

Two New Species of the Genus *Acinolaemus* (Pulmonata: Pupillidae) from Thailand

Bang-on Changlom¹, Tanya Chan-ard¹ and Pongrat Dumrongrojwattana^{2,*}

¹Natural History Museum, National Science Museum, Thailand, Technopolis, Khlong 5, Khlong Luang, Pathum Thani, 12120 Thailand

²Department of Biology, Faculty of Science, Burapha University, Bangsaen, Chon Buri Province, 20131 Thailand

ABSTRACT: Two new species of the genus *Acinolaemus* Thompson and Upatham, 1997 from northern Thailand are described: *A. cryptidentatus* **sp. nov.** and *A. muangonensis* **sp. nov.** These two new species differ from other congener species in term of their position of the complex arrangement of plicae and lamellae.

KEY WORDS: *Acinolaemus*, *Pupillidae*, terrestrial microsnails, Thailand.

INTRODUCTION

Terrestrial microsnails in the genus *Acinolaemus* was first described by Thompson and Upatham in 1997, which *A. ptychochilus* as the type species. Currently, six species of the genus have been recorded from Southeast Asia. Among them, five species are known from Thailand, *A. colphodon* Thompson and Upatham 1997, *A. ptychochilus* Thompson and Upatham 1997, *A. rhamphodon* Thompson and Upatham 1997, *A. sphinctinon* Thompson and Upatham 1997, and *A. stenopus* Thompson and Upatham 1997 and only one species, *A. carcharodon* Vermeulen, Phung and Truong, 2007 was described from southern Vietnam (Thompson and Upatham, 1997; Panha and Burch, 2005; Nabhitabhata, 2009; Vermeulen *et al.*, 2007; Schileyko, 2011). The known species of the genus and their type localities are shown in Table 1.

During our survey of the Thai *Acinolaemus*,

two unidentified species belonging to the genus were found from northern Thailand. After carefully examining specimens of these two species under a stereomicroscope and comparing them with the type materials of congener species, it was concluded that both species are new to science which both new species are described in the present study.

MATERIALS AND METHODS

Specimens of both species were collected from limestone hills at Tham (cave) Wua, Mae Hong Son Province and Tham Mueang On, Chiang Mai Province in northern Thailand (Fig. 1). Empty shells were cleaned and air-dried. Adult specimens were photographed. The photographs were taken using Cannon MP-E 65 mm Macro lens, and Scanning Electron Microscope LEO 1450 VP at the Microscopic Center, Faculty of Science, Burapha University. Shell measurements were done using Image J 1.47v program. Shell

*Corresponding author.

E-mail: pongrat@buu.ac.th

Table 1. List of known *Acinolaemus* species and their distribution records.

Species	Type Locality	References
<i>Acinolaemus colphodon</i> Thompson and Upatham, 1997	Khao Bot, Rayong Province, Thailand	1, 2
<i>Acinolaemus ptychochilus</i> Thompson and Upatham, 1997	Doi Pha San Sao (Mountain), Chiang Mai Province, Thailand	1, 2
<i>Acinolaemus ramphodon</i> Thompson and Upatham, 1997	Khao Tam Raet, Chachaengsao Province, Thailand.	1, 2
<i>Acinolaemus sphinctinion</i> Thompson and Upatham, 1997	Khao Sam Roy Yot National Park, Prachuap Khiri Khan Province, Thailand.	1, 2
<i>Acinolaemus stenopus</i> Thompson and Upatham, 1997	Limestone ridge, 3 km west N Yai Ham, Chantaburi Province, Thailand.	1, 2
<i>Acinolaemus carcharodon</i> Vermeulen, Phung and Truong, 2007	Kien Luong, Hon Chong Hill, Kien Giang Province, Vietnam.	3, 4
<i>Acinolaemus cryptidentatus</i> sp. nov.	Tham Wua, Mae Hong Son Province, Thailand.	This study
<i>Acinolaemus mueangonensis</i> sp. nov.	Tham Mueang On, Chiang Mai Province, Thailand.	This study

*References: 1 = Thompson and Upatham (1997); 2 = Panha and Burch (2005); 3 = Vermeulen et al. (2007) and 4 = Schileyko (2011).

dimensions of type specimens are described in this paper as minimum-maximum (mean \pm standard deviation). Shell terminology e.g. whorls number, apertural barrier teeth etc., follows Panha and Burch (2005). Type materials of the two new species are deposited in the Thailand Natural History Museum, Pathum Thani, Thailand (THNHM) and Zoological Research Collection of Burapha University, Chon Buri, Thailand (ZRCBUU).

