DESCRIPTIONS OF THE NYMPHAL STAGES OF *Gestroiella limnocoroides* Montandon, 1897 (Hemiptera: Naucoridae)

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ABSTRACT

Gestroiella limnocoroides Montandon, 1897, a species belonging to the subfamily Cheirochelinae has been recorded from Vietnam for the first time nearly 20 years ago. This study presents the first descriptions of the nymphal stages of the species. All five nymphal instars are described and illustrated in detail. Both adults and nymphs of *G. limnocoroides* were collected from vegetated stream margins in Vu Quang National Park, Ha Tinh province, where no other closely related species were observed. Each nymphal instar exhibits a head with a square-shaped ventral margin that is dark brown in color; a pronotum with a squarely concave anterior margin and a convex posterior margin that curves posteriorly; and a dorsal surface marked with alternating dark and light brown spots and two distinct black dots. Additionally, a morphometric analysis based on 22 morphological traits is provided for the nymphal stages.

Keywords: Nepomorpha, Cheirochelinae, nymph, morphometric, Vietnam.

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INTRODUCTION

Species of the genus *Gestroiella* Montandon, 1897 (Hemiptera: Naucoridae: Cheirochelinae) are aquatic bugs characterised by a broadly oval to nearly circular body. The pronotum is broad, with its posterior width approximately twice that of the head. The anterolateral angles are simple and do not form ventral cup-shaped depressions, while the posterolateral angles are acute and lack spines. In brachypterous forms, the hemelytra are elongated (Polhemus et al., 2008).

In Vietnam, prior to this study, only one species of the genus had been recorded: *Gestroiella limnocoroides* Montandon, 1897, from Cao Bang, Lao Cai, Hoa Binh, Nghe An, Quang Ngai, Kon Tum, and Lam Dong provinces (Polhemus et al., 2008). Two additional species, *Gestroiella schoutedeni* Montandon, 1909 and *Gestroiella perfecta* Montandon, 1911, have been treated as synonyms of *G. limnocoroides*, based on limited material collected from Northern Vietnam (Montandon, 1909, 1911).

To date, morphological studies of the nymphal instars of *Gestroiella* species remain limited. Only the five nymphal instars of *Gestroiella siamensis* Polhemus, Polhemus, and Sites, 2008 have been described and illustrated, based on specimens collected from Ton Nga Chang Wildlife Sanctuary in Southern Thailand (Mason et al., 2022).

G. limnocoroides Montandon typically inhabits lowland rivers below 1,000 m elevation, with substrates composed of gravel and cobble. It is generally absent from higher-elevation, colder, and fast-flowing streams. Additionally, this species has been reported as a host for chironomid larvae (Chironomidae). However, the morphology and biology of the nymphal stages of *G. limnocoroides* remain undocumented.

This study provides the first detailed descriptions of the five nymphal instars of *G. limnocoroides* and presents a morphometric analysis based on 22 morphological characters.

MATERIALS AND METHODS

Material examined and specimen depository. Specimens of *G. limnocoroides* were collected using a pond net with a mesh size of 0.5 mm and a net area of 0.5 m², attached to a 180 cm extension rod. At each sampling site, the net was swept across various microhabitats to ensure comprehensive coverage, including different vegetation zones, substrate types, pond and stream banks, and open water areas. Sampling was conducted in both flowing and still waters, typically near the shoreline, around aquatic vegetation, and across diverse bottom substrates. Particular attention was given to sweeping through areas containing submerged plant material, fallen branches, roots, and leaf litter to increase the likelihood of encountering target specimens.

Adults and nymphs of *G. limnocoroides* were collected from vegetated edges of a stream in Vu Quang National Park, Ha Tinh province, where no related species were present, thus ensuring a reliable association of nymphs with adults. A set of 62 nymphal specimens of *G. limnocoroides* were designated TXLGNY01–TXLGNY41 and TXLGNY42–TXLGNY62. Additional adult specimens of *G. limnocoroides* were collected from various aquatic environments in Bach Ma National Park, Hue province. The adult specimens (male, female) and nymph specimens of *G. limnocoroides* were collected and deposited at the Institute of Biology (IB). Specimens were labelled with their specimen identifications and locality information and individually preserved in vials containing 99% ethanol.

Morphological examination and imaging. The external morphological characteristics were analysed for dry-mounted specimens using a Nikon SMZ800N stereomicroscope. The examination of the genitalia was prepared as outlined below. Initially, each male specimen underwent relaxation by being immersed for 3 days in 70% ethanol. Subsequently, the male genitalia were separated from the body and immersed in hot 10% KOH for five minutes until the body fat

and musculature were released. The endosoma was extracted from the phallosoma using fine tweezers after the phallus was taken out of the pygophore. All parts of the male genitalia were preserved in a genitalia vial filled with propylene glycol and subsequently associated with the pinned specimens. Following this, the female genitalia were assessed without being removed from the body. A Nikon SMZ800N stereomicroscope was employed to investigate male and female genital morphology. Focus stacking was carried out using Helicon Focus Pro 8.2.0 software (Helicon Soft Ltd., Ukraine) based on a sequence of the source pictures photographed by a Canon EOS Kiss X10 digital camera connected to a Nikon SMZ 800N stereomicroscope, and artefacts were removed using the retouch function of the software.

Morphological terminology, measurement and indices. Morphological terminology followed that of Montandon (1909, 1911), Nieser & Chen (1991), Sites et al. (1997), Nieser & Chen (1991), Polhemus et al. (2008). The following parts of the bodies were measured for adults and nymphs of *G. limnocoroides*, using the software Image-J (http://imageJ.nih.gov/ij/) based on the direct stacking pictures designed as stated above. The assessment features were stated below, and all dimensions were given in mm.

