



*Cnemaspis biocellata* Grismer, Chan, Nurolhuda, and Sumontha 2008

## New Faces from Ancient Places: Uncovering Peninsular Malaysia's Hidden Lizard Diversity Part I: Geckos

L. Lee Grismer<sup>1,2</sup>, Norhayati Ahmad<sup>2,3</sup>, and Chan Kin Onn<sup>3</sup>

<sup>1</sup>Department of Biology, La Sierra University, Riverside, California, 92515 USA (lgrismer@lasierra.edu)

<sup>2</sup>Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor Darul Ehsan, Malaysia (yati\_68@yahoo.co.uk)

<sup>3</sup>School of Environment and Natural Resource Sciences, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor Darul Ehsan, Malaysia

Photographs by L. Lee Grismer.

Deeply embedded in the tropical latitudes of Southeast Asia's Greater Sunda Shelf, sculpted by millions of years of tectonic upheavals and accretion, and re-shaped by thousands of years of fluctuating sea levels, peninsular Malaysia is emerging as one of the world's premiere megadiversity hotspots. Its dynamic geological history has been the environmental engine driving the evolution of some of the world's most amazing species. Emblematic in this emergence is peninsular Malaysia's rapidly growing lizard fauna, wherein 30 new species have been discovered and described within the last five years (28 from our labs). This is more species than were described during the entire previous century. The irony that these numbers illustrate is that, prior to 2002, we didn't even know enough about the lizard fauna to recognize that we didn't know anything. Whereas today, we have finally acquired enough knowledge to be certain that we know practically nothing! Any time you see an increase of this magnitude in the number of species from a given area in such a short period of time, it is an indication that we have a significant knowledge deficit and that much still remains to

be learned. As exciting as this may sound, it comes with a disturbing dark side. We view this deficit as an indictment of the scientific community for not protecting and cataloging the diversity of this community in light of the accelerating decline of global biodiversity.

The two largest groups of lizards in peninsular Malaysia are geckos and skinks; so, that these lizards account for the greatest number of the region's newly discovered species is not surprising. Among the geckos, two genera in particular lead this charge: The Rock Geckos (*Cnemaspis*) and the Bent-toed Geckos (*Cyrtodactylus*). *Cnemaspis* ranges throughout much of Indochina, and all species share a general body plan of broad, flattened heads and bodies; large, upwardly directed eyes; and long, widely splayed limbs with slender digits. Although such characters give them a rather cartoonish appearance, they are well suited for this group's specialized rock-climbing habits and for seeking refuge within crevices. This sedentary life style in restrictive microhabitats has contributed to their isolation and the evolution of many new species in localized regions such as mountaintops, karst formations, and islands. In fact,



*Cnemaspis bayuensis*  
Grismer, Grismer, Wood, and Chan 2008



*Cnemaspis karsticola*  
Grismer, Grismer, Wood, and Chan 2008



*Cnemaspis monachorum*  
Grismer, Norhayati, Chan, Daicus, Muin, Wood, and Grismer 2009



*Cnemaspis pemanggilensis*  
Grismer and Das 2006



*Cnemaspis flavigaster*  
Chan and Grismer 2008



*Cnemaspis limi*  
Das and Grismer 2003



*Cnemaspis baueri*  
Das and Grismer 2003



*Cnemaspis perhentianensis*  
Grismer and Chan 2008



*Cyrtodactylus seribuatensis*  
Youmans and Grismer 2006



*Cyrtodactylus batucolus*  
Grismer, Chan, Grismer, Wood, and Daicus 2008



*Cnemaspis mcguirei*  
Grismer, Grismer, Wood, and Chan 2008



*Cnemaspis pseudomcguirei*  
Grismer, Norhayati, Chan, Daicus, Muin, Wood, and Grismer 2009



*Cyrtodactylus pantiensis*  
Grismer, Chan, Grismer, Wood, and Daicus 2008



*Cyrtodactylus macrotuberculatus*  
Grismer and Norhayati 2008

13 of the 19 species of *Cnemaspis* in peninsular Malaysia are found nowhere else in the world, and 11 of these were described within the last five years (Chan and Grismer 2008; Das and Grismer 2003; Grismer 2008; Grismer and Chan 2008; Grismer and Das 2006; Grismer et al. 2008a, 2008b, 2009).

