

**A REVIEW OF *LIPAROCEPHALUS* MÄKLIN
(COLEOPTERA: STAPHYLINIDAE: ALEOCHARINAE)
WITH DESCRIPTIONS OF LARVAE¹**

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Abstract.—A systematic review of the aleocharine genus *Liparocephalus* Mäklin is presented. *Liparocephalus* Mäklin is redescribed, and three species (*L. brevipennis* Mäklin, *L. cordicollis* LeConte, *L. tokunagai* Sakaguti) are described. Late instar larvae of *L. cordicollis* are redescribed and late instar larvae of *L. brevipennis* and *L. tokunagai* are described for the first time. A key is provided for separation of both adults and late instar larvae of known species of *Liparocephalus*, and illustrations of diagnostic features are presented.

Key Words.—Insecta, Coleoptera, Staphylinidae, Aleocharinae, *Liparocephalus*, systematic review, intertidal.

Members of the genus *Liparocephalus* are confined to the rocky seashores of the Pacific Coast of Japan, Alaska, Canada, and U.S.A. Topp & Ring (1988) studied adaptations to the marine environment of *L. cordicollis* LeConte from the Pacific coast of Canada. This species is a predator on small chironomid larvae, and can respire when submerged in seawater. Adults of *L. cordicollis* can stabilize their body weight at different salinities by regulating osmotic pressure.

The genus *Liparocephalus* was first described and characterized by Mäklin (1853), who described *L. brevipennis* from the coast of Alaska. Later LeConte (1880) described *L. cordicollis* from Alaska and Sakaguti (1944) described *L. tokunagai* from the coast of Japan. The adults and larvae of *L. cordicollis* (incorrectly identified as *L. brevipennis*) were described by Saunders (1928) and Chamberlin & Ferris (1929). Moore (1956b) also discussed the larvae of *Liparocephalus*.

However, the genus *Liparocephalus* has not been clearly described in detail in spite of revisionary studies of the North American taxa (Moore 1956a). In addition, the late instar larvae of the *Liparocephalus* species should be described according to the appropriate technique developed recently (Ashe & Watrous 1984).

For these reasons, I redescribe *Liparocephalus* and *L. brevipennis*, *L. cordicollis*, and *L. tokunagai* and their associated late instar larvae. The described larvae were collected in association with adults of *L. brevipennis* in Alaska, *L. cordicollis* in Canada, and *L. tokunagai* in Japan, respectively. There were no other larvae or adults of any other aleocharine species present and larvae of other possible species of intertidal Aleocharinae known to me are distinctly different from these larvae. Therefore, I have described them as probable larvae of *L. brevipennis*, *L. cordicollis*, and *L. tokunagai*.

Depository Abbreviations.—California Academy of Sciences, San Francisco (CAS); Cornell University Insect Collections, Ithaca (CUIC); Field Museum of

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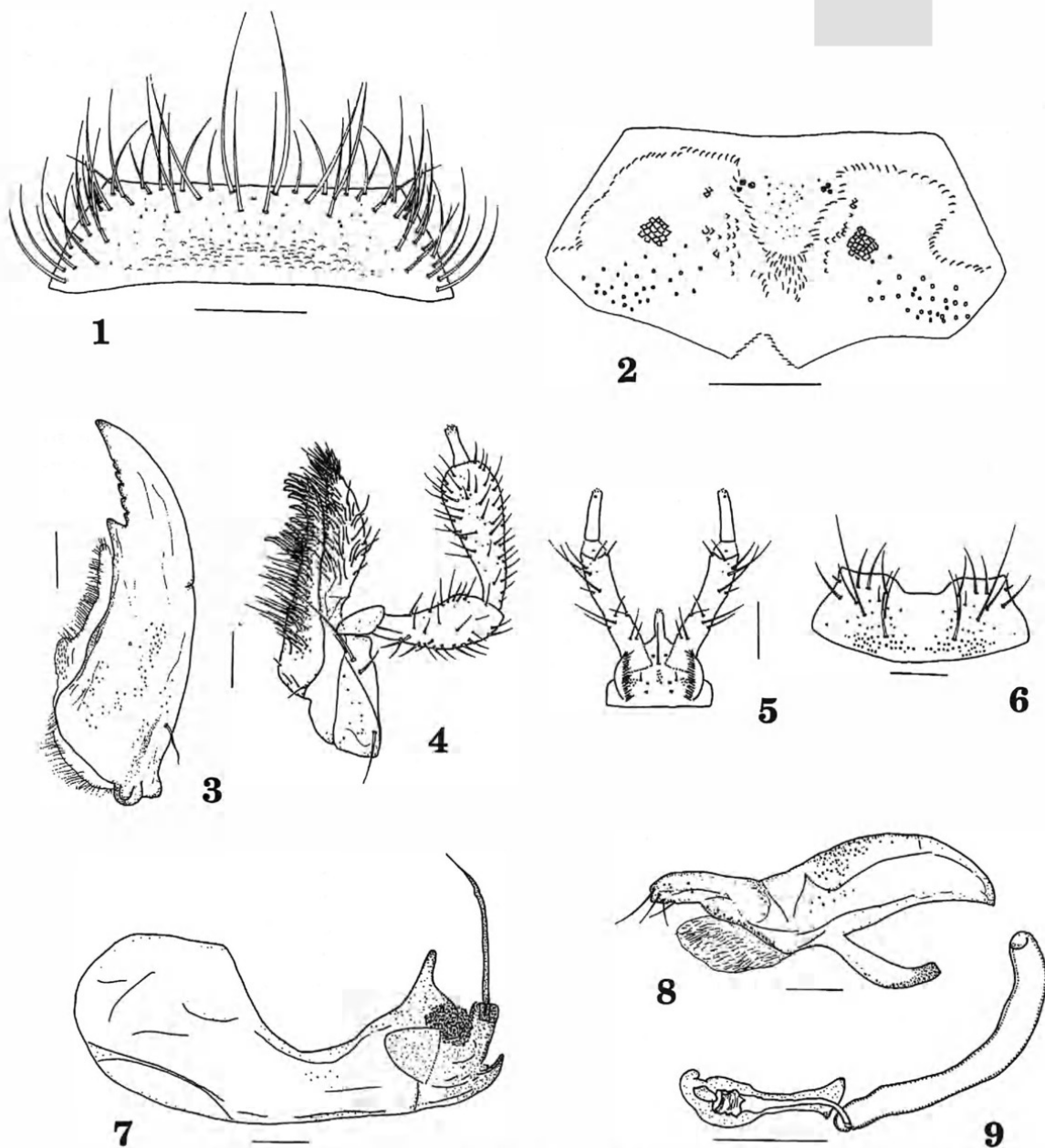
Natural History, Chicago (FMNH); Finnish Museum of Natural History, Helsinki, Finland (FMNHC); Snow Entomological Museum at the University of Kansas, Lawrence (KSEM); Museum of Comparative Zoology at Harvard University, Cambridge (MCZ); Natural History Museum and Institute, Chiba, Japan (NHMIC); National Museum of Natural History, Washington, D.C. (NMNH); Spencer Entomological Museum at the University of British Columbia, Vancouver, Canada (UBCZ); University of California at Riverside (UCR); James Entomological Collection at the Washington State University, Pullman (WSUC).

LIPAROCEPHALUS MÄKLIN

Liparocephalus Mäklin, 1853: 191; LeConte, 1861: 66; Casey, 1886: 229; 1893: 353; Fenyès, 1918: 106; Bernhauer & Scheerpeltz, 1926: 550; Chamberlin & Ferris, 1929: 143; Blackwelder, 1952: 222; Moore, 1956a: 116; Hatch, 1957: 149; Moore & Legner, 1975: 445, 1976: 531; Seevers, 1978: 171.

