ACADEMIA JOURNAL OF BIOLOGY 2024, 46(3): 85–93
DOI: 10.15625/2615-9023/20212

REDESCRIPTION OF *Gedea pinguis* Cao & Li, 2016 (Araneae: Salticidae) WITH THE FIRST RECORD FOR VIETNAM

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Received 28 February 2024; accepted 4 September 2024

ABSTRACT

The jumping spider species *Gedea pinguis* Cao & Li, 2016 is newly recorded from Vietnam and redescribed based on the sole male specimen. A detailed redescription, illustrations of the copulatory organs, and somatic features, along with an updated distribution map are provided. DNA barcode derived from the mitochondrial cytochrome c oxidase subunit I (COI) gene of the species *G. pinguis* from Vietnam is also included for future use and to compare the genetic distances with *Gedea* cf. *tibialis* Zabka, 1985 from Malaysia. With the addition of a new record, the genus *Gedea* Simon, 1902 in Vietnam now reaches 3 species, but doubts arise regarding the conspecificity of the two opposite sex species, *Gedea tibialis* Żabka, 1985 (male) and *Gedea typica* (Żabka, 1985) (female), as they share the same type locality. Additionally, a dichotomous key to all *Gedea* species is also given in this study.

Keywords: China, dichotomous key, DNA barcode, Hasariini, jumping spiders.

Citation: Hoang Quang Duy, Phan Quoc Toan, Vo Van Minh, 2024. Redescription of *Gedea pinguis* Cao & Li, 2016 (Araneae: Salticidae) with the first record for Vietnam. *Academia Journal of Biology*, 46(3): 85–93. https://doi.org/10.15625/2615-9023/20212

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INTRODUCTION

The jumping spider genus *Gedea* Simon, 1902 belongs to the tribe Hasariini Simon, 1903 (Maddison, 2015), within the family Salticidae Blackwall, 1841. It encompasses 11 described species found across China, Indonesia, Japan, and Vietnam (World Spider Catalog, 2024), with more than half of them known only from one sex (i.e., four from male and two from female). So far, the members of the genus *Gedea* are primarily reported from their type locality, as shown in Table 1 (excluding *Gedea tibialis* Żabka, 1985). Although, the species *Gedea* cf. *tibialis* Zabka, 1985 has been reported from Malaysia with its DNA barcodes and habitus (Maddison et al., 2014; Maddison, 2015), lacking illustrations of its genital organs.

To date, the genus *Gedea* has been documented in Vietnam with only two species by Żabka (1985), namely *G. tibialis* Żabka, 1985 (♂) and *Gedea typica* (Żabka, 1985) (♀). Of which, *G. typica* was originally described within the genus *Meata* Żabka, 1985. However, Maddison (2015) recognized the genus *Meata* as a junior synonym of *Gedea* Simon, 1902. Moreover, both species were described from the same type of location as Ha Noi (Żabka, 1985), and from opposite sexes, suggesting a potential synonymy between them.

Table 1. List of extant species of the genus *Gedea* Simon, 1902

No.	Species (sex)	Locality	Reference
1	*Gedea daoxianensis* Song & Gong, 1992 (♂♀)	China (Hunan)	Song & Gong (1992)
2	*Gedea flavogularis* Simon, 1902 (♂♀)	Indonesia (Java)	Simon (1902)
3	*Gedea fungiformis* (Xiao & Yin, 1991) (♂)	China (Yunnan)	Xiao & Yin (1991b)
4	*Gedea liangweii* Wang & Li, 2023 (♂♀)	China (Hainan)	Wang & Li (2023)
5	*Gedea okinawaensis* Ikeda, 2013 (♂♀)	Japan (Okinawa)	Ikeda (2013)
6	*Gedea pinguis* Cao & Li, 2016 (♂)	China (Yunnan) and Vietnam (Dak Lak) (New record)	Cao et al. (2016) and this study
7	*Gedea sinensis* Song & Chai, 1991 (♂)	China (Hainan)	Song & Chai (1991)
8	*Gedea tibialis* Żabka, 1985 (♂)	Vietnam (Ha Noi) and Singapore (Bukit Timah)	Żabka (1985), Song et al. (2002)
9	*Gedea typica* (Żabka, 1985) (♀)	Vietnam (Ha Noi)	Żabka (1985)
10	*Gedea unguiformis* Xiao & Yin, 1991 (♂♀)	China (Guangxi)	Xiao & Yin (1991a)
11	*Gedea zabkai* (Prószyński & Deeleman-Reinhold, 2010) (♀)	Indonesia (Bali)	Prószyński & Deeleman-Reinhold (2010)

Cao et al. (2016) described the species *Gedea pinguis* Cao & Li, 2016, based on a single male specimen from China. However, the male holotype has never been fully described due to its poor state of preservation and the original description included only details about the male genitalia.

