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# *Varanus indicus* and its Presence on the Mariana Islands: Natural Geographic Distribution vs. Introduction

MICHAEL COTA
*Thailand Natural History Museum, National Science Museum*
*Technopolis, Khlong 5, Khlong Luang, Pathum Thani 12120, TH*
Herpetologe@gmail.com

## Introduction

The presence of *Varanus indicus* on the Mariana Islands has been most often regarded as a recent introduction and not a part of its natural geographic distribution. The introduction of reptile species, particularly *V. indicus* by the Germans before World War I and later by the Japanese on many Pacific islands, has been speculated and documented respectively (Uchida, 1969); however, there is evidence to suggest that its presence in the Mariana Islands, specifically on Guam, is from natural dispersal rather than a product of human introduction.

It is suggested here that introduction of *V. indicus* in Micronesia, to include the Marianas Islands and Guam, pre-dates European presence in the region (Brown, 1956; Lever, 2003) and that it was introduced by Polynesian colonists. Lever (2003), cites both Rodda & Fritts (1992b), which does not shed light on the subject, and McCoid (1993), which was speculation on what he wrote rather than what he actually stated in writing. However, strong linguistic evidence exists that *V. indicus* did exist before there was a European presence in the region; there is a Chamorro (native language of the people of the Marianas) word for monitor lizard, which is '*Hilitai*'. This suggests that *V. indicus* was either present before the Chamorros arrived or they brought it with them. The Spanish presence on Guam and the Mariana Islands dates back to 1565. New words incorporated into the vocabulary of the Chamorro people after the arrival of the Spanish came from the Spanish or later from the Tagolog language. The only Pacific location where there is a European name for a monitor is on Condore Island, off the coast of Vietnam, which is '*Iguana*' (Bayless, 2004), from what the Spanish were calling them; '*Iguana*' typically refers to any large lizard. German, Japanese and English appear to have had no influence over the Chamorro language and there is no '*Waran*' from the German or '*Dai Tokage*' or '*Ootokage*', from the Japanese in reference to monitor lizards. If *V. indicus* was introduced at all, it would have been over 400 years ago.

## Consideration of Introduction by Polynesian Colonists

What reason would there have been for the Polynesian colonists to have introduced *V. indicus*? This is a question that needs to be answered if introduction by Polynesian colonists is to be fully accepted. The Japanese purportedly introduced *V. indicus* to some Pacific islands in order to control the rat population (Uchida, 1969), even though there is no direct documentation or evidence of introduction.

Why would the Polynesian colonists want or need to control a rat infestation that probably did not exist at the time? Since most rat infestations have come about through colonization and it is widely held that *Rattus exulans* was introduced by Polynesian colonists as a food source (Matisoo-Smith et al. 1999), it is unlikely that Polynesian colonists would have introduced *V. indicus* for the reason of controlling rats. *Varanus indicus* is diurnal and *Rattus* is nocturnal; therefore, they would have little interaction with each

Figure 1. Strong linguistic evidence suggests the existence of *Varanus indicus* in the Mariana Islands is either a product of natural dispersal or an introduced presence of over four centuries.
Photograph by **Joe Sablan**.

other to include a predator/prey relationship. Due to the fact that *Varanus* consume a large amount of prey with comparatively little meat to offer in return, along with the fact that they prey on other small domestic animals used for human food, such as chickens, which were commonly brought along by Polynesian colonists throughout the Pacific, and their eggs, resulting in *V. indicus* becoming a pest species, it is highly unlikely that they would have been introduced as a food source. Not only is *V. indicus* considered a pest in modern times by peoples of the Pacific Islands (Ulchida, 1969), but they would have been considered as such in the past as a competitor of limited food resources, such as crabs, which are highly prized by people of Pacific islands, birds, their eggs, fish and the rats that they may have introduced to eat. One of the only possible reasons that they may have been taken along purposely by Polynesian colonists is that they are able to survive long periods without food (Sweet pers. com.); however, there is no evidence, at least in the Mariana Islands, of Polynesian colonists consuming monitor lizards, as there exists evidence of eating birds. Although it is highly unlikely that they would have been introduced by Polynesian colonists for the aforementioned reason, it is not at all impossible and as such, can not be completely dismissed. Man continues even today, with all the knowledge we have acquired, to cause ecological disasters by introducing invasive species for all the wrong reasons, e.g. the introduction of *Bufo marinus* in Australia as a failed biological control agent.