RESULTS

SYSTEMATICS

Family Pupillidae Turton, 1831

Genus *Acinolaemus* Thompson and Upatham, 1997

Type species: *Acinolaemus ptychochilus* Thompson and Upatham, 1997

Diagnosis. Thomson and Upatham described this genus in 1997 are as follows: "The most distinctive feature of *Acinolaemus* is the enlargement of the angular lamella. It is the most conspicuous tooth in the aperture. In the closely related Southeast Asian genera *Hypselostoma*, *Gyliotrachela*, *Boysidia* and *Paraboysidia*, the angular lamella is underdeveloped compared to the parietal lamella. The auriculate-shaped aperture has a well-defined bay in the posterior corner formed by the angular lamella and the upper palatal fold. This is accentuated by a tendency for the species to have a strong tubercle along the margin of the peristome in front of the upper palatal fold at the point where the lip is indented. In closely related genera the bay is not nearly as well differentiated from the rest of the aperture. In *Acinolaemus* one or more of the palatal, basal and columellar teeth

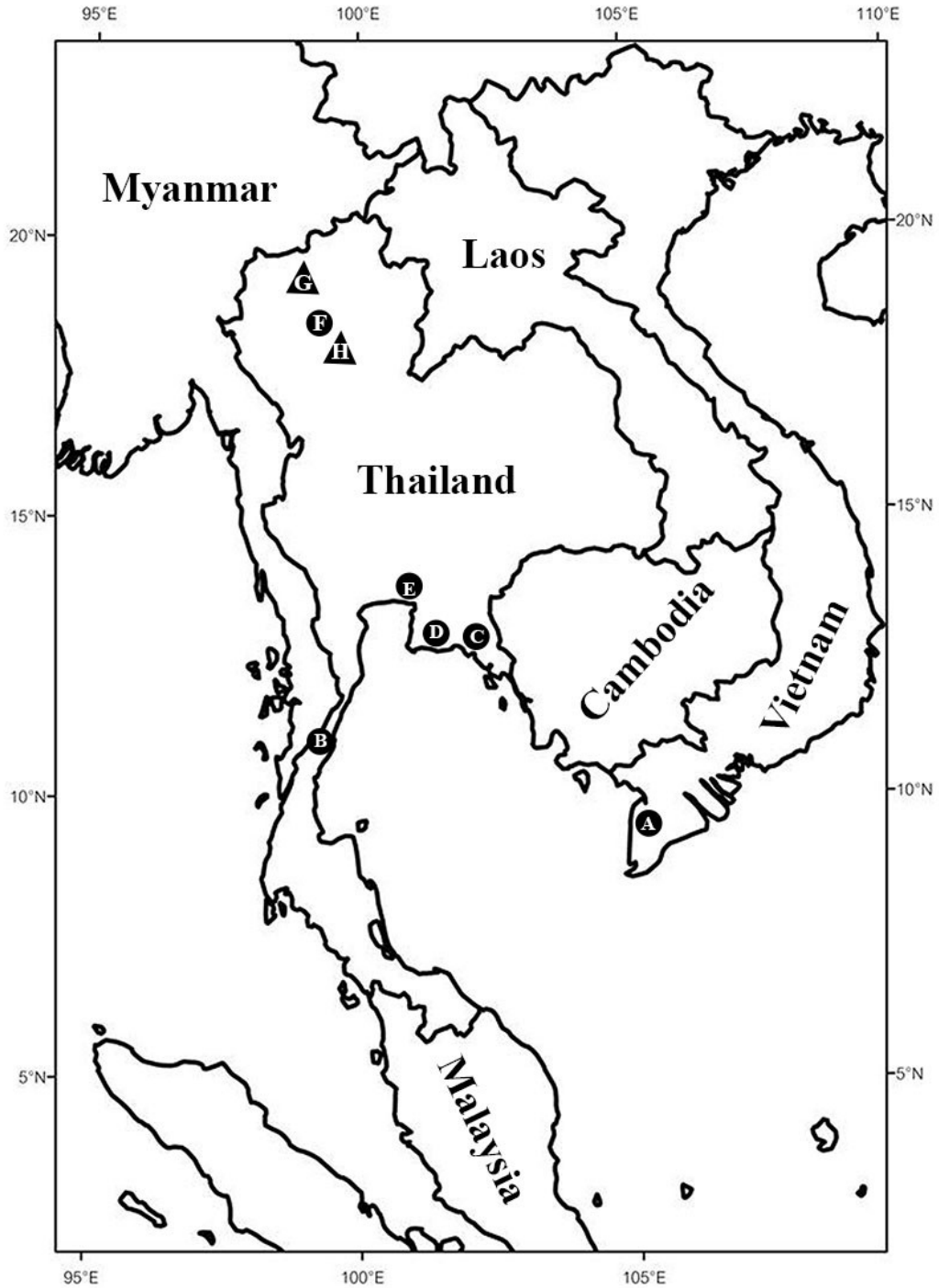


Figure 1. Distribution map of *Acinolaemus* recorded in Southeast Asia. A) *A. carcharodon*, B) *A. sphinctinon*, C) *A. stenopus*, D) *A. colphodon*, E) *A. ptychochilus*, F) *A. ptychochilus*, G) *A. cryptidentatus* **sp. nov.**, H) *A. mueangoensis* **sp. nov.**

are developed as sharp thorns that point toward the aperture, although this feature is repeated in some species of closely related genera. The last whorl is constricted behind the aperture in the region of the internal dentition. The genus also is characterized by having a