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Article

"Anteaters" under the airport: a slender new species of blindsnake, genus *Indotyphlops*, from Timor-Leste (Scolecophidia: Typhlopidae: Asiatyphlopinae)

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Abstract

We describe a slender immature female blindsnake from the main airport in Dili, Timor-Leste, as a new species of *Indotyphlops*, adding a third species to the country's known blindsnake fauna of *Sundatyphlops polygrammicus* (Schlegel, 1839) and *Virgotyphlops braminus* (Daudin, 1803). The new species has the following combination of characteristics: small size (snout–vent length = 119 mm), slender body (relative body thickness 71), T-V supralabial imbrication pattern, relative rostral width 0.36, 434 middorsal scales, relative tail length 1.7%, absence of enlarged occipital scales, and apical spine absent. The snake was found in an ant nest under several flat rocks near the fuel depot of Nicolau Lobato International Airport, and this habitat and the discovery in a busy location with heavy human impacts indicate that the species is likely a primarily subterranean myrmeco- or termitophage.

Key words: *Indotyphlops*, new species, wormsnake, supralabial imbrication pattern, relative body thickness, Lesser Sunda Islands, Dili Municipality, morphology, biogeography

Introduction

Scolecophidian snakes account for approximately 11.6% of extant snake species and the group is currently divided into the families Anomalepididae (21 species), Leptotyphlopidae (141), Gerrhopilidae (23), Xenotyphlopidae (1), and Typhlopidae (275), for a total of 461 species (Uetz et al. 2022), with at least 20 more species in the process of being described (V. Wallach, unpublished data). The genus *Indotyphlops* was erected by Hedges et al. (2014) to accommodate 22 species of *Typhlops* sensu lato within the new subfamily Asiatyphlopinae, which contains Asian, Australasian, Pacific, and European blindsnakes. Wallach (2020) transferred *Indotyphlops braminus* to a new genus, *Virgotyphlops*[1], but a recent molecular analysis showed that *Virgotyphlops* may be included in an *Indotyphlops* clade (Wickramasinghe et al. 2022). Given the taxonomic complexity of this group, we here maintain the use of *Virgotyphlops* until more comprehensive data regarding the phylogeny of *Indotyphlops*, particularly regarding *Indotyphlops pammeces* (Günther, 1864), the type species of the genus, become available. In terms of their morphological characterization, most of the 20 recognized typhlopoid genera are characterized by a single supralabial imbrication pattern (SIP), which Wallach (1993) defined as the overlap of head scales by supralabial (SL) scales. In general, SIPs include the character states of T-0 (no overlap; *Cyclotyphlops*, *Grypotyphlops*, *Rhinotyphlops*, *Xenotyphlops*), T-I (SL1 overlaps; *Typhlops*), T-II (SL2 overlaps; *Cathetorhinus*), T-III (SL3 overlaps; *Acutotyphlops*, *Amerotyphlops*, *Anilios*, *Antillotyphlops*, *Cubatyphlops*, *Malayotyphlops*, *Ramphotyphlops*, *Typhlops*, *Virgotyphlops*), and T-V (SL2 and SL3 overlap; *Argyrophis*). However, six genera are variable, including *Gerrhopilus* (T-II or T-V), *Afrotyphlops* and *Letheobia* (T-0 or T-II), and *Madatyphlops*, *Xerotyphlops*, and *Indotyphlops* (T-III or T-V). In some of those genera, different SIPs may represent taxonomic groupings although this has not yet been established.

After changes in the taxonomy of *Indotyphlops* by Wallach (2000), who synonymized *Typhlops ductuliformes* Khan 1999*a* with *I. porrectus* (Stoliczka 1871) and placed *T. madgemintonae* Khan 1999*b* and *T. ahsanuli* Khan 1999*b* into Typhlopidae incertae sedis, the remaining species of *Indotyphlops* with a T-V

[1] Wallach (2020) intended to erect the genus *Virgotyphlops* for the parthenogenetic species *braminus*, but this publication was not compliant with the online-only publication rules in the International Code of Zoological Nomenclature (ICZN; Frétey and Dubois 2021). The situation was rectified by Wallach (2021).

pattern are *I. exiguus* (Jan, 1864) of India, *I. porrectus* of South Asia, *I. lazelli* (Wallach and Pauwels, 2004) of Hong Kong, and *I. schmutzi* (Auffenberg, 1980) of Indonesia. The nomenclatural status of *I. filiformis* (Duméril and Bibron, 1844), a species considered incertae sedis by Hahn (1980) and McDiarmid et al. (1999), remains somewhat uncertain. Absent any published evidence to the contrary, we consider this species as a member of *Indotyphlops* and include it in our comparisons. It is currently under study by Addison Wynn (Wallach et al. 2014) and may be a senior synonym of *I. porrectus*.

The sovereign nation of Timor-Leste occupies the eastern half of Timor Island, at 30 777 km^2 the 44th-largest island on Earth and the fifth-largest island in the Malay Archipelago (Wallace 1869), after Borneo, Sumatra, Sulawesi, and Java. Located in the Outer Banda Arc (Fig. 1A, inset), it is the largest island in the Lesser Sunda Archipelago. Timor-Leste also includes the Oecusse Municipality, an exclave on the northern coast of Timor surrounded by Indonesian West Timor, Ataúro Island in the Inner Banda Arc, and the tiny corallogenic Jaco Island off the country's easternmost tip. The country's capital is Dili (sometimes in historical sources spelt Dilly or Diely) on the north coast (8.5569°S, 125.5603°E), which was an important trade and aviation hub during the Portuguese colonial period and retains this importance in modern times. The city is the main entry point into Timor-Leste, with Presidente Nicolau Lobato International Airport (PNLIA; Figs. 1B and 1C) located ca. 6.5 km east of Dili's city centre at the Palácio do Governo. Here, we report the discovery of a new *Indotyphlops* species with a T-V SIP, discovered in 2014 among the airport's facilities, and recount some related aspects of the area's history.

Materials and methods

Locality

PNLIA was an airfield constructed in the early 1930s during Portuguese colonial rule and was originally christened the Aeródromo Humberto da Cruz in 1934 (Fig. 2A) after a famous Portuguese military aviator, who made an epic return flight from Lisbon to Dili that year[2]. At only 1849 m length and a width below the standard of other gust-prone airports, the runway at PNLIA generally restricts the airport's use to single aisle aircraft (e.g., Airbus A320, Boeing 737, C-130 Hercules[3]). Dili Airport remains the premier airport of the country today and was rechristened Presidente Nicolau Lobato International Airport[4] (Fig. 2B) in 2002. The airport is located at 8.0 m above sea level on a small rocky plain formed by the outflow of the Comoro River (8.5469°S, 125.5234°E). The Wetar Strait is to the north and west, the Comoro River and Dili to the east, and hills and mountains rise steeply to the south.

