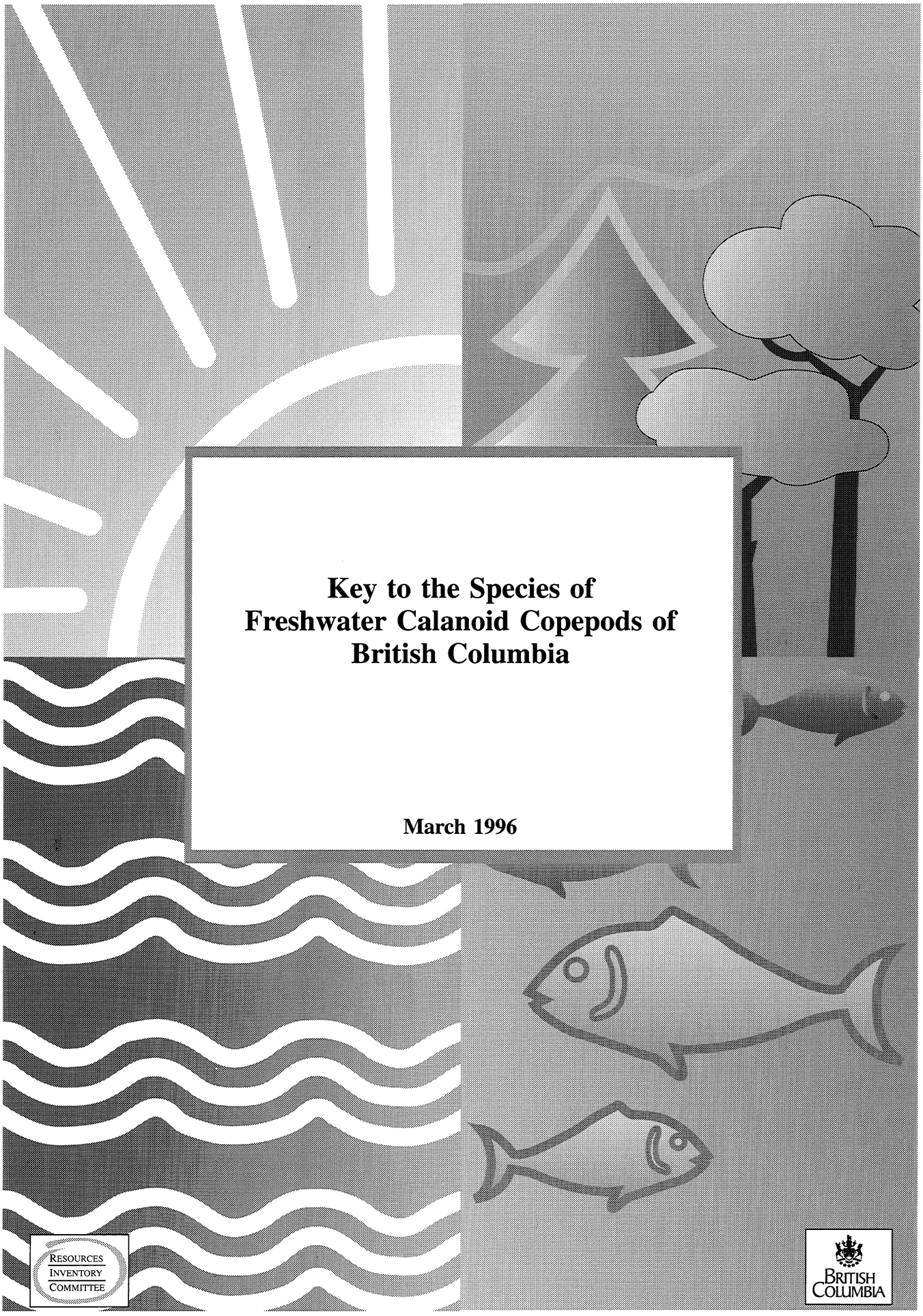

Key to the Species of Freshwater Calanoid Copepods of British Columbia

March 1996

RESOURCES INVENTORY COMMITTEE

BRITISH COLUMBIA

Resources Inventory Committee

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Key to the Species of Freshwater Calanoid Copepods of British Columbia

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Ministry of Environment, Lands and Parks
Water Quality Branch
for the Aquatic Ecosystems Task Force
Resources Inventory Committee

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The Resources Inventory Committee consists of representatives from various ministries and agencies of the Canadian and the British Columbia governments as well as from First Nations peoples. RIC objectives are to develop a common set of standards and procedures for the provincial resources inventories, as recommended by the Forest Resources Commission in its report “The Future of our Forests”.

Aquatic Ecosystems Task Force

A March 1994 draft of the key was reviewed at that time by the late T.E. Bowman and T.G. Northcote. We are indebted to Launi Lucas, Zoology, UBC, for help with the final illustrations and final preparation of the text. F.K. Sandercock helped with collecting and final MS preparation. The comments made by N.T. Johnston were appreciated.

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Funding was provided from RIC with the support of R. Nordin, MELP, Water Branch, Victoria.

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KEY TO THE FRESHWATER CALANOID COPEPODS OF BRITISH COLUMBIA

Calanoid copepods are small crustaceans, 1-5 mm in length, commonly found as part of the free-living zooplankton in freshwater lakes and ponds (Williamson 1991). The monitoring of species change in calanoids can detect environmental changes, such as that resulting from acidification or toxification (Marmorek & Korman 1993). Calanoids are important as both predators and prey in the food webs of freshwater ecosystems.

Calanoids are recognized by the position of the body articulation, which is after the last metasomal (or thoracic) segment, and before the urosome (Fig. 1). They usually have an elongated body, long 1st antennae, and well-developed 5th legs, which are used in copulation. These and other characteristics separate them from the other fresh-water copepod groups, the cyclopoids and harpacticoids (Wilson 1959, Williamson 1991). The many variations in the appearance of the calanoid body are illustrated in Huys and Boxshall (1991).

This key was prepared to simplify the process of identification of the thirty species of calanoids we have found in British Columbia, as opposed to the 100 or more species covered in other North American keys (Wilson 1959, Pennak 1989). This key is a part of a larger work on "The Freshwater Calanoid Copepods of British Columbia" (Unpub. MS, by G.A. Sandercock and G.G.E. Scudder).

The species included in the checklist (p. 4) and key (p. 6) of B.C. freshwater calanoids are based on previously published data, and our unpublished records. The latter includes the B.C. records of the late Mildred S. Wilson (MSW, *in litt.*). The nomenclature used follows Dussart and Defaye (1983). Table 1 (p. 4) lists the B.C. freshwater calanoid species under their usual habitat type,

based on our unpublished records. Habitat notes for these species are also found in Wilson (1959), based on their North American distributions.

The major features of the morphology of the male calanoid copepod are given (Figs. 1a, 1b, 2a, 2b), and the female is illustrated for comparison (Figs. 1c, 1d, 2c, 2d). Male calanoids are recognized by having a geniculate right 1st antenna and a non-geniculate left 1st antenna (Fig. 1a), relatively large asymmetric 5th legs (Fig. 2b), and a 5-segmented urosome (Fig. 1b). Females are recognized by having both 1st antennae non-geniculate (Fig. 1c), the 5th legs are relatively small and symmetric (Fig. 2d). The female urosome has 2 or 4 segments, with the enlarged genital segment formed from the fusion of two segments (Figs. 1d, 2c). A female may be ovigerous, carrying eggs in two egg sacs (Fig. 1c) (Wilson 1959, Williamson 1991).

In the lateral view of the whole animal (Figs. 1b, 1d, 7b), the mouthparts and swimming legs 1-4 are represented diagramatically (mouthparts redrawn after Vanderploeg & Paffenhöffer 1985; legs 1-4 redrawn after Sars 1903, and Einsele 1989).

The key provided is for male calanoids only. Wilson (1959) included a key to North American female calanoids, but the taxonomic characteristics are less definitive for females than for males. Pennak (1989) suggested that calanoid females can only be identified to species tentatively, when associated with a known male.

Most of the male key characters are located on the 1st antennae (Table 2, Figs. 3a, 3c) and the 5th legs (Figs. 2a, 2b). Users should be aware that accurate species identification in most cases will involve dissection of parts, slide making and viewing with a compound microscope.

Acknowledgements

A March 1994 draft of the key was reviewed at that time by the late T.E. Bowman and T.G. Northcote. We are indebted to Launi Lucas, Zoology, UBC, for help with the final illustrations and final preparation of the text. F.K. Sandercock helped with collecting and final MS preparation.

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Funding was provided from RIC with the support of R. Nordine, MELP, Water Branch, Victoria.

CHECKLIST OF FRESHWATER CALANOID COPEPODS OF BRITISH COLUMBIA

Order COPEPODA
- Suborder CALANOIDA
  - Family PSEUDOCALANIDAE Gurney, 1931
    - Genus *Senecella* Juday, 1923
      - *Senecella calanoides* Juday, 1923
  - Family TEMORIDAE G.O. Sars, 1903
    - Genus *Eurytemora* Giesbrecht, 1881
      - *Eurytemora affinis* (Poppe, 1880)
    - Genus *Epischura* Forbes, 1882
      - *Epischura nevadensis* Lilljeborg, 1889
    - Genus *Heterocope* G.O. Sars, 1863
      - *Heterocope septentrionalis* Juday & Muttkowski, 1915
  - Family DIAPTOMIDAE G.O. Sars, 1903
    - Subfamily DIAPTOMINAE Kiefer, 1932a
      - Genus *Acanthodiaptomus* Kiefer, 1932a
        - *Acanthodiaptomus denticornis* (Wierzejski, 1887)
      - Genus *Aglaodiaptomus* Light, 1938
        - *Aglaodiaptomus forbesi* (Forbes, 1882)
        - *Aglaodiaptomus leptopus* Light, 1938
      - Genus *Hesperodiaptomus* Light, 1938
        - *Hesperodiaptomus arcticus* (Marsh, 1920)
        - *Hesperodiaptomus caducus* Light, 1938[3]
        - *Hesperodiaptomus eiseni* (Lilljeborg, 1889)
        - *Hesperodiaptomus franciscanus* (Lilljeborg, 1889)
        - *Hesperodiaptomus hirsutus* Wilson, 1953
        - *Hesperodiaptomus kenai* Wilson, 1953
        - *Hesperodiaptomus kiseri* (Kincaid, 1953)
        - *Hesperodiaptomus nevadensis* Light, 1938
        - *Hesperodiaptomus novemdecimus* Wilson, 1953
      - Genus *Leptodiaptomus* Light, 1938
        - *Leptodiaptomus ashlandi* (Marsh, 1893)
        - *Leptodiaptomus connexus* Light, 1938
        - *Leptodiaptomus insularis* Kincaid, 1956
        - *Leptodiaptomus novamexicanus* (Herrick, 1895)
        - *Leptodiaptomus nudus* (Marsh, 1904)
        - *Leptodiaptomus pribilofensis* (Juday & Muttkowski, 1915)
        - *Leptodiaptomus sicilis* (Forbes, 1882)
        - *Leptodiaptomus siciloides* (Lilljeborg, 1889)
        - *Leptodiaptomus signicauda* (Lilljeborg, 1889)
        - *Leptodiaptomus tyrrelli* (Poppe, 1888)
      - Genus *Onychodiaptomus* Light, 1939
        - *Onychodiaptomus hesperus* Wilson & Light, 1951
        - *Onychodiaptomus sanguineus* (Forbes, 1876)
      - Genus *Skistodiaptomus* Light, 1939
        - *Skistodiaptomus oregonensis* (Lilljeborg, 1889)
        - *Skistodiaptomus pallidus* (Herrick, 1879)

Table 1. The B.C. calanoid copepod species, listed under their usual freshwater habitat.

PONDS ONLY	PONDS & LAKES	LAKES ONLY
Hesperodiaptomus caducus	*Aglaodiaptomus leptopus*	*Acanthodiaptomus denticornis*
Hesperodiaptomus hirsutus	*Eurytemora affinis*	*Aglaodiaptomus forbesi*
Hesperodiaptomus kiseri	*Epischura nevadensis*	*Hesperodiaptomus eiseni*
Leptodiaptomus siciloides	*Hesperodiaptomus arcticus*	*Hesperodiaptomus kenai*
	Hesperodiaptomus franciscanus	*Hesperodiaptomus nevadensis*
	Hesperodiaptomus novemdecimus	*Leptodiaptomus ashlandi*
LAKES & RIVERS	*Heterocope septentrionalis*	*Leptodiaptomus connexus*
	Leptodiaptomus novamexicanus	*Leptodiaptomus insularis*
Skistodiaptomus pallidus	*Leptodiaptomus nudus*	*Leptodiaptomus signicauda*
	Leptodiaptomus pribilofensis	*Leptodiaptomus tyrrelli*
	Leptodiaptomus sicilis	*Onychodiaptomus sanguineus*
	Onychodiaptomus hesperus	*Senecella calanoides*
		Skistodiaptomus oregonensis

Table 2. Numbers of setae on segments of the left 1st antenna of B.C. diaptomids (after Light 1938, Wilson & Light 1951, Wilson 1953, 1954, 1955, 1959). Note: Some antenna may be anomolous.

Left 1st antenna with:

1 seta on segment 11, 1 seta on segments 13-19	2 setae on segment 11, 1 seta on segments 13-19	2 setae on segment 11, 2 setae on some or all of segments 13-19
Acanthodiaptomus denticornis	*Aglaodiaptomus leptopus*	*Aglaodiaptomus forbesi*
Hesperodiaptomus franciscanus	*Hesperodiaptomus arcticus*	2 setae on segment 16
Leptodiaptomus ashlandi	*H. eiseni*	1 seta on remaining segments
L. connexus	*H. kenai*	
L. insularis	*H. kiseri*	*Hesperodiaptomus caducus* *
L. novamexicanus	*H. nevadensis*	2 setae on segments 13-19
L. nudus		
L. pribilofensis		*H. hirsutus*
L. sicilis		Male - 1 seta on segment 13
L. siciloides		and 2 setae on segments 14-19
L. signicauda		Female - 2 setae on segments 13-19
L. tyrrelli		
Onychodiaptomus hesperus		*H. novemdecimus*
O. sanguineus		2 setae on segments 14, 16, 18, 19
Skistodiaptomus oregonensis		
S. pallidus		

* Only diaptomid with 4 setae on segment 2, all others with 3 setae.

KEY TO THE SPECIES OF FRESHWATER CALANOID COPEPODS OF BRITISH COLUMBIA (Males Only)

1. Caudal ramus with 5 short terminal setae (Figs. 4a, 10a, 23a, 28a), length of caudal setae ⅓ to ½ that of the urosome (Figs. 4a, 23a, 28a); right 5th leg with right exopod 2 ending in a long claw (Figs. 4c, 13a, 19a, 23b); **2**

– Caudal ramus with 3 long terminal setae (Fig. 6a) or 4 long terminal setae (Figs. 7a, 8a), length of caudal setae more than ½ the length of the urosome (Figs. 6a, 7a, 8a); right 5th leg with right exopod 2 ending in a long claw (Figs. 7b, 7c, 8b, 8c), a reflexed claw (Figs. 5b, 5c), or no claw (Figs. 6b, 6c) **3**

2. Apex of last segment (segment 25) of right 1st antenna with an outwardly produced process (Fig. 4b); inner process of exopod 2 on left 5th leg digitiform, inserted distally (Fig. 4d); distal process digitiform, inserted on outer side of exopod 2 (Figs. 4e, 4f) ..... ***Acanthodiaptomus denticornis*** (Wierzejski)

– Apex of last segment (segment 25) of right 1st antenna without an outwardly produced process (Fig. 23f); inner process of exopod 2 on left 5th leg digitiform or not, inserted on the inside of exopod 2 and directed laterally away from midline of the body (Figs. 10c, 13c, 21d); distal process digitiform or not, but inserted at distal end of exopod 2 (Figs. 10b) **6**

3. Basal segment 2 of left 5th leg with a long curved process (Figs. 5b, 5c, 6b, 6c) **4**

– Basal segment 2 of left 5th leg without a long curved process **5**

4. Urosome asymmetrical, sometimes twisted, with projection on right side in dorsal view (Fig. 5a); right exopod 2 with only one segment, the distal end with a reflexed claw (Figs. 5b, 5c); distal end of left exopod 2 with 2 short spines (Fig. 5c) ..... ***Epischura nevadensis*** Lilljeborg

– Urosome symmetrical, not twisted, without projection on right side in dorsal view (Fig. 6a); right exopod 2 with two segments, the distal end rounded at tip and without claw (Fig. 6c); distal end of left exopod 2 with 1 long spine and 1 short spine (Fig. 6b)... ***Heterocope septentrionalis*** Juday and Muttkowski

5. Right 1st antenna geniculate (Fig. 7a); distal end of exopod 2 on left 5th leg enlarged with 2 processes, joined by a "U-shaped" area as seen in posterior view (Fig. 7d), in anterior view the distal end appears as a cup-like structure (Fig. 7c); hairs on dorsal surface of caudal ramus (Fig. 7b) .. ***Eurytemora affinis*** (Poppe)

– Right 1st antenna non-geniculate (Fig. 8a); distal end of exopod 2 on left 5th leg rounded, without processes, and with a small spine (Figs. 8b, 8c); without hairs on dorsal surface of caudal ramus ..... ***Senecella calanoides*** Juday

6. Left 1st antenna with 2 setae on segment 11 (Figs. 10c, 12h, 18c), and either 1 seta (Fig. 18c) or 2 setae on some or all of segments 13-19 (Fig. 17c) **7**

– Left 1st antenna with only 1 seta on segment 11 (Fig. 3b), and only 1 seta on segments 13-19 (Fig. 3b) **16**

7. Exopod 2 on left 5th leg with inner process long (Figs. 9b, 10c); inner process of exopod 2 long and curved, approximately equal to exopod 2 in length (Fig. 10c) **8**

– Exopod 2 on left 5th leg with both inner and distal processes short (Figs. 13b, 14d, 15a, 15b, 18a); inner process of left exopod 2 a short spine, tooth-shaped or pointed, shorter than exopod 2 (Figs. 13b, 14c, 15b, 17d, 18d) **9**

8. Segment 23 of right 1st antenna with an antennal process (Fig. 9a), this process long, out-curved and tapering and reaching past antennal segment 24 (Fig. 9a) ..... ***Aglaodiaptomus forbesi*** Light

– Segment 23 of right 1st antenna without an antennal process but with a hyaline membrane along segment margin, extending slightly past distal end of segment (Fig. 10e) ..... ***Aglaodiaptomus leptopus*** (Forbes)

9. Inner margin of basal segment 2 on right 5th leg with serrate border (Fig. 13a), or with cuticular outgrowths (Fig. 11b) or denticulate border (Figs. 12b, 12d) **10**

– Inner margin of basal segment 2 on right 5th leg smooth, without serrate, or cuticular outgrowths, or denticulate border (Figs. 14a, 14b, 15c) **12**

10. Inner process of exopod 2 on left 5th leg a short, narrow-based spine (Fig. 11a); spines on segment 10 of right 1st antenna shorter than spine on segment 13 (Figs. 11c-11e).....***Hesperodiaptomus kiseri*** (Kincaid)

– Inner process of exopod 2 on left 5th leg a short, wide-based spine (Figs. 11c, 12c); spines on segment 10 same length as spine on segment 13 (Figs. 11e-11g)..... **11**

11. Basal segment 2, right 5th leg, with lengthwise ridge on posterior face usually bearing a large spine (Fig. 12d); right 1st antennal process on segment 23 extending well past segment 24 (Figs. 12i, 12j) .....***Hesperodiaptomus eiseni*** (Lilljeborg)

– Basal segment 2, right 5th leg, with lengthwise ridge on posterior face bearing a very small spine in mid-point of ridge (Fig. 13a); right 1st antennal process on segment 23 extending to end of segment 24 (Figs. 13d, 13e) ..... ***Hesperodiaptomus arcticus*** (Marsh)

12. Segment 3 of left 1st antenna with 1 unusually long seta, reaching to distal end of antennal segment 8 (Fig. 14e) ..... ***Hesperodiaptomus hirsutus*** Wilson

– Segment 3 of left 1st antenna with seta not so elongate, not reaching past distal end of segment 6 ..... **13**

13. Segment 2 of left 1st antenna with 4 setae (Fig. 15d); segment 11 with 2 setae (Fig. 15d) and each of segments 13-19 with 2 setae ..... ***Hesperodiaptomus caducus*** Light

– Segment 2 of left 1st antenna with 3 setae; segment 11 with 2 setae and each of segments 13-19 with one seta on each segment (Fig. 18c); or segments 13-19 with 1 seta on some of the segments and 2 setae on others (Fig. 17c)..... **14**

14. Basal segment 1 of right 5th leg with inner protrusion extending between left and right legs (Figs. 16a, 16b)..... ***Hesperodiaptomus nevadensis*** Light

– Basal segment 1 of right 5th leg without inner protrusion (Fig.17b)..... **15**

15. Claw on right 5th leg long, with length equal to combined lengths of basal segments 1 and 2 plus lengths of exopods 1 and 2 (Fig. 17a)..... ***Hesperodiaptomus novemdecimus*** Wilson

– Claw on right 5th leg short, with length about equal to combined lengths of exopods 1 and 2 (Fig. 18b) ..... ***Hesperodiaptomus kenai*** Wilson

16. Distal pad of exopod 2 on left 5th leg with distinctive transparent lobes[1] (Figs. 19b, 19c) ..... ***Hesperodiaptomus franciscanus*** (Lilljeborg)

– Distal pad of exopod 2 on left 5th leg not lobed or transparent **17**

17. Processes of exopod 2 on left 5th leg not similar to one another, either both modified to form a pincer-like structure (Figs. 20b, 20c), or inner process modified into a curved seta with distal process digitiform (Figs. 21c, 21d, 22a, 22c) **18**

– Both processes of exopod 2 on left 5th leg similar to one another, digitiform (Figs. 23d, 23e, 26a, 31b); not modified to form a pincer-like structure, the inner process not modified into a curved seta **20**

18. Both inner and distal processes of exopod 2 on right 5th leg modified to form a pincer-like structure (Figs. 20b, 20c); lateral spine inserted mid-segment (Fig. 20a)***Onychodiaptomus sanguineus*** (Forbes)

– Both inner and distal processes of exopod 2 on right 5th leg not modified to form a pincer-like structure; inner process either short and curved (Fig. 21c), or long and curved, reaching well beyond end of inner process (Figs. 22a, 22c); distal process digitiform (Fig. 21d); lateral spine inserted in lower part of segment (Figs. 21b, 22a) **19**

19. Right 5th leg slender, basal segment 2 elongate, its length 3x its width (Fig. 21a); and with inner proximal portion produced upward (Fig. 21b) ..... ***Onychodiaptomus hesperus*** Wilson and Light

– Right 5th leg not slender, basal segment 2 not elongate but nearly square-shaped and without inner proximal portion produced upward (Fig. 22b)..... ***Skistodiaptomus pallidus*** (Herrick)

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[1] Lobes may not be visible if left leg is at an angle (Fig. 19a). Lobes are most easily seen before cover slip is put on slide.