Morphometric analyses. The Principal Component Analyses (PCA) were performed for the morphometric datasets using R software 4.1.2 (R core team, 2021). Both the two morphometric dataset comprised 22 morphological features body length, body width, head length, head width, width across eyes, maximal width of eye, interocular width, pronotum length, humeral width of pronotum, mesonotum length, metanotum length, length of scutellum, width of scutellum, length of femur of fore leg, length of tibia fore leg, length of tarsi fore leg, length of femur of middle leg, length of tibia middle leg, length of tarsi middle leg, length of femur of hind leg, length of tibia hind leg, length of tarsi hind leg (Kassambara & Mundt, 2020). The function "fviz_pca_ind" (factoextra package) (Kassambara & Mundt, 2020) was used to graph the 2D plot of PCA. The raw morphometric dataset and the R-script used for the data design and analyses are presented in additional files (Suppl. material 1).

RESULTS AND DISCUSSION

Morphometric analyses

Within the assemblage of 62 nymphal specimens of *G. limnocoroides* (TXLGNY01–41, TXLGNY42–62), five morphospecies were initially identified and assigned to the first, second, third, fourth, and fifth instars based on external morphological characteristics. These morphospecies were subsequently designated as first-instar, second-instar, third-instar, fourth-instar, and fifth-instar nymphs, respectively. Principal Component Analysis (PCA) performed on the morphometric dataset (Suppl. Material 1; Fig. 1) clearly differentiated the five instars.

Taxonomy

Family Naucoridae Leach, 1815

Subfamily Cheirochelinae Montandon, 1897

Gestroiella Montandon, 1897

Gestroiella limnocoroides Montandon, 1897

Gestroiella limnocoroides Montandon, 1897: 371.

Gestroiella schoutedeni Montandon, 1909: 45. Syn. by Horváth, 1918: 142.

Gestroiella perfecta Montandon, 1911: 86. Syn. by Horváth, 1918: 142.

Material examined

VIETNAM: 1♂+1♀; TXLG1, TXLG2; Ha Tinh province, Vu Quang National Park, Stream, 18°09'23"N - 105°16'41"E, H = 553 m; 14.viii.2023; XL Truong leg.; IB. 1♀; TXLG3; Ha Tinh province, Vu Quang National Park, stream, 18°09'23"N - 105°16'41"E, H = 553 m; 14.viii.2023; QC Nguyen leg.; IB. 1♂; TXLG4; Ha Tinh province, Vu Quang National Park, stream, 18°09'22" N - 105°16'36"E, H = 589 m; 17.viii.2023; XL Truong leg.; IB. 1♀;

TXLG5; Ha Tinh province, Vu Quang National Park, stream, 18°09’22”N - 105°16’36”E, H = 589 m; 17.viii.2023; QC Nguyen leg.; IB. 2♂+1♀; TXLG6, TXLG7, TXLG8; Hue province, Bach Ma National Park, 16°07’35”N - 107°45’17”E, H = 813 m, 16.ix. 2025; XL Truong leg leg.; IB. 41 nymphs; TXLGNY01-41; Ha Tinh province, Vu Quang National Park, stream, 18°09’23”N - 105°16’41”E, H = 553 m; 14.viii.2023; XL Truong leg.; IB. 21 nymphs; TXLGNY42-62; Ha Tinh province, Vu Quang National Park, Stream, 18°09’22”N - 105°16’36”E, H = 589 m; 17.viii.2023; XL Truong leg.; IB.

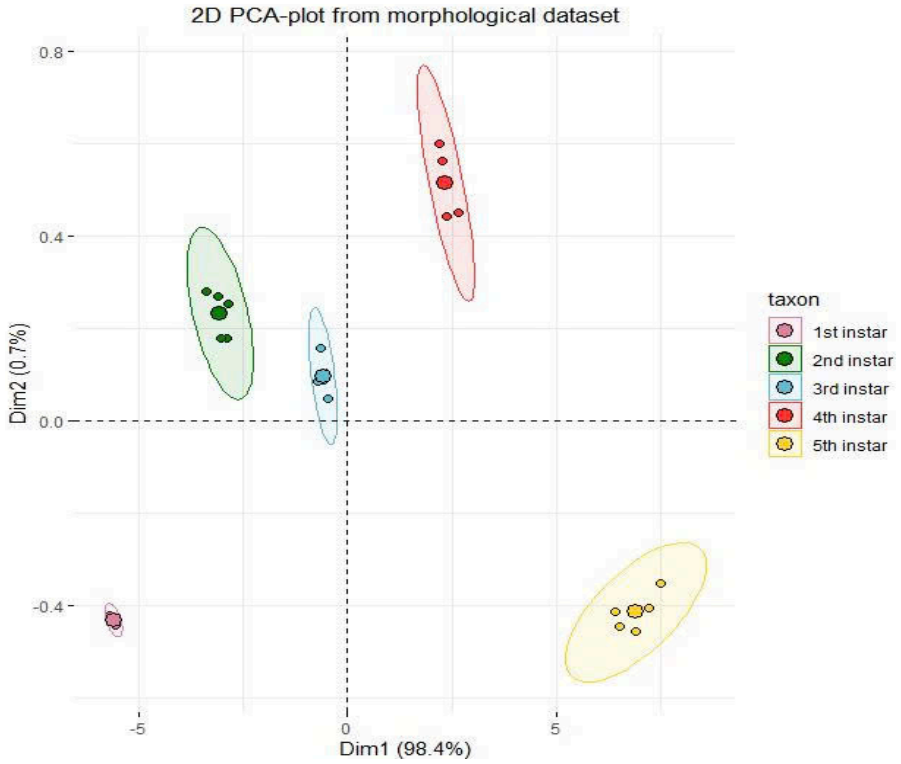

Figure 1. 2D PCA-plots based on the morphological dataset of the nymphal instars of *Gestroiella limnocoroides* Montandon, 1897 (nymphs, TXLGNY01-41, TXLGNY42-62)

Re-description (Figs. 2, 3)

The hemelytra exhibit distinct dark brown and dark yellow markings extending across the head, pronotum, scutellum, and lateral margins. The head is dark golden in color, bearing a centrally positioned, darker V-shaped mark on the frons that opens posteriorly; the eyes are ebony. The pronotum is also dark golden, narrowly bordered with brown laterally, and bears symmetrical brown markings centrally, corresponding to muscle attachment points (Fig. 2A).