Vogt & Williams (2004) stated that it appears that *V. indicus* were probably transported by the early Chamorros (Polynesian colonists that settled in Micronesia) in canoes either intentionally or accidentally; however, there is no supporting evidence other than the lack of fossil remains in pre-human deposits.

It is highly unlikely that the early Chamorros would not have noticed monitor lizards aboard the small canoes and if they were intentionally introduced by the Chamorros, there is again the question, why the Chamorros would have brought them along.

**Consideration of Introduction by Europeans or Japanese**

There is no record of the Spanish introducing *V. indicus* over the 334 years that they ruled over Guam or the over two centuries that they actually had an active presence in Guam, the Mariana Islands or any of the other islands in the surrounding area. Guam was an important resupply point and stop for Spanish ships going to the Philippines from South America and from the Philippines to South America. Spanish ships did not travel through areas where *V. indicus* was present before or after their transit through Guam, which makes introduction by the Spanish (whether intentional or inadvertent) highly unlikely, if not historically impossible. There is a record of them being seen on Tinian by Don Filipe de la Corte in the mid-1800s (de la Corte, 1875; Lever, 2003). In 1874, Giacomo Doria reported *Monitor chlorostigma*, synonym of *V. indicus* (Mertens, 1942), in Palau, also in Micronesia, to the southwest of the Mariana Islands, in the Caroline Islands. This would predate any of the other claims of them being introduced later by the Germans or Japanese (Fisher, 1948; Marshall, 1975).

At the end of the 19th century, Guam became a possession of the United States. The rest of the Mariana Islands were sold to Germany and during World War I were taken by Japan. Both Germany and Japan had purportedly brought *V. indicus* to Pacific islands and it is suggested that they may have died out and have been reintroduced (Lever, 2003). Although it is suggested that introductions were made and their presence could have been augmented, it appears highly unlikely that they had become extinct for any length of time in the Mariana Islands since the Chamorro and Micronesian words for *V. indicus* would have disappeared from the vocabulary of their respective languages over centuries or even a generation of non-use. Again,

Figure 2. *Varanus indicus* on Saipan. The population on Saipan was described as *V. tsukamotoi* by Kashida in 1929; later, this taxon was placed as a synonym of *V. indicus* by Mertens in 1942. Photograph by **Peter Bonser**.

it was reported in the mid-1800s on Tinian by de la Corte. There is also a description of a monitor lizard on Saipan (Kishida, 1929), which he described as a new species, *V. tsukamotoi*, which has been placed in synonomy with *V. indicus* (Mertens, 1942), the only monitor lizard found on Saipan. No records exist that monitors were introduced by the Japanese to Saipan.

**Archeological Evidence**

Archeological evidence neither supports prehistoric presence nor discounts natural presence of *V. indicus* on Guam or elsewhere in the Mariana Islands. Pregill (1988) reported archeological evidence of *V. indicus* on Rota. He states in the abstract that they were found in historic sites, but did not conclude whether they were introduced in historic times, introduced in prehistoric times, or native. He does describe them as introduced in the abstract, but they were only found at two sites, in historic layers. Pregill reports charring of avian bones found in his excavations, which shows that they were cooked and consumed, because they were charred (Pregill, 1998), but does not report charring on the bones of *V. indicus* nor have there been any bones found in cultural sites, which could be seen as more evidence that they were not introduced by the early Chamorros as a food source, since their bones would have been disposed of in cultural sites, as were the avian bones. Surely, if the Chamorros brought them to the Mariana Islands as a food source and ate them, monitor bones would have been found in cultural sites, in the same sites where bones of other animals eaten were discarded, such as the charred avian bones.

