

# A Review of the Beetle Genus *Corticarina* of Taiwan, with Description of a New Species (Coleoptera, Latridiidae)

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The genus *Corticarina* in Taiwan was previously known to contain three species, *C. bhutanensis* Johnson, *C. clareae* Johnson, and *C. minuta* (Fabricius). *Corticarina bhutanensis* Johnson and *C. clareae* Johnson are known from the Palearctic, and *C. minuta* (Fabricius) is a cosmopolitan species. In this study, the genus *Corticarina* in Taiwan is reviewed for the first time, with three species being recognized, including two recorded species, *C. bhutanensis* Johnson and *C. clareae* Johnson, and a species new to science, *C. tenuis* sp. nov. The species *Corticarina minuta* (Fabricius) that had been recorded previously was not collected from Taiwan in this study. The description, habitus, and male genitalia of three species are provided, and the distributions and genetic distances of three species in Taiwan are discussed.

**Key words:** Latridiidae, Corticariinae, *Corticarina*, New species, Taxonomy, Taiwan

## BACKGROUND

The genus *Corticarina* is a species-rich and well-studied genus within the Latridiidae, comprising more than 130 species worldwide (Rücker, 2020). This genus is characterized by the following characters: 1) antenna with eleven segments, with apical three segments clubbed; 2) lateral margin of pronotum smooth, without large teeth; 3) pronotal disc with a fovea close to basal margin; and 3) 1st tarsomere of hind leg apically expanded, usually reaching apex of 2nd tarsomere.

Several studies have recorded the *Corticarina* of Taiwan. The first record is from Grouvelle (1913), in which the author recorded *Melanophthalma fuscula* (Gyllenhal) based on two specimens from Hoozan (currently Fengshan, Kaohsiung) and later this species was treated as the synonym of *Corticarina minuta* (Fabricius) (Johnson 2007), a species with worldwide distribution. The next record came from Johnson (2007) who recorded two species, *C. bhutanensis* Johnson and *C. clareae* Johnson in Taiwan without specific locality

records. These two species are distributed in the northern part of India, Bhutan, Nepal, and China (Johnson 2007).

In this study, three *Corticarina* species, except for *C. minuta* (Fabricius), have been recognized, including one new species. The description and redescriptions of three species, including photographs of the habitus and male genitalia, are provided. The *COI* and 28S sequences of three species have been added to provide more evidence for our species delimitation.

## MATERIALS AND METHODS

### Morphological observations

To observe the male genitalia of the specimens, the abdomen was removed, soaked in a high-concentration KOH solution for at least 10 minutes (depending on the specimen condition), and was then rinsed in distilled water several times. The abdominal ventrites, tergites, and aedeagus of male specimens were removed

for further examination under a stereomicroscope. Photographs of adults were taken with a Canon EOS 650D camera equipped with a Canon MP-E65 f/2.8 1-5x macro lens, and photographs of 8th to 10th abdominal segments were taken with a Canon EOS 650D camera attached to a Zeiss Axioskop 2 microscope. All photographs were subsequently focus stacked with Helicon Focus software.

A total of 86 specimens examined during the course of this study are deposited in the following institutions: National Museum of Natural Science, Taichung, Taiwan (NMNS); Ehime University Museum, Matsuyama, Japan (EUMJ); Manchester Museum, Manchester University, UK (MMUE); Private collection of Yu-Hsiang Ho, Taichung, Taiwan (PCHO).

The terminology used herein is mainly modified from Ho et al. (2019), R cker (2018 2020), and Hammond and Chambers (2020). Abbreviations used for the measurements are mainly modified from Hammond and Chambers (2020) and described as follows: Total length (TL): From anterior margin of head to apex of elytra. Head length (HL): From frontoclypeal suture to base of head. Head width (HW): Dorsal greatest width of head across eyes. Interocular space (IO): Shortest distance between inner margins of eyes. Eye length (EyL): Greatest length of eye from dorsal view, parallel to HW. Eye width (EyW): Greatest width of eye from dorsal view, parallel to HL. Pronotal length (PL): Greatest length of pronotum along midline. Pronotal width (PW): Greatest pronotal width, vertical to PL. Elytral length (EL): Midline length of elytra from base of scutellar shield to apex of elytra. Elytral width (EW): Greatest width of elytra, vertical to EL, usually near middle.

## Molecular analysis

Fresh specimens were collected during 2020–2021 and preserved in 95% EtOH. The complete genomic DNA was extracted using a QuickExtract DNA extraction kit (Epicentre Biotechnologies, Madison, WI). The abdomen of the fresh specimen was removed, and the remaining body was soaked in a 25- L extraction buffer and processed according to the manufacturer’s protocol. After the process of DNA extraction was complete, the remaining body was removed from the solution, rinsed with distilled water, and kept as the primary voucher specimen. Portions of two genes, Cytochrome *c* oxidase I (*COI*) and 28S ribosomal DNA, were amplified and sequenced. The primers used to amplify both genes are listed in table S1 (Folmer et al. 1994; Lin et al. 2003). A PCR assay based on *COI* sequences was performed in a 20- L volume under the following conditions: initial denaturation at 94 C for

2 min, followed by 35 cycles of denaturation at 94 C for 40 s, annealing at 45 C for 1 min, and extension at 72 C for 1 min. The final extension was at 72 C for 10 min. PCR assay for 28S sequences was performed in a 20- L volume under the following conditions: initial denaturation at 94 C for 2 min, followed by 35 cycles of denaturation at 94 C for 40 s, annealing at 45 C for 40 s, and extension at 72 C for 40 s. The final extension was at 72 C for 10 min.