Specimen work

After collection, the snake was photographed in life on a small set built in a 30 cm × 30 cm × 30 cm Lastolite Cubelite photographic enclosure using Canon EOS 7D cameras, a Canon EF 60 mm macro lens, and a Canon MP-E 65 mm macro lens for the head closeups[5], with illumination provided by Canon Macro Twin-Lite MT-24EX flash units. Blindsnakes were also photographed on a porous piece of coconut bark to provide a natural background. After photography, specimens were euthanized using an intracardiac injection of 5% procaine (Livezey 1958), fixed in 10% formalin in the field, and transferred to 70% ethanol for storage after arrival in the museum collection. Additional photography of the specimen after preservation was done using the same photographic equipment. Line drawings were prepared from photographs on a Macintosh desktop computer using Adobe Photoshop and a Wacom Cintiq 13" HD Touch.

Evaluation

Measurements were taken using a metric ruler for body and tail lengths (to the nearest mm) and digital callipers for body width measurements and scale dimensions (to the nearest 0.1 mm). Body measurements include snout–vent length

[2] Lieutenant Humberto Amaral da Cruz (1900–1981) was a Portuguese military aviator who qualified as a pilot in 1927 (Oliveira and Moreira 2017). On 25 October 1934, he and his navigator, mechanical sergeant António Lobato (1910–1935), departed Amadora in Portugal and, flying via Algeria, Tunisia, Tripoli (Libya), Gaza (Palestine, then under British Mandate), Basra (Iraq), Allahabad (India), Bangkok (Thailand), Prachuap Khiri Khan (Thailand), and Singapore, reached Dili on 7 November, whereupon the airport at Dili was renamed in da Cruz's honour. For the return trip, da Cruz and Lobato left Dili on 13 November and called at the Portuguese colonies of Macau (now part of China) and Goa (now part of India), arriving in Lisbon on 21 December after a 42 670 km journey (Cruz 1935).

[3] In January 2008, the Portuguese charter airline EuroAtlantic Airways flew a 140 strong unit of the Guarda National Republica directly from Portugal, into Dili Airport aboard a Boeing 757 (Westmoreland 2009), and in 2020 the same airline repatriated Portuguese and other Europeans from Dili during the COVID-19 pandemic using a Boeing 767 (Leigh 2020). The latter type of aircraft was also used to fly the Portuguese president and dignitaries to attend the 2022 Presidential Inauguration, meaning larger aircraft may be allowed to land and take off on occasion and with specially trained pilots (HK, personal observation).

[4] Nicolau dos Reis Lobato (1946–1978) was a senior leader in the centre-left FRETILIN (Revolutionary Front for an Independent East Timor) party, who became the first Prime Minister of independent Timor-Leste (Durand 2009) after the sudden Portuguese decolonization until the time of the Indonesian invasion (28 November–7 December 1975). During the time of guerrilla warfare against the invading forces, Lobato became the de facto president of the country in 1977, even though the Indonesian occupying force had dissolved the post in 1975 (CAVR 2005; Guterres 2014). On 31 December 1978, he was killed in an ambush by Indonesian Special Forces (Guterres 2014). It is believed that having been shot in the leg and surrounded by Indonesian troops, he committed suicide in their sight, but that the Indonesian soldiers also shot him to "claim the kill". The whereabouts of Lobato's body have never been disclosed (Tempo Timor 2019), but he is lauded as a hero by the East Timorese. His statue at the airport roundabout greets all those who arrive in the country by air.

[5] This macro lens provides optical magnification of up to 5× life size at f16 for depth of field, and up to 10× life size if fitted with a Canon EF 2× Extender.

Fig. 1. Timor-Leste and Dili orientation maps. (A) Map of Timor-Leste illustrating the country's 13 municipalities (administrative regions), including the Oecusse exclave. Timor-Leste has two islands, Ataúro Island and tiny, near-circular Jaco Island off the country's easternmost tip. The inset map shows Timor-Leste in relation to the other Lesser Sunda Islands. The globe shows the location of the Lesser Sunda Islands (white rectangle) north of Australia. Red arrow and rectangle indicate the location of Dili, the capital city of Timor-Leste, and of Presidente Nicolau Lobato International Airport. Scale = 100 km. Base map adapted and licensed from a GERTiL map downloaded from Mapsland (mapsland.com) under Creative Commons Attribution-ShareAlike 3.0. The globe was produced using Mountain High Maps software (available at digiwis.com). (B) Google Earth satellite view of Presidente Nicolau Lobato International Airport. The airport is in a location called Comoro, separated from Dili by the Comoro River, whose discharge can be seen at the top of the image. Scale = 1.6 km. Image on Google Earth ©TerraMetrics and ©Airbus. (C) Map of the same area shown in panel (B), adapted from a 1:50 000 map provided to us by the Government of Timor-Leste (Edition 1, DIGO Series T755, Sheet 2407 33, produced with assistance from the Australian Department of Defence). Scale as in panel (B).