Structural characteristics (male) (Figs. 2, 3). The overall body form is elongate-ovate, with a body length of 16.54–17.56 mm and a maximum width of 11.84–12.13 mm. The ratio of maximum eye width to interocular width (0.32–0.34), and the ratio of head width across the eyes to head length (1.66–1.68). The scutellum bears a pair (1 + 1) of small, roughly circular brown spots on either side of the midline in the basal half. The hemelytra are dark brown, with clearly defined claval sutures and a complete embolium (Fig. 2A). Head length/width 1.11–1.22/1; scutellum with/length 1.95–2.22/1. The hemelytra do not reach the abdominal tip; the membrane is absent, and the hemelytral apices are acutely rounded (Fig. 2A).

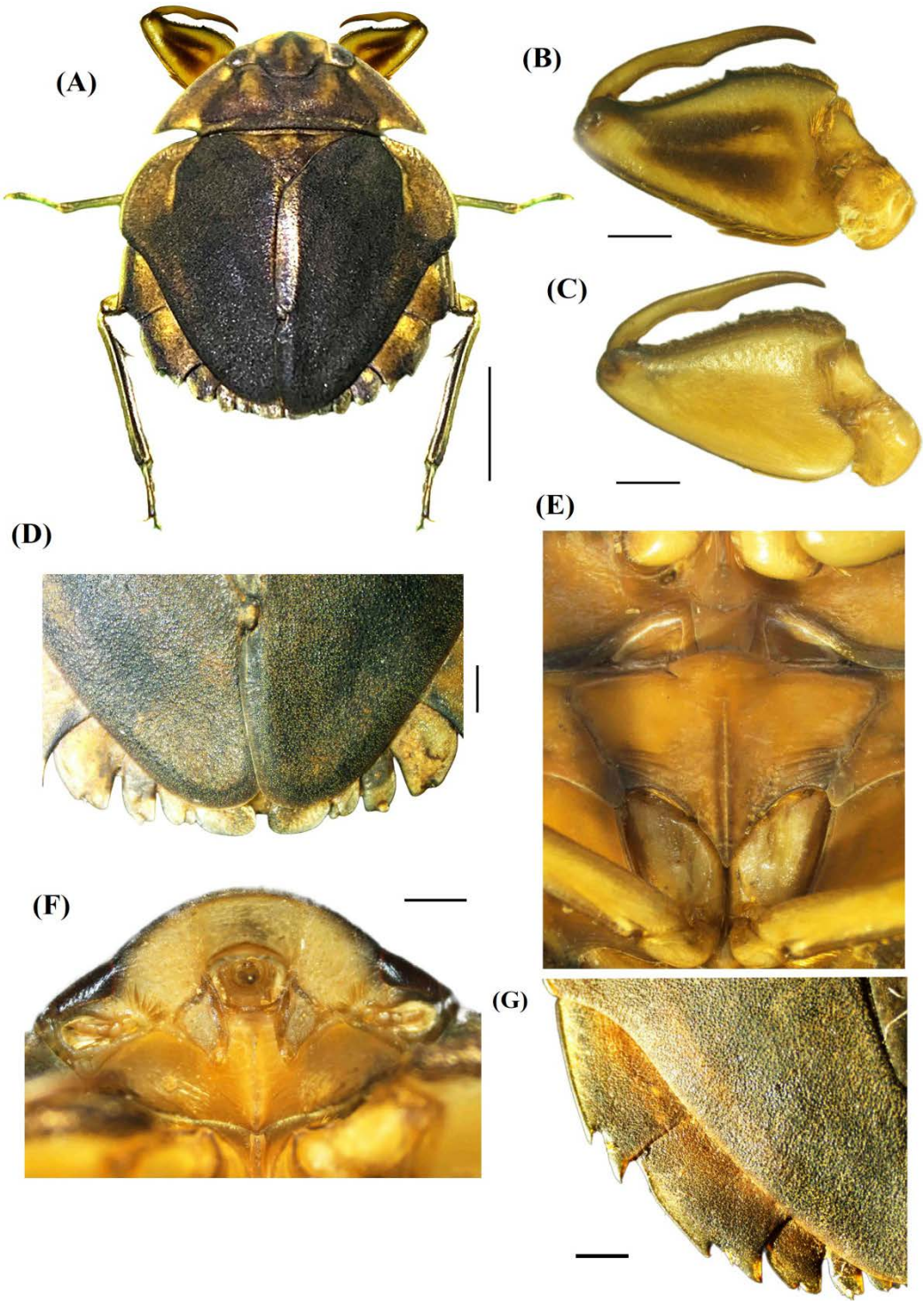

Figure 2. Gestroiella limnocoroides Montandon, 1897 (Male, TXLG1). (A) Dorsal habitus; (B) left foreleg, dorsal view; (C) left foreleg, ventral view; (D) apex of hemelytra; (E) Meso and metasternum; (F) Head and antenna ventral view; (G) Abdominal margined dorsal view. Scale bar: 5 mm for A; 1 mm for B, C, D, E, G; 0.5 mm for F

