

The most northern distribution record of the genus *Lepidodens* (Collembola: Entomobryidae) with description of a new species from Zhejiang Province

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Abstract: A new species, *Lepidodens huadingensis* Guo & Pan **sp. nov.**, was collected from Zhejiang Province. This is the most northern record of a species in this genus. This new species is identified by a narrow longitudinal stripe on lateral side from head to thoracic segment III, a labial chaetal formula of $M_1M_2R(R_2)EL_1L_2$, dorsal abdominal segments I–III with 3/6/7 mac, and two smooth chaetae on posterior face of ventral tube. A detailed comparison among four recorded species, a key to species of this genus were provided.

Key words: Entomobryinae; chaetotaxy; taxonomy; key

鳞齿蚋属最北分布记录及浙江一新种记述（弹尾纲：长角蚋科）

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摘要: 描述了浙江天台县鳞齿蚋属 1 新种, 华顶鳞齿蚋 *Lepidodens huadingensis* Guo & Pan **sp. nov.**。该新种为该属的最北分布记录, 鉴定特征有自头到胸部第 III 节两侧具 1 纵向窄条纹, 下唇毛序为 $M_1M_2R(R_2)EL_1L_2$, 腹部第 I–III 节背部大刚毛数量为 3/6/7, 腹管后侧具 2 根光滑刚毛。本文还给出了该新种与其他 3 个已知种的详细特征比较和分种检索表。

关键词: 长角蚋亚科; 毛序; 分类; 检索表

Introduction

The genus *Lepidodens* was established by Zhang & Pan (2016) based on morphology and molecular evidence of the type species *Lepidodens nigrofasciatus* Zhang & Pan, 2016 from Guangdong Province, China. Members of this genus possess dental scales present in all scaled subfamilies of Entomobryidae, and are identified by body with relatively long ribs, pointed scales, ventral side of dens scaled, and specialised microchaeta anterior to chaeta m3 on the first abdominal segment (Zhang *et al.* 2016). So far, three species (*Lepidodens hainanicus* Zhang & Pan, 2016, *Lepidodens nigrofasciatus* Zhang & Pan, 2016, and *Lepidodens similis* Zhang & Pan, 2016) in this genus have been recorded from southern China (Guangdong and Hainan).

Tiantai County is located in Zhejiang Province of the eastern China. To date, three

collembolan species have been reported as new to science from Tiantai (*Homidia tiantaiensis* Chen & Lin, 1998; *Homidia latifolia* Chen & Li, 1999; *Homidia zhangii* Pan & Shi, 2012). Here, a new species, *Lepidodens huadingensis* Guo & Pan **sp. nov.**, the fourth one of Collembola, is reported from Tiantai County. It is the first species of *Lepidodens* recorded from Zhejiang and holds the record as the most northern distribution of *Lepidodens*.

Material and methods

Specimens were sieved from leaf litter onto a tray, collected by an aspirator in the field, and then stored in 99% ethanol at -20° in the laboratory. Photographs were captured by a Canon 5D marker IV camera in the field (Figs 1–3). Lab photos were taken by a Nikon DS-Fi1 camera mounted on a Nikon SMZ1000 stereomicroscope (Figs 4–6), a Nikon 80i phase-contrast microscope (Figs 7–11), or a Hitachi scanning electron microscope S4800 (Figs 12–18). Lengths were measured by NIS-Elements Documentation 3.1 software. Labels were added by Adobe Photoshop CS5. Specimens were cleared in lactic acid on an electric hot plate and mounted under a coverslip in Hoyer's medium.

The annotations of cephalic chaetotaxy follows Soto-Adames (2008), labial chaetotaxy is after Gisin (1967), labial palp chaetae follows Fjellberg (1998), dorsal thoracic and abdominal macrochaetotaxy is after Szeptycki (1979) and Zhang *et al.* (2019), tergal sensory chaetae follow Zhang & Deharveng (2015). The number of macrochaetae on the dorsal body is provided by half-tergite in the descriptions.

Abbreviations. Ant. — antennal segment; Th. — thoracic segment; Abd. — abdominal segment; ms — specialised microchaeta(e); sens — specialised ordinary chaeta(e); S-chaeta(e) — specialised chaetae, including ms and sens; mac — macrochaeta(e); mic — microchaeta(e); VT — ventral tube.