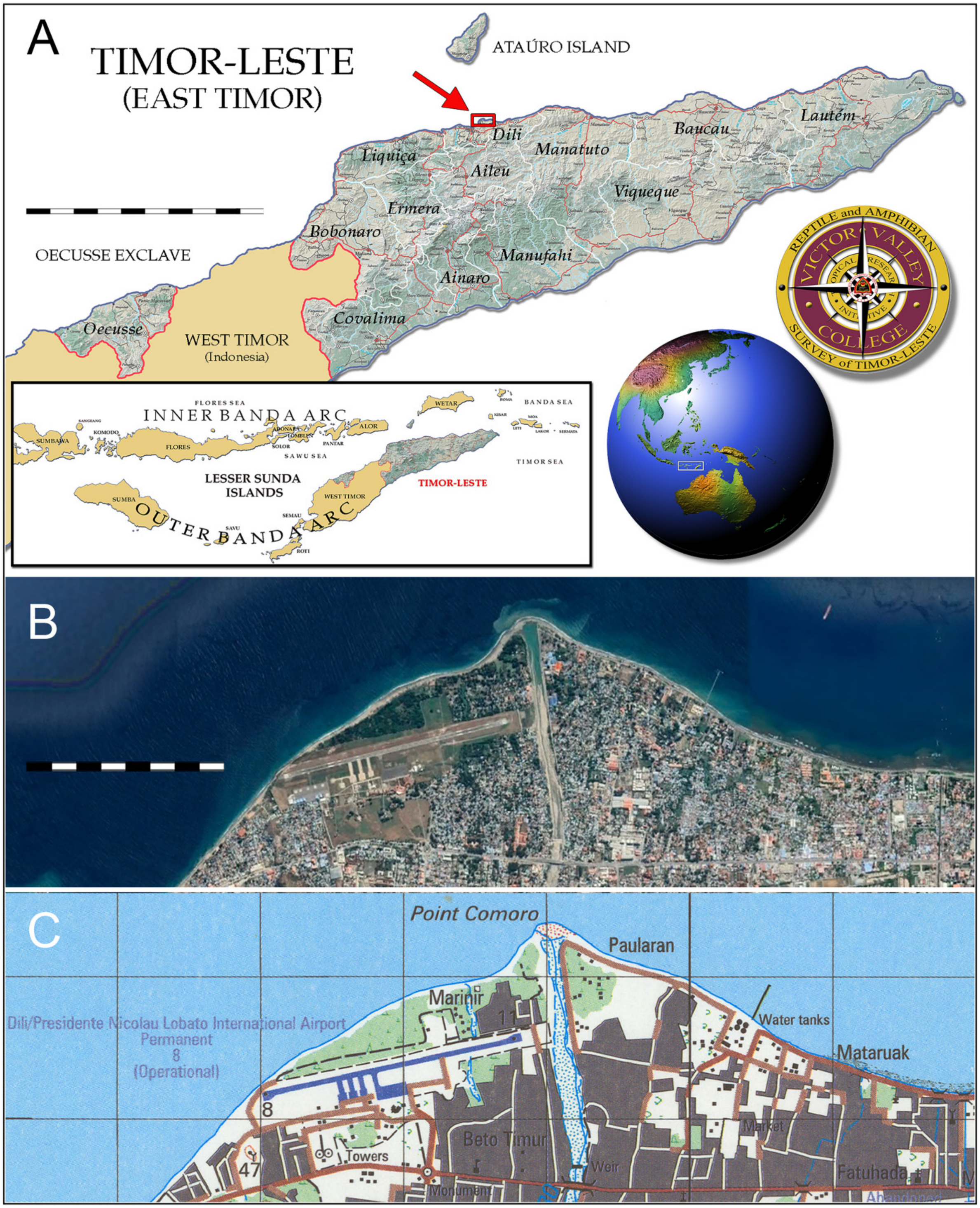
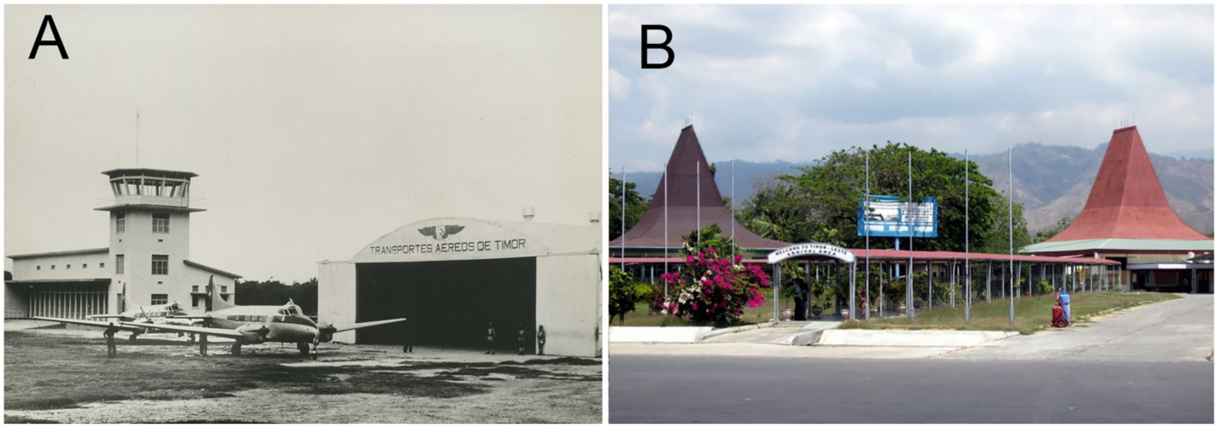


Fig. 2. (A) Aeródromo Humberto da Cruz during Portuguese colonial rule, pre-1975 (photographer and date unknown, Wikipedia Public Domain). (B) The modern Presidente Nicolau Lobato International Airport (photo by David Stanley, used unchanged by permission under CC BY 2.0). The fuel depot is located 300 m to the right (west).



(SVL), tail length (TL), tail width, total length (TTL), head width (measured at the ocular level), and body diameter (at midbody and at midtail). Scale measurements include rostral length and rostral width (measured transversely at the longitudinal midpoint between its lateral margins). Relative tail length was calculated as the ratio of TL divided by TTL. Relative body thickness was calculated by two methods: (1) the traditional method used in scolecophidian taxonomy of dividing TTL by body diameter at midbody, and (2) expressing midbody diameter as a percentage of TTL. Relative rostral width was calculated as the ratio of rostral width divided by head width. Scale counts were done using small entomological pins inserted beneath scales as a base from which to count under a dissecting microscope. The middorsal scale row was counted along the length of the entire body, with the exclusion of the rostral and the apical spine. The number of scale rows around the body was established one head length posterior to the head, at midbody, and one head length anterior to the vent.

Colouration

Colours were assessed from digital photographs using the colour guides of Smithe (1975) and Köhler (2012) and are reported by listing the closest colour matches by swatch number (#) and including the letter S (Smithe) or K (Köhler) to indicate the reference. Given the interplay of scales, suture lines, and underlying glands, which makes the description of colouration in blindsnakes somewhat more complex than in many other snake taxa, we differentiate between coloured, pigmented skin (i.e., an outer epithelial layer with chromatophores) and unpigmented skin (i.e., an outer epithelial layer without chromatophores, but perhaps with some colouration derived from sequentially deeper epithelial layers, connective tissues, and muscles). In blindsnakes, pigmentation patterns on individual scales may be quite complex, with significant unpigmented or less densely pigmented areas producing these patterns.

Indotyphlops laca sp. nov.

Laca's Wormsnake (ENG), Ular Kawat Laca (IND), Samea Matan Delek Laca (TET).

Figures 3–5, 8

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HOLOTYPE: MCZ R-192968 (field No. MOS 3264), an immature female (Fig. 3) collected by H. Kaiser and M. O'Shea on 10 August 2014 near the fuel depot at Nicolau Lobato International Airport, Dili Municipality, Timor-Leste (8.5485°S, 125.5204°E, elevation ca. 10 m).

DIAGNOSIS: *Indotyphlops laca* (Figs. 3–5) is a small (SVL = 119 mm), slender (relative body thickness 71 or 1.4% of TTL) member of the genus with a T-V SIP, 18 scale rows along the body lacking posterior reduction, 434 middorsal scales, rostral oval with relative rostral width 0.36, semidivided nasal shield, inferior nasal suture contacting second supralabial, eyespot lacking pupil or iris, relative tail length 1.6%, occipital scales not enlarged, and lacking apical spine.

ETYMOLOGY: This species epithet is a patronym, using the name as a noun in apposition. We dedicate this species to Agivedo "Laca" Varela Ribeiro (Fig. 6A), a citizen of Timor-Leste and a native of Raça in Lautém, the country's easternmost municipality. When we floated the idea of naming the species collectively for the Timorese members of our research team, they requested that we honour Laca instead.

MOS and HK first met Laca through an introduction by Venancio "Benny" Carvalho while these two were students at the Universidade Nacional Timor Lorosa'e, the country's national university. Laca's interests had led him to pursue a degree in science education, but with a twist: he and two of his fellow students wanted to write research theses in biology, which had not been done before. We decided to help and recruited Laca and his friends, Zito Afranio Soares and Luis

Fig. 3. Holotype of *Indotyphlops laca* sp. nov. in life, demonstrating its slender body compared with its length. The head of the snake is the lighter coloured region at left.