In the present study, we report the first record of *G. pinguis* from Vietnam and provide a detailed redescription of the male. Additionally, we also provide the DNA barcode for the species based on the newly collected Vietnamese samples to facilitate sex matching in future studies. An identification key to all *Gedea* species is presented as well.

MATERIALS AND METHODS

Specimens were collected by beating trays from bushes in the Yok Don National Park, Central Highlands of Vietnam. Legs II and III on the right side were cut out and preserved in absolute ethanol for DNA analyses, the remaining body was preserved in 70% ethanol for morphological examination.

Morphological examination

Newly collected specimens of *G. pinguis* from Vietnam were morphologically identified by referring to the original description provided by Cao et al. (2016). The specimens were examined with a Leica M205C stereo microscope. Photos were taken using a Jenoptik ProgRess CF Scan 12.5MP camera attached to the same stereo microscope and the Jenoptik ProgRes Capture Pro 2.10.0.1 software. The left male palp was examined and illustrated after dissection. Photos were stacked using the Helicon focus 8.2.2 Pro software and subsequently modified using Adobe Photoshop CS2 9.0. All measurements are given in millimeters (mm). Leg segment lengths are given as follows: femur + patella + tibia + metatarsus + tarsus (total length). The distribution map was created using Google Earth Pro v.7.3 (64-bit). The studied specimens have been deposited in the Vietnam National Museum of Nature (VNMN), Ha Noi, Vietnam.

Abbreviations used in the text are as follows: ALE, anterior lateral eye; AME, anterior median eye; PLE, posterior lateral eye; PME, posterior median eye; RTA, retrolateral tibial apophysis.

Molecular methodology

The GeneJET Genomic DNA Purification Kit (Thermo Scientific, Lithuania) was used to extract genomic DNA from two legs of the specimen following the manufacturer's instructions. A partial fragment of the mitochondrial cytochrome c oxidase subunit I (COI) gene was successfully amplified by using the following pair of combined primers: C1-J-1718 (Simon et al., 1994), and C1-N-2776 (Hedin & Maddison, 2001). The polymerase chain reaction (PCR) cocktail included 8 μL nuclease-free water, 1.5 μL of two primers of forward and reverse primer (10 μM), 3 μL of DNA template, and 12.5 μL DreamTaq PCR Master Mix 2X (Thermo Scientific). The PCR protocol was as follows: Initial denaturation at 95 ^{o}C for 3 min, 40 cycles of denaturation at 95 ^{o}C for 30 seconds, annealing at 48 ^{o}C for 30 seconds, and elongation at 72 ^{o}C for 1 min, and a final extension at 72 ^{o}C for 5 min. Then, the PCR products were visualized through agarose gel electrophoresis (1.5% agarose). Each successfully amplified band in the agarose gel under a UV light was excised and purified using the GeneJET Gel Extraction Kit (ThermoFisher Scientific, Lithuania). Subsequently, the purified samples were sent for sequencing at the First-Base company (Malaysia). Finally, the correctness of the resulting COI sequence was verified by using BLAST (https://www.ncbi.nlm.nih.gov) and deposited in GenBank (accession number: PP389594). The COI sequences for *G. pinguis* and *Gedea* cf. *tibialis* were aligned using MUSCLE (Edgar, 2004) built in the software MEGA version 11.0.13 (Tamura et al., 2021), under default parameters. Subsequently, the genetic distance was calculated using Kimura's two-parameter (K2P) model also within MEGA version 11.0.13.

RESULTS

Taxonomy

Family Salticidae Blackwall, 1841

Subfamily Salticinae Blackwall, 1841

Tribe Hasariini Simon, 1903

Genus *Gedea* Simon, 1902

***Gedea pinguis* Cao & Li, 2016** (Figs. 1, 2)

Gedea pinguis Cao & Li, in Cao, Li & Żabka, 2016: 76, Figs. 23A–D (♂).

Type material. Holotype male: CHINA: Yunnan province: Mengla County, Menglun Town, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences: Lvshilin (21^{o}54.705'N, 101^{o}16.898'E, 656 m), 11.xi. 2009, G Zheng leg., not examined.