The type specimens are deposited in the School of Life Sciences, Taizhou University, Taizhou, Zhejiang, China.

Taxonomy

Key to species of genus *Lepidodens*

1. Mesothorax protruded, overlapping head 2
- Mesothorax not protruded 3
2. Without longitudinal stripes present on lateral head to thorax *L. hainanicus* Zhang & Pan
- A longitudinal stripes present on lateral head to thorax *L. huadingensis* Guo & Pan **sp. nov.**
3. Dorsal Abd. IV without blue pigment *L. nigrofasciatus* Zhang & Pan
- Dorsal Abd. IV with dark blue pigment *L. similis* Zhang & Pan

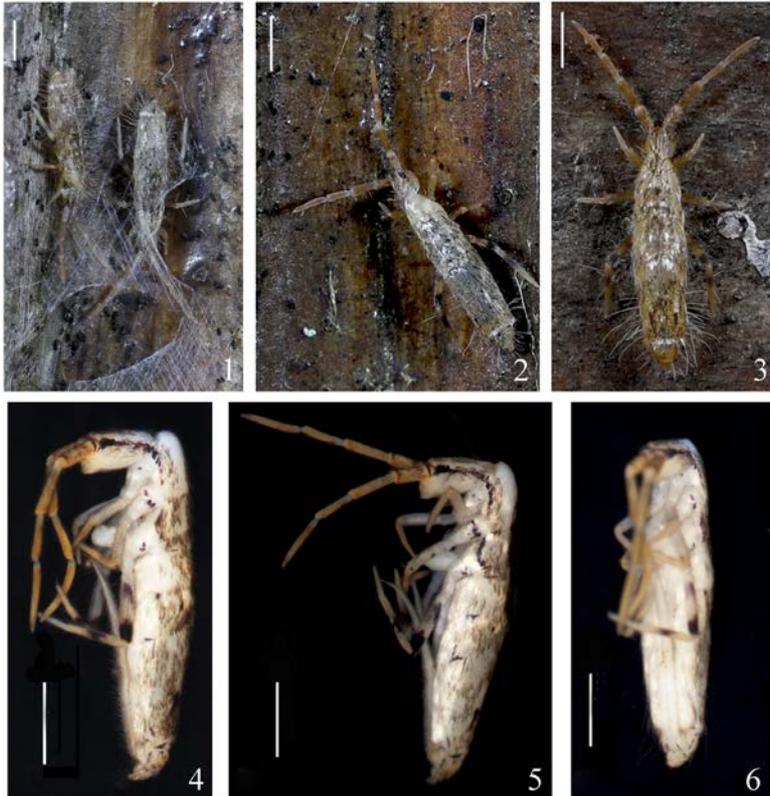
Lepidodens huadingensis Guo & Pan **sp. nov.** (Figs 1–36)

Size. Body length up to 4.21 mm.

Colour pattern. Ground colour pale or yellow in alive specimen (Figs 1–3) and pale in ethanol (Figs 4–6). Basal Ant. I with one dark ring. Eye patches dark blue. Longitudinal narrow stripes present on lateral part from head to Th. III. Irregular short bands present on lateral part of posterior margin of Abd. II–III and anterior margin of Abd. V. Posterior part of