20. Segment 23 of right 1st antenna without antennal process (Fig. 23f) **21**

– Segment 23 of right 1st antenna with antennal process (Figs. 26c, 27c, 27d)..... **23**

21. Distal process of exopod 2 on left 5th leg almost the same length as inner process (Fig. 23e) ..... ***Leptodiaptomus pribilofensis*** (Juday and Muttkowski)[2]

– Distal process of exopod 2 on left 5th leg twice as long as inner process (Figs. 24a, 24c, 25c, 25d)..... **22**

22. Lateral spine of exopod 2 on right 5th leg inserted in lower part of segment, just above claw base (Figs. 24b, 24d)..... ***Skistodiaptomus oregonensis*** (Lilljeborg)

– Lateral spine of exopod 2 on right 5th leg inserted close to middle of segment, some distance from claw base (Figs. 25a, 25b)..... ***Leptodiaptomus tyrrelli*** (Poppe)[2]

23. Antennal process on segment 23 of right 1st antenna long, reaching beyond distal end of segment 24 (Figs. 26c; 27c, 27d) **24**

– Antennal process on segment 23 of right 1st antenna short, not reaching beyond distal end of segment 24 (Figs. 28b, 28c, 29c, 29d) **25**

24. Exopod 2 of right 5th leg with proximal part of segment distinctly angled at point of insertion of lateral spine (Fig. 26b) ..... ***Leptodiaptomus ashlandi*** (Marsh)

– Exopod 2 of right 5th leg with proximal part of segment slightly curved but not angled at point of insertion of lateral spine (Figs. 27a, 27b)..... ***Leptodiaptomus insularis*** Kincaid

25. Lateral spine of exopod 2 on right 5th leg inserted above middle of segment (Figs. 28d, 28e)..... ***Leptodiaptomus nudus*** (Marsh)

– Lateral spine of exopod 2 on right 5th leg inserted below middle of segment (Figs. 29a, 29b, 30a, 30b, 31a, 31b, 32a)..... **26**

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[2] In *Leptodiaptomus* the lateral spine on exopod 2 of the male 5th leg is inserted at an angle to its segment, and is directed backwards (Wilson 1959) so the lateral spine may appear in different positions in slide mounts (Fig. 23b, 23c, 23d).

26. Spine on segment 8 of right 1st antenna unusually large, about ½ the size of the spine on segment 11 (Figs. 29e, 29f) ..... ***Leptodiaptomus connexus*** Light

– Spine on segment 8 of right 1st antenna small, approximately $^1/_5$ the size of the spine on segment 11 (Figs. 32c, 32d) **27**

27. Segment 23 of right 1st antenna with base of antennal process originating at mid-length of segment (Figs. 30c-30e) ..... ***Leptodiaptomus novamexicanus*** (Herrick)

– Segment 23 of right 1st antenna with base of antennal process originating at apex of segment (Figs. 31d, 31e, 32e, 32f, 33a) **28**

28. Segment 23 of right 1st antenna with antennal process slender, reaching distal end of segment 24, and with swollen tip (Figs. 31d, 31e) ..... ***Leptodiaptomus sicilis*** (Forbes)

– Segment 23 of right 1st antenna with antennal process broad, only reaching as far as mid-length of segment 24, and with tip outcurved (Figs. 32e, 32f, 33a) **29**

29. Spine on segment 11 of right 1st antenna subequal to or longer than spine on segment 13 (Figs. 32c, 32d); 5th leg, right exopod 2 with a square-shaped inner process (Fig. 32b) ..... ***Leptodiaptomus siciloides*** (Lilljeborg)

– Spine on segment 11 of right 1st antenna about ½ the length of the spine on segment 13 (Fig. 33c); 5th leg, right exopod 2 with rounded inner process (Fig. 33b) ..... ***Leptodiaptomus signicauda*** (Lilljeborg)

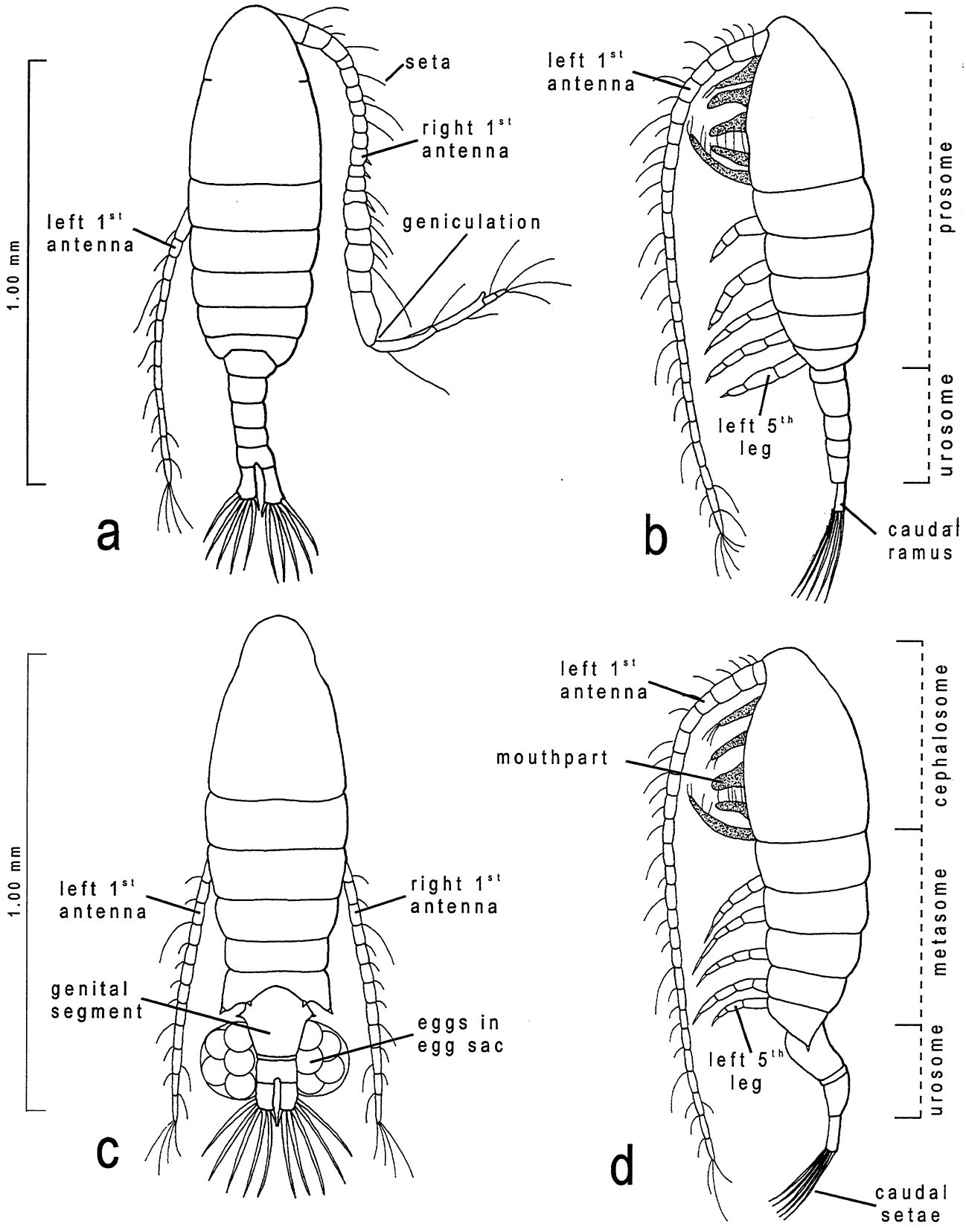

Figure 1. *Leptodiaptomus nudus* (Marsh). Characteristics of male and female adult calanoid, with major parts of the body indicated. (a) male dorsal view; (b) male lateral view, left side; (c) female dorsal view, with egg sacs; (d) female lateral view; (a-d) Cobb L., B.C.

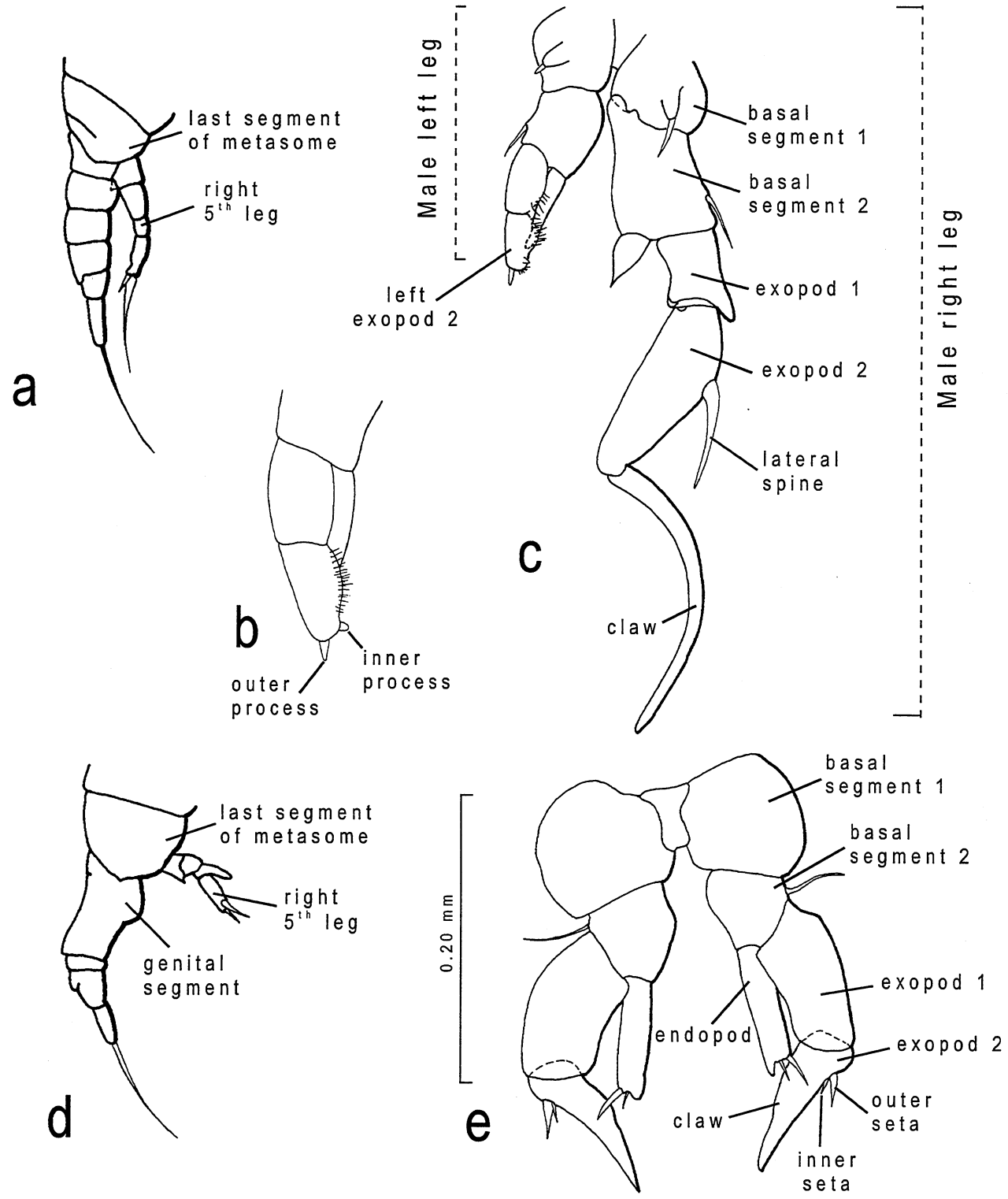

Figure 2. *Leptodiaptomus nudus* (Marsh). Diaptomid male and female 5th legs, showing the position of the 5th legs on the body in lateral view, and male and female 5th legs with parts identified. (a) Posterior part of male diaptomid body, showing location of 5th legs, right side. (b) left 5th leg, exopod 2, detail of inner and outer processes; (c) male 5th legs, posterior view, (b-c) after Wilson (1959); (d) posterior part of female diaptomid body, showing location of 5th legs, right side; (e) female 5th legs, posterior view (redrawn after Shih & Maclellan 1977); (a-c) (redrawn after Ravera and Tonolli 1956).

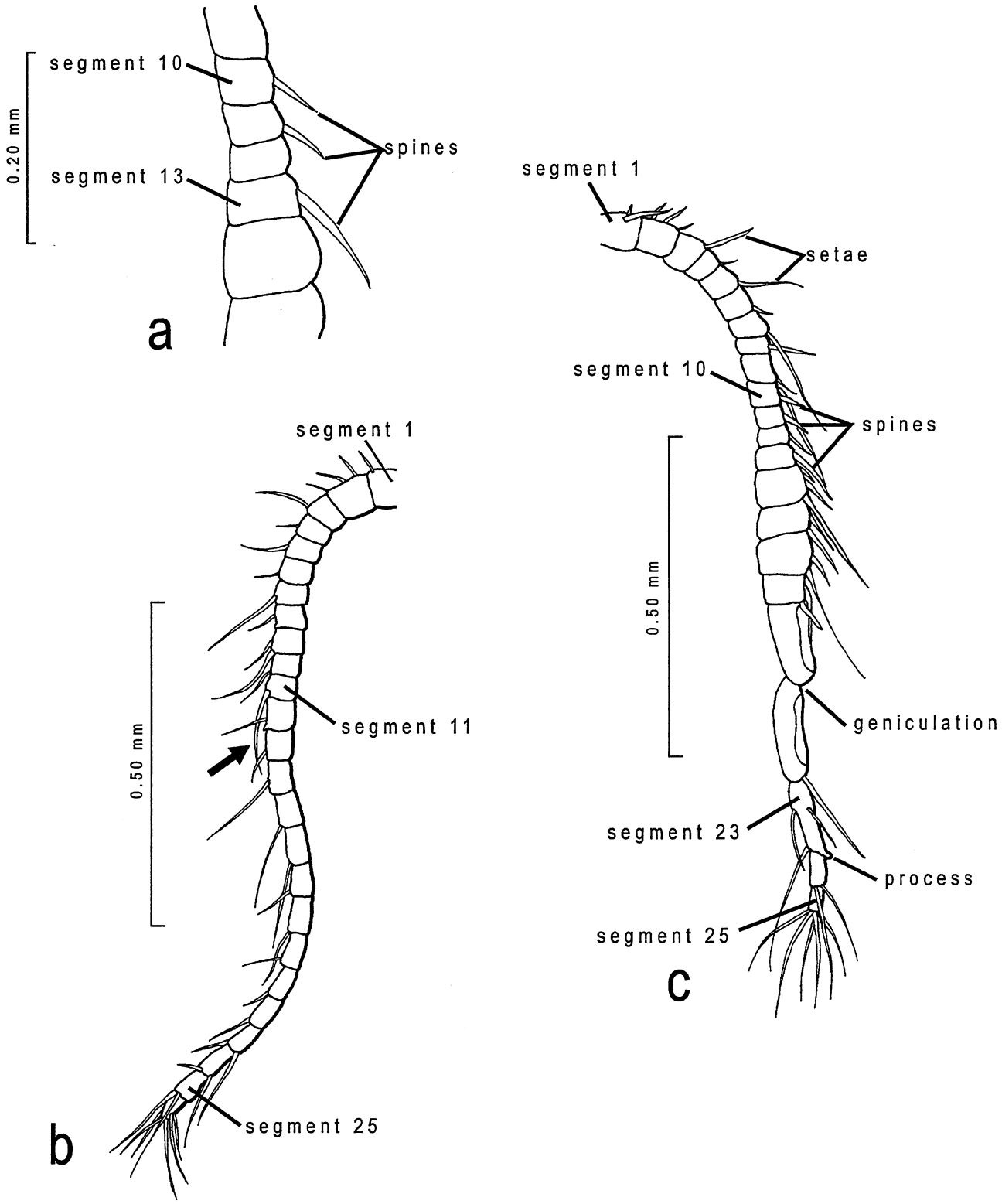

Figure 3. *Leptodiaptomus nudus* (Marsh). Male. Left and right 1st antennae, and spines on right 1st antenna, with features identified. (a) right 1st antenna, segments 10-14, showing spines on segments 10, 11 and 13, setae not included; (b) left 1st antenna, segments 1-25; (c) right 1st antenna, segments 1-25. (a-c) (redrawn after Shih & Maclellan 1977).

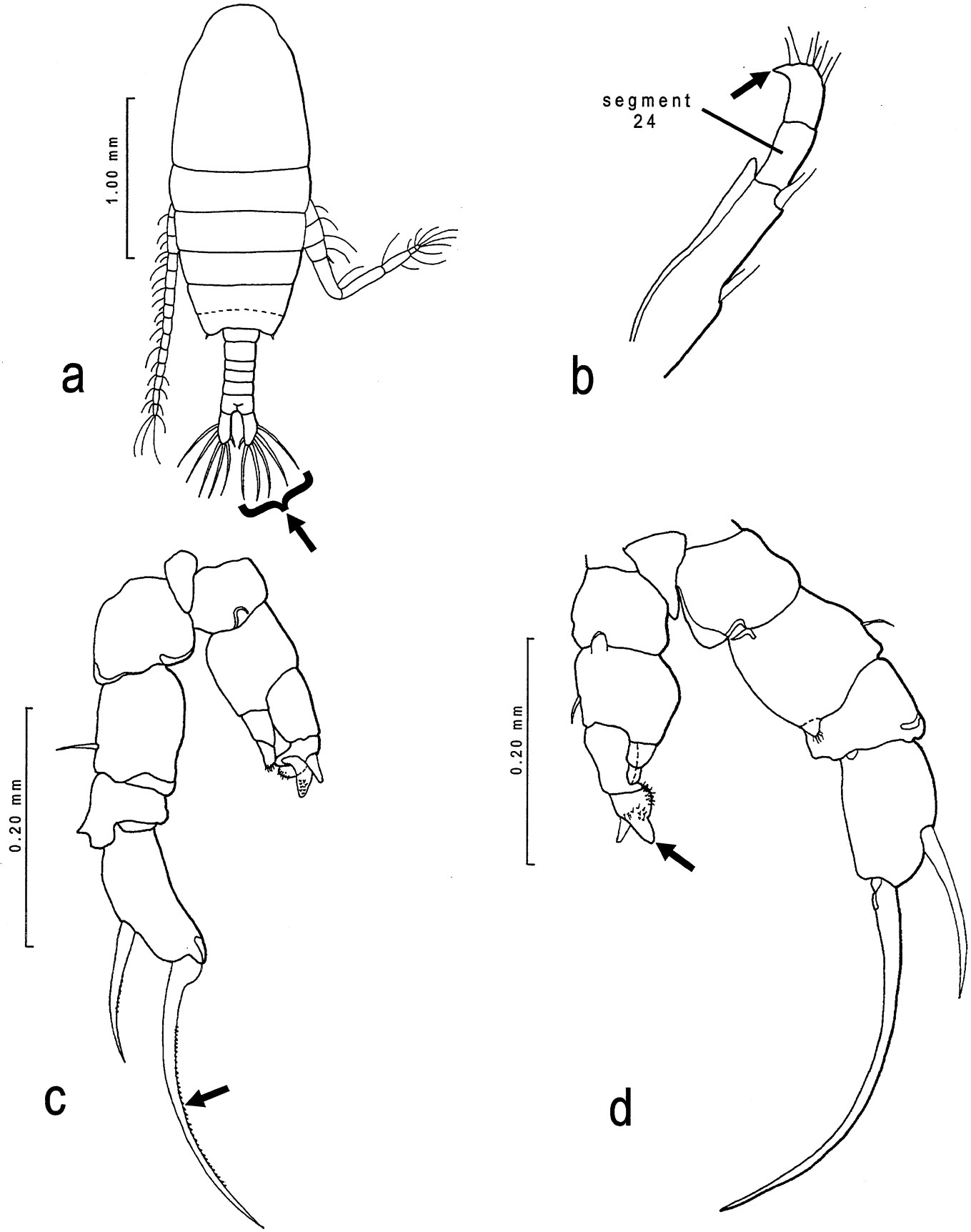

Figure 4. *Acanthodiaptomus denticornis* (Wierzejski). Male. (a) dorsal view, Bickle L., B.C.; with antennae from slide, Big La Salle L., B.C.; (b) right 1st antenna, segments 23-25 (redrawn after Wilson 1959); (c) 5th legs, anterior view, Chubb L., B.C.; (d) 5th legs, posterior view, Big La Salle L., B.C.

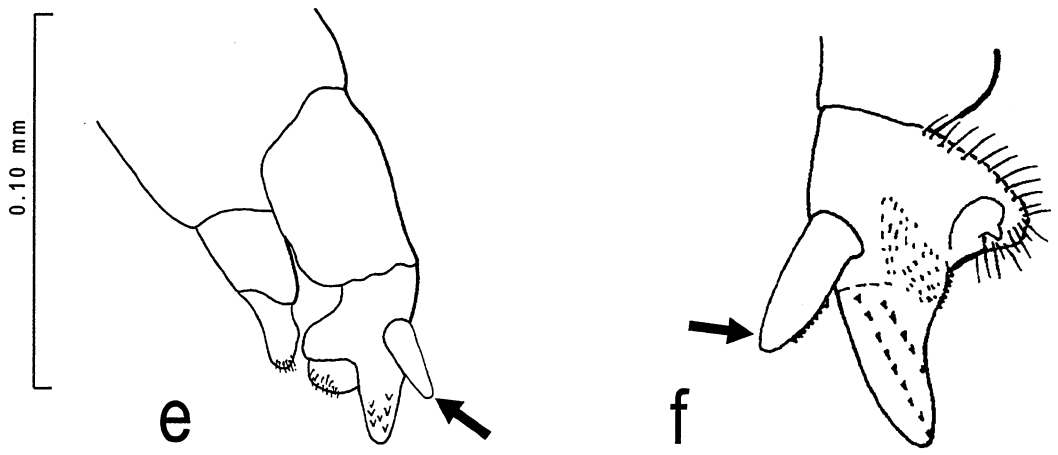

Figure 4. continued. *Acanthodiaptomus denticornis* (Wierzejski). Male. (e) detail of left 5th leg, exopod 2, anterior view, Big La Salle L., B.C.; (f) detail of right 5th leg, exopod 2, posterior view (redrawn after Wilson 1959).

