REVIEW OF THE GENUS *MACDUNNOA* (EPHEMEROPTERA: HEPTAGENIIDAE) WITH DESCRIPTION OF A NEW SPECIES FROM FLORIDA

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ABSTRACT

The imago, nymph, and egg of *Macdunnoa brunnea* n. sp. are described from the southeastern U.S. *Heptagenia persimplex* is transferred to *Macdunnoa* and additional diagonostic characters are given for this species and for *Macdunnoa nipawinia*. The relationship of *Macdunnoa* to *Stenacron* and *Stenonema* is discussed.

Over the last three decades an interesting but rare heptageniid mayfly nymph has been collected sporadically in eastern North America from Florida to Canada. The nymph is easily recognized by its dark body, pale caudal filaments and greatly reduced abdominal gills 6 and 7. Lehmkuhl (1979) discovered a population of these nymphs in Saskatchewan and reared female imagos. He established the genus *Macdunnoa* for these nymphs and female imagos.

Male imagos of a new species of *Macdunnoa* have now been reared in Florida, and examination indicates the species is congeneric with *Heptagenia persimplex* McDunnough. Study of the types of *Heptagenia persimplex* confirms that the species should be transferred to *Macdunnoa* and that the Florida specimens represent a new species, *Macdunnoa brunnea*. Three species of *Macdunnoa* are now known: *M. brunnea* n. sp., from the southeastern U.S.; *M. persimplex* new combination, from the Midwest; and *M. nipawinia* Lehmkuhl, from Saskatchewan.

Because Lehmkuhl's (1979) generic description did not include the male imago and his brief nymphal description omitted a number of important characters, *Macdunnoa* is redescribed below.

Macdunnoa Lehmkuhl
Heptagenia partim (McDunnough 1929:179)
(Figs. 1–16)

IMAGO. Length of male: body, 6.0–8.0 mm; fore wings, 7.0–8.0 mm. Length of female: body, 6.0–7.7 mm; fore wings, 7.0–8.9 mm. Eyes of male moderate in size, separated dorsally by 5 times width of median ocellus; eyes of female separated dorsally by 6 times width of median ocellus. Frontal margin of head with small median emargination. Fore wings with basal costal cross veins well developed, stigmatic cross veins simple, not slanted; cross veins in anterior half of male wings tan to black. Hind wings with obtuse costal projection; 2 long cubital intercalaries; length 1/3 as long as fore wings. Fore legs of male: tibiae (1.7–1.8 mm) 1.0–1.1 times as long as femora; tarsi 1.6–1.7 times length of femora, 1.5–1.7 times length of tibia; tarsal segments in order of descending length: 2, 3, 4, 1, 5; basal tarsal segment 0.50–0.57 times length of segment 2. Hind legs: tibiae (1.4–1.6 mm) 0.7–1.0 times length of femora; tarsi 0.4 times length of femora, 0.4–0.6 times length of tibiae; tarsal segments in order of descending length: 5, 1, 2, 3, 4; basal tarsal segment subequal to segment 2. Claws of a pair on all legs dissimilar, one blunt, pad-like, other hooked. Male genitalia: posterior margin of subgential plate concave; combined segments 3 and 4 of forceps 3/5 length of segment 2; penes (Figs. 13, 14) fused in basal 7/8, median titillators smooth, swollen, acute at apex, with or without minute lateral spines. Ninth sternum of female with a shallow median emargination to truncate. Cerci 1.4–1.8 times length of body.