The alignments of *COI* and 28S sequences were performed using the ClustalW multiple alignment program and then edited in Bioedit 7.2 (Hall 1999). *Corticicara bhutanica* Johnson, *Melanophthalma* (s. str.) *angulicollis* Motschulsky, and *Cartodere* (s. str.) *constricta* (Gyllenhal) were selected as outgroups. The GenBank accession numbers of *COI* and 28S sequences used in this study are listed in table S2. The alignment of each sequence was concatenated by Sequence Matrix 1.8 (Vaidya et al. 2011). The results of alignment datasets were analyzed by using maximum likelihood analysis (ML) and Bayesian inference analysis (BI). The best fit model of both analyses was selected by PartitionFinder v2.1.1 (Lanfear et al. 2012). In ML analysis, the models of evolution were set to ‘all’ (models = all), and the scheme was set to ‘greedy’ (search = greedy) under the corrected Akaike Information Criterion (AICc) (model selection = aicc). In BI analysis, the models of evolution were set to ‘MrBayes’ (models = mrbayes), and the scheme was selected as mentioned in ML analysis. The ML analysis was performed in IQ-TREE v1.6.12 (Nguyen et al. 2015), with 1,000 replicates of ultrafast bootstrapping and SH-aLRT test. The BI analysis was performed in MrBayes v3.2.7 (Ronquist et al. 2012). Markov chain Monte Carlo (MCMC) was run with three heated chains and one cold chain for 11,000,000 generations, sampling every 1,000 generations. Analysis was settled when the standard deviation of split frequencies was below 0.01. The first 25% of trees were removed as burn-in to obtain the consensus tree. The phylogenetic trees of both analyses were visualized in iTOL (Letunic and Bork 2021); if the same morphospecies formed a monophyletic group, then they were collapsed into one clade for better readability. In BI analysis, branches with posterior probability greater than 0.90 were considered well-supported, and in ML analysis, ultrafast bootstrap values greater than 0.95 and SH-aLRT values greater than 0.80 were considered well-supported. The intra- and interspecific genetic distances of each morphospecies were calculated with a *p*-distance algorithm in MEGA 11 (Kumar et al. 2021).

**RESULTS**

**TAXONOMY**

**Family Latridiidae Erichson, 1842  
Subfamily Corticariinae Curtis, 1829**

**Genus *Corticarina* Reitter, 1881**

*Corticarina* Reitter, 1881: 70. Type species: *Corticaria truncatella* Mannerheim, 1844.

*Oropsime* Gozis, 1881: 161. Type species: *Melanophthalma carinulata* Motschulsky, 1867, synonymized by Fauvel, 1885: 179.

**Key to species of *Corticarina* in Taiwan**

- 1. Elytra elongate, lateral margins subparallel .....  
..... *Corticarina tenuis* sp. nov.
- Elytra oval ..... 2
- 2. Pronotum distinctly transverse; median lobe with apical end strongly expanded ..... *Corticarina minuta* (Fabricius)
- Pronotum less transverse; median lobe with apical end sharp ... 3
- 3. Pronotum narrower (PW/EW  $\leq$  0.67); median lobe with apical end narrower in lateral view ..... *Corticarina clareae* Johnson
- Pronotum wider (PW/EW  $\geq$  0.69); median lobe with apical end wider in lateral view ..... *Corticarina bhutanensis* Johnson

***Corticarina bhutanensis* Johnson, 1977  
(Figs. 1A, 2A–B)**

*Corticarina bhutanensis* Johnson, 1977: 333; Johnson, 2007: 645 (catalogue); R cker, 2020: 24 (catalogue).

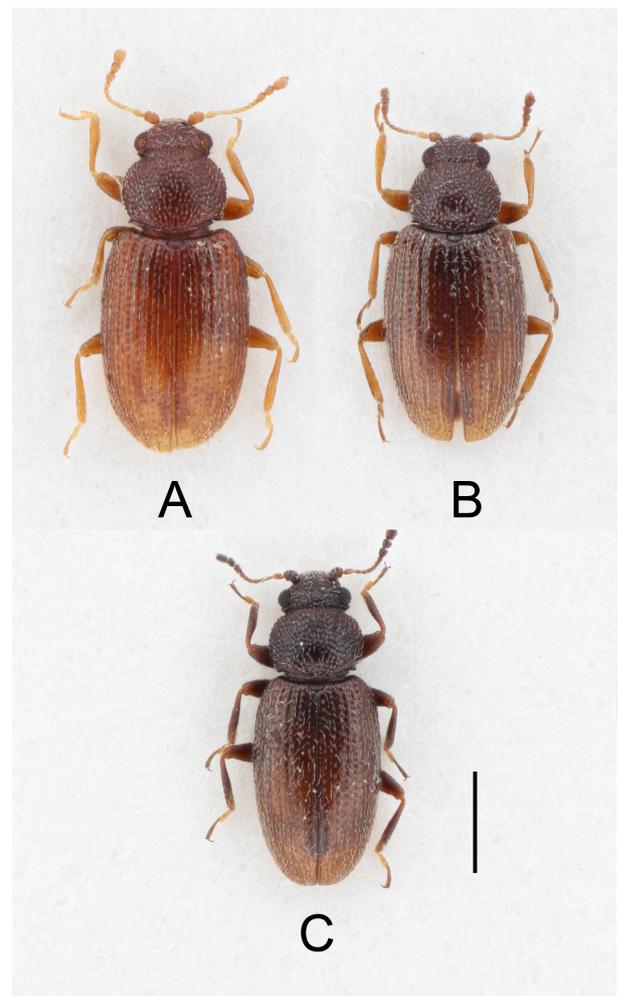
**Material examined:** TAIWAN. 1 ♀. Taichung City, Heping, Dasyueshan. 19.IX.2020. Beating. Y. H. Ho & C. T. Hsu leg. (PCHO). 1 ♀. Nantou County, Ren'ai, Guandaoshan. 4.VII.2021. Sweeping. Y. H. Ho & C. T. Hsu leg. (PCHO). 1 ♀. Nantou County, Ren'ai, Meifeng. 15.VI.2021. Y. H. Ho leg. (PCHO). 1 ♂. Same collection data as for preceding. 31.VIII.2021. (PCHO). 5 ♂. Nantou County, Yuanfeng. 25.VII-22.VIII.2006. Malaise trap. C. S. Lin & W. T. Yang leg. (NMNS) (NMNS ENT 7423-3102, 7423-3100, 7423-1879, 7423-3112, 7423-3095). 1 ♂. Same collection data as for preceding. 2.VIII-8.IX.2005. (NMNS) (NMNS ENT 7392-1153). 1 ♂. Same collection data as for preceding. 8.XII.2005-3.I.2006. (NMNS) (NMNS ENT 7493-18). 1 ♂. Nantou County, Ren'ai, Yuanfeng. 24.12.14, 121.2435. 8.III-6.V.2021. Malaise trap. Y. H. Ho & W. T. Yang leg. (NMNS). 3 ♂. Same collection data as for preceding. 6.V-15.VII.2021. (NMNS). 1 ♂. Same collection data as for preceding. 15.VII-15.X.2021. (NMNS). 2 ♂. Chiayi County, Fenchihu. 1400 m. 10.V.1977. J. Klapperich leg. (MMUE). 1 ♂. Chiayi County, Alishan, Shishan race. 8.VIII.2020. Beating. Y. H. Ho & P. Y. Shih leg. (NMNS). 4 ♂ 1 ♀. Same collection data as for preceding. 24.VIII.2021. Y. H.