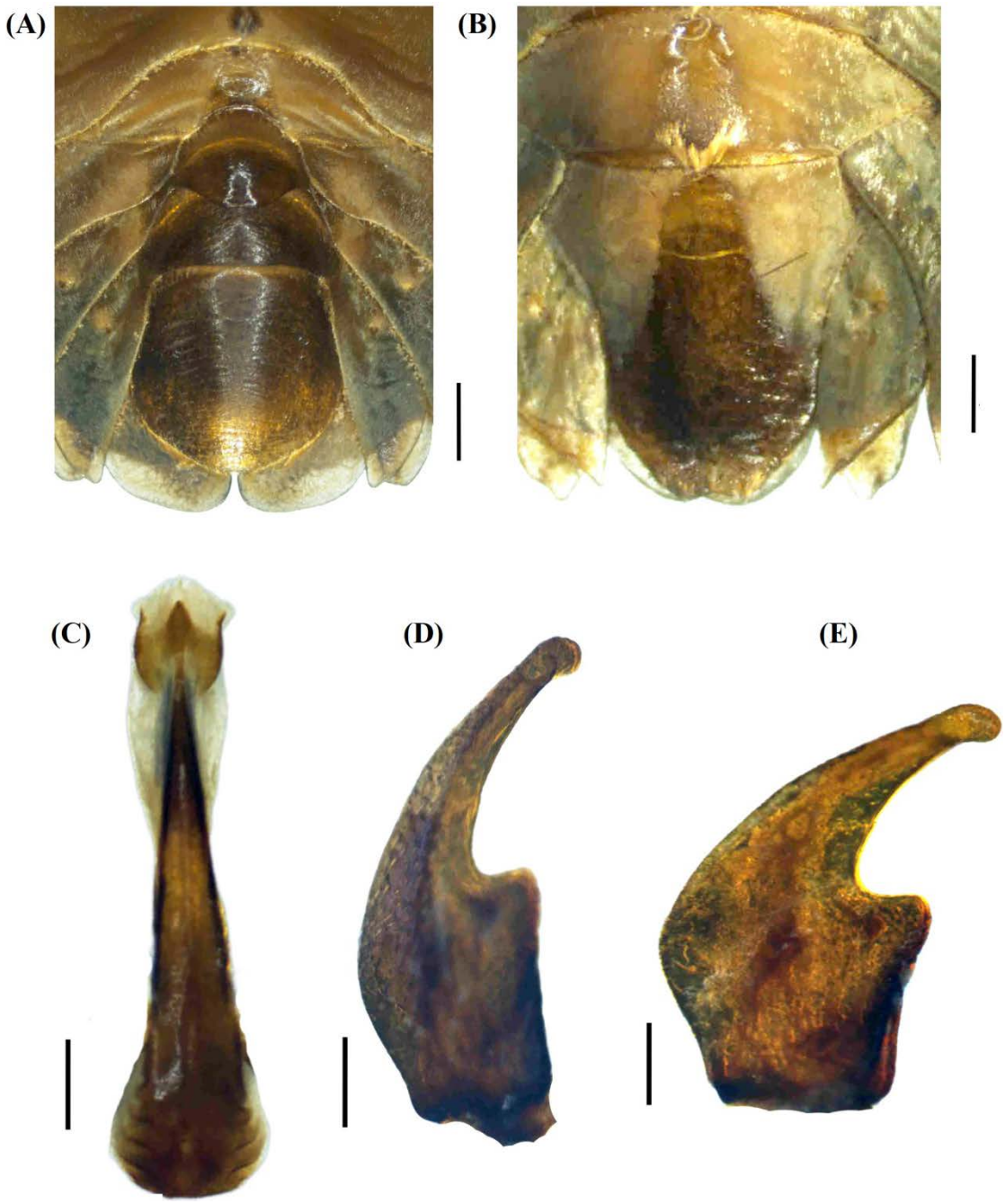

Figure 3. Gestroiella limnocoroides Montandon, 1897, male genitalia structural details. (A) apex of abdomen of male dorsal view; (B) apex of abdomen of female dorsal view; (C) phallotheca dorsal view. (D) paramere dorsal view; (E) paramere ventral view. Scale bar: 1 mm for A, B; 0.3 mm for C, D, E

Legs (Fig. 2B). All coxae are pruinose and bear short, dark, recumbent setae. Trochanters through tarsi are shiny on all legs. The distal end of the femur and the entire tibia and tarsus are light brown. Length of femur of fore leg 1.34–1.75 mm; tibia length 4.52–4.99 mm;

tarsus length 3.72–4.19 mm. The length ratios of fore femur:tibia:tarsus are 0.43–0.45:1.11–1.16:1.00. Apex of the hemelytra (Fig. 2D); meso- and metasternum (Fig. 2E); head and antenna, ventral view (Fig. 2F); abdomen, dorsal view (Fig. 2G).

Apex of male abdomen, dorsal view (Fig. 3A); apex of female abdomen, dorsal view (Fig. 3B). Genitalia with pygophore broad. Parameres (Figs. 3D, E) symmetrical; devoid of vestiture; concave, wrapping dorsad toward aedeagus; elongate, gradually tapering toward apex (Figs. 3D, E); apex slightly deflexed mesad; rounded lobe. Phallotheca (Fig. 3C).

Female. Similar to male in general size and colouration; body length 17.35–17.56 mm, maximum width 12.13–12.70 mm. Measurements (mm) of males were given in Table 1.

Table 1. Descriptive measurements of stages of *Gestroiella limnocoroides* Montandon

