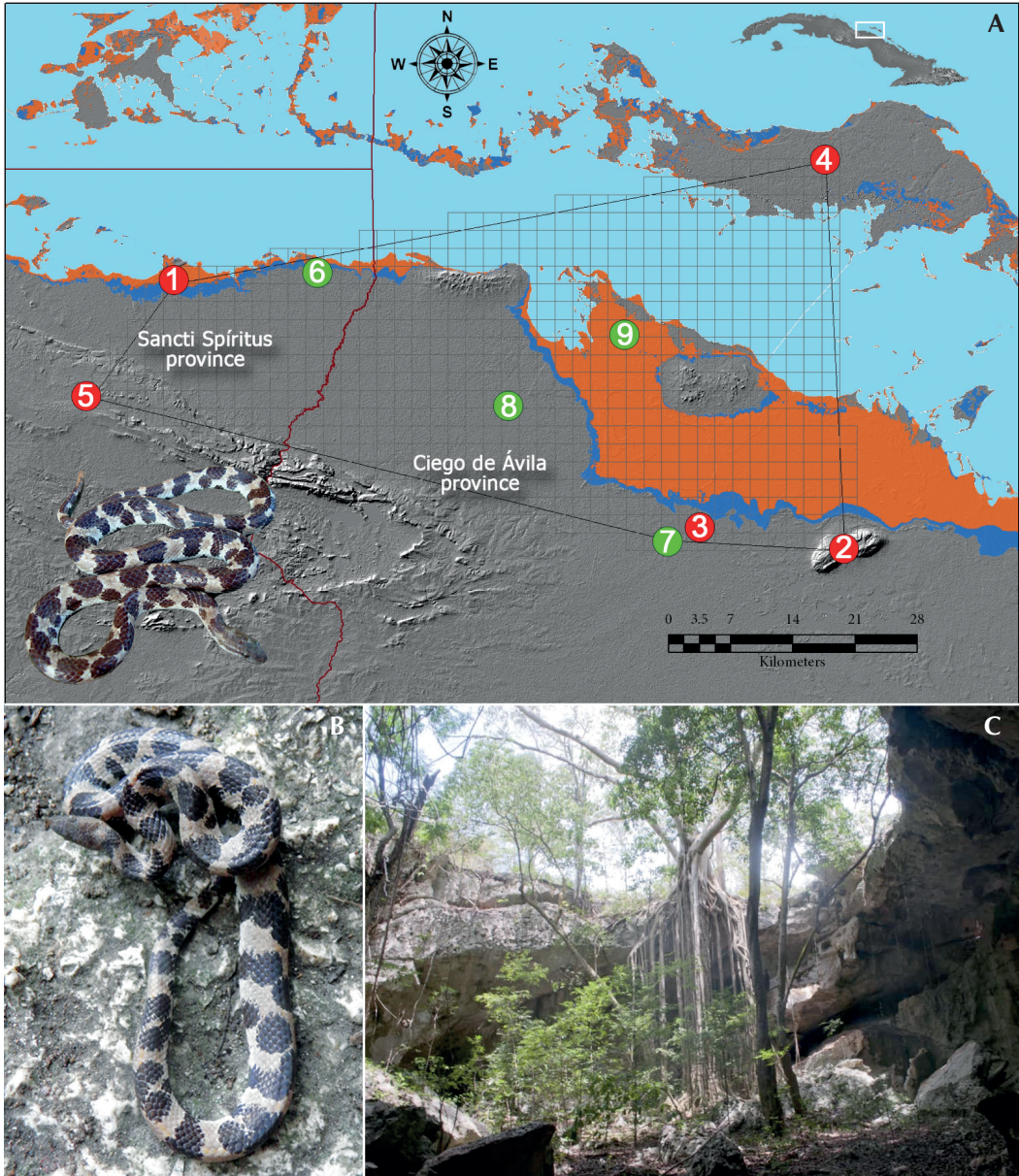
According to Tolson and Henderson (1993), despite the large number of species of *Tropidophis* in Cuba, many are known from few specimens, and their distributions are poorly understood. In the last decade, the reports of distribution records for several Cuban dwarf boas have increased (e.g. Fong and Armas 2011, Torres *et al.* 2013, 2016, Díaz *et al.* 2014, Iturriaga and Olcha 2015, Cajigas *et al.* 2018, Rodríguez-Cabrera *et al.* 2020, 2021, Rodríguez-Cabrera and Teruel, 2022). The addition of new localities increases our knowledge about natural history and fills gaps in records from field observations that allow for the implementation of management and conservation programs (Torres *et al.* 2013, Díaz *et al.* 2014, Tanaka *et al.* 2018). We herein report new locality records and morphological data of *T. morenoi*, and we propose to reassess its conservation status.