Ho & Y. N. Chiu leg. (NMNS). CHINA. 2 ♂ 1 ♀. Prov. Fukien, Kuatun, Tschungsen. 2.IV.1946. J. Klapperich leg. (MMUE). INDIA. 1 ♂. Darjeeling Distr., Lopchu. 1500m. 3.V.1976. W. Wittmer leg. (MMUE). 1 ♀. Meghalaya, Shilong Peak. 26.XI.1974. T. SenGupta leg. (MMUE).

**Type specimen examined:** Paratype. BHUTAN. 1 ♀. Chimakothi. 22.V.1972. (MMUE).

**Diagnosis:** In Taiwan, this species may be misidentified as *C. clareae* Johnson, and can be distinguished by the width of pronotum. In *C. bhutanensis*, the pronotum is wider (PW/EW  $\geq$  0.69) than in *C. clareae* (PW/EW  $\leq$  0.67). The most reliable character to separate both species is the shape of the median lobe. In *C. bhutanensis*, the apical end of the median lobe is wider than in *C. clareae*.

**Redescription:** Body length, 1.53–1.82 mm. Measurements are given in table 1. General body colour



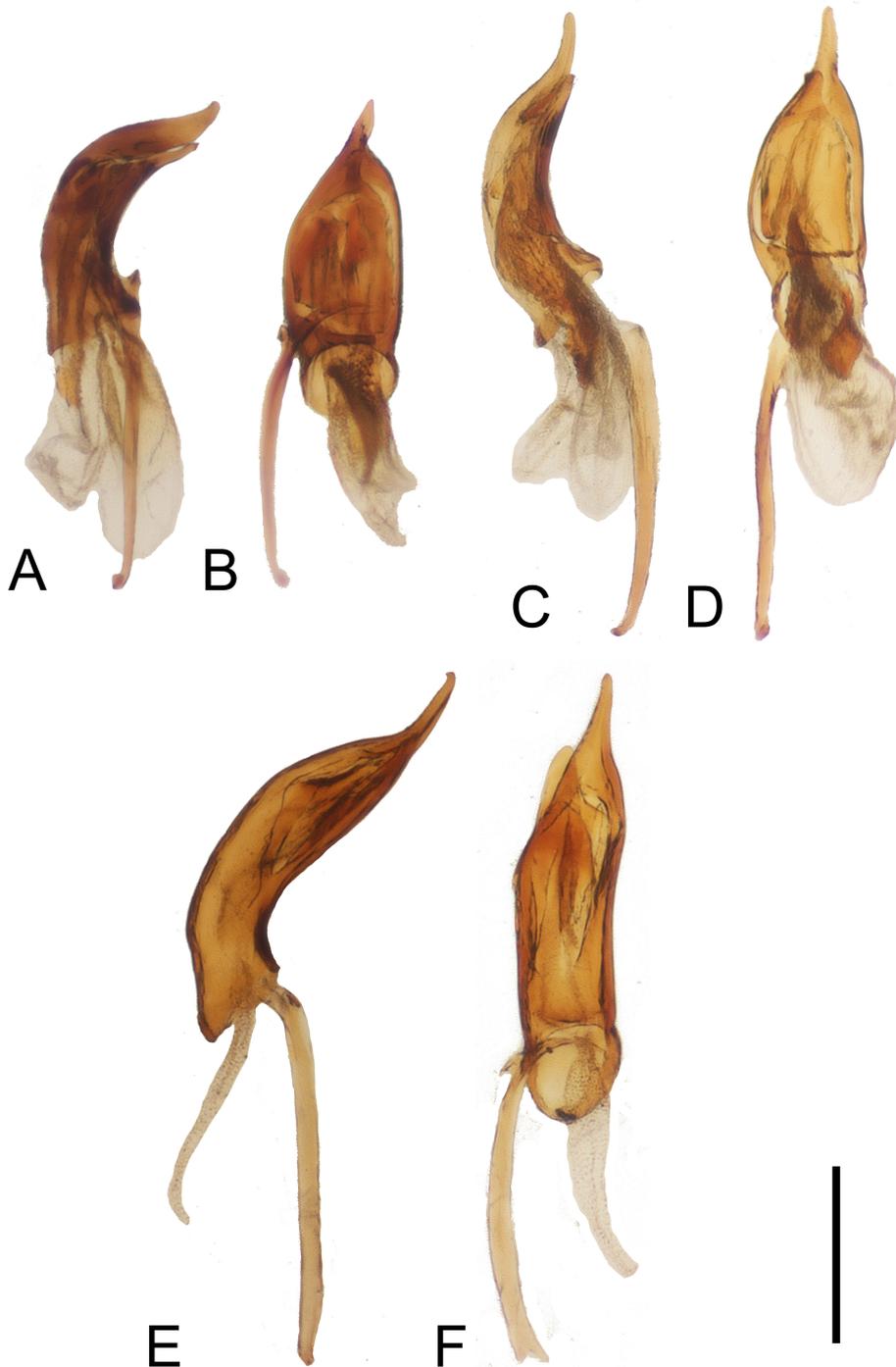
**Fig. 1.** Habitus of *Corticarina* species of Taiwan. A, *C. bhutanensis* Johnson, 1977. B, *C. clareae* Johnson, 1972. C, *C. tenuis* sp. nov. Scale bar = 0.1 mm.

