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Aglaodiaptomus atomicus, a new species (Crustacea: Copepoda: Calanoida: Diaptomidae) from freshwater wetland ponds in South Carolina, U.S.A., and a redescription of *A. saskatchewanensis* (Wilson 1958)

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Abstract.—A new calanoid copepod, *Aglaodiaptomus atomicus*, is described from freshwater wetland ponds in Aiken County, South Carolina, U.S.A. It is common in Aiken and Barnwell Counties. It has been collected from shallow, acidic wetland ponds, most of which dry periodically. *Aglaodiaptomus atomicus* resembles *A. saskatchewanensis*, which is redescribed from Saskatchewan, Canada, and Louisiana, U. S. A. The male of *A. atomicus* differs from all of its congeners by possessing a distinctively large distolateral process on the right leg 5, exopod 1. The female differs from its closest congener, *A. saskatchewanensis*, in possessing nearly symmetrical thoracic wings. In *A. saskatchewanensis*, the wings are distinctly asymmetrical.

A survey of freshwater wetland ponds on the upper coastal plain of western South Carolina revealed an apparently undescribed calanoid copepod species. This species, which was incorrectly reported as *Diaptomus conipedatus* Marsh, 1907 by Mahoney et al. (1990), is one of the most common calanoid copepod species occurring in Carolina bays and other isolated, shallow, wetland ponds in Aiken and Barnwell Counties, South Carolina. It most closely resembles *Aglaodiaptomus saskatchewanensis* Wilson, 1958. However, detailed comparisons with specimens of *A. saskatchewanensis* proved it to be a separate, undescribed species.

In her original description of *Aglaodiaptomus saskatchewanensis*, Wilson (1958) provided an illustration of only the male fifth leg and a partial description of the species. Few additional details were added to her 1959 key (Wilson 1959). A more detailed description of *A. saskatchewanensis* is presented here, as well as a description of the new species, *A. atomicus*.

Diaptomid copepods vary in the following morphological characteristics: body length, features of the thoracic somites (especially the 6th somite), length, number of and armature of the antennules in both sexes, number of somites of the female urosome, and segmentation, shape and ornamentation of the fifth leg of both sexes (Wilson 1959). The mouth parts and legs 1–4 of the species presented in this paper correspond to those of *Leptodiaptomus siciloides* (Comita & Tommerdahl 1960).

Descriptions and measurements of whole copepods were made in glycerine. Dissected specimens were mounted either in lactophenol or in CMC-9. Most were stained with Chlorazol Black E before being mounted.

Family Diaptomidae Baird 1850
Genus *Aglaodiaptomus* Light, 1939
Aglaodiaptomus saskatchewanensis
(Wilson 1958)
Figs. 1–3

Diaptomus saskatchewanensis Wilson, 1958:490–491, 493–495, fig. 3.—*Diaptomus* (*Aglaodiaptomus*) *saskatchewanensis* Robertson, 1972:202.—*Aglaodiaptomus saskatchewanensis*, Chengalath & Shih, 1994:2422.

Material.—Saskatchewan: 8 ♂♂, 6 ♀♀; farm reservoir near Lucky Lake, Saskatchewan, Canada, 107°20′N, 50°10′W, 16 Jun 1948; USNM 210784; coll. J. R. Nursall. Louisiana: 33 ♂♂, 28 ♀♀; shallow roadside pond 19.4 km south of Natchitoches, Natchitoches Parish, Louisiana, U.S.A., 31°60′N, 93°05′W, 10 Apr 1953; USNM 278233; coll. W. G. Moore.

Female.—Length, excluding caudal setae, of specimens from Saskatchewan, range: 1.24–1.64 mm (n = 6), from Louisiana, range: 1.34–1.64 mm (n = 28). Body broadest at pedigers 1 and 2 in dorsal view (Fig. 1A). Pedigers 4 and 5 incompletely separated with faint sutures visible laterally. Pediger 5 small with posteriorly-directed wings (Fig. 1B). Left wing with large dorsomedial lobe (Fig. 1C) reaching beyond posterior margin of wing in dorsal view (Fig. 1B). Right wing has 2 poorly-developed lobes (Fig. 1D). Each lobe on both wings tipped with short sensillum. Urosome of 3 segments (Fig. 1B). Genital segment with slight asymmetrical lateral protrusions; left protrusion more rounded than right. Both protrusions tipped with sensillum. Caudal rami (Fig. 1B) nearly twice as long as broad; inner margins hairy.

Antennules 25-segmented, extending to middle of caudal setae (Fig. 1A). Appendages per segment as follows (Roman numeral = segment, Arabic numeral = number of setae, sp = spine, a = aesthetasc): I(1+a), II(3+a), III(1+a), IV(1), V(1+a), VI(1), VII(1+a), VIII(1+sp), IX(2+a), X(1), XI(2), XII(1+sp+a), XIII(1), XIV (1+a), XV(1), XVI(1+a), XVII(1), XVIII (1), XIX(1+a), XX(1), XXI(1), XXII(2), XXIII(2), XXIV(2), XXV(5+a). Setae on segments 17, 19, 20, 22 with hooked ends (Fig. 1E); length of seta approximately ¾ that of respective segment.

Leg 2 endopod 2 with Schmeil's organ (not figured).

Leg 5 (Fig. 1F): Coxa with posterior lateral protrusion ending in sensillum. Basis with short lateral seta. Exopod segments 1 and 2 approximately equal in length. Claw of exopod 2 slightly curved with denticles on inner and outer margins. Exopod 3 not articulated. Lateral spine of exopod 2 about ¾ the length of outer seta of exopod 3. Exopod 3 inner seta plumose, twice the length of outer seta. Endopod single-segmented, equal in length to exopod 1, two plumose setae and pointed protrusion at tip (Fig. 1G).