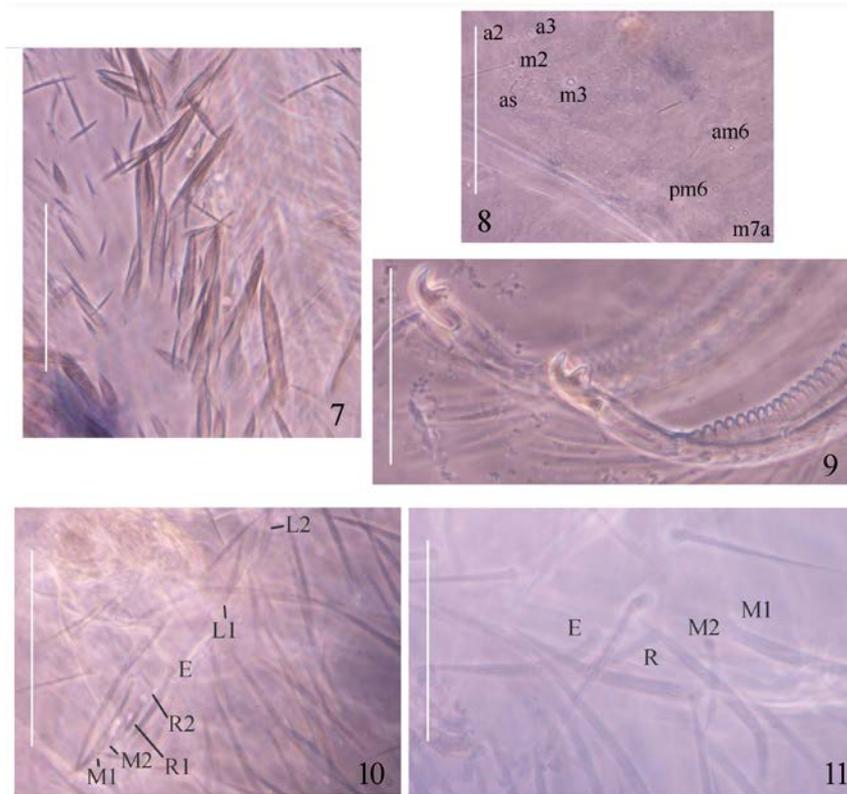
Abd. IV with two longitudinal short stripes. Coxae of leg I–III with dark spots. Median and distal femur of leg III with dark pigment. Ventral side of body without pigment (Figs 1–6).

Scale. Scales pointed, heavily striate with basal ribs longer than distal ones (Figs 7, 16); scales on ventral side of dens narrower than those on dorsum (Figs 15–17). Scales present on Ant. I–II (Fig. 7), head, dorsal body, legs and ventral side of manubrium and dens, but absent on Ant. III–IV, ventral tube, tenaculum and dorsal side of manubrium and dens.



Figures 1–6. *Lepidodens huadingensis* sp. nov. 1–3. Ecological habitus; 4–6. Colour pattern. 1–3. Dorsal views; 4, 5. Lateral views; 6. Ventral view. Scale bars = 1000 μ m.

Head. Antenna 1.18–1.81 as long as cephalic diagonal. Antennal segment ratio as I: II: III: IV = 1: 1.18–1.37: 1.16–1.23: 1.62–1.78. Smooth spiny mic at base of antennae unclear. Antennal apical bulb unilobed (Fig. 20). Eyes 8+8, G and H smallest. Interocular chaetae as p, r, t, q, s, with p as largest (Figs 12, 19). Labral margin with four conical papillae. Labral intrusion U-shaped. Prelabral and labral chaetae 4/5, 5, 4, prelabrals ciliate, labrals smooth (Figs 14, 24). Clypeal chaetae ciliate, but their arrangement and number unclear. Dorsal cephalic chaetotaxy with 11 antennal (An), four (M1–4) median and six (S2–3, S5, S5i, S6, S6i) sutural mac (Fig. 19). Labial chaetae M₁M₂R(R₂)EL₁ L₂, all ciliate; R/M₁ = 0.60, M₂ shorter than R (Figs 11, 21); one individual with R₂ (Fig. 10). Chaetae posterior to labium ciliate and not expanded (Fig. 21). Labial papillae A–E with 0, 5, 0, 4, 4 guard chaetae, respectively; lateral process thin, and with tip not reaching apex of labial papilla E (Fig. 22). Subapical chaeta of maxillary outer lobe subequal to apical one; three hairs on sublobal plate (Fig. 23). Mandibles with four and five teeth.