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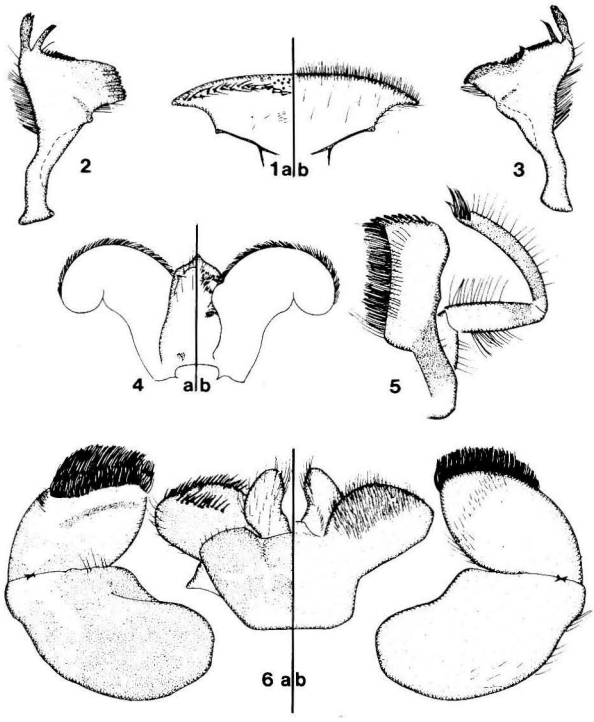
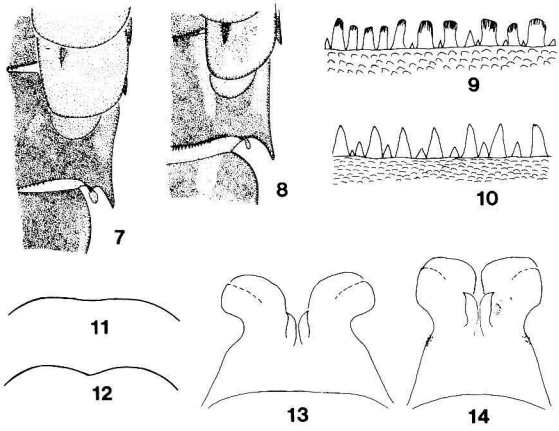


Figs. 1–6. *Macdunnoa brunnea*, mouthparts of mature nymph: (1) labrum (a-ventral, b-dorsal), (2) left mandible, (3) right mandible, (4) hypopharynx (a-ventral, b-dorsal), (5) left maxilla, ventral, (6) labium (a-ventral, b-dorsal).

MATURE NYMPH. Length of body, 6.1–8.3 mm. Head capsule 1.2–1.6 times as wide as long; anterior margin straight or with a median emargination, lateral margins convex. Mouthparts (Fig. 1–6). Labrum (Fig. 1) 1/2 as wide as head capsule, greatest width 2 times basal width, anterior margin straight, densely setaceous dorsally, a row of subapical spines ventrally. Mandibles (Figs. 2, 3): outer incisors longer, serrate; prostheca consisting of a single long seta on left mandible, lacking on right mandible; apical margin between incisor and molar areas with a row of short setae, lateral margins setaceous. Maxillae (Fig. 5): galea-lacinia with 8–9 pectinate spines on crown, ventral setae in a submedian row; palp with segments 2 and 3 fused and 1.5 times length of segment 1. Hypopharynx (Fig. 4) with lingua pointed at apex; superlingua with lateral arms well developed. Labium (Fig. 6) with narrow separation of glossae; glossae elongate, bent at middle; paraglossae moderately produced laterally; apical segment of palpi blunt, 4/5 length of basal segment. Pronotum widest at middle, expanded laterally, posterior margin with shallow median emargination. Fore legs: femora with a few small spines on anterior (leading) margin and dorsal surface, posterior margin with fringe of long setae and several large clavate setae on apical half, tibiae and tarsi with a row of setae on outer margins, small spines along inner margins; tibiae 0.8–1.0 times length of femora; tarsi 0.4–0.5 times length of femora, 0.3–0.5 times length of tibiae. Middle and hind legs with numerous small spines on anterior margin and dorsal surface of femora, posterior margin with a fringe of long setae and regularly spaced clavate setae on apical half; tibiae and tarsi with a row of setae on outer margins. Hind legs with tibiae 0.8–0.9 times length of femora; tarsi 0.3–0.4 times length of femora and 0.3–0.4 times length of tibiae.



Figs. 7–8. Mature nymph, abdominal tergum 7, lateral margin: (7) *Macdunnoa brunnea*, (8) *M. persimplex* (?). Figs. 9–10. Posterior margin of tergite 7 of mature nymph: (9) *M. brunnea*, (10) *M. persimplex* (?): Figs. 11–12. Front margin of head capsule of mature nymph: (11) *M. brunnea*, (12) *M. nipawinia*. Figs. 13–14. Penes of male imago: (13) *M. brunnea*, (14) *M. persimplex*.