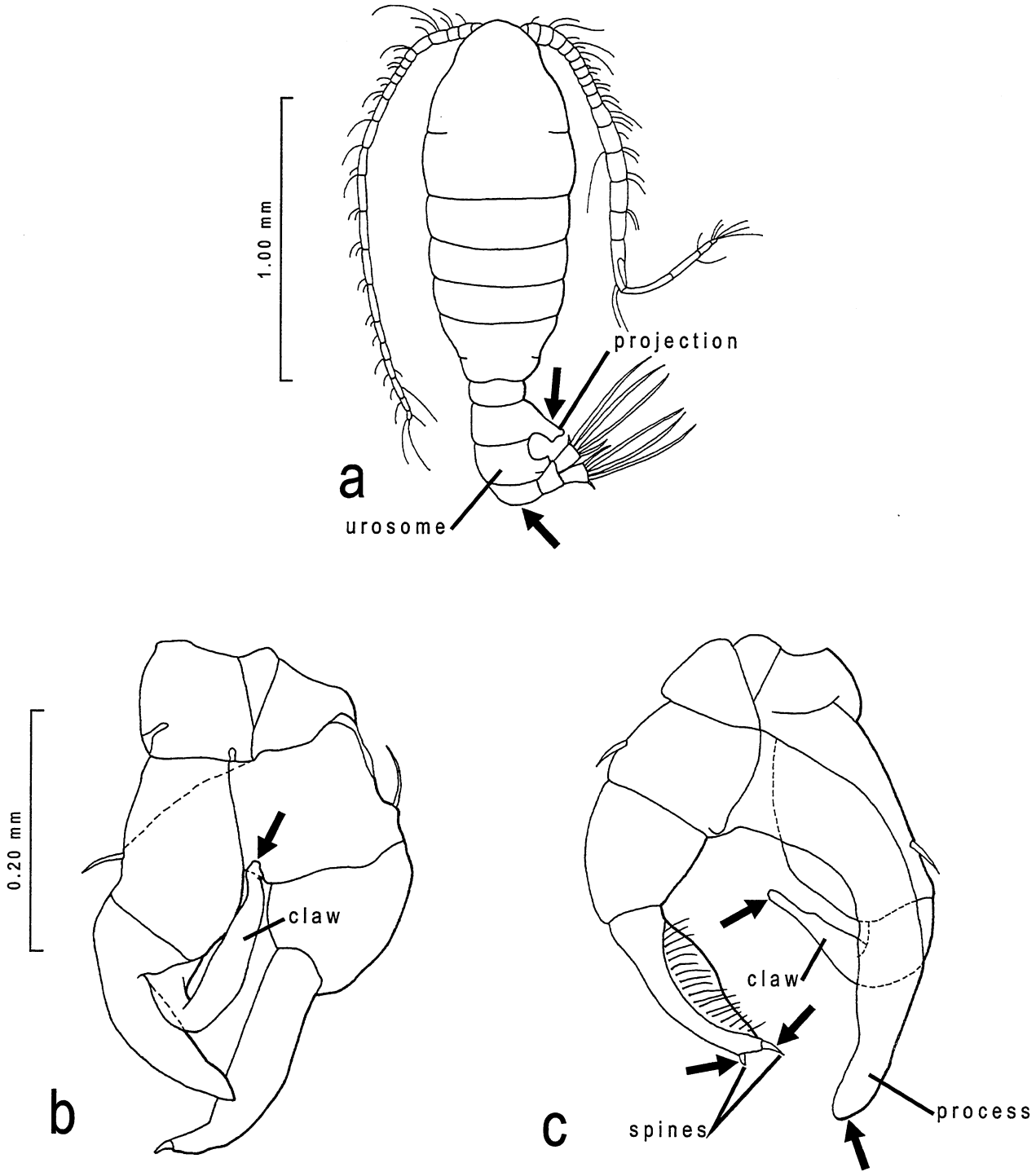

Figure 5. *Epischura nevadensis* Lilljeborg. Male. (a) dorsal view, Shuswap L., B.C., with antennae from slide, Cheslatta L., B.C.; (b) 5th legs, anterior view, Chubb L., B.C.; (c) 5th legs, posterior view (redrawn after Wilson 1959).

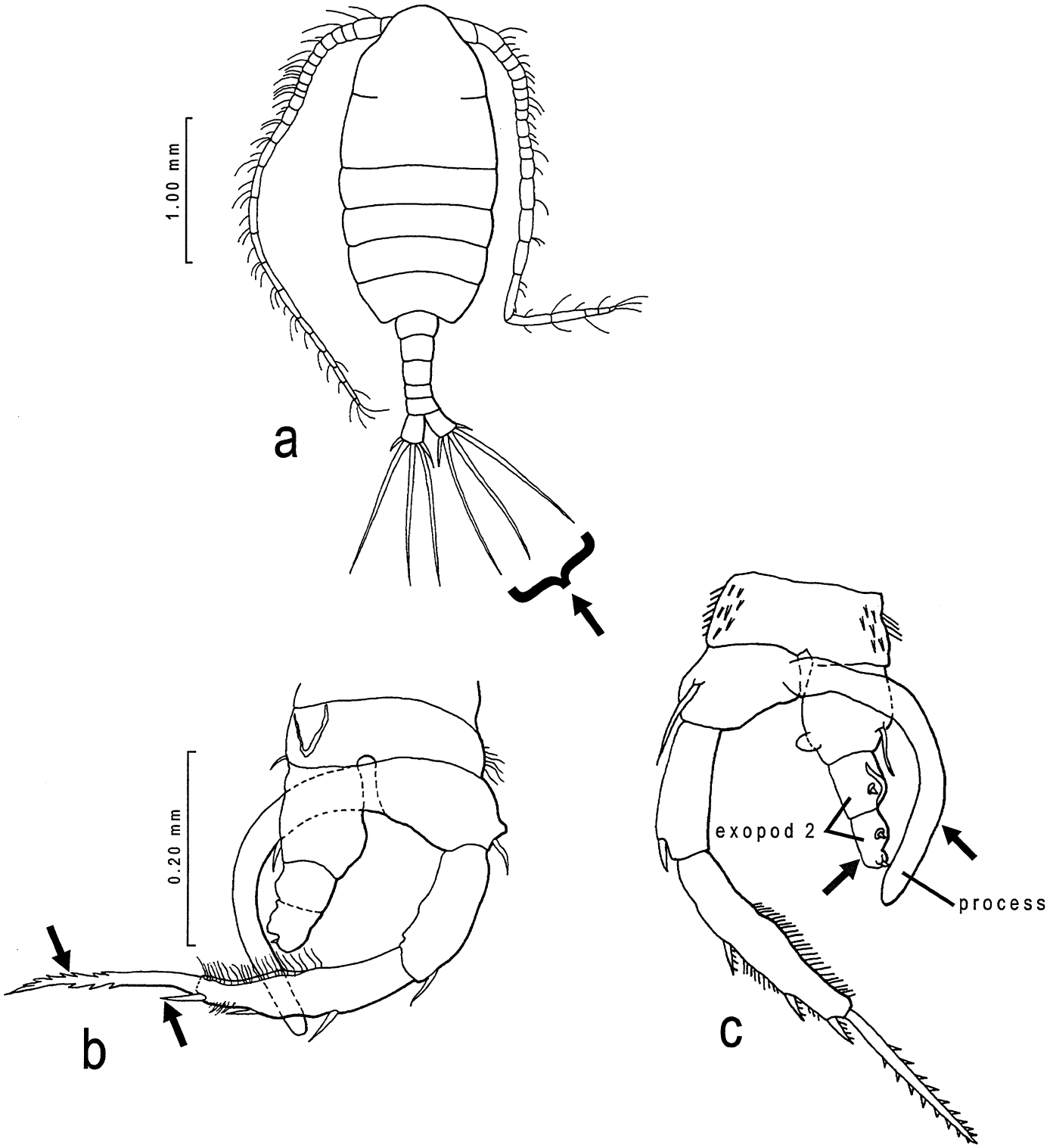

Figure 6. *Heterocope septentrionalis* Juday & Muttkowski. Male. (a) dorsal view, Fraser L., B.C., with antennae from slide, Chief L. B.C.; (b) 5th legs, anterior view, Chief L. B.C.; (c) 5th legs, posterior view (redrawn after Wilson 1959).

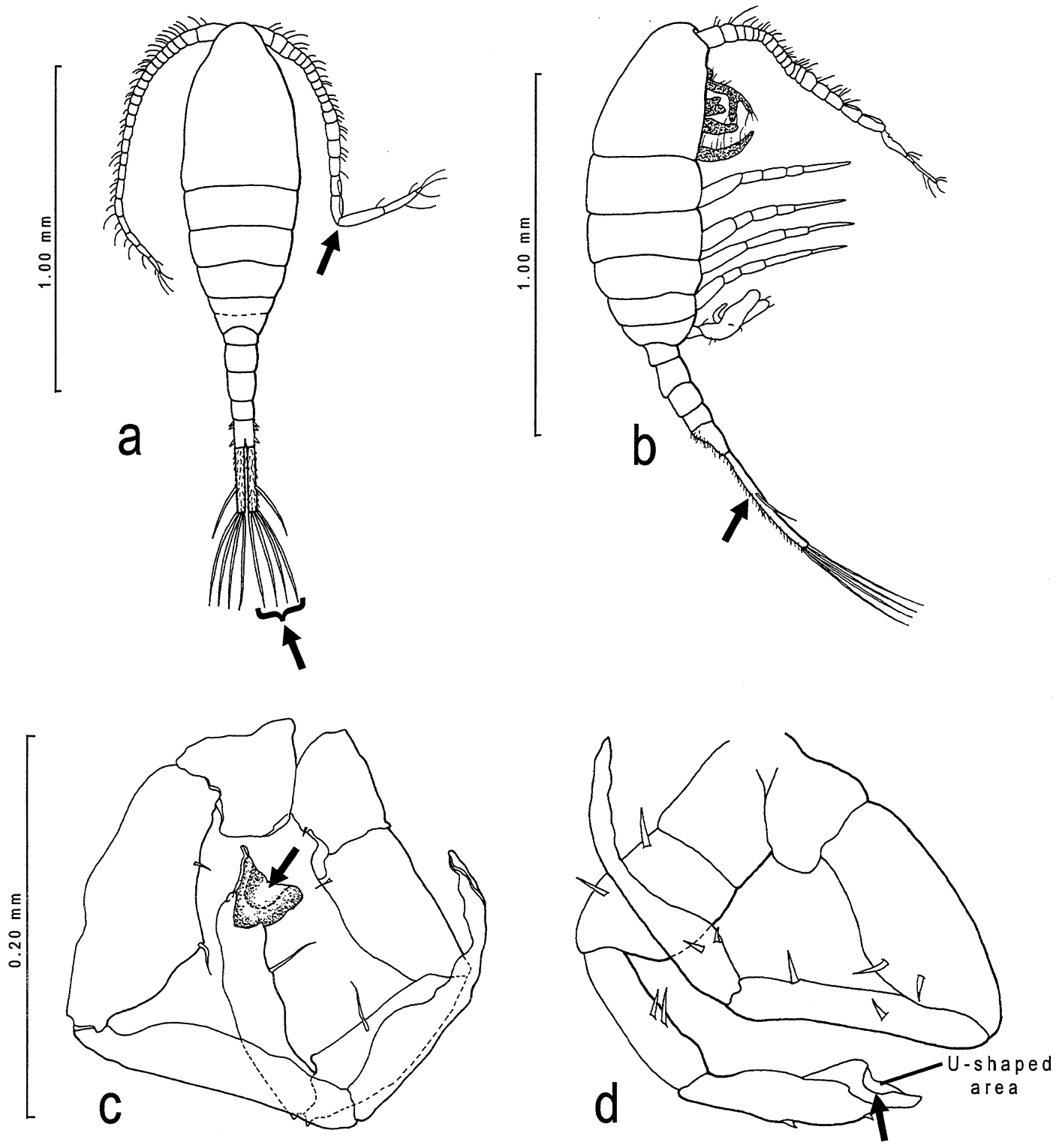

Figure 7. *Eurytemora affinis* (Poppe). Male. (a) dorsal view, Nitinat L., B.C.; (b) lateral view (redrawn after Katona 1971); (a-b) (with antennae redrawn after Gardner & Szabo 1982); (c) 5th legs, anterior view, Nitinat L. B.C.; (d) 5th legs, posterior view (modified after Wilson 1959).

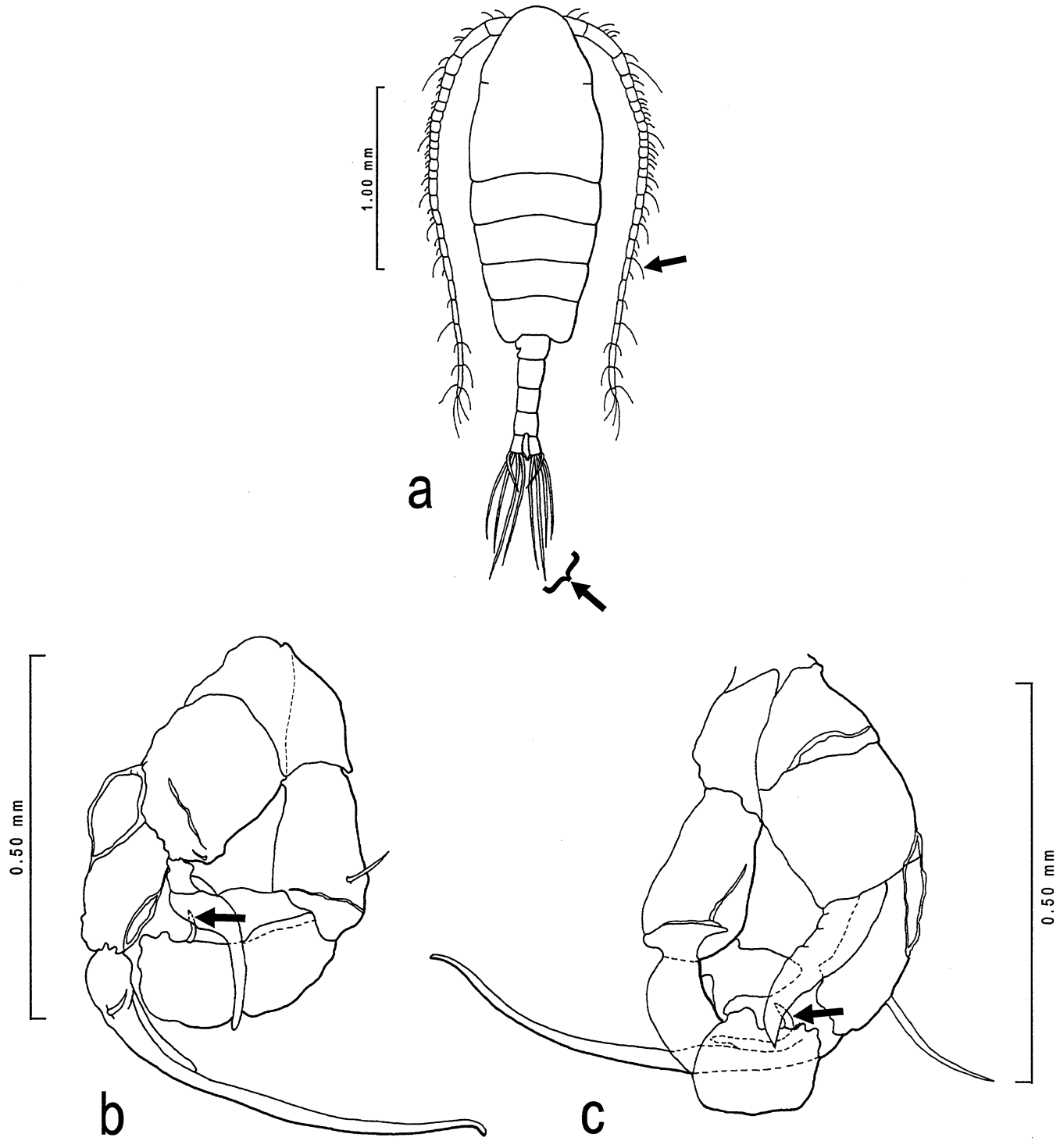

Figure 8. *Senecella calanoides* Juday. Male. (a) dorsal view, Cayuga L., NY; (b) 5 th legs, anterior view; (c) 5th legs, posterior view; (b-c) Cayuga L., NY.

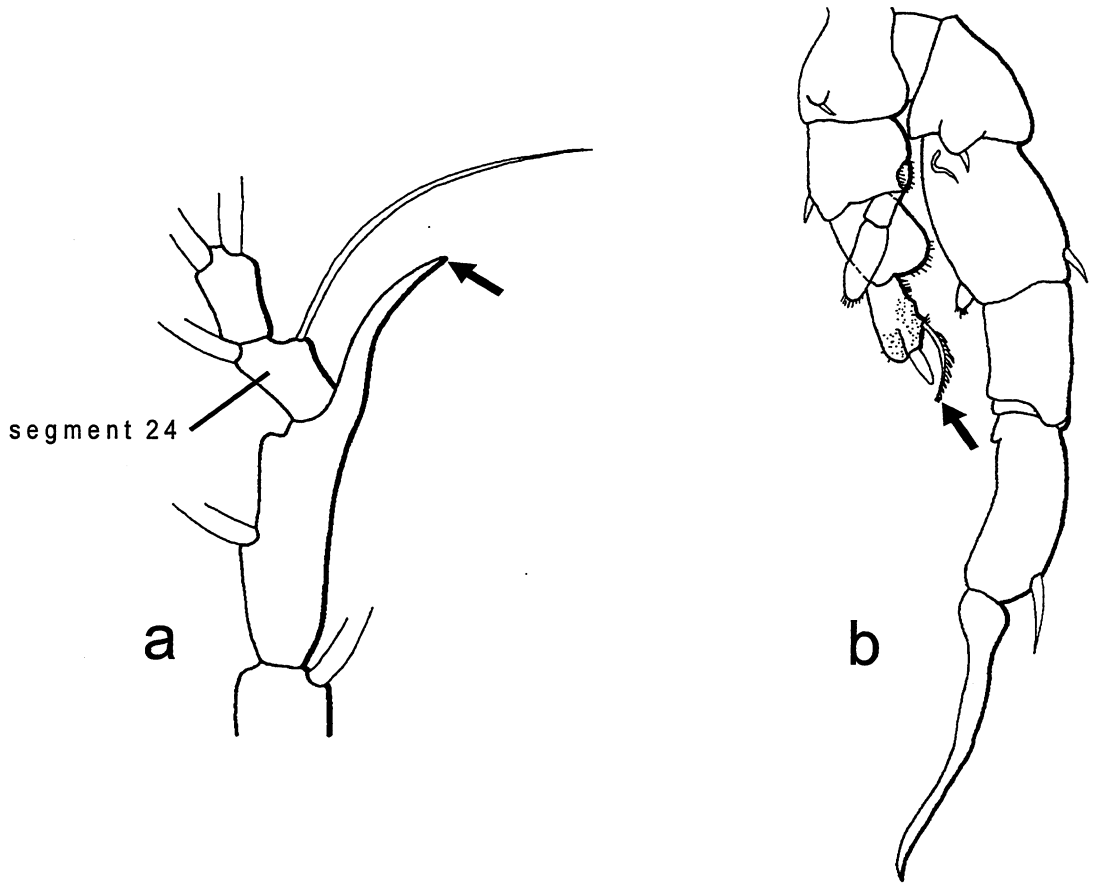

Figure 9. *Aglaodiaptomus forbesi* Light. Male. (a) right 1st antenna, segments 23-25 (redrawn after Light 1938); (b) 5th legs, posterior view (redrawn after Wilson 1959).

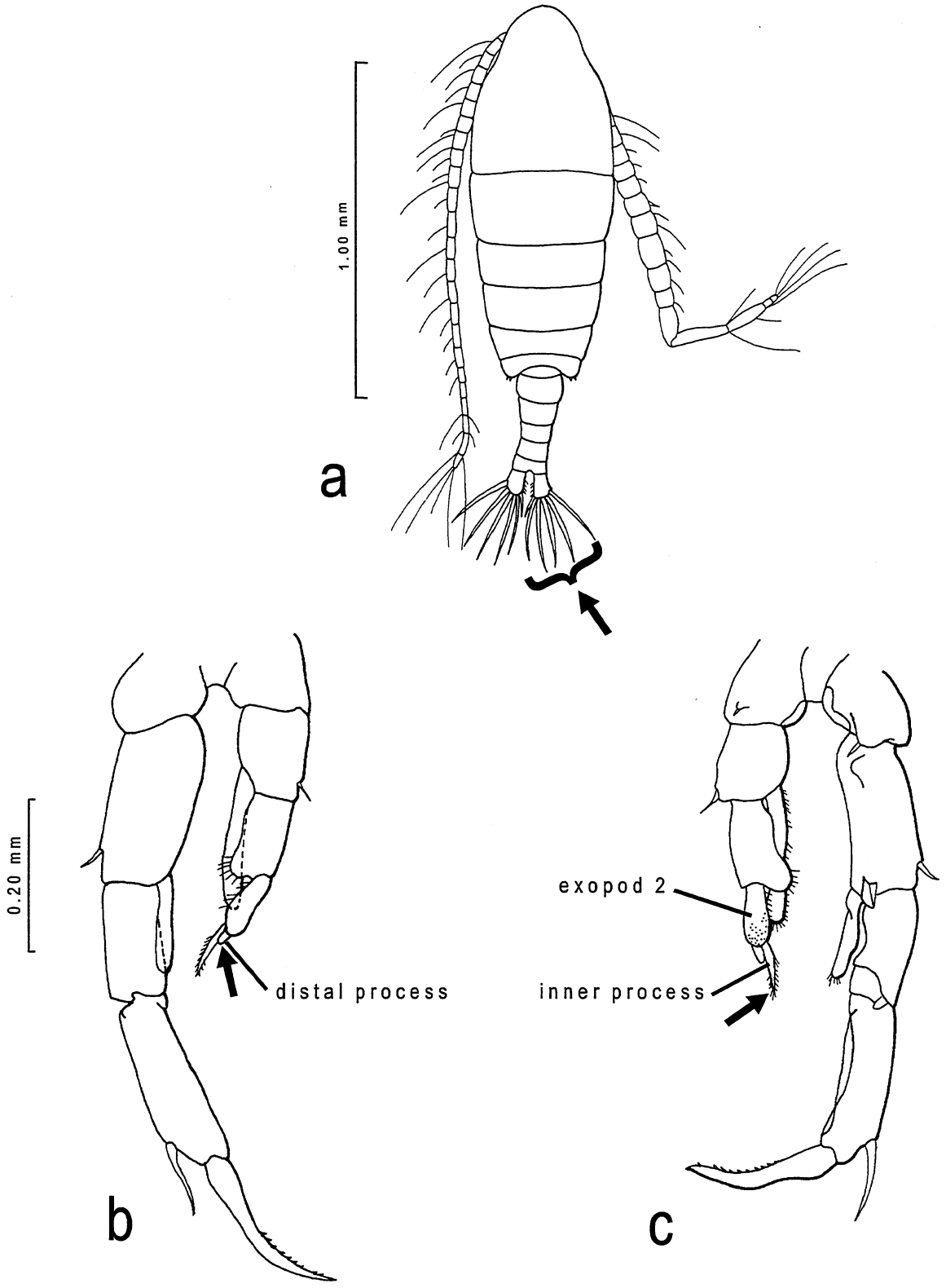

Figure 10. *Aglaodiaptomus leptopus* (Forbes). Male. (a) dorsal view (redrawn after Pinel-Alloul & Lamoureux 1988); (b) 5th legs, anterior view (redrawn after Pinel-Alloul & Lamoureux 1988); (c) 5th legs, posterior view (redrawn after Wilson 1959).