Male.—Length, excluding caudal setae, of specimens from Saskatchewan, range: 1.24-1.44 mm (n = 8), of specimens from Louisiana, range: 1.28-1.64 mm (n = 33). Body (Fig. 2A) as in female, with 5-segmented urosome. Thoracic wings (Fig. 2B) asymmetrical, right wing developed into elongated lobe, left wing small. Each wing with 2 sensilla; sensilla of right wing twice as large as left. Urosome (Fig. 2B): segment 1 asymmetrical in dorsal view, left margin shorter than right; left posterior corner bifid with obliquely directed lobe tipped with sensillum, right posterior corner simple, also tipped with sensillum. Segments 2–4 approximately equal in size; ventral sensilla on segments 2 and 3 visible under high magnification (not figured). Segment 4 asymmetrical, left margin shorter than right. Caudal rami with hairs on inner margins.

Antennules (Fig. 2A, C–E) extend to proximal margin of caudal rami. Right antennule geniculate between segments 18–19 and 20–21. Segments 18–19 (Fig. 2D), 20–21 (not figured) and 22–23 (Fig. 2E) fused. Large parallel spiniform processes on segments 10, 11; additional large spine on segment 13 (Fig. 2C). Spines on segments 10

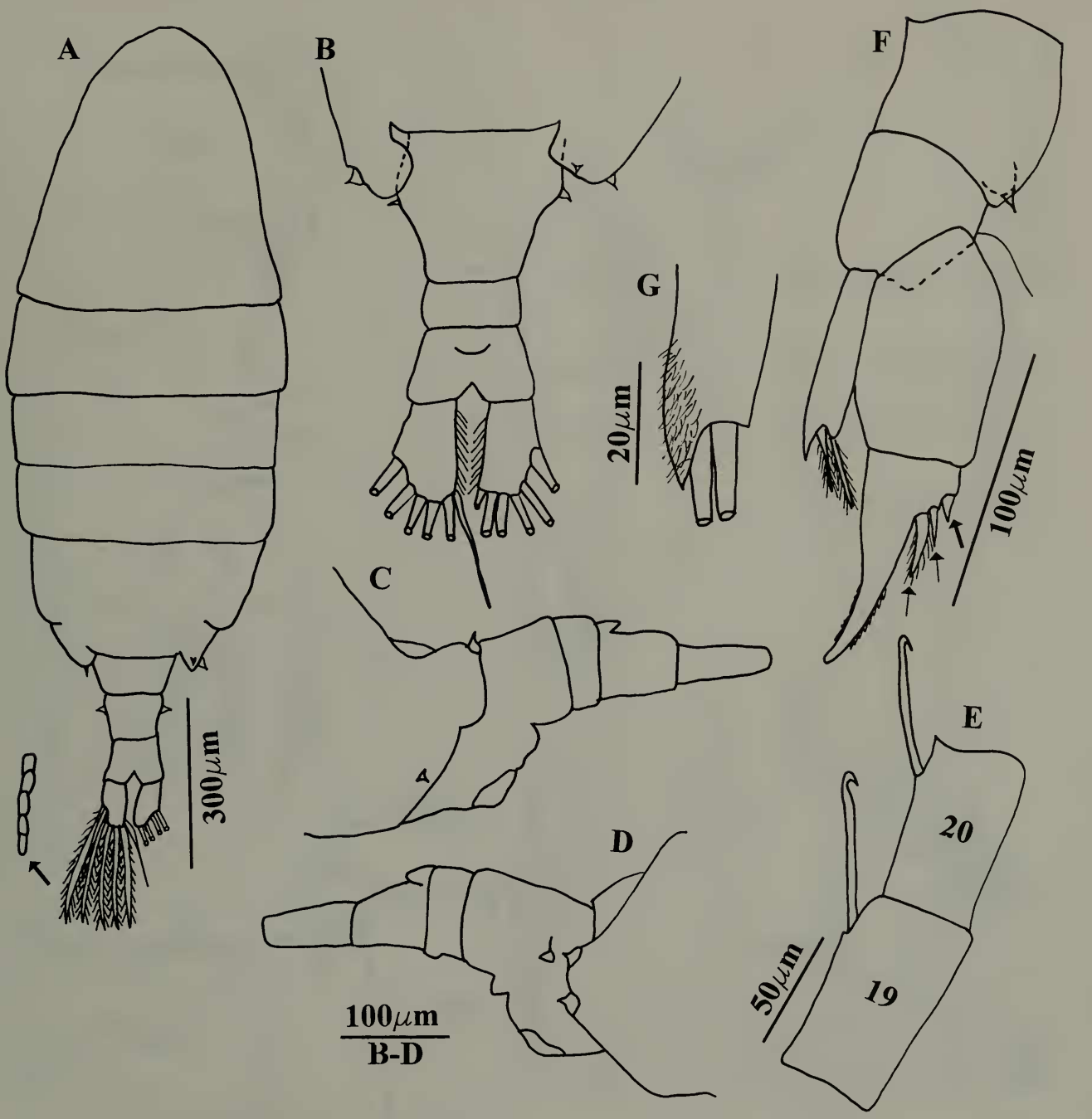

Fig. 1. *Aglaodiaptomus saskatchewanensis* Wilson, 1958. Paratype female (USNM 278233): A, Habitus, dorsal, distal segments of antennule indicated by arrow; B, Urosome, dorsal; C, Left thoracic wing and urosome, lateral; D, Right thoracic wing and urosome, lateral; E, Antennule, segments 19, 20; F, Leg 5, anterior, setae of exopod 3 (thin arrows), lateral seta of exopod 2 (thick arrow); G, Leg 5 endopod, distal end.

and 11 equal in length, shorter than spine on segment 13. Spines on segments 15–17 with bifurcated tip (Figs. 2C, D). Segment 17 (Fig. 2D) with flat, digitiform seta extending to center of segment 18–19. Additional modified seta arising from proximal ¼ of segment 18–19, running length of segment. Segment 22–23 (Fig. 2E) with curved distal process; process about as long as segment 24.