During a field expedition to Caguanes National Park, in the north of Central Cuba, on 22 August 2017, a speleological group visited Cueva del Abono (22°22'46.429" N, 78°58'56.744" W) in Judas' hill, Yaguajay municipality, Sancti Spiritus province. The group found two specimens of *T. morenoi*, but only one, a male, was captured (Figure 1B). Each individual was resting on a rock at the entrance to the cave. The captured specimen was identified by Michel Domínguez and deposited in the Institute of Ecology and Systematics, Havana Cuba (CZACC 4.13169). This locality is approximately 15.2 km airline E from the type locality. The cave is located within semideciduous forest on limestone (Figure 1C), in a mountain system formed by three small adjacent kartsic hills with a maximum height of 33.4 m a.s.l., an area of 0.5 km<sup>2</sup>, and a distance of 1.5 km from the coastline. In the past, this area was dedicated to growing sugar cane, but is now used for grazing and agriculture, and there is also abundant secondary vegetation. We took the linear measurements and meristic characters of the collected male specimen and it represents a new size record, with 429 mm snout-vent length (SVL), and 479 mm total length (TL). The previous record was 359 mm SVL and 416

mm TL for an adult female, (Domínguez *et al.* 2006). The morphological data on the specimens are in Table 1.

A field expedition by biologists from the Coastal Ecosystems Research Center (CIEC) in April 2012 collected an adult male in the city of Morón (22°06'34.025" N, 78°37'38.213" W), Morón municipality and a pregnant female in the elevations of Punta Alegre (22°14'40.227" N, 78°47'27.958" W), Chambas municipality, both from Ciego Ávila province. The latter locality is completely covered by sicklebush *Dichrostachys cinerea* (L.) Wight and Arn. (Fabaceae) presently. The first specimen was deposited in the herpetological collection of CIEC (CIEC 55) (Figure 2A), and the last one was kept in captivity for two weeks until it had three offspring. The mother was later released at its point of capture and the offspring were kept in captivity for a month. They were fed frogs of the genus *Eleutherodactylus* and small *Anolis sagrei* Duméril and Bibron, 1837. Later, they were euthanized and deposited in the herpetological collection of the CIEC (CIEC 78-80) (Figure 2B). On another field expedition, a third specimen was sighted at El Coy (22°18'47.830" N, 78°40'20.280" W), Isla de Turiguanó, Morón municipality, Ciego de Ávila province. This locality is lowland with mangroves and swamp forests. These reports represent one and three new geographic records of *T. morenoi* for Sancti Spiritus and Ciego de Ávila provinces, respectively, and increase the number of localities within its distribution range (Díaz and Cádiz 2020).