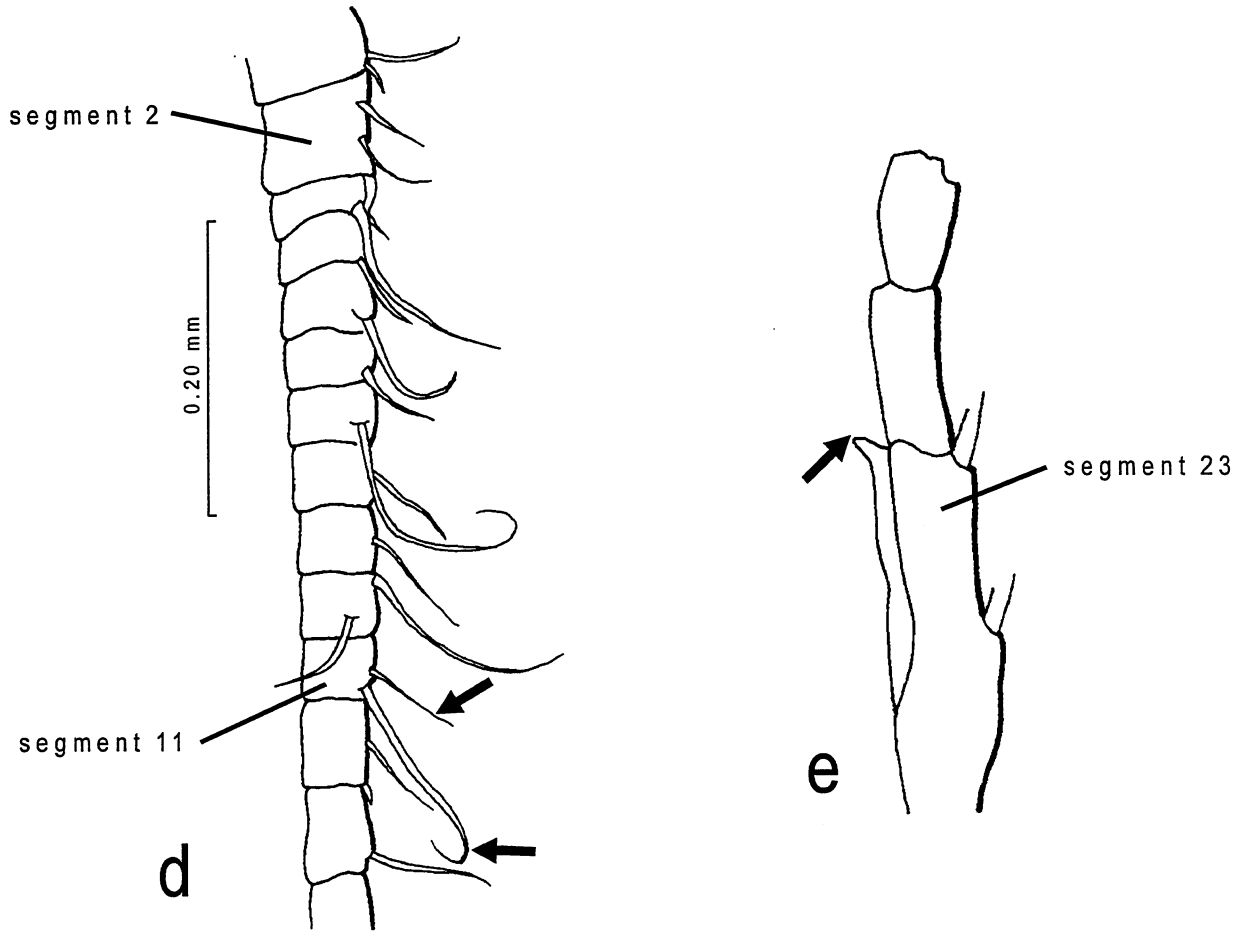

Figure 10 continued. *Aglaodiaptomus leptopus* (Forbes). Male. (d) left 1st antenna, segments 2-13 (redrawn after Pinel-Alloul & Lamoureux 1988); (e) right 1st antenna, segments 23-25 (redrawn after Wilson (1959).

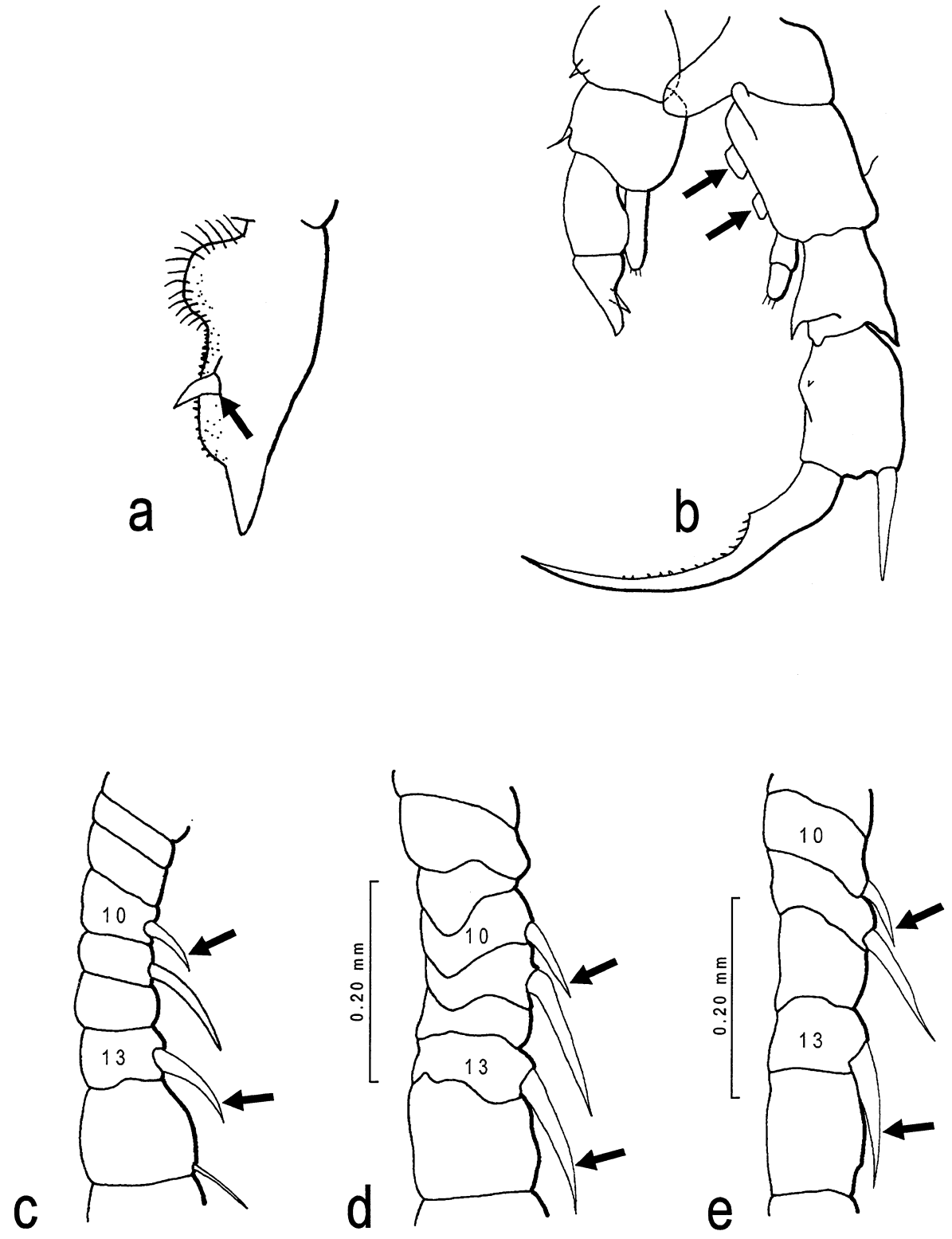

Figure 11. *Hesperodiaptomus kiseri* (Kincaid). Male. (a) detail of left 5th leg, exopod 2, anterior view; (b) 5th legs, posterior view; (a-b) (redrawn after Wilson 1959); (c-d) right 1st antenna, segments 8-14; (c) (redrawn after Kincaid 1953); (d) Boitano Ph. Pond, B.C.; (e) right 1st antenna, segments 10-14, Boitano Ph. Pond, B.C.

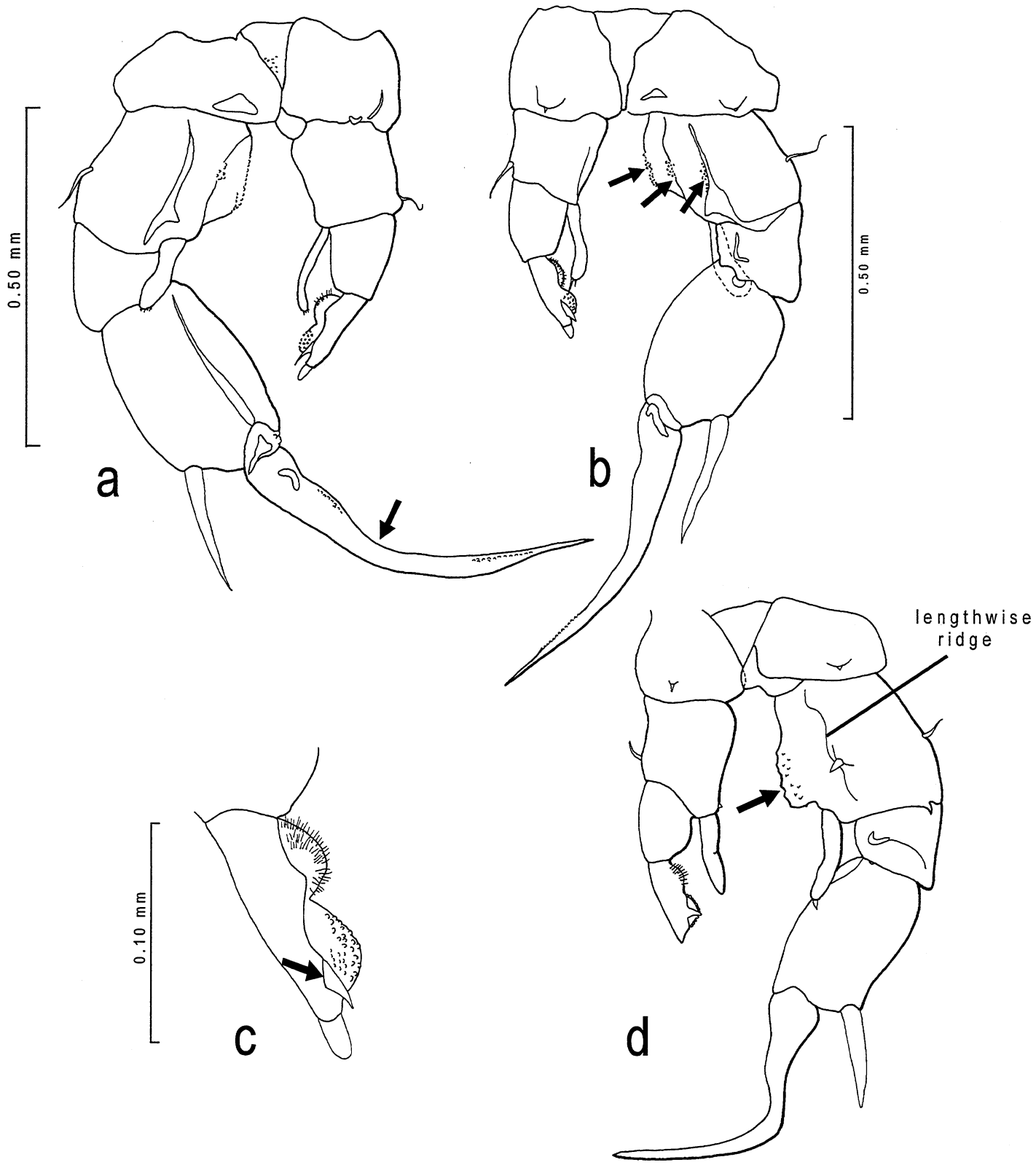

Figure 12. *Hesperodiaptomus eiseni* Lilljeborg. Male. (a) 5th legs anterior view; (b) 5th legs posterior view; (c) detail left 5th leg, exopod 2, posterior view; (a-c) Lake Lagunita, CA; (d) 5th legs, posterior view (redrawn after Wilson 1959).

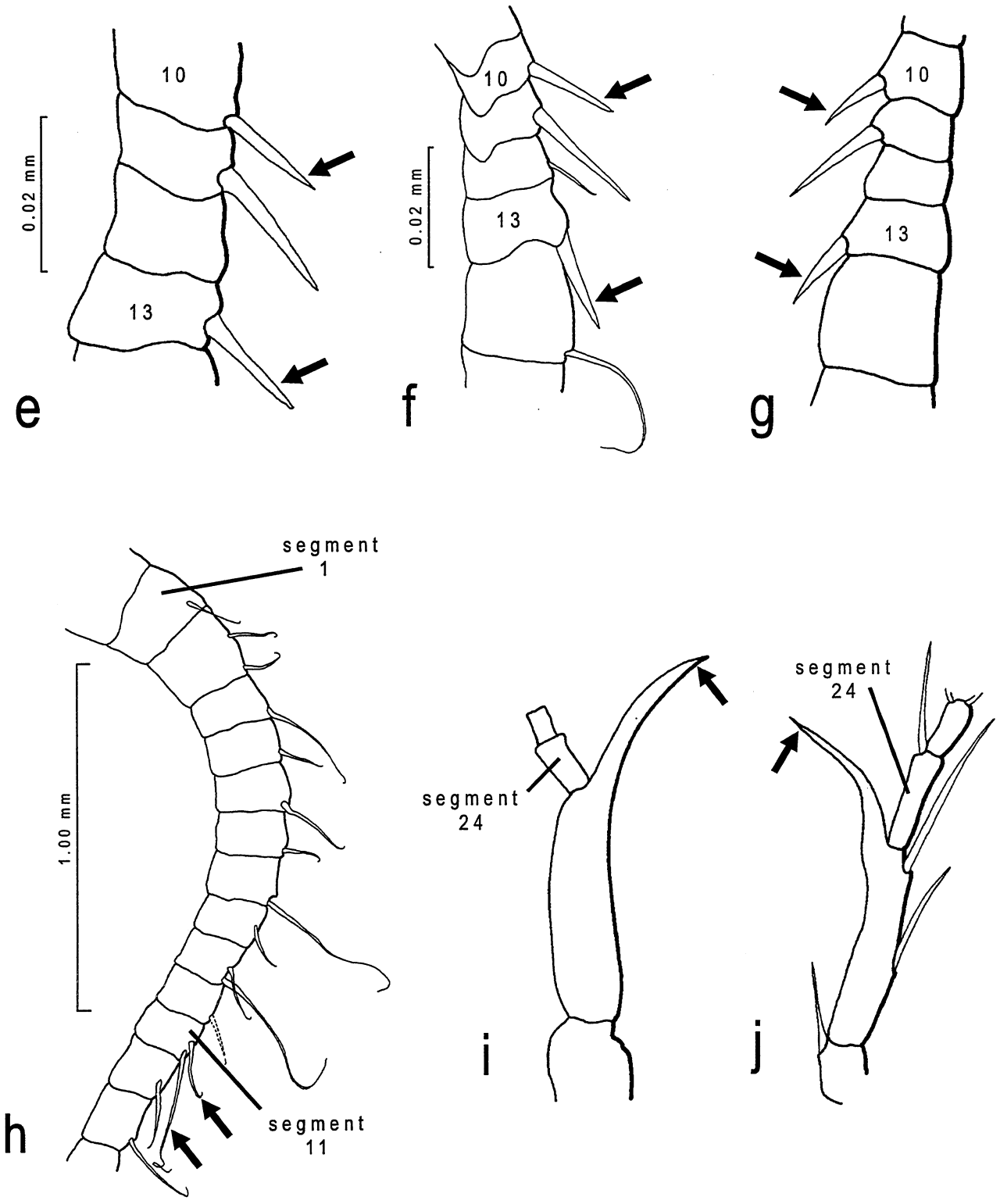

Figure 12 continued. *Hesperodiaptomus eiseni* Lilljeborg. Male. (e) right 1st antenna, segments 10-13; (f-g) right 1st antenna, segments 10-14; (e-f) Lake Lagunita, CA; (g) (redrawn after Wilson 1959); (h) left 1st antenna, segments 1-13, Lake Lagunita, CA; (i-j) right 1st antenna, process on segment 23; (i) Lake Lagunita, CA; (j) after Lilljeborg 1889.

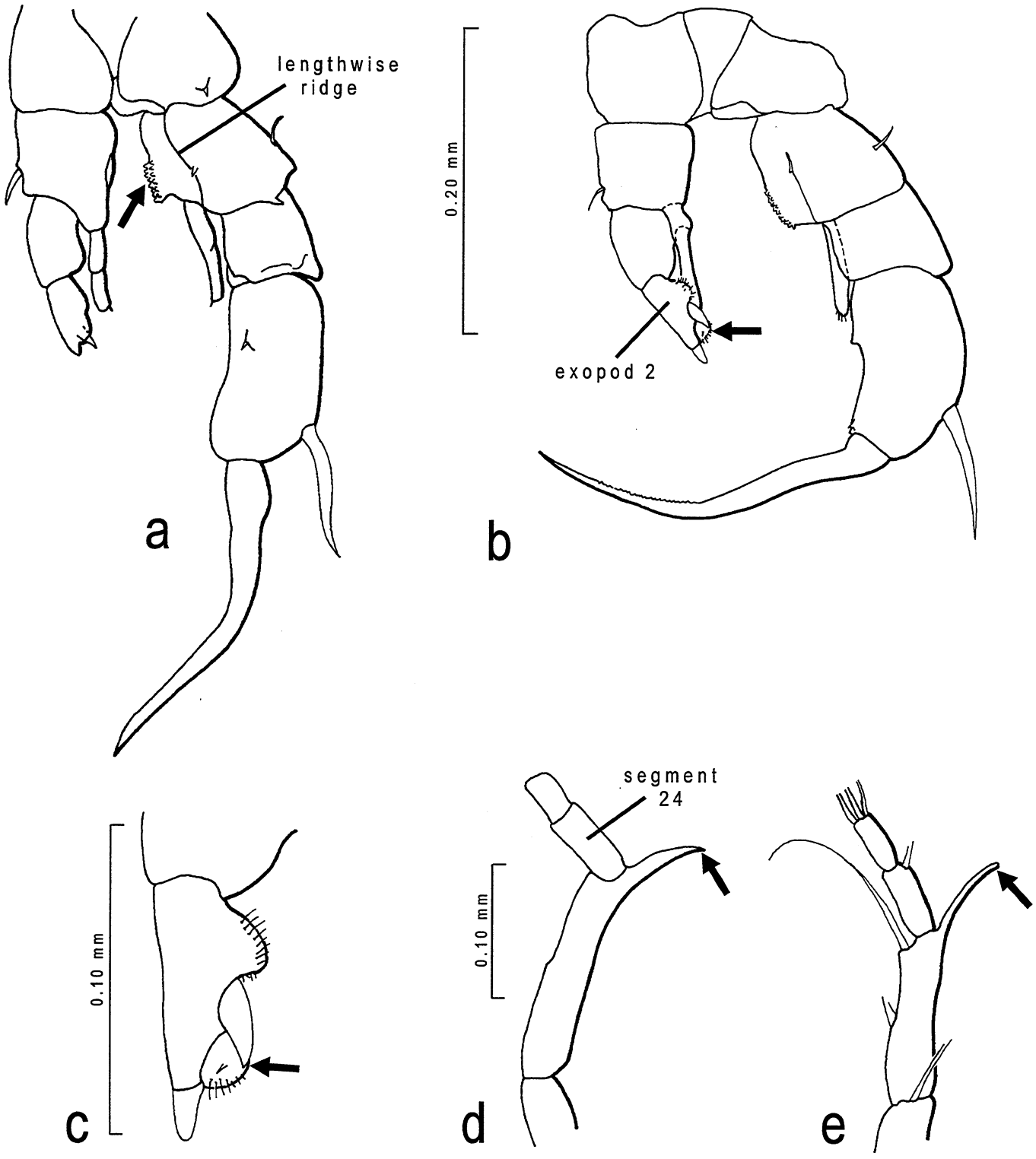

Figure 13. *Hesperodiaptomus arcticus* Marsh. Male. (a-b) 5th legs, posterior view, (a) (redrawn after Wilson 1959); (b) Clearwater L., B.C.; (c) detail of left 5th leg, exopod 2, posterior view; Clearwater L., B.C.; (d-e) right 1st antenna with antennal process on segment 23; (d) Clearwater L., B.C.; (e) (after Rylov 1922)

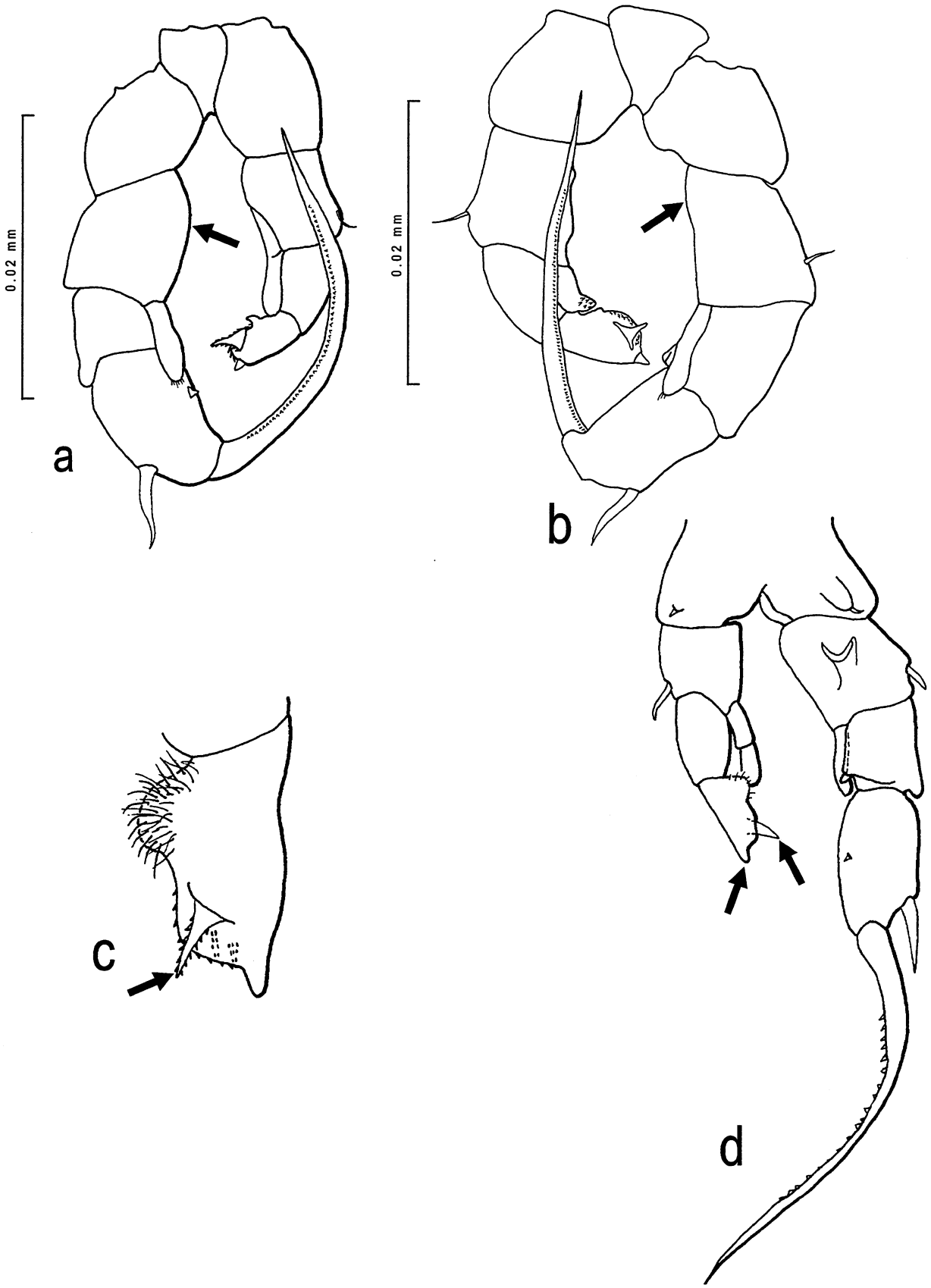

Figure 14. *Hesperodiaptomus hirsutus* Wilson. Male. (a-b) 5th legs, Westwick 1 pond, B.C. (a) anterior view, (b) posterior view; (c) detail left 5th leg, exopod 2 anterior view; (d) 5th legs posterior view; (c-d) (redrawn after Wilson 1959).