**Geological Evidence**

When one looks at the history and plate movements of Asia and the Pacific, one sees that the Caroline and Mariana Islands were too far separated from Asia (Hall, 2002) and far away from the Thorne-Green Line for anything except a fairly recent arrival of *V. indicus* by natural means to be possible. The Thorne-Green Line represents a major cut off point in the natural distribution of many plant and animal species between near Oceania in close proximity to Asia to the west and remote Oceania to the east. If *V. indicus* did naturally disperse to the Mariana Islands, it would have first established itself in southern Micronesia, which is part of the Caroline Plate. No monitor lizards are known to have existed east of the Throne-Green line until recent times in the earth's history.

**Considerations of Natural Dispersal of Geographical Distribution**

Dispersal across vast bodies of water is not unknown in *Varanus*; the *V. salvator* Complex has an extensive range across large bodies of water that were not ever part of the land bridges that existed from mainland Southeast Asia to Borneo and have radiated to such far away localities as islands of the Lesser Sundas, off the coast of Sulawesi and throughout the Philippine archipelago. Because the *V. indicus* Complex appears to have found its niche on islands/costal regions and its several species are known to have dispersed, increasing their natural geographic distribution to a great number of islands in the seas of Indonesia and the Pacific Ocean, it is logical that they could have dispersed to the Mariana Islands as well; it is much more logical than an introduction by Polynesian colonists for which no strong reasoning exists. Recently, it has also been suggested that the presence of *V. indicus* in the Mariana Islands is possibly due to dispersal based on the aforementioned reasoning (Sweet & Pianka, 2007). Physiologically, *V. indicus* is well suited for dispersal across large bodies of salt water and to distant island chains; *V. indicus* is one of only two species of *Varanus*, the other being *V. semiremex*, that possess salt-excreting nasal glands, which