Type Species.—*Liparocephalus brevipennis* Mäklin. Designated by Fenyès (1918).

Description.—*Adult.* Length 3.8–5.2 mm. Body shape broad, robust and more or less convex, black to dark brown, pubescent with relatively long microsetae more or less densely and uniformly distributed. HEAD. Slightly deflexed, about as long as wide. Eyes small, 0.2 times length of head; without setae between facets. Tempora very long. Neck absent. Microsetae uniformly distributed. Antenna with 11 antennomeres; all antennomeres elongate. MOUTHPARTS. Labrum (Fig. 1) transverse, trapezoidal, ≈ 50 –80 major setae distinct, additional setae present, sensilla indistinct on anterior margin of labrum, small pores scattered; epipharynx (Fig. 2) with ≈ 15 large lateral pores on each side and ≈ 10 –20 small medial pores. Mandibles (Fig. 3) symmetrical, apex more or less acute and not curved downward; median tooth well developed, 4–5 internal teeth present between apex and median tooth; protheca well developed, membranous with fibrils; 3 or 5 setae present laterally, most basal one largest. Maxilla (Fig. 4) with galea and lacinia elongate, almost equal in length; galea corneous, apex densely pubescent with long filiform setae, and many long setae uniformly distributed on dorsal surface; lacinia more or less acute, internal surface with comb of single row of about 11 well separated spines followed by several setae, many long setae uniformly distributed on dorsal surface; maxillary palpus with 4 articles, robust, article 3 incrassate distally and longer than article 2, article 4 narrowed distally with indistinct sensilla at apex, distinct filamentous sensilla at base. Labium (Fig. 5) with palpi of 2 articles, elongate, article 1 partially articulated, article 2 with indistinct sensilla at apex, much narrower and shorter than article 1; twin pores, median pore and distal pores present; ligula simple, elongate; one medial seta present or none on prementum; real pores, setal pores, and basal pores present; ≈ 10 –16 pseudopores medially, and ≈ 6 pseudopores laterally; a pair of comb-like hypoglossae present. Mentum (Fig. 6) with v setae; more or less trapezoidal, anterior margin deeply emarginate, or anterior margin deeply truncate internally, posterior margin prolonged roundly, and apico-lateral margin with projecting knob. Submentum with numerous punctures and setae. THORAX. Pronotum about 0.8–0.9 \times as long as wide, narrowest at base and widest near apex; pattern of pubescence with setae subparallel, those on apical half of pronotum directed anteriorly, those on basal half directed posteriorly in a narrow median strip, others curve correspondingly (pattern G, Seevers 1978); microsetae uniformly distributed; two long filiform setae present on each side. Hypomera visible in lateral aspect. Mesocoxal cavities contiguous; mesosternal process very short, and more or less pointed. Metasternum shorter than width of mesocoxa. Legs with tarsal formula 4-4-5, tarsus with spatulate setae. Claws narrow, long, sickle-shaped. Scutellum more or less diamond-shaped. ELYTRA. 0.5–0.6 \times as long as pronotum; microsetae numerous, directed posteriorly, uniformly distributed; two long filiform setae present, 1 on disc and 1 on lateral margin. Hind wings absent. ABDOMEN. General shape broadest at segment VII or VIII; microsetae numerous, directed posteriorly, uniformly distributed. Tergites not impressed at base. Sternites not constricted at base. Tergite X broader than long, without major setae but with numerous additional setae. SECONDARY SEXUAL CHARACTERISTICS. Sternite VIII (Fig. 22) of male prolonged posteriorly as broad triangular projection. Female



Figures 1–9. Adult *Liparocephalus cordicollis*. Figure 1. Labrum, dorsal aspect. Figure 2. Epipharynx, dorsal aspect. Figure 3. Mandible, ventral aspect. Figure 4. Maxilla, dorsal aspect. Figure 5. Labium, dorsal aspect. Figure 6. Mentum, dorsal aspect. Figure 7. Median lobe, lateral aspect. Figure 8. Paramere, lateral aspect. Figure 9. Spermatheca, lateral aspect. Scale = 0.1mm.

sternite slightly prolonged. AEDEAGUS. Median lobe (Figs. 7, 23, 25). Parameres (Fig. 8). SPERMATHECA. (Figs. 9, 24, 26).

Diagnosis.—Among aleocharine general with 4-4-5 tarsal formula, members of *Liparocephalus* are recognized by the combination of: relatively long setae densely and uniformly distributed; all antennomeres elongate; eyes without setae between facets; labrum (Fig. 1) transverse with 50–80 major setae; mandibles (Fig. 3) almost symmetrical, with 4–5 large teeth between apex and median tooth; lacinia (Fig. 4) with setae distributed uniformly over dorsal surface; galea (Fig. 4) with setae distributed uniformly over dorsal surface; medial setae on labium (Fig. 5) one or none; mentum with v setae (Fig. 6); elytra shorter than pronotum; hind wings

absent; mesocoxal cavities contiguous; tarsus with spatulate setae; tergites not impressed at base; distinctive secondary sexual characteristics (Fig. 22); and occurrence in the intertidal zone of rocky shores.

Distribution.—Alaska to California (USA) and Japan.