Four of these new species, *Cnemaspis bayuensis* from southwestern Pahang, *C. biocellata* from northern Perlis, *C. karsticola* from northern Kelantan, and *C. monachorum* from Pulau Langkawi are remarkable, diminutive lizards that are restricted to living on karst formations. *Cnemaspis monachorum* is so small (<32 mm SVL) that

females can carry only one egg. *Cnemaspis limi*, *C. pemanggilensis*, *C. baueri*, and *C. perhentianensis* are island endemics restricted to outcroppings of granitic boulders in the Seribuat Archipelago on the islands of Tioman, Pemanggil, and Aur, and on Pulau Perhentian, respectively. Of these four species, the activity of *C. perhentianensis*

is unique in that it is closely tied to periods of rain — no rain, no geckos.

Two other new species, *Cnemaspis mcguirei* and *C. pseudomcguirei*, come from the same upland locality at Bukit Larut in Perak. These two species are remarkably similar in color pattern. When we



*Cyrtodactylus jarakensis*  
Grismer, Chan, Grismer, Wood, and Daicus 2008

were collecting and describing the larger *C. mcguirei*, we thought the smaller lizards were juveniles. What tipped us off was when we began to realize that *C. mcguirei* was found only on granitic boulders and *C. pseudomcguirei* was on the vegetation next to the boulders as well as under logs and rocks on the forest floor. The final piece of information came when we found a gravid (carrying eggs) 34-mm long *C. pseudomcguirei* sleeping on a leaf in the middle of the forest, kilometers away from any rock outcrops. The smallest, gravid *C. mcguirei* we recorded was just under 60 mm, and these lizards never leave the rocks. We are currently examining the genetics of this species pair as an example of cryptic speciation.

Our biggest surprise, however, was the discovery of *Cnemaspis flavigaster* (Chan and Grismer 2008), which had remained hidden for years in the well-explored and studied Forest Research Institute Malaysia (FRIM) just a few kilometers from Kuala Lumpur! In fact, this population was found along the most popular trails just before the entrance onto the famous canopy walk.

Peninsular Malaysia's Bent-toed Geckos (*Cyrtodactylus*) exhibit a far greater range of anatomical diversity than that seen in the Rock Geckos. This probably accounts for its more varied ecological diversity and wider distribution throughout most of Asia and Australasia. In fact, this is the world's largest and fastest growing group of geckos. Fourteen species are known to occur in peninsular Malaysia; 11 of them are endemic and, of those, six

have been described during the last three years (Grismer 2005, Grismer and Leong 2005, Grismer and Norhayati 2008, Grismer et al. 2008c).

Five of these species are islands forms, attesting to this group's ability to colonize, evolve, and adapt to the new selection pressures attendant with insular ecosystems. On Pulau Aur, in the Serinuat Archipelago, *Cyrtodactylus aurensis* makes its living in a relatively specialized habitat beneath overhanging vegetation on granitic boulders, whereas *C. seribuatensis* ekes out a living in the harsh, intertidal zone on seven tiny islands. Changing tides result in an hourly state of flux in this hypersaline environment. This poses huge challenges to this species that we have not yet begun to understand. This may be the world's only exclusively intertidal gecko — and we have no idea where it goes at high tide or even what it eats. On Pulau Besar in the Water Islands off the coast of Meleka, *C. batucolus* is clearly the most abundant nocturnal lizard on the island. We found this robust, tuberculate species on rocks, trees, in caves, and even on the sides of buildings. How did such an abundant, obvious lizard go unnoticed? Clearly the most isolated insular endemic is *C. jarakensis* from the small, rocky island of Jarak, 45 km off the western coast of Perak. We still have much to learn about this species, which was described on the basis of a single adult female. The problem is that many of the characters used to diagnose the different species of *Cyrtodactylus* are secondary sexual characters found only in males. However, this single female was so distinctive that we were sure that she was the sole representative of a new species. We will still have to fill in the “character gaps” for this species when males become available. Our most recent discovery was the beautiful and elegant *C. macrotuberculatus* from Pulau Langkawi. For years this species was misidentified as the more common *C. pulchellus*. We had always questioned this species assignment, but only after the accumulation of enough material were we able to demonstrate that it was clearly not *C. pulchellus*. Because both species occur on Pulau Langkawi and they are similar in appearance, we also are looking at the genetics of these populations.