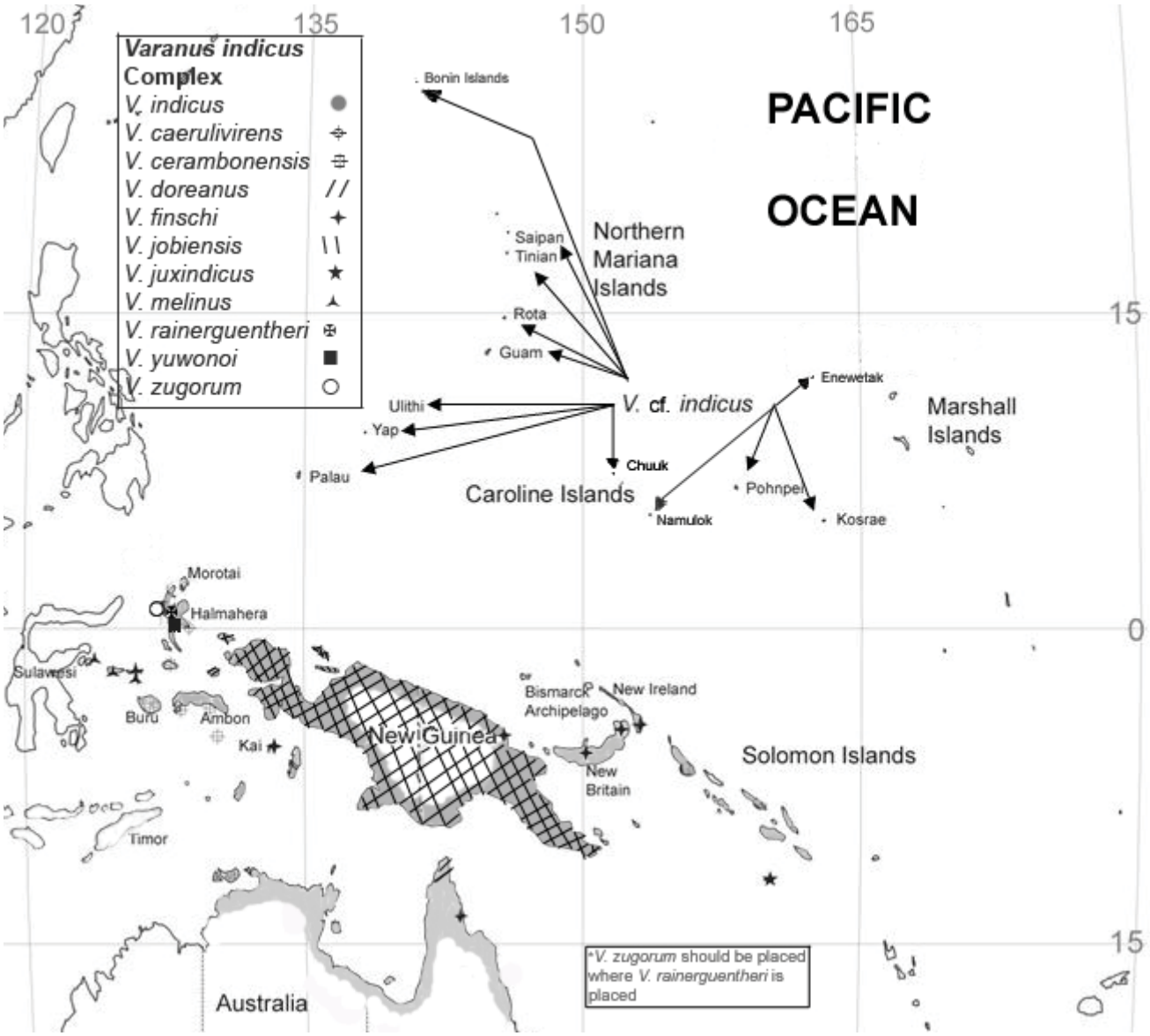


Figure 3. Distribution map of the *Varanus indicus* Complex, showing an almost continuous geographic distribution. *Varanus doreanus* and *V. jobiensis* do not occur at elevations above 1500 m. Modified from species accounts of the *V. indicus* Complex (see references) in E.R. Pianka and D.R. King , Varanoid Lizards of the World (2004), Ziegler et al. (2007), Mertens (1942), Davis (1999), Bayless (2004) & Sweet (pers. comm.)

enable them to survive in saltwater conditions and to consume marine prey (Dunson, 1974).

If one looks at the present distribution of the *V. indicus* Complex, one sees a rather continuous geographic distribution from the eastern Indonesian archipelago to the Mariana Islands, which is more of a pattern of natural dispersal of a geographical distribution rather than introduction. The Mariana Islands represent the furthest extent of its range with the exception of the Bonin Islands and therefore, most likely, among the most recent locations that it has established itself.

Since evidence is lacking that *V. indicus* was present in prehistoric times and that there is no logical reason that Polynesian colonists would have introduced this species, another possibility is that it had dispersed to the Pacific islands in historic times. In one of the few areas there is evidence that they may

have been introduced, on Falalap Islet, Ifaluk Atoll in the Caroline Islands ca. 1939, they spread to and established themselves on the other islets of Ifaluk Atoll within 20 years (Uchida, 1969), showing just how rapid this species can expand their range, in this case through suspected introduction. Even in this case, introduction is suspected; there is no actual documentation of or witness to introduction. Although this atoll does not represent much distance across open water in comparison to dispersal to another island chain, one can imagine what could be accomplished in centuries or millennia.

Farrell (1991) states that *V. indicus* arrived in the Mariana Islands before any human presence; however, there is no supporting evidence present. The archeological evidence found (Pregill, 1998) does not support Farrell's claims and findings in Guam have not been published and are believed to be inconclusive. Farrell (1991) represents the only published past claim that *V. indicus* was not introduced.

Figure 4. Large adult *V. indicus* in Guam. *Varanus indicus* has salt-excreting glands which enable it to live in saltwater environments and eat marine prey, making it among the most capable *Varanus* spp. to disperse over extensive saltwater obstacles. Photograph by **Joe Sablan**.