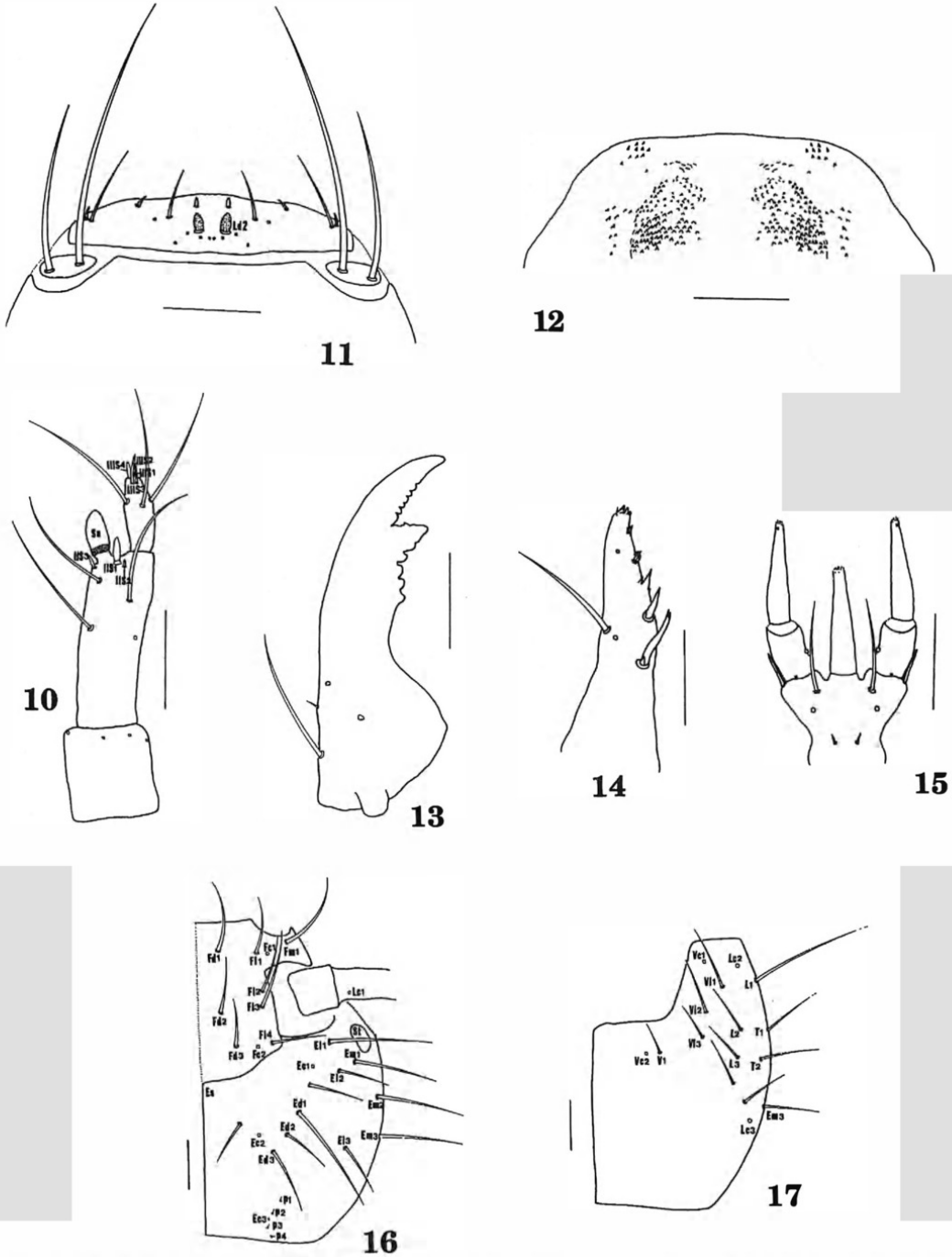
Late Instar Larva.—Length 3.0–3.4 mm. Body shape elongate, flattened, parallel-sided, dark brown in color. HEAD. (Figs. 16, 17) $\approx 0.9\times$ as long as wide. One small stemma on each side. Ecdysial sutures distinct and complete from antennal fossae anteriorly to base of head posteriorly. Chaetotaxy as in Figs. 16 and 17. Antenna as in Figure 10, with 3 articles; article 1 elongate, $\approx 1.1\text{--}1.4\times$ as long as wide, with 5 campaniform sensilla around apical margin; article 2 $\approx 1.4\text{--}2.0\times$ length of article 1; article 3 $\approx 0.4\times$ length of article 2; article 2 with 3 solenidia in addition to inflated, acorn-shaped and faintly fenestrate sensory appendage which is shorter than article 3; IIS1 spinose, short, $\approx 0.2\text{--}0.4\times$ as long as IIS2; IIS2 elongate, digitiform, about as long as sensory appendage or shorter, IIS3 present; article 3 with 3 solenidia, IIS3 long digitiform, IIS4 present. MOUTHPARTS. Labrum (Fig. 11) narrow, with 4 distinct setae (Ld1–Ld2, Ll1, Lm2) and 4 additional setae on each side, campaniform sensilla absent; Ll1 and Lm2 on small lateral sclerite distinctly separated from main body of labrum by suture; seta Ld2 short, robust and inflated. Epipharynx as in Fig. 12. Mandibles (Fig. 13) more or less symmetrical, median tooth large, $\approx 5\text{--}10$ serrations present on internal edge (absent or 4–5 between apex and median tooth, 4–5 between median tooth and base), 2 setae in basi-lateral half, distal seta very small and basal seta large and long. Maxilla with cardo broadly oval, with one seta near stipes; stipes narrow at base, not distinctly separated from mala, surface with 3 large setae, 2 on disk and 1 near lateral margin; mala (Fig. 14) with apex acute, 5 spinose setae on mesal region with large seta most basal, both right and left ones branched, several short spinules scattered on dorsal surface; maxillary palpus with 3 articles and basal crescentic palpifer; article 1 elongate, $\approx 1.6\text{--}2.3\times$ as long as wide; article 2 $\approx 0.4\text{--}0.5\times$ as long as article 1; article 3 $\approx 0.7\text{--}0.8\times$ as long as article 1 and 2 together; article 3 with basal digitiform sensory appendage on external surface. Labium (Fig. 15) consisting of indistinctly separated prementum, mentum, and more or less broad and sclerotized submentum; ligula elongate; labial palpus with 2 articles, article 2 $\approx 2.0\text{--}2.3\times$ as long as article 1; submentum with 1 pair of setae; mentum with 2 pairs of setae and 1 pair of campaniform sensilla; prementum with 2 pairs of setae and 1 pair of campaniform sensilla; 2–3 more or less sword-shaped spines present on antero-lateral margin of labium. THORAX. Pronotum (Fig. 18) transverse; chaetotaxy as in Fig. 18. Mesonotum (Fig. 19) transverse; chaetotaxy as in Fig. 19. Metanotum similar to mesonotum. Tarsus with 2 robust dorsal spines. ABDOMEN. Abdominal tergites I–VII transverse. Tergal gland reservoir (Fig. 20) slightly sclerotized, with distinctive pattern of internal hoop-like sclerotizations; 4 gland ducts in form of coiled tubules. Abdominal tergite IX (Fig. 21) with granulose integument. Urogomphus short, articulated, length of article $\approx 0.5\text{--}1.0\times$ as long as postero-lateral prolongation of tergite IX, with minute seta ventrally and 1 long apical seta. Tergite X with 4 small, unsclerotized pygopodial hooks.

Diagnosis.—Larvae of *Liparocephalus* can be distinguished from all other described aleocharine larvae by the combination of: elongate antenna (Fig. 10) with sensory appendage shorter than article 3; narrow labrum (Fig. 11) without campaniform sensilla; maxilla with most basal seta on both right and left malar surfaces (Fig. 14) branched; urogomphus (Fig. 21) short, articulated, with minute setae ventrally, and 1 long seta arising from apex; tergite X with 4 small unsclerotized pygopodial hooks; and many additional setae (in comparison with standard patterns described by Ashe and Watrous) on head, pronotum, mesonotum and abdominal tergites.

KEY TO THE SPECIES OF *LIPAROCEPHALUS*

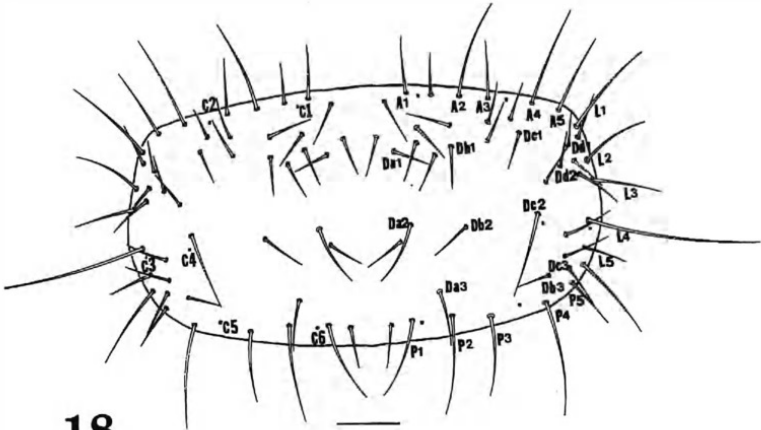
ADULTS

1. Mentum trapezoidal, anterior margin emarginate; male abdominal sternite VIII prolonged posteriorly as broad triangular projection, its median margin shorter than lateral margin (Fig. 22); median lobe as in Fig. 23; spermatheca as in Fig. 24; Alaska *L. brevipennis*

