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Research Note

A Record of an Asian House Gecko, *Hemidactylus frenatus*, from Laos as a Host of the Pentastome, *Kiricephalus pattoni*, with Comments on the Distribution and Natural History of This Parasite

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ABSTRACT: An Asian house gecko (*Hemidactylus frenatus* Schlegel, 1836) was collected in a forested area near the town of Thakhek, Laos. Inspection of the lizard revealed that it had a subcutaneous lump on its abdomen, which was determined to be caused by a nymph of the pentastome *Kiricephalus pattoni* (Stephens, 1908). Although *H. frenatus* has been recorded as a host of *K. pattoni* in Taiwan, Thakhek, Laos represents a new distribution record for this parasite.

KEY WORDS: Gekkonidae, Indochina, Maxillopoda, new distribution record, Pentastomida, Porocephalidae.

Pentastomes, also known as tongue worms, are endoparasitic crustaceans belonging to the class Maxillopoda and subclass Pentastomida (Riley et al., 1978; Abele et al., 1989; Martin and Davis, 2001). They are hematophagous, pulmonary, or nasopharyngeal parasites, and as adults primarily infect amphibians, crocodilians, lizards, and snakes in tropical and semitropical regions (Byford and Maurice, 2007; Paré, 2008). A few species infect some chelonians, sea birds, canines, felines, ungulates, or the sugar glider (*Petaurus breviceps*), and may even infect humans (Anonymous, 1922; Paré, 2008).

The Asian house gecko, *Hemidactylus frenatus* Schlegel, 1836, is generally accepted to be native to Asia and the Indo-Pacific region, but through anthropogenic activities has spread to various localities throughout the tropics (Case et al., 1994; Rödder et al., 2008; Hoskin, 2011). Throughout its range (native and introduced) *H. frenatus* is often associated with areas disturbed by anthropogenic activities. Herein we report on an instance of an adult *H. frenatus* from Laos being infected by a nymph of the pentastome *Kiricephalus pattoni* (Stephens, 1908) and summarize what is known about the natural history of this parasite.

On 26 November 2016, an adult female *H. frenatus* was collected by hand in a forested area near the town of Thakhek, Laos (17°26′20.4″N; 104°51′39.6″E; datum: WGS84). The lizard had a snout–vent length and tail length of 70 mm and 25 mm, respectively. A closer inspection of the lizard revealed that it had a subcutaneous lump on its abdomen (Fig. 1), caused by a parasite. A small superficial incision was made through the epidermis and the parasite was removed (Fig. 2) with a pair of forceps. The lizard was subsequently released and did not suffer any apparent damage. The parasite was preserved in 70% ethanol and sent to the Department of Biology, Pennsylvania State University to determine the species. On the basis of the morphology of the cephalothorax (enlarged), hook arrangement (in a straight line), position and shape of the mouth (pear-shaped and positioned between the inner hooks), and the collection locality, the parasite was determined to be a nymph of *K. pattoni* (Riley and Self, 1980; Christoffersen and De Assis, 2013) and was subsequently deposited in the Harold W. Manter Museum, University of Nebraska at Lincoln, U.S.A. (voucher number HWML 99821).

Kiricephalus pattoni has been recorded from parts of Madagascar, India, Sri Lanka, Southeast and East Asia, and Australia (Riley and Self, 1980; Christoffersen and De Assis, 2013), but Laos appears to be

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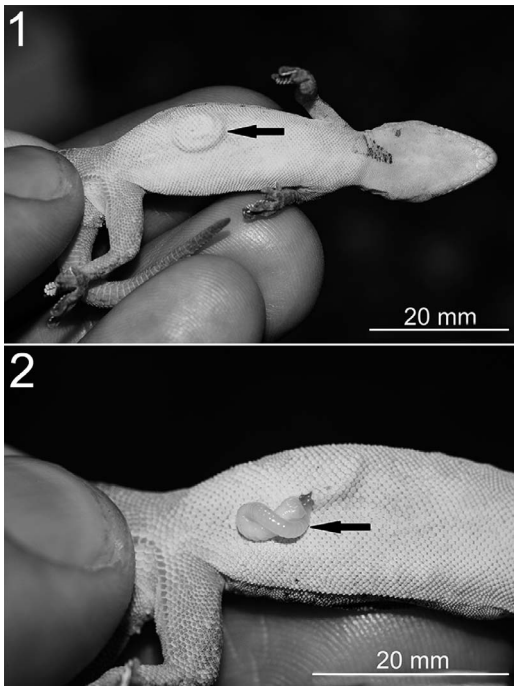

Figures 1, 2. Photographs of *Kiricephalus pattoni* infecting the Asian house gecko, *Hemidactylus frenatus*. **1.** Ventral side of *H. frenatus* with arrow indicating *K. pattoni* nymph visible as a subcutaneous lump. **2.** *Kiricephalus pattoni* nymph emerging from subcutaneous lump (as seen in Fig. 1) via small superficial incision.