**Conclusions**

All the evidence points to the presence of *V. indicus* in Guam and the Mariana Islands to be either natural dispersal or that they were introduced prior to any Western or Japanese presence. This has yet to be completely resolved in the future one way or the other through archeological evidence. If introduction is considered, the question as to why they were introduced must be answered. It is clear that they were not introduced to control rat populations, which probably did not exist before colonization or as a food source since no evidence of bones have been found in cultural sites, where other bones of consumed animals were discarded. Without archeological evidence of prehistoric presence, one must consider that natural dispersal expanding the geographical distribution could have possibly occurred during the historical period.

There were sightings of monitor lizards in the Mariana Islands and surrounding islands long before any known or suspected recent era introductions were made by the Germans or Japanese. They purportedly did make introductions, which may have established them in areas they would not have lived otherwise or possibly augmented local existing populations, but there is no documentation or evidence of introductions.

The geographical distribution of the *V. indicus* Complex is nearly continuous and dispersal, as well as allopatric speciation has occurred widely over a vast area and across large bodies of water, which has also occurred in the *V. salvator* Complex. *Varanus indicus* has not only shown the ability to rapidly extend its range, it is physiologically suited to do so by possessing salt-excreting glands giving it the ability to live in saltwater conditions for extended periods of time. Future morphological and molecular analysis of those monitors in the Caroline, Mariana and Bonin Islands may give valuable insight into whether or not they are different and may show whether or not they are naturally occurring, by showing morphological variation from distant populations and molecular similarities to adjacent populations or introduced, by showing molecular similarities to populations of origin.

Figure 5. *Varanus indicus* in Guam, Mariana Islands. Photograph by **Joe Sablan**.

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**Literature Cited**

Bayless, M. K. 2004. The Local Names of Pacific Monitor Lizards (Sauria: Varanidae) of Oceanica & Indo-Malaysia, excluding Australia. Micronesica 37(1): 49-55.

Brown, W.C. 1956. The distribution of terrestrial reptiles in the islands of the Pacific Basin. Proceedings of the 8th Pacific Science Congress. 3A: 1479-1491.

Davis, A.E. 1999. A Preliminary List of Animal Names in the Chuuk District, Micronesia. Micronesica 31(1): 1-245.

Corte, D.F. de la. Journal of Governor Don Filipe de la Corte. 1875: 75.

Dunson, W.A. 1974. Salt gland secretion in a mangrove monitor lizard. Comp. Biochem. Physiol. 47A: 1245-1255.

Dryden, G. & T. Ziegler. 2004. *Varanus indicus.* In E.R. Pianka and D.R. King, Varanoid Lizards of the World, 298-307. Indiana Univ. Press, Bloomington, Indiana.

Böhme, W., Philipp, K.M. & T. Ziegler. 2004. *Varanus doreanus*. In E.R. Pianka and D.R. King, Varanoid Lizards of the World, 168-171. Indiana Univ. Press, Bloomington, Indiana.

Böhme, W., Philipp, K.M. & T. Ziegler. 2004. *Varanus juxindicus*. In E.R. Pianka and D.R. King, Varanoid Lizards of the World, 193-196. Indiana Univ. Press, Bloomington, Indiana.

Farrell, D.A. 1991. History of the Northern Mariana Islands. Public School System, CNMI, Saipan, Commonwealth of the Northern Mariana Islands: 51.

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

Hall, R. 2002. Cenozoic geological and plate tectonic evolution of SE Asia and the SW Pacific: computer-based reconstructions and animations. Journal of Asian Earth Sciences. 20 (4): 353–434.

Kishida, K. 1929. A new Monitor from the island of Saipan, South Sea Islands. Lansania. 1(1): 13-16.

Lever, C. 2003. Naturalized Reptiles and Amphibians of the World. Oxford University Press. Oxford. 318pp.

Marshall, M. 1975. The Natural History of Namoluk Atoll, Eastern Caroline Islands. Atoll Research Bulletin. 189: 1-53.

Matisoo-Smith, E., Allen, J.S., Roberts, R.M., Irwin, G.J. & D.M. Lambert. 1999. Rodents of the Sunrise: Mitochondrial DNA Phylogenies of Polynesian *Rattus exulans* and the Settlement of Polynesia. In J-C Galipaud and I. Lilley, The Pacific from 5000 to 2000 BP: Colonisation and Transformations, 259-276. Institut de Recherche pour le Developpement, Paris.