Claws not denticulate. Gills with lamellae broad on segments 1–5, reduced on 6, vestigial on 7 (Figs. 7, 8); fibrilliform portion present on gills 1–6. Abdominal segments 2–9 with posterolateral projections. Caudal filaments with whorls of spines at articulations, intersegmental setae on both sides of median filament and mesal sides of cerci.

EGG. Oval; chorion with deep ridges at poles, smooth elsewhere; vesicles evenly scattered on surface (Figs. 15, 16).

Type-species. *Macdunnoa nipawinia* Lemkuhl, by original designation.

Species included. *M. nipawinia* Lehmkuhl; *M. persimplex* (McDunnough) n. comb.; *M. brunnea* Flowers, n. sp.

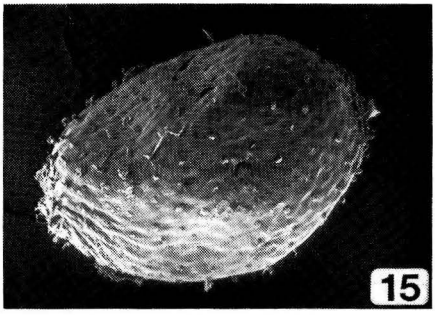
Specimens examined. *M. persimplex*, paratype male imago, holotype male genitalia; *M. brunnea*, male and female imagos, nymphs; *Macdunnoa* sp., nymphs from Ohio.

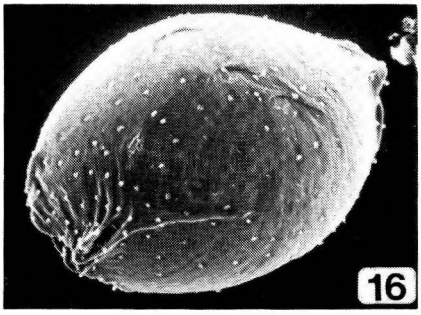
Discussion. *Macdunnoa* can be distinguished from all genera of the Heptageniidae by the following combinations of characters. In the imagos: (1) median titillators of male genitalia thick and abruptly narrowed at apex (Figs. 13, 14); (2) apex of penes expanded laterally, lacking spines (Figs. 13, 14); and (3) male eyes separated by 5 times width of median ocellus. In the nymph: (1) maxillae with ventral setae in a submedian row (Fig. 5); (2) superlingua of hypopharynx with lateral arms well developed (Fig. 4); (3) prosthecae lacking on right mandible; mandibles with a row of short setae between incisor and molar areas (Figs. 2, 3); and (4) gills reduced on abdominal segment 6, vestigial on segment 7 (Figs. 7, 8).

Macdunnoa appears to be most closely related to *Stenonema*, from which it can be distinguished in the male imago by the thick median titillators and lack of spines on the apical lobes of the penes (Figs. 13, 14), in the female imago by the lack of any dark markings on the abdomen, in the nymph by the vestigial seventh gill (Figs. 7, 8), and in the egg by the vescicles and polar ridges of the chorion (Figs. 15, 16).

Macdunnoa brunnea Flowers, n. sp.
(Figs. 1–7, 9, 11, 13, 15)

MALE IMAGO (in alcohol). Length: body, 6.0–8.0 mm; fore wings, 7.4–7.9 mm. Eyes black (bright yellow-green when living). Head pale yellowish-white; antennae white. Basal half of ocelli black, apical half white. Thorax yellowish-white. Legs yellowish-white; fore





Figs. 15–16. Eggs; (15) *M. brunnea* (440X), (16) *M. persimplex* (400X).

legs brown at joint of tibia and tarsus. Wings: membrane hyaline; longitudinal veins hyaline, cross veins brown between C and MP of fore wings, remainder of cross veins hyaline. Abdominal segments 1–7 translucent white, segments 8–10 pale yellowish-tan. Genitalia (Fig. 13) pale yellowish-tan; penes lack lateral spines. Cerci white.