is light to dark brown, with appendages light brown.

Head wider than long (HL/HW = 0.59–0.68). Eyes large and protuberant, with more than twenty facets. Interocular space large (IO/HW = 0.63–0.70). Temple weakly developed. Frons sparsely covered with long hairs and punctures, separated by one to two times the puncture diameter. Clypeus short, about half as long as

labrum, surface sparsely covered with long hairs and densely and transversely reticulated microsculpture. Labrum covered with long hairs on surface. Antennae eleven-segmented and covered with short hairs, with apical three segments strongly clubbed, length reaching hind angle of pronotum.

Pronotum broadly cordate, wider than long, widest



**Fig. 2.** Aedeagus of *Corticarina* species of Taiwan. A–B, *C. bhutanensis* Johnson, 1977. C–D, *C. clareae* Johnson, 1972. E–F, *C. tenuis* sp. nov. A, C, E: lateral view. B, D, F: ventral view. Scale bar = 0.2 mm.

at middle, narrowest at anterior end, surface densely covered with long hairs and punctures, separated by half to one times the puncture diameter. Posterior one third with a round depression. Anterior margin straight, narrower than head. Lateral margins smooth, broadly curved outwardly, lacking denticles denticles, and each hind angle has a small projection. Posterior margin feebly curved outwardly, narrower than elytra.

Elytra elongate oval (EL/EW = 1.35–1.45), lateral margins subparallel, broadest at anterior one third, apex round, slightly convex in lateral view. Shoulders round, not protruding at anterior margin. Each stria with row of punctures, interstria with very small punctures. Each punctures with hairs, without significant difference in length; without any strong carinae on interstria. Scutellum broadly pentagonal.

Prosternum wider than long, surface sparsely covered with short hairs and densely and transversely reticulated microsculpture, pair of transverse punctures present on anterior margin. Procoxae contiguous, large and protuberant. Prosternal process short, situated at base of prosternum. Mesoventrite short, surface sparsely covered with short hairs and densely and transversely reticulated microsculpture. Metaventrite moderately wide, surface covered with moderately long hairs, posterior margin with an adjacent row of punctures, separated at middle.

Abdomen with six ventrites, each surface covered with long hairs and densely and transversely reticulated microsculpture. 1st ventrite two times longer than rest of ventrites. Apical margin of 6th ventrite curved outwardly.

Legs subequal in length. Femur densely covered with short hairs. Tibia covered with moderately long hairs, and becoming longer at apical end. Tarsus one and half times shorter than tibia. Tarsomere 3-3-3, 3rd tarsomere long, longer than 1st and 2nd combined, 1st tarsomere strongly expanded, reaching apex of 2nd tarsomere; arolium indistinct. Foretibia slender, straight,

male with a distinct tooth on anterior one third; mid and hindtibia without any tooth. Female without any tooth on legs.

Median lobe short, strongly sclerotized, lateral margins subparallel in ventral view, constricted at anterior one sixth, curved outwardly at middle in lateral view; apical end sharp. Ejaculatory duct and median strut absent. Tegmen long, as long as median lobe.

*Distribution:* This species can be found in Bhutan, India, China, and Taiwan (Johnson 2007). In Taiwan, this species is widely distributed in mid- to high-altitude areas (Fig. 3).

*Biology:* This species can be found on the withered part of leaves in different species of plants, mainly Poaceae Barnhart. This species is sympatric with *Corticarina clareae* Johnson in Taichung City, Nantou County, and Chiayi County, and sympatric with *C. tenuis* sp. nov. in Nantou County.

### ***Corticarina clareae* Johnson, 1972**

(Figs. 1B, 2C–D)

*Corticarina clareae* Johnson, 1972: 102; Johnson, 2007: 646 (catalogue), Rucker, 2020: 24 (catalogue).

*Material examined:* TAIWAN. 2 ♂. Taichung City, Heping, Xueshan. 14.X.2009. Sweeping. W. B. Yeh leg. (NMNS). 2 ♂. Same collection data as for preceding. 15.X.2009. (NMNS). 2 ♂. Same collection data as for preceding. 8.X.2010. (NMNS). 1 ♂. Same collection data as for preceding. 8.X.2011. (NMNS). 3 ♂. Taichung City, Heping, Qika. 17.IV.2021. Sweeping. C. T. Hsu, W. B. Yeh, S. Huang & Y. H. Ho leg. (NMNS). 3 ♂. Nantou County, Yuanfeng. 7.III-13.IV.2006. Malaise trap. C. S. Lin & W. T. Yang leg. (NMNS) (NMNS ENT 7421-70, 7421-65, 7421-100). 1 ♂. Same collection data as for preceding. 11.I-15.II.2005. (NMNS) (NMNS ENT 7387-54). 1 ♂. Same collection data as preceding. 6.VI-25.VII.2006. (NMNS) (NMNS ENT 7423-1912). 1 ♂. Same collection data as preceding. 11.V-

