

## Three new species of Echinoderidae (Kinorhyncha: Cyclorhagida) from two seamounts and the adjacent deep-sea floor in the Northeast Atlantic Ocean

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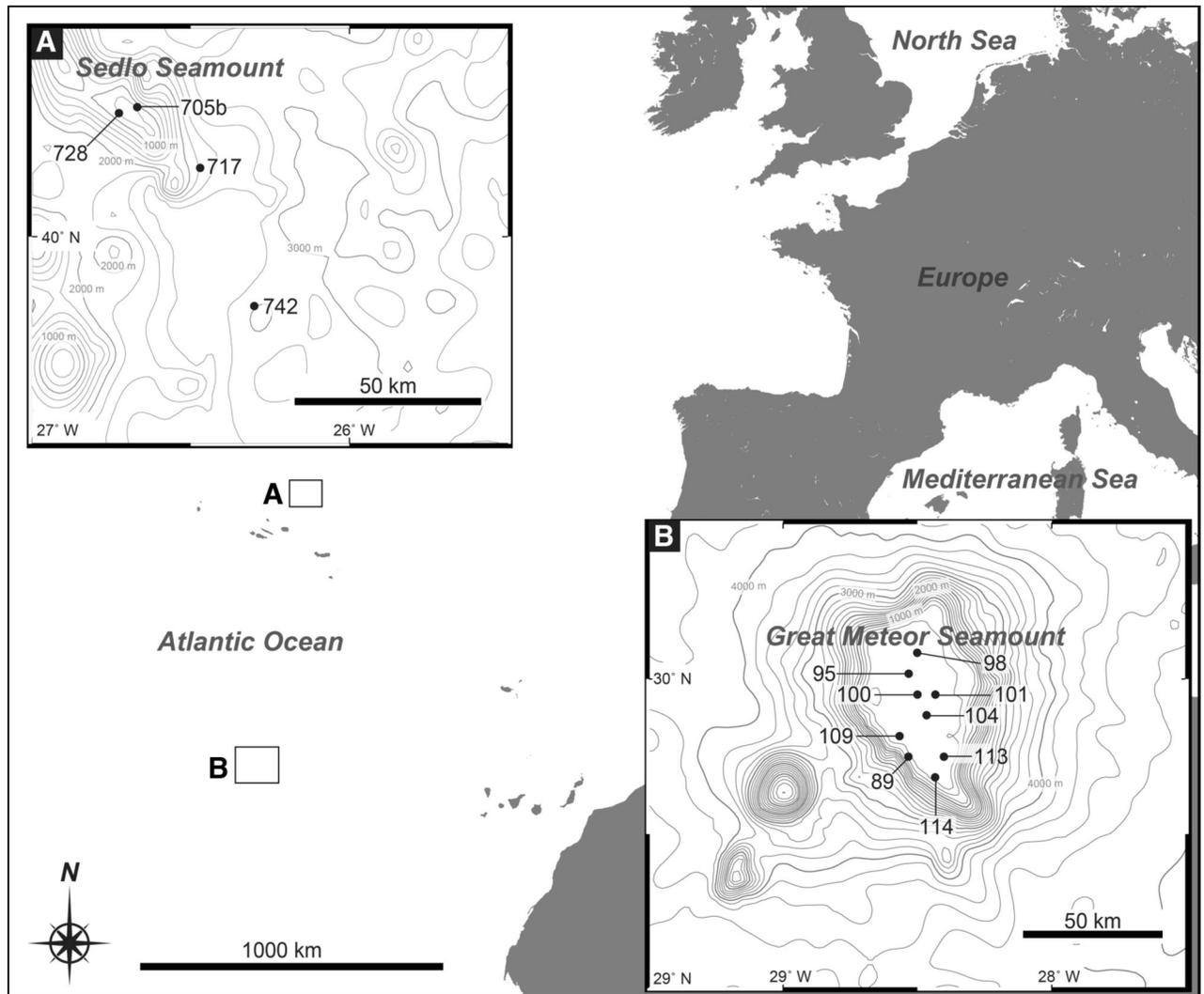
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**Figure 1.** Map of the sampling localities. **A.** Enlarged map of the Sedlo seamount and surrounding deep-sea floor. **B.** Enlarged map of the Great Meteor Seamount.

After the specimens were sorted, they were transferred into 4% formaldehyde.

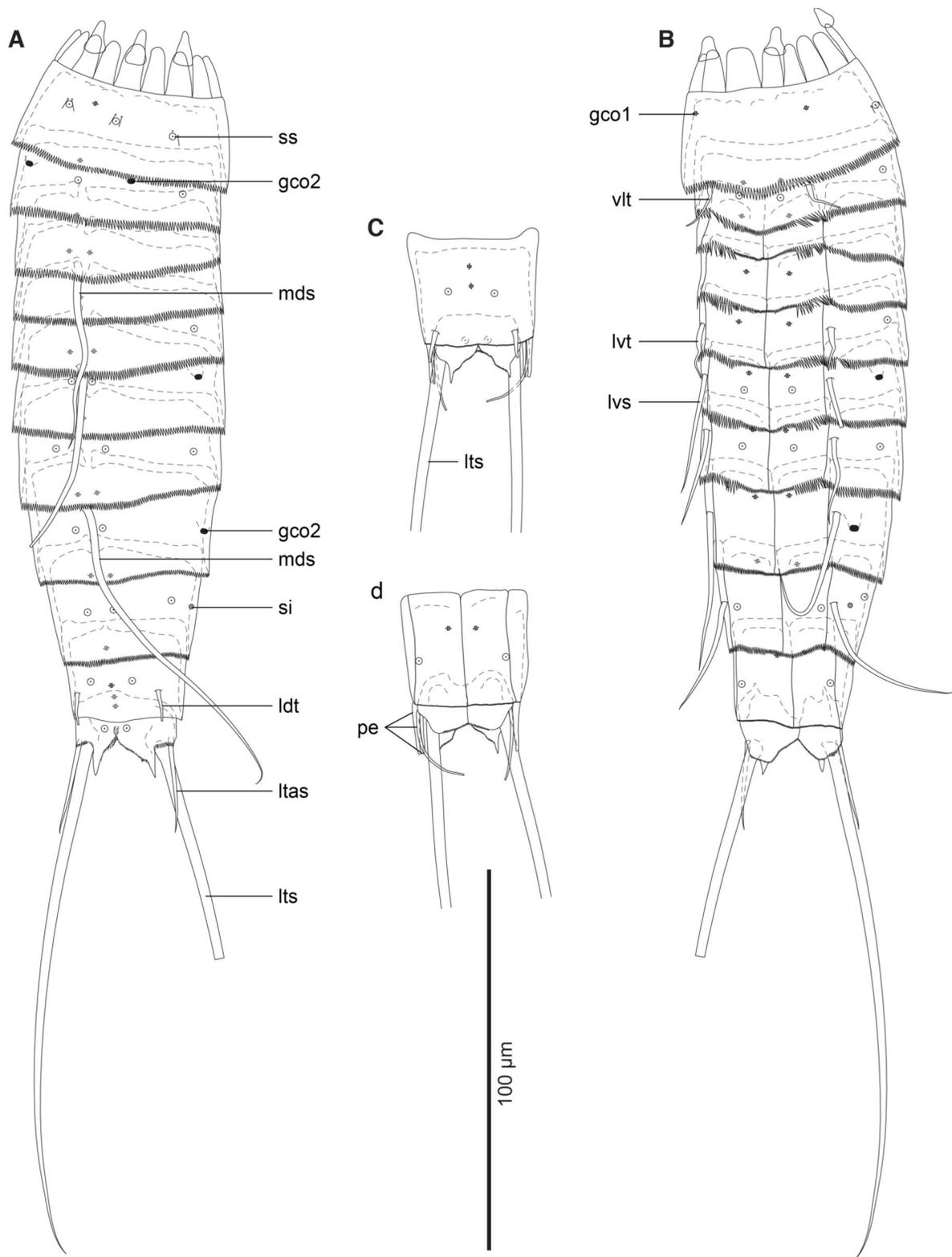
Specimens for light microscopy (LM) were mounted as glycerol-paraffin slides on Cobb aluminum frames. LM specimens were observed with a Zeiss Axioskop 50 microscope equipped with Nomarski differential interference contrast, an Optovar 1.6 $\times$ , objectives Plan-Neofluar 63/0.90 Korr. and 100/1.30 oil, and a camera lucida for drafts of line illustrations and measurements. Final line illustrations were drawn with Adobe Illustrator CS6 based on the drafts. Specimens were photographed with a Zeiss AxioCam MRc5 and objectives Plan-Neofluar 40 $\times$ /0.75 and 100 $\times$ /1.30 Ph3 oil attached to a microscope Zeiss Axioplan 2 mot.