minute, yellowish, turban-shaped shell with a nearly straight-sided spire, although these feature are not unique to the genus. The last whorl regularly descends or is deflected upward. The lower whorls are sculptured with raised spiral threads that are crossed by oblique axial threads. Spiral threads are reported in other genera but they are not crossed by oblique threads. The microsculpture of the protoconch consists of a fine mesh of granular reticulations upon which are superimposed evenly spaced continuous raised spiral threads. Raise spiral threads on the protoconch are not know for the other genera except in *Systemostoma*.”

Descriptions of new species

Acinolaemus cryptidentatus sp. nov.

(Figure 2A–F)

Types. Holotype (THNHM-Iv-18091, THNHM) and four paratype shells (two specimens [No. THNHM-Iv-18092], THNHM and two specimens [No. ZRCBUU 0670], ZRCBUU), collected from Tham Wua (Wua Cave), Mueang District, Mae Hong Son Province, 19°31.77'N, 98°04.92'E, 22.X.2014, Tanya Chan-ard.

Holotype measurements. Shell height 1.89 mm; shell width 1.67 mm; aperture height 0.71 mm; aperture width 0.77 mm. Shell width/shell height ratio = 0.88; aperture width/aperture height ratio = 1.08.

Paratype measurements (n = 4). Shell height 1.49–1.59 mm (1.54 ± 0.04 mm); shell width 1.36–1.52 mm (1.42 ± 0.07 mm); aperture height 0.56–0.67 mm (0.63 ± 0.05 mm); aperture width 0.54–0.68 mm (0.62 ± 0.06 mm).

Shell width/shell height ratio = 0.93 ± 0.05; aperture width/aperture height ratio = 0.99 ± 0.13.

Diagnosis. Shell minute, conical-shaped, surface reticulated, peristome weakly expanded, Apertural teeth with two tiny plica located deeply inside the aperture.