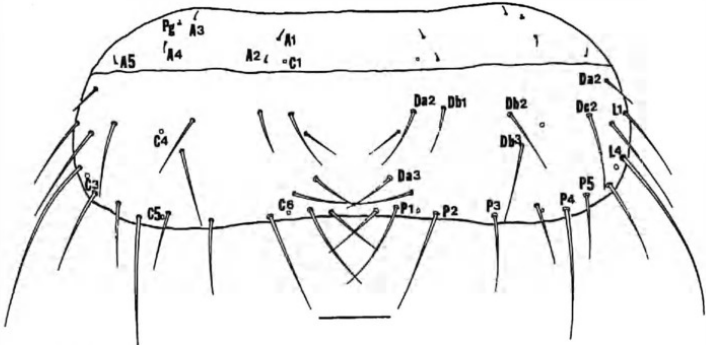


Figures 10–17. Late instar larva of *Liparocephalus cordicollis*. Figure 10. Antenna, dorsal aspect. Figure 11. Labrum, dorsal aspect. Figure 12. Epipharynx, dorsal aspect. Figure 13. Mandible, dorsal aspect. Figure 14. Mala, dorsal aspect. Figure 15. Labium, dorsal aspect. Figure 16. Head, dorsal aspect. Figure 17. Head, ventral aspect. Symbols according to Ashe & Watrous (1984). Scale = 0.1mm.

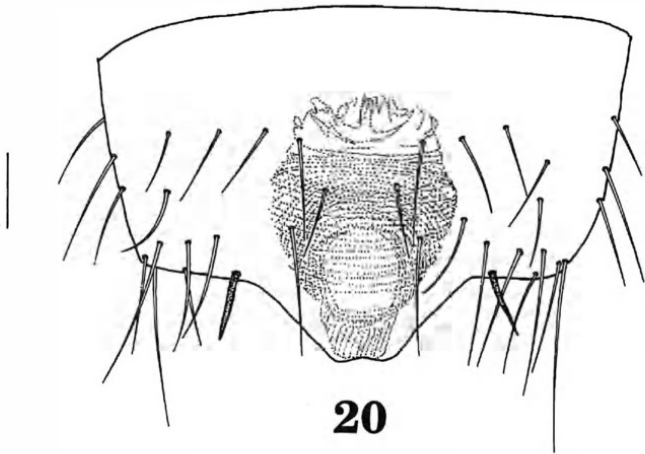
- 1'. Mentum not trapezoidal, anterior margin deeply truncate internally, posterior margin prolonged, rounded, and apico-lateral margin with projecting knob (Fig. 6); male abdominal sternite VIII prolonged posteriorly as broad triangular projection and median margin longer than lateral margin; Alaska to California, Japan 2
- 2(1'). Color black or dark brown; median lobe as in Fig. 7; spermatheca as in Fig. 9; Alaska to California *L. cordicollis*



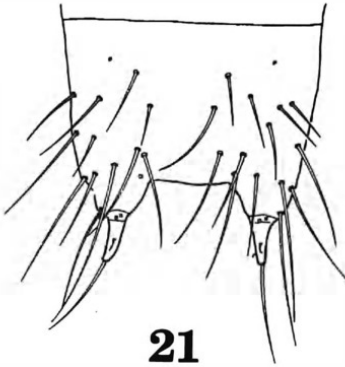
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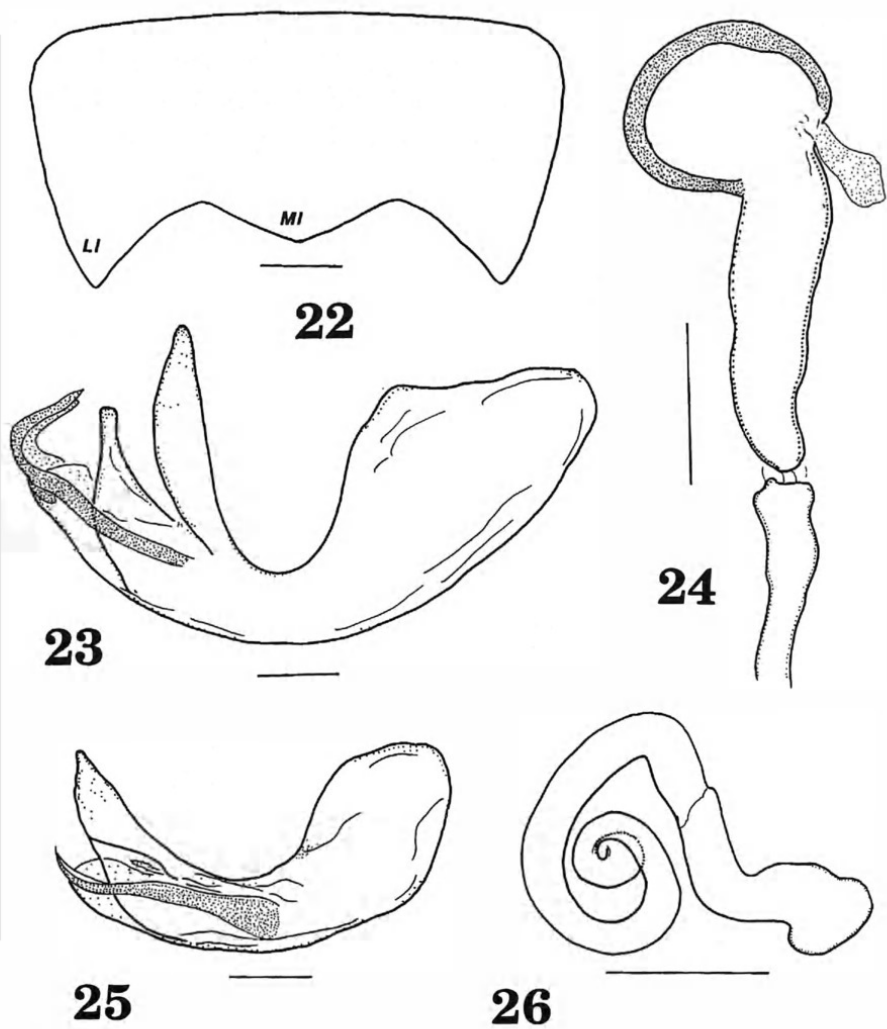
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Figures 18–21. Late instar larva of *Liparocephalus cordicollis*. Figure 18. Pronotum, dorsal aspect. Figure 19. Mesonotum, dorsal aspect. Figure 20. Abdominal tergite VIII, dorsal aspect. Figure 21. Abdominal tergite IX, dorsal aspect. Symbols according to Ashe & Watrous (1984). Scale = 0.1mm.

2'. Color brown; median lobe as in Fig. 25; spermatheca as in Fig. 26;
Japan *L. tokunagai*

LATE INSTAR LARVAE

1. Head chaetotaxy complete (Ashe & Watrous 1984), additional setae absent; pronotal chaetotaxy complete, additional setae absent; mesonotal chaetotaxy complete, additional setae absent . . . *L. tokunagai*



Figures 22–24. *Liparocephalus brevipennis*. Figure 22. Sternite VIII of male, dorsal aspect. Figure 23. Median lobe, lateral aspect. Figure 24. Spermatheca, lateral aspect. Figures 25–26. *Liparocephalus tokunagai*. Figure 25. Median lobe, lateral aspect. Figure 26. Spermatheca, lateral aspect. MI: median lobe, Ll: lateral lobe. Scale = 0.1mm.