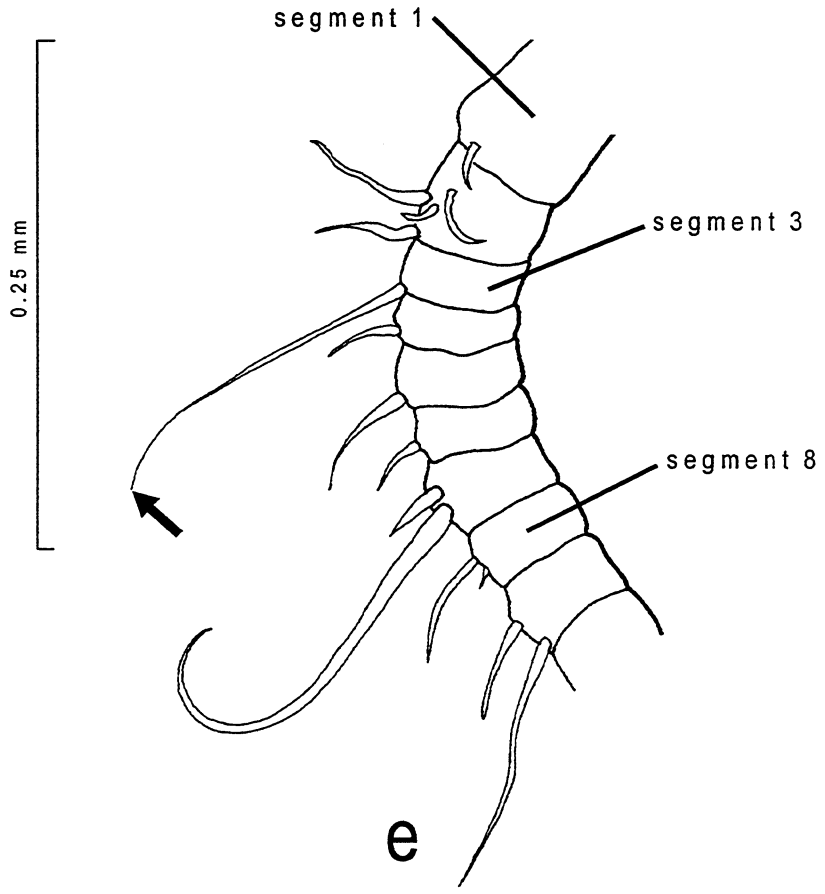

Figure 14. continued. *Hesperodiaptomus hirsutus* Wilson. Male. (e) left 1st antenna, segments 1-9, Westwick 1 pond, B.C.

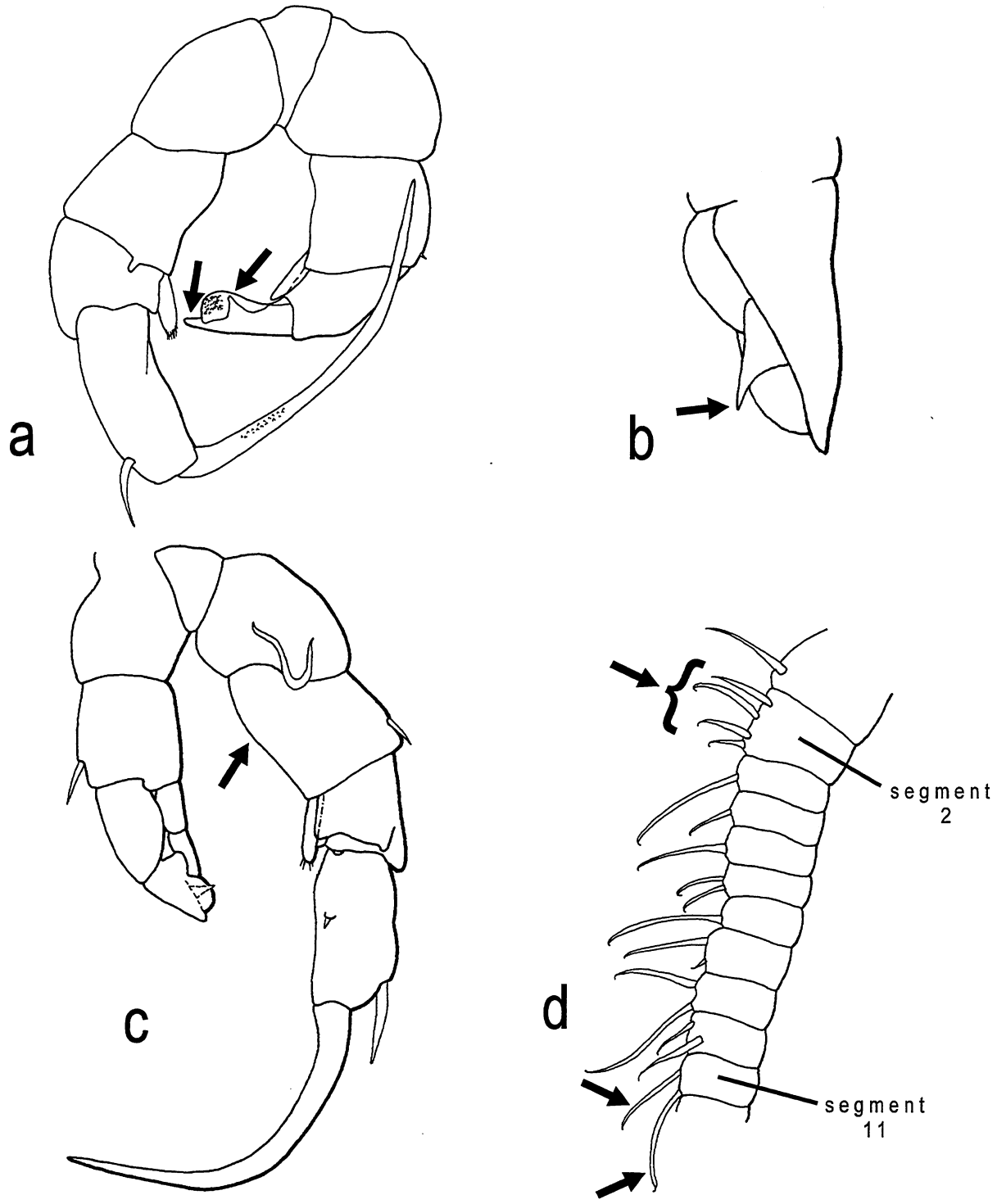

Figure 15. *Hesperodiaptomus caducus* Light. Male. (a) 5th legs, anterior view, St. Anselm's pond, B.C.; (b) detail left 5th leg, anterior view (redrawn after Wilson 1959); (c) 5th legs, posterior view (redrawn after Wilson 1959); (d) left 1st antenna, segments 2-11 (redrawn after Wilson 1959).

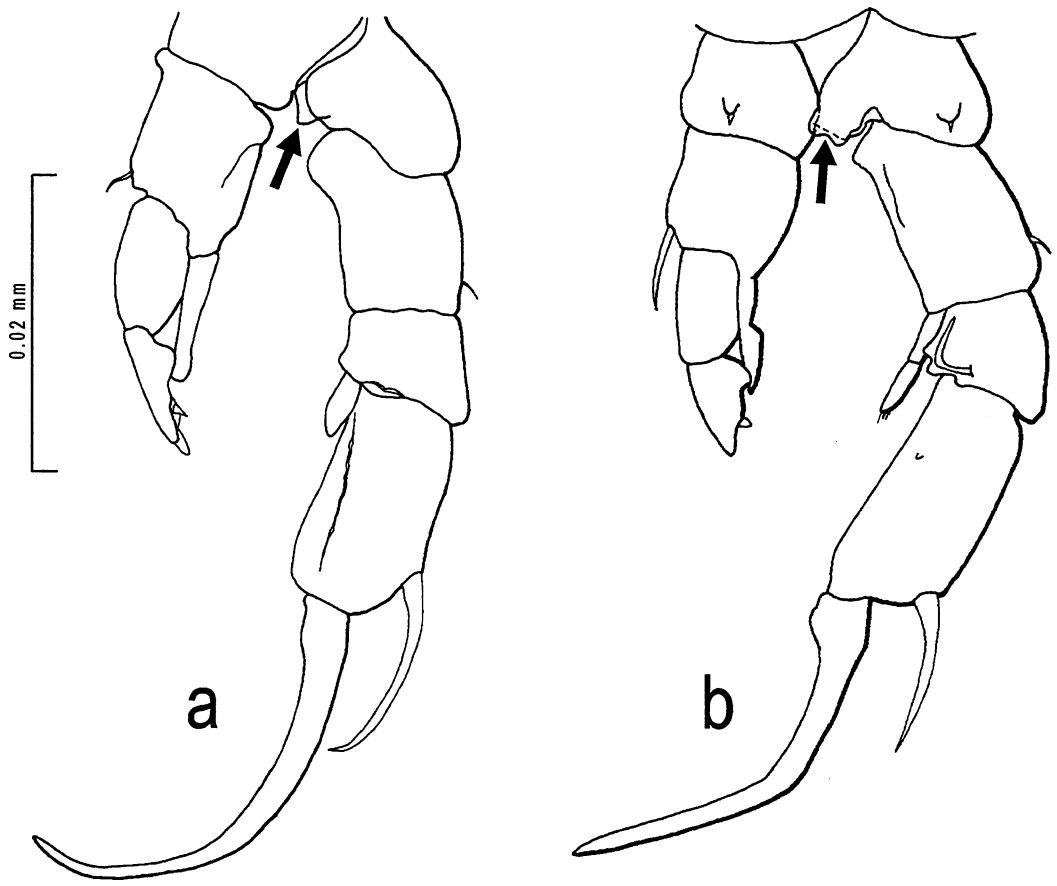

Figure 16. *Hesperodiaptomus nevadensis* Light. Male. (a-b) 5th legs, posterior view, (a) White L. B.C., (b) (redrawn after Wilson 1959).

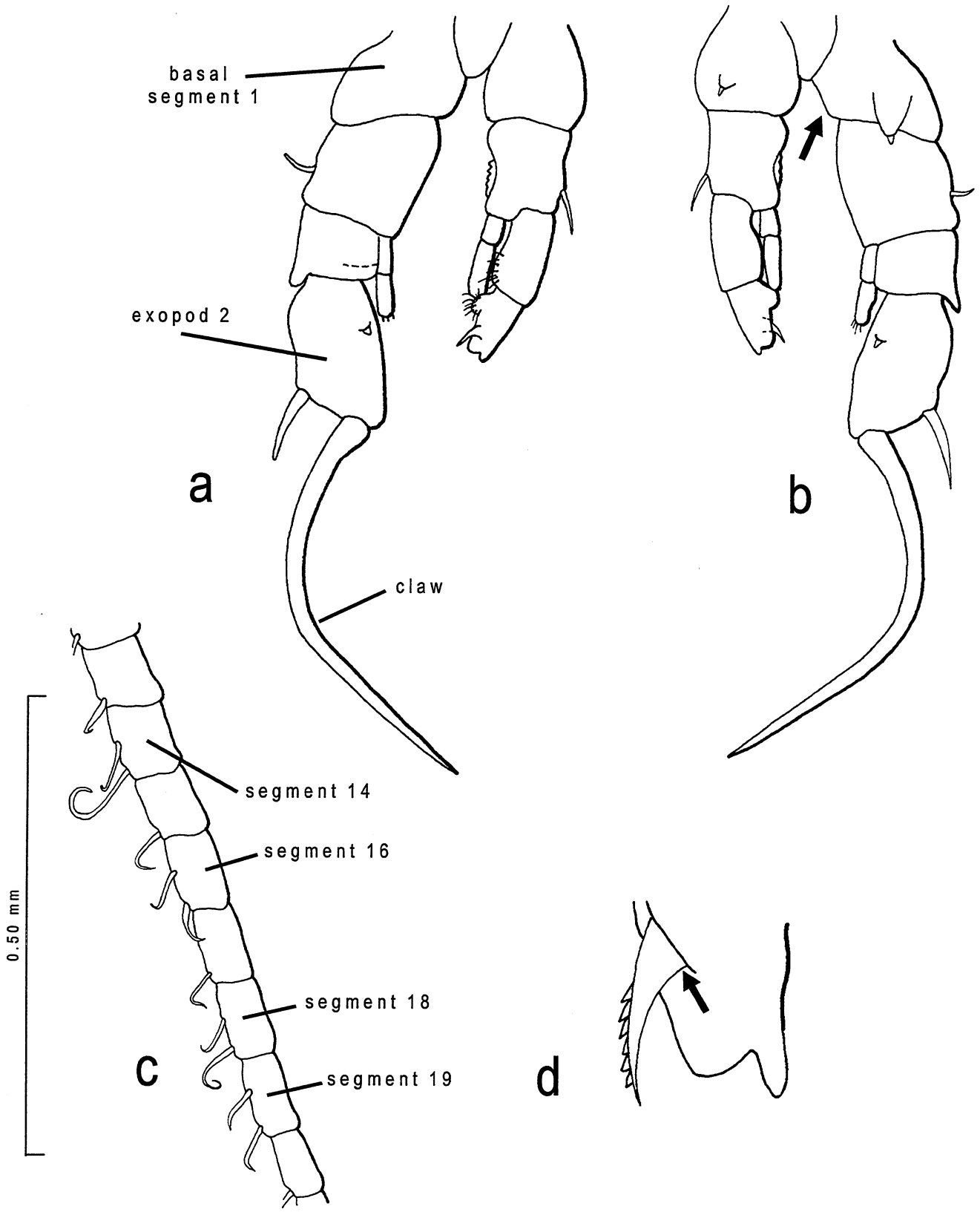

Figure 17. *Hesperodiaptomus novemdecimus* Wilson. Male. (a) 5th legs, anterior view; (b) 5th legs, posterior view; (a-b) (redrawn after Wilson 1959); (c) left 1st antenna, segments 13-20, Springhouse Pond, B.C.; (d) detail left leg, exopod 2 in part, anterior view (redrawn after Wilson 1959).

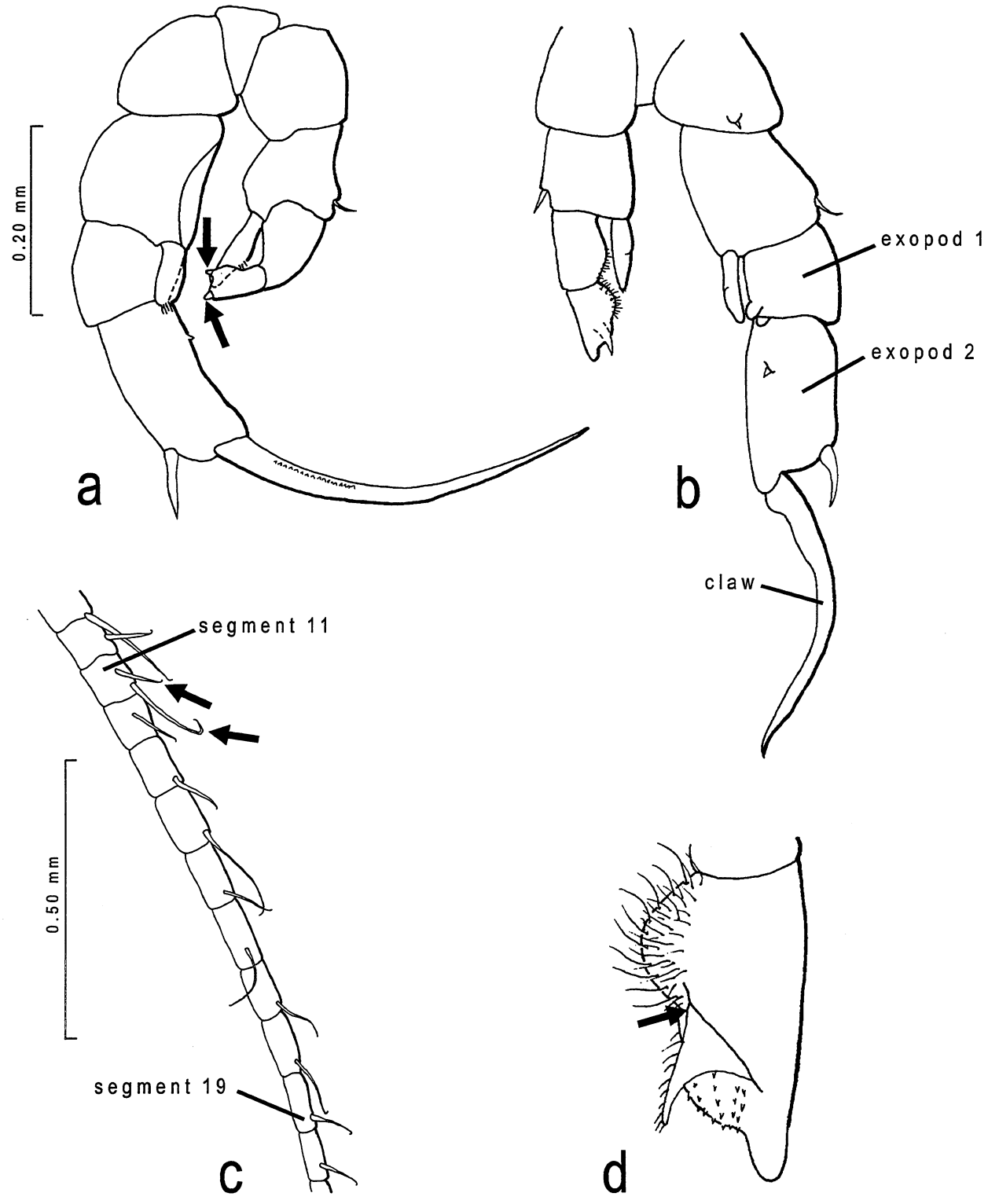

Figure 18. *Hesperodiaptomus kenai* Wilson. Male. (a) 5th legs, anterior view, Sumas L., B.C.; (b) 5th legs, posterior view (redrawn after Wilson 1959); (c) left 1st antenna, segments 10-20 , Sumas L., B.C.; (d) detail left leg, exopod 2 anterior view (redrawn after Wilson 1959).