**Table 1.** Measurements data for *Corticarina*

	<i>C. bhutanensis</i> (n = 20)	<i>C. clareae</i> (n = 18)	<i>C. tenuis</i> (n = 20)
HL	0.256–0.303 mm	0.220–0.267 mm	0.263–0.316 mm
HW	0.363–0.430 mm	0.314–0.359 mm	0.372–0.414 mm
EyL	0.120–0.140 mm	0.109–0.130 mm	0.112–0.140 mm
EyW	0.055–0.075 mm	0.050–0.068 mm	0.049–0.073 mm
IO	0.243–0.301 mm	0.197–0.227 mm	0.249–0.283 mm
PL	0.353–0.410 mm	0.316–0.382 mm	0.377–0.425 mm
PW	0.468–0.550 mm	0.417–0.495 mm	0.471–0.543 mm
EL	0.885–1.092 mm	0.891–1.016 mm	0.977–1.114 mm
EW	0.654–0.778 mm	0.638–0.748 mm	0.636–0.704 mm

13.VII.2004. (NMNS) (NMNS ENT 6660-543). 5 ♂. Nantou County, Ren'ai, Yuanfeng. 24.I.214, 121.2435. 15.VII-15.X.2021. Y. H. Ho & W. T. Yang leg. (NMNS). 1 ♂. Same collection data as preceding. 8.III-6.V.2021. (NMNS). 1 ♂. Same collection data as preceding. 6.V-15.VII.2021. Y. H. Ho & W. T. Yang leg. (NMNS). 1 ♂. Nantou County, Tsuifeng, 2306 m, 3.VIII.1979. K. Ushijima leg. (EUMJ). 1 ♂. Chiayi County, Fenchihu. 1400 m. 10.V.1977. J. Klapperich leg. (MMUE). 1 ♀. Tainan City, Nanxi, Meiling. 22.III-27.VIII.2021. 23.1966, 120.5739. Malaise trap. M. L. Jeng, W. T. Yang & Y. H. Ho leg. (NMNS). 1 ♂ 2 ♀. Kaohsiung City, Nishyudan, nr. Liukuei. 7.IV.1976. K. Ushijima leg. (EUMJ). INDIA. 1 ♂. Assam, Upper Shillong. 26.IV.1976. T. Sen Gupta leg. (MMUE). NEPAL. 1 ♂. KOSI, Crête S. Mangsingma. 2800 m. 7.IV.1984. L. Smetana leg. (MMUE).

*Type specimens examined:* Paratypes. INDIA. 2 ♂. Kuman, W. Almora. H. G. Champion leg. (F3572.189, F3572.191) (MMUE). 1 ♂ 1 ♀. Utta Pradesh, Kuman, Nainital. H. G. Champion leg. (♂: 3572.197, ♀: F3572.190) (MMUE).

*Diagnosis:* In general, this species is closely related to *C. fraudulentus* Johnson in external morphology, and can only be separated by the aedeagus, the median lobe of which is and can only be separated by the aedeagus, the median lobe of which is shorter (about twice as long as wide) in *C. fraudulentus* and longer (about three times as long as wide) in *C. clareae*. In Taiwan, this species may be misidentified with *C. bhutanensis*, and can be separated by the width ratio between the pronotum and elytra, and the shape of median lobe, which are described in the key and the diagnosis of *C. bhutanensis*.

*Redescription:* Length 1.44–1.65 mm. Measurement data are given in table 1. General body colour light to dark brown, with appendages light brown.

Head wider than long (HL/HW = 0.62–0.70). Eyes large and protuberant, with more than twenty facets. Interocular space large (IO/HW = 0.60–0.66). Temple weakly developed, barely visible. Frons sparsely covered with long hairs and punctures, separated by one to two times of puncture diameter, densely covered with densely and transversely reticulated microsculpture. Clypeus short, about half as long as labrum; surface of clypeus and labrum sparsely covered with long hairs. Antennae eleven-segmented and covered with short hairs, with apical three segments strongly clubbed.

Pronotum broadly cordate, wider than long, widest at middle, narrowest at anterior end, surface sparsely covered with long hairs and punctures, separated by one to one and half times of puncture diameter; posterior one third with a shallow round depression. Anterior margin

straight, narrower than head. Lateral margins smooth, broadly curved outwardly, without any denticles, hind angle each with a small projection. Posterior margin feebly curved outwardly, narrower than elytra.

Elytra elongate oval (EL/EW = 1.33–1.45), lateral margins subparallel, broadest at anterior one third, apex round, slightly convex in lateral view. Shoulders round, not protruding at anterior margin. Each stria with row of punctures, interstria with smaller punctures; each puncture with hairs, without significant difference in length; interstria without any strong carinae. Scutellum broadly pentagonal.

Prosternum wider than long, surface sparsely covered with short hairs and densely and transversely reticulated microsculpture, a pair of transverse depressions present on anterior margin. Procoxae contiguous, large and protuberant. Prosternal process short, situated at base of prosternum. Mesoventrite short, surface sparsely covered with short hairs and densely and transversely reticulated microsculpture. Metaventrite moderately wide, surface covered with moderately long hairs, posterior margin with an adjacent row of punctures, separated at middle.

Abdomen with six ventrites, each surface covered with long hairs and densely and transversely reticulated microsculpture. 1st ventrite two times longer than rest of ventrites. Apical margin of 6th ventrite curved outwardly.

Legs subequal in length. Femur densely covered with short hairs. Tibia covered with moderately long hairs, and becoming longer at apical end. Tarsus short, half of tibia length. Tarsomere 3-3-3, 3rd tarsomere long, longer than 1st and 2nd combined; 1st tarsomere strongly expanded, reaching apex of 2nd tarsomere; arolium indistinct. Foretibia slender, straight, male with a distinct tooth on anterior one third; mid- and hindtibia without any tooth. Female without any tooth on legs.