- 1'. Head chaetotaxy complete, additional setae present; pronotal chaetotaxy complete, additional setae present; mesonotal chaetotaxy complete, additional setae present 2
- 2(1'). Head chaetotaxy complete, 3 additional setae present; pronotal chaetotaxy complete, 3 additional setae present; mesonotal chaetotaxy complete; chaetotaxy of abdominal tergite I complete
..... *L. brevipennis*
- 2'. Head chaetotaxy complete, 4 additional setae present (Figs. 16, 17); pronotal chaetotaxy complete, about 20 additional setae present (Fig. 18); mesonotal chaetotaxy complete, 6 additional setae present (Fig. 19); chaetotaxy of abdominal tergite I complete, many additional setae present *L. cordicollis*

LIPAROCEPHALUS BREVIPENNIS MÄKLIN
(Figs. 22–24)

Liparocephalus brevipennis Mäklin, 1853: 192; Bernhauer & Scheerpeltz, 1926: 550; Moore, 1956a: 117; Moore & Legner, 1975: 445.

Types.—*Liparocephalus brevipennis* Mäklin: Lectotype, here designated, in the collection of the Finnish Museum of Natural History (Helsinki, Finland), with labels as follows: "Chtagaluk, Constant, Holmberg; Mus. Zool. H:fors, Spec. typ. No. 2228, *Liparocephalus brevipennis* Mäklin; Lectotype, *Liparocephalus brevipennis* Mäklin, Desig. K. J. Ahn, 1995."

Description.—*Adult*. Length 4.2–4.4 mm. Body color black or dark brown. Head about as long as wide, infraorbital carina present. Ratio of length of compound eyes to length of head ≈ 0.2 . Antennomeres all elongate. Labrum with 25–30 + 25–30 major setae; epipharynx with ≈ 10 medial pores. Mandible with 4 internal teeth between apex and median tooth. Labium with 1 medial seta on prementum, ≈ 10 pseudopores present medially. Mentum more or less trapezoidal, anterior margin deeply emarginate. Pronotum subquadrate, $\approx 0.9\times$ as long as wide, long filiform setae absent from lateral margin. Elytra $\approx 0.9\times$ as long as wide; $\approx 0.5\times$ as long as pronotum, long filiform setae absent. Aedeagus. Median lobe (Fig. 23). Spermatheca. (Fig. 24).

Distribution.—Alaska.

Material Examined.—USA. ALASKA. DILLINGHAM Co.: Unalaska I., Dutch Harbor, Sep 1890, F. E. Blaisdell (FMNH, 4; CAS, 18); same loc., 9 Jul 1907, Van Dyke (CAS, 18); same except, 14 Aug 1907 (CAS, 1); same loc., F. E. Blaisdell (CAS, 4). INLET Co.: Clam Gulch St. Rec. area, 23 May 1994, K. J. Ahn, ex rock crevice on mud flat at low tide (KSEM, 15); Cook Inlet, Clam Culch, 23 Jul 1973, G. Schulte, ex rocky shore, polyhaline water among *Enteromorpha*, *Fucus* and barnacles (KSEM, 1); Homer, Coal Bay, 24 May 1994, K. J. Ahn, ex under rock at low tide (KSEM, 4). SKAGWAY Co.: Saldovia, 21 Jun 1899, T. Kincaid (NMNH, 9). VALDEZ CORDOVA Co.: Valdez, 1 Aug 1978, P. P.-H., Madaline & S. Arnaud, under intertidal rock (UCR, 5; CAS, 29). UNKNOWN: Wickham, Ft. Wrangel (NMNH, 1). UNKNOWN: (MCZ, 1).

Late Instar Larva.—Length 3.4 mm. General body shape elongate, flattened, parallel-sided, dark brown in color. HEAD. About $0.9\times$ as long as wide. Chaetotaxy of frontal, epicranial, temporal, lateral, and ventral regions complete (Fd1–Fd3, Fl1–Fl4, Fm1, Ed1–Ed3, El1–El3, Em1–Em3, T1–T2, L1–L3, V11–V14, and V1–V2 all present), 3 additional setae present (1 between Ed2 and Ed3, 2 more L setae), campaniform sensilla Fc1–Fc2, Ec1–Ec2, P1–P4, Lc1–Lc3, and Vc1–Vc2 present. Antenna with 3 articles; article 1 elongate, $\approx 1.4\times$ as long as wide; article 2 $\approx 1.4\times$ length of article 1; article 3 $\approx 0.4\times$ length of article 2; sensory appendage shorter than article 3; IIS1 spinose, short, $\approx 0.4\times$ as long as IIS2; IIS2 elongate, digitiform, shorter than sensory appendage. MOUTHPARTS. Mandibles with ≈ 10 serrations on internal edge (4–5 between apex and median tooth, 4–5 between median tooth and base). Maxilla with article 1 of maxillary palpus elongate, $\approx 1.6\times$ as long as wide; article 2 $\approx 0.5\times$ as long as article 1; article 3 $\approx 0.7\times$ as long as article 1 and 2 together. Labial palpus with article 2 $\approx 2.3\times$ as long as article 1. THORAX. Pronotum transverse; chaetotaxy with anterior, lateral, posterior and discal rows complete (A1–A5, L1–L5, P1–P5, Da1–Da3, Db1–Db3, Dc1–Dc3, and Dd1–Dd2 all present), 3 additional setae present (1 below Dd2, 1 between Dc3, P5, and L5, 1 between A1 and A2); campaniform sensilla C1–6 present. Mesonotum transverse; chaetotaxy with anterior, lateral, posterior and discal rows complete (A1–A5, L1 and L4, P1–P5, Da2–Da3, Db1–Db3, Dc2, and Dd2 all present); campaniform sensilla C1, C3, C4, C5, and C6 present. Metanotum similar to mesonotum. ABDOMEN. Chaetotaxy of abdominal tergite I with anterior, lateral, posterior and discal rows complete (A2, A4, A5, L1 and L4, P1–P5, Da2, Db2, Dc2, and Dd2 all present). Urogomphus slender, about as long as postero-lateral prolongation of tergite IX.

Diagnosis.—Larvae of *Liparocephalus brevipennis* can be distinguished from all other described *Liparocephalus* larvae by the combination of: antenna with IIS1 $\approx 0.4\times$ as long as IIS2, IIS2 shorter than sensory appendage; urogomphus about as long as postero-lateral prolongation of tergite IX; head chaetotaxy complete, 3 additional setae present; pronotal chaetotaxy complete, 3 additional setae present; mesonotal chaetotaxy complete; and chaetotaxy of abdominal tergite I complete (in comparison with standard patterns described by Ashe & Watrous).

Material Examined.—USA. ALASKA INLET CO.: Clam Gulch St. Rec. area, 23 May 1994, K. J. Ahn, ex rock crevice on mud flat at low tide (KSEM, 4); Seward, 25 May 1994, K. J. Ahn, ex under boulder at mid-tide (KSEM, 10).

LIPAROCEPHALUS CORDICOLLIS LeCONTE

(Figs. 1–21)

Liparocephalus cordicollis LeConte, 1880: 177; Casey, 1893: 354; Bernhauer & Scheerpeltz, 1926: 550; Chamberlin & Ferris, 1929: 143; Moore, 1956a: 118; Hatch, 1957: 149; Moore & Legner, 1975: 445.

Liparocephalus brevipennis, Casey, 1893: 354; Keen, 1897: 285, Fenyès, 1918: 106; Saunders, 1928: 543; Chamberlin & Ferris, 1929: 143.