Left leg 5 (Figs. 3A–E): Leg (excluding spines) extending slightly beyond right basis. Coxa, small process tipped with sensillum near outer posterodistal margin. Basis with short lateral seta. Exopod segment 1 longer than segment 2; inner margin with pad; distal corner of pad hairy (Fig. 3B). Exopod 2 articulating at distolateral margin of exopod 1. Inner margin of exopod 2 with hairs extending the length of the segment

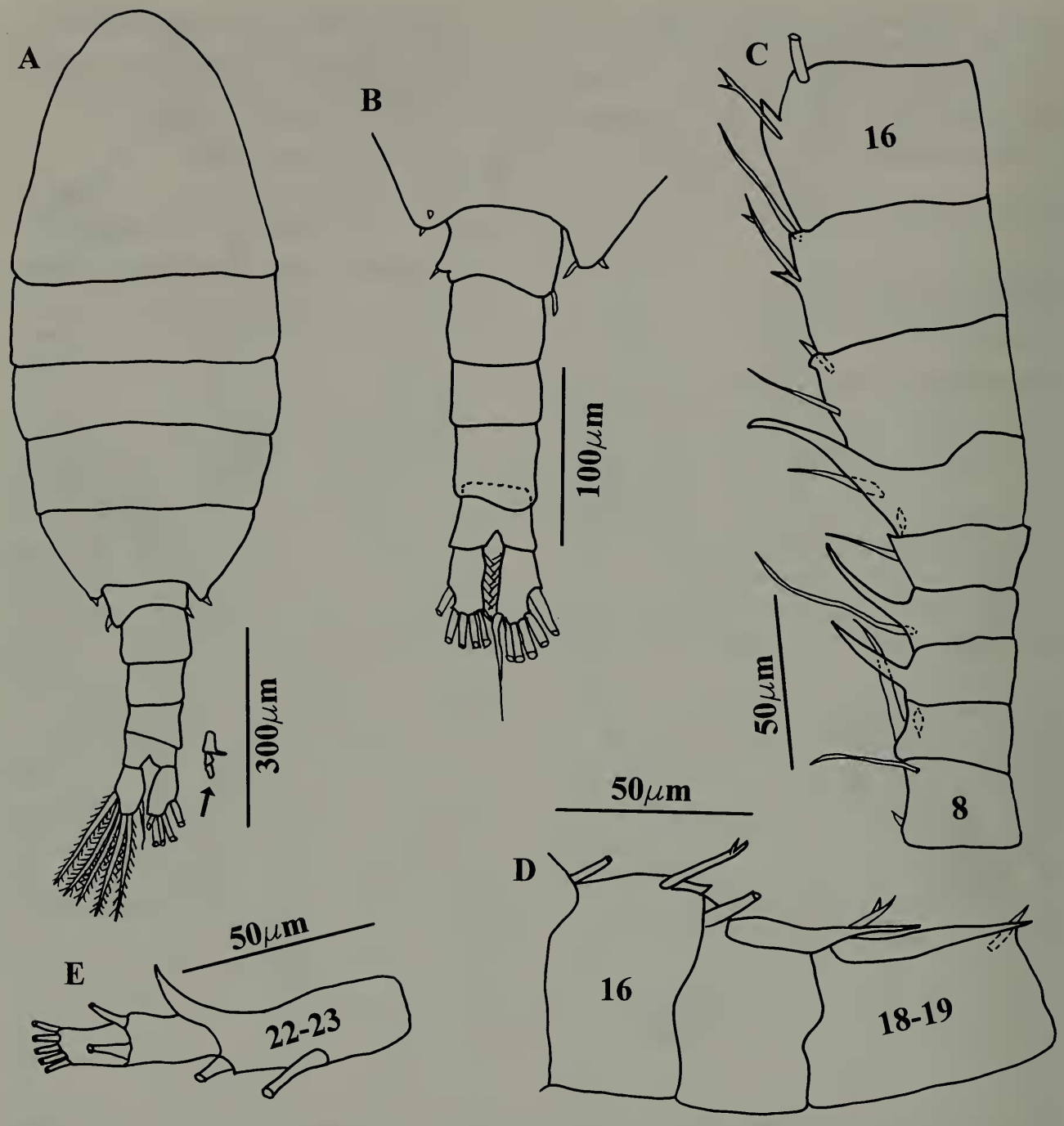

Fig. 2. *Aglaodiaptomus saskatchewanensis* Wilson, 1958. Paratype male (USNM 278233): A, Habitus, dorsal, distal segments of antennule indicated by arrow; B, Urosome, dorsal; C, Right antennule, segments 8–16; D, Right antennule, segments 16–19; E, Right antennule, segments 23–25.

(Fig. 3B); hairs extend to cover ⅓ of anterior surface (Fig. 3C). Outer distal quadrant of exopod 2 covered with minute protuberances in both anterior and posterior views. Terminal seta about as long as segment and plumose, terminally placed on inner margin; short, rounded digitiform process placed on outer distal margin, covered with short hairs. Endopod as long as exopod; outer margin of posterior face (Fig. 3D) with crenate longitudinal groove; remaining surface of endopod with small rows or clusters of short spinules. Outer ⅔ of anterior face of endopod (Fig. 3E) crenulate; small pad on inner distal edge covered with tiny spinules.