Aedeagus with median lobe long, strongly sclerotized, lateral margins subparallel in ventral view, constricted at anterior one fourth, apical end sharp; curved outwardly at middle in lateral view, curved inwardly at anterior one fourth. Ejaculatory duct and median strut absent. Tegmen long, as long as median lobe.

*Distribution:* This species can be found in Bhutan, India, Nepal, and Taiwan (Johnson 2007). They are mainly distributed in mid- to high-altitude environment in Taiwan. (Fig. 3).

*Biology:* This species can be found on the withered part of leaves in different species of plants, mainly Poaceae Barnhart. This species is sympatric with *Corticarina bhutanensis* Johnson in Taichung City, Nantou County, and Chiayi County, and sympatric with *C. tenuis* sp. nov. in Nantou County.

***Corticarina minuta* (Fabricius, 1792)**

*Dermestes minuta* Fabricius, 1792: 235.

*Latridius fuscus* Gyllenhal, 1827: 133, synonymized by Johnson, 2007: 78.

*Corticaria brevicollis* Mannerheim, 1844: 52, confirmed by Johnson, 2007: 646.

*Corticaria trifoveolata* Redtenbacher, 1849: 211, confirmed by Johnson, 2007: 646.

*Corticaria compta* LeConte, 1855: 301, synonymized by Fall, 1899: 181.

*Corticaria melanocara* Gistel, 1857: 585, synonymized by Johnson, 2007: 78.

*Corticaria ovalipennis* Reitter, 1875: 441, synonymized by Johnson, 2007: 79.

*Melanophthalma fuscula* (Gyllenhal, 1827): Grouvelle, 1913: 75 (Taiwan).

*Corticarina minuta* (Fabricius, 1792): Johnson, 2007: 646 (catalogue); Rucker, 2018: 321 (description); Rucker, 2020: 26 (catalogue).

**Distribution:** Cosmopolitan species (Johnson 2007; Rucker 2020).

**Remark:** No specimens of the species are available for this study.

***Corticarina tenuis* Ho, Li & Chan, sp. nov.**

(Figs. 1C, 2E–F)

urn:lsid:zoobank.org:act:AFB0ED4A-18A2-4036-AAB4-34C32DD4E9F8

**Material examined:** Holotype. ♂. TAIWAN, Nantou County, Ren'ai, Meifeng. 24.0965, 121.1793. 31.VIII.2021. Beating. Y. H. Ho & C. T. Hsu leg. (NMNS). Paratypes. 6 ♂ 4 ♀. Same collection data as holotype. (NMNS). 5 ♂ 2 ♀. Same collection data as preceding. 15.X.2021. (NMNS). 1 ♂. New Taipei City, Wulai, Happen. 9.XII.1985. Sweeping net. C. C. Chiang leg. (NMNS) (NMNS ENT 2493-8). 1 ex., sex undetermined. Nantou County, Shanlinchi. 10.V.1990. Sweeping net. C. C. Chiang leg. (NMNS) (NMNS ENT 630-7). 1 ♀. Kaohsiung City, Tenchih. 24.IV.1990. Sweeping net. C. C. Chiang leg. (NMNS) (NMNS ENT 601-2).

**Diagnosis:** This species is closely related to *C. bhutanensis* Johnson in external morphology, and can be distinguished by the following characters: 1) Elytra more elongate ( $EL/EW \geq 1.5$ ) than in *C. tenuis*, while more oval in *C. bhutanensis* ( $EL/EW \leq 1.46$ ); 2) median lobe more elongate (four times longer than wide, while in *C. bhutanensis* the median lobe is three times longer than wide). This species can be distinguished from *C. clareae* by following characters: 1) elytra more elongate ( $EL/EW \geq 1.5$ ) than in *C. tenuis*, while more oval in *C. clareae* ( $EL/EW \leq 1.45$ ); 2) median lobe more elongate (four times longer than wide, while in *C. clareae* the median lobe is three times longer than wide).

**Description:** Length 1.62–1.83 mm. Measurements

are given in table 1. General body dark brown, with appendages light brown.

Head wider than long ( $HL/HW = 0.59–0.67$ ). Eyes large and protuberant, with more than twenty facets. Interocular space large ( $IO/HW = 0.63–0.70$ ). Temple weakly developed, barely visible. Frons sparsely covered with long hairs and punctures, separated by one to two times of puncture diameter, covered with densely and transversely reticulated microsculpture. Clypeus short, about half as long as labrum; surface of clypeus and labrum sparsely covered with long hairs. Antennae eleven-segmented and covered with short hairs, with apical three segments strongly clubbed.

Pronotum broadly cordate, wider than long, widest at middle, narrowest at anterior end, surface densely covered with long hairs and punctures, separated by half to one time of puncture diameter; posterior one third with a shallow round depression. Anterior margin straight, narrower than head. Lateral margins smooth, broadly curved outwardly, without any denticles, hind angle each with a small projection. Posterior margin straight to feebly curved outwardly, narrower than elytra.

Elytra cylindrical ( $EL/EW = 1.50–1.65$ ), lateral margins subparallel, broadest at anterior one third, apex round, slightly convex in lateral view. Shoulders round, not protruding at anterior margin. Each stria with a row of punctures, interstria with smaller punctures; each puncture with hairs, subequal in length; interstria without strong carinae. Scutellum broadly pentagonal.

Prosternum wider than long, surface sparsely covered with short hairs, a pair of transverse depressions present on the anterior margin. Procoxae contiguous, large and protuberant. Prosternal process short, situated at base of prosternum. Mesoventrite short, surface sparsely covered with short hairs and densely and transversely reticulated microsculpture. Metaventrite moderately wide, surface covered with moderately long hairs and sparsely covered with punctures, separated by one to one and half times of puncture diameter; posterior margin having an adjacent row of punctures, separated at middle.