Specimens for scanning electron microscopy (SEM) were transferred to distilled water through a graded series

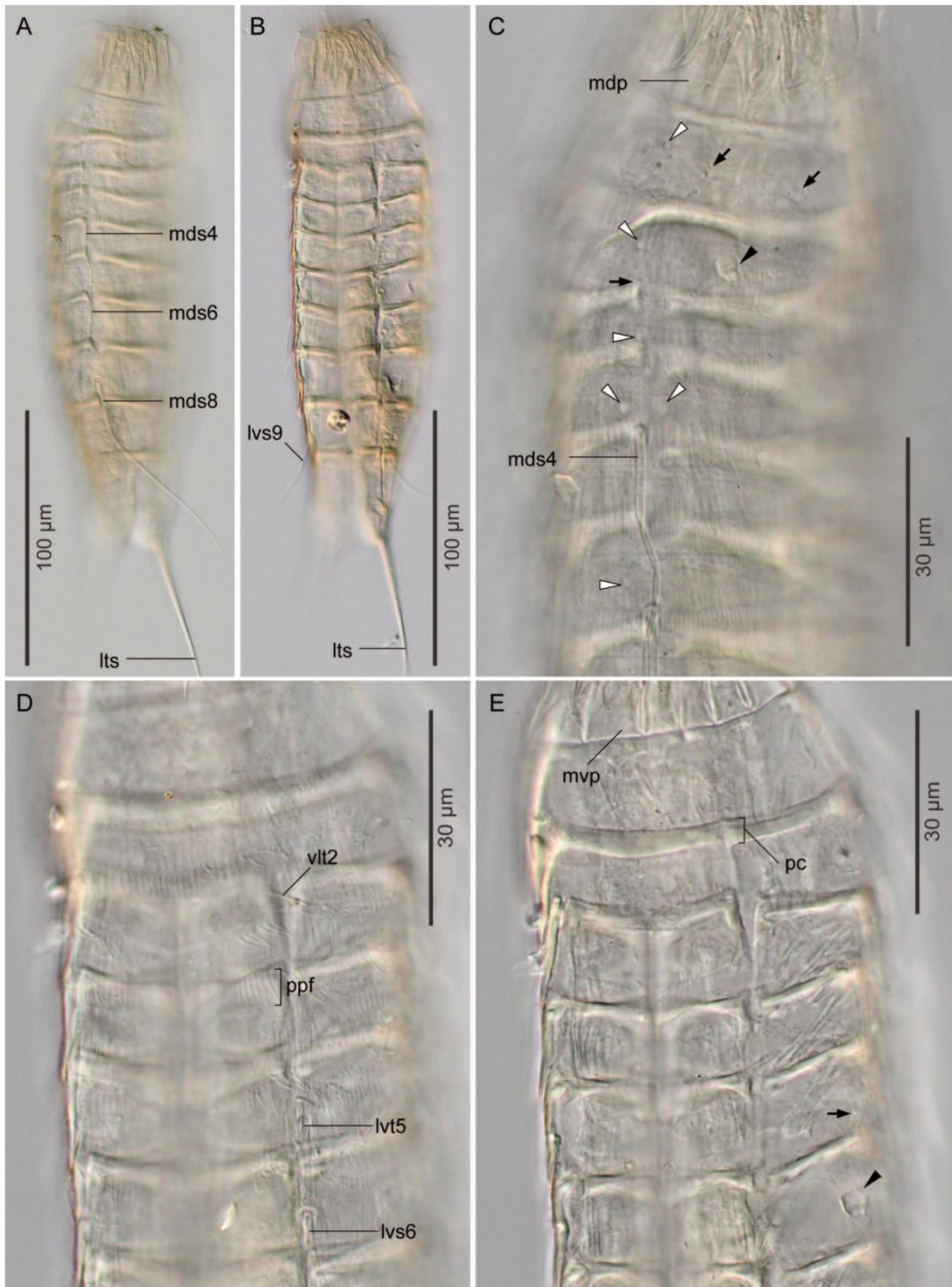
of ethanol, postfixed with OsO<sub>4</sub> in 0.05 M phosphate buffer (pH = 7.3) with 0.3 M sodium chloride and 0.05% sodium azide for 2.5 hours, dehydrated through a graded series of ethanol, critical-point dried, mounted on aluminum stubs, sputter-coated with gold-palladium, and observed with a Zeiss EVO LS 10 scanning electron microscope.

The terminology follows Neuhaus & Higgins (2002), Sørensen & Pardos (2008), and Neuhaus (2013). For comparison, ten specimens of *Echinoderes* cf. *ferrugineus*, which were collected at Sicily, Italy and reported in Dal Zotto & Todaro (2016), were given on loan by Dr Matteo Dal Zotto (University of Modena and Reggio Emilia). All specimens have been deposited in the Museum für Naturkunde Berlin (= ZMB, former Zoological Museum Berlin), Germany and catalogued in the collection “Vermes” in the “Generalkatalog Freilebende Würmer”.