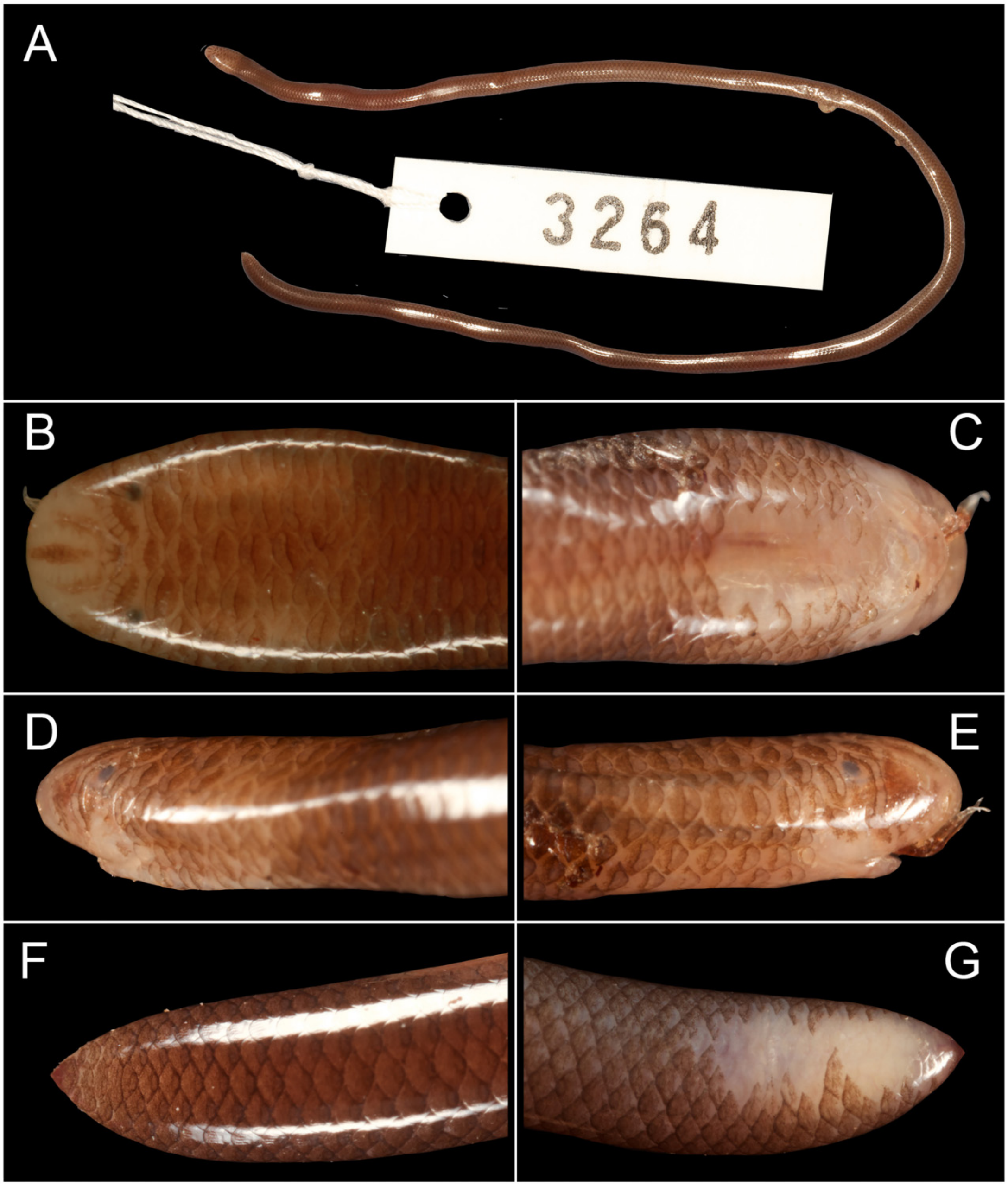
Lemos de Araujo, to assist with our survey work. Laca presented a research thesis and graduated, and he has continued his work in environmentalism and science by assisting other researchers with fieldwork, by participating in mangrove reforestation projects, and by promoting environmental issues through art (Fig. 6B).

While Laca certainly is an exceptional fieldworker and environmentalist, we would be remiss not to mention Laca's role as a member of our fieldwork team, comprising Laca, Luis, Zito, and Benny, who were collectively known to us as "the Jets" (Fig. 6C). These four gentlemen quickly became invaluable colleagues and close friends, and their knowledge of multiple diverse cultures and languages in this small country proved critical, as the Jets acted as translators and fixers, which was ideally complemented by their enthusiastic involvement in fieldwork (O'Shea and Kaiser 2013). These surveys would never have been as successful as they became without their help. Their sobriquet "Benny and the Jets" was coined by MOS in 2009 after the well-known song about a fictitious band[6], Bennie and the Jets, written by Sir Elton John CBE and Bernie Taupin CBE, which was included on Sir Elton's 1973 album Goodbye Yellow Brick Road. It is serendipitous that this snake was located in an installation accommodating jet aircraft. Laca was the remaining Jet present during our last expedition, a flag expedition of the Explorer's Club of New York (Flag #97, Fig. 6D), during which the holotype of *I. laca* was discovered.

Description of the holotype: An immature female (Fig. 4A) with length measurements (in mm) of 119 SVL + 2 TL = 121 TTL, TL = 1.7% of TTL; midbody diameter 1.7, relative body thickness = 71 or 1.4% of TTL, midtail diameter 1.2, tail 1.6 times longer than wide. 18-18-18 scale rows, lacking posterior reduction. 434 middorsals, nine subcaudals, ten dorsocaudals. Snout rounded in dorsal view with the head wider than the neck (Fig. 4B); rostral oval, 0.36 rostral width, extending nearly to the intraocular level (Fig. 5A); frontal and postfrontal subequal in size; interparietal transversely enlarged, larger than frontal and postfrontal (Fig. 5A); parietals twice as broad as deep and transversely oriented; occipitals not enlarged; rostral and nasal with broad yellow gland lines beneath scale margins; in lateral view (Figs. 4D and 4E), the snout is rounded and projecting beyond the countersunk lower jaw (Figs. 4C and 4E); tongue protruding slightly, without any lateral tongue papillae; nasal shield mostly lacking melanophore pigmentation except for along basal glands, semidivided with inferior suture contacting second supralabial and incomplete superior suture extending nearly horizontally to cover 0.3 nostril–rostral distance; posterior nasal border with a deep, rather angular concavity; preocular single, 1.5 times as broad as ocular (Fig. 5B); ocular twice as tall as broad with eye reduced to a dark spot lacking discernible pupil and iris, located in upper central portion of ocular in lateral view (Figs. 4D and 4E), in dorsal view it appears beneath the supraocular near the junction of the preocular and ocular (Fig. 4B); postocular single, twice as tall as broad; four supralabials, all approximately as broad as deep, increasing in size posteriorly, arranged in a T-V pattern with second supralabial overlapping the preocular and third supralabial overlapping the ocular; first supralabial minute, third supralabial twice the size of second, fourth supralabial the largest, three times the size of the third; tail lacking a terminal spine and ending in a nubbin (Figs. 4F and 4G). Presence of a right oviduct confirmed the gender as female; the ovaries, which resembled adipose deposits, were undeveloped and devoid of follicles, indicating an immature specimen.