Description.—*Adult.* Length 3.8–5.2 mm. Body color black or dark brown. Head about as long as wide, infraorbital carina present. Ratio of length of compound eyes to length of head ≈ 0.2 . Antennomeres all elongate. Labrum (Fig. 1) with 35–40 + 35–40 major setae; epipharynx (Fig. 2) with 20 small medial pores. Mandible (Fig. 3) with 5 internal teeth between apex and median tooth. Labium (Fig. 4) with 1 medial seta or none on prementum, ≈ 16 pseudopores present medially. Mentum (Fig. 6) with anterior margin deeply truncate internally, posterior marginal prolongation rounded, and apico-lateral margin with projecting knob. Pronotum subquadrate, $\approx 0.8\times$ as long as wide, with long filiform setae 1 on disc and 1 on lateral margin. Elytra $\approx 0.8\times$ as long as wide; $\approx 0.6\times$ as long as pronotum, long filiform setae present. Aedeagus. Median lobe (Fig. 7). Paramere (Fig. 8). Spermatheca (Fig. 9).

Distribution.—Alaska to California (Monterey Co.).

Material Examined.—USA. ALASKA. KETCHIKAN Co.: Prince of Wales Isl., Port Protection, 10–20 Aug 1951, B. Malkin (FMNH, 4); Prince of Wales Isl., Red Bay, 13–14 Sep 1951, B. Malkin (FMNH, 2). PRINCE OF WALES OUTER WRANGELL Co.: Kah Sheets Bay, Kupreanof Isl., 31 Aug 1951, B. Malkin (FMNH, 15); same except, 28 Aug 1951, (FMNH, 1). SKAGWAY Co.: Yakutat, 21 Jun 1899, T. Kincaid (MCZ, 1). UNKNOWN: Admiralty Isl., 25 Jun 1933, R. R. Sheppard (MCZ, 3). CALIFORNIA. HUMBOLDT Co.: Trinidad Head, Trinidad, Mar 1963, J. D. Pinto (UCR, 1); Samoa, Apr 1962, J. Pinto (UCR, 2). MARIN Co.: Rocky Point, 1 mi. SE. of Stinson Beach, 1 Jun 1968, V. F. Lee (CAS, 2); Agate Beach, 30 Mar 1971, D. Giuliani (UCR, 2); Bolinas Point, 1.6 mi. due West of Bolinas, 10 Apr 1977, V. F. Lee (CAS, 7); Strawberry Point, Brickyard Park, 2 Apr 1978, V. F. Lee (CAS, 10); Angel Island State Park, Pt. Blunt, Sandy Beach, 29 May 1976, V. F. Lee (CAS, 1); Tomales Bay, 9 Sep 1912, Van Dyke (CAS, 32). MENDOCINO Co.: Needle Rock, 6 Oct 1974, D. Giuliani (UCR, 1). MONTEREY Co.: Pescadero Pt., 1 Aug 1968, W. G. Evans, ex intertidal on *Egregia* (KSEM, 1); same except, 1 Apr 1966, P. Schroeder (KSEM, 6); Asilomar Beach, 23 Feb 1967, W. G. Evans, ex just above *Porphyra* (KSEM, 1); Asilomar Beach (Moss?) Beach, 9 Jan 1967, W. G. Evans, ex in crevice (KSEM, 2); Bird Rock Beach, 9 Dec 1966, W. G. Evans, ex mid-tide crevice (KSEM, 1); Pacific Grove, Mussel Pt., 9 Dec 1966, W. G. Evans (KSEM, 2); Carmel, 4 Nov 1925, F. E. Blaisdell (CUIC, 1); same except, 12 Nov 1914, (FMNH, 1); same except, 10 Apr 1932, L. S. Slevin (CAS, 2); same except, 27 May 1922 (CAS, 6); same except, 15 Apr 1919 (CAS, 1); same except, 17 Feb 1929 (CAS, 1); same except, 3 Mar 1917 (CAS, 1); same except, 6 May 1914 (CAS, 3); same except, 16 Nov 1914 (CAS, 1); same except, 20 Jan 1915 (CAS, 1); same except, 12 Nov 1914 (CAS, 1); same except, 26 Oct 1914 (CAS, 1). SANTA CRUZ Co.: Año Nuevo Beach, 3 Apr 1953 (FMNH, 3). SAN FRANCISCO Co.: San Francisco, Baker Beach, 2 Apr 1967, V. F. Lee (CAS, 18); Cove West of Phelan Beach, 24 May 1978, V. F. Lee (CAS, 2). SAN MATEO Co.: Halfmoon Bay, 24 Jan 1925, A. Davis (KSEM, 5); same except, 9 Mar 1957 (FMNH, 1); same except, H. C. Fall (MCZ, 6); same except, 2 Jan 1929 (FMNH, 6); Pillar Point, 15 Oct 1966, V. F. Lee, low tide, intertidal rocks (CAS, 4); Frenchman's Reef, 22 Feb 1967, V. F. Lee (CAS, 7); Moss Beach, 16 May 1991, K. J. Ahn & J. S. Ashe, ex on rocks in the intertidal zone (KSEM, 8); same loc., 6 Jul 1966, W. G. Evans, ex in mid-tide crevice (KSEM, 1); same except, Aug. F. E. Blaisdell (FMNH, 1); same except, 7 Jul 1912 (CAS, 7); same except, 1 May 1910 (CAS, 6); same loc., 2 Oct 1950 (CAS, 1); same loc., Nov 1928, G. F. Ferris (CAS, 2); same loc., 27 Apr 1947, H. P. Chandler (CAS, 1). SONOMA Co.: Bodega Bay, 23 Nov 1973, W. G. Evans, ex high crevice (KSEM, 3); 7 May 1950, G. H. Hanna (CAS, 1); 27 Apr 1971, J. Hafernik (KSEM, 1); Bodega Marine Laboratory, Horseshoe Cove, 25 May 1975, V. F. Lee (CAS, 3);