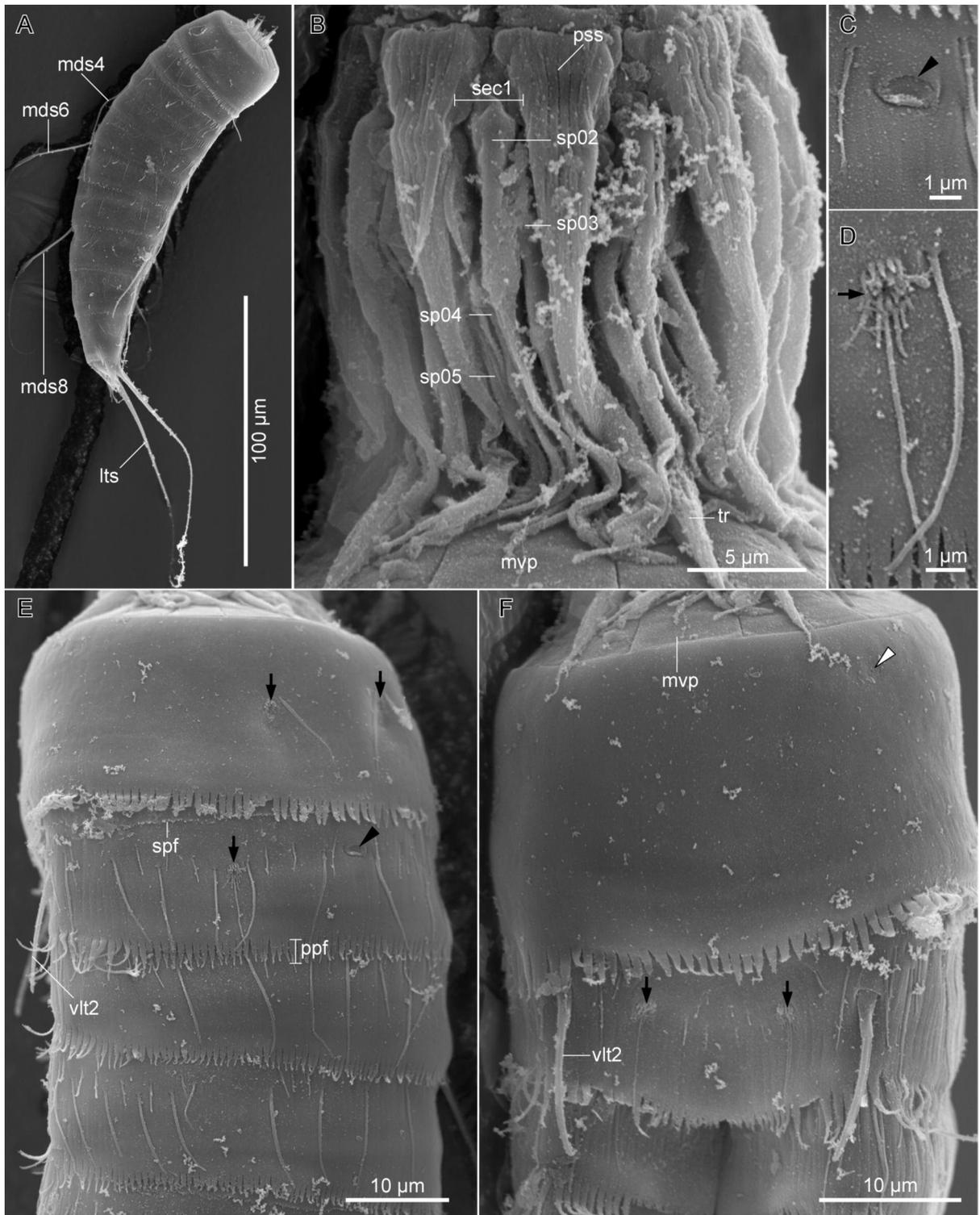




**Figure 2.** *Echinoderes apex* sp. nov. Camera lucida drawings. **A & B.** Holotype, female (ZMB 11561), entire animal, dorsal and ventral view of segments 1-11, respectively. **C & D.** Paratype, male (ZMB 11564d), segments 10 and 11, dorsal and ventral view, respectively. Abbreviations: gco1, type-1 glandular cell outlet; gco2, type-2 glandular cell outlet; ldt, laterodorsal tube; lta, lateral terminal accessory spine; lts, lateral terminal spine; lvs, lateroventral acicular spine; lvt, lateroventral tube; mds, middorsal acicular spine; pe, penile spine; si, sieve plate; ss, sensory spot; vlt, ventrolateral tube.



**Figure 3.** *Echinoderes apex* sp. nov. Nomarski photomicrographs of the holotypic female (ZMB 11561). **A.** Entire animal, dorsal view. **B.** Entire animal, ventral view. **C.** Neck and segments 1-6, dorsal view. **D.** Segments 1-6, ventral view, focusing on cuticular surface. **E.** Neck and segments 1-6, ventral view, focusing on subcuticular structures. Black arrows, white arrowheads, and black arrowheads indicate sensory spot, type-1 glandular cell outlet, and type-2 glandular cell outlet, respectively. Abbreviations: lts, lateral terminal spine; lvs, lateroventral acicular spine; lvt, lateroventral tube; mdp, middorsal placid; mds, middorsal acicular spine;.mvp, midventral placid; pc, pachycyclus; ppf, primary pectinate fringe; vlt, ventrolateral tube. Digits after abbreviations indicate the corresponding segment number.

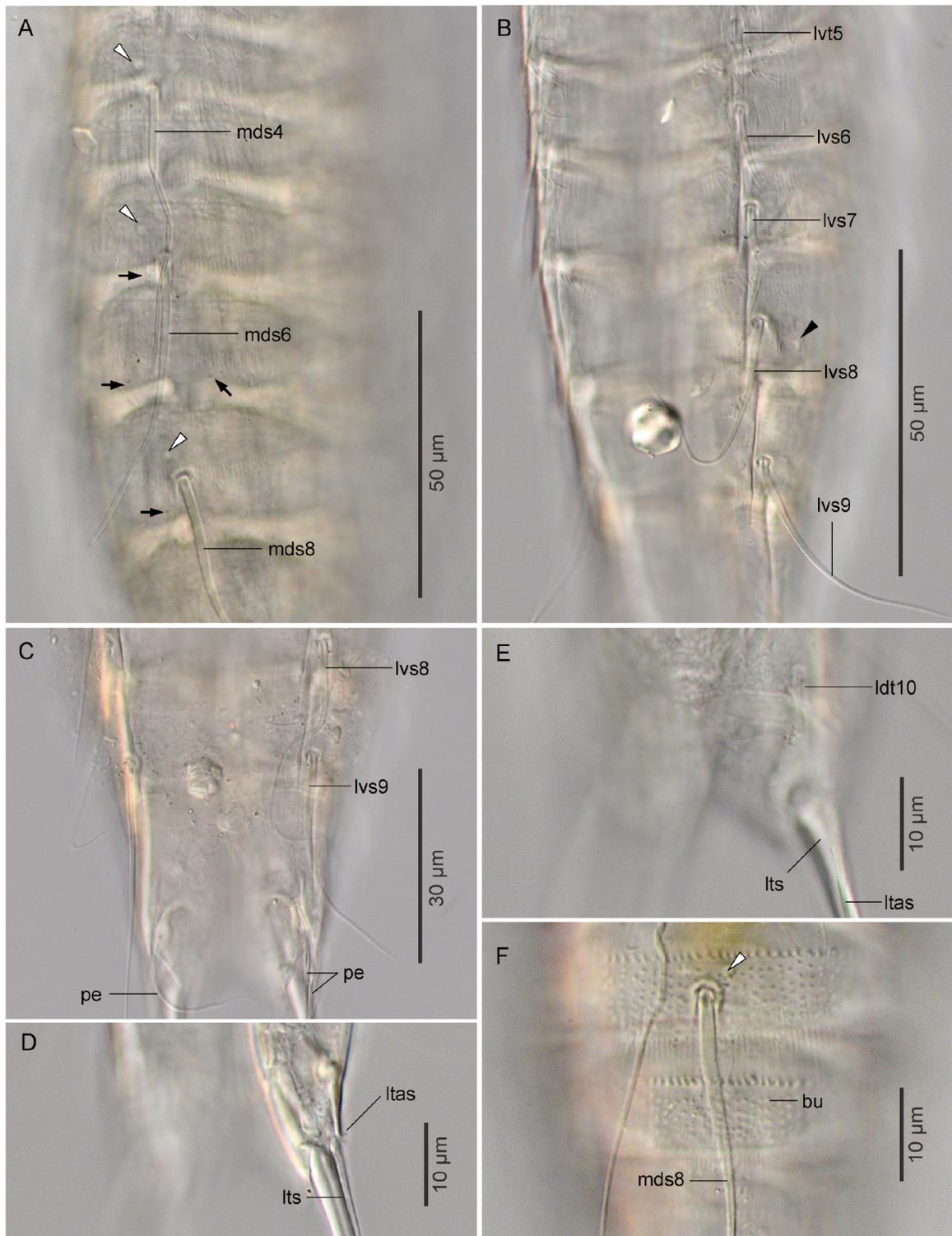


**Figure 4.** *Echinoderes apex* sp. nov. Scanning electron micrographs of males. **A.** Entire male animal, lateral view (right side). **B.** Introvert, ventral view. **C.** Close-up of subdorsal type-2 glandular outlet on segment 2. **D.** Close-up of midlateral sensory spot on segment 2. **E.** Segments 1-4, lateral view (left side). **F.** Segments 1-3, ventral view. Black arrows, white arrowhead, and black arrowheads indicate sensory spot, type-1 glandular cell outlet, and type-2 glandular cell outlet, respectively. Abbreviations: lts, lateral terminal spine; mds, middorsal acicular spine;.mvp, midventral placid; ppf, primary pectinate fringe; pss, primary spinoscalid; sec, sector number; sp, spinoscalid; spf, secondary pectinate fringe; tr, trichoscalid; vlt, ventrolateral tube. Digits after abbreviations indicate sector number, ring number, or the corresponding segment number.