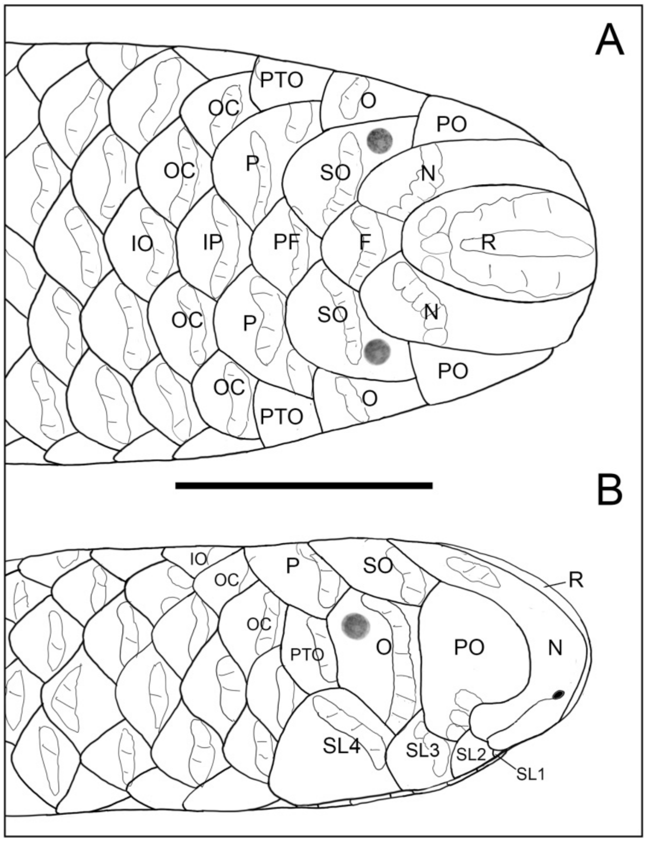
[6] We are indeed aware that Bennie in the song is a female character, but the name stuck to our amazing team, nonetheless.

Fig. 4. Holotype of *Indotyphlops laca* sp. nov. (MCZ R-192968). (A) Whole body with field tag MOS 3264. The head of the specimen is in the upper area of the image. (B) Dorsal head view. (C) Ventral head view. (D) Left lateral head view. (E) Right lateral head view. (F) Dorsal tail view. (G) Ventral tail view.



Colouration in life: *Indotyphlops laca* has a dorsal colouration of reddish or pinkish brown (colour between S#32 Chestnut and S#132b Mahogany Red, and between K#80 Tawny and K#34 Mahogany Red) on the middorsal scale row and six longitudinal scale rows on either side of it. This colour lightens anteriorly to form a reddish-pink head cap (S#108D Rose Pink; K#219 Pinkish Rose or K#243 Rose Pink) on the head shields and the first 6–7 posteriad scale rows. The colour on the 6–7 caudal-most scale rows is a pale brown. All costal scales have a crescent-shaped, basal spot of darker pigmentation covering 20%–25% of each scale. This darker colour is dark brown on dorsally oriented scales and pale brown on ventrally oriented scales. The snout has distinctly visible, unpigmented, yellow-hued gland lines that create separation between the reddish-pink brown scale pigmentation of the rostral and the nasal shields (Fig. 4B); the labials appear mostly unpigmented, yellow-hued with some brownish pigmentation extending from the dorsal part of the head onto the scales only along their sutures. This is also seen in the ocular, which is generally lighter than the more anterior scales; the skin around the eye is unpigmented. The remaining head shields are predominantly pinkish brown.

Fig. 5. Holotype of *Indotyphlops laca* sp. nov. Head drawings show the scalation of the dorsum (A) and a right lateral view (B) of the head, taken from photographs by MOS. Scale abbreviations include rostral (R), nasals (N), preoculars (PO), frontal (F), supraoculars (SO), oculars (O), postfrontal (PF), parietals (P), interparietal (IP), postoculars (PTO), occipitals (OC), interoccipital (IO), and numbered supralabials (SL). Scale = 1 mm.



The chin and the throat are devoid of darker pigmentation, and this light area extends eight scale rows posteriad from the mental. The five longitudinal scale rows on the ventral side are generally lighter than those on the dorsum, nearly lacking pigmentation except for pale brown basal spots. The cloacal and subcaudal regions mirror the size of the unpigmented pattern on the chin and this pattern extends to the ventral part of the apical nubbin, which is pigmented dorsally.

COLOURATION AFTER PRESERVATION: After 8 years in preservation, the entire specimen lacks most discernible pigmentation except for the distal dorsocaudal 7–8 scale rows, which exhibit the faintest tan pigmentation. This rather rapid pigmentation loss is puzzling, since preserved blindsnakes typically retain their pigmentation for decades, but in this case it may be a further characteristic of a fully fossorial snake when natural selection does not act against skin pigmentation instability.

COLLECTION AND NATURAL HISTORY: On 10 August 2014, during the tenth and final phase of a 6-year project surveying the herpetofauna of Timor-Leste (Kaiser et al. 2011, 2013; O'Shea et al. 2012, 2015; Sanchez et al. 2012), the expedition team was granted special access to PNLIA to investigate stories of Macklot's water pythons (*Liasis m. mackloti* Duméril and Bibron, 1844) and other snakes that were periodically found around the containers and buildings that constitute the airport fuel depot (Figs. 7A, 7C–7E). The fuel depot is located approximately 300 m to the west of the passenger terminal, while the light aircraft and helicopter hangar is located about 200 m west of the terminal (Fig. 2B). In the event, and despite an intensive search by the eight team members, only two snakes were found: one specimen of *Virgotyphlops braminus* (MCZ-R192967) and the holotype of *I. laca*. Coincidentally, the *Indotyphlops* specimen was the final specimen collected before the expedition departed the country 2 days later, and it was entirely unexpected that a specimen collected in such a heavily impacted area should be such a strikingly different new species.

The snake was found by HK when he turned over a series of rocks in a small depression (Figs. 7A and 7F) just to the left of the light aircraft and helicopter hangar (Figs. 7A and 7G). Beneath a top layer of rounded, hand-sized rocks were several larger, flat boulders. Removal of these revealed the presence of a colony of black ants. The lowest flat rock was centrally located in the ant colony, and lifting it revealed the entrances to several narrow tunnels as well as the blindsnake. Blindsnakes are well known to be myrmecophagous (e.g., Webb and Shine 1993; Parpinelli and Marques 2015), earning them the moniker of a reptilian "anteater". Upon being uncovered, the snake did not move directionally but immediately began to writhe wildly and was captured by hand with some difficulty due to its very slender build and the presence of a large number of aggressive ants. When the individual was subsequently placed on a piece of coconut palm bark for photography purposes, it was observed to disappear through relatively narrow holes and move around with ease in the fibrous material between the inner and outer layers of bark (Figs. 8A–8F), where to our consternation it occasionally disappeared entirely for several minutes during the photoshoot. The *V. braminus* specimen (Fig. 7H) was also found by HK, under a rock near a fence at Location H (Fig. 7A).

