Micronesica 2017-01: 1–13

Indotyphlops braminus (Daudin, 1803): distribution and oldest record of collection dates in Oceania, with report of a newly established population in French Polynesia (Tahiti Island, Society Archipelago)[1]

IVAN INEICH[2]
Muséum national d'Histoire naturelle, Sorbonne Universités, Institut de Systématique, Évolution et Biodiversité (ISyEB), UMR 7205 (CNRS, MNHN, UPMC, EPHE), CP 30 (Reptiles) – 25, rue Cuvier, 75005 Paris, France
ivan.ineich@mnhn.fr

ADDISON WYNN
Department of Vertebrate Zoology, National Museum of Natural History
Smithsonian Institution, Washington, DC 20560-0162, USA

CHRISTOPHE GIRAUD
Département de la qualité alimentaire et de l'action vétérinaire, Service du Développement Rural, BP 100
rue Tuterai Tane, Pirae, 98713 Papeete – Tahiti, Polynésie française

VAN WALLACH
Potter Park, Cambridge, MA 02138, USA

Abstract— The authors provide a general review of the first collection date or first literature publication date for *Indotyphlops braminus* from all Oceanian archipelagos and/or islands from where it has been reported. This terrestrial worm-like snake (Typhlopidae) is reported here for the first time as having been introduced, most likely accidentally, to Tahiti Island. The snake will certainly rapidly spread over most islands of the five archipelagos of French Polynesia.

French Abstract— Les auteurs établissent une révision générale des dates de première collecte ou de première mention aussi précises que possible pour l'introduction du serpent terrestre vermiforme *Indotyphlops braminus* (Typhlopidae) sur toutes les îles et archipels océaniens. L'introduction probablement accidentelle de ce serpent est ici signalée pour la première fois sur l'île de Tahiti. Ce reptile va très certainement étendre rapidement sa répartition à l'ensemble des cinq archipels de Polynésie française.

Introduction

Indotyphlops braminus (Daudin, 1803), also known as the Brahminy blindsnake or flowerpot snake, is a small worm-like snake often mistaken for an earthworm. It is always among the smallest snakes wherever it occurs. Its mean total length is between 100-130 mm with a weight of 0.75 gm (Wallach 2009).

Based on the presence of retrocloacal sacs (indicated as "retro-cloacal formations") as well as unique features of the hemipenes, Robb (1966) showed that the genus *Ramphotyphlops* Fitzinger, 1843 had to be revalidated to accommodate certain Australasian species. Later McDowell (1974) noted that *braminus* could be assigned to the genus *Typhlina* Wagler, 1830 (a synonym of

[1] Citation: Ineich, I., A. Wynn, C. Giraud & V. Wallach. 2017. *Indotyphlops braminus* (Daudin, 1803): distribution and oldest record of collection dates in Oceania, with report of a newly established population in French Polynesia (Tahiti Island, Society Archipelago), *Micronesica* 2017-01, 13 pp. Published online 21 September 2017. http://micronesica.org/volumes/2017

[2] Corresponding Author

Ramphotyphlops) based on similarities with the head scale pattern of "*Typhlina erycina*." A complete nomenclatural history of the species (as *R. braminus*) can be found in Wallach (2009), who indicated that a new genus has to be proposed for that species. The new genus *Indotyphlops* (type species *Typhlops pammeces* Günther, 1864) was later created by Hedges et al. (2014) to accommodate 22 species. Note, however, that Pyron & Wallach (2014) only considered 20 species in the genus. That new genus was included in the new subfamily Asiatyphlopinae Hedges et al., 2014 which comprised 10 genera from southern and eastern Asia, the Malay Archipelago, Australasia, and islands of the western and southern Pacific. Pyron & Wallach (2014) only recognized seven genera in that subfamily. *Indotyphlops braminus* is the most successful species in the entire family, spreading on all continents most often in recent years but also sometimes earlier through human involuntary introduction through trading and movement of people and goods around the Indian Ocean and beyond. The snake is, however, not present in South America, and arid, high latitude and high altitude areas. According to numerous changes in its taxonomic history, some geographic records related to *I. braminus* appear under *Typhlina bramina*, *Typhlops braminus* or *Ramphotyphlops braminus*.

Indotyphlops braminus is generally present in relatively moist places like under flower pots, detritus, stones or dead trees, and also in the moist layers at the base of young coconut trees most often to as high as 50 cm (II pers. obs.). It is often abundant and easy to find under objects deposited beneath houses, particularly in villages recently colonized by the snake. The species is terrestrial, but some specimens have been observed in arboreal habitats (Bazzano 2007). Ota et al. (1991) estimated clutch size of this snake as 1-8, but Kamosawa and Ota (1996) pointed out their possible overestimation and provide a more reliable range of 1-6. Incubation period is of up to 58 days (Ota et al. 1991). Parthenogenesis, first suspected (McDowell 1974, Nussbaum 1980), was demonstrated by Wynn et al. (1987) and Ota et al. (1991). Its populations only comprise triploid females that reproduce through obligate parthenogenesis, a characteristic unique among snakes (Booth & Schuett 2016). *Indotyphlops braminus* is likely the product of hybridization between two (or more) parental species of *Indotyphlops*, possibly through two distinct hybridization events due to its triploidy. Some or all parental species could now be extinct through competition with their most successful hybrid descendants.

Indotyphlops braminus feeds primarily on the soft parts of ants and termites, sometimes on earth worms and caterpillars (Wallach 2009, Geniez 2015). Recently Mizuno & Kojima (2015) showed that it decapitates its termite prey and consumes only the thorax and abdomen in about half the specimens it eats. Heads often remain undigested in the feces. Decapitation can allow the snake to avoid consuming termite heads which are of poor nutritive value or to escape chemical defense of termites by non-ingestion of toxic compounds mostly located in their heads.