Description. Shell minute whitish, translucent, slightly thin, conical shape with 4 ¼–4 ½ convex whorls. Spire high. Sutures deeply impressed (Fig. 2A–C). Apex blunt and smooth. Protoconch contains 1–1 ½ whorls which is increasing slowly and continued increase in size to the teleoconch whorls; microsculpture consist of mesh of fine reticulate granules on first half whorl and follow by distinct evenly parallel thin spiral threads (Fig. 2D). Teleoconch convex, sculptured with fine mesh-like reticulated which composed of spiral striae crossed with oblique striae (Fig. 2E). Last whorl slightly expanded peristome adnate, auriculate in shape. The aperture with a complex arrangement of plica and lamella (Fig. 2C). On the parietal side, the infraparietal lamella (infP) and angular lamella (A) are discontinuous, consists of a large high blade deep-set within the aperture and extending nearly to the edge of the peristome with a small knob. On the palatal wall, three plicae appeared. The Upper palatal plica (upl) is also discontinuous, consist of a thin, low blade-like set deeply inside and a large knob nearly the edge of peristome. The interpalatal (inPl) and lower-palatal plicae (Lpl) are blade-like, continuous extending from the edge of peristome into the deep of aperture. There are two tiny twin appear deeply inside at the posterior conner of the aperture (Fig. 2F). The basal plica (B) is blade-like thin and small, setting deeply inside the aperture. The Collumellar (C) and supracolumellar lamella (supC) are short folds. The columellar lamella is higher than supracolumella lamella. Umbilicus deep and widely open.

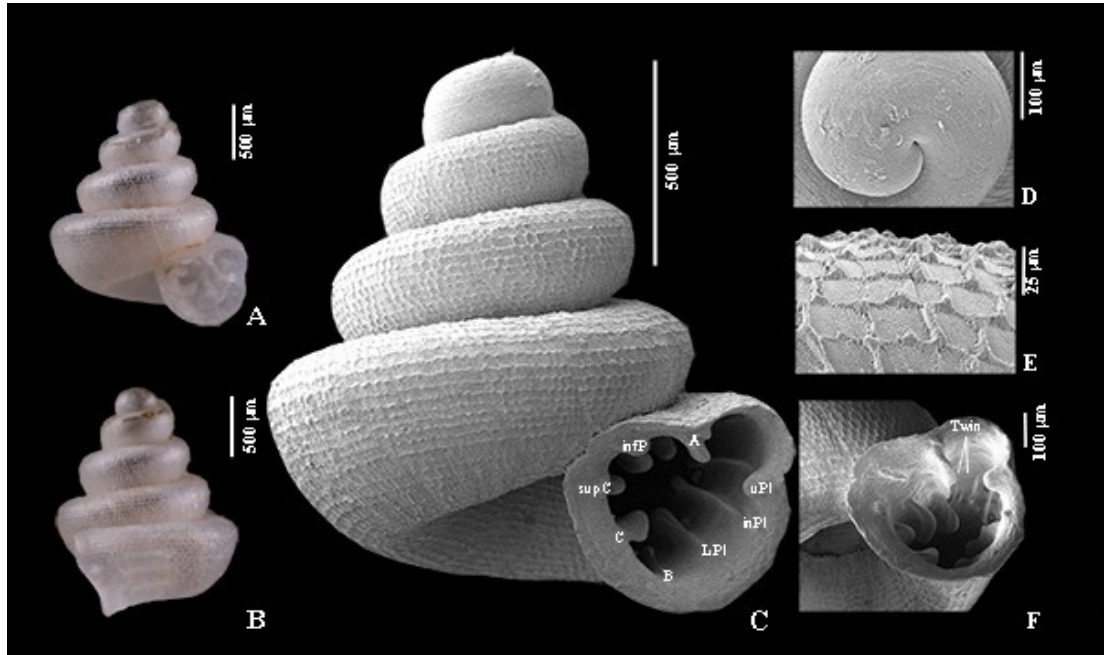


Figure 2. *Acinolaemus cryptidentatus* sp. nov. (Holotype). A–B) Digital photo, C–F) Scanning Electron Microscograph: C) apertural teeth, D) Protoconch, E) microsculpture of shell surface, and F) twin inside aperture. Abbreviation; infP = infraparietal lamella, A = angular lamella, uPl = upperpalatal plica, inPl = interpalatal plica, LPl = lower palatal plica, B = basal plica, C = columellar lamella, and supC = supracolumellar lamella.

Etymology. We named this new species “*cryptidentatus*” from the character of two tiny teeth that located deep inside the aperture.

Distribution and Habitat. *Acinolaemus cryptidentatus* sp. nov. was collected from soil at the base of a lime stone hill and only known from the type locality.