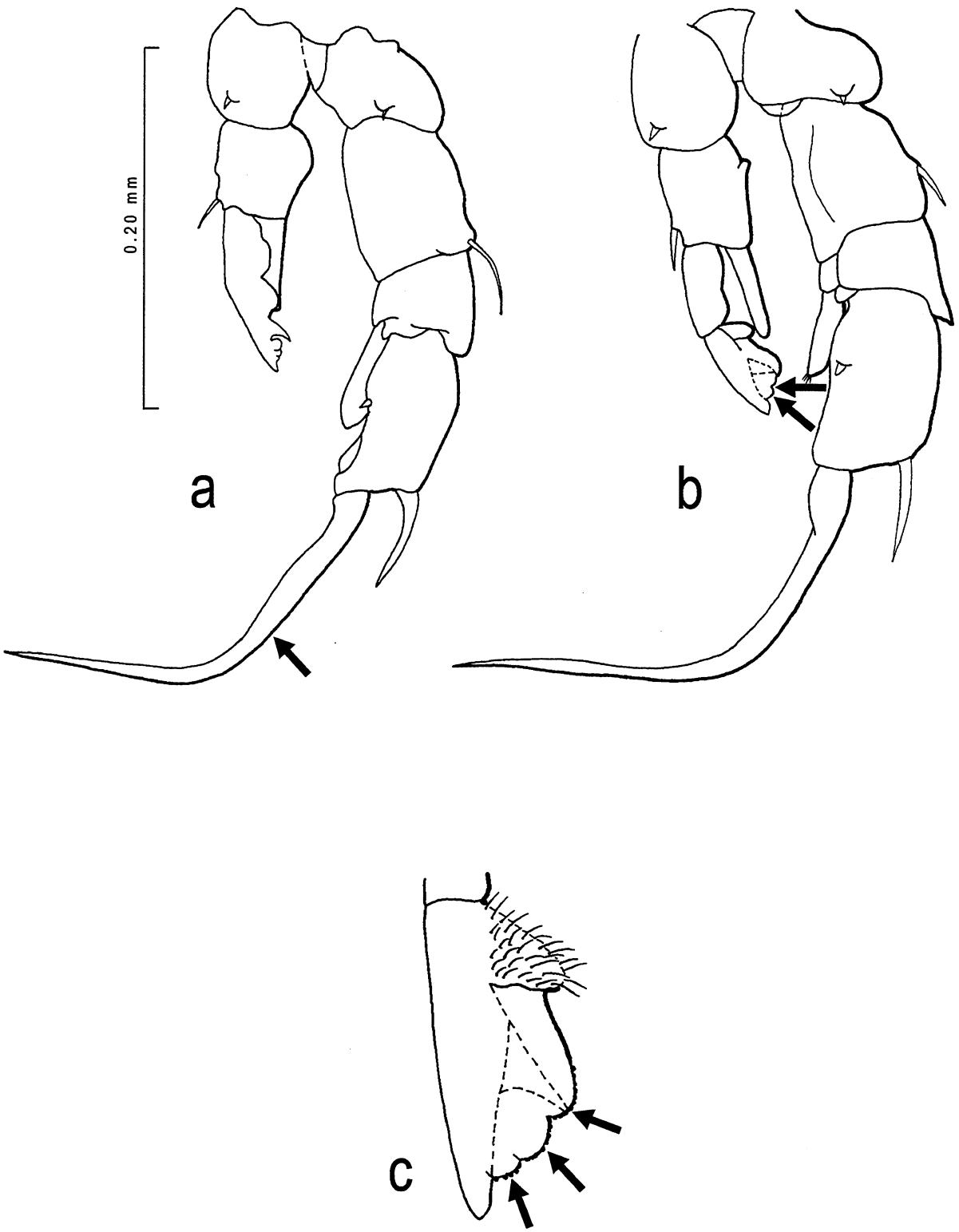

Figure 19. *Hesperodiaptomus franciscanus* (Lilljeborg). Male. (a-b) 5th legs, posterior view; (a) Quatansta L., B.C. (b) (redrawn after Wilson 1959); (c) detail left leg, exopod 2 posterior view (redrawn after Wilson 1959).

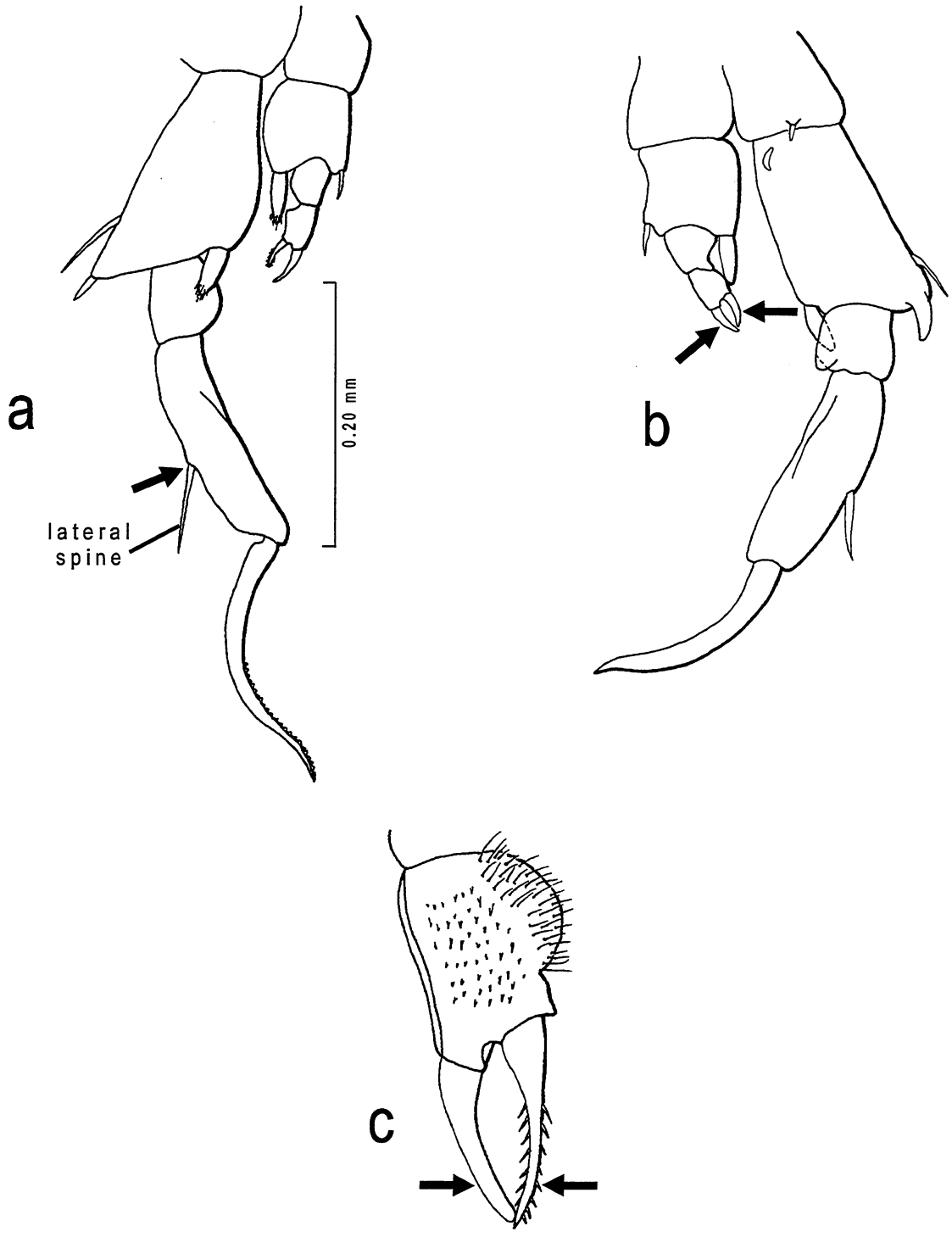

Figure 20. *Onychodiaptomus sanguineus* (Forbes). Male. (a) 5th legs, anterior view (redrawn after Humes & Wilson 1951); (b) 5th legs, posterior view; (c) detail left leg, exopod 2 posterior view; (b-c) (redrawn after Wilson 1959).

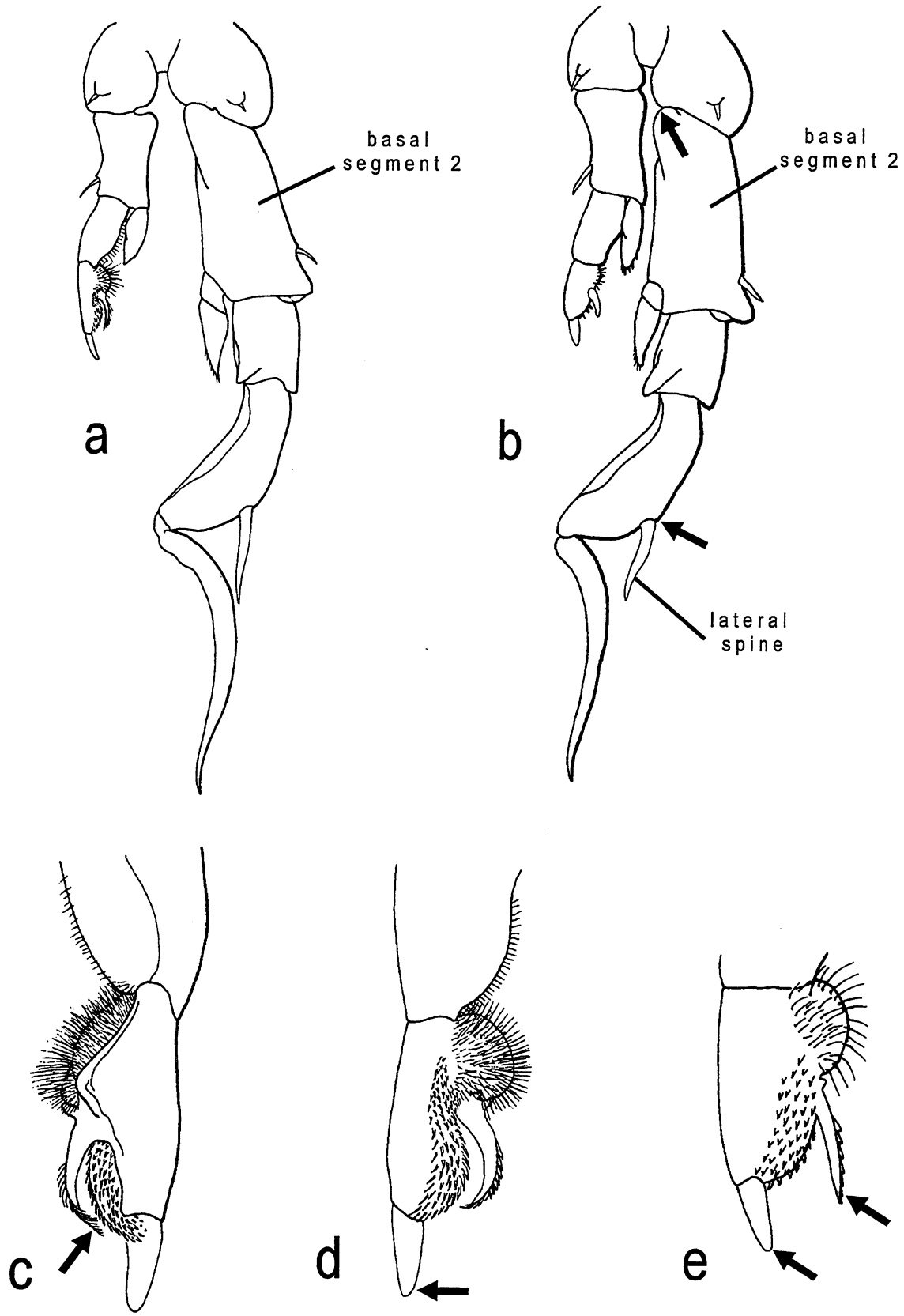

Figure 21. *Onychodiaptomus hesperus* Wilson & Light. Male. (a-b) 5th legs, posterior view; (a) (redrawn after Wilson & Light 1951); (b) (redrawn after Wilson 1959); (c-e) detail left leg, exopod 2; (c) anterior view; (d) posterior view; (c-d) (redrawn after Wilson & Light 1951); (e) posterior view (redrawn after Wilson 1959).

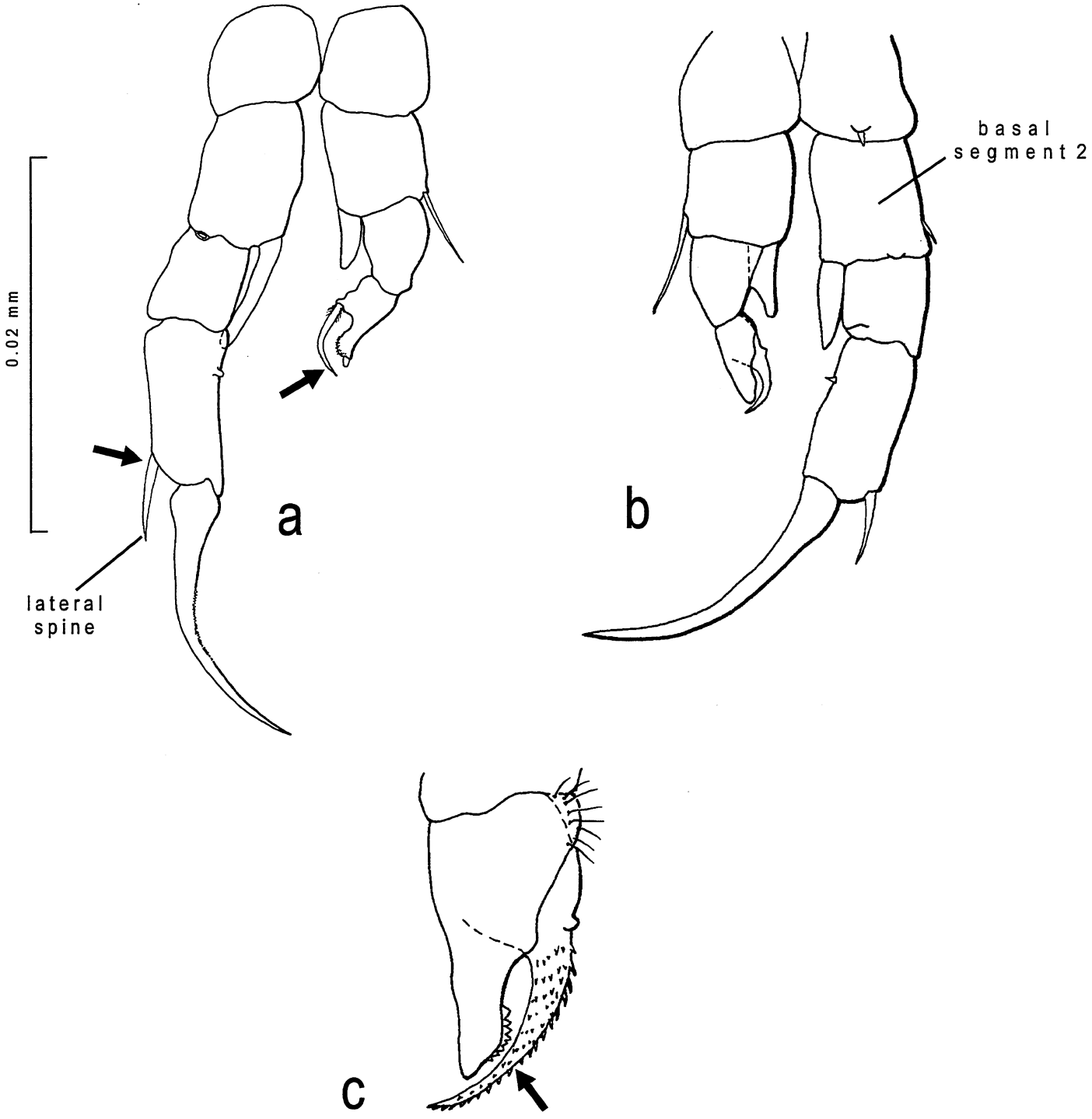

Figure 22. *Skistodiaptomus pallidus* (Herrick). Male. (a) 5th legs, anterior view, Nikomekl R., B.C.; (b) 5th legs, posterior view; (c) detail left leg, exopod 2, posterior view ; (b-c) (redrawn after Wilson 1959).

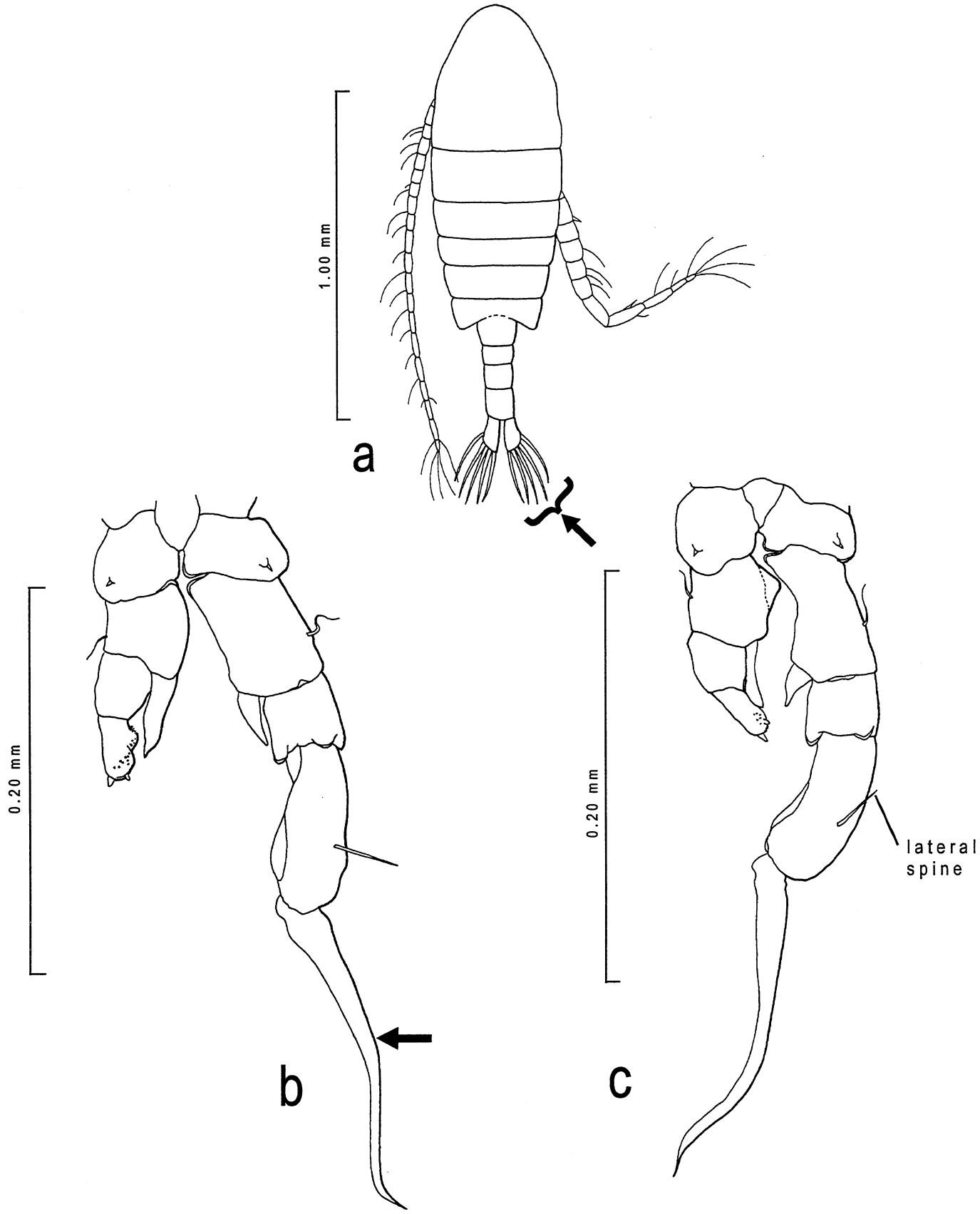

Figure 23. *Leptodiaptomus pribilofensis* (Juday & Muttkowski). Male. (a) dorsal view, Chilkat Pass pond, B.C.; (b-c) 5th legs, posterior view; (b) Chilkat Pass pond, B.C.; (c) Heart L., B.C.

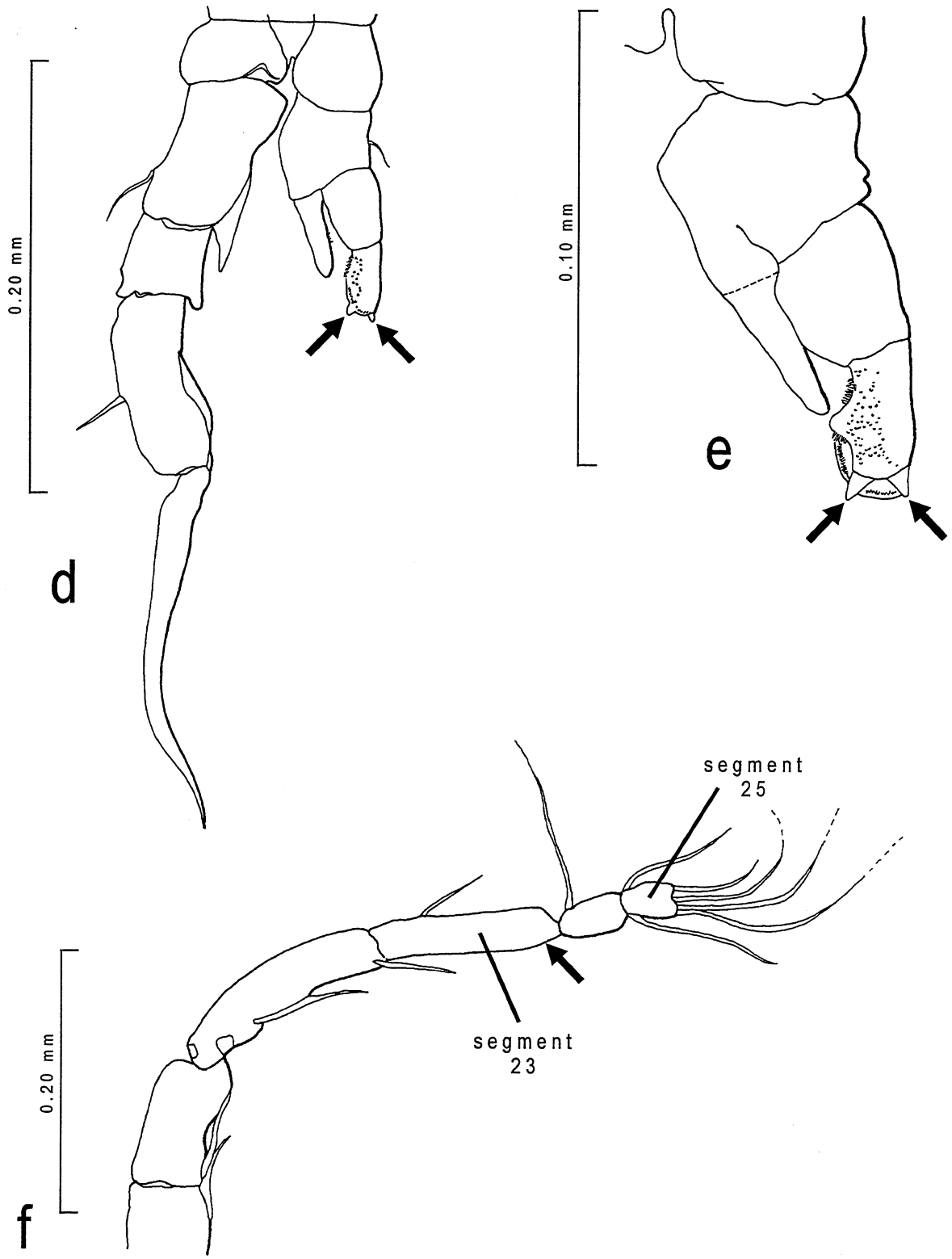

Figure 23. continued. *Leptodiaptomus pribilofensis* (Juday & Muttkowski). Male. (d) 5th legs, anterior view; (e) detail left leg, exopod 2 anterior view; (d-e) Chilkat Pass pond, B.C.; (f) right 1st antenna, segments 21-25, Kitlope L., B.C.