General reviews of the natural distribution and spreading of *I. braminus* based on literature record synthesis can be found in McDiarmid et al. (1999), Wallach (2009) and Kraus (2009). *I. braminus* is most likely a native of India or Sri Lanka and probably spread (naturally or through man) to other nearby southern Asian countries like Bangladesh, Nepal, and Pakistan, and perhaps also to southeast Asian countries like Cambodia, Laos, Myanmar, Singapore, Thailand, Vietnam, and West Malaysia, or east Asian countries like China (including Hainan, Hong Kong, and Macau) and Taiwan (Wallach 2009, Hedges et al. 2014, Pyron & Wallach 2014). The snake was, however, recently introduced in many regions and countries including the West Indies (e.g. Censky & Hodge 1997, Wallach 2008) and Cuba (Díaz & Cádiz 2014, Borotto-Paez et al. 2015), Asia (including Japan [e.g. Ota et al. 1991]), Australia (e.g. Cogger 2014), most Indian Ocean Islands (e.g. Wallach 2009), Near- and Middle-East (e.g. Safaei-Mahroo et al. 2015), Africa (including northern arid countries like Egypt [e.g. Venchi & Sindaco 2006, Ibrahim 2013]), and Madagascar (e.g. Nagy et al. 2015). The snake was also reported from numerous peripheral islands and archipelagos all over the world (e.g. Wallach 2008) in Africa and on Atlantic oceanic islands (e.g. de Urioste & Mateo 2011, Jesus et al. 2013) or Asia (e.g. Kaiser et al. 2011, Qing et al. 2015). It also was introduced to

Central America (e.g. Dixon & Hendricks 1979, McCranie et al. 2010) and North America (Mexico; USA: Alabama, Arizona, California, Florida, Georgia, Louisiana, Massachusetts, Minnesota, North Carolina, Ohio, Texas, and Virginia [e.g. Wallach 2008, Hegan 2014]). *Indotyphlops braminus* has not yet invaded South America (Wallach 2009). The snake was even recently introduced to the Canary Islands, and to Europe in the Balearic Islands and southern Spain mainland (e.g. Mateo et al. 2011, Rato et al. 2015)!

Materials and Methods

The recent spread of *I. braminus* has also included many islands in Oceania (Zug 2013). We here provide a complete summary of the distribution of *I. braminus* in Oceania and its earliest known report date based on literature examination and/or museum collections. We also report the first record of *I. braminus* on Tahiti Island (Society Archipelago, French Polynesia) based on two recently collected snakes.

Results

Indotyphlops braminus was reported from New Guinea[3] (Barbour 1912, Kopstein 1926, Brongersma 1934, McDowell 1974, Room 1974, Heatwole 1975, McCoy 1980, Nussbaum 1980, O'Shea 1996, Kraus & Allison 2004, Kraus 2013); Bonin Islands (Shigei 1971); Palau, (Fehlmann 1960 [not seen], McDowell 1974, Crombie & Pregill 1999, Zug 2013); the Mariana Islands and Guam (A.M.C. Duméril & Bibron 1844, Safford 1905, Van Denburgh 1917, Cagle 1946 [Guam, Tinian, Saipan, Aguiguan, Anatahan], Downs 1948 [Tinian], Tanner 1948 [Guam], Oliver & Shaw 1953 [Tinian], Brown 1956, Dryden & Taylor 1969 [Saipan, Guam], McDowell 1974 [Saipan, Guam], Wiles et al. 1989 [Tinian], Wiles et al. 1990 [Rota], Rodda & Dean-Bradley 2001 [Guam]); Federated States of Micronesia (Vollbrecht 1945 [Carolines], McDowell 1974 [Pohnpei], Thomas 1997 [Pohnpei], Buden 2000 [museum specimens dated 1936 from Pohnpei], Wood & Law 2010 [Kosrae], Zug 2013 [Kosrae, Pohnpei, Yap], Buden & Taborosi 2016 [? for a specimen observed on Ulithi Atoll (Falalop), but its identity not ascertained, identification confirmed on Kosrae, Pohnpei, and Yap]); the Marshall Islands (Knight 1984, Lamberson 1987, Vander Velde 2003, Zug 2013); Nauru (Buden 2008, Zug 2013); the Solomon Islands (McDowell 1974, McCoy 1980, 2006); Vanuatu (Medway & Marshall 1975, Anonymous 1981, Cranbrook 1985, Allison 1996, Shea & Wallach 2000, Jennings 2004, de Pous & Dingemans 2008, Ineich 2009, 2011, Zug 2013); New Caledonia and the Loyalty Islands (Bauer 1987, Ineich & Bauer 1992, Bauer 1999, Shea & Wallach 2000); New Zealand (not established in New Zealand and known only from a single intercepted stowaway according to Gill et al. [2001]); Fiji (Clunie 1983, Morrison 2003, Watling et al. 2010, Zug 2013); Kiribati (Gilbert Islands [Craven & Shea 2010]); Western Samoa (Bonin & Shea 2009); American Samoa (voucher Calif. Acad. Sciences CAS 195919 collected 1992, Trail 1993, Craig 2002, Goldin 2002, Kraus 2009, Zug 2013 [Samoa only, no precision]); Hawaii (Slevin 1930 [Oahu], Tinker 1938, Fisher 1948 [Oahu], Oliver & Shaw 1953 [Oahu], Hunsaker & Breese 1967 [Maui Isl.], Liebermann & Liebermann 1970 [Hawaii Isl.], McKeown 1978, Jones 1979, McCoy 1980, Nussbaum 1980, Kraus 2005 [Hawaii Isl.], Bazzano 2007, Zug 2013); and Midway Island (Wallach 2008, Taylor et al. 2009).