Two new Bent-toed Geckos discovered in lowlands of southern Johor State nicely illustrate how closely related species of similar sizes can occur in the same habitat and avoid competition. We discovered *Cyrtodactylus pantiensis* in a semi-swampy riparian area living alongside *C. semenanjungensis*, a species we had described from this area a few years earlier. What we discovered last year was that *C. pantiensis* appears to restrict its activity to the edges of slow-moving streams and is always found in the vicinity of dense root tangles into which it takes refuge. *Cyrtodactylus semenanjungensis*, on the other hand, is a more widely ranging forest species that is not restricted to the edges of streams and, as such, avoids direct competition with *C. pantiensis*. The most bizarre and rarest of the recently described new species is *C. stresemanni* (Rösler and Glaw 2008). This species too is known only from a single specimen, but this one is a male. This individual was actually collected in the early 1900s in the vicinity of Batang Padang, Perak by a Dutch explorer, but was not “discovered” and described until 2008, when it was found in a jar during a museum inventory. Rösler and Glaw's (2008) description left no doubt as to its distinctive species status. Its body morphology and color pattern suggest that it may be an arboreal leaf-mimic. It will be an exciting day when one of these new geckos is found again and we can evaluate it in the light of what we have learned about Bent-toed Geckos in the recent past.

So why the rapid and sudden increase in the lizard diversity of peninsular Malaysia? Did nature all of a sudden decide to whip up a new batch of species for us to discover? Such a scenario is unlikely. These species evolved a long time ago and the reason for us not noticing they were here is that we never really looked. Many regions in peninsular Malaysia remain woefully unexplored, and we will need much more than a few visits to understand their faunal complexity. Additionally, many of the places we believe are well explored aren't. Just because people have been going there for many years doesn't mean that new discoveries aren't there to be made. For example, we discovered three new species of lizards from Pulau Langkawi since 2007, three new species at Bukit Larut since 2008, three new species from Pulau Tioman since 2003, two new species in the Gunung Panti Forest Reserve since 2005, two new species from Fraser's Hill and Cameron Highlands since 2007, and a new species from FRIM in 2008. These are all very well known areas that are often explored — and we have not even mentioned the new species of frogs and snakes we discovered.

Most disturbing, however, is the fact that we are not looking closely enough at the specimens we collect or those already collected and sitting in jars. For example, we originally believed *Cyrtodactylus macrotuberculatus* of Pulau Langkawi was *C. pulchellus* and that *Cnemaspis mcguirei* of Bukit Larut was either *C. affinis* or *C. kenadlii* simply because we never looked closely enough at what we had. The point is that the knowledge deficit is our fault, not something romantically and beautifully elusive about nature, as we are so fond of claiming. Simply stated, we are not thoroughly exploring as many places as we should be and we are not studying the material we collect in enough detail — if at all! Some may posit that, in this era of molecular systematics, the identification of new species is much easier — and this is why we are seeing such a dramatic increase in new discoveries. We disagree — and note that the 39 new species of frogs, lizards, and snakes that we have described from peninsular Malaysia in the past five years were done the old fashioned way — with a microscope, literature, and hard work. We believe that, if scientists are not going to carefully examine the material they collect, then perhaps that material is better left in the wild. This is difficult for us to say, being that we are systematic biologists who view collecting as the cornerstone for knowledge-based conservation efforts



*Cyrtodactylus semenanjungensis*  
Grismer and Leong 2005

— but we can only conserve what we understand and we can only understand what we study.

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*Cyrtodactylus aurensis*  
Grismer 2005



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An undescribed species in the *Gekko smithii* species complex from peninsular Malaysia.