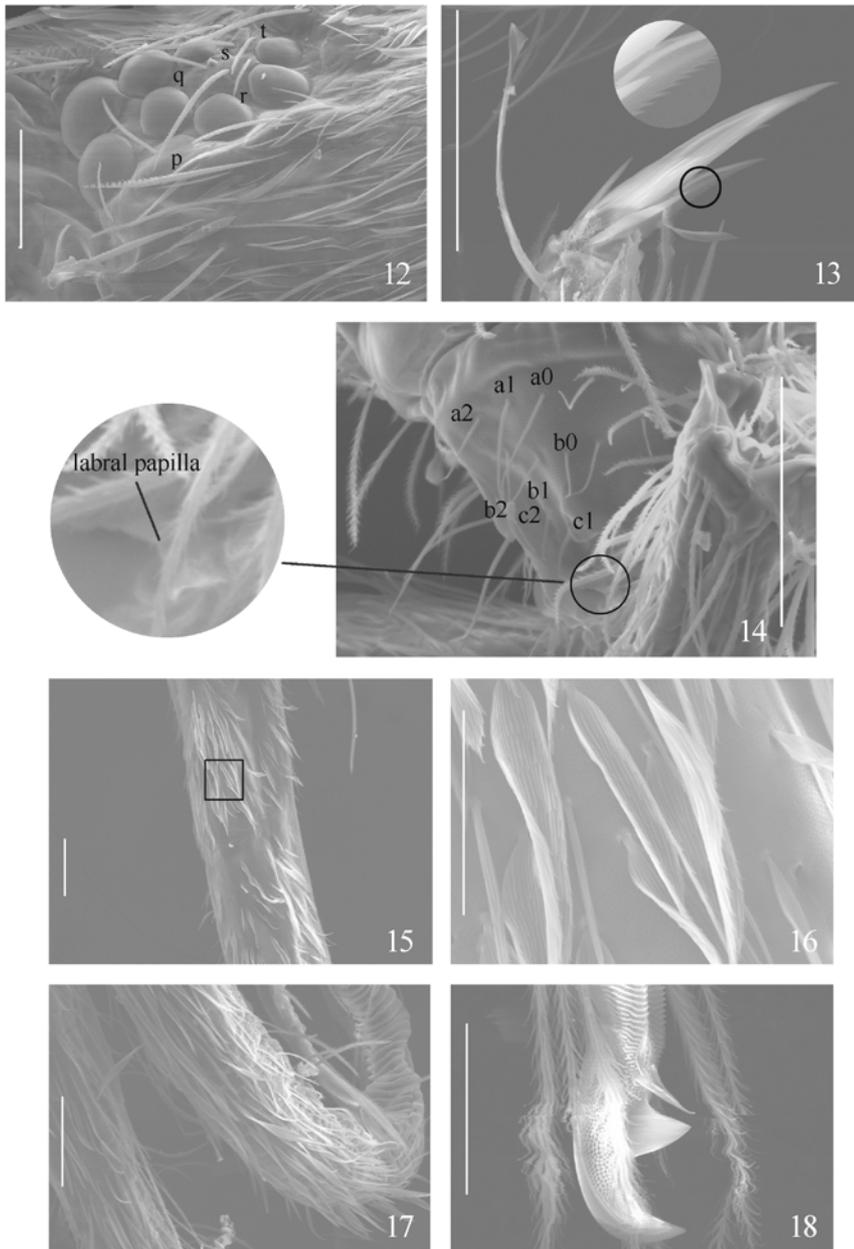


Figures 7–11. *Lepidodens huadingensis* sp. nov. 7. Scales on Ant. II; 8. Chaetotaxy on Abd. III; 9. Apical dens and mucro. 10, 11. Two types of labial chaetotaxy from two individuals. 7, 9. Lateral views; 8. Dorsal view; 10, 11. Ventral views. Scale bars = 50 μ m.

Thorax. Th. II protruded, overlapping head (Figs 1–5), with three (m1, m2, m2i) medio-medial, two (m4, m4i) medio-lateral, 11 posterior mac; m5 as mac; p5, p6, ms and sens unclear. Th. III with 16 mac and two sens (Fig. 25). Mid and hind coxae with 8 and 8 mac, pseudopore unclear (Fig. 26). Trochanteral organ of leg III with about 57 smooth spiny chaetae (Fig. 27). Unguis with two lateral and four inner teeth, most distal one in inner very tiny (Lateral teeth not show in the figure). Unguiculus lanceolate with outer edge serrate. Tenent hair clavate and subequal to unguis in length (Figs 13, 28).