Remark. *Acinolaemus cryptidentatus* is most similar to *A. ptychochilus* in the general appearance. However, this species distinctly differs from congener, *A. ptychochilus* in term of the barrier teeth position. *A. cryptidentatus* has fewer complex barrier teeth than in *A. ptychochilus* and *A. cryptidentatus* has a few knob-like structures on the peristome than in *A. ptychochilus*.

***Acinolaemus mueangonensis* sp. nov.**

(Figure 3 A–G)

Types. Holotype (THNHM-Iv-18093, THNHM) and four shells (two specimens [No. THMNH-Iv-18094], THNHM and two specimens [No. ZRCBUU 0671], ZRCBUU) collected from Tham Mueang on [Mueang On Cave], Mae On District, Chiang Mai Province, 18°47.39'N, 99°14.43'E, 21.X.2014, Tanya Chan-ard.

Holotype measurements. Shell height 2.19 mm; shell width 2.24 mm; aperture height 0.95 mm; aperture width 0.92 mm. Shell width/shell height ratio = 1.02; aperture width/aperture height ratio = 0.97.

Paratype measurements (n = 4). Shell height 1.63–1.95 mm (1.79±0.09 mm); shell width 1.49–1.79 mm (1.64±0.09 mm);

aperture height 0.83–0.74 mm (0.79 ± 0.04 mm); aperture width 0.74–0.86 mm (0.80 ± 0.04 mm). Shell width/shell height ratio = 1.10 ± 0.09 ; aperture width/aperture height ratio = 1.02 ± 0.04 .

Diagnosis. Shell minute, conical-shaped, surface reticulated, peristome weakly expanded, apertural teeth with eight complex barrier teeth.

Description. Shell brownish, translucent, minute, slightly thin, conical shape with 4 $\frac{1}{2}$ –5 convex whorls. Spire high. Sutures moderately deep impressed (Figure 3A, 3B, 3C, and 3D). Apex blunt and smooth. Protoconch contains 1 $\frac{1}{2}$ –1 $\frac{3}{4}$ whorls which is increasing slowly and continued increase in size to the teleoconch whorls; microsculpture consist of mesh of fine reticulate granules on first half whorl and follow by distinct evenly parallel thin spiral threads (Fig. 2E). Teleoconch convex, sculptured with fine

mesh-like reticulated which composed of spiral striae crossed with oblique striae (Fig. 2F). Last whorl slightly expanded peristome adnate, auriculate in shape. The aperture with a complex arrangement of plica and lamella (Fig. 2G). On the parietal wall, the infraparietal lamella (infP) blade-like, relative low and moderately long and distorted. The angular lamella (A) is relatively high, flat, and moderately long. On the palatal wall, three plicae appeared. The Upper palatal plica (upl) is discontinuous, consist of a thin, low blade-like set deeply inside the aperture and a large knob nearly the edge of peristome. The interpalatal (inPl) and lower-palatal plicae (Lpl) are thick at the edge of peristome and continuous running as low, moderately long blade-like plica extending into the deep of the aperture. The basal plica (B) is small, blade-like, thicken at the peristome and thin when extending inside the shell. On the columellar side, the