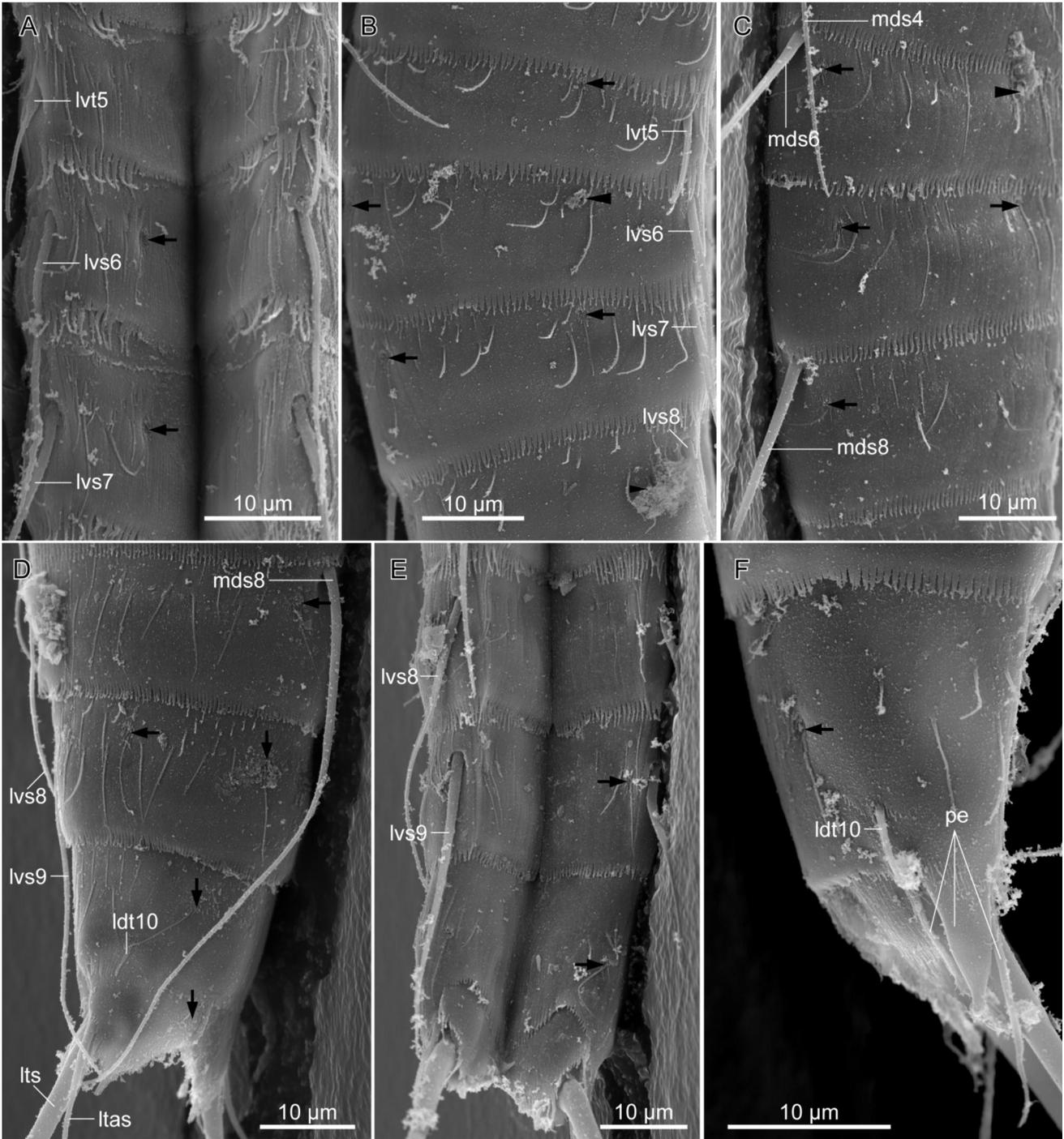






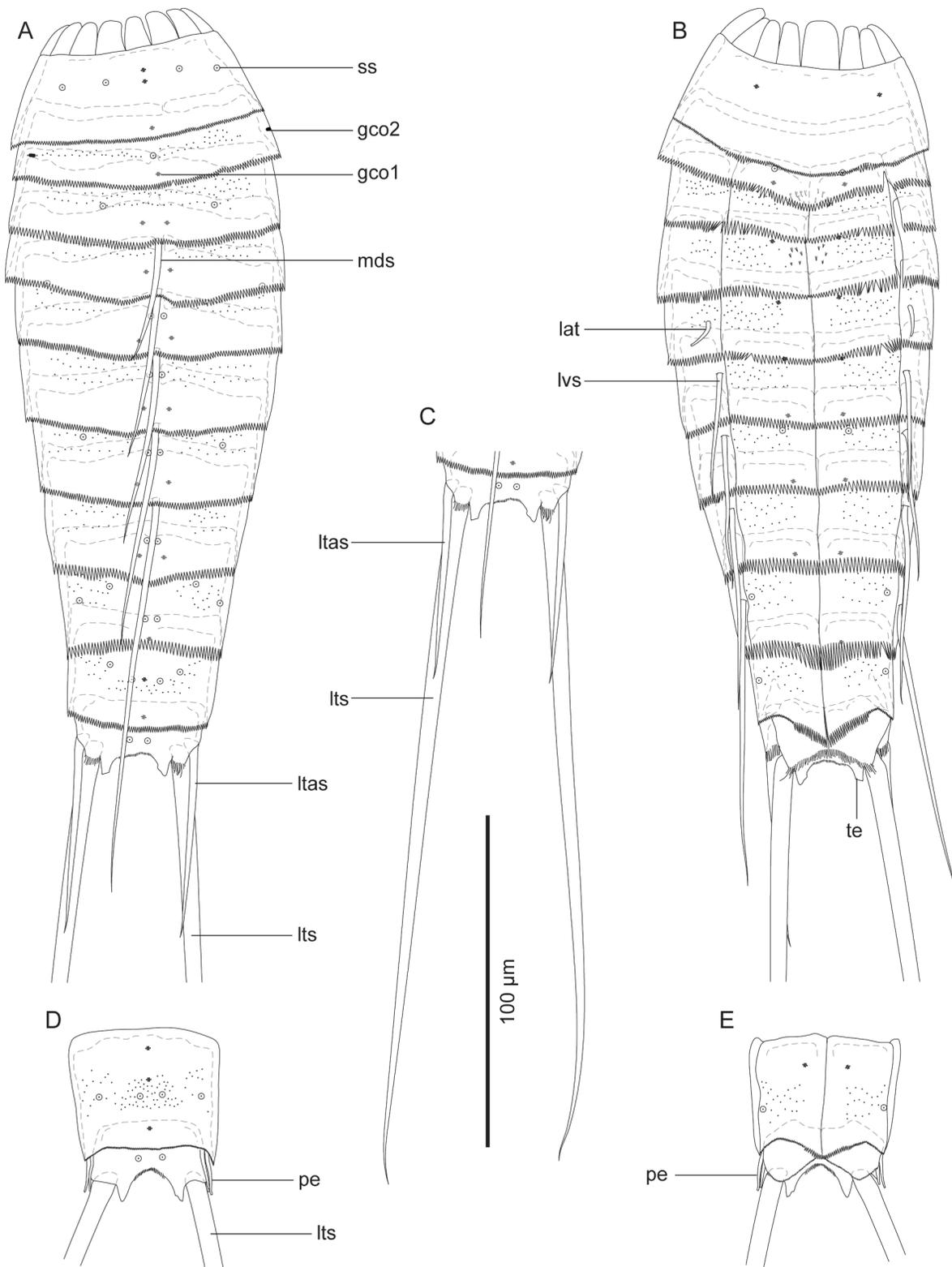


**Figure 6.** *Echinoderes apex* sp. nov. Nomarski photomicrographs of the holotypic female (ZMB 11561) (A, B, D, E), a paratypic male (ZMB 11564d) (C), and a recently moulted female (ZMB 11566d) (F). **A.** Segments 4-8, dorsal view. **B.** Segments 5-10, ventral view. **C.** Segments 6-11, ventral view. **D.** Segments 11, ventrolateral view. **E.** Segments 10 and 11, dorsal view. **F.** Segments 8 and 9, dorsal view. Black arrows, white arrowheads, and black arrowheads indicate sensory spot, type-1 glandular cell outlet, and type-2 glandular cell outlet, respectively. Abbreviations: bu, button-like structure; ldt, laterodorsal tube; ltas, lateral terminal accessory spine; lts, lateral terminal spine; lvs, lateroventral acicular spine; lvt, lateroventral tube; mds, middorsal acicular spine; pe, penile spine. Digits after abbreviations indicate the corresponding segment number.