Table 1 summarizes the linear measurements and morphological characters of *T. morenoi* specimens deposited in the herpetological collections of IES and CIEC. All individuals were similar to one another; and the morphological characteristics agree in general with the description of the holotype and paratype (Hedges *et al.* 2001), although there are some small variations. The specimen CIEC 55 measures 258 mm SVL and tail length 39 mm; its dorsal scale rows formula is very different,



**Figure 1.** (A) Previous and new records (red and green circles, respectively): (1) Cueva de Humboldt, Cayo Caguanes, Sancti Spíritus province; (2) Loma de Cunagua, Ciego de Ávila province; (3) Alevinaje, Ciego de Ávila province; (4) Coco Key, Sabana-Camagüey archipelago; (5) Jobo Rosado, Sancti Spíritus province; (6) Cueva del Abono, Judas' hill, Caguanes, Sancti Spíritus province; (7) city of Morón, Ciego de Ávila province; (8) Punta Alegre, Ciego de Ávila province; (9) El Coy, Isla de Turiguanó, Ciego de Ávila province. Area of extent of occurrence, and modeling of potentially lost areas by 2050 (orange zone) and 2100 (blue zone) of *T. morenoi*. Photo: Dariel López. (B) Adult male Zebra Trope (*Tropidophis morenoi*, CZACC 4.13169) photo by ARL. (C) Area under a sinkhole with associated vegetation in Cueva del Abono, Judas' hill, Yaguajay municipality, Sancti Spíritus province. Photo: Raudel del Llano.



**Figure 2.** (A) Adult male of Zebra Trope, *Tropidophis morenoi*, (CIEC 55), (B) and three juvenile specimens (CIEC 78-80). Photos by EM.

because the anterior and middle counts of scale rows are less than in the type series and specimens CZACC 4.12052 and CZACC 4.13169. The ventral scale count ranges from 190 to 199, although the specimen CZACC 4.13169 has the lowest count with 187 scales. Subcaudal scale counts are between 41 and 44, although specimens CZACC 4.12052 and CIEC 55 have the lowest counts with 38 and 37, respectively. The specimen CZACC 4.13169 has nine supralabials and 10 infralabials on each side, the remainder of specimens have 10 supralabials and 11 infralabials. All specimens exhibit very similar ground and dorsal color pattern, and rows of spots. CIEC 78 and 80 have the fewest body spots. The tail tip is whitish yellow, light beige, tan or yellowish tan.

The addition of new locality records for *T. morenoi* increases the area of occupancy (AOO) by 36 km<sup>2</sup>, from the 16 km<sup>2</sup> given by Rodríguez-Schettino (2012). The known and new localities cover an extent of occurrence of 1530 km<sup>2</sup> by

means of the minimum convex polygon (Fig 1A). The nine localities where this species occurs can be assigned to five threat-based locations according to the topographic features of landscape and main known threats (Figure 1 A). Location 1: Jobo Rosado, is a Managed-Resources Protected Area, located in the mountainous system of Meneses-Cueto's Mountain Range and belongs to the Special Regions of Sustainable Development of Bamburanao-Turquino (CNAP 2013). The main threats are logging, excessive ecological tourism, agriculture, livestock and expansion of human settlements (González *et al.* 2015). Location 2: is Judas' hill, Caguanes National Park and Isla de Turiguanó. These localities are situated in lowlands, with mangroves and swampy areas, very close to the north coast of Sancti Spiritus and Ciego de Ávila provinces. The main threats are livestock, agriculture, and expansion of human settlements. Location 3: Cunagua hill is a mountain range with a surface area of 24.2 km<sup>2</sup>

**Table 1.** Main linear measures and meristic characters of specimens of *Tropidophis morenoi* of herpetological collections from Institute of Ecology and Systematics (CZACC) and Coastal Ecosystems Research Center (CIEC). \* Linear measurements and meristic data of specimen CZACC 4.12052 not available, the body anterior third is damaged. \*\* Data of specimens CIEC 78-80 not available.