Character	Measurements (mm) (Mean)/Min–Max					
	Adult (♂, n = 5)	First instar (n = 15)	Second instar (n = 13)	Third instar (n = 12)	Fourth instar (n = 11)	Fifth instar (n = 11)
Body length	(16.92) 16.54–17.56	(4.91) 4.84–4.98	(6.81) 6.66–6.91	(8.96) 8.85–9.12	(11.69) 11.56–11.93	(15.47) 14.76–15.86
Body width	(12.01) 11.84–12.13	(3.27) 3.22–3.32	(4.70) 4.62–4.78	(6.38) 6.24–6.52	(8.54) 8.46–8.66	(11.23) 11.06–11.29
Head length	(2.83) 2.61–3.00	(0.96) 0.95–0.97	(1.39) 1.33–1.46	(1.64) 1.44–1.78	(2.01) 1.93–2.07	(2.90) 2.73–3.16
Head width	(2.86) 2.79–2.95	(0.95) 0.94–0.96	(1.19) 1.12–1.23	(1.49) 1.46–1.52	(1.92) 1.84–1.98	(2.52) 2.42–2.59
Width across eyes	(4.79) 4.67–4.90	(1.61) 1.59–1.63	(2.15) 2.11–2.18	(2.74) 2.63–2.81	(3.42) 3.39–3.46	(4.42) 4.30–4.52
Maximal width of eye	(0.93) 0.91–0.96	(0.31) 0.31–0.31	(0.47) 0.42–0.51	(0.62) 0.59–0.63	(0.77) 0.75–0.80	(0.99) 0.94–1.04
Interocular width	(2.80) 2.76–2.83	(0.98) 0.97–0.99	(1.25) 1.22–1.28	(1.58) 1.56–1.59	(1.95) 1.88–2.01	(2.48) 2.46–2.52
Pronotum length	(2.24) 2.16–2.31	(0.39) 0.38–0.40	(0.66) 0.63–0.74	(0.87) 0.82–0.90	(1.21) 1.14–1.25	(1.68) 1.61–1.73
Humeral width of pronotum	(10.10) 9.86–10.25	(1.38) 1.36–1.40	(4.02) 3.97–4.05	(5.34) 5.20–5.45	(7.04) 6.96–7.13	(9.14) 8.97–9.27
Mesonotum length	(3.19) 3.12–3.25	(0.86) 0.85–0.87	(1.28) 1.24–1.34	(1.79) 1.76–1.81	(2.35) 2.27–2.46	(3.09) 2.93–3.15
Metanotum length	(2.09) 1.81–2.31	(0.51) 0.50–0.51	(0.62) 0.61–0.64	(1.01) 1.00–1.02	(1.03) 1.00–1.06	(1.90) 1.88–1.92
Length of scutellum	(2.58) 2.51–2.63					
Width of scutellum	(5.21) 4.87–5.66					
Length of femur of fore leg	(1.58) 1.34–1.75	(0.18) 0.18–0.19	(0.61) 0.59–0.62	(0.83) 0.81–0.85	(1.08) 1.04–1.11	(1.32) 1.23–1.44
Length of tibia fore leg	(4.73) 4.52–4.99	(1.23) 1.21–1.24	(1.58) 1.51–1.62	(2.02) 1.98–2.06	(2.73) 2.65–2.85	(3.42) 3.19–3.73
Length of tarsi fore leg	(3.92) 3.72–4.19	(1.09) 1.07–1.11	(1.36) 1.28–1.43	(1.79) 1.76–1.81	(2.33) 2.28–2.38	(3.03) 2.86–3.31

Character	Measurements (mm) (Mean)/Min–Max					
	Adult (♂, n = 5)	First instar (n = 15)	Second instar (n = 13)	Third instar (n = 12)	Fourth instar (n = 11)	Fifth instar (n = 11)
Length of femur of middle leg	(4.15) 3.97–4.47	(1.12) 1.10–1.14	(1.64) 1.58–1.69	(2.17) 2.09–2.22	(2.88) 2.77–2.98	(3.76) 3.61–3.90
Length of tibia middle leg	(3.95) 3.88–4.00	(0.92) 0.90–0.93	(1.30) 1.17–1.39	(1.78) 1.74–1.81	(2.31) 2.26–2.39	(3.14) 2.97–3.25
Length of tarsi middle leg	(1.48) 1.46–1.50	(0.40) 0.39–0.41	(0.64) 0.62–0.68	(0.73) 0.72–0.74	(0.87) 0.81–0.92	(1.19) 1.09–1.25
Length of femur of hind leg	(5.77) 5.69–5.92	(1.39) 1.37–1.41	(2.00) 1.91–2.08	(2.62) 2.58–2.65	(3.73) 3.63–3.80	(4.88) 4.61–5.05
Length of tibia hind leg	(6.00) 5.78–6.19	(1.42) 1.40–1.44	(1.95) 1.85–2.02	(2.82) 2.80–2.83	(3.82) 3.63–4.02	(5.16) 4.79–5.44
Length of tarsi hind leg	(1.94) 1.84–2.00	(0.58) 0.57–0.58	(0.82) 0.77–0.85	(1.01) 0.97–1.07	(1.16) 1.03–1.23	(1.60) 1.56–1.62

Distribution. Vietnam: Ha Tinh, Hue provinces (In this study); Cao Bang, Lao Cai, Hoa Binh, Nghe An, Quang Ngai**,** Kon Tum**,** Lam Dong provinces **(**Polhemus, 1909, 1911; Polhemus et al., 2008). Myanmar, China, Laos**,** Thailand, Indochina **(**Polhemus et al., 2008).

Discussion. G. limnocoroides Montandon was recorded in Vietnam by Polhemus et al. (2008). The male morphological characteristics observed in this study (Figs. 2, 3) correspond closely with those described by Polhemus et al. (2008), including key features such as the elongate oblong-oval body shape; structures of the head, pronotum, and elytra; ventral and dorsal surfaces; metacoxal regions; fore-, mid-, and hind legs; protarsomeres; metafemora; the median lobe of the aedeagus; and the parameres. However, the male genitalia of *G. limnocoroides* are illustrated in greater detail in the present study (Figs. 3C–E).

Descriptions of immature stages

First instar (Fig. 4A)

Body length 4.84–4.98 mm (mean 4.91 mm); width 3.22–3.32 mm (mean 3.27 mm) (n = 15). Body elongate-oval, widest at the mesothorax; dorsally convex and ventrally concave; coloration includes dark and light brown spots dorsally and ventrally, with two faint black dots; margins pale. Head small, with a squared basal edge, partially concealed beneath the anterior thorax. Two prominent black compound eyes are visible laterally. Anterior margin convex and continuous with the lateral margins of the pronotum; posterior margin convex, dark brown ventrally and light brown dorsally. Interocular width is approximately 2.5 times the eye width. Labium originates posterior to the anterior head margin.

Pronotum with a square, concave anterior margin; lateral margins evenly rounded; posterior margin convex centrally and curved posteriorly, overlapping the mesonotum. Mesonotum has a curved posterior margin and shows no indication of wing development. Metanotum is longest at the midline, measuring 1.3 times the length of the pronotum and half the length of the mesonotum. Metanotal wing pads are absent. The metanotum completely overlaps abdominal tergum I.

Morphometric ratios include: body length to width, 1.5; pronotum length to humeral width, 0.3; head length to width, 1.0; interocular width to maximum eye width, 3.2. Foreleg femur:tibia:tarsus length ratios are 0.2:1.1:1.0; midleg ratios are 2.8:2.3:1.0; hind leg ratios are 2.4:2.5:1.0. All metathoracic leg segments are longer than their mesothoracic counterparts.