McCoid, M.J. 1993. The 'new' herpetofauna of Guam, Mariana Islands. Herpetological Review 24: 16-17.

McCoy, M. 1980. Reptiles of the Solomon Islands. Wau Ecology Institute. Handbook No. 7. Sheck Wah Tong Printing Press Ltd. Hong Kong. 80pp.

Mertens, R. 1942c. Die Familie der Warane (Varanidae). Dritter Teil: Taxonomie. Abh. senckenberg. naturf. Ges. 466. 235-391.

Philipp, K.M., Ziegler, T. & W. Böhme. 2004. *Varanus cerambonensis.* In E.R. Pianka and D.R. King, Varanoid Lizards of the World, 165-167. Indiana Univ. Press, Bloomington, Indiana.

Philipp, K.M., Ziegler, T. & W. Böhme. 2004. *Varanus jobiensis.* In E.R. Pianka and D.R. King, Varanoid Lizards of the World, 189-192. Indiana Univ. Press, Bloomington, Indiana.

Philipp, K.M., Ziegler, T. & W. Böhme. 2004. *Varanus finschi.* In E.R. Pianka and D.R. King, Varanoid Lizards of the World, 176-178. Indiana Univ. Press, Bloomington, Indiana.

Philipp, K.M., Ziegler, T. & W. Böhme. 2004. *Varanus yuwonoi.* In E.R. Pianka and D.R. King, Varanoid Lizards of the World, 279-281. Indiana Univ. Press, Bloomington, Indiana.

Philipp, K.M., Ziegler, T. & W. Böhme. 2007. Preliminary Investigations of the Natural Diet of Six Monitor Lizard Species of the *Varanus* (*Euprepiosaurus*) *indicus* Group. pp. 336-345 in Horn, H.-G., W. Böhme and U. Krebs (eds.), Advances in Monitor Research III. Mertensiella 16, Rheinbach.

Pregill, G. 1998. Squamate Reptiles from Prehistoric Sites in the Mariana Islands. Copeia, 1998(1): 54-75.

Rodda, G.H. & T.H. Fritts. 1992a. The impact of the introduction of colubrid snake *Boiga irregularis* on Guam's lizards. Journal of Herpetology. 26: 166-174.

Sweet, S.S. and E.R. Pianka. 2007. Monitors, mammals and Wallace's Line. pp. 79-99 in Horn, H.-G., W. Böhme and U. Krebs (eds.), Advances in Monitor Research III. Mertensiella 16, Rheinbach.

Uchida, T.A. 1969. Rat control procedures on the Pacific islands, with special reference to the efficiency of biological control agents. 1. Appraisal of the monitor lizard *Varanus indicus* (Daudin) as a rat control agent on Ifaluk, western Caroline Islands. Journal of the Faculty of Agriculture, Kyushu University 15: 311-330.

Vogt S.R. & L.L. Williams 2004. *Varanus indicus*, Monitor Lizard, Hilitai. Prehistoric (Guam) or recent arrival. Common Flora & Fauna of the Mariana Islands. Published by Laura L. Williams and Scott R. Vogt, Northern Mariana Islands, 2004. (CNMI): 76-77.

Ziegler, T. & W. Böhme. 2004. *Varanus melinus*. In E.R. Pianka and D.R. King, Varanoid Lizards of the World, 215-219. Indiana Univ. Press, Bloomington, Indiana.

Ziegler, T., Böhme, W. & K.M. Philipp. 2004. *Varanus caerulivierens*. In E.R. Pianka and D.R. King, Varanoid Lizards of the World, 161-164. Indiana Univ. Press, Bloomington, Indiana.

Ziegler, T., Schmitz, A., Koch, A. & W. Böhme. 2007. A review of the subgenus *Euprepiosaurus* of *Varanus* (Squamata: Varanidae): morphological and molecular phylogeny, distribution and zoogeography, with an identification key for members of the *V. indicus* and *V. prasinus* species groups. Zootaxa 1472: 1-28.