Right leg 5 (Fig. 3A): Coxa with distomedial lobe on posterior surface tipped with sensillum. Basis with narrow, inwardly rounded longitudinal hyaline membrane on

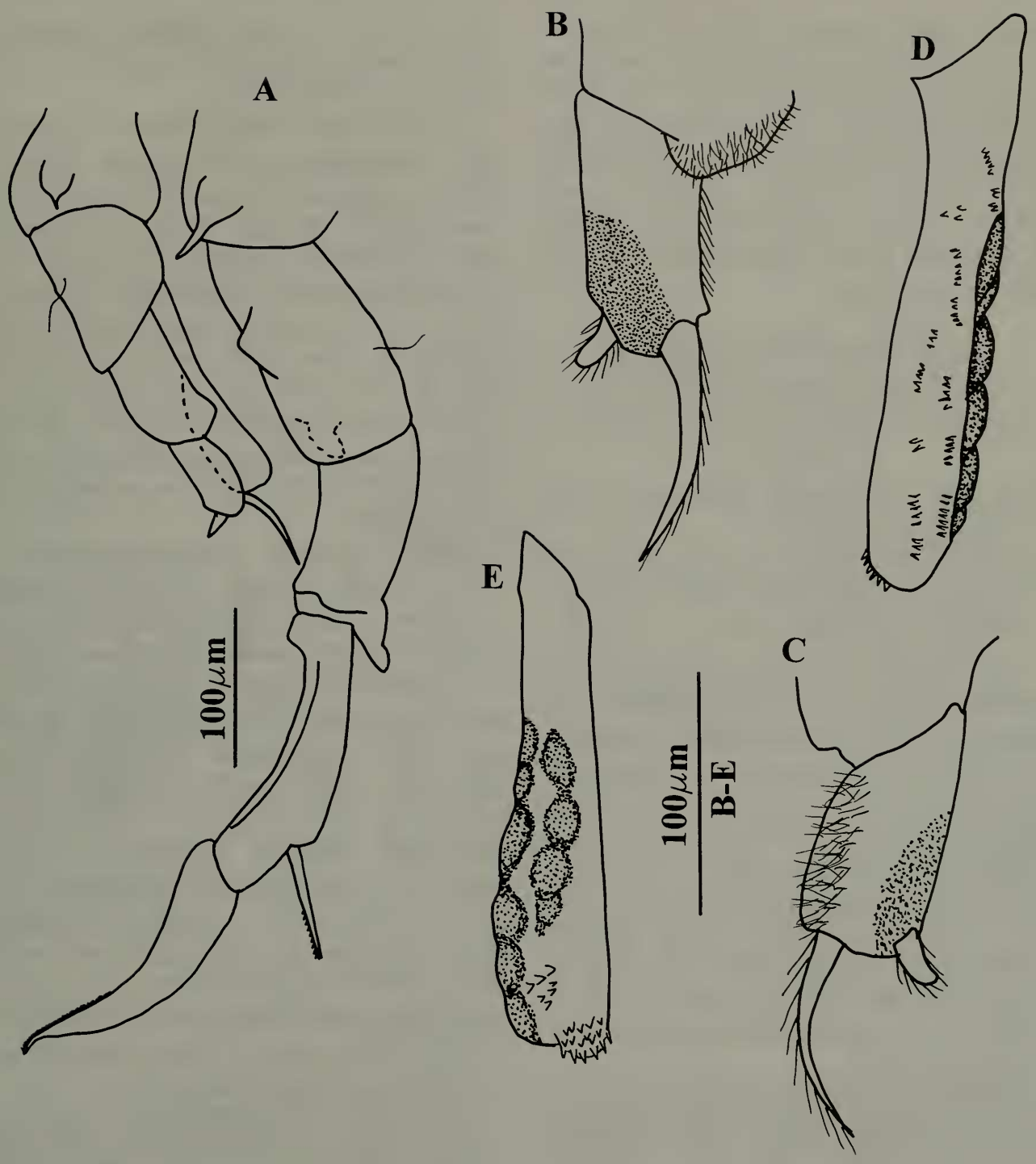

Fig. 3. *Aglaodiaptomus saskatchewanensis* Wilson, 1958. Paratype male (USNM 278233): A, Leg 5, posterior; B, Left leg 5 exopod 2, posterior; C, Left leg 5 exopod 2, anterior; D, Left leg 5 endopod, posterior; E, Left leg 5 endopod, anterior.

posteromedial face; fine setule on lateral margin slightly distal to mid-length of segment margin. Endopod greatly reduced, with fine setae on distomedial surface. Exopod 1 with distally directed process on distolateral corner, less than ¼ length of segment. Exopod 2, slightly longer than exopod 1. Lateral spine inserted at ¾ the length of the segment, spine about ½ as long as exopod 2, distal ½ of inner surface with fine teeth. Terminal claw as long as exopod 1; distal ¾ of inner surface lined with fine denticles.

Distribution and ecology.—Only three records exist beyond the Louisiana and southern Saskatchewan collections used for Wilson's (1958) description. Reed (1959) collected specimens from Frobisher Lake

on the upper Churchill River in Saskatchewan, extending the range of *A. saskatchewanensis* northward. Patalas & Salki (1984) recorded it in Southern Indian Lake, Manitoba, another lake along the Churchill River. Robertson (1972) reported *A. saskatchewanensis* from southeastern Oklahoma in oxbow lakes, farm reservoirs, ditches and swampy areas.

Family Diaptomidae Baird 1850
Genus *Aglaodiaptomus* Light, 1939
Aglaodiaptomus atomicus, new species
Figs. 4–6

Diaptomus conipedatus Mahoney et al., 1990: 247, 252, Fig. 2.
Diaptomus sp. DeBiase & Taylor, 1993: 388; Boileau & Taylor, 1994:193, 195–196, 197–199, Figs. 1–3.