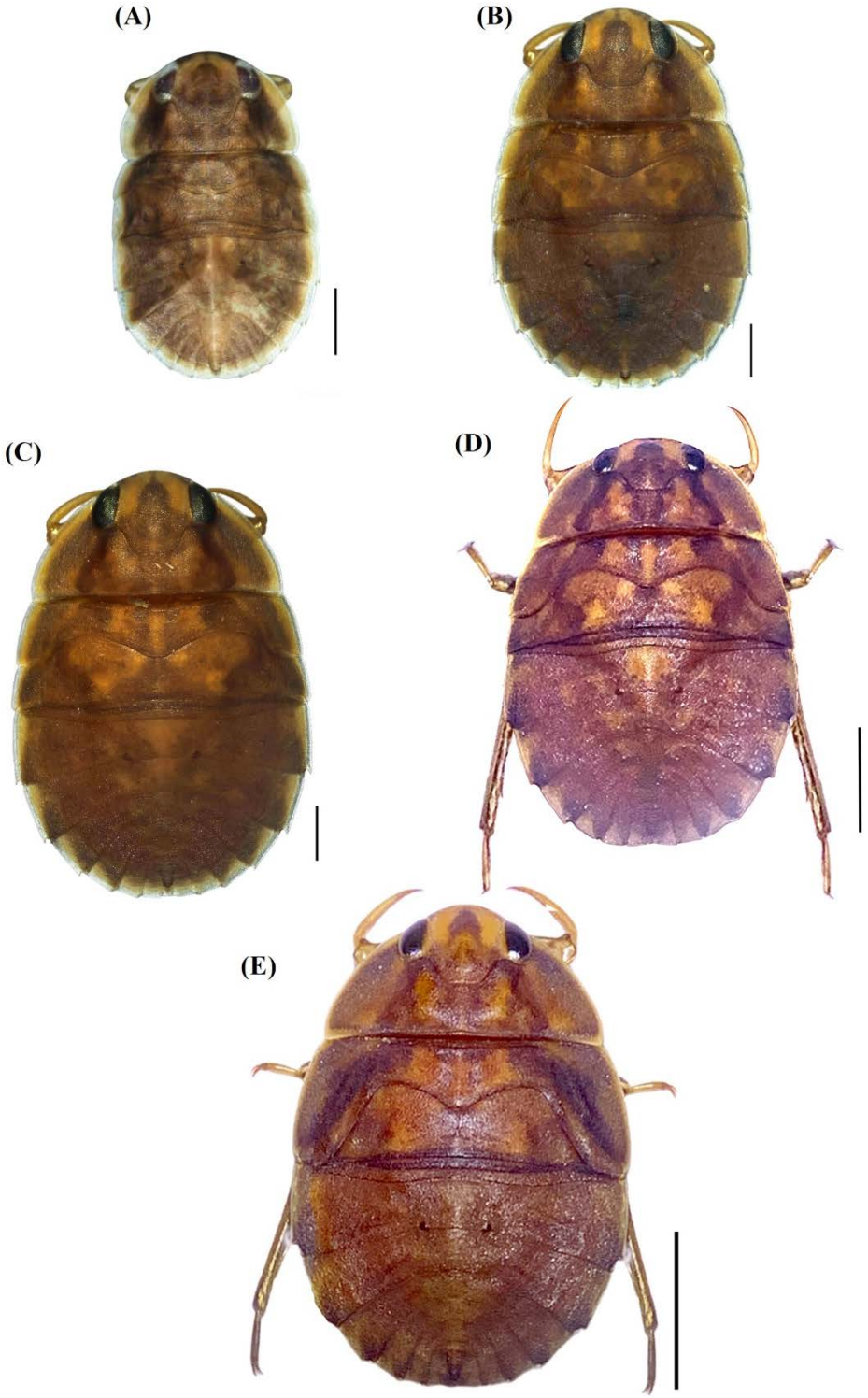

Figure 4. Nymphs of *Gestroiella limnocoroides* Montandon. (A) First instar; (B) Second instar; (C) Third instar; (D) Fourth instar; (E) Fifth instar. Scale bar: 0.5 mm for A; 1 mm for B; 1.5 mm for C; 3 mm for D; 5 mm for E

Abdomen light brown with pale coloration along the anterior two-thirds of the lateral margins of each segment; spines arise from tubercles. Lateral abdominal margins bear a row of short spines; posterolateral margins have a single spine and a sparse setae. The abdominal apex is entire and without clefts. Ventrally, the middle third is convex and covered with short setae. Spiracles are located at one-third to halfway between the lateral margin and midline of the segments.

Second instar (Fig. 4B)

Body length ranges from 6.66 to 6.91 mm (mean 6.81 mm); width ranges from 4.62 to 4.78 mm (mean 4.70 mm) (n = 13). The body is elongate-oval, widest at the mesothorax; dorsally convex and ventrally concave. The dorsal surface shows dark and light brown spots with two faint black dots; the body margins are pale.

The small head has a square basal edge, partially concealed beneath the anterior thorax. Two distinct black compound eyes are visible laterally. The anterior margin is convex and continuous with the lateral margins of the pronotum; the posterior margin is convex, dark brown ventrally and light brown dorsally. Interocular width is 2.6–2.9 times the width of the eye. The labium originates posterior to the anterior margin of the head.

The pronotum has a square, concave anterior margin; lateral margins are evenly rounded; the posterior margin is convex centrally and curves posteriorly, overlapping the mesonotum. The mesonotum has a curved posterior margin without indication of wing development. The metanotum is longest at the midline, equal in length to the pronotum and 0.6 times the length of the mesonotum. Metanotal wing pads are absent. The metanotum completely overlaps abdominal tergum I.

Morphometric ratios are as follows: body length to width, 1.4; pronotum length to humeral width, 0.2; head length to width, 1.2; interocular width to maximal eye width, 2.6–2.9. Length ratios of fore femur:tibia:tarsus are 0.4:1.2:1.0; mid leg ratios 2.6:2.0:1.0; hind leg ratios 2.5:2.4:1.0.