Material examined. VIETNAM: Dak Lak province: 1♂ (VNMN-ARA-SAL-387.1): Buon Don district, Yok Don National Park, 12.9433^{o}N, 107.7281^{o}E, 180 m, 30.ix.2022, H. Q. Duy leg.; 1♂ (VNMN-ARA-SAL-387.2), same locality, 12.9279^{o}N, 107.7119^{o}E, 190 m, 04.ii.2024, H. Q. Duy leg.

Diagnosis. The male of *G. pinguis* resembles that of *G. tibialis* in having a long, strong, and curved embolus with a pointed tip, a tegulum with a posterior lobe protruding at 6 o'clock and headed posteriorly. It differs from the male of the latter species by the following combination of characters: embolus with a triangular membrane (Fig. 1f) vs. without the membrane in *G. tibialis* (see Figs. 263–264 in Żabka, 1985), a bifurcated RTA with a clusters of long apical bristles (Figs. 1f–g) vs. a non-bifurcated, RTA lacking any long bristles in *G. tibialis* (cf. Figs. 1f–g & Figs. 265–266 in Żabka, 1985).

Description. Male: Measurements: Total length 2.93; Carapace length 1.55, width 1.25; Abdomen length 1.38, width 1.07. Carapace high, brownish dark, with long white and black setae (Figs. 1a–c), eye field dark (Fig. 1a). Anterior eyes with yellow-orange orbital setae (Fig. 1d). Clypeus with dense long white setae (Fig. 1d). Sternum dark brown, oval, truncated anteriorly, with sparse long white setae (Fig. 1b). Endites and labium lighter than sternum, lighter at distal margin (Fig. 1b). Chelicerae yellowish brown; promargin with 4 teeth, and 1 retromarginal tooth with 4 cusps on left paturon (5 on right) (Fig. 1e). Width of eye rows: anterior eye row 1.11; posterior medial eye row 1.02; posterior lateral eye row 1.03. Distance between ALE–PME 0.40; ALE–PLE 0.73. Diameter of eyes: AME 0.36; ALE 0.20; PME 0.06; PLE 0.17. Length of leg segments: I 1.12 + 0.65 + 0.87 + 0.65 + 0.37 (3.66); II 0.88 + 0.55 + 0.58 + 0.50 + 0.29 (2.80); III 1.10 + 0.52 + 0.62 + 0.66 + 0.31 (3.21); IV 0.93 + 0.40 + 0.54 + 0.67 + 0.36 (2.90). Leg formula I–III–IV–II. Abdomen dark brown with long white and black setae and some lighter areas (Fig. 1a); venter dark brown, with some pale spots (Fig. 1b). Lateral sides of abdomen with white setae (Fig. 1c). Spinnerets yellow.

Palp (Figs. 1f–g) yellowish brown, tibia short ~1/5 of cymbium in length (Figs. 1f–g); RTA bifurcated, with clusters of long apical bristles in both branches (Figs. 1f–g); posterior lobe of tegulum protruding at 6 o'clock, heading posteriorly (Fig. 1f); embolus long, strongly sclerotized, winding, with pointed tip and with an unique triangular membrane near distal part of the embolus (Fig. 1f, blue arrow).

DNA barcode: (VNMN-ARA-SAL-387.1; GenBank accession number: PP389594): 5'GGCTTTTCCTCGAATGAATAATTTAA GTTTTTGATTATTACCACCATCATTAAT ATTGTTATTTATAAGCTCTATGTCTGAG ATAGGGGTAGGAGCTGGTTGAACTGTA TATCCGCCTTTAGCTTCTGTTGTAGGAC ATGCTGGAAGATCGGTTGATTTTGCAA TTTTTTCTTTACATTTGGCTGGTGCTTC GTCTATTATGGGTGCTGTTAATTTTATT TCTACGGTAATTAATATACGTTTAGTA GGGATATCTATAGATAAGGTTCCTTTA TTTGTGTGATCTGTATTAATTACTGCAG TATTATTATTATTATCTCTACCAGTTTT AGCTGGTGCTATTACTATACTACTAAC TGATCGAAATTTTAATACTTCTTTTTTT GATCCTGCTGGGGGTGGTGATCCAATT TTATTTCAACATTTATTTTGATTCTTCG GTCATCCGGAAGTGTATATTTTGATTCT TCCAGGGTTTGGAATTGTATCTCATGTT ATTAGAGTTTCGGTGGGAAAGCGTGAG CCTTTTGGTTCATTAGGGATAATTTATG CAATAGTTGGAATTGGAGTAATGGGTT TTGTTGTATGGGCACATCATATGTTTTC TGTTGGAATGGATGTTGATACACGAGC ATATTTTACAGCAGCAACTATAATTAT TGCTGTACCGACAGGTATTAAGGTATT TAGATGAATAGCTACTTTATATGGTTC TTATTTTAAGATAAGAACTTCATTATTA TGAAGAATTGGATTTGTATTTTTATTTA CTTTGGGTGGAATTACTGGGGTTGTTTT ATCTAATTCATCATTAGATATTATTTTA CATGATACTTATTATGTGGTTGCGCATT TTCATTACGTATTAAGAATAGGGGCTG TCTTTGCAATTTTAGCTGGAATTACTTA 3'.