Abdomen with six ventrites, each surface covered with long hairs and densely and transversely reticulated microsculpture, 1st ventrite three times longer than rest of ventrites. Apical margin of 6th ventrite curved outwardly.

Legs subequal in length. Femur densely covered with short hairs. Tibia covered with moderately long hairs, becoming longer towards apex. Tarsus long, two thirds of tibia length. Tarsomeres 3-3-3, 3rd tarsomere long, longer than 1st and 2nd combined, 1st tarsomere strongly expanded, reaching apex of 2nd tarsomere; arolium indistinct. Foretibia slender, straight, male with

a distinct tooth at middle; mid- and hindtibia without any teeth. Female without any tooth on legs.

Aedeagus with median lobe long, strongly sclerotized, lateral margins parallel in ventral view, slightly constricted at anterior one fifth; curved outwardly at posterior one fifth in lateral view, straight at anterior one fifth. Ejaculatory duct and median strut absent. Tegmen long, as long as median lobe.

**Distribution:** This species is endemic to Taiwan and is mainly distributed in mid- to high-altitude areas (Fig. 3).

**Biology:** This species can be collected in large numbers by beating dead leaves of Poaceae in the type locality.

### Molecular analysis

The alignment of *COI* sequences resulted in a 658-bp dataset, and the alignment of 28S sequences

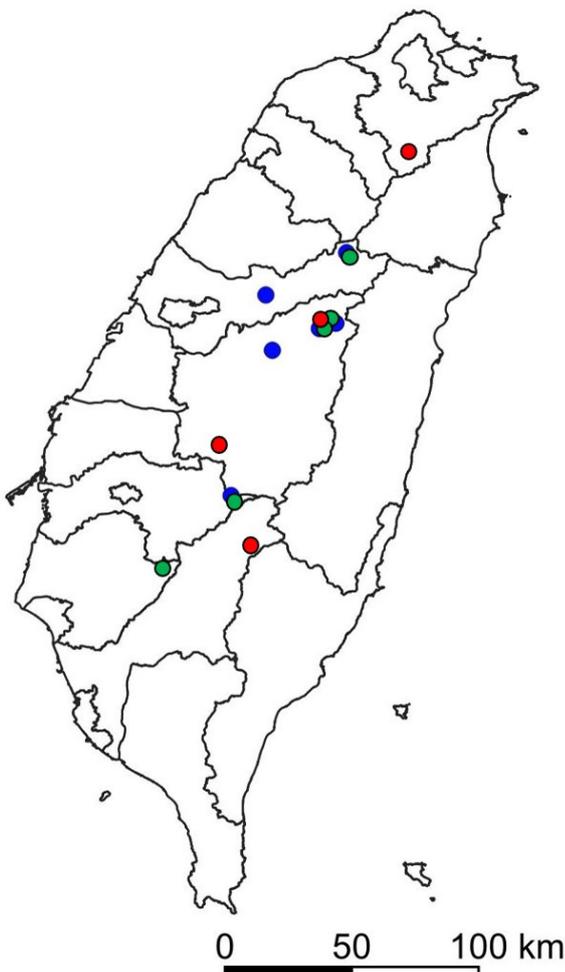
resulted in a 916-bp dataset. We successfully acquired the *COI* and 28S sequences for the three species in this study, with fourteen specimens for *Corticarina bhutanensis*, eight specimens for *C. clareae*, and three specimens for *C. tenuis* sp. nov. *Corticarina minuta* was not included in this analysis due to absence of specimens. The analysis results are shown in figure 4, with the ultrafast bootstrap values, the SH-aLRT values, and the posterior probability given for each node. The analysis results of ML analysis and BI analysis show strong support for the clade of each species, with ultrafast bootstrap values greater than 90 and posterior probability greater than 0.90, strongly supporting our taxonomic results.

The analysis results of *COI* genetic distances for *Corticarina* are provided, and the values are shown in table 2. The intra- and interspecific genetic distances show significant divergence, with intraspecific genetic distances ranging from 0.41% to 0.73%, and interspecific genetic distances ranging from 9.30% to 11.39%.

### DISCUSSION

In Taiwan, three species of the genus *Corticarina* were recorded previously, and this study confirmed two of those species. Additionally, a new species was described. The only species not found in this study is *C. minuta*, a cosmopolitan species commonly found in stored products (Bousquet 1990; Majka et al. 2009). The absence of records for this species in Taiwan might be attributed to the limited study of stored product pests in the region or simply the misidentification of *Melanophthalma fuscula* (Gyllenhal) (= *C. minuta*) in the previous study. Further investigations on stored product pests in Taiwan are necessary to confirm this assumption. Notably, during our field study, no *Corticarina* species were captured using light traps, which deviates from the typical pattern observed in the Corticariinae fauna of Taiwan, where other genera of Corticariinae were frequently collected using light traps. Instead of relying on light traps, we found that beating the leaves of Poaceae, particularly the withered and yellow sections, was an effective method for collecting *Corticarina* species.