Soberanes Pt., 4 Mar 1974, J. Norman, ex low tide crevice (KSEM, 3). *UNKNOWN*. (KSEM, 3). OREGON. *CLATSOP Co.*: Cannon Beach, 11 Jun 1927, E. C. Van Dyke (FMNH, 2; CAS, 9). *COOS Co.*: Squaw Isl., 19 Jun 1947, I. M. Newell (FMNH, 6). *CURRY Co.*: Pt. N. Cape Blanco, 7 Oct 1974, D. Giuliani (UCR, 1). *LANE Co.*: Winchester Bay, 13 Apr 1947, B. Malkin & I. M. Newell (FMNH, 2). *LINCOLN Co.*: 1 mi. N. Depoe Bay, 1 Aug 1970, S. R. Leftler (WSUC, 1); Agate Beach, 9 Jul 1925, W. J. Chamberlin (NMNH, 2); Charleston, 20 Jun 1947, G. Nelson (FMNH, 4); same except, 2 Jul 1947 (MCZ, 1); same except, 7 Jul 1947 (MCZ, 1); same except, 23 Jul 1947 (MCZ, 2). *UNKNOWN*. O. B. Johnson (WSUC, 2); (KSEM, 5). WASHINGTON. *CLALLAM Co.*: nr. Neah Bay, 9 Oct 1974, D. Giuliani (UCR, 4); Olympic Natl. Park, 28 Jul 1980, J. S. Ashe, ex intertidal on rocks (KSEM, 10); Salt Water Park, 17 Jun 1977, A. Borkent, ex among barnacles and mussels (KSEM, 1); Ilwaco, Jul 1917, A. L. Melander (FMNH, 1). *KING Co.*: Seattle, Alki Point, 16 Jul 1965, L. Russell (UCR, 2). CANADA. *BRITISH COLUMBIA*: Queen Charlotte Islands, Graham Island, Runnell Sound, 17 Jul 1988, J. S. Ashe, ex on rocks in intertidal zone (KSEM, 75); Massett, Keen (FMNH, 13); Queen Charlotte Islands, J. H. Keen (NMNH, 3); same loc., J. Fletcher (MCZ, 6); same loc., Liebeck (MCZ, 3); same loc., Hubbard & Schwarz (NMNH, 4); same loc., Rev. Keene (NMNH, 1); Massett (FMNH, 2; CAS, 26); Agate Beach near Toe Hill, 16 Jul 1988, J. S. Ashe, ex on rocks in the intertidal zone (KSEM, 3); Hope Isl., 13 Sep 1970, W. G. Evans, ex low tide crevice on beach (KSEM, 29); Vancouver, Wreck Beach, 24 Jul 1980, J. S. Ashe, ex wrack and intertidal zone (KSEM, 1); Vancouver Isl., Courtenay, 6 Mar 1932, H. C. Fall (MCZ, 1); Vancouver, 30 Jun 1951, H. Leech (UBCZ, 5; CAS, 8); same loc., 2 Apr 1952, G. J. Spencer (UBCZ, 6); same loc., 10 Mar 1931, K. Graham (UBCZ, 2); same except, 27 Feb 1932 (FMNH, 1); same except, 10 Mar 1931 (FMNH, 2); Indian R., 3 Jul 1931, H. B. Leech (UBCZ, 1; CAS, 4); Victoria, Vanc., Hubbard & Schwarz (NMNH, 5); Univ. British Columbia Campus, 3 Jul 1988, J. S. Ashe, ex on rocks (KSEM, 1); same loc., Tofino, Jun–Jul 1926, G. J. Spencer (UBCZ, 14); Jul 1926, Spencer (CAS, 1).

Late Instar Larva.—Length 3.0 mm. General body shape elongate, flattened, parallel-sided, dark brown in color. HEAD (Figs. 16, 17). About $0.9 \times$ as long as wide. Chaetotaxy with setae of frontal, epicranial, temporal, lateral, and ventral regions complete (Fd1–Fd3, Fl1–Fl4, Fm1, Ed1–Ed3, El1–El3, Em1–Em3, T1–T2, L1–L3, V11–V14, and V1–V2 all present), 4 additional setae present (1 between Ed2 and Ed3, 1 between Ed1 and El2, 2 more L setae), campaniform sensilla Fc1–Fc2, Ec1–Ec2, P1–P4, Lc1–Lc3, and Vc1–Vc2 present. Antenna as in Figure 67, with 3 articles; article 1 $\approx 1.1 \times$ as long as wide; article 2 $\approx 2.0 \times$ length of article 1; article 3 $\approx 0.4 \times$ length of article 2; sensory appendage slightly shorter than article 3; IIS1 spiniform, short, $\approx 0.2 \times$ as long as IIS2, IIS2 elongate, digitiform, about as long as sensory appendage. MOUTHPARTS. Labrum as in Fig. 11. Epipharynx as in Fig. 12. Mandibles (Fig. 13) with ≈ 10 serrations on internal edge (4–5 between apex and median tooth, 4–5 between median tooth and base). Maxillary palpus with article 1 elongate, $\approx 2.3 \times$ as long as wide; article 2 $\approx 0.4 \times$ as long as article 1; article 3 $\approx 0.8 \times$ as long as article 1 and 2 together. Labium (Fig. 15) with article 2 of labial palpus $\approx 2.0 \times$ as long as article 1. THORAX. Pronotum (Fig. 18) transverse; chaetotaxy with anterior, lateral, posterior and discal rows complete (A1–A5, L1–L5, P1–P5, Da1–Da3, Db1–Db3, Dc1–Dc3, and Dd1–Dd2 all present), ≈ 20 additional setae present, campaniform sensilla C1–6 present. Mesonotum (Fig. 19) transverse; chaetotaxy with anterior, lateral, posterior and discal rows complete (A1–A5, L1 and L4, P1–P5, Da2–Da3, Db1–Db3, Dc2, and Dd2 all present), 6 additional setae present, campaniform sensilla C1, C3, C4, C5, and C6 present. Metanotum similar to mesonotum. ABDOMEN. Abdominal tergites I–VII transverse with many additional setae; tergite I chaetotaxy with anterior, lateral, posterior and discal rows complete (A2, A4, A5, L1 and L4, P1–P5, Da2, Db2, Dc2, and Dd2 all present). Urogomphus (Fig. 21) slender, about as long as postero-lateral prolongation of tergite IX.

Diagnosis.—Larvae of *Liparocephalus cordicollis* can be distinguished from all other described *Liparocephalus* larvae by the combination of: antenna (Fig. 10) with IIS1 $\approx 0.2 \times$ as long as IIS2; IIS2 almost as long as sensory appendage; urogomphus (Fig. 21) about as long as postero-lateral prolongation of tergite IX; head chaetotaxy complete, 4 additional setae present (Figs. 16, 17); pronotal chaetotaxy complete, about 20 additional setae present (Fig. 18); mesonotal chaetotaxy complete, 6 additional setae present (Fig. 19); and chaetotaxy of abdominal tergite I complete, many additional setae present (in comparison to standard patterns described by Ashe & Watrous).

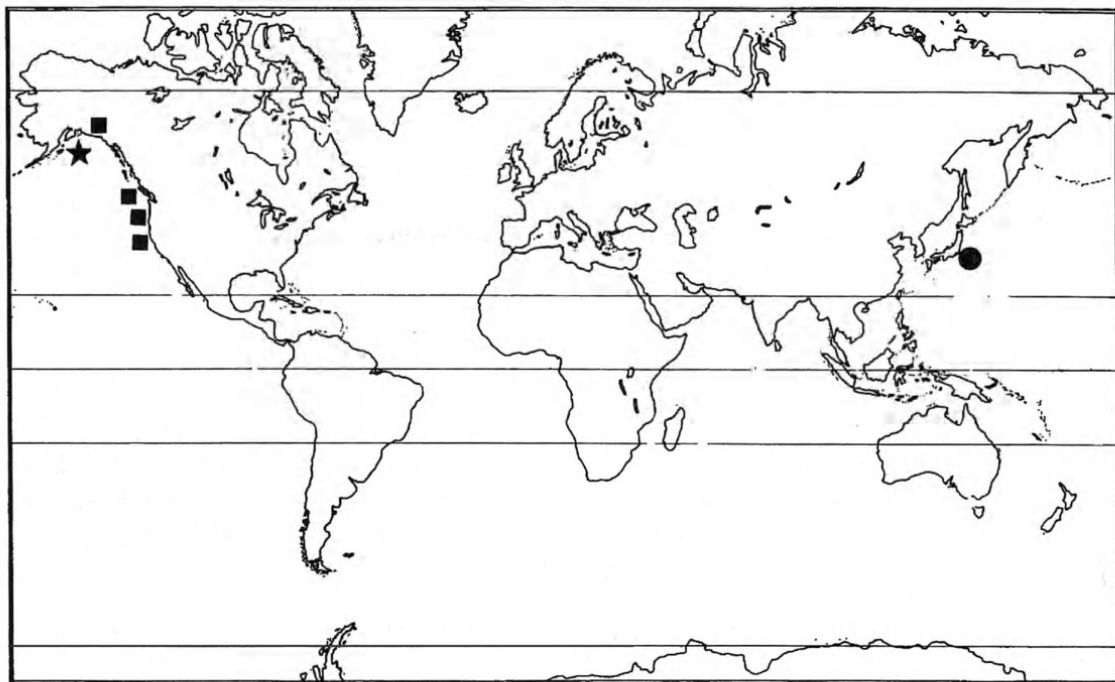


Figure 27. Distribution of *Liparocephalus brevipennis* (star), *L. cordicollis* (squares), and *L. tokunagai* (circle).