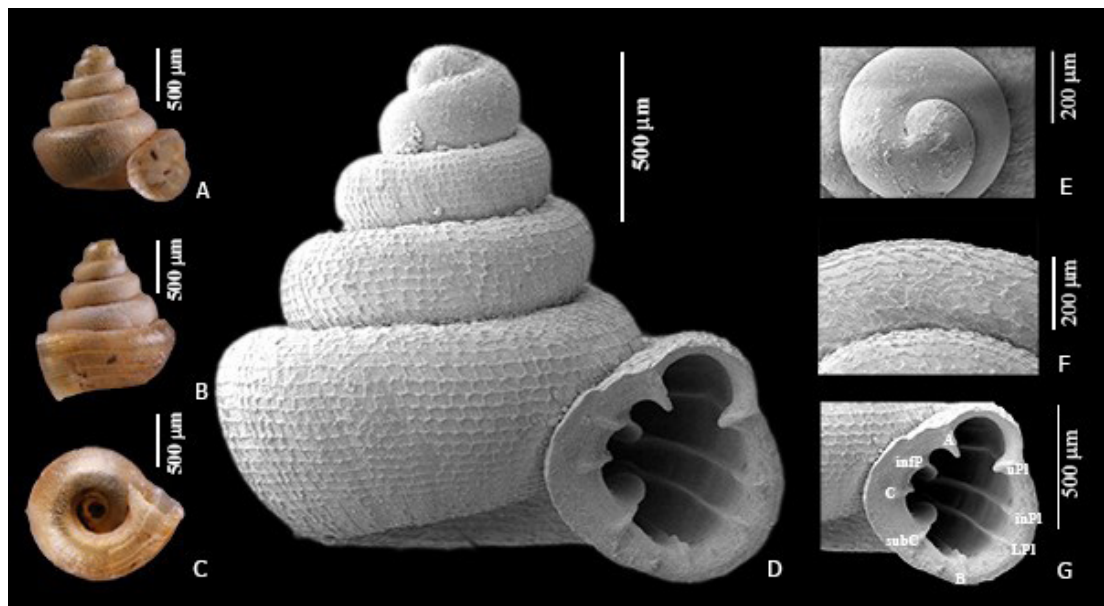


Figure 3. *Acinolaemus muangonensis* sp. nov. Holotype A–C) Digital photos, D–G) Scanning Electron Microscograph: D) front view, E) Protoconch, F) microsculpture of shell surface, and G) apertural teeth. Abbreviation; infP = infraparietal lamella, A = angular lamella, uPl = upperpalatal plica, inPl = interpalatal plica, LPl = lower palatal plica, B = basal plica, subC = subcolumellar lamella, and C = columellar lamella.

subcollumellar and columellar lamella are thick at the edge of peristome, continuously thin, blade-like setting within the aperture. The subcolumellar lamella is higher than columella lamella. Umbilicus deep and widely open.

Etymology. The specific epithet “*mueangonensis*” refers to Mueang On Cave, the type locality of this new species.

Distribution and Habitat. *Acinolaemus mueangonensis* **sp. nov.** was collected from soil sample at the base of a limestone hill in Mueang On Cave and only known from the type locality.

Remark. *Acinolaemus mueangonensis* is most similar to *A. ptychochilus*. However, this species can be distinguished *A. ptychochilus* by the character of its barrier teeth, *A. mueangonensis* has all continuous plicae and lamella except the upperpalatal tooth and while *A. ptychochilus* shows discontinuous plicae and lamellar on the edge of parietal, palatal, basal and columellar wall. *Acinolaemus mueangonensis* is also similar to *A. cryptidentatus*, but it can be separated from *A. cryptidentatus* by thick apertural fold of plicae and lamellae appear in *A. mueangonensis* (shows only knob on the edge of parietal and palatal wall in *A. cryptidentatus*).

ACKNOWLEDGEMENTS

This work was financial supported by the National Science Museum and Research Grant of Burapha University through National Research Council of Thailand (Grant no. 136/2561).

REFERENCES

- Nabhitabhata, J. 2009. *Checklist of Mollusca Fauna in Thailand*. Office of Natural Resources and Environmental Policy and Planning, Bangkok, Thailand. 576 pp.
- Panha, S. and J.B. Burch. 2005. An introduction to the microsnails of Thailand. *Malacological Review* 37/38: 1–155.
- Schileyko, A.A. 2011. Check-list of land pulmonate molluscs of Vietnam (Gastropoda: Stylommatophora). *Ruthenica* 219(1): 1–68.
- Thomson, F.G., and Dance, P.S. 1983. Non-marine mollusks of Borneo II Pulmonata: Pupillidae, Clausiliidae. III Prosobranchia: Hydrocenidae, Helicinidae. *Bulletin of the Florida state museum, Biological Sciences* 29(3), 101–152.
- Vermeulen, J.J., L.C. Phungand and Q.T. Truong. 2007. New species of terrestrial molluscs (Caenogastropoda, Pupinidae & Pulmonata, Vertiginidae) of the Hon Chong-Ha Tien limestone hills, Southern Vietnam. *Basteria* 71: 81–92.

Received: 15 July 2019

Accepted: 16 September 2019

Published: 31 December 2019