Characters	Holotype	Paratype	CZACC 4. 12052		CZACC 4. 13169		CIEC 55	CIEC 78	CIEC 79	CIEC 80
	Female	Female	Female	Male	Male	Male	Juvenile	Juvenile	Juvenile	Juvenile
Sex	Female	Female	Female	Male	Male	Male	Juvenile	Juvenile	Juvenile	Juvenile
Snout-vent length	295	285	359	429	258	116	122	107		
Tail length	42	44	57	50	39	20	13	20		
Total length	337	329	416	479	297	136	135	127		
Head width	7.2	6.4	*	7.6	6.6	4.1	4.0	4.3		
Neck width	5.2	4.2	*	4.9	4.8	2.5	2.3	2.3		
Head width/Neck width	1.38	1.52	*	1.56	1.38	1.64	1.74	1.87		
Eye width/Head width	0.24	0.27	*	0.25	0.14	0.17	0.20	0.19		
Dorsal scale rows formula	23-23-17	23-23-17	21-23-17	21-23-16	20-20-17	**	**	**		**
Ventral scales	198	199	*	187	195	191	195	190		
Subcaudal scales	42	44	38	41	37	43	41	43		
Supralabials	10i/10d	10i/10d	*	9i/9d	10i/10d	10i/10d	10i/10d	10i/10d		
Scales in contact with eye	4-5	4-6	*	8i/8d	7i/7d	7i/7d	7i/7d	7i/7d		
Infralabials	11i/11d	11i/11d	*	10i/10d	11i/11d	11i/11d	11i/11d	11i/11d		
Preoculars	1i/1d	1i/1d	*	1i/1d	1i/1d	1i/1d	1i/1d	1i/1d		
Postoculars	3i/3d	3i/2d	*	3i/3d	3i/3d	3i/3d	3i/3d	3i/3d		
Ground color	Whitish beige	Whitish beige	Tan	Whitish beige	Beige	Beige	Beige	Beige		
Dorsal pattern	Narrow bands	Narrow bands	Narrow bands	Narrow bands	Narrow bands	Narrow bands	Narrow bands	Narrow bands		
Ventral pattern	Spots	Spots	Spots	Spots	Spots	Spots	Spots	Spots		
Spot rows	6	6	6	6	6	6	6	6		
Body spots	38i/39d	38i/38d	35i/38d	31i/30d	34i/33d	31i/32d	33i/33d	31i/31d		
Tail spots	4i/5d	8i/6d	5i/4d	5i/5d	6i/6d	5i/5d	6i/6d	5i/6d		
Tail tip	Whitish yellow	Whitish yellow	Tan	Yellowish tan	Light beige	Yellowish tan	Yellowish tan	Yellowish tan		

and a height of 321 m a.s.l., located 14 km SE airline from La Laguna de la Leche, inland of Ciego de Ávila province and bordered by lowlands (Nerey-Contreras *et al.* 2014). It is a Faunal Refuge Protected Area that is affected by forest fires, felling of remaining forests for grazing and sugar cane cultivation, and expansion of human settlements (Lima-Moreno *et al.* 2019). Location 4: The city of Morón, Alevinaje and Punta Alegre are located in the plain area of inland of Ciego de Ávila province, and suffer the greatest anthropic disturbances from aquaculture, agriculture, grazing, gypsum mining and human construction. Location 5: Coco Key is located in Sabana-Camagüey archipelago, 15 km from the main island. The main threat to this locality is tourism and fragmentation of semideciduous forest patches from construction of two main roads and various buildings.