Introduction dates on those Pacific islands remain unclear since the snake could have been undetected long after its arrival. However, natural occurrence on some north-western Oceania islands has been suggested by Pregill (1998). He showed that snake remains attributed to *I. braminus* occur at archeological sites on Aguiguan and Tinian islands in the Marianas, presumably

[3] See discussion in McDowell (1974) about New Guinea records prior to Second World War.

at prehuman levels of strata. However, it cannot be excluded that those fossil remains belong to another species, extinct or still unnoticed, and not to *I. braminus*. In the Caroline Islands, not far from the Marianas, two endemic species were recently described (Wynn et al. 2012), *Ramphotyphlops hatmaliyeb* and *Ramphotyphlops adocetus*. A first hypothesis could be that Pregill's fossil remains from the Mariana Islands derive from one of those species or other endemic species related to them. All of those remains should most likely belong to the genus *Ramphotyphlops* native radiation as recently redefined (see above) and not to the genus *Indotyphlops*. Pregill's (1998) identification of the fossil vertebrae attribute them to typhlopids based on their morphology and to *I. braminus* (as *R. braminus*) only because there was no other species known from the area at that time. Morphological differences allowing separation of vertebrae of *Ramphotyphlops* from those of *Indotyphlops* are unknown, thus our above statement is only hypothetical. One early report (A.M.C. Duméril & Bibron 1844) of a specimen from the Mariana Islands (Guam) collected by Jean René Constant Quoy and Joseph Paul Gaimard in 1819 during the Freycinet Expedition was referred to *I. braminus*. That specimen, MNHN-RA 6332 is available in Paris Natural History Museum (MNHN) collections. We first thought that it could be referable to the endemic Micronesian *Ramphotyphlops* radiation with 22 midbody scale rows (Wynn et al. 2012), which could explain its early occurrence in the area. Examination of that specimen confirms it is *I. braminus*, having 20 midbody scale rows and typical head scales. Two additional old specimens dated prior to 1889 (MNHN-RA 1889.0543-544) from the same location also belong to *I. braminus*. Thus, those MNHN-RA specimens are the earliest verified occurrence (vouchers) of that species in Oceania, later confirmed by Cagle (1946), Downs (1948), and Dryden & Taylor (1969) in Micronesia. The situation in Micronesia is particularly interesting and needs further study since *I. braminus* seems to have been present on those islands for a long time (the oldest verified occurrence in Oceania is dated from the early 19th century). However, *I. braminus* may have also occurred there with an endemic radiation of the genus *Ramphotyphlops*. If Pregill's (1998) fossil vertebrae from the Marianas are from an extinct endemic typhlopid (genus *Ramphotyphlops*), the species may have gone extinct before or just after *I. braminus* arrived on the islands, and the two may not have occurred there together. Alternatively, the endemic species could still exist and remains undetected, which is unlikely due to the changes in faunal composition (numerous introduced predators and competitors which are often more threatening to endemic than alien species) and habitat modifications on the Marianas. A second hypothesis could be that those remains really belong to *I. braminus* and thus such an early occurrence of the species could be related to colonization events originating from Asia prior to human arrival. Establishment of osteological characters allowing separation of *Indotyphlops* from *Ramphotyphlops* based on vertebrae from modern well identified specimens would be mandatory to clarify the question of the past occurrence and distribution of these genera in Micronesia.

Concerning the date of arrival of *I. braminus* in Oceania (Table 1), the oldest record is from the Marianas (1819; A.M.C. Duméril & Bibron 1844), followed by a record from Manokwari in west of New Guinea (Barbour 1912), and the Hawaiian Islands dated prior to 1930 (Slevin 1930). The snake could have been introduced to Hawaii early in the XXth century. Note that *I. braminus* occurred in the Indian Ocean for a much longer period of time. The Paris Natural History Museum catalogues refer to specimens collected at La Réunion Island before 1862 (MNHN-RA catalogues; specimens collected by Maillard but not found in collections; Ineich, pers. obs.) and Zanzibar in 1884 (MNHN-RA 1884.0061; Ineich, pers. obs.) and those were probably voluntarily introduced at the same time as several other lizards and snakes now indigenous to La Réunion (e.g. the agamid lizard *Calotes versicolor* and the colubrid snake *Lycodon aulicus*) which most likely originated from India where they are common species.

Table 1. Earliest known arrival dates of the snake *Indotyphlops braminus* on the Oceanian islands and archipelagos according to publications or collection vouchers.

Country	Earliest date	Reference
Mariana Islands	1819	A.M.C. Duméril & Bibron 1844
Mariana Islands, Guam	1819	A.M.C. Duméril & Bibron 1844
New Guinea	1912	Barbour 1912
Hawai'i	1930	Slevin 1930
Carolines (Pohnpei)	1936	Buden 2000
Mariana Islands, Tinian	1945	Cagle 1946
Mariana Islands, Saipan	1945	Cagle 1946
Marshall Islands	1954	Knight 1984
Palau (Belau)	1955	Crombie & Pregill 1999
Solomon Isl.	1961	McDowell 1974
Vanuatu	1971	Medway & Marshall 1975
Bonin Island	1971	Shigei 1971
New Caledonia	1974	Ineich & Bauer 1992
Fiji	1983	Clunie 1983
Mariana Islands, Rota	1987	Wiles et al. 1990
Loyalty Islands	1991	Shea & Wallach 2000
American Samoa	1992	CAS 195919
Midway Atoll	1998	Wallach 2008
Nauru	2007	Buden 2008
Kiribati (Gilbert Isl.)	2007	Craven & Shea 2010
Western Samoa	2009	Bonin & Shea 2009
Tahiti Island, French Polynesia	2014	This paper

Indotyphlops braminus was reported as occurring on Pohnpei by 1936 and in the Marshall Islands in 1954. It was only reported from New Caledonia and Vanuatu around 1970, and from Fiji in 1983 (Table 1). The snake has not been reported from Tonga (Gill 1987, 1988, 1990, Gill & Rinke 1990, Steadman et al. 1999, Zug 2013, Atherton et al. 2015) where it most likely has not been introduced for the moment. There are also no published records for Rotuma (Boulenger 1897, Zug et al. 1989), Wallis and Futuna (Gill 1995), Tuvalu (Waite 1897), Tokelau (Whitaker 1970, Clapp 1975), Niue (Wodzicki 1969), the Cook Islands (McCann 1994, Clapp 1977, Crombie & Steadman 1986, Gill 1998), and the Pitcairn Island Group (Gill 1993, Edgar 2010).