Female: Unknown.

Distribution. China (Yunnan), Vietnam (Dak Lak) (Fig. 2).

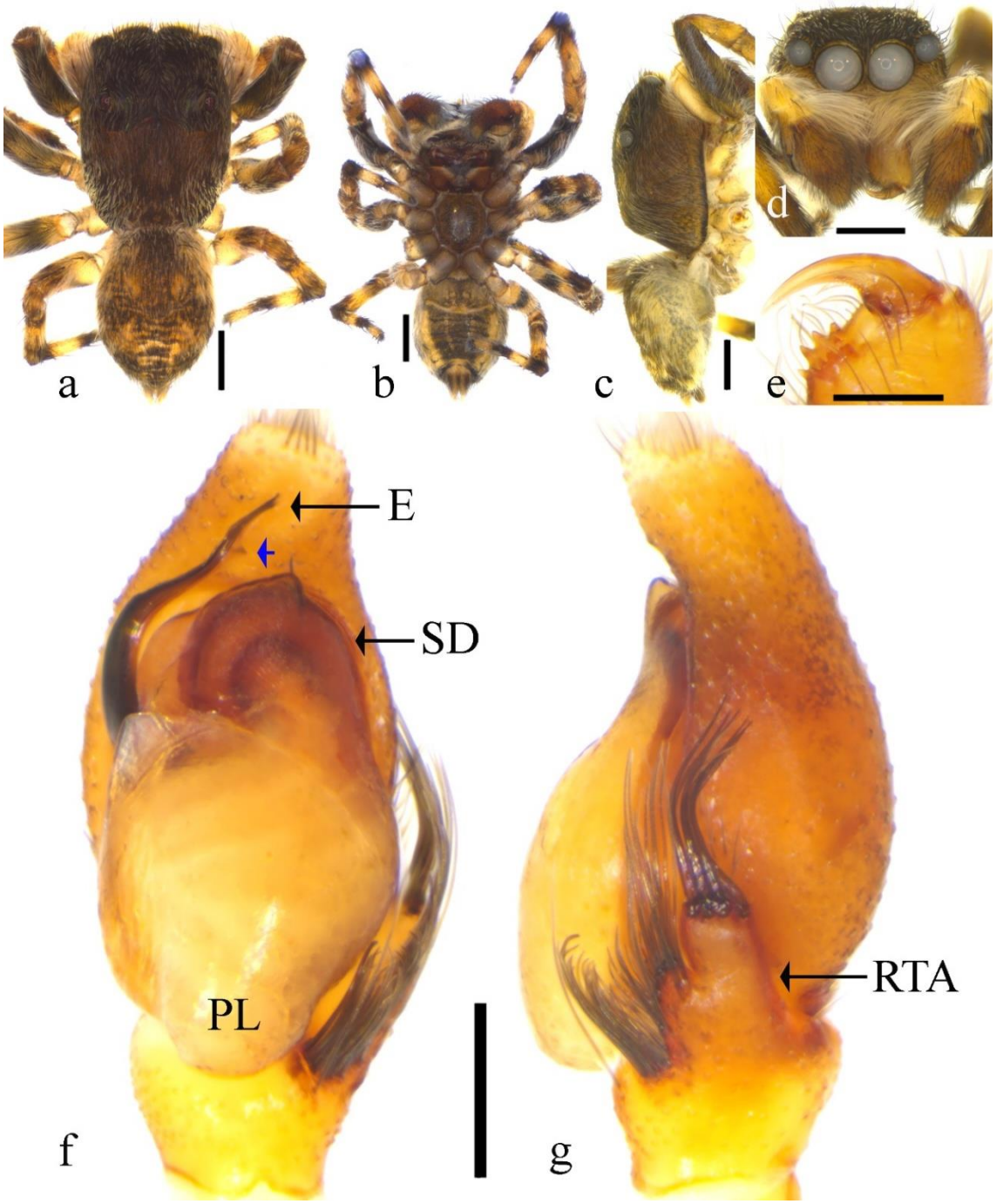

Figure 1. Male of *Gedea pinguis* Cao & Li, 2016. a. Habitus, dorsal view; b. Same, ventral view; c. Same, lateral view; d. Carapace, frontal view; e. Chelicerae, ventral view; f. Palp, ventral view (the blue arrow refers to the triangular membrane); g. Same, retrolateral view. Scale bars: (a–d) 0.5 mm; (e) 0.2 mm; (f–g) 0.2 mm. Abbreviations: E. Embolus; PL. Posterior lobe; RTA. Retrolateral tibial apophysis; SD. Sperm duct

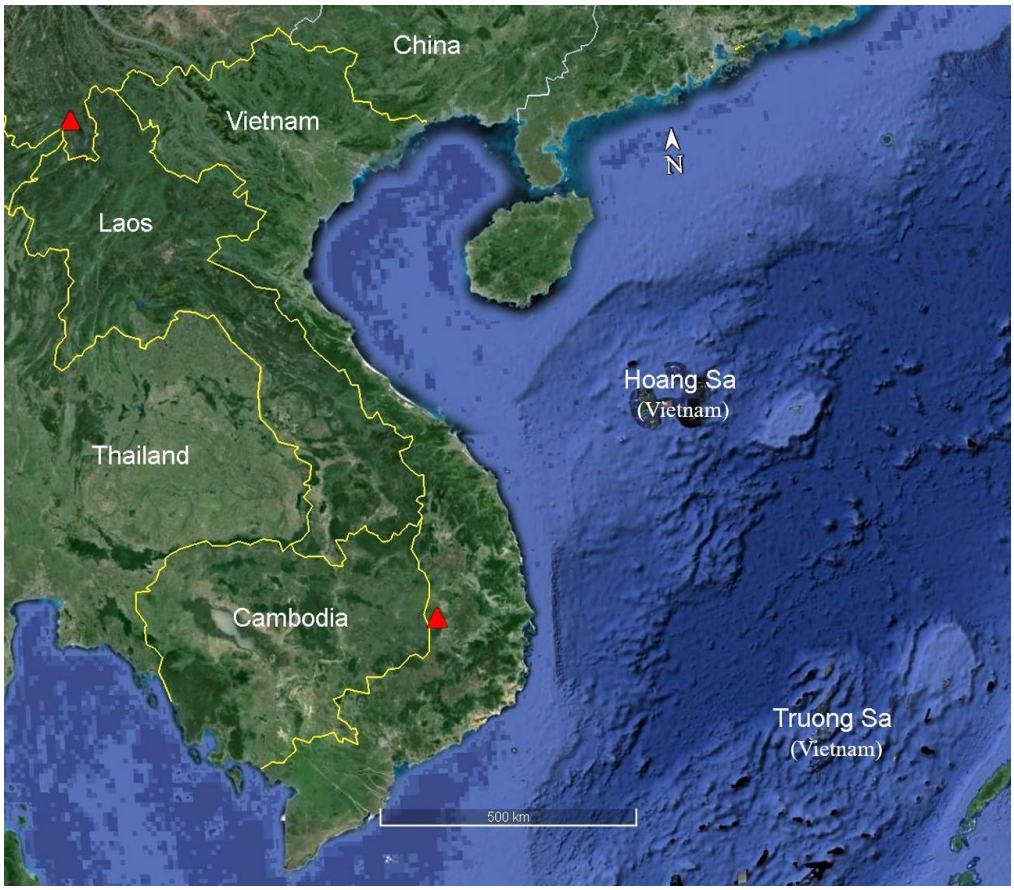

Figure 2. Distribution of the species *Gedea pinguis* Cao & Li, 2016 (red triangle)

Key to all species of genus *Gedea*

1. Male……..2

- Female……9

2. Palpal tibia with two apophyses……...3

- Palpal tibia with three apophyses (Fig. 6 in Ikeda, 2013)…….*G. okinawaensis*

3. Chelicerae with a fissidentate tooth of six cusps at retromargin (Fig. 2 in Xiao & Yin, 1991a)…….*G. unguiformis*

- Chelicerae with a fissidentate tooth of below six cusps at retromargin…….4

4. Bulbus with a posterior lobe directed prolaterally (see the illustrations for the type of *G. flavogularis* by Prószyński (1987): p. 27)……..*G. flavogularis*