Type material.—Holotype, ♂, USNM 259989; allotype ♀, USNM 259990, each dissected on slide in lactophenol; paratypes: 5 ♂♂ 5♀♀, each dissected on slide in lactophenol, and 20 ♂♂ 20 ♀♀, USNM 267334; all from South Carolina, Aiken County, Flamingo Bay (Bay 3), 33°20′N, 81°41′W, Savannah River Site, 300 m west side of Road F at about 0.8 km south of intersection of Roads 2 and F. All collected 7 Feb 1994 with 102 μm dip net by A. E. DeBiase. All undissected paratypes preserved in ethanol.

Additional, non-type material.—20 ♂♂ 20 ♀♀, USNM 267333, South Carolina, Barnwell County, Bay 40, 33°16′N, 81°46′W, Savannah River Site, 25 m north of Road F-6 and 500 m east of Road F; 20 ♂♂ 20 ♀♀, USNM 267332, South Carolina, Aiken County, Bay 11, 33°1′N, 81°36′W, Savannah River Site, 400 m west of SC 125, about 500 m south of Gate 6. All paratypes undissected and preserved in ethanol. Also 500+ ♂♂ ♀♀, dissected on slides in glycerin, and 2000+ ♂♂ ♀♀ + copepodids, undissected in formalin, from 25 additional ponds in South Carolina, Aiken and Barnwell Counties (all located on Savannah River Site, 33°05′–33°24′N, 81°27′–81°47′W). All collected February and December 1990 with 102 μm mesh dip net by A. E. DeBiase.

Co-occurring Diaptomidae.—Flamingo Bay: *Aglaodiaptomus clavipoides* Wilson, 1955, *A. stagnalis* Forbes, 1882, *Leptodiaptomus moorei* Wilson, 1954, *Onychodiaptomus sanguineus* Forbes, 1876; Bay 11: *Hesperodiaptomus augustaensis* Turner, 1910, *O. sanguineus*; Bay 40: no other diaptomids; other SRS ponds: *A. clavipoides*, *A. stagnalis*, *H. augustaensis*, *L. moorei*, *Onychodiaptomus birgei* Marsh, 1894, *O. sanguineus*, *Skistodiaptomus pallidus* Herrick, 1879, up to five of these species per pond.

Female.—Length, excluding caudal setae: 1.65–2.00 mm (n = 25). Body broadest at pedigers 1 and 2 in dorsal view (Fig. 4A). Pedigers 4 and 5 incompletely fused. Weakly asymmetrical thoracic wings; left dorsomedial lobe (Fig. 4C) slightly more developed than ventrolateral lobe; each lobe tipped with small sensillum. Lobes of right wing (Fig. 4B) of equal size, each tipped with small sensillum. Urosome of 3 segments (Fig. 4D). Genital segment twice as long as broad, with very slight, rounded lateral expansions at mid-length, each with short, laterally-directed spine. Left expansion slightly more distally placed than right. Caudal rami about 1½ times longer than broad; inner margins hairy.

Antennules 25-segmented, reaching slightly beyond distal end of caudal rami (Fig. 4A). Appendages per segment as follows (Roman numeral = segment, Arabic numeral = number of setae, a = aesthetasc, sp = spine): I(1+a), II(3+a), III(1+a), IV(1), V(1+a), VI(1), VII(1+a), VIII(1+sp), IX(2+a), X(1), XI(2), XII(1+sp+a), XIII (1), XIV(1+a), XV(1), XVI(1+a), XVII(1), XVIII(1), XIX(1+a), XX(1), XXI(1), XXII (2), XXIII(2), XXIV(2), XXV(5+a). As in *A. saskatchewanensis*, setae (see Fig. 1E) on segments 17, 19, 20, 22 with hooked ends; length of setae approximately ¾ that of respective segments.