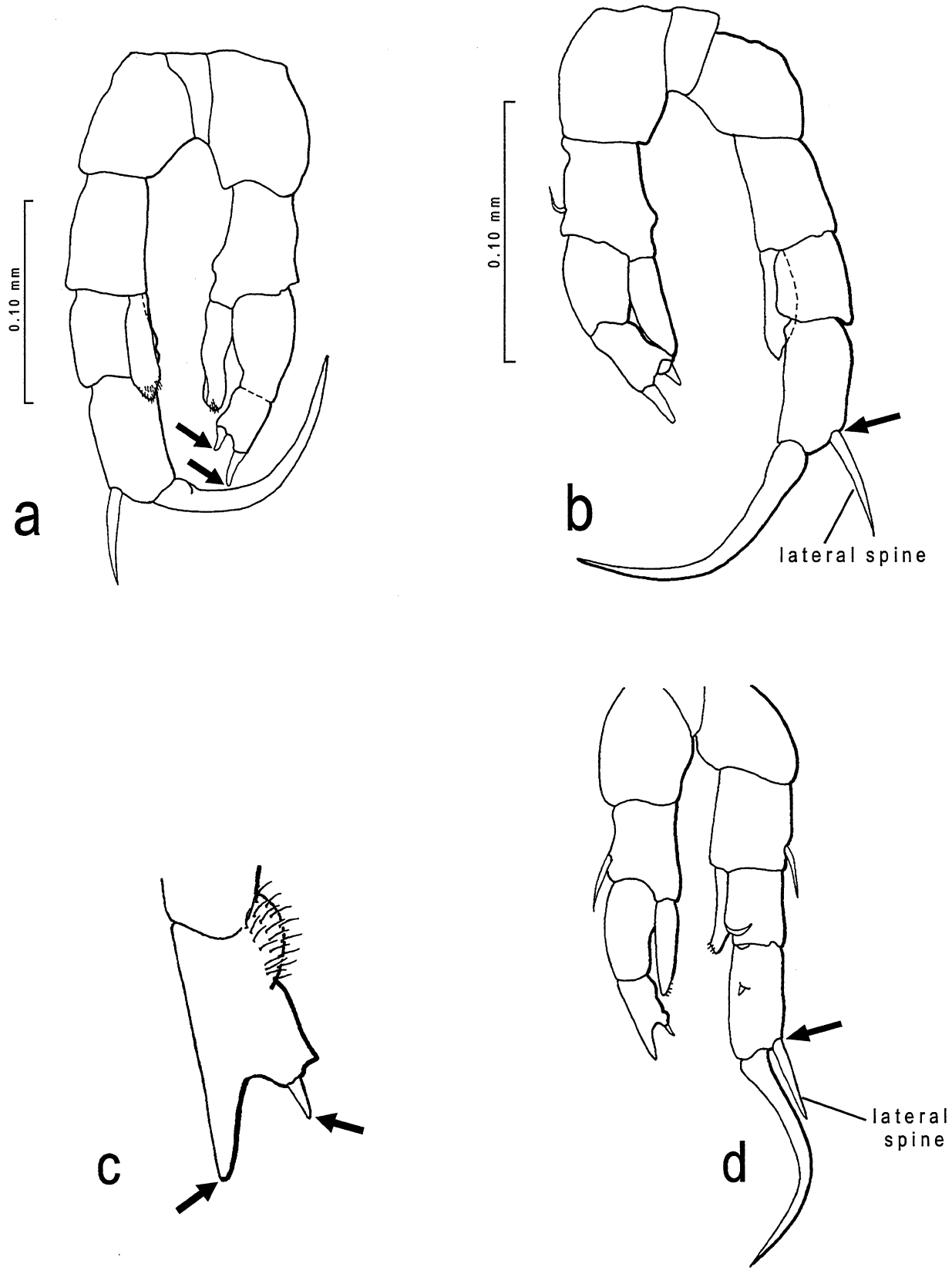

Figure 24. *Skistodiaptomus oregonensis* (Lilljeborg). Male. (a) 5th legs, anterior view; (b) 5th legs, posterior view; (a-b) Como L., B.C.; (c) detail left leg, exopod 2 posterior view; (d) 5th legs, posterior view; (c-d) (redrawn after Wilson 1959).

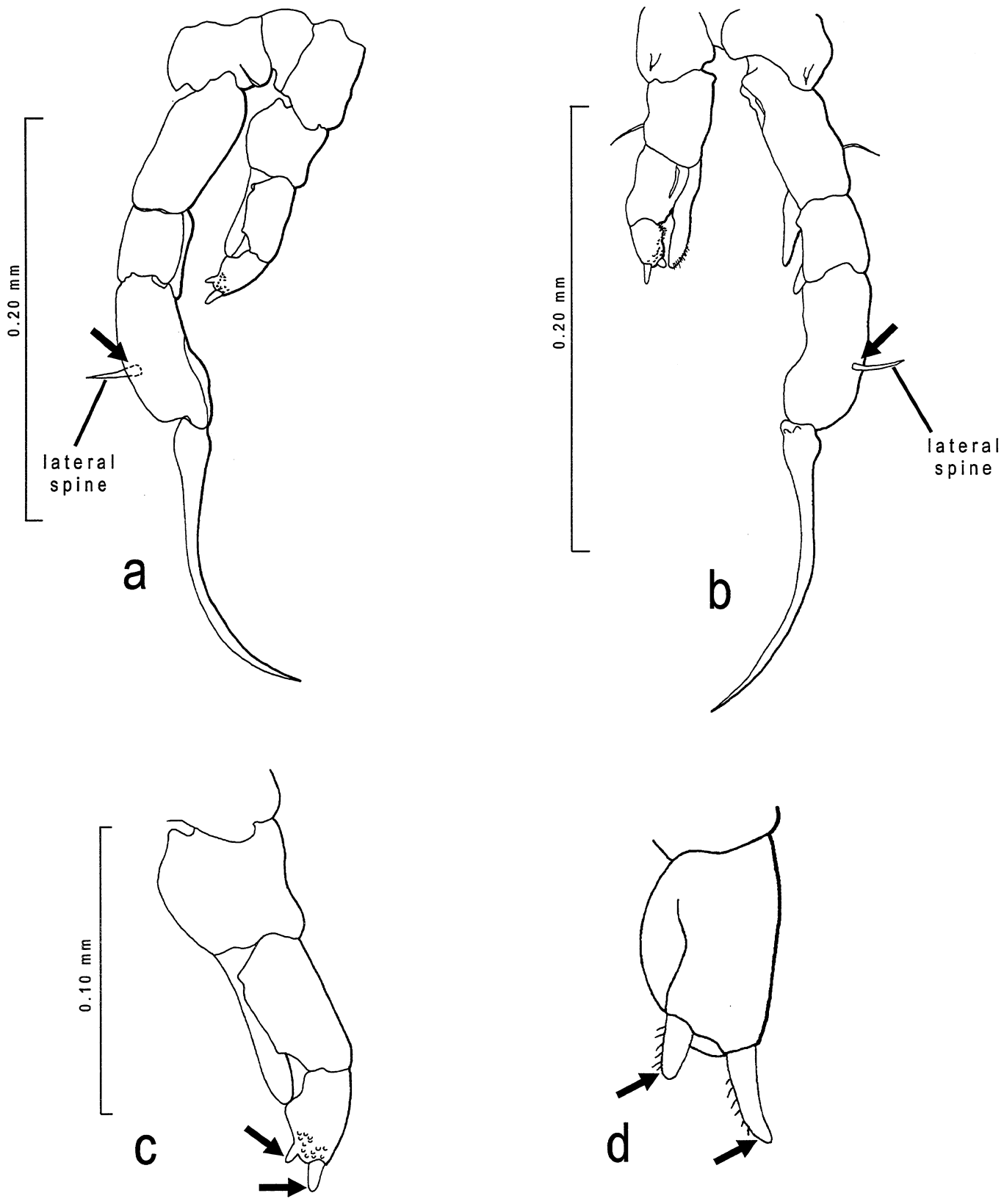

Figure 25. *Leptodiaptomus tyrrelli* (Poppe). Male. (a) 5th legs, anterior view; (b) 5th legs, posterior view; (a-b) Venables L., B.C.; (c-d) detail left leg, exopod 2 anterior view; (c) Venables L., B.C. (d) (redrawn after Wilson 1959).

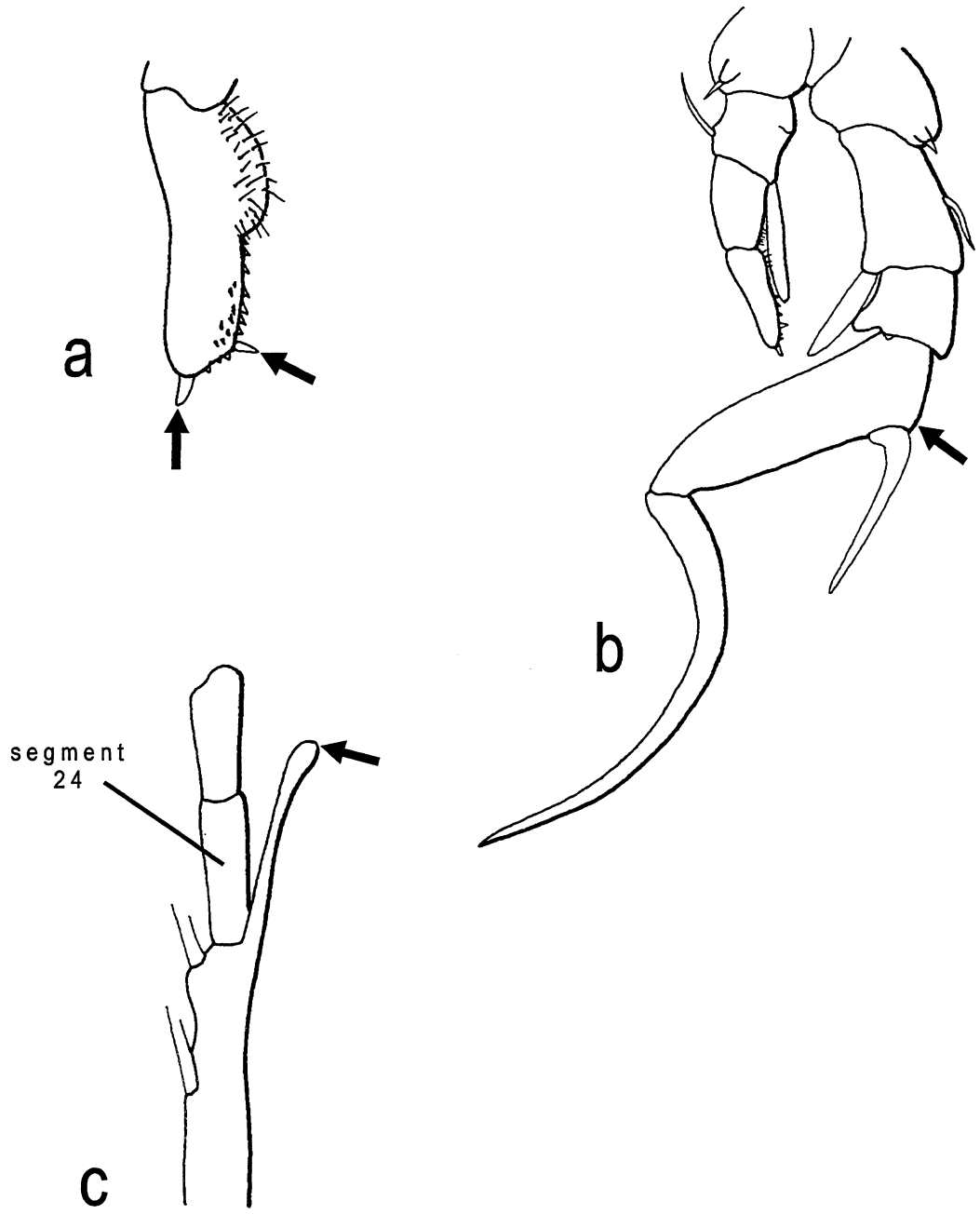

Figure 26. *Leptodiaptomus ashlandi* (Marsh). Male. (a) detail left leg, exopod 2 posterior view; (b) 5th legs, posterior view; (c) right 1st antenna, segments 23-25, showing antennal process; (a-c) (redrawn after Wilson 1959).

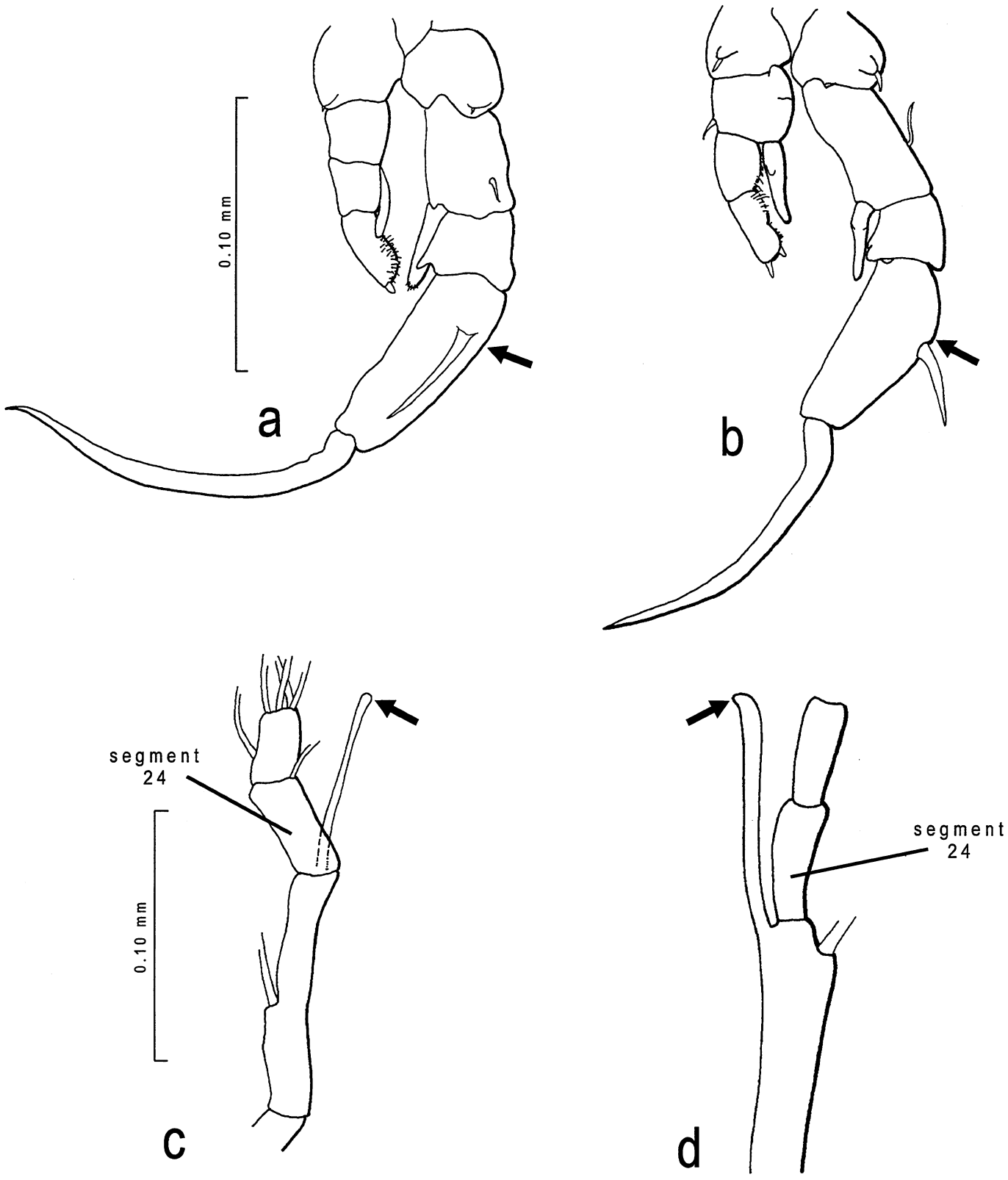

Figure 27. *Leptodiaptomus insularis* Kincaid. Male. (a-b) 5th legs, posterior view; (a) right 5th leg twisted slightly, Marie L., B.C.; (b) (redrawn after Wilson 1959); (c-d) right 1st antenna, segments 23-25, showing antennal process; (c) Marie L., B.C.; (d) (redrawn after Wilson 1959).

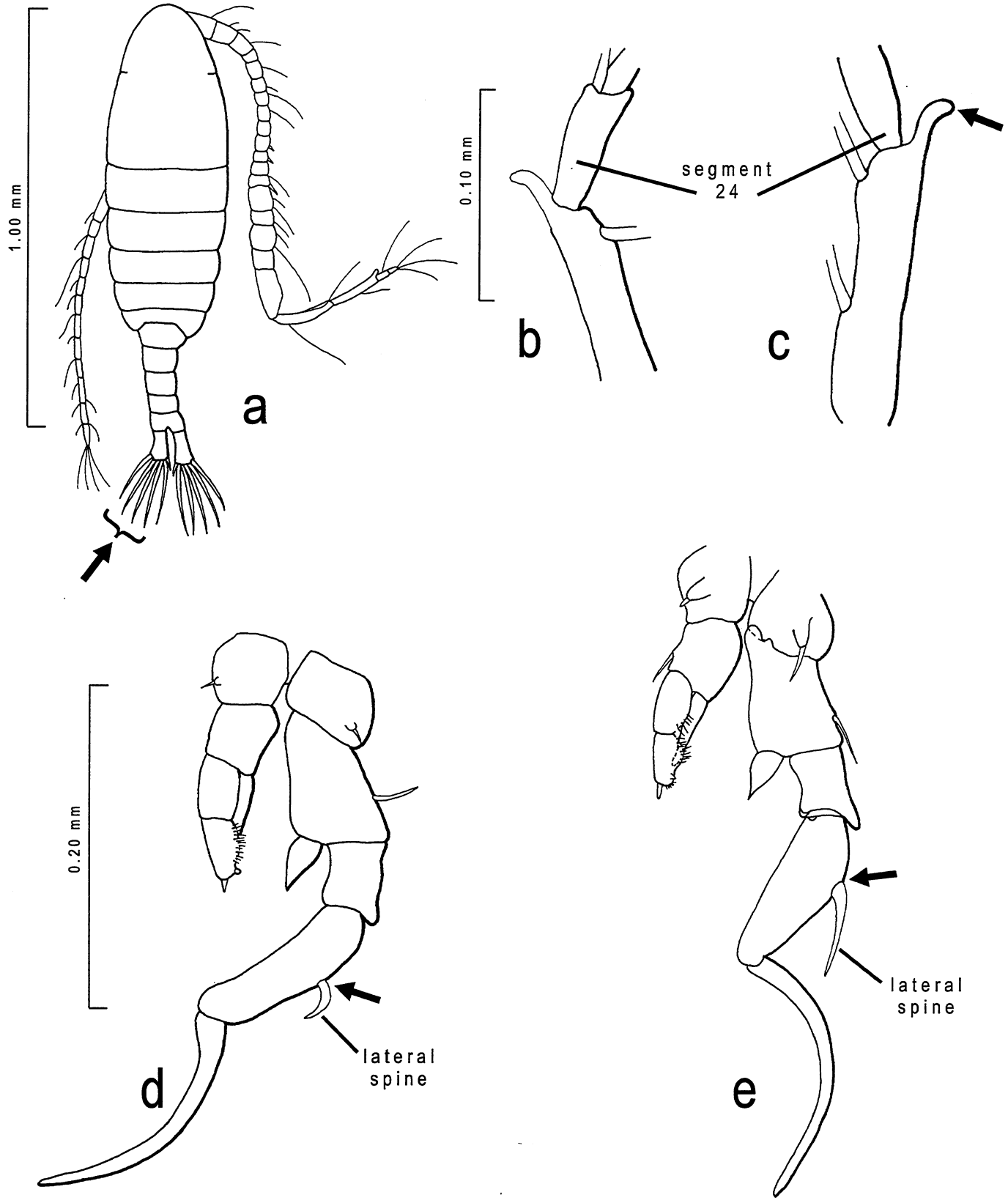

Figure 28. *Leptodiaptomus nudus* (Marsh). Male. (a) dorsal view, Copp L., B.C. (b-c) right 1st antenna, segments 23-25; (b) (redrawn after Shih & Maclellan 1977); (c) (redrawn after Wilson 1959); (d-e) 5th legs, posterior view; (d) (redrawn after Shih & Maclellan 1977); (e) (redrawn after Wilson 1959).

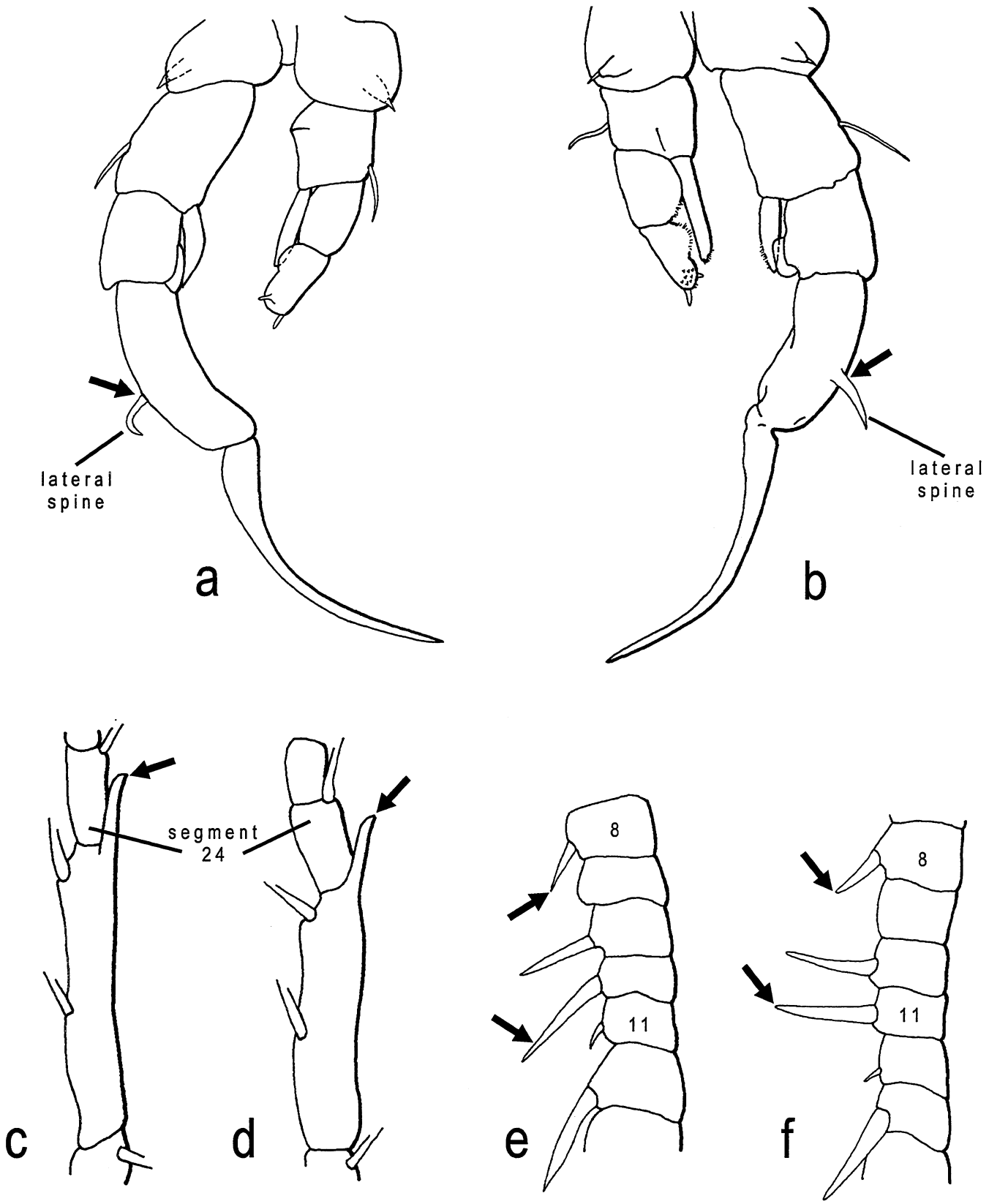

Figure 29. *Leptodiaptomus connexus* Light. Male. (a-b) 5th legs; (a) anterior view (redrawn after Wilson 1959); (b) posterior view (redrawn after Anderson 1970); (c-d) right 1st antenna, segments 23-25; (c-d) (redrawn after Anderson 1970); (e-f) right 1st antenna, segments 8-13; (e) (redrawn after Wilson 1959); (f) (redrawn after Anderson 1970).