Indotyphlops braminus has not been reported in Eastern Polynesia, but its probable introduction was highly suspected in French Polynesia (Ineich & Blanc 1987, 1989). French Polynesia comprises about 130 islands distributed in five archipelagos dispersed throughout a marine area similar in size to Europe.

We report here the first verified case of the most likely accidental introduction of *I. braminus* on Tahiti Island in French Polynesia, attested to by two recently collected vouchers deposited in the Muséum National d'Histoire Naturelle (Paris) collections (MNHN-RA) (Fig. 1). The larger specimen, MNHN-RA 2015.0057, has a total length of 132 mm and 20 scale rows around midbody. Its gular area is whitish contrary to other body parts, which are all greyish brown (Fig. 2).

Figure 1. Two introduced specimens of *Indotyphlops braminus* from Tahiti Island in French Polynesia. MNHN-RA 2015.0058 above and MNHN-RA 2015.0057 below. Scale bar: 1cm. Picture: I. Ineich.

Figure 2. Anterior ventral area of *Indotyphlops braminus* MNHN-RA 2015.0057 showing the whitish gular coloration. Picture: I. Ineich.

It was collected on Tahiti Island, in a heap of earth in a construction site at Punaauia on 11 November 2014. It was first frozen and later placed in 75% ethanol, therefore never in contact with formalin. The second and smaller specimen, MNHN-RA 2015.0058, has a total length of 114 mm and also 20 scale rows around midbody. It was collected on 30 November 2015 in works at the Music Conservatory site of Papeete also on Tahiti Island, in rubble originating from Pirae. It was first kept in a terrarium, and then placed in the freezer, and subsequently in ethanol. Both specimens fully agree with morphometric and scalation characters indicated by Wallach (2009) and we refer them to *I. braminus*.

According to the separate geographic origin of our two specimens and the huge colonization capacities of *I. braminus*, it is more likely that several populations are now present and well established on Tahiti Island and most likely on other islands and atolls of French Polynesia. Tahiti is the main island of French Polynesia and most if not all air and sea travels passes through it, thus facilitating the spread of the snake from one island to another. The current precise distribution of *I. braminus* in French Polynesia, like that of the introduced gecko *Hemidactylus frenatus*, is incompletely known, but most likely covers several archipelagos at present (Ineich et al. 2007).

Discussion

The introduction of *I. braminus* to French Polynesia will not have direct visible consequences. It can however have a hidden impact either on its prey populations (mainly ants and termites) or by introduction of internal parasites (viruses, bacteria, worms, hemogregarines) able to infect other reptiles or even other animals. *I. braminus* also can carry mites. Such external parasites could potentially be introduced in addition to internal parasites and be hosts of pathogens such as bacteria and viruses. There is no native or fossil terrestrial snake in French Polynesia, from where all terrestrial snakes were previously absent. This is attested to by all previous intensive collections, which lack any terrestrial snake (Ineich & Blanc 1989). The situation is not the same in some parts of Micronesia (Carolines) where confusion of *I. braminus* is possible with unnoticed and unprotected species only recently described (Wynn et al. 2012). Competition between endemic species and the alien *I. braminus* is possible there and certainly could have an impact on the survival of endemic biota (Fisher 2011).

Ineich & Blanc (1987) suspected the introduction of *I. braminus* in French Polynesia about 30 years ago. Finally the snake was discovered later than expected, contrary to the gecko *H. frenatus*, another alien species widespread in the Pacific, which arrived just before 1988 to Tahiti (Petren et al. 1993). Let us hope that the brown tree snake, *Boiga irregularis*, a snake with a dramatic and serious impact on the native bird populations of Guam (Hegan 2014), will not follow those introduced species and accidentally colonize French Polynesia.

Acknowledgements

The authors thank Hidetoshi Ota for his review of an earlier version of this paper. Thanks also to Glenn Shea for sharing information.

References

Allison, A. 1996. Zoogeography of amphibians and reptiles of New Guinea and the Pacific region. *In* A. Keast & S.E. Miller (eds),The origin and evolution of Pacific Island biotas, New Guinea to Eastern Polynesia: patterns and processes, pp. 407–436. SPB Academic Publishing, Amsterdam, The Netherlands.

Anonymous. 1981. A new snake for Efate. Naika 2: 13.

Atherton, J.N., S.A. McKenna & A. Wheatley (eds.). 2015. Rapid Biodiversity Assessment of the Vava'u Archipelago, Kingdom of Tonga. Pacific Regional Environment Programme (SPREP), Apia, Samoa. 312 pp.

Barbour, T. 1912. A contribution to the zoogeography of the East Indian Islands. Memoirs of the Museum of Comparative Zoology, Cambridge, Massachusetts 44: 1–203.

Bauer, A.M. 1987. Geographic distribution - Serpentes - *Ramphotyphlops braminus* (Brahminy Blind Snake). Herpetological Review 18(2): 41.

Bauer, A.M. 1999. The terrestrial reptiles of New Caledonia: the origin and evolution of a highly endemic herpetofauna. *In* H. Ota (ed.), Tropical island herpetofauna: origin, current diversity, and conservation, pp. 3–25. Amsterdam, The Netherlands, Elsevier Science.

Bazzano, J. 2007. Herpetological inventory in West Hawai'i national parks: Pu'uhonua o Honaunau National Historical Park, Koloko-Honokohau National Historical Park, and Pu'ukoholà Heiau National Historic Site. Honolulu, Hawai'i, Pacific Cooperative Studies Unit, University of Hawai'i at Mànoa: i–iii + 1–27.