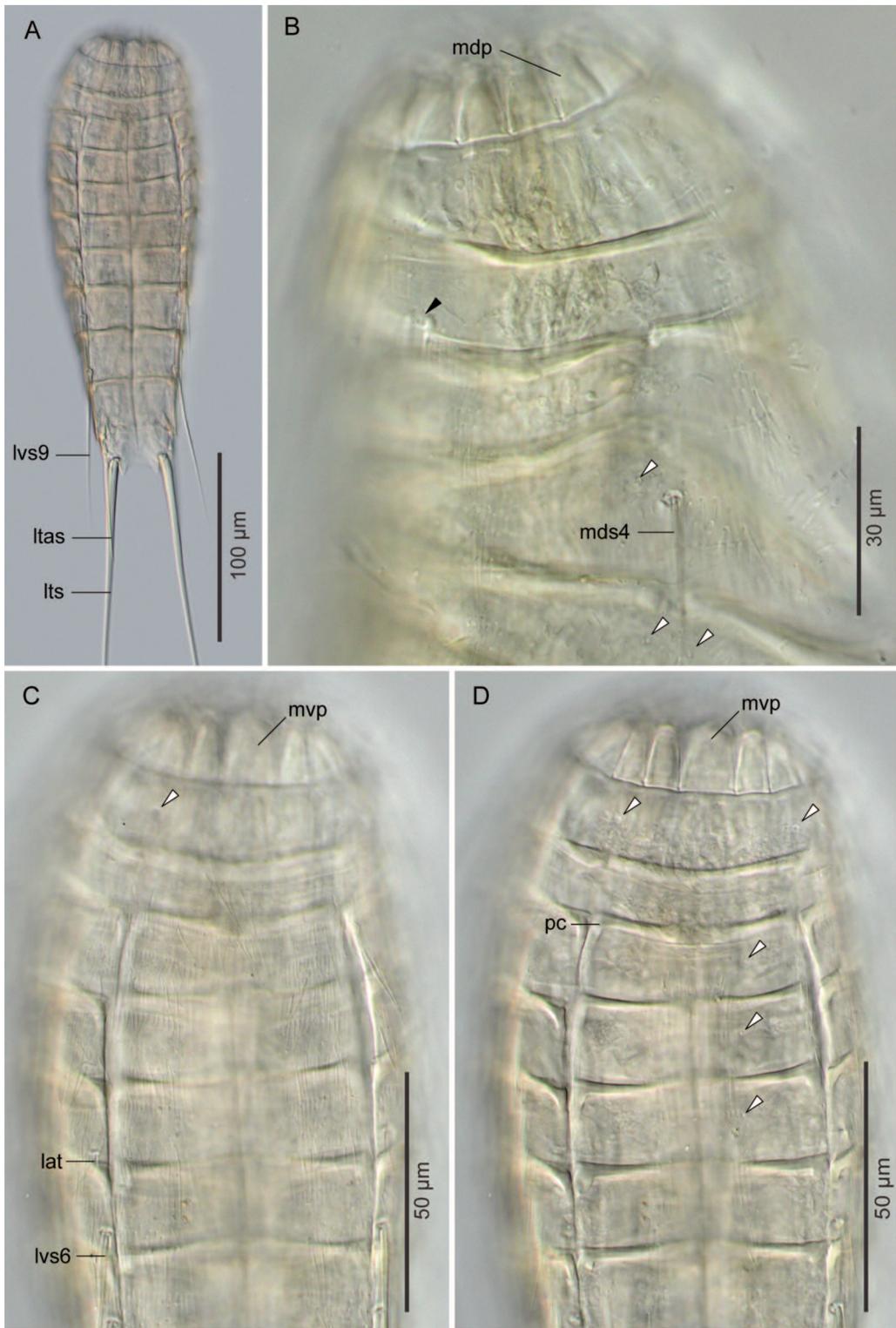


**Figure 7.** *Echinoderes apex* sp. nov., scanning electron micrographs of males (A-C, E, F) and a female (D). **A.** Segments 5-7, ventral view. **B.** Segments 4-8, lateral view (right side). **C.** Segments 6-8, laterodorsal view. **D.** Segments 8-11, laterodorsal view. **E.** Segments 8-11, ventral view. **F.** Segments 10-11, lateral view (right side). Black arrows and black arrowheads indicate sensory spot and type-2 glandular cell outlet, respectively. Abbreviations: *ldt*, laterodorsal tube; *ltas*, lateral terminal accessory spine; *lts*, lateral terminal spine; *lvs*, lateroventral acicular spine; *lvt*, lateroventral tube; *mds*, middorsal acicular spine; *pe*, penile spine. Digits after abbreviations indicate the corresponding segment number.

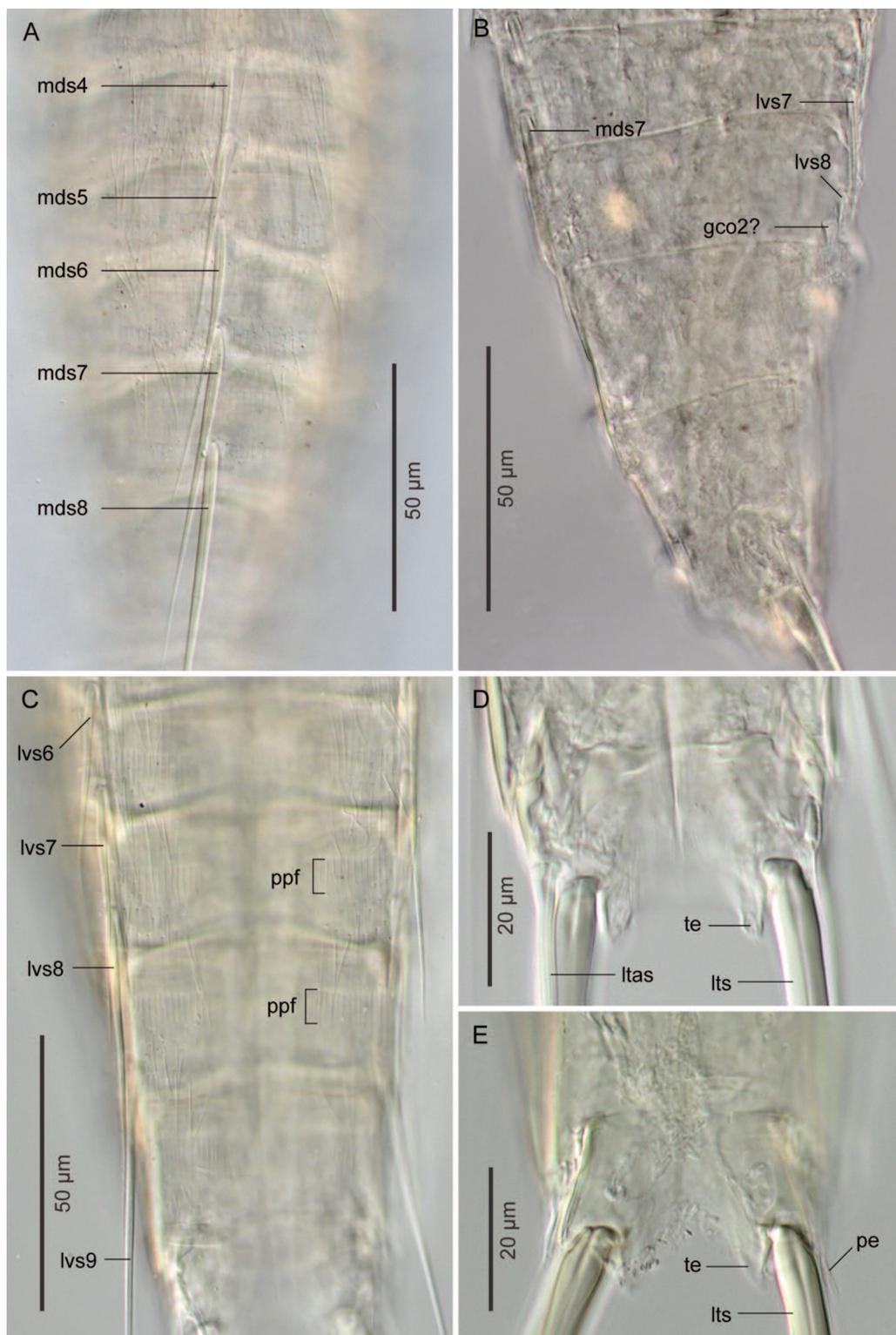




**Figure 8.** *Echinoderes bathyalis* sp. nov. Camera lucida drawings. **A-C.** Holotype, female (ZMB 11576), entire animal, dorsal and ventral view of segments 1-11 and dorsal view of segment 11 with lateral terminal spines, respectively. **D & E.** Paratype, male (ZMB 11577), segments 10 and 11, dorsal and ventral view, respectively. Abbreviations: gco1, type-1 glandular cell outlet; gco2, type-2 glandular cell outlet; lat, lateral accessory tube; lvs, lateroventral acicular spine; mds, middorsal acicular spine; pe, penile spine; ss, sensory spot; te, tergal extension.