a new distribution record for this parasite. The type specimens of *K. pattoni* (described as *Porocephalus pattoni*) were taken from an Indian rat snake (*Ptyas mucosa*; originally reported as *Zamenis* v. *Ptyas mucosus*) and donated by Captain Patton, I.M.S. (Stephens, 1908). The collection locality of the type specimens has been listed as Madagascar (Poore, 2012; Christoffersen and De Assis, 2013), but this is likely an error, since *P. mucosa* does not occur in Madagascar (Uetz et al., 2016) and Capt. W. S. Patton was a member of the King Institute of Preventative Medicine, located in Madras, India (Patton, 1909). We therefore support the statement of Faust (1927) that India is the type locality where the type specimens originated.

Riley and Self (1980) proposed that the life cycle of *Kiricephalus* involves first and second intermediate hosts, which are then preyed upon by the definitive host. However, it is not clear how the eggs of *K. pattoni* infect the first intermediate host. The adults of *K. pattoni* are usually found in the lungs of the definitive hosts, which include a few species of large snakes that prey primarily on frogs, lizards, and other snakes (Riley and Self, 1980). On the other hand, the nymphs and larvae are usually found in the body cavity, muscles, viscera, or under the skin of the first and second intermediate hosts, which include various species of frogs, lizards, and snakes (Riley and Self, 1980; Norval, Bursey, Goldberg, and Mao, 2009; Christoffersen and De Assis, 2013; Norval, Goldberg, Bursey, and Mao, 2014). The nymphs of *K. pattoni* have also been found in purportedly accidental dead-end hosts, such as cats (Faust, 1927; Hett, 1934). Although infections by *K. pattoni* can be chronic with little or no symptoms and disturbance to the host's tissue, they can also result in chronic inflammation, necrosis, metaplasia, and perforation of the host's tissue (Self and Kuntz, 1967; Deakins, 1973).

Several lizard species have been recorded as first intermediate hosts of *K. pattoni* (Table 1), and except for in the common garden lizard reported by Hett (1934), where the infection was in the liver, the other records involved nymphs that were observed as subcutaneous lumps. The intensities of the infections in these previous reports ranged from 1 to 6, with a mean and standard deviation of 2.1 and 1.9 respectively. The 2 smaller reported host species (*Anolis sagrei* and *H. frenatus*) were infected with fewer nymphs than the larger

Table 1. First intermediate hosts of *Kiricephalus pattoni*, with their reported infection intensities (mean and SD in parentheses if originally reported).

Lizard species	Locality	Intensity	Reference
Anolis sagrei	Taiwan	1	Norval, Bursey, Goldberg, Tung, and Mao, 2009
Common garden lizard (*Calotes* sp.?)	Burma	—	Hett, 1934
Hemidactylus frenatus	Taiwan	1	Riley and Self, 1980
	Laos	1*	This study
Japalura swinhonis	Taiwan	1	Riley and Self, 1980
	Taiwan	1–6 (3.5 ± 3.5)*	Norval, Goldberg, Bursey, and Mao, 2014
	Taiwan	4	Norval, Goldberg, Bursey, Mao, and Slater, 2014
Plestiodon elegans	Taiwan	2*	Norval, Goldberg, Bursey, and Mao, 2014

*Recorded as subcutaneous lumps (i.e., the host was not dissected).

reported host species, suggesting that the nymphs of *K. pattoni* have a significant impact on the host they infect and that smaller hosts most likely do not survive if they are infected by a larger number of nymphs.

Various authors have reported the natural distribution of *K. pattoni* to include Madagascar and Australia (Heymons and Vitzhum, 1935; Mitchell, 2007). However, Riley and Self (1980) stated that the specimens from Madagascar could possibly be a different species and not *K. pattoni*. Christofferson and De Assis (2013) also pointed out that the records from Australia reported by Heymons and Vitzhum, (1935) are not based on any definitive hosts. In addition to that, in parts of its range (e.g., in parts of Taiwan) *K. pattoni* is sympatric with the pentastome *Raillietiella orientalis* (Norval et al., 2012). Yet, even though *R. orientalis* was collected from snakes during a recent study done in Australia (Kelehear et al., 2014), we found no recent confirmations of the existence of *K. pattoni* in Australia. Because of these uncertainties, we support the opinion of Norval, Goldberg, Bursey, and Mao (2014) that empirical studies incorporating morphological, allometric, and molecular approaches on *K. pattoni* are warranted.

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LITERATURE CITED

Abele, L. G., W. Kim, and B. E. Felgenhauer. 1989. Molecular evidence for inclusion of the phylum Pentastomida in the Crustacea. Molecular Biology and Evolution 6:685–691.

Anonymous. 1922. The Linguatulidae as parasites of man. Journal of Tropical Medicine and Hygiene 25: 389–390.