Bonin, M. & G. Shea. 2009. First record of the Brahminy Blind Snake, *Ramphotyphlops braminus* (Serpentes: Typhlopidae), from Samoa, South Pacific. Herpetofauna 39(2): 74–77.

Booth, W. & G.W. Schuett. 2016. The emerging phylogenetic pattern of parthenogenesis in snakes. Biological Journal of the Linnean Society, London 118: 172–186.

Borroto-Paez, R., R. Alonso Bosch, B.A. Fabres & O. Alvarez García. 2015. Introduced amphibians and reptiles in the Cuban Archipelago. Herpetological Conservation and Biology 10(3): 985–1012.

Boulenger, G.A. 1897. On the reptiles of Rotuma Island, Polynesia. Annals and Magazine of Natural History (6)20: 306–307.

Brongersma, L.D. 1934. Contributions to Indo-Australian herpetology. Zoologische Mededelingen, Leiden 17(3/4): 161–251.

Brown, W.C. 1956. The distribution of the terrestrial reptiles in the islands of the Pacific basin. Proceedings of the 8th Pacific Science Congress 34: 1479–1491.

Buden, D.W. 2000. The reptiles of Pohnpei, Federated States of Micronesia. Micronesica 32(2): 155–180.

Buden, D.W. 2008. The Reptiles of Nauru. Pacific Science 62(4): 499–507.

Buden, D.W. & D. Taborosi. 2016. Reptiles of the Federated States of Micronesia. Palikir, Island Research & Education Initiative. 311 pp.

Cagle, F.R. 1946. *Typhlops braminus* in the Marianas Islands. Copeia 1946(2): 101.

Censky, E.J. & K. Hodge. 1997. Geographic distribution: Serpentes. *Ramphotyphlops braminus* (Brahminy Blind Snake). Lesser Antilles: Anguilla. Herpetological Review 28(4): 210.

Clapp, R.B. 1975. Additional records of lizards from the Tokelau Islands, Polynesia. Journal of Herpetology 9: 369.

Clapp, R.B. 1977. Notes on the vertebrate fauna of Tongareva Atoll. Atoll Research Bulletin (198): 1-8.

Clunie, F. 1983. Fijian land snakes. Domodomo 1: 11–21.

Cogger, H.G. 2014. Reptiles & Amphibians of Australia - seventh edition. CSIRO Publishing, Collingwood, Australia.

Craig, P. 2002. Snakes in Samoa! *In* P. Craig (ed), Natural history guide to American Samoa: a collection of articles, pp. 43–44. National Park of American Samoa, Pago Pago, AS.

Cranbrook, E. of 1985. The herpetofauna of Vanuata [sic] (Pacific Ocean). Bulletin of the British Herpetological Society 11: 13.

Craven, R. & G.M. Shea. 2010. Geographic Distribution. *Ramphotyphlops braminus* (Brahminy Blindsnake). Kiribati: Gilbert Islands. Herpetological Review 41(4): 518.

Crombie, R.I. & G.K. Pregill. 1999. A checklist of the herpetofauna of the Palau Islands (Republic of Belau), Oceania. Herpetological Monographs 13: 29–80.

Crombie, R.I., Steadman D.W. 1986. The lizards of Rarotonga and Mangaia, Cook Island Group, Oceania. Pacific Science 40: 44–57.

de Pous, P.E. & D.J. Dingemans. 2008. Geographic distribution - *Ramphotyphlops braminus* (Brahminy Blind Snake). VANUATU: AMBRYM: Wakon village, Lake Fanteng Conservation area (16.221831°S, 167.923889°E). Herpetological Review 39(4): 486–487.

de Urioste, J.A. & J.A. Mateo. 2011. Nuevos datos acerca de la culebrilla ciega de las macetas, *Ramphotyphlops braminus*, en Canarias. Boletin de la Asociación Herpetologica Espanola 22: 135–137.

Díaz, L.M. & A. Cádiz. 2014. First record of the Brahminy Blindsnake *Indotyphlops braminus* (Squamata: Typhlopidae), in Cuba. IRCF Reptiles & Amphibians 21(4): 140–141.

Dixon, J.R. & F.S. Hendricks. 1979. The wormsnakes (family Typhlopidae) of the neotropics, exclusive of the Antilles. Zoologische Verhandelingen 173: 1–39.

Downs, T. 1948. Amphibians and reptiles of Tinian Island. Transactions of the Kansas Academy of Sciences 51(1): 112–116.

Dryden, G.L. & E.H. Taylor. 1969. Reptiles from the Mariana and Caroline islands. University of Kansas Scientific Bulletin 48(8): 269–279.

Duméril, A.M.C. & G. Bibron. 1844. Erpétologie générale ou histoire naturelle complète des Reptiles. Tome VI. Paris, Roret, Imprimerie de Fain et Thunot, 28 rue Racine, Paris.

Edgar, P. 2010. The Amphibians and Reptiles of the UK Overseas Territories, Crown dependencies and Sovereign Base Areas - Species Inventory and Overview of Conservation and research Priorities. Amphibian and Reptile Conservation, Boscombe, Bournemouth, Dorset, UK: 1–132.

Fehlmann H.A. 1960. Ecological distribution of fishes in a stream drainage in the Palau Islands. PhD Dissertation. Stanford University. Stanford, California.

Fisher, H. 1948. Locality records of Pacific island reptiles and amphibians. Copeia 1948(1): 69.

Fisher, R.N. 2011. Considering native and exotic terrestrial reptiles in island invasive species eradication programmes in the Tropical Pacific. *In* C.R. Veitch, M.N. Clout & D.R. Towns (eds), Island invasives: eradication and management, pp. 51–55. UICN, Gland, Switzerland.

Geniez, P. 2015. Serpents d'Europe, d'Afrique du Nord et du Moyen-Orient. Guide Delachaux, Delachaux and Niestlé, Paris.