Abdomen. Abd. IV 6.55–9.08 as long as Abd. III along dorsal midline. Abd. I with three (m2–4) mac and two S-chaetae; ms anterior to m3. Abd. II with six (a2, m3, m3e, m3ea, m3ep, m5) mac and two S-chaetae. Abd. III with seven (a2, a3, m3, am6, pm6, m7a, p6) mac and three S-chaetae (Figs 8, 29). Chaetotaxy on dorsal Abd. IV shown in Figure 30, central chaetae A2, I, M, B5, B6 as mac; A3, Ae3, Ae6–7 as mes; one individual with two mes between Ae and B series chaetae; eight S-chaetae (two shorter and six longer) (Fig. 30). Abd. V with a3, a5, a6, m2, m3, m5, p1, p3, p4, p5 as mac and three S-chaetae (Fig. 31). Accessory mic of bothriotrichial complexes on Abd. II–IV unmodified (Fig. 8). Ventral tube anterior face with three larger chaetae (Fig. 32); posterior face with two apical smooth chaetae; each lateral flap with 5–11 smooth chaetae; ciliate chaetae variable, one individual without and one with 22 (Fig. 33). Tenaculum with 4+4 teeth and one large striate chaeta (Fig. 34). Manubrial

plaque with one pseudopore and 11–12 ciliate chaetae, inner two larger than others (Fig. 35). Distal smooth part longer than mucro. Mucro bidentate, basal spine short with tip reaching apex of subapical tooth (Figs 9, 18, 36).



Figures 12–18. *Lepidodens huadingensis* **sp. nov.** 12. Eye patch; 13. Distal tibiotarsus and claw; 14. Labrum; 15. Manubrium; 16. Scales on ventral side of manubrium, magnification of Fig. 15; 17. Ventral side of dens; 18. Distal dens and mucro. 12. Dorsal view; 13, 18. Lateral views; 14, 15–17. Anterior views. Scale bars = 50 μ m (Figs 12–14); 20 μ m (Figs 15–18).

Holotype. ♂ on slide, **China**, Zhejiang, Tiantai, Huading National Forest Park, 29°15'19.01"N, 121°5'19.75"E, alt 929±5 m, collected by Zhixiang PAN, Jijia GUO, Honghao YANG & Zaiming CHEN, 19-VII-2021, sample number 4704. **Paratypes.** 1♂4♀ on slides, three in ethanol, same data as holotype.

Etymology. This new species was named after the type locality at Huading National Forest Park.

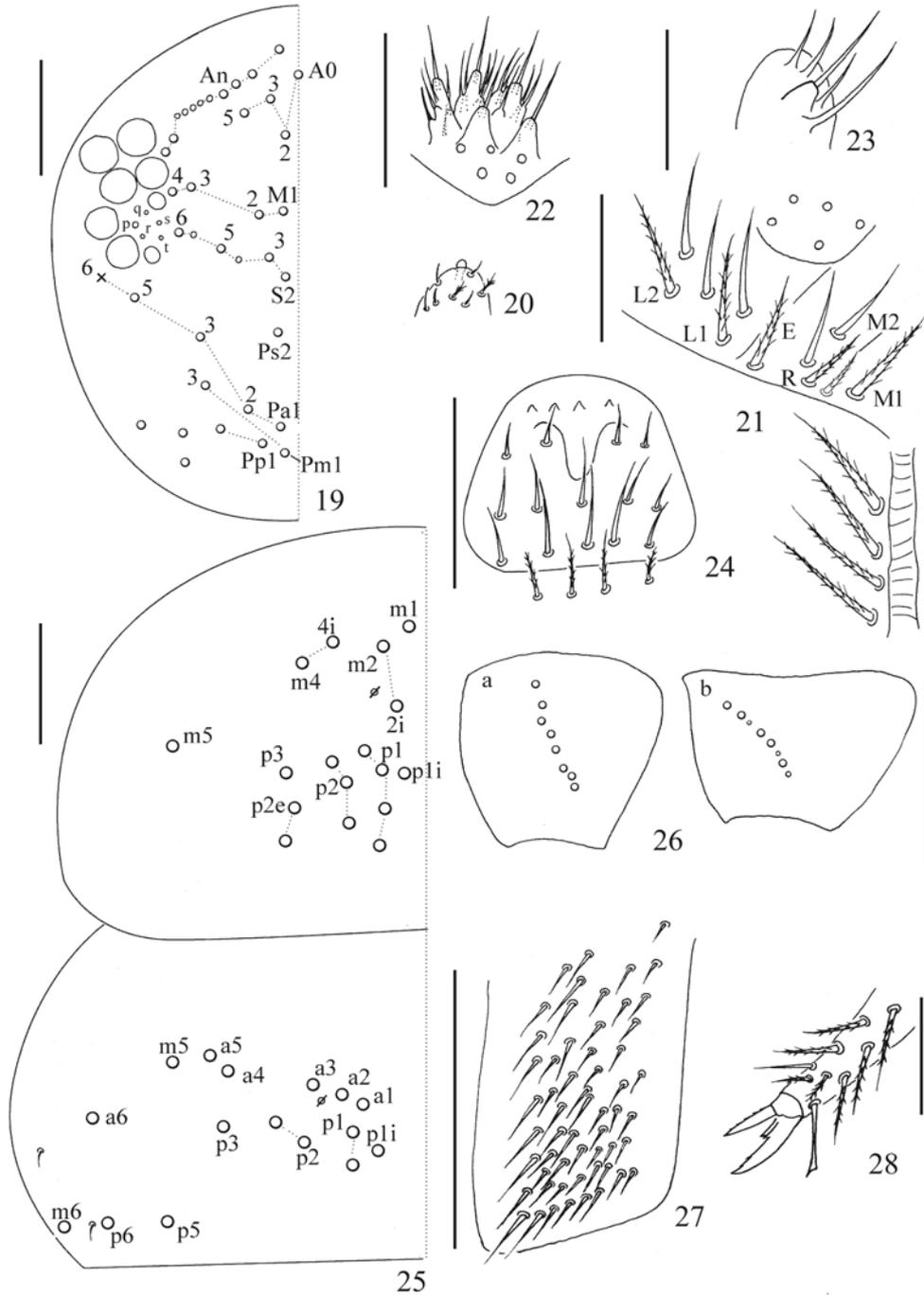
Habitat. Living on branch or leaf of *Rhododendron fortunei*.