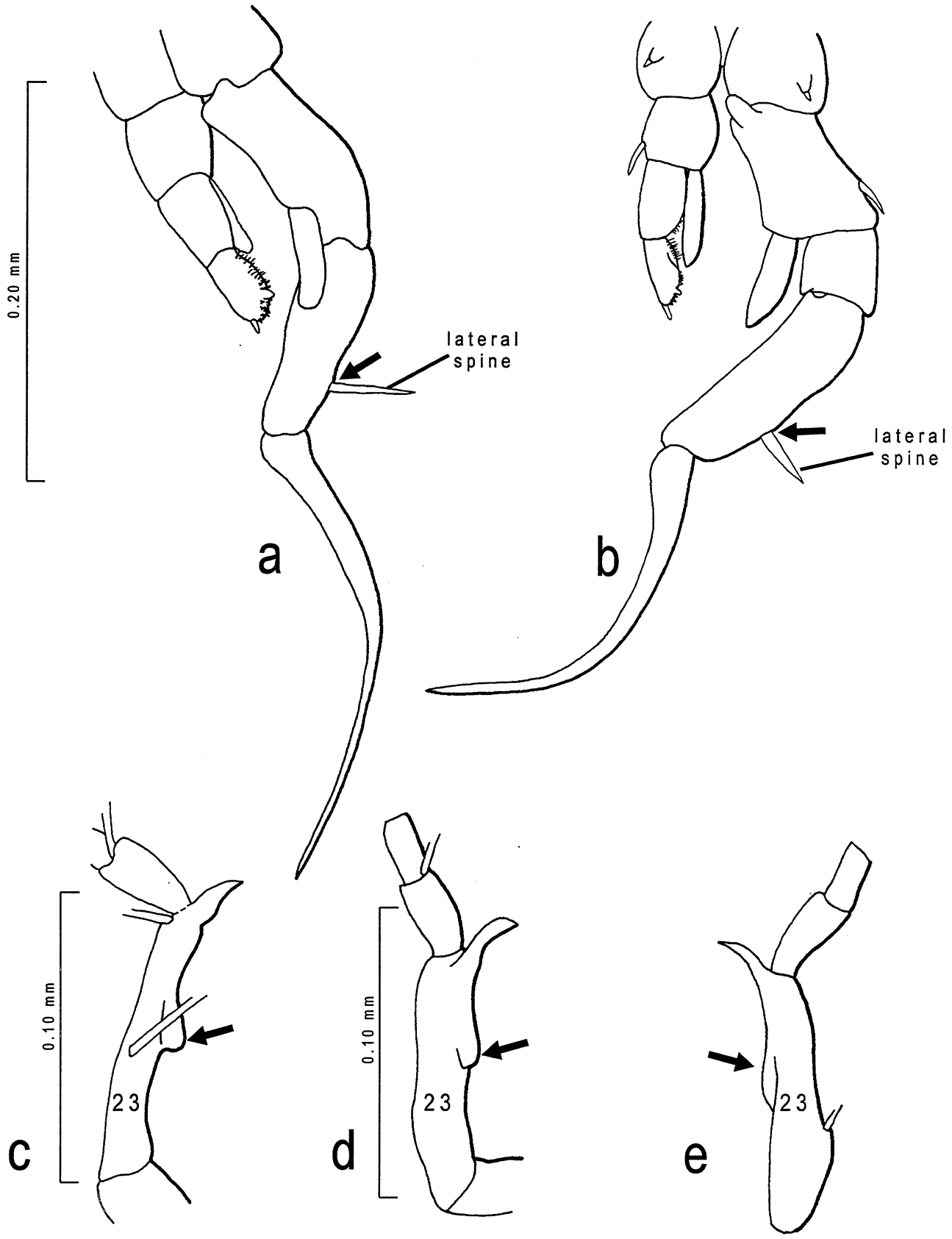

Figure 30. *Leptodiaptomus novamexicanus* (Herrick). Male. (a-b) 5th legs, posterior view; (a) Kootenay L., B.C.; (b) (redrawn after Wilson 1959); (c-e) right 1st antenna, segments 23-25; (c-d) Kootenay L., B.C.; (e) (redrawn after Wilson 1959).

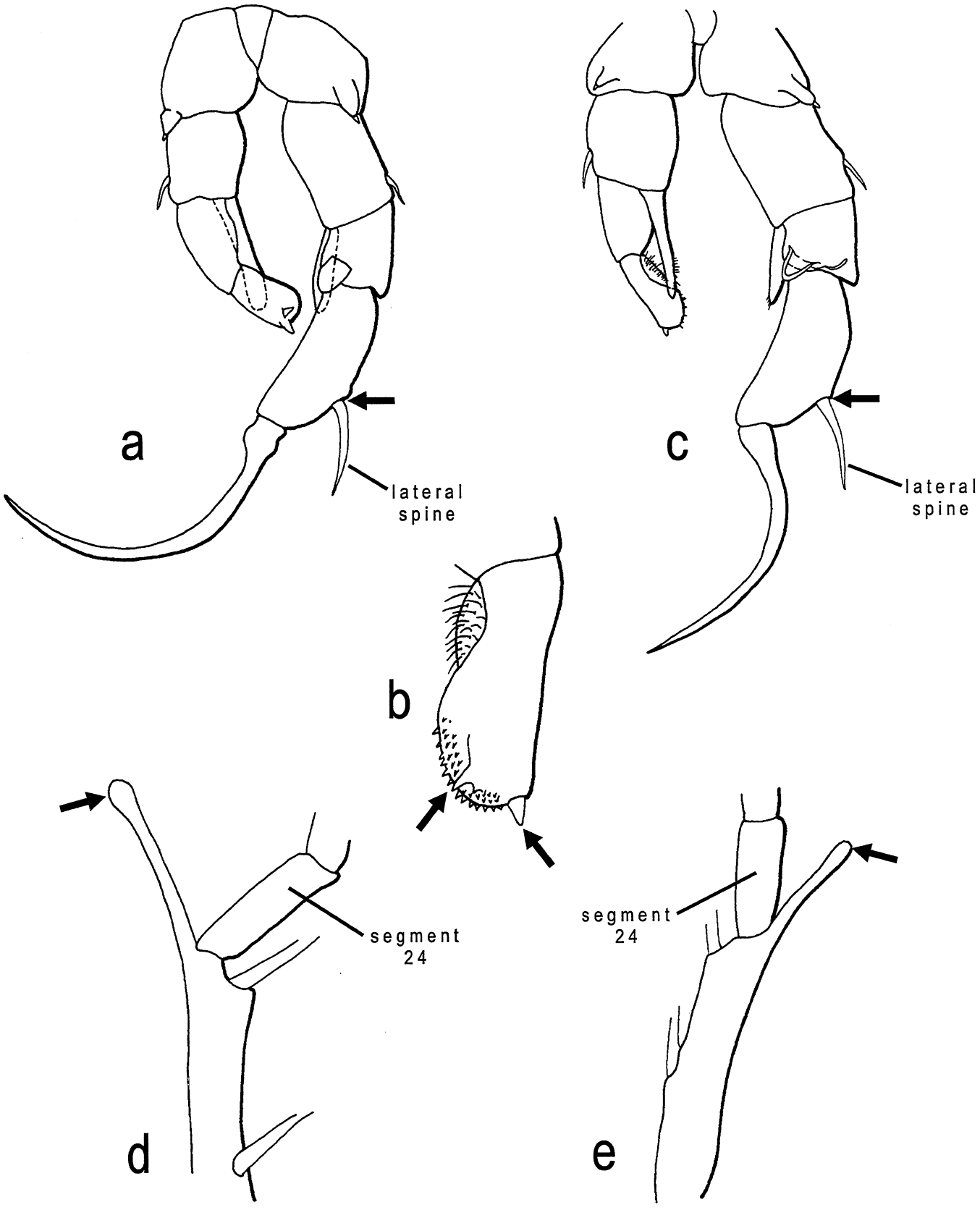

Figure 31. *Leptodiaptomus sicilis* (Forbes). Male. (a) 5th legs, posterior view (redrawn after Smith & Fernando 1978); (b) detail left 5th leg, exopod 2 anterior view; (c) 5th legs, posterior view (redrawn after Wilson 1959); (d-e) right 1st antenna, segments 23-24; (d) (redrawn after Smith & Fernando 1978); (e) (redrawn after Wilson 1959).

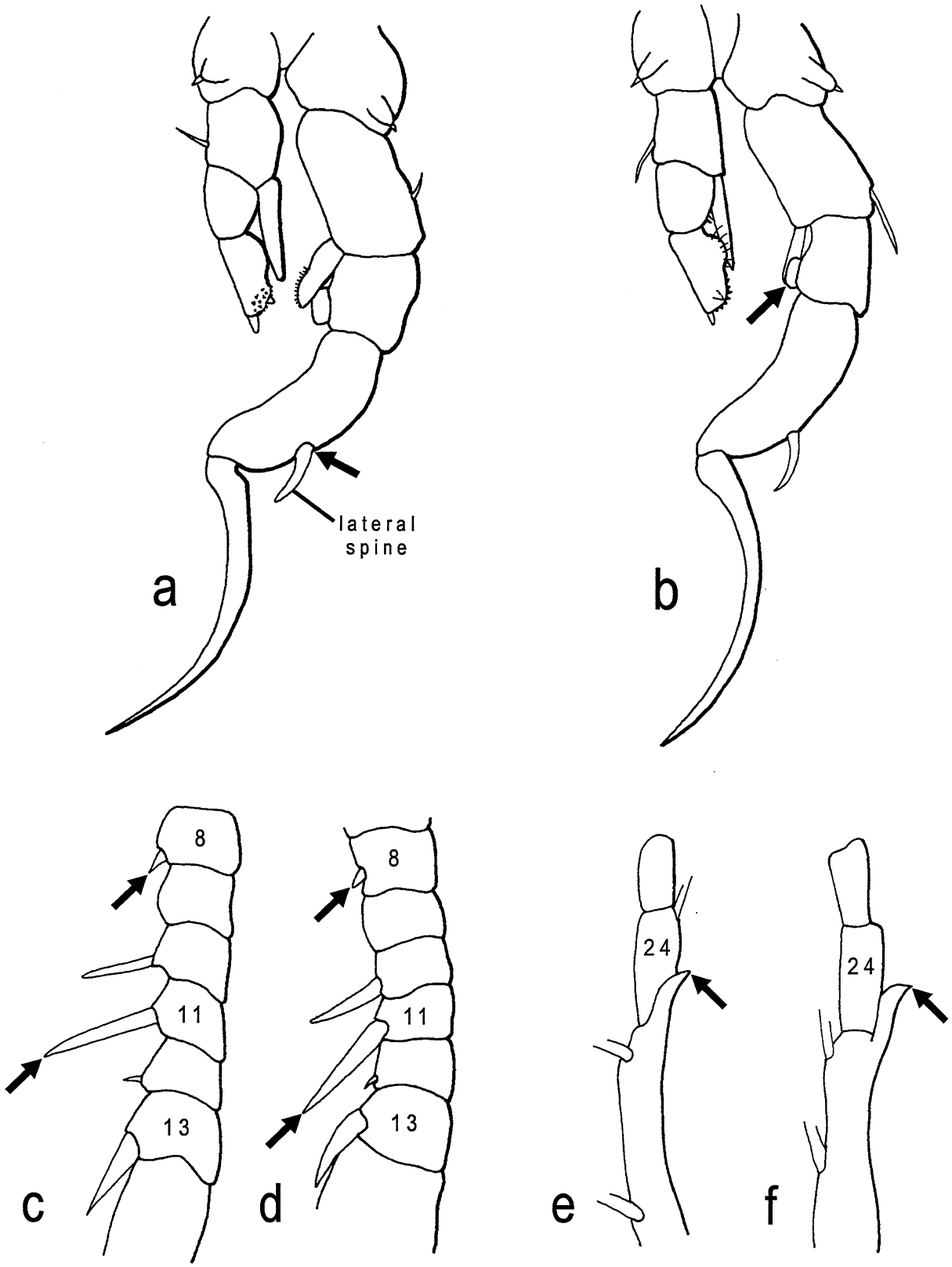

Figure 32. *Leptodiaptomus siciloides* (Lilljeborg). Male. (a-b) 5th legs, posterior view; (a) (redrawn after Anderson 1970); (b) (redrawn after Wilson 1959); (c-d) right 1st antenna, segments 8-13; (c) redrawn after Wilson 1959); (d) (redrawn after Anderson 1970); (e-f) right 1st antenna, segments 23-25; (e) (redrawn after Anderson 1970); (f) (redrawn after Wilson 1959).

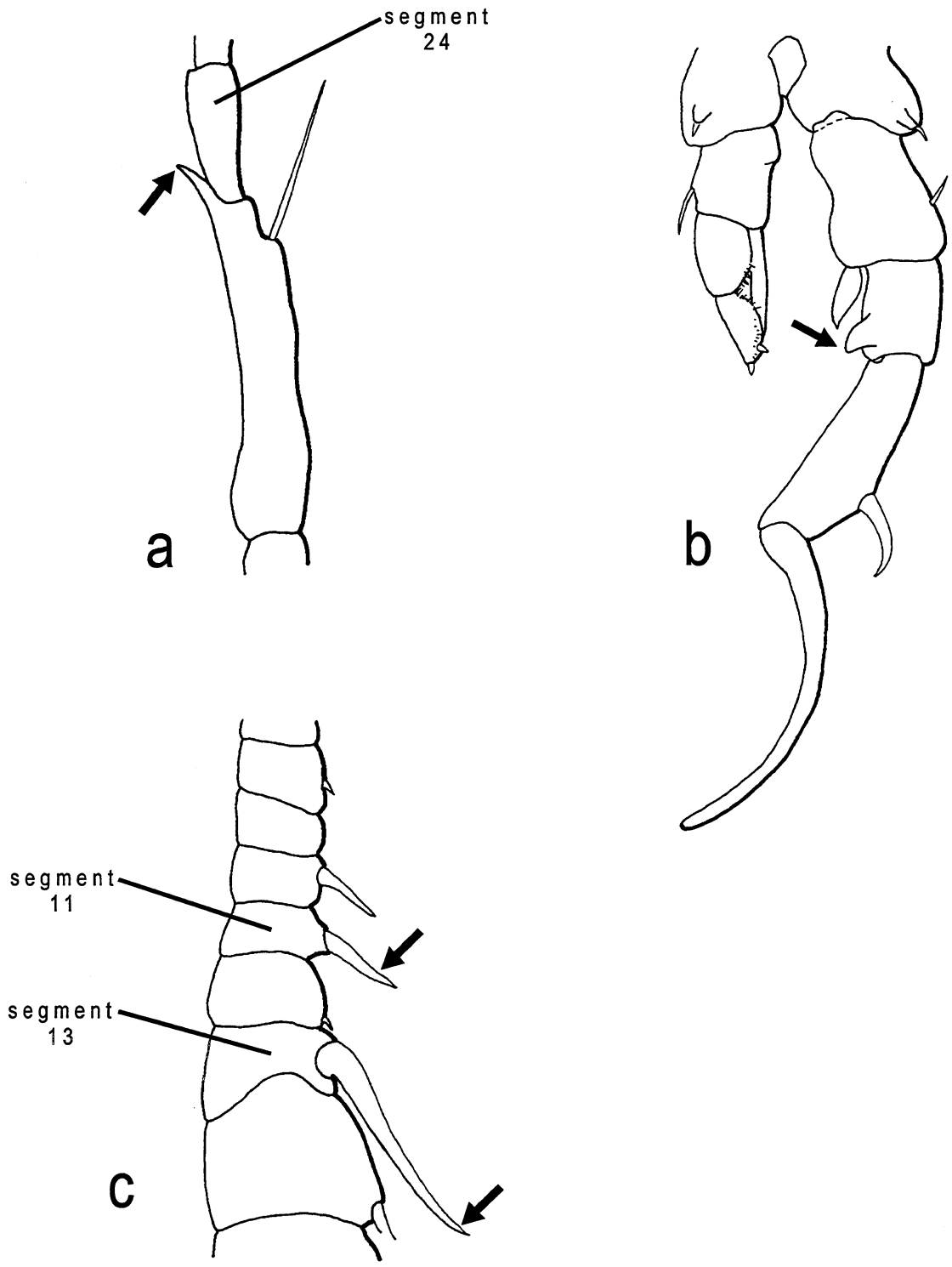

Figure 33. *Leptodiaptomus signicauda* (Lilljeborg). Male. (a) right 1st antenna, segments 23-24 (redrawn after Lilljeborg 1889); (b) 5th legs posterior view (redrawn after Wilson 1959); (c) *Leptodiaptomus moorei* Wilson, right 1st antenna, segments 8-14 (redrawn after Wilson 1959).

REFERENCES

Anderson, R.S. 1970. *Diaptomus* (*Leptodiaptomus*) *connexus* Light 1938 in Alberta and Saskatchewan. Can. J. Zool., 48:41-47.

Dussart, B. and D. Defaye. 1983. Répertoire mondial des crustacés copépodes des eaux intérieures. 1. Calanoïdes. Centre National de la Recherche Scientifique, Paris. 224 pp. [in French]

Einsele, U.K. 1989. The identification of copepodid instars of some calanoid and cyclopoid copepods of Lake Konstanz, Federal Republic of Germany. Crustaceana, 57(1):79-87.

Gardner, G.A. and I. Szabo. 1982. British Columbia pelagic marine copepoda: An identification manual and annotated bibliography. Special Publ., Can. Fish. Aquatic Sci., No. 62:536 pp.

Humes, A.G. and M.S. Wilson. 1951. The last copepodid instar of *Diaptomus sanguineus* Forbes (Copepoda). J. Wash. Acad. Sci., 41:395-399.

Huys, R. and G.A. Boxshall. 1991. Copepod evolution. The Ray Society, London. 468 pp.

Katona, S.K. 1971. The developmental stages of *Eurytemora affinis* (Poppe 1880) (Copepoda, Calanoida) raised in laboratory cultures including a comparison with the larvae of *Eurytemora americana* Williams 1906, and *Eurytemora herdmani* Thompson and Scott, 1897. Crustaceana, 21:5-21.

Kincaid, T. 1953. A contribution to the taxonomy and distribution of the American fresh-water calanoid crustacea. Calliostoma Co., Seattle. 73 pp.

Light, S.F. 1938. New subgenera and species of diaptomid copepods from the inland waters of California and Nevada. Univ. Calif. Pub. Zool., 43:67-78.

Lilljeborg. 1889. Révisions de Calanides d'eau douce, pp. 53-181. *In:* J. de Guèrne and J. Richard (eds.). Mémoires Soc. Zool. de France, vol. 2. [in French and Latin]

Marmorek, D.R. and J. Korman. 1993. The use of zooplankton in a biomonitoring program to detect lake acidification and recovery. Water, Air, Soil Poll., 69(3-4):223-241.

Pennak, R.W. 1989. Freshwater invertebrates of the United States. 3rd ed. John Wiley & Sons, New York. 628 pp.

Pinel-Alloul, B. and J. Lamoureux. 1988. Développement post-embryonnaire du copépode calanoïde *Diaptomus* (*Aglaodiaptomus*) *leptopus* S.A. Forbes, 1882. II. Phases copépodites et adulte. Crustaceana, 54(2):171-195. [in French]

Ravera, O. 1953. Gli stadi di svilluppo dei copepodi pelagici del Lago Maggiore. Mem. Ist. Ital. Idrobiol. Dotl. Marco. Marchi., 7:129-151. [in Italian]

Rylov, V. 1922. Une forme nouvelle de *Diaptomus* de l'Amerique du Nord (Entomostraca, Copepoda) prouvenant de Siberie orientale. Rev. Russe d'Entom., 18:1-7. [in Russian]

Sars, G.O. 1903. An account of the crustacea of Norway. 4. Copepoda: Calanoida. Bergen Museum, Bergen. 171 pp.

Shih, C.T. and D.C. Maclellan. 1977. Descriptions of copepodite stages of *Diaptomus* (*Leptodiaptomus*) *nudus* Marsh 1904 (Crustacea: Copepoda). Can. J. Zool., 55:912-921.

Smith, K. and C.H. Fernando. 1978. A guide to the fresh-water calanoid and cyclopoid crustacea of Ontario. Univ. Waterloo Biol. Ser., 18:74 pp.

Vanderploeg, H.A. and G.A. Paffenhöfer. 1985. Modes of algal capture by the freshwater copepod *Diaptomus sicilis* and their relation to food-size selection. Limnol. Oceanogr., 30(4):871-885.

Williamson, C.E. 1991. Copepoda, pp. 787-822. *In:* J.H. Thorp and A.P. Covich (eds.). Ecology and classification of North American freshwater invertebrates. Academic Press, Inc., San Diego.

Wilson, M.S. 1959. Calanoida, pp. 738-794. *In:* W.T. Edmondson (ed.). Freshwater Biology, 2nd ed. John Wiley & Sons, New York.

Wilson, M.S. and S.F. Light. 1951. Description of a new species of diaptomid copepod from Oregon. Trans. Am. Microsc. Soc., 70(1):25-30.

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