*Corticarina bhutanensis* and *C. clareae* have a wide distribution across mainland Asia, spanning from Northern India to China. Their continuous presence from Northern India, through the east Himalayas, and all the way to Taiwan suggests that both species likely dispersed from the mainland to Taiwan, possibly during the glacial period. In Taiwan, *C. bhutanensis* and *C. clareae* are predominantly found in mid to high-altitude

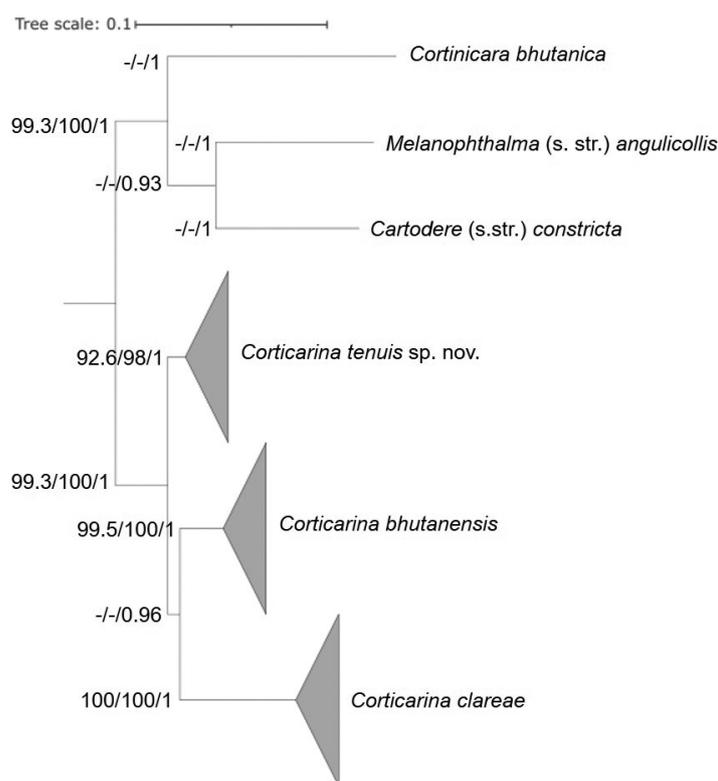


**Fig. 3.** Distribution map of *Corticarina* in Taiwan. Red circles: *Corticarina tenuis* sp. nov. Blue circles: *C. bhutanensis*. Green circles: *C. clareae*.

areas, ranging from 700 to 3400 meters, and appear to be widely distributed throughout the entire island. Interestingly, Taiwan is the sole location, apart from mainland Asia, where *C. clareae* and *C. bhutanensis* have been recorded. However, it is important to note that these records may be a result of limited investigations into the Latridiidae fauna in nearby areas. To gain a better understanding of the biogeography and potential dispersal history of both species, it is necessary to obtain molecular data from mainland Asia.

*Corticarina bhutanensis* and *C. clareae* are closely related in both ML and BI analysis when

compared to *C. tenuis* sp. nov. This result may relate to the morphology of the three species, e.g., the elytra are slenderer in *C. tenuis* sp. nov., and broader in the other two species. This study is also the first to provide the intraspecific and interspecific genetic distances of the latridiid species. Genetic distance has been widely used in Coleoptera for species delimitation, including Dytiscidae, Hydrophilidae, Scarabaeidae, Chrysomelidae, and Coccinellidae, etc. In previous studies, the intraspecific genetic distance of Coleoptera ranged from 0–3.10%, and the interspecific genetic distance ranged from 1.90–29.10% (Miller et al. 2005;



**Fig. 4.** Bayesian inference phylogenetic tree of *Corticarina* in Taiwan. Numbers next to the nodes indicate the SH-aLRT value (left) and ultrafast bootstrap value (middle) from the ML analysis, and posterior probability (right) of BI analysis. SH-aLRT values less than 0.80, ultrafast bootstrap values less than 0.90, and posterior probability less than 0.90 are indicated as hyphens.

**Table 2.** *COI* intra- and interspecific genetic distances in this study. The numbers in the grey background indicate intraspecific genetic distance. 1: *Corticarina bhutanensis*. 2: *C. clareae*. 3: *C. tenuis* sp. nov. 4: *Corticarina bhutanica*. 5: *Melanophthalma (s. str.) angulicollis*. 6: *Cartodere (s. str.) constricta*

	1	2	3	4	5	6
1	0.0073					
2	0.0930	0.0067				
3	0.1139	0.1047	0.0041			
4	0.1545	0.1411	0.1424	N		
5	0.1630	0.1499	0.1434	0.1550	N	
6	0.1603	0.1769	0.1586	0.1824	0.1717	N

Monaghan et al. 2005; Germain et al. 2013; Huang et al. 2020). In our study, the intraspecific genetic distance of the three species of *Corticarina* ranged from 0.41–0.63%, while the interspecific genetic distance between the three species ranged from 9.30–11.30%. The wide barcoding gap indicates that genetic distance can be an effective species delimitation method for *Corticarina*, and more studies are needed to find out whether this method can apply to other genera of Latridiidae.

## CONCLUSIONS

*Corticarina tenuis* sp. nov. is described in our study and represents the fourth species of *Corticarina* in Taiwan. In addition, two previously recorded species, *C. bhutanensis* and *C. clareae*, are redescribed. One species, *C. minuta*, although recorded to be distributed in Taiwan, was not observed in this study. *C. tenuis* sp. nov. can be distinguished from all known species of *Corticarina* in Taiwan by more parallel-shaped elytra and the structure of the male aedeagus. The biological information and distribution records of the three species are provided and discussed. The *COI* and 28S sequences of *Corticarina tenuis* sp. nov., *C. bhutanensis*, and *C. clareae* are provided, and the ML analysis, BI analysis, and genetic distances all support that these are three different species. This is also the first study to provide the genetic distance of Latridiidae, and we expect more studies in the future can confirm whether this method can be applied to other genera as well.

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**Authors' contributions:** YHH collected samples, took the color photos, ran the molecular analysis, and drafted the manuscript. HFL and MLC drafted the manuscript. All authors read and approved the final manuscript.

**Competing interests:** YHH, HFL and MLC declare that they have no conflict of interests.

**Availability of data and materials:** All specimens are deposited in museum collections or private collections as stated in the paper. The GenBank accession numbers of all sequences used in this study are listed in table S2.

**Consent for publication:** Not applicable.

**Ethics approval consent to participate:** Not applicable.

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## Supplementary materials

**Table S1.** Primers used amplification and sequencing in this study. (download)

**Table S2.** Taxa included in the analyses with corresponding GenBank accession numbers in this study. (download)