SPECIES COMPARISONS: In the following comparisons, characters of *I. laca* are provided in parentheses. The geographically closest congener, *I. schmutzi*, has 403–413 middorsals (434), a completely divided nasal (semidivided), relative tail length 1.9–2.0 (1.7), terminal spine present (absent), and maximum body size at 140 mm TTL (121 mm). It can be separated from most other *Indotyphlops* by the presence of a T-V SIP. In addition to a great geographical separation, *I. laca* differs from the four non-Lesser Sunda *Indotyphlops* species exhibiting a T-V pattern by the following diagnostic characteristics. *Indotyphlops exiguus* has only 348 middorsal scales (434), a clavate rostral (oval), preocular equal in size to ocular (larger than ocular), and a longer body at 196 mm TTL (121 mm). *Indotyphlops filiformis* has only 389 middorsals (434), the first six vertebral scales transversely enlarged (only the interparietal transversely enlarged), enlarged occipitals (not enlarged), and apical spine present (absent). *Indotyphlops*

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Fig. 6. (A) Agivedo "Laca" Varela Ribeiro, for whom we name *Indotyphlops laca*, shown here rescuing a small *Malayopython reticulatus*. (B) Laca constructing a beachside driftwood art installation. (C) The four citizens of Timor-Leste, whom MOS and HK know as the Jets. They formed an integral part of the Reptile and Amphibian Survey of Timor-Leste (2009–2014). Shown while scale-counting a specimen of *Virgotyphlops braminus* on Ataúro Island are (from left to right) Laca (red shirt), Luis Lemos de Araujo (wearing magnifiers), Zito Afranio Soares, and Venancio Lopes Carvalho; a second specimen lies on the concrete slab. (D) Participants of Phase X (26 July–12 August 2014) of the Reptile and Amphibian Survey of Timor-Leste, on Jaco Island off the extreme eastern tip of Timor. Shown from left to right are a local boatman and Laca holding the flag of Timor-Leste; Mirco Wölfelschneider holding a blowgun; Sven Mecke, HK, and Laura Fuchs holding Flag #97 of the Explorer's Club of New York; MOS, Lukas Hartmann, and Max Kieckbusch.

lazelli has 409–427 middorsals (434), a long superior nasal suture at 0.67–0.90 of nostril–rostral distance (0.33), cone-shaped terminal spine (absent), and longer TTL of 158 mm (121 mm). *Indotyphlops porrectus* has the first four vertebrals transversely enlarged (only the interparietal transversely enlarged), superior nasal suture of 0.7–1.0 (0.33), postnasal concavity absent (present), ocular larger than preocular (vs. smaller than ocular), enlarged occipitals (not enlarged), apical spine present (absent), and larger body size at 285 mm TTL (121 mm).

Discussion

Scolecophidian diversity in the Lesser Sundas

The Lesser Sunda Islands generally appear to have a depauperate scolecophidian biodiversity with only three formally described species (de Lang 2011*a*, 2011*b*). Three species in three genera are presently recognized: *V. braminus*, *I. schmutzi*, and *Sundatyphlops polygrammicus* (Schlegel, 1839), the latter with five subspecies that may prove to be valid species after further study. *Virgotyphlops braminus* is widely distributed in the region and is known from Alor, Bali, Flores, Kawasang, Komodo, Lembata, Lomblen, Lombok, Nusa Penida, Rinca, Savu, Sumba, Sumbawa, and Timor, at elevations from sea level to 2150 m (Eliosa-Leon et al. 1995; Wallach 2009). *Indotyphlops schmutzi* is restricted to Flores and Komodo. *Sundatyphlops p. brongersmai* (Mertens, 1929) is endemic to Sumba, *S. p. elberti* (Roux, 1911) is endemic to Lombok, *S. p. florensis* (Boulenger, 1897) is endemic to Flores, *S. p. undecimlineatus* (Mertens, 1927) inhabits Moyo, Komodo, and Sumbawa, and the nominate subspecies was described from Timor, where it occurs at elevations of 0–900 m (O'Shea et al. 2015). Two additional species that were erstwhile considered members of *S. polygrammicus* are now recognized as *Anilios nigrescens* Gray, 1845 from eastern Australia and *Anilios torresianus* (Boulenger, 1889) from the Torres Strait Islands, Queensland, Australia, and southern New Guinea. The addition of *I. laca* to the Lesser Sunda fauna increases the number of scolecophidian species to four with three typhlopids known from Timor-Leste (O'Shea et al. 2015).

Fig. 7. Location of the search area at Presidente Nicolau Lobato International Airport (PNLIA), Dili, Timor-Leste. (A) Google Earth 2011 aerial view of the fuel depot and light aircraft/helicopter hangers. Search localities C–H are indicated by yellow markers. (B) Map of PNLIA, with the area shown in panel (A) identified by the yellow box. (C–E) Areas of the fuel depot searched unsuccessfully for *Liasis mackloti* by MOS with half of the team. (F) Precise collection locality for the holotype of *Indotyphlops laca* sp. nov. (MCZ R-192968), indicated by the position of the snake stick held by HK, who searched around the light aircraft and helicopter hangers with the other half of the team. (G) Light aircraft/helicopter hangar. Note the Smoking Prohibited, Aviation Gasoline, and Mission Aviation Fellowship signs, which are also just visible at top right in panel (F), and which pinpoint the type locality. (H) Specimen of *Virgotyphlops braminus* (MCZ-R192967) collected under a rock in front of fence at Yellow Marker H in panel (A), near the fuel depot.