All Cuban dwarf boas are included in appendix II of CITES (UNEP-WCMC 2021), and also in the appendix I of resolution 160/2011 of Minister of Science, Technology and Environment of Cuba. They are found in 29.4% of protected areas of the National System of Protected Areas of Cuba (Rodríguez-Schettino *et al.* 2015). In the Red Book of Vertebrates of Cuba (González-Alonso *et al.* 2012), *T. morenoi* was one of 11 threatened species of *Tropidophis* included, with an AOO of 16 km<sup>2</sup> and unknown population size. The main threats were anthropic activities and sea-level rise; therefore, it was assessed as Critically Endangered by Rodríguez-Schettino (2012). Meanwhile, Fong (2021) listed this species as Vulnerable on the IUCN Red List, due to its restricted range, in three locations with these main threats: agricultural activities, tourism development and continuing decline in the extent and quality of existing habitat. According to the IUCN criteria (IUCN Standards and Petitions Committee 2019), we believe that *T. morenoi* could be reclassified as Endangered (EN) under criterion B.1, and the subcriterion a (number of locations  $\leq 5$ ) and biii (continuing decline in quality of habitat); contrary to proposals of Rodríguez-Schettino (2012) in the Red Book of Vertebrates of Cuba, and Fong

(2021) for IUCN. We suggest that the conservation status of the species and EOO be reassessed by IUCN appropriately.

We reviewed the management plans of Ciego de Ávila province, and the habitat loss and fragmentation are more serious for those localities outside of jurisdiction of National System of Protected Areas of Cuba (Lima-Moreno *et al.* 2019). Despite the level of disturbance in some areas, the records of *T. morenoi* from localities such as the city of Morón and Alevinaje provide hope for the conservation of this species, and highlight the resilience that the dwarf boas show in disturbed areas (e.g. Torres *et al.* 2013, Díaz *et al.* 2014, Rodríguez-Cabrera *et al.* 2021). Fong (2021), also mentioned that the collection of specimens for the illegal pet trade is another threat for *T. morenoi*. Although there are currently no species of Cuban dwarf boa cited on pet trade lists (Altherr *et al.* 2019), the surveillance and measures implemented by the Cuban authorities need to be stricter to prevent any illegal trading. Finally, we predict by future projections that for 2050 and 2100, 24% (371 km<sup>2</sup>) and 29% (447 km<sup>2</sup>) of the total EOO of *T. morenoi* will be lost, respectively, in areas very close to the coast (Figure 1A). Therefore, the sea-level rise should be considered as a potential threat to those populations in the lowlands near the north coast of Sancti Spiritus and Ciego de Ávila provinces. The situation is similar for *Tropidophis celiae* Hedges, Estrada and Díaz, 1999, a species with a restricted distributional range, very close to the north coast of western Cuba (Rodríguez-Cabrera and Teruel 2022). According to Iturralde-Vinent and Serrano (2015), there are many localities prone to coastal flooding due to sea-level rise in the Cuban archipelago, and the implementation of measures to face this threat are necessary. In summary, comprehensive species extinction risk assessments are necessary to provide an appropriate threat category and implement species-specific conservation programs; especially for this species of dwarf boa, for which there is currently no management plan (Fong 2021).

**Acknowledgments.**—We are very grateful to the speleological group “Cayo-Barien” for logistical support during fieldwork. MI thanks Michel Domínguez, National Museum of Natural Sciences of Madrid, Spain, for the identification of specimen CZACC 4.13169, and EM thanks Alain Parada, for the identification of specimens deposited in the CIEC herpetological collection of Cayo Coco, Ciego de Ávila province. We thank to Julio Pavel García-Lahera from Botanical Garden of Sancti Spíritus, Sancti Spíritus province, for access to the management plan of the Managed-Resources Protected Area “Jobo Rosado”. We also thank Sonia Seuc, Florida, USA, Luis F. de Armas, San Antonio de los Baños, Artemisa province, Cuba, Tim Lyons, ABQ BioPark Center for Species Survival, Albuquerque, New Mexico, USA for critically reviewing an earlier draft of this manuscript. MI thanks to Ansel Fong, BIOECO, Santiago de Cuba, Cuba for helpful advice on IUCN criteria and assessments, and encouraging to publish this note. Collection permits and Environmental Licenses to carry out fieldwork were kindly authorized by the Oficina de Regulación y Seguridad Ambiental (ORSA), Playa municipality, Havana, Cuba. 🐍

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Editor: Ross D. MacCulloch