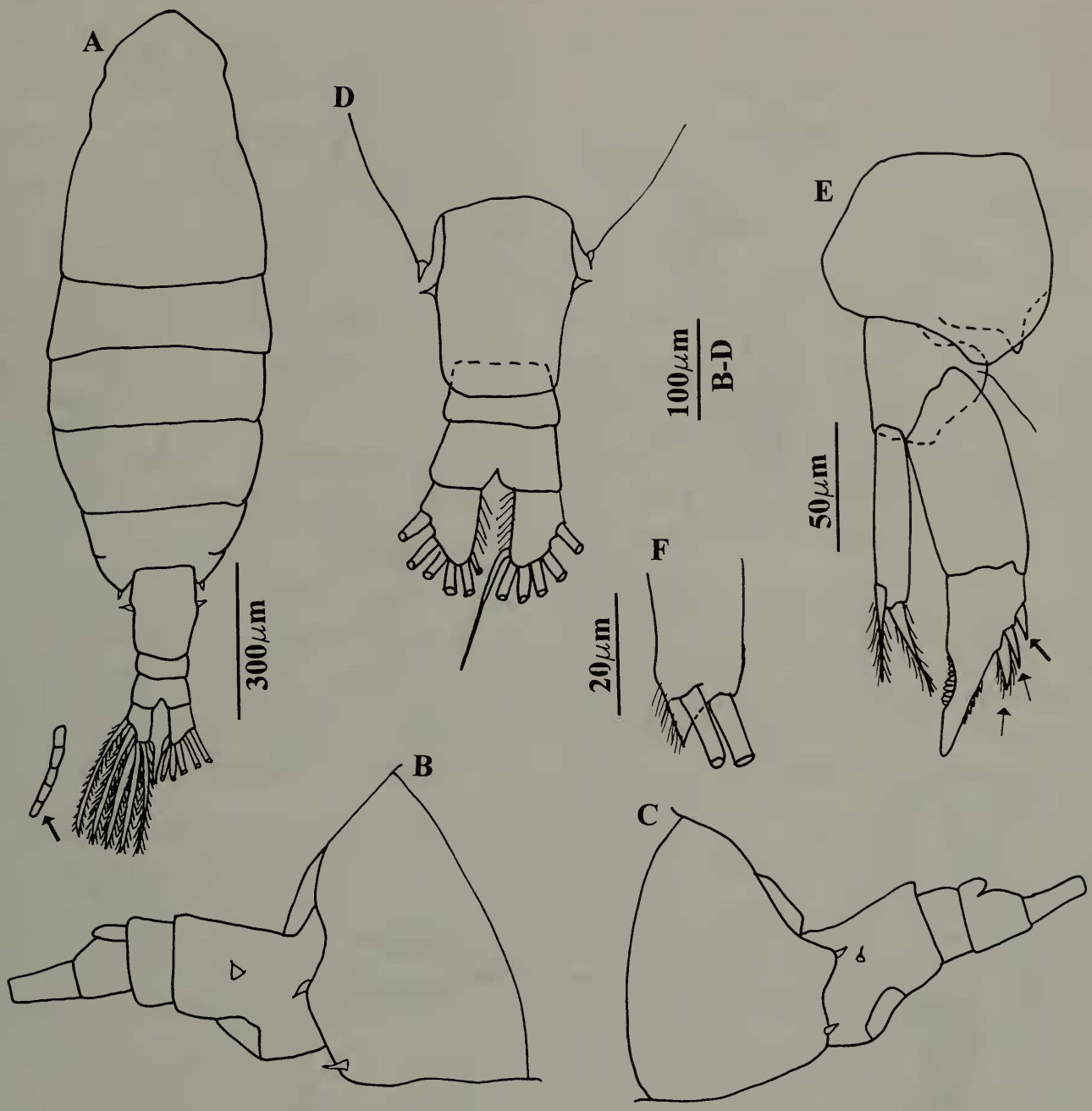

Fig. 4. *Aglaodiaptomus atomicus*, new species. Paratype female (USNM 267334): A, Habitus, dorsal, distal segments of antennule indicated by arrow; B, Right thoracic wing and urosome, lateral; C, Left thoracic wing and urosome, lateral; D, Urosome, dorsal; E, Leg 5, anterior, setae of exopod 3 (thin arrows), lateral seta of exopod 2 (thick arrow); F, Leg 5 endopod, distal end.

Leg 2 endopod 2 with Schmeil's organ (not figured).

Leg 5 (Fig. 4E): Coxa with posterior lateral protrusion tipped with sensillum. Basis with lateral seta. Exopod 1 approximately equal in length to exopod 2. Exopod 2 claw slightly curved with denticles on inner and outer margins. Exopod 3 not articulated. Lateral spine of exopod 2 about ⅔ the length of outer seta of exopod 3. Exopod 3 inner seta plumose, twice the length of outer seta. Endopod reaching slightly beyond distal end of exopod 1; tipped with two plumose setae and pointed protrusion (Fig. 4F).

Male.—Length, excluding caudal setae: 1.50–1.85 mm (n = 25). Prosome segmentation as in female (Fig. 5A). Thoracic wings reduced, with small dorsolateral and ventromedial sensilla; sensilla of right wing twice as long as left. Left posterior corner of urosome segment 1 bifid, tipped with