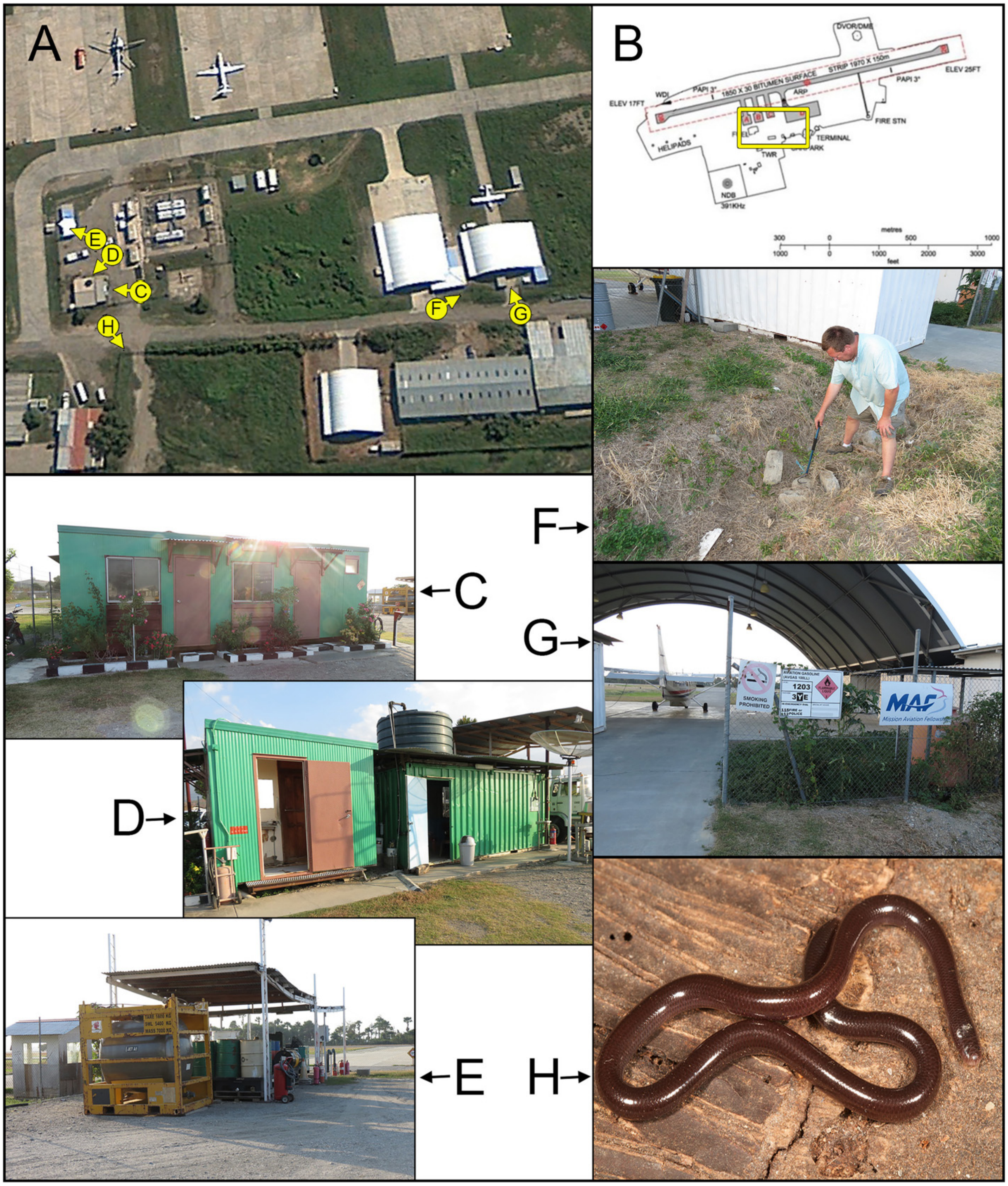
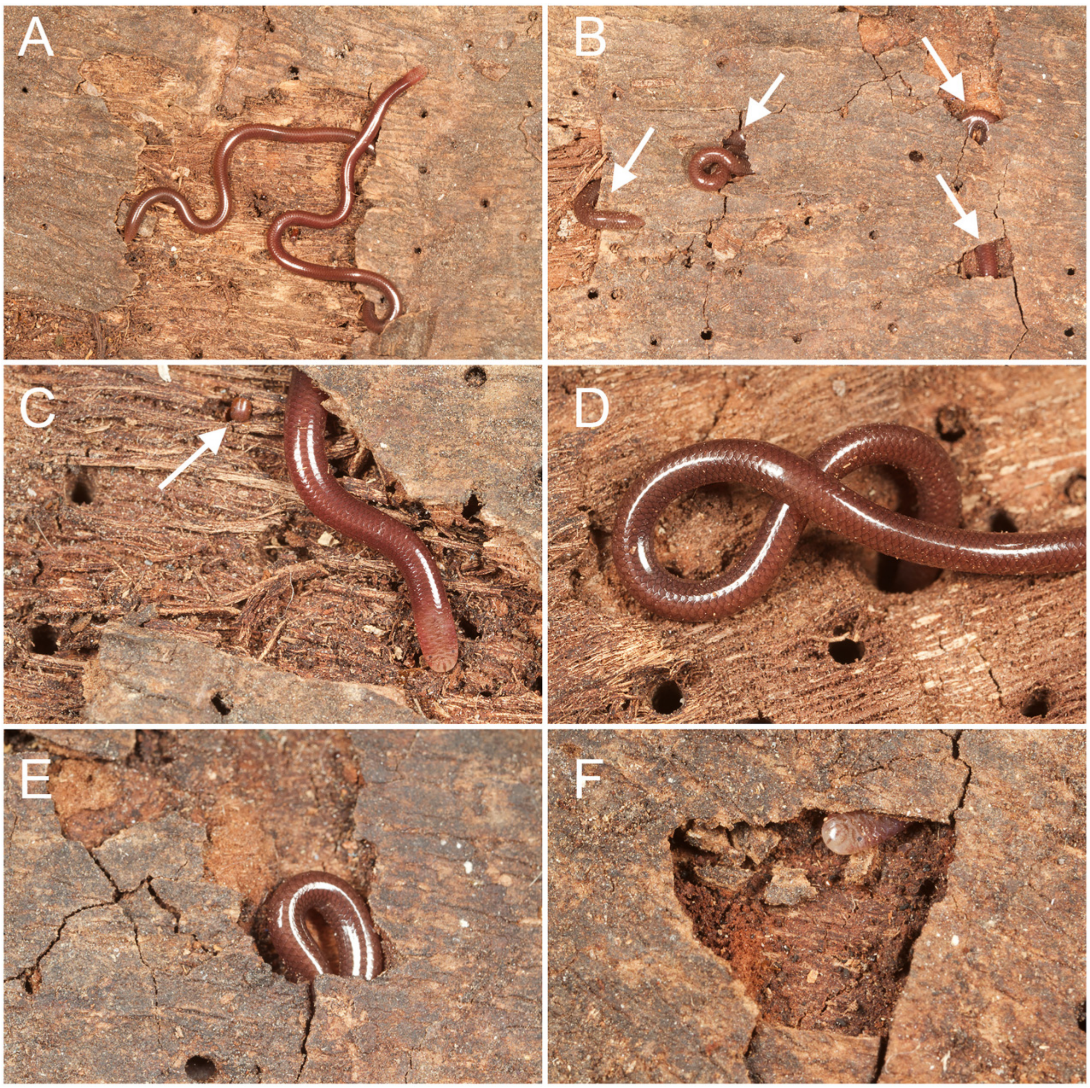


Fig. 8. An illustration of the ease with which the holotype of *Indotyphlops laca* sp. nov. moves through coconut palm bark. This was discovered while trying to set up the specimen for photography in a hotel room, where a brief turn to get the camera allowed the snake to disappear completely! (A) The entire snake was rarely visible during the photoshoot as it took any opportunity to venture into the pores and tunnels of the bark. (B) The blindsnake is visible at four points (white arrows) as it moves through the inner fibrous bark from left to right. (C) The head and anterior body emerge from the outer layer of bark, but a glimpse of its body (white arrow) is visible in the layer below. (D) The blindsnake is seen taking advantage of one of the slightly larger pores in the bark. (E) The blindsnake emerged, turned around at the sight of a perceived threat, and retreated back into the bark at the same point. (F) Occasionally, only the head would appear in a gap, then it would withdraw, to appear in an entirely different area of the bark seconds later. Unfortunately, we did not measure the diameter of the pores, but from the ease with which this slender snake moved through the coconut palm bark, it is evident that it would be perfectly at home in the galleries and chambers of termite mounds or ant nests.



Assessing scolecophidian girth

Upon examination of the captured specimen, MOS immediately commented on the slender body, the snake's length seeming completely out of proportion to its girth, and how similar it appeared to a photograph of the holotype of *Ramphotyphlops longissimus* Aplin, 1998, now *Anilios longissimus* (Cogger 2014: 805). The holotype of *Anilios longissimus* (WAM R120049) was collected on Barrow Island, Western Australia, and Aplin (1998: 6) described it as "extremely elongate and slender". *Anilios longissimus* is over twice as long as *I. laca* (268 mm vs. 121 mm TTL in *I. laca*) with a much higher number of middorsals (750 vs. 434) and fewer scale rows (16 vs. 18). Data from Aplin (1998) include body diameter measurements of 1.8 mm width, resulting in a relative body thickness of 150 compared with 71 in *I. laca*—whose body width is actually equally as slender at 1.7 mm. This apparent incongruity prompted the following analysis.