Diagnosis. This new species is most similar to *L. hainanicus* in colour pattern and chaetotaxy on dorsal Th. II–III. However, it can be discriminated from the latter by longitudinal stripes on lateral head (absent in the latter), M_2 present on labium (without in the latter), 3/6/7 mac on Abd. I–III (1/4/6 in the latter). Also, this new species can easily be distinguished from *L. nigrofasciatus* and *L. similis* by morphology of Th. II, colour pattern and mac on Abd. I–III. A detailed comparison between these four species in this genus are listed in Table 1.

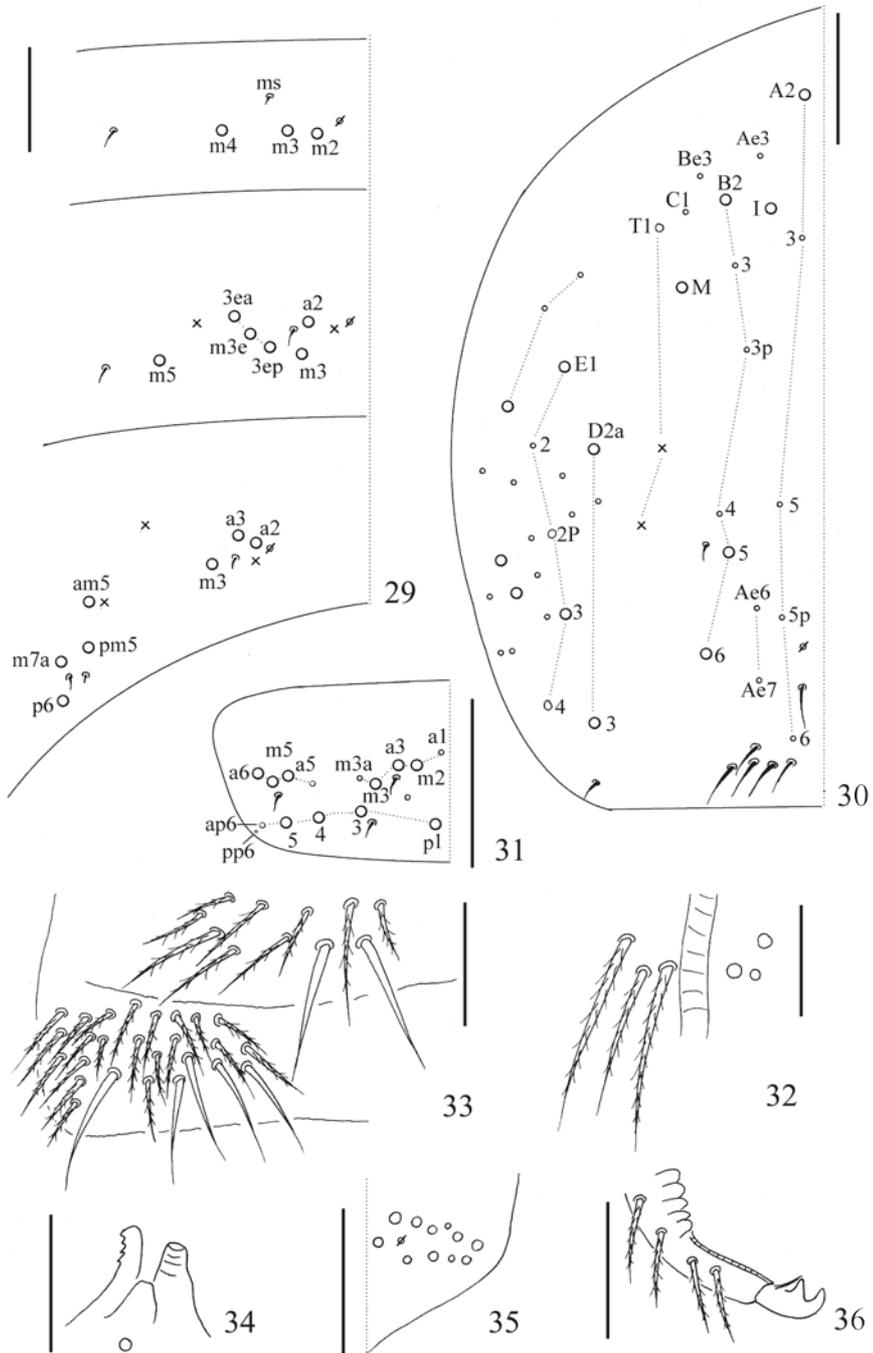
Table 1. Detailed comparison between four recorded species of *Lepidodens*