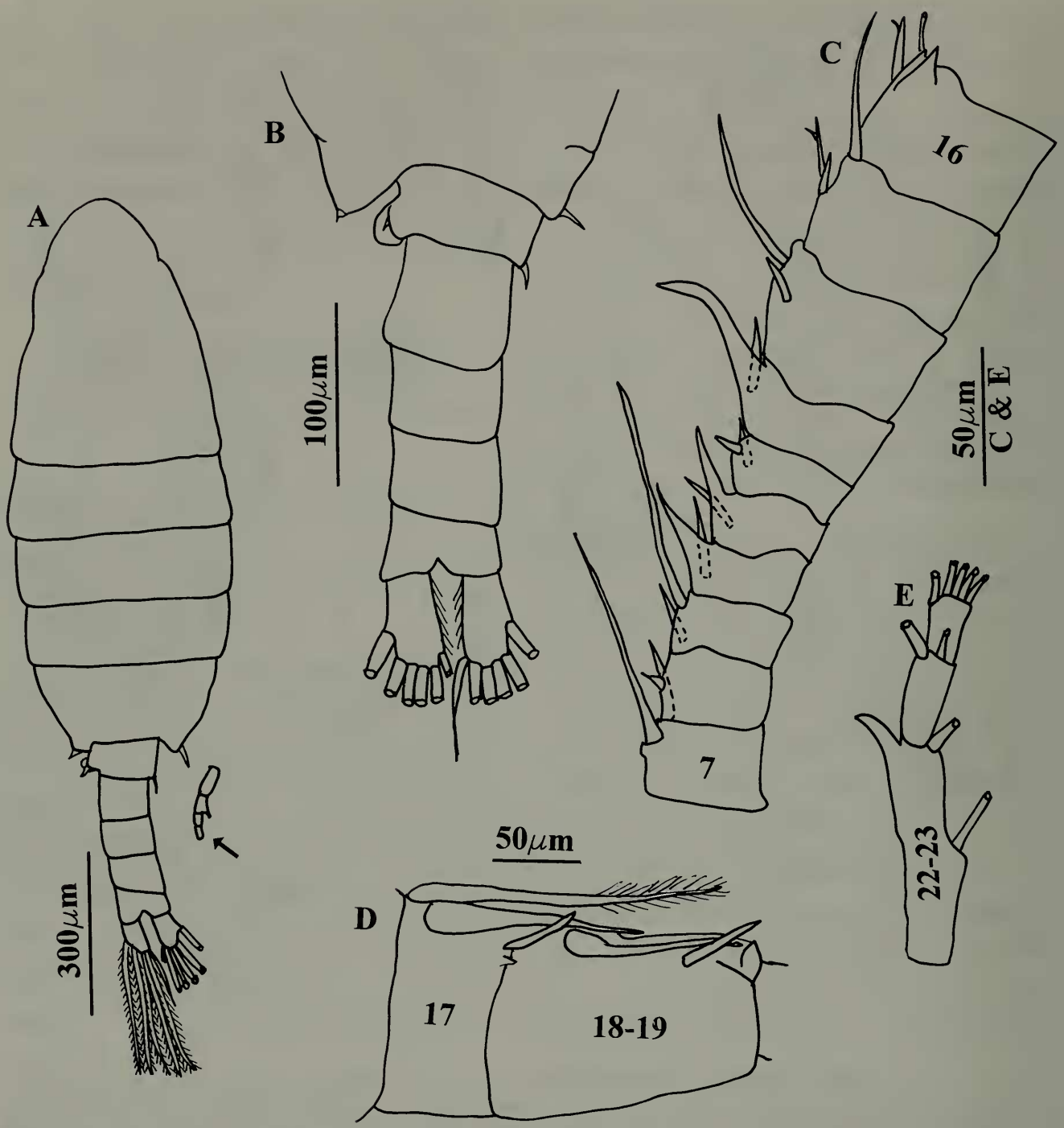

Fig. 5. *Aglaodiaptomus atomicus,* new species. Paratype male (USNM 267334): A, Habitus, dorsal, distal segments of antennule indicated by arrow; B, Urosome, dorsal; C, Right antennule, segments 7–16; D, Right antennule, segments 17–19; E, Right antennule, segments 23–25.

sensillum; right posterior corner simple, with sensillum that is slightly larger than left. Urosome 5-segmented (Fig. 5B). Segments 2–3, ventral margin lined with fine hair-like setae visible in lateral view under high magnification (not figured). Fourth segment asymmetrical, right margin longer than left. Caudal rami with fine setules lining inner margins.

Antennules extend to mid-length of urosome (Fig. 5A). Right antennule geniculate between segments 18–19 and 20–21. Segments 18–19 (Fig. 5D), 20–21 (not figured) and 22–23 (Fig. 5E) fused. Long, parallel spines (Fig. 5C) on segments 10, 11, and 13. Spines on segments 15 and 16 bifurcated (Fig. 5C). Modified digitiform seta (Fig. 5D) emerging from proximal ¼ of segment 17 and extending to mid-length of segment 18–19. Additional modified seta

emerging from proximal ¼ of segment 18–19, extending length of segment. Curved distal process (Fig. 5E) on segment 22–23 about ½ as long as segment 24.

Left leg 5 (Figs. 6A–E): Leg (excluding spines) extending approximately to distal edge of basis. Lateral lobe of coxa minute, tipped with sensillum. Basis with fine lateral seta. Exopod 1 longer than exopod 2, with hairy pad on distomedial corner. Exopod 2 (Figs. 6B,C) articulating at distolateral margin of exopod 1; processes placed subterminally. Inner process is about as long as exopod 2, outer margin covered with setules. Outer process about ⅓ length of inner process, covered with setules. Outer distal quadrant of exopod 2 with minute protuberances on posterior surface (Fig. 6B). Endopod about as long as exopod with long patch of small teeth on distal ⅓ paralleling inner margin of posterior face (Fig. 6D). Outer margin crenulated (Figs. 6D, E); crenation more developed on anterior surface.

Right leg 5 (Figs. 6A): Coxa with distomedial lobe tipped with sensillum. Basis ornamented only with bilobed protrusion on median-posterior face, proximal lobe slightly larger; outer seta on lateral margin of segment. Endopod reduced, represented by laterally bent lobe, covered with fine setae. Process on distolateral corner of exopod 1, about ¼ length of exopod 1. Exopod 1 shorter than exopod 2, claw equal in length to exopod 2. Lateral spine inserted at ⅘ length of segment, about ⅔ the length of the claw, inner surface with fine denticles. Terminal claw as long as exopod 2; distal ¾ of inner surface lined with fine denticles.

Color.—Body pale blue; legs, distal ⅓ of antennule, and setae of caudal rami bright red-orange. The blue pigment is lost during preservation. If the specimens are preserved in formalin, the red pigment remains but becomes purple-red.

Type locality.—Flamingo Bay (Bay 3), 33°20′N, 81°41′W, Savannah River Site, Aiken County, South Carolina.

Etymology.—The species name is given after the Savannah River Site (SRS), where this species was first recognized. The SRS is a production facility for nuclear materials and was originally operated by the United States Atomic Energy commission.

Distribution and ecology.—*Aglaodiaptomus atomicus* is known only from Carolina bays and other shallow (usually <1 m deep) isolated wetland ponds in Aiken and Barnwell Counties, South Carolina. The ponds range in size from 0.1–50 ha. Most of these are temporary ponds. Hydrology is controlled mainly by precipitation and evapotranspiration (Lide et al. 1995). Filling tends to occur during late autumn–early winter, and drying during late spring–early summer.

The ponds usually lack fish, and all are acidic (pH 4.4–6.6). *Aglaodiaptomus atomicus* most often occurs at pH 5.1–5.7, and has a broad temperature range (10–35°C).

Discussion and comparisons.—The male of *A. atomicus* differs from all other congeners by possessing a relatively large protuberance on the outer distal corner of exopod 1 of right leg 5. It is at least ¼ the length of exopod 1, while this projection, when present on males of other species, is much shorter. The exception is *A. dilobatus* Wilson, 1958, which has a fairly long protuberance. However, the left leg 5 of *A. dilobatus* is morphologically different from that of *A. atomicus*. It possesses an exopod 1 which widens distally and a globular exopod 2. Both of these segments are relatively rectangular in *A. atomicus*.