Third instar (Fig. 4C)

Body length ranges from 8.85 to 9.12 mm (mean 8.96 mm); width ranges from 6.24 to 6.52 mm (mean 6.38 mm) (n = 12). The body is elongate-oval, with forelegs visible from the dorsal view and the greatest width at the mesothorax; dorsally convex and ventrally concave. The dorsal surface bears dark and light brown spots, along with two distinct black dots; body margins are pale.

The head, with a square basal edge, is partially concealed beneath the anterior thorax. Two distinct black compound eyes are clearly visible laterally. The anterior margin is convex and continuous with the lateral margins of the pronotum; the posterior margin is convex, dark brown ventrally and light brown dorsally. Interocular width is 2.5–2.6 times the width of the eye. The labium originates posterior to the anterior margin of the head.

The pronotum has a square, concave anterior margin; lateral margins are evenly rounded; the posterior margin is convex centrally and curves posteriorly, overlapping the mesonotum. The mesonotum exhibits a curved posterior margin with indications of wing development. The metanotum measures 1.2 times the length of the pronotum and 0.6 times the length of the mesonotum. Metanotal wing pads are not evident. The metanotum completely overlaps abdominal tergum I.

Ratio of body length/body width 1.4; ratio of pronotum length/humeral width of pronotum 0.2; ratio of head length/head width 1.0; ratio of interocular width/maximal width of eye 2.5–2.6; ratio of length of femur of fore leg/length of tibia fore leg/length of tarsi fore leg 0.5/1.1/1.0; ratio of length of femur of middle leg/length of tibia middle leg/length of tarsi middle leg 3.0/2.40/1.0; ratio of length of femur of hind leg/ length of tibia hind leg/length of tarsi hind leg 2.7/2.9/1.0.

Fourth instar (Fig. 4D)

Body length ranges from 11.56 to 11.93 mm (mean 11.69 mm); width ranges from 8.46 to 8.66 mm (mean 8.54 mm) (n = 11). The body is elongate-oval, with all legs visible from the dorsal view and the greatest

width at the mesothorax; dorsally convex and ventrally concave. The dorsal surface displays dark and light brown spots and two distinct rows of black dots.

The head, with a square basal edge, is partially concealed beneath the anterior thorax. Two distinct black compound eyes are visible laterally. The anterior margin is convex and continuous with the lateral margins of the pronotum; the posterior margin is convex, dark brown ventrally and brown dorsally near the eyes. Interocular width is approximately 2.5 times the width of the eye.

The pronotum has a square, concave anterior margin; lateral margins are evenly rounded; the posterior margin is convex centrally and curves posteriorly, overlapping the mesonotum. The mesonotum has a curved posterior margin and shows an indication of wing development. The metanotum measures 0.9 times the length of the pronotum and 0.4 times the length of the mesonotum. Metanotal wing pads are not evident. The metanotum completely overlaps abdominal terga I and II.

Ratio of body length/body width 1.4; ratio of pronotum length/humeral width of pronotum 0.2; ratio of head length/head width 1.0; ratio of interocular width/maximal width of eye 2.5; ratio of length of femur of fore leg/length of tibia fore leg/length of tarsi fore leg 0.5/1.2/1.0; ratio of length of femur of middle leg/length of tibia middle leg/length of tarsi middle leg 3.2/2.7/1.0; ratio of length of femur of hind leg/length of tibia hind leg/length of tarsi hind leg 3.3/3.4/1.0.

Fifth instar (Fig. 4E)

Body length ranges from 14.76 mm to 15.86 mm (mean 15.47 mm); width ranges from 11.06 to 11.29 mm (mean 11.23 mm) (n = 11). The body is elongate-oval, with all legs visible dorsally and the greatest width at the mesothorax; dorsally convex and ventrally concave. The dorsal surface shows dark and light brown spots and two distinct rows of dots.

The head has a square basal edge with two distinct black compound eyes visible laterally. The anterior margin is convex and continuous with the lateral margins of the pronotum; the posterior margin is convex and pointed medially, dark brown ventrally and brown dorsally near the eyes. Interocular width is approximately 2.5 times the eye width.

The pronotum features a square, concave anterior margin; lateral margins are evenly rounded; the posterior margin is convex and pointed centrally, overlapping the mesonotum. The mesonotum has a curved posterior margin with short wing pads present. The metanotum measures 1.1 times the length of the pronotum and 0.6 times the length of the mesonotum. The metanotum fully overlaps abdominal terga I and II.

Ratio of body length/body width 1.4; ratio of pronotum length/humeral width of pronotum 0.2; ratio of head length/head width 1.1; ratio of interocular width/maximal width of eye 2.5; ratio of length of femur of fore leg/length of tibia fore leg/length of tarsi fore leg 0.4/1.1/1.0; ratio of length of femur of middle leg/length of tibia middle leg/length of tarsi middle leg 3.1/2.6/1.0; ratio of length of femur of hind leg/length of tibia hind leg/length of tarsi hind leg 3.1/3.2/1.0.

Discussion

This species was previously known only from Vietnam (Polhemus et al., 2008). However, its nymphal stages have not yet been described or illustrated. The nymphs of *G. limnocoroides* Montandon differ clearly from those of *G. siamensis* Polhemus, Polhemus, and Sites (Mason & Robert, 2022) in overall body size and morphology. Specifically, the nymphs of *G. limnocoroides* exhibit a small head with a square basal edge, dark brown coloration ventrally and light brown dorsally; a pronotum with a square, concave anterior margin and a posterior margin that is convex medially and curves posteriorly; and a dorsal surface patterned with dark and light brown spots along with two distinct black dots.