- Bulbus with a posterior lobe straight, directed posteriorly……5

5. Embolus straight, narrow and short (Fig. 6C in Song & Chai, 1991)……..*G. sinensis*

- Embolus bent……..6

6. Embolus accompanied a triangle membrane near the tip (Fig. 1f & Figs. 23C–D in Cao et al., 2016)……*G. pinguis*

- Embolus without a triangle membrane……..7

7. Embolus strong, longer than half cymbium (Figs. 263–264 in Żabka, 1985)…...*G. tibialis*

- Embolus shorter than half cymbium……..8

8. DTA accompanied by six digitiform apophyses distally in retrolateral view (Fig. 3C in Wang & Li, 2023)……...*G. liangweii*

- DTA accompanied by several long setae-like apophyses (Fig. 6 in Song & Gong, 1992)….. ……..*G. daoxianensis*

9. Epigyne with a "Y" shaped, median guide (Fig. 7 in Ikeda, 2013)...……..*G. okinawaensis*

- Epigyne without any median guide……..10

10. Epigyne with a large depression medially and two anterior hoods (Figs. 7, 9 in Xiao & Yin, 1991a)…….*G. unguiformis*

- Epigyne without a large median depression……11

11. Copulatory openings posteriorly located, near epigastric furrow (Figs. 3–4 in Song & Gong, 1992)……..*G. daoxianensis*

- Copulatory openings anteriorly located……...12

12. Epigyne with two posterior hoods laterally (Fig. 4A in Wang & Li, 2023)….*G. liangweii*

- Epigyne without any hoods……..13

13. Epygine with an oval anterior depression, copulatory ducts touching each other posteriorly, spermathecae almost rectangular (Figs. 109–110 in Prószyński & Deeleman-Reinhold, 2010)……...*G. zabkai*

- Epygine with a wider than long of anterior depression, copulatory ducts touching each other anteriorly, spermathecae almost rounded……..14

14. Copulatory ducts narrow, chelicerae with a fissidentate tooth of five cusps at retromargin (Figs. 3–5 in Xiao & Yin, 1991b)……...*G. fungiformis*

- Copulatory ducts wide, chelicerae with a fissidentate tooth of four cusps at retromargin (Figs. 280, 282 in Żabka, 1985)……...*G. typica*

DISCUSSION

The distribution range of the species *G. pinguis* is expanded southward from Yunnan (southern China) to the Central Highlands of Vietnam, approximately 1.200 km away from its type locality. This expansion is not too surprising, considering that several species of the Salticidae as well as other families appeared between these regions. For instance, the jumping spider species *Phintella sancha* Cao & Li, 2016; two species *Leucauge celebesiana* (Walckenaer, 1841) and *Tetragnatha geniculata* Karsch, 1892 in the family Tetragnathidae Menge, 1866 and the species *Argiope jinghongensis* Yin, Peng & Wang, 1994 in the family Araneidae Clerck, 1757 were also reported from both Yunnan and Central Highlands of Vietnam (Hoang et al., 2023; Logunov & Jäger, 2015; Zhang, 2018; Zhu et al., 2003; Yin et al., 1994). In the genus *Gedea*, *G. tibialis* has been also known from only two localities, Ha Noi (Vietnam) and Bukit Timah (Singapore) which is about 2.900 km in distance.

The genetic distance between *G. pinguis* from Vietnam and *G.* cf. *tibialis* Żabka, 1985 (GenBank accession number: KM033223) from Malaysia was calculated at 13.74% using the K2P model based on the COI gene. The result indicates a high interspecies genetic distance between them. However, further study on the genus *Gedea* is still needed to confirm whether or not synonymy of *G. tibialis* and *G. typica*, as well as to elucidate the relationships among the genera

of the tribe Hasariini Simon, 1903 (Maddison et al., 2014).

CONCLUSION

Although the original description of *G. pinguis* is incomplete, we found no differences in the structure of the male palp between specimens from China and Vietnam. Thus, we consider them as conspecific in the present study.

Acknowledgements: The authors express gratitude to Mr. Pham Tuan Linh and Mr. Le Van Thua (Yok Don National Park) for their assistance in the field. This study was supported by a grant from the Ministry of Education and Training, Vietnam to Hoang Quang Duy (code: B2024-TTN-05). Finally, we thank the editor, two anonymous reviewers for their critical suggestions and for editing the manuscript.

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