The female of *A. atomicus* most closely resembles *A. forbesi* Light, 1938, *A. lintoni* Forbes, 1893 and *A. saskatchewanensis*. These species are difficult to tell apart, except that the endopod of *A. lintoni* reaches well beyond exopod 1, while it is approximately as long as exopod 1 in the others. Also, exopod 3 is more developed in *A. lintoni* and *A. forbesi*. *Aglaodiaptomus atomicus* can be distinguished from *A. saskatchewanensis* by the thoracic wings. The wings of *A. saskatchewanensis* are asymmetrical, with the left dorsal lobe more developed

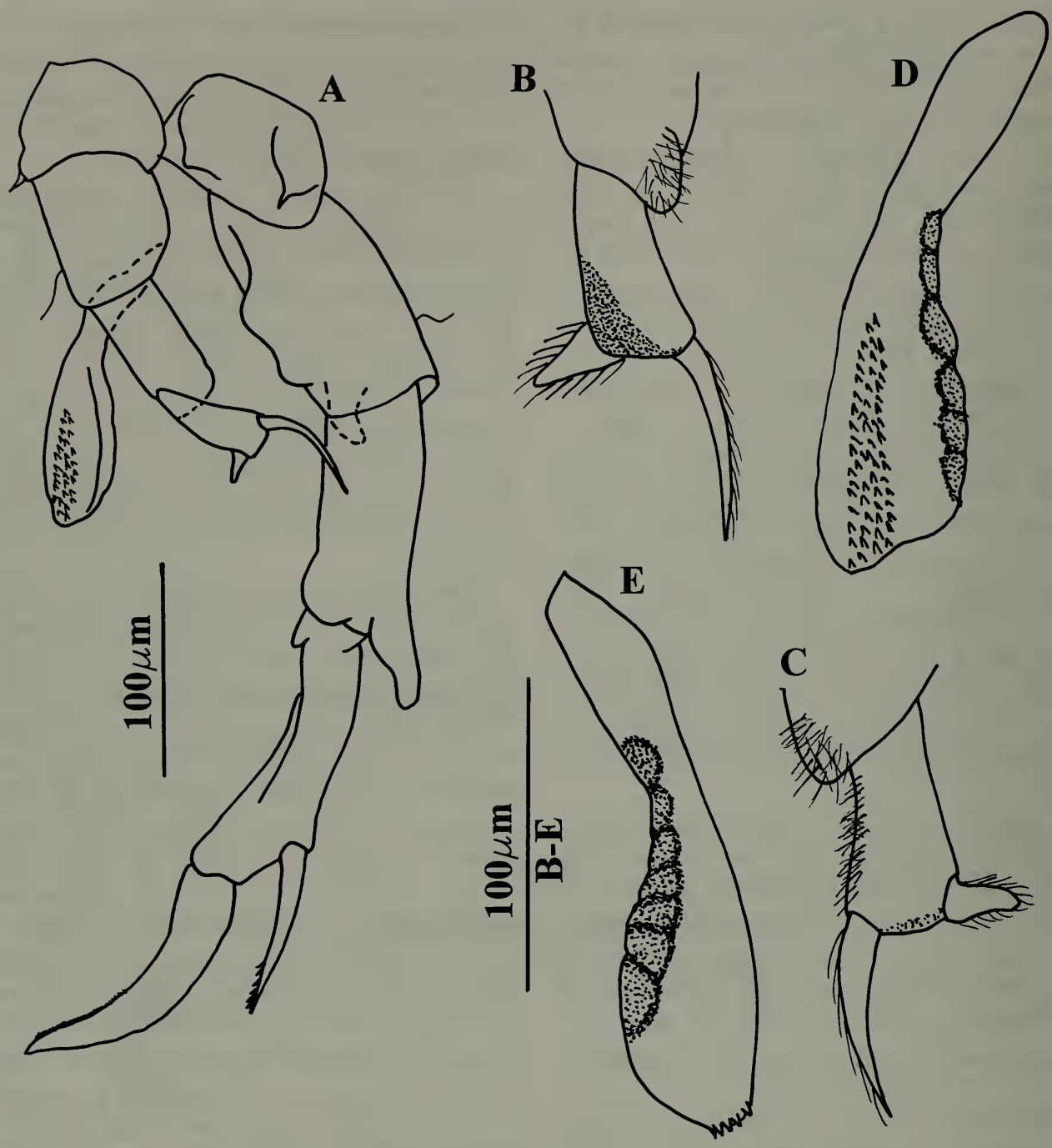

Fig. 6. *Aglaodiaptomus atomicus,* new species. Paratype male (USNM 267334): A, Leg 5, posterior; B, Left leg 5 exopod 2, posterior; C, Left leg 5 exopod 2, anterior; D, Left leg 5 endopod, posterior; E, Left leg 5 endopod, anterior.

than the right dorsal lobe, while the lobes of *A. atomicus* are almost equally developed on both sides.

Aglaodiaptomus atomicus keys out to *A. saskatchewanensis* in Wilson (1959). These species are easily separated by the ornamentation of the male antennules and leg 5 and the female thoracic wings. Also, *A. atomicus* is slightly larger.

Aglaodiaptomus atomicus and *A. saskatchewanensis* may also be separated geographically. As described in the "Distribution and ecology" section, *A. saskatchewanensis* has been reported from a few widely separated locations from the south–central and north–central regions of North America, while *A. atomicus* was discovered in southeastern North America. Most studies in central North America have concentrated on large reservoirs and lakes. Studies

on wetlands and farm ponds, which appear to be the preferred habitat of *A. saskatchewanensis*, have dealt mainly with other microcrustacean groups, particularly cladocerans. A similar problem occurs with *A. atomicus*. Southeastern North America is also a relatively unstudied region, and few records of calanoid copepods exist for this area. There are no other reports of *A. atomicus*, *A. saskatchewanensis* or similar unidentified species from this area.

Acknowledgments

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