Material Examined.—USA. WASHINGTON. CLALLAM Co.: Olympic Natl. Park, 28 Jul 1980, J. S. Ashe, ex intertidal on rocks (KSEM, 3). CANADA. BRITISH COLUMBIA: Queen Charlotte Isls., Graham Isl., Toe Hill, 14 Jul 1988, J. S. Ashe, ex low intertidal on rocks (KSEM, 23).

LIPAROCEPHALUS TOKUNAGAI SAKAGUTI
(Figs. 25, 26)

Liparocephalus tokunagai Sakaguti, 1944: 20.

Description.—*Adult*. Length 4.9 mm. Body color brown, abdominal tergite VI black. Head more or less quadrate, as long as wide, lateral margin almost straight, infraorbital carina present, not reaching to maxilla. Ratio of length of compound eye to length of head ≈ 0.2 . Antennomeres all elongate. Labrum with 35–40 + 35–40 major setae; epipharynx with 20 small medial pores. Mandible with 5 internal teeth between apex and median tooth. Labium without medial setae on prementum. Mentum anterior margin very deeply truncate internally, posterior margin rounded, and apico-lateral margin with projecting knob. Pronotum subquadrate, $\approx 0.8\times$ as long as wide, long filiform setae present, 1 on disc and 1 on lateral margin. Elytra $\approx 0.9\times$ as long as wide; $\approx 0.6\times$ as long as pronotum, with long filiform setae. Aedeagus. Median lobe (Fig. 25). Spermatheca. (Fig. 26).

Distribution.—Japan.

Material Examined.—JAPAN. SHIKOKU. Aburatsubo Beach, Miura, Kanagawa, 19 May 1985, Y. Shibata (KSEM, 1); same loc., 3 Jul 1985 (KSEM, 1). KYUSHU. Kekura, Kagoshima, C. 31 Mar 1983, T. Sunose (NHMIC, 1).

Late Instar Larva.—Length 3.4 mm. General body shape elongate, flattened, parallel-sided. Color dark brown. HEAD. About $0.9\times$ as long as wide. Chaetotaxy with frontal, epicranial, lateral, and ventral regions complete (Fd1–Fd3, Fl1–Fl4, Fm1, Ed1–Ed3, El1–El3, Em1–Em3, T1, L1–L3, V11–V14, and V1–V2 all present but T2 absent), campaniform sensilla Fc1–Fc2, Ec1–Ec2, P1–P4, Lc1–Lc3, and Vc1–Vc2 present. Antenna with 3 articles; article 1 elongate, $\approx 1.4\times$ as long as wide; article 2 $\approx 1.5\times$ length of article 1; article 3 $\approx 0.4\times$ length of article 2; sensory appendage shorter than article 3; IIS1 spiniform, short, $\approx 0.2\times$ as long as IIS2; IIS2 elongate, digitiform, shorter than sensory appendage. MOUTHPARTS. Mandibles with ≈ 5 serrations present on internal edge (all 5 between

median tooth and base). Article 1 of maxillary palpus elongate, $\approx 1.9\times$ as long as wide; article 2 $\approx 0.4\times$ as long as article 1; article 3 $\approx 0.8\times$ as long as article 1 and 2 together. Article 2 of labial palpus $\approx 2.0\times$ as long as article 1. THORAX. Pronotum transverse; chaetotaxy with anterior, lateral, posterior and discal rows complete (A1–A5, L1–L5, P1–P5, Da1–Da3, Db1–Db3, Dc1–Dc3, and Dd1–Dd2 all present); campaniform sensilla C1–6 present. Mesonotum transverse; chaetotaxy with anterior, lateral, posterior and discal rows complete (A1–A5, L1 and L4, P1–P5 present, Da2–Da3, Db1–Db3, Dc2 and Dd2 all present); campaniform sensilla C1, C3, C4, C5, and C6 present. Metanotum similar to mesonotum. ABDOMEN. Abdominal tergites I–VII transverse; abdominal tergite I chaetotaxy with anterior, lateral, posterior and discal rows complete (A2, A4, A5, L1 and L4, P1–P5, Da2, Db2, Dc2, and Dd2 all present). Urogomphus slender, $\approx 0.5\times$ as long as postero-lateral prolongation of tergite IX.

Diagnosis.—Larvae of *Liparocephalus tokunagai* can be distinguished from all other described *Liparocephalus* larvae by the combination of: antenna with IIS1 $\approx 0.2\times$ as long as IIS2; IIS2 shorter than sensory appendage; urogomphus $\approx 0.5\times$ as long as postero-lateral prolongation of tergite IX; and, chaetotaxy of head, pronotum, mesonotum and abdominal tergite I complete (in comparison to standard patterns described by Ashe & Watrous).

Material Examined.—JAPAN. KYUSHU. Kekura, Kagoshima, C. 31 Mar 1983, T. Sunose (NHMIC, 3).

DISCUSSION

Casey (1893) placed *Liparocephalus* in Bolitocharides based on the 4-4-5 tarsal formula and 11-articled antennae. He noted that *Liparocephalus*, *Diaulota*, and *Amblopusa* could be a well isolated group of genera among Bolitocharides based on their species distribution along the Pacific coast, elytra very short, tibiae short, devoid of lateral spinules, long sparse hairs present, and tarsi very short.

Fenyès (1918), who next mentioned *Liparocephalus*, placed it in the tribe Bolitocharini (group Liparocephali) based on the number of the tarsal joints (4-4-5), antennal articles (11), segments of the maxillary (4), and labial palpi (2 or indistinctly 3).

Bernhauer & Scheerpeltz (1926) and Hatch (1957) likewise classified the genus based on Casey's description and Fenyès's placement.

Chamberlin & Ferris (1929) compared the structure of members of *Liparocephalus*, *Diaulota*, and *Amblopusa* and described two species of *Liparocephalus*. However, Moore (1956a) revealed that they incorrectly identified *L. cordicollis* as *L. brevipennis*. He placed *Liparocephalus* in the subtribe Phytosi and made mention of the systematic relationships of *Liparocephalus* among the Phytosi.

The latest mention of this aleocharine genus was by Seevers (1978). He removed the subtribe Phytosina from the tribe Bolitocharini and raised it to tribal status (tribe Phytosini) placing *Liparocephalus* in it based primarily on tarsal formula (4-4-5), elytra shorter than pronotum, and hind wings absent.

From the time of its description, *Liparocephalus* Casey has been consistently classified with a number of other intertidal aleocharine genera in the tribe Phytosini, or its equivalent. However, Ahn & Ashe (1996) have shown that *Liparocephalus* and related genera represent a monophyletic lineage separated from *Phytosus* and related genera (= Phytosini) and should be placed in the tribe Liparocephalini.

I compared the structure of members of *Liparocephalus* to that of members of several intertidal phytosine genera. This examination revealed that the members

of *Liparocephalus* comprise a well-supported monophyletic group. Cladistic analysis (Ahn & Ashe, 1996) indicates that members of *Liparocephalus* are sister group to the species of *Diaulota*. Within the *Liparocephalus* lineage, *L. cordicollis* + *L. tokunagai* show a sister group relationship to *L. brevipennis*.

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