Byford, R. L., and E. C. Maurice. 2007. Biology of arthropods. Pages 51–68 *in* D. G. Baker, ed. Flynn's Parasites of Laboratory Animals, 2nd ed. Wiley-Blackwell, Hoboken, New Jersey. 840 pp.

Case, T. J., D. T. Bolger, and K. Petren. 1994. Invasions and competitive displacement among house geckos in the tropical Pacific. Ecology 75:464–477.

Christofferson, M. L., and J. E. De Assis. 2013. A systematic monograph of recent Pentastomida with a compilation of their hosts. Zoologische Mededeligen 87: 1–206.

Deakins, D. E. 1973. Pentastome pathology in captive reptiles. Ph.D. Dissertation. The University of Oklahoma, Norman. 53 pp.

Faust, E. C. 1927. Linguatulids (order Acarina) from man and other hosts in China. American Journal of Tropical Medicine 7:311–325.

Hett, M. L. 1934. On a collection of Linguatulids (Pentastomida) from Burma with description of a new subgenus. Proceedings of the Zoological Society (London) 2: 425–431.

Heymons, R., and H. G. Vitzhum. 1935. Beiträge zur Systematik der Pentastomiden. Zeitschrift für Parasitenkunde 8:1–103.

Hoskin, C. J. 2011. The invasion and potential impact of the Asian house gecko (*Hemidactylus frenatus*) in Australia. Austral Ecology 36:240–251.

Kelehear, C., D. M. Spratt, D. O'Meally, and R. Shine. 2014. Pentastomids of wild snakes in the Australian tropics. International Journal for Parasitology: Parasites and Wildlife 3:20–31.

Martin, J. W., and G. E. Davis. 2001. An updated classification of the recent Crustacea. Natural History Museum of Los Angeles, Science Series 39:1–124.

Mitchell, M. A. 2007. Parasites of reptiles. Pages 177–216 *in* **D. G. Baker**, ed. Flynn's Parasites of Laboratory Animals, 2nd ed. Wiley-Blackwell, Hoboken, New Jersey. 840 pp.

Norval, G., C. R. Bursey, S. R. Goldberg, and J. J. Mao. 2009. The first record of *Kiricephalus pattoni* Stephens, 1908 as a parasite of *Lycodon ruhstrati ruhstrati* Fischer, 1886 from Chiayi County, Taiwan. Herpetology Notes 2:79–80.

Norval, G., C. R. Bursey, S. R. Goldberg, C. L. Tung, and J. J. Mao. 2009. *Norops sagrei* (Brown anole) pathology and endoparasite. Herpetological Bulletin 107:42–44.

Norval, G., S. R. Goldberg, C. R. Bursey, S. Dieckmann, and J. J. Mao. 2012. A description of parasites from mountain wolf snakes, *Lycodon ruhstrati ruhstrati* (Serpentes: Colubridae), from two localities in western Taiwan. Asian Journal of Conservation Biology 1:130–133.

Norval, G., S. R. Goldberg, C. R. Bursey, and J. J. Mao. 2014. Notes on *Kiricephalus pattoni* nymphs, recorded as subcutaneous lumps in some squamates from the same locality in southwestern Taiwan, Republic of China. Comparative Parasitology 81:122–124.

Norval, G., S. R. Goldberg, C. R. Bursey, J. J. Mao, and K. Slater. 2014. Internal parasites of lizards from Taiwan. Herpetological Conservation and Biology 9:484–494.

Paré, J. A. 2008. An overview of pentastomiasis in reptiles and other vertebrates. Journal of Exotic Pet Medicine 17:285–294.

Patton, W. S. 1909. The parasite of kala-azar and allied organisms. Transactions of the Society of Tropical Medicine and Hygiene 2:113–141.

Poore, G. C. B. 2012. The nomenclature of the recent pentastomida (Crustacea), with a list of species and available names. Systematic Parasitology 82:211–240.

Riley, J., A. A. Banaja, and J. L. James. 1978. The phylogenetic relationships of the Pentastomida: the case for their inclusion within the Crustacea. International Journal of Parasitology 8:245–254.

Riley, J., and T. J. Self. 1980. On the systematics and life-cycle of the pentastomid genus *Kiricephalus* Sambon 1922 with descriptions of three new species. Systematic Parasitology 1:127–140.

Rödder, D., M. Solé, and W. Böhme. 2008. Predicting the potential distributions of two alien invasive house

geckos (Gekkonidae: *Hemidactylus frenatus*, *Hemidactylus mabouia*). North-Western Journal of Zoology 4:236–246.

Self, J. T., and R. E. Kuntz. 1967. Host–parasite relationships in some Pentastomida. Journal of Parasitology 53:202–206.

Stephens, J. W. W. 1908. Two new human cestodes and a new linguatulid. Annals of Tropical Medicine and Parasitology 1:548—558.

Uetz, P., P. Freed, and J. Hošek (eds.). 2016. The reptile database. http://www.reptile-database.org. Accessed 2017 May 4.