**Figure 9.** *Echinoderes bathyalis* sp. nov. Nomarski photomicrographs of the holotypic female (ZMB 11576) (A, C, D) and a paratypic male (ZMB 11577) (B). **A.** Entire animal, ventral view. **B.** Neck and segments 1-5, dorsal view. **C.** Segments 1-7, ventral view, focusing on the cuticle surface. **D.** Segments 1-7, ventral view, focusing on different focal plane. White and black arrowheads indicate type-1 and type-2 glandular cell outlets, respectively. Abbreviations: lat, lateral accessory tube; ltas, lateral terminal accessory spine; lts, lateral terminal spine; lvs, lateroventral acicular spine; mdp, middorsal placid; mds, middorsal acicular spine; mvp, midventral placid; pc, pachyclus. Digits after abbreviations indicate the corresponding segment number.

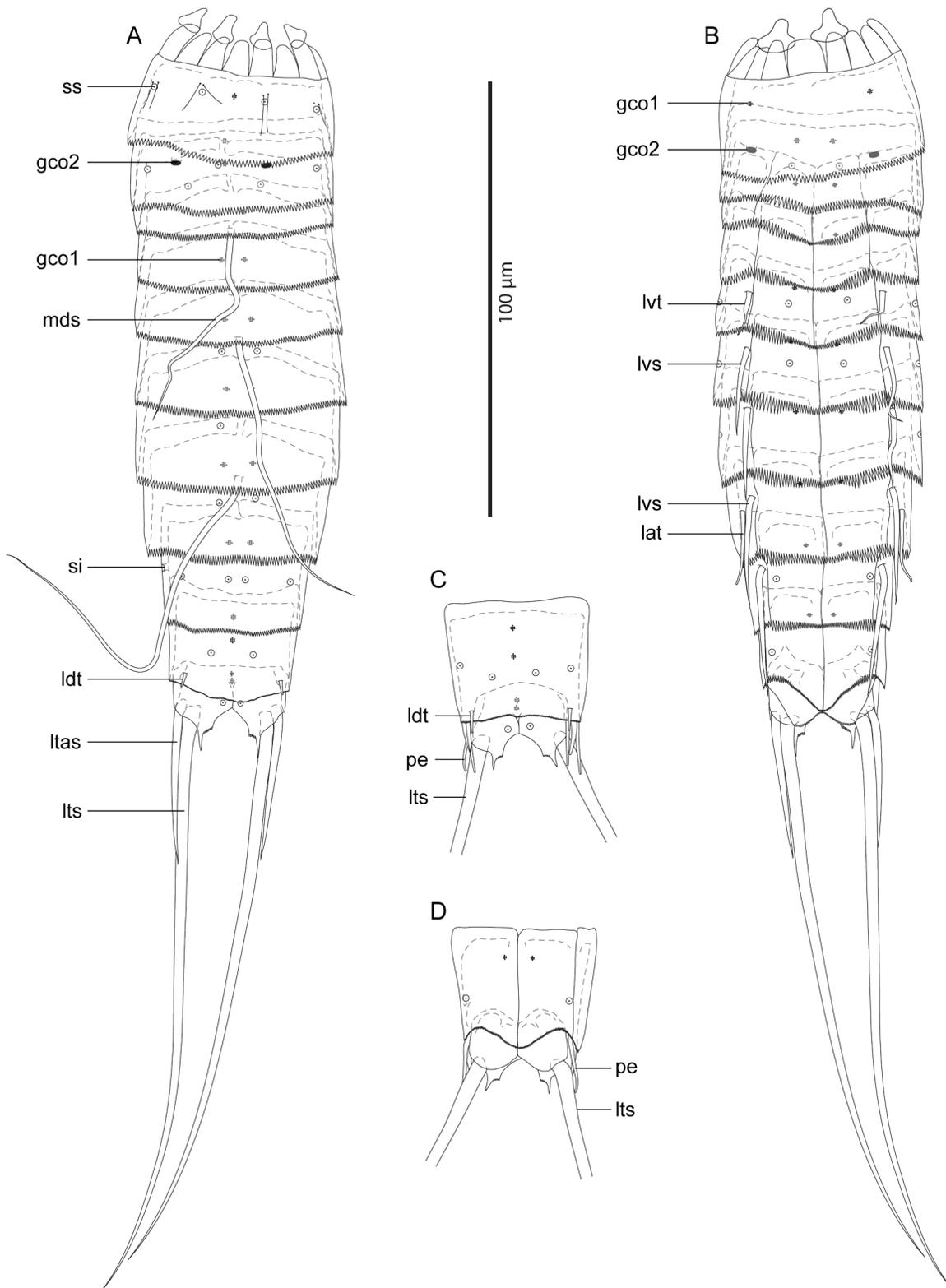


**Figure 10.** *Echinoderes bathyalis* sp. nov. Nomarski photomicrographs of the holotypic female (ZMB 11576) (A, C, D), a paratypic male (ZMB 11577) (E), and a paratypic recently moulted male (ZMB 11578) (B). **A.** Segments 4-8, dorsal view. **B.** Segments 7-11, lateral view (right side). **C.** Segments 7-11, ventral view. **D.** Segment 11 of female, ventral view. **E.** Segment 11 of male, ventral view. Abbreviations: gco2, type-2 glandular cell outlet; ltas, lateral terminal accessory spine; lts, lateral terminal spine; lvs, lateroventral acicular spine; mds, middorsal acicular spine; pe, penile spine; ppf, primary pectinate fringe; te, tergal extension. Digits after abbreviations indicate the corresponding segment number.