Gill, B.J. 1987. Notes on the birds, reptiles and mammals of Tongatapu and 'Eua (Tonga). Notornis 34: 217–223.

Gill, B.J. 1988. Records of birds and reptiles from Tonga. Records of the Auckland Institute and Museum 25: 87–94.

Gill, B.J. 1990. Records of wildlife from Tonga, especially Vava'u. Records of the Auckland Institute and Museum 27: 165–173.

Gill, B.J. 1993. The lizards of the Pitcairn Island group, South Pacific. New Zealand Journal of Zoology 20: 161–164.

Gill, B.J. 1995. Notes on the land reptiles of Wallis and Futuna, south-west Pacific. Records of the Auckland Museum 32: 55–61.

Gill, B.J. 1998. Records of Cook Island lizards. Tuhinga, Records of the Museum of New Zealand Te Papa Tongarewa 10: 151–157.

Gill, B.J., D. Bejakovich & A.H. Whitaker. 2001. Records of foreign reptiles and amphibians accidentally imported to New Zealand. New Zealand Journal of Zoology 28: 351–359.

Gill, B.J., D.R. Rinke. 1990. Records of reptiles from Tonga. Records of the Auckland Institute and Museum 27: 175–180.

Goldin M.R. 2002. Field guide to the Sãmoan Archipelago, fish, wildlife and protected areas. Bess Press, Honolulu, HI.

Heatwole, H. 1975. Biogeography of reptiles on some of the islands and cays of Eastern Papua-New Guinea. Atoll Research Bulletin 180: 1–33.

Hedges, S.B., A.B. Marion, K.M. Lipp, J. Marin & N. Vidal. 2014. A taxonomic framework for typhlopid snakes from the Caribbean and other regions (Reptilia, Squamata). Caribbean Herpetology 49: 1–61.

Hegan, A.E. 2014. Alien herpetofauna pathway, invasions, current management practices and control methods ethics: A review of some significant problems in the USA. Herpetological Bulletin 129: 3–14.

Hunsaker, D. & P. Breese. 1967. Herpetofauna of the Hawaiian Islands. Pacific Science 21: 423–428.

Ibrahim, A.A. 2013. The Herpetology of the Suez Canal Zone, Egypt. Vertebrate Zoology 63(1): 87–110.

Ineich, I. 2009. The terrestrial herpetofauna of Torres and Banks Groups (northern Vanuatu), with report of a new species for Vanuatu. Zootaxa 2198: 1–15.

Ineich, I. 2011. Amphibians and Reptiles. *In* P. Bouchet, H. Le Guyader & O. Pascal (eds), The Natural History of Santo, pp. 187–236 (572 pp.). MNHN Paris, IRD Marseille, PNI, Paris 70.

Ineich, I. & A.M. Bauer. 1992. Nouvelles données sur la date d'arrivée du premier serpent terrestre en Nouvelle-Calédonie. Bulletin de la Société Herpétologique de France 59[dated 1991]: 49.

Ineich, I. & C.-P. Blanc. 1987. Le peuplement herpétologique de Polynésie française. Adaptations et aléas. Bulletin de la Société zoologique de France 112(3-4): 381–400.

Ineich, I. & C.-P. Blanc. 1989. Distribution des Reptiles terrestres en Polynésie orientale. Atoll Research Bulletin 318 [dated 1988]: 1–75.

Ineich, I., A. Gouni, L. Blanc, J. Durieux & J.-F. Butaud. 2007. Lizards of Niau Atoll, Tuamotu Archipelago, French Polynesia. Herpetological Review 38(4): 491–492.

Jennings, A.H. 2004. Preliminary report for 2004 fieldwork on the lizard fauna of Vanuatu. Baton Rouge, LA 70802 USA, Museum of Natural Sciences and Department of Biological Sciences, Louisiana State University**:** 1–8.

Jesus, J., R. Goncalves, C. Spinola & A. Brehm. 2013. First record of *Ramphotyphlops braminus* (Daudin, 1803) on Madeira Island (Portugal). Herpetozoa 26(1/2): 106–109.

Jones, R.E. 1979. Hawaiian lizards - their past, present and future. Bulletin of the Maryland Herpetological Society 15(2): 37–45.

Kaiser, H., V.L. Carvalho, J. Ceballos, P. Freed, S. Heacox, B. Lester, S.J. Richards, C.R. Trainor, C. Sanchez & M. O'Shea. 2011. The herpetofauna of Timor-Leste: a first report. ZooKeys 109: 19–86.

Kamosawa, M. & H. Ota. 1996. Reproductive biology of the Brahminy blind snake (*Ramphotyphlops braminus*) from the Ryukyu Archipelago, Japan. Journal of Herpetology 30(1): 9–14.

Knight, J.L. 1984. Geographic distribution. Serpentes. *Typhlina braminus*. Herpetological Review 15(4): 115.

Kopstein, F. 1926. Reptilien von den Molukken und den Benachbarten Inseln. Zoologische Mededelingen, Leiden 9: 71–112.

Kraus, F. 2005. Inventory of reptiles and amphibians in Hawai'i volcanoes, Haleakalà, and Kalaupapa National Parks. Honolulu, Hawai'i, Pacific Cooperative Studies Unit, Dept. of Botany, University of Hawai'i: 1–16.

Kraus, F. 2009. Alien Reptiles and Amphibians - a Scientific Compendium and Analysis. Heidelberg - New York, Springer Verlag.

Kraus, F. 2013. Further range extensions for reptiles and amphibians from Papua New Guinea. Herpetological Review 44(2): 277–280.

Kraus, F. & A. Allison. 2004. New records of reptiles and amphibians from Milne Bay Province, Papua New Guinea. Herpetological Review 35(4): 413–418.

Lamberson, J.O. 1987. Reptiles of Enewetok Atoll. *In* D.N. Devaney, E.S. Reese, B.L. Burch & P. Helfrich (eds), The natural history of Enewetok Atoll. Biogeography and systematics, Vol. 1, pp. 325–329. United States Department of Energy, Office of Scientific and Technical Information, Oak Ridge, TN.