Characters	<i>L. huadingensis</i> sp. nov.	<i>L. hainanicus</i>	<i>L. nigrofasciatus</i>	<i>L. similis</i>
Whole dorsal head dark pigmented	no	no	yes	yes
Longitudinal narrow stripes from lateral head to Th. III	yes	no	no	no
Whole dorsal Abd. I–III dark pigmented	no	no	yes	yes
Dark rings on apical part of Ant. I–III	no	yes	no	no
Chaetae of An series of dorsal head	11	8–9	5	5
Prelabral chaetae	ciliate	ciliate	smooth	smooth
Labial chaetal formula	$M_1M_2R(R_2)EL_1L_2$	$MREL_1L_2$	MEL_1L_2	MEL_1L_2
Mac on Abd. I/II/III	3/6/7	1/4/6	2/4/7	2/4/7
Smooth chaetae of trochanteral organ	about 57	about 28	8–12	8–11
Smooth chaetae on posterior face/lateral flap of VT	2/5–11	?/at least 7	8/8	8/8–14
Distribution	Zhejiang	Hainan	Guangdong	Guangdong

Note: ? = the character not provided in original description.



Figures 19–28. *Lepidodens huadingensis* sp. nov. 19. Dorsal cephalic chaetotaxy; 20. Distal Ant. IV; 21. Labium; 22. Labial papillae; 23. Maxillary outer lobe; 24. Labrum; 25. Chaetotaxy on Th. II–III; 26. Chaetotaxy on mid and hind coxae; 27. Trochanteral organ; 28. Distal tibiotsarsus and claw. 19, 20, 24, 25. Dorsal views; 21–23. Ventral views; 26–28. Lateral views. Scale bars = 50 μ m.



Figures 29–36. *Lepidodens huadingensis* **sp. nov.** 29. Chaetotaxy of Abd. I–III; 30. Chaetotaxy of Abd. IV; 31. Chaetotaxy of Abd. V; 32. Anterior face of VT; 33. Posterior face and lateral flap of VT; 34. Tenaculum; 35. Manubrial plaque; 36. Distal dens and mucro. 29–31, 35. Dorsal views; 32. Anterior view; 33. Postero-lateral view; 34. Posterior view; 36. Lateral view. Scale bars = 50 μ m.

Acknowledgements

This research was supported by the Zhejiang Provincial Natural Science Foundation (LTY20C030001) and the Project for Investigation of Wild Animal Diversity in Tiantai County.

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