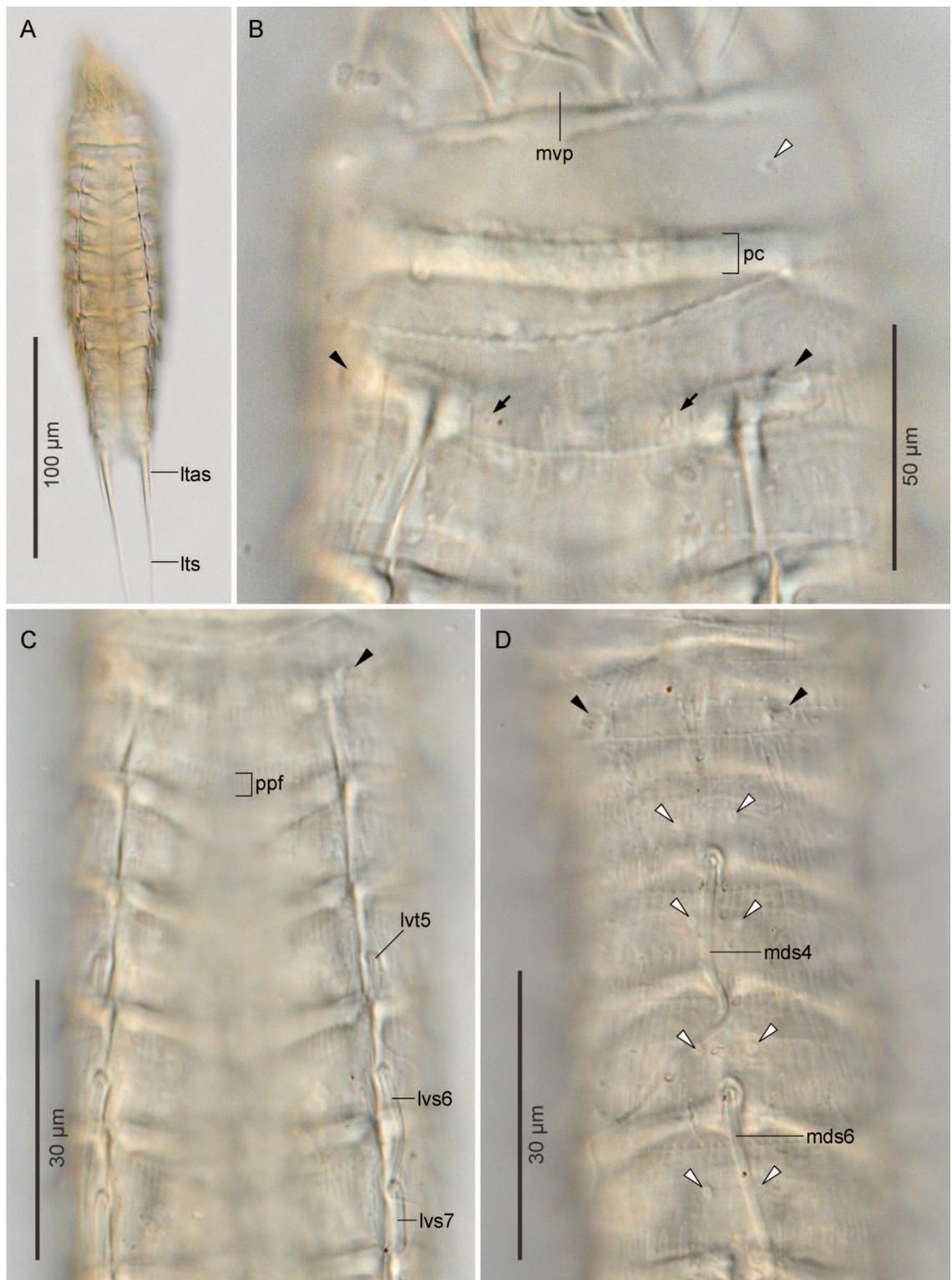




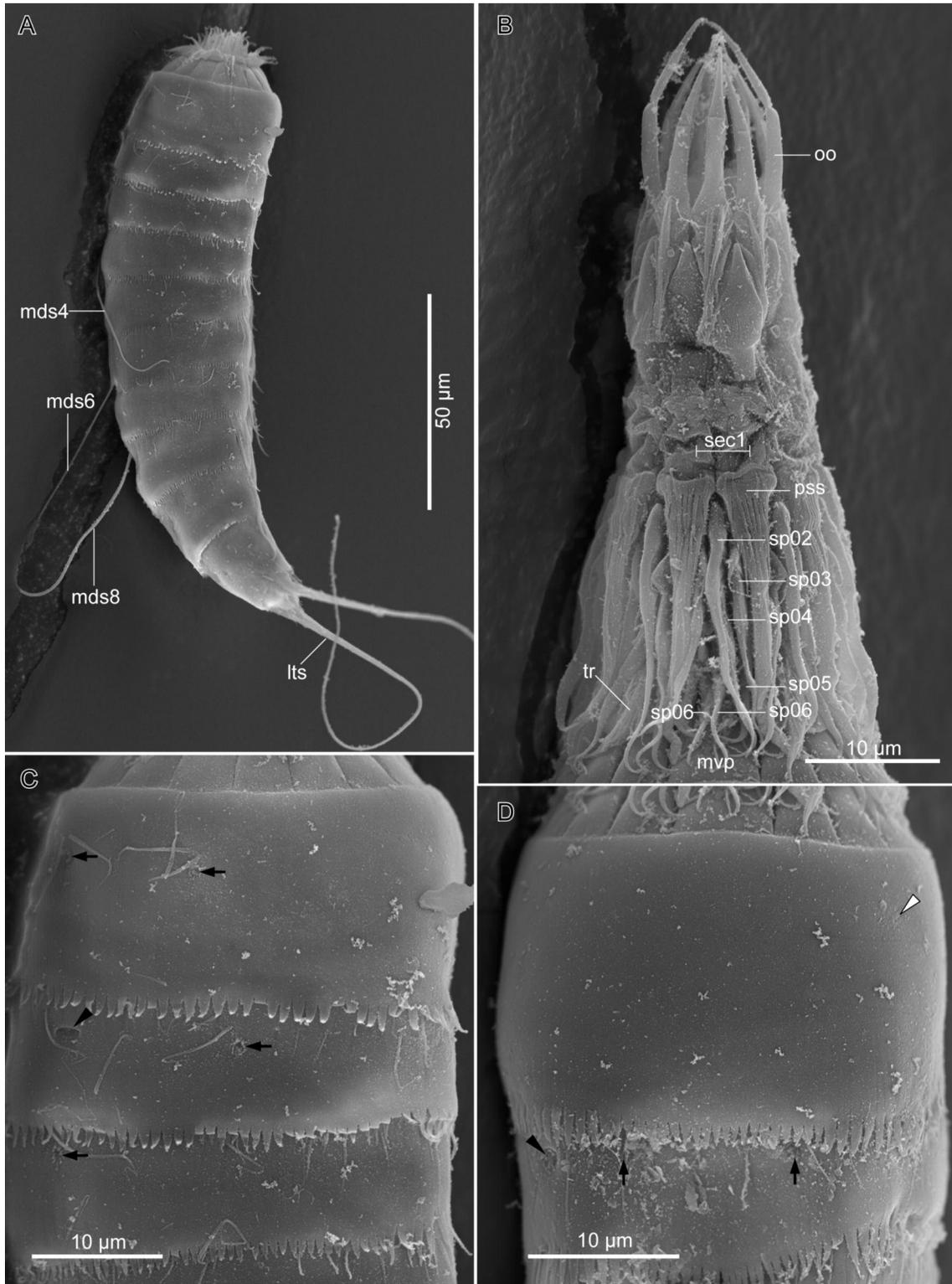




**Figure 11.** *Echinoderes meteorensis* sp. nov. Camera lucida drawings. **A & B.** Holotype, female (ZMB 11570), entire animal, dorsal and ventral view of segments 1-11, respectively. **C & D.** Paratype, male (ZMB 11571c), segments 10 and 11, dorsal and ventral view, respectively. Abbreviations: gco1, type-1 glandular cell outlet; gco2, type-2 glandular cell outlet; lat, lateral accessory tube; ldt, laterodorsal tube; ltas, lateral terminal accessory spine; lts, lateral terminal spine; lvs, lateroventral acicular spine; lvt, lateroventral tube; mds, middorsal acicular spine; pe, penile spine; si, sieve plate; ss, sensory spot.