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Suppl. material 1. The morphometric datasets used for the data design and analysis of the instars of *Gestroiella limnocoroides* Montandon, 1897

Character	First instar (mm) (n = 5)					Second instar (mm) (n = 5)					Third instar (mm) (n = 5)				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Body length	4.91	4.95	4.98	4.89	4.84	6.66	6.91	6.91	6.79	6.77	8.88	8.94	9.12	9.00	8.85
Body width	3.27	3.29	3.32	3.26	3.22	4.62	4.75	4.78	4.69	4.68	6.39	6.30	6.52	6.46	6.24
Head length	0.96	0.97	0.97	0.96	0.95	1.33	1.37	1.46	1.35	1.43	1.44	1.70	1.78	1.61	1.68
Head width	0.95	0.96	0.96	0.95	0.94	1.12	1.21	1.23	1.17	1.21	1.49	1.47	1.52	1.51	1.46
Width across eyes	1.61	1.62	1.63	1.60	1.59	2.16	2.18	2.15	2.17	2.11	2.81	2.66	2.78	2.80	2.63
Maximal width of eye	0.31	0.31	0.31	0.31	0.31	0.42	0.51	0.49	0.47	0.48	0.63	0.60	0.63	0.63	0.59
Interocular width	0.98	0.99	0.99	0.98	0.97	1.22	1.27	1.28	1.25	1.25	1.59	1.58	1.59	1.59	1.56
Pronotum length	0.39	0.39	0.40	0.39	0.38	0.63	0.74	0.64	0.69	0.63	0.82	0.90	0.90	0.86	0.89
Humeral width of pronotum	1.38	1.39	1.40	1.37	1.36	4.01	4.04	4.05	4.03	3.97	5.40	5.25	5.45	5.43	5.20
Mesonotum length	0.86	0.87	0.87	0.86	0.85	1.24	1.34	1.27	1.29	1.24	1.76	1.80	1.81	1.79	1.78
Metanotum length	0.51	0.51	0.51	0.50	0.50	0.61	0.64	0.63	0.63	0.62	1.00	1.02	1.01	1.01	1.01
Length of femur of fore leg	0.18	0.18	0.19	0.18	0.18	0.61	0.62	0.60	0.62	0.59	0.82	0.85	0.81	0.82	0.84
Length of tibia fore leg	1.23	1.23	1.24	1.22	1.21	1.51	1.62	1.61	1.57	1.58	2.06	2.03	1.98	2.02	2.01
Length of tarsi fore leg	1.09	1.10	1.11	1.09	1.07	1.28	1.38	1.43	1.33	1.40	1.79	1.78	1.81	1.80	1.76
Length of femur of middle leg	1.12	1.13	1.14	1.12	1.10	1.58	1.64	1.69	1.61	1.66	2.09	2.22	2.20	2.15	2.20
Length of tibia middle leg	0.92	0.92	0.93	0.91	0.90	1.17	1.33	1.39	1.25	1.36	1.74	1.81	1.79	1.77	1.79
Length of tarsi middle leg	0.40	0.40	0.41	0.40	0.39	0.62	0.68	0.63	0.65	0.62	0.72	0.74	0.73	0.73	0.73
Length of femur of hind leg	1.39	1.40	1.41	1.38	1.37	1.91	2.02	2.08	1.97	2.04	2.63	2.61	2.65	2.64	2.58
Length of tibia hind leg	1.42	1.43	1.44	1.41	1.40	1.85	2.00	2.02	1.93	1.98	2.81	2.83	2.83	2.82	2.80
Length of tarsi hind leg	0.58	0.58	0.58	0.57	0.57	0.77	0.83	0.85	0.80	0.83	1.07	0.98	0.99	1.03	0.97

Suppl. material 1. The morphometric datasets used for the data design and analysis of the instars of *Gestroiella limnocoroides* Montandon, 1897 (continue)

Character	Fourth instar (mm) (n = 5)					Fifth instar (mm) (n = 5)				
	1	2	3	4	5	1	2	3	4	5
Body length	11.66	11.93	11.56	11.61	11.69	15.86	15.65	14.76	15.76	15.34
Body width	8.57	8.66	8.46	8.52	8.49	11.28	11.29	11.24	11.29	11.06
Head length	1.93	2.04	2.07	2.00	2.00	3.16	2.79	2.85	2.98	2.73
Head width	1.84	1.98	1.94	1.89	1.94	2.59	2.47	2.57	2.53	2.42
Width across eyes	3.40	3.46	3.43	3.42	3.39	4.52	4.39	4.41	4.46	4.30
Maximal width of eye	0.75	0.78	0.80	0.78	0.76	0.97	1.04	0.94	1.01	1.02
Interocular width	1.88	2.01	1.98	1.93	1.97	2.47	2.52	2.46	2.50	2.47
Pronotum length	1.14	1.24	1.25	1.20	1.22	1.73	1.69	1.61	1.71	1.66
Humeral width of pronotum	6.96	7.13	7.11	7.04	6.99	9.27	9.15	9.12	9.21	8.97
Mesonotum length	2.27	2.46	2.31	2.29	2.41	3.14	3.15	2.93	3.15	3.09
Metanotum length	1.05	1.06	1.00	1.03	1.04	1.90	1.92	1.91	1.91	1.88
Length of femur of fore leg	1.11	1.06	1.08	1.10	1.04	1.44	1.26	1.33	1.35	1.23
Length of tibia fore leg	2.65	2.85	2.70	2.68	2.79	3.73	3.25	3.42	3.49	3.19
Length of tarsi fore leg	2.35	2.38	2.28	2.32	2.33	3.31	2.92	2.94	3.12	2.86
Length of femur of middle leg	2.89	2.98	2.77	2.83	2.92	3.90	3.76	3.61	3.83	3.68
Length of tibia middle leg	2.27	2.31	2.39	2.33	2.26	3.25	3.17	2.97	3.21	3.11
Length of tarsi middle leg	0.89	0.92	0.81	0.85	0.90	1.25	1.21	1.09	1.23	1.19
Length of femur of hind leg	3.80	3.79	3.63	3.72	3.71	4.85	5.05	4.61	4.95	4.95
Length of tibia hind leg	4.02	3.86	3.63	3.83	3.78	5.44	5.18	4.79	5.31	5.08
Length of tarsi hind leg	1.23	1.21	1.03	1.13	1.19	1.62	1.61	1.56	1.62	1.58