Liebermann, D.D. & M.E. Liebermann. 1970. Records of the Brahminy blind snake, *Typhlops braminus*, from the island of Hawaii. Pacific Science 24(4): 528.

Loveridge, A. 1957. Check list of the reptiles and amphibians of East Africa (Uganda, Kenya, Tanganyika, Zanzibar). Bulletin of the Museum of Comparative Zoology 117(2): 153–362 + i-xxxvi.

Mateo, J.A., C. Ayres & F. Lopez-Jurado. 2011. Los anfibios y reptiles naturalizados en Espana; historia y evolucion de una problematica creciente. Boletin de la Asociacion Herpetologica Espanola, Madrid 22: 2–42.

McCann, C. 1994. Reptiles from Manihiki Atoll. Pp. 61–63 *In* Bullivant J.S., C. McCann (eds.). Contributions to the Natural History of Manihiki Atoll, Cook Islands. Memoirs of the New Zealand Oceanographic Institute (31).

McCoy, M. 1980. Reptiles of the Solomon Islands. Wau Ecology Institute Handbook 7: 1–88.

McCoy, M. 2006. Reptiles of the Solomon Islands. Sofia-Moscow, Pensoft.

McCranie, J.R., M.R. Espinal & A. Wynn. 2010. Geographic Distribution. *Ramphotyphlops braminus* (Brahminy Blindsnake). Honduras. Herpetological Review 41(4): 518.

McDiarmid, R.W., J.A. Campbell & T. Touré. 1999. Snake species of the world. A taxonomic and geographic reference. Washington DC, USA, The Herpetologist's League.

McDowell, S.B. 1974. A catalogue of the snakes of New Guinea and the Solomons, with special reference to those in the Bernice P. Bishop Museum, Part 1. Scolecophidia. Journal of Herpetology 8(1): 1–57.

McKeown, S. 1978. Hawaiian reptiles and amphibians. The Oriental Publishing Company, Honolulu.

Medway, L. & A.G. Marshall. 1975. Terrestrial vertebrates of the New Hebrides: origin and distribution. Philosophical Transactions of the Royal Society of London, ser. B 272: 423–465.

Mizuno, T. & Y. Kojima. 2015. A blindsnake that decapitates its termite prey. Journal of Zoology 297: 220–224.

Morrison, C. 2003. A field guide to the Herpetofauna of Fiji. The University of the South Pacific, Institute of Applied Sciences, Suva, Fiji: 1–121.

Nagy, Z.T., A.B. Marion, F. Glaw, A. Miralles, J. Noppers, M. Vences & B.S. Hedges. 2015. Molecular systematics and undescribed diversity of Madagascan scolecophidian snakes (Squamata: Serpentes). Zootaxa 4040(1): 31–47.

Nussbaum, R.A. 1980. The brahminy blind snake (*Ramphotyphlops braminus*) in the Seychelles Archipelago: distribution, variation, and further evidence for parthenogenesis. Herpetologica 36(3): 215–221.

Oliver, J.A. & C.E. Shaw. 1953. The amphibians and reptiles of the Hawaiian Islands. Zoologica 38(2): 65–95.

O'Shea M. 1996. A guide to the snakes of Papua New Guinea (The first comprehensive guide to the snake fauna of Papua New Guinea with a section on snakebite and its treatment in Papua New Guinea, by Prof David A. warrell and Dr David G. Lalloo). Port Moresby, Papua New Guinea, Independent Publishing, Independent Group Pty Ltd.

Ota, H., T. Hikida, M. Matsui, A. Mori & A.H. Wynn. 1991. Morphological variation, karyotype and reproduction of the parthenogenetic blind snake, *Ramphotyphlops braminus*, from the insular region of East Asia and Saipan. Amphibia-Reptilia 12: 181–193.

Petren, K., D.T. Bolger & T.J. Case. 1993. Mechanisms in the competitive success of an invading sexual gecko over an asexual native. Science 259(5093): 354–358.

Pregill, G.K. 1998. Squamate reptiles from prehistoric sites in the Mariana Islands. Copeia 1998: 64–75.

Pyron, R.A. & V. Wallach. 2014. Systematics of the blindsnakes (Serpentes: Scolecophidia: Typhlopoidea) based on molecular and morphological evidence. Zootaxa 3829(1): 1–81.

Qing, N., Z. Xiao, G.J. Watkins-Colwell, M. Hou, W.-H. Lu, J. Lazell & Z.-W. Sun. 2015. Additions to the Reptile and Amphibian Fauna of Nan Ao Island: A Chinese Treasure Trove of Biogeographic Patterns. Bulletin of the Peabody Museum of Natural History 56(1): 107–124.

Rato, C., I. Silva-Rocha, E. Gonzalez-Miras, F. Rodriguez-Luque, B. Farina & M.A. Carretero. 2015. A molecular assessment of European populations of *Indotyphlops braminus* (Daudin, 1803). Herpetozoa 27(3-4): 179–182.

Robb, J. 1966. The generic status of the Australasian typhlopids (Reptilia: Squamata). Annals and Magazine of Natural History, London 13: 675–679.

Rodda, G.H. & K. Dean-Bradley. 2001. Inventory of the reptiles of the War in the Pacific National Historical Park, Guam. Pacific Cooperative Studies Unit, University of Hawai‘i at Mānoa, Department of Botany. Honolulu, HI, USA. Technical Report 169: 1–41.

Room, P.M. 1974. Lizards and snakes from the Northern District of Papua New Guinea. British Journal of Herpetology 5: 438–446.