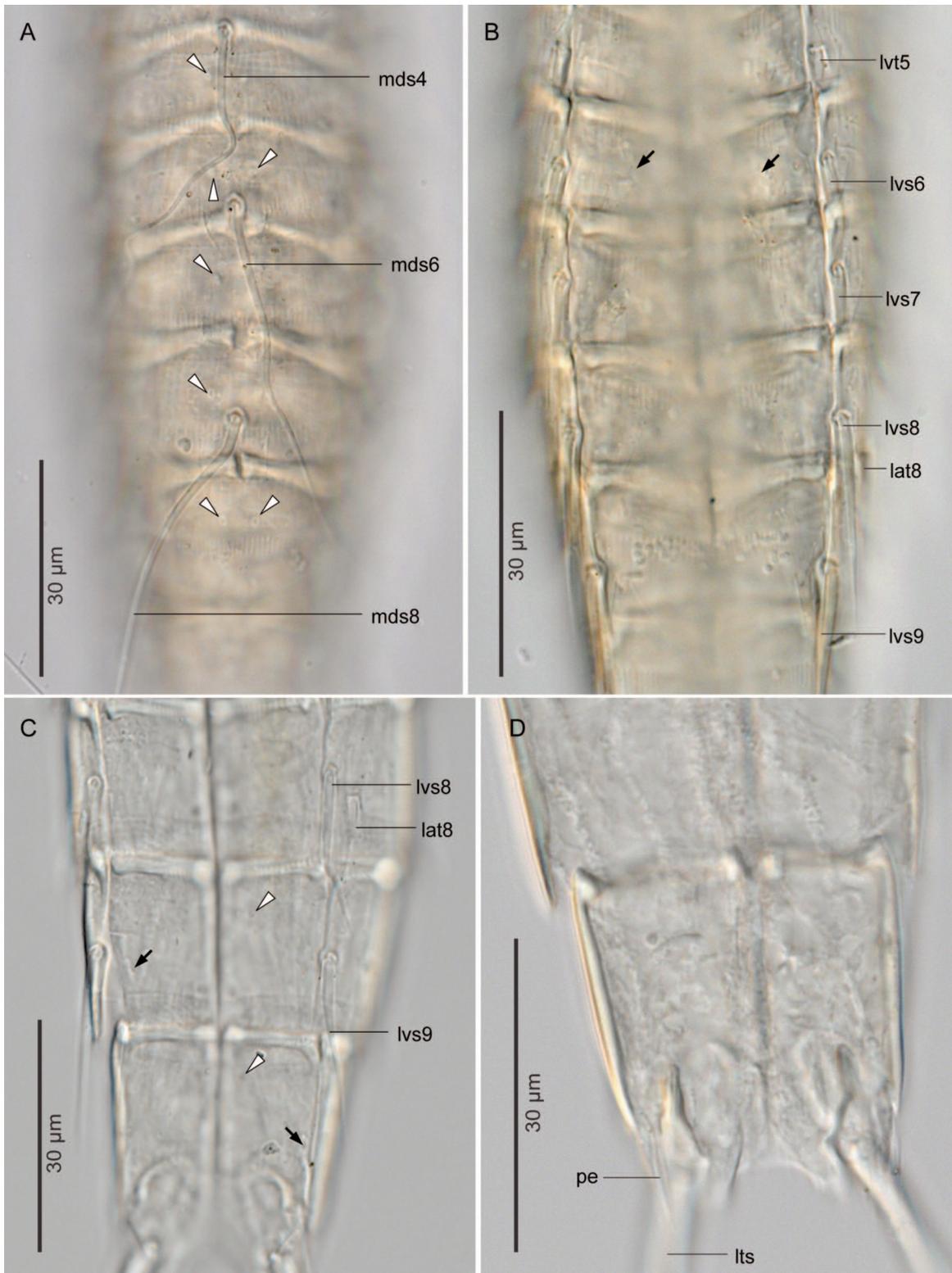


**Figure 12.** *Echinoderes meteorensis* sp. nov. Nomarski photomicrographs of the holotypic female (ZMB 11570). **A.** Entire animal, ventral view. **B.** Neck and segments 1-3, ventral view. **C.** Segments 2-7, ventral view. **D.** Segments 2-6, dorsal view. Black arrows, white arrowheads, and black arrowheads indicate sensory spot, type-1 glandular cell outlet, and type-2 glandular cell outlet, respectively. Abbreviations: ltas, lateral terminal accessory spine; lts, lateral terminal spine; lvs, lateroventral acicular spine; lvt, lateroventral tube; mds, middorsal acicular spine; mvp, midventral placid; pc, pachycycclus; ppf, primary pectinate fringe. Digits after abbreviations indicate the corresponding segment number.

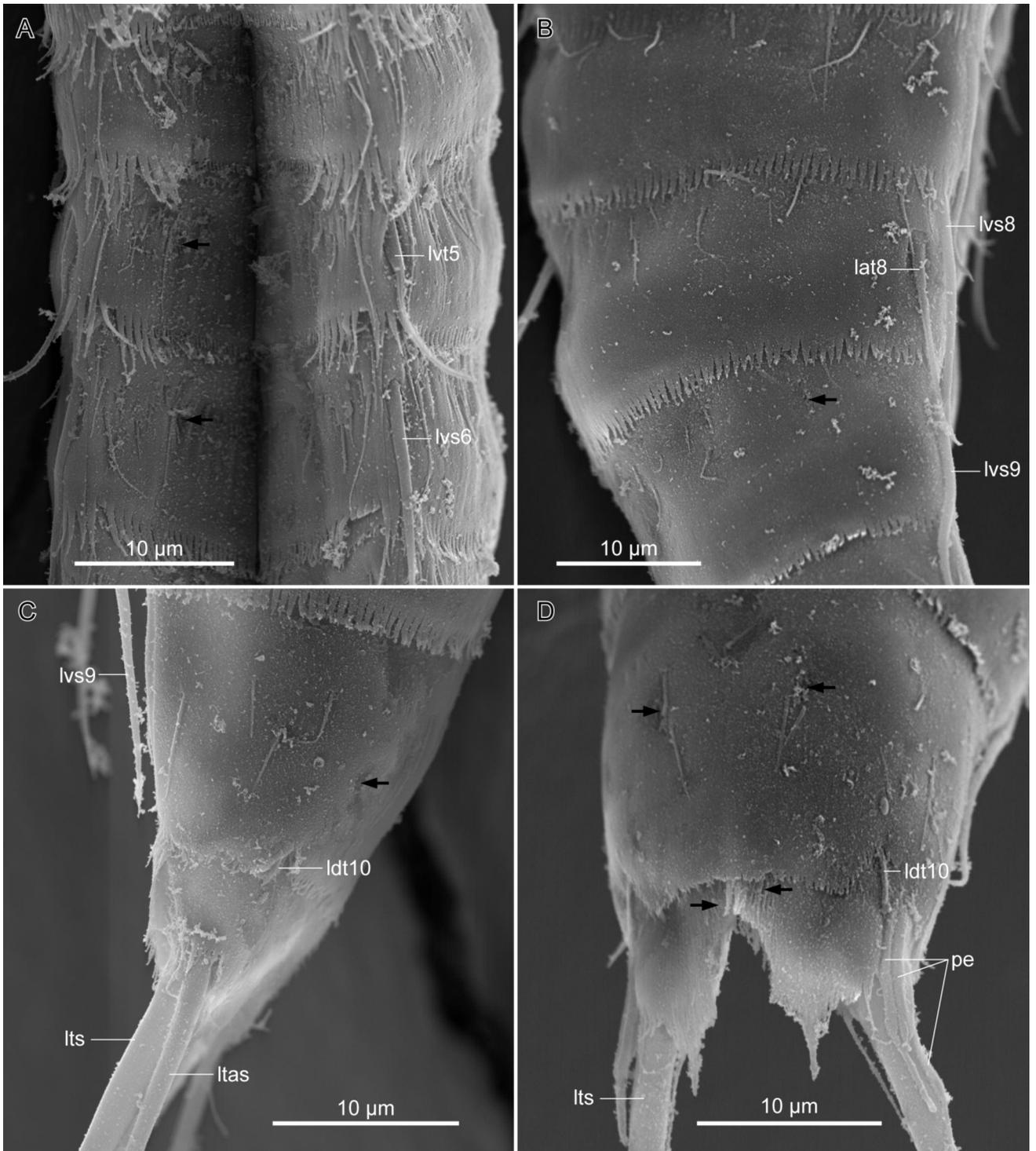


**Figure 13.** *Echinoderes meteorensis* sp. nov.. Scanning electron micrographs of a male (A, C) and a female (B, D). **A.** Entire male animal, lateral view (right side). **B.** Head, ventral view. **C.** Segments 1-3, lateral view (right side). **D.** Segments 1 and 2, ventral view. Black arrows, white arrowhead, and black arrowheads indicate sensory spot, type-1 glandular cell outlet, and type-2 glandular cell outlet, respectively. Abbreviations: lts, lateral terminal spine; mds, middorsal acicular spine;.mvp, midventral placid; oo, outer oral style; pss, primary spinoscalids; sec, sector number; sp, spinoscalid; tr, trichoscalid. Digits after abbreviations indicate sector number, ring number, or the corresponding segment number.





**Figure 15.** *Echinoderes meteorensis* sp. nov., Nomarski photomicrographs of the holotypic female (ZMB 11570) (A & B) and a paratyptic male (ZMB 11571c) (C & D). **A.** Segments 4-9, dorsal view. **B.** Segments 5-9, ventral view. **C.** Segments 8-11, ventral view. **D.** Segments 9-11, dorsal view. Black arrows and white arrowheads indicate sensory spot and type-1 glandular cell outlet, respectively. Abbreviations: lat, lateral accessory tube; lts, lateral terminal spine; lvs, lateroventral acicular spine; lvt, lateroventral tube; mds, middorsal acicular spine; pe, penile spine. Digits after abbreviations indicate the corresponding segment number.



**Figure 16.** *Echinoderes meteorensis* sp. nov. Scanning electron micrographs of a male (B & D) and a female (A & C). **A.** Segments 4-6, ventral view. **B.** Segments 7-9, lateral view (right side). **C.** Segments 10 and 11, laterodorsal view. **D.** Segments 10 and 11, laterodorsal view. Black arrows indicate sensory spot. Abbreviations: lat, lateral accessory tube; ldt, laterodorsal tube; ltas, lateral terminal accessory spine; lts, lateral terminal spine; lvs, lateroventral acicular spine; lvt, lateroventral tube; pe, penile spine. Digits after abbreviations indicate the corresponding segment number.