As the body width measurements of *A. longissimus* and *I. laca* attest, both snakes have basically the same absolute thinness (1.8 and 1.7 mm), yet the approach of assessing blindsnake girth as body length divided by body width produces a significant arithmetic difference that is not easily reconciled with an observer's perception. To wit, the species with which we are comparing *I. laca* have girth parameters that make them quite different from *A. longissimus* (150) but not very different from each other. In order from relatively stout to slender, these values are 57 (*I. porrectus*), 61 (*I. filiformis*), 71 (*I. laca*), 73 (*I. schmutzi*), 78 (*I. exiguus*), and 80 (*I. lazelli*), with mean ± standard deviation of 70 ± 8 and a range of 57–80. Among these, the highest is 10% away from the mean and the lowest is 13% away from the mean. In contrast, percentage TTL values for these species are 1.8% (*I. porrectus*), 1.7% (*I. filiformis*), 1.4% (*I. laca*), 1.3% (*I. lazelli*), 1.3% (*I. exiguus*), and 1.2% (*I. schmutzi*), with mean ± standard deviation of 1.5 ± 0.2% on a range of 1.2%–1.8%, resulting in a slight reordering of the species. Using percentages, the maximum value is 20% higher than the mean, the minimum 20% lower. It therefore appears that the traditional length/width calculation minimizes the mathematical effect of the differences and obscures what the human eye perceives (the calculations provide half the effective percentage difference from the sample mean). Our initial impression that *I. laca* was ultra-slender does not hold true in these comparisons, yet its girth is roughly the same as that of *A. longissimus*, whose body girth percentage is much smaller at 0.8% of body length. While it is obvious that the traditional length/width approach to girth used in scolecophidian taxonomy since at least the days of Duméril and Bibron (1844) has been extremely successful in establishing a consistent methodology in surveying species groups, we posit that the percentage measurement could be an additional parameter that helps with establishing how an animal's width fits into a broader environmental context. Either measurement challenges our concept of what a "slender girth" in a blindsnake really looks like, and this certainly warrants further study.

Environments for ultra-slender species

In terms of how ultra-slender animals like *A. longissimus* and *I. laca* fit into their respective environments, their extreme slenderness suggests that convergence of body shape may be occurring when inhabiting narrow, constricted spaces is of selective advantage. The circumstances under which *A. longissimus* was collected, as reported by Aplin (1998), may be particularly informative in this regard. The holotype of *A. longissimus* was collected on 22 May 1995 by Lloyd Whitsed during maintenance of an anode water well located at Bandicoot Bay, Barrow Island, Western Australia (20.8722°S, 115.3208°E). Vertically drilled cathodic protection anode system wells range in depth from 30 to 150 m deep to locate groundwater. The holotype was one of a pair of individuals brought to the surface on a section of well casing that had been raised from a significant depth. One individual escaped back into the well hole, but the other was grabbed by Mr. Whitsed, who mistook it for an eel or a worm and placed it in a jar of water. It was later delivered alive to the Western Australian Museum in Perth, Western Australia.

Aplin reported that drilling operations on Barrow Island, an area of Miocene karstic limestone, often penetrated deep caverns partially containing red sediments, and he postulated that this could be the habitat of *A. longissimus*. The species may be a deep cavern troglodyte from an environment out of reach of larger vertebrates, including humans, where even generally slender vertebrates, such as blindsnakes, must be especially slender to exist. This idea is supported by the lack of pigmentation observed in the holotype of *A. longissimus*, described by Aplin (1998: 6) as "translucent, without any obvious pigment apart from very small eyes", with the exception of some faint "ghosting" of posterior dorsal scale margins. The lack of pigmentation is a characteristic feature of troglobite animals, including olms (*Proteus anguis* Laurenti, 1768), fish (e.g., *Astyanax jordani* (Hubbs and Innes, 1936)), and crayfish (e.g., *Orconectes australis* (Rhoades, 1941)), as is their reduced eyesight. However, while much of the eastern part of Timor-Leste is also composed of limestone and riddled with cave systems, the geology of northwestern Timor-Leste, including Dili, comprises more coralline substrate and sedimentary rocks (Durand 2002). *Indotyphlops laca* may therefore be sufficiently slender to negotiate the narrow chambers and galleries of termite mounds or ant nests, whose greater bulk, iceberg-like, lies beneath the surface. If the tops of such mounds were removed during airport construction, ant and termite communities may have survived in the sizeable remainders of their citadels, which became levelled with the surface of the land. Any species relying on these social insects for food or shelter would equally continue to thrive and retain nontroglobite features, including skin pigmentation. That said, the holotype of *I. laca* was collected in a nest of black ants, and it may therefore be a species that interacts with ants rather than termites. Without knowing the species of ant, specimens of which could readily be collected under the rocks of the collecting site, it is impossible to speculate on the structure, size, or depth of their colony. It is distinctly possible that *I. laca* is a relatively deep-dwelling species rarely encountered on the surface, even after rain.

Whither *Typhlops filiformis*?

The status of *Typhlops filiformis* (now considered a member of the genus *Indotyphlops*) remains questionable. Duméril and Bibron's (1844) description of the holotype (MNHN 929, of unknown provenance and the only known specimen) contained a number of errors that probably contributed to its placement as incertae sedis by Hahn (1980) and McDiarmid et al. (1999). One of us (VW) has examined the type (correct values in parentheses) and noted the following discrepancies with the account of Duméril and Bibron: total length 135 mm (121), 20 scale rows (17-18-18), 380 total middorsals (389), inferior nasal suture contacting SL1 (contacting SL2), and three postoculars (one). *Indotyphlops filiformis* closely resembles *I. porrectus*. All characters of *I. filiformis* fall within the range of *I. porrectus* and the two taxa may be conspecific. If so, the name *filiformis* (Duméril and Bibron 1844) has priority over *porrectus* (Stoliczka 1871) and this would have to be addressed in terms of nomenclature, with two possible options: either *filiformis* replaces *porrectus* as its senior synonym (Article 23.1 of the International Code of Zoological Nomenclature) or the International Commission on Zoological Nomenclature would

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have to suppress *filiformis* in deference to the prevailing usage of the name *porrectus* (Articles 23.9.1 or 81).

Wallacean gaps

The discovery of *I. laca* in south-central Wallacea, the diverse biogeographic realm at the intersection between Southeast Asian and Melanesian faunas (Ali and Heany 2021), is not only relevant because it adds to our understanding of herpetofaunal diversity in the region. It also shows that the Age of Discovery in this part of the globe is far from over and that there must be a significant gap in our knowledge of the blindsnake fauna in the Lesser Sunda Islands and Wallacea as a whole. Additional exploration will be necessary to obtain a more complete record of blindsnake diversity and the role these interesting but rarely seen animals play in their respective, secret ecosystems.

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