Safaei-Mahroo, B., H. Ghaffari, H. Fahimi, S. Broomand, M. Yazdanian, E. Najafi Majd, S.S. Hosseinian Yousefkhani, E. Rezazadeh, M.S. Hosseinzadeh, R. Nasrabadi, M. Rajabizadeh, M. Mashayekhi, A. Motesharei, A. Naderi & S.M. Kazemi. 2015. The Herpetofauna of Iran: Checklist of Taxonomy, Distribution and Conservation Status. Asian Herpetological Research 6(4): 257–290.

Safford, W.E. 1905. The useful plants of the island of Guam. Contributions from the United States National Herbarium 9: 1–416.

Shea, G.M. & V. Wallach. 2000. Reexamniation of an anomalous distribution: resurrection of *Ramphotyphlops becki* (Serpentes: Typhlopidae). Pacific Science 54(1): 70–74.

Shigei, M. 1971. The reptiles of the Bonin Islands. Journal of the Faculty of Science, Tokyo University (4)12: 145–166.

Slevin, J.R. 1930. A note on the discovery of the genus *Typhlops* in the Hawaiian Islands. Copeia 1930(4): 158.

Steadman D.W., J. Franklin, D.R. Drake, H.B. Freifeld, L.A. Bolick, D.S. Smith & T.J. Motley. 1999. Conservation status of forests and vertebrate communities in the Vava'u Island Group, Tonga. Pacific Conservation Biology 5: 191–207.

Tanner, V.M. 1948. Pacific Islands herpetology, n° I. Marianas Islands. A new species of *Typhlops*. Great Basin Naturalist 9(1-2): 1–20.

Taylor, S.K., C.S. Gorbics, E. Luciani, C. Zeeman, J. Gibson & A. Little. 2009. Ecological risk assessment for lead in soil and Laysan Albatross chicks on Sand Island, Midway Atoll National Wildlife Refuge. Environmental Contaminants Division, Carlsbad Fish and Wildlife Office, USFWS, Region 8, Carlsbad, CA**:** i-vii + 1–30 + appendices 31–47.

Thomas, L.A. 1997. Geographic distribution: Serpentes: *Ramphotyphlops braminus.* Herpetological Review 28: 98.

Tinker, S. 1938. Animals of Hawaii. Nippu Jiji Co., Honolulu, HI.

Trail, P.W. 1993. Zoological survey of the Ottoville lowland forest. Department of Marine and Wildlife Biological Report (40): 1–11.

Van Denburgh, J. 1917. Notes on the herpetology of Guam, Mariana Islands. Proceedings of the California Academy of Sciences, 4th ser. 7(3): 37–39.

Vander Velde, N. 2003. Republic of the Marshall Islands. *In* C. Shine, J.K. Reaser & A.T. Gutierrez (eds), Invasive alien species in the Austral-Pacific region, pp. 51–60. Global Invasive Species Program, Cape Town.

Venchi, A. & R. Sindaco. 2006. Annotated checklist of the reptiles of the Mediterranean countries, with keys to species identification. Part 2 - Snakes (Reptilia, Serpentes). Annali del Museo Civico di Storia Naturale "Giacomo Doria", Genova 98: 259–364.

Vollbrecht, J.L. 1945. The "Ulithi" encyclopedia. Armed Forces Radio Station WVTY, Ulithi.

Waite, E.R. 1897. The mammals, reptiles, and fishes. Pp. 165-201 *In* The Atoll of Funafuti, Ellice Group: its zoology, botany, ethnology, and general structure based on collections made by Mr. Charles Hedley, of the Australian Museum, Sydney, N.S.W. Memoirs of the Australian Museum 3(3).

Wallach, V. 2008. Range extensions and new island records for *Ramphotyphlops braminus* (Serpentes: Typhlopidae). Bulletin of the Chicago Herpetological Society 43(5): 80–82.

Wallach, V. 2009. *Ramphotyphlops braminus* (Daudin): a synopsis of morphology, taxonomy, nomenclature and distribution (Serpentes: Typhlopidae). Hamadryad 34: 34–61.

Watling, D., A. Wynn & G.R. Zug. 2010. Rediscovery of the Taveuni blind snake. Oryx 44(2): 165–166.

Whitaker, A.H. 1970. A note on the lizards of the Tokelau Islands, Polynesia. Herpetologica 26: 355–358.

Wiles, G.J., A.J. Jr. Binion Amerson & R.E. Jr. Beck. 1989. Notes on the herpetofauna of Tinian, Mariana Islands. Micronesica 22(1): 107–118.

Wiles, G.J., G.H. Rodda, T.H. Fritts & E.M. Taisacan. 1990. Abundance and habitat use of reptiles on Rota, Mariana Islands. Micronesica 23(2): 153–166.

Wodzicki, K. 1969. A preliminary survey of rats and other land vertebrates of Niue Island, South Pacific. Report prepared for the Niue Island Administration in association with the Departments of Maori and Island Affairs and Scientific and Industrial Research. Government Printer, Wellington.

Wood, K.R. & W. Law. 2010. Geographic Distribution. *Ramphotyphlops braminus* (Brahminy Blindsnake). Federated States of Micronesia: Kosrae. Herpetological Review 41(4): 518.

Wynn, A.H., R.P. Reynolds, D.W. Buden, M. Falanruw & B. Lynch. 2012. The unexpected discovery of blind snakes (Serpentes: Typhlopidae) in Micronesia: two new species of *Ramphotyphlops* from Caroline Islands. Zootaxa 3172: 39–54.

Wynn, A.H., C.J. Cole & A.L. Gardner. 1987. Apparent triploidy in the unisexual Brahminy Blind Snake, *Ramphotyphlops braminus*. American Museum Novitates 2868: 1–7.

Zug, G. 2013. Reptiles and Amphibians of the Pacific Islands – a comprehensive guide. Berkeley, Los Angeles, London, University of California Press.

Zug, G.R., V.G. Springer, J.T. Williams & G.D. Johnson. 1989. The vertebrates of Rotuma and surrounding waters. Atoll Research Bulletin (316): 1–25.

Received 05 May 2016, revised 17 Jan. 2017.