FEMALE IMAGO (in alcohol). Length: body, 7.3–7.7 mm; fore wings, 8.3–8.9 mm. Eyes black, color of head and ocelli as in male imago. Thorax and legs yellowish-white, claws slightly darker. Wings: membrane hyaline; longitudinal veins hyaline; cross veins between C and MP of fore wings light brown, remainder of cross veins hyaline. Abdomen yellowish-white. Caudal filaments white.

MATURE NYMPH (in alcohol). Head: dorsum dark brown, sutures pale; white streak anterior and lateral to eyes. Scape, pedicle and first segment of flagellum of antennae brown, remainder white. Venter of maxillary palpi, labium and labial palpi dark brown (Figs. 5, 6). Thorax: dorsum dark brown, median suture pale; small pale spots on pro- and mesonotum; venter with sclerites dark brown, and pleural membranes pale. Legs: femora dark brown with scattered small pale maculae, tibiae dark brown in basal 3/4, apical 1/4 pale yellow; tarsi pale yellow with wide median brown band; claws pale yellow. Abdomen: dorsum dark brown with indistinct pale submedian streaks at anterior margin of terga 1–8. Spine on both sides of gill base on segment 7 (Fig. 7). Denticles on posterior margin of terga spatulate and serrate (Fig. 9). Sterna dark brown with 1 median and 2 pairs of submedian pale maculae on segments 1–8. Gills smoky black; pale maculae on dorsal 1/3 and along ventral margin of gills 1–5. Caudal filaments: 5 basal segments brown, remainder of basal half of caudal filaments white: apical half of caudal filaments with repeating pattern of 1 tan and 3 white segments.

Egg. Micropyle small, crescent shaped. (Fig. 15).

Specimens. Holotype male imago (reared, with nymphal exuvium and subimaginal skin), FLORIDA: Gadsden Co., Rocky Comfort Creek at Hwy 65 B, 1-V-1979, R. W. Flowers; Allotype female imago (reared, with nymphal exuvium), same locality as holotype, 20-III-1975, J. Jones; Paratypes: 4 male imagos, 1 male subimago, 6 female imagos, same locality as holotype, 13-V-1980, R. W. Flowers; 1 male subimago, 2 female imagos, same locality as holotype, 6-V-1980, R. W. Flowers; 1 female subimago (reared, with nymphal exuvium), 8 nymphs, same locality as holotype, 1-V-1979, R. W. Flowers; 5 nymphs, same locality as holotype, 15-IV-1980, R. W. Flowers; 2 male imagos, same locality as holotype, 10-VI-1970, J. Jones et al.; 1 male imago, same locality as holotype, 26-IV-1974, J. Jones; 1 male subimago, same locality as holotype, 21-IV-1968, W. L. Peters et al.; 4 nymphs, same locality as holotype, 9-IV-1967, W. L. & J. G. Peters; 2 nymphs, same locality as holotype, 29-III-1968, W. L. Peters et al.; 1 male imago, 4 female imagos, FLORIDA: Gadsden Co., Turkey Creek at Hwy 65 B, 2-V-1980, A. R. Soponis et al.; 1 male imago, FLORIDA: Okaloosa Co., Blackwater R., Florida A&M Univ. Biological Station, 4 1/2 mi, NW of Holt, 4-V-1975 (light), W. L. & J. G. Peters; 2 nymphs, FLORIDA: Escambia Co. Escambia Riv., 28-29-III-1953, W. M. Beck, Jr.; 4 nymphs, SOUTH CAROLINA: Anderson Co., Hwy 76, 1.6. mi. W junct of Hwy 178 and 76, nr. Anderson, 8-VI-1955, C. D. Hynes and L. Berner; 1 nymph, SOUTH CAROLINA: Laurens Co., Duncan Creek at Hwy 72, 4.6 miles SW of Whitmire, 9-VI-1955, C. D. Hynes and L. Berner; 1 nymph, NORTH CAROLINA: Rockingham Co.,

Creek at Hwy 150, 1 mi S of junct w Hwy 97, 2-VII-1955, C. D. Hynes and L. Berner. All specimens preserved in alcohol. Types are deposited in the following collections: holotype, allotype, 3 male paratypes, 3 male subimaginal paratypes, 5 female paratypes, 1 female subimaginal paratype, 13 nymphal paratypes at Florida A&M University; 3 male, 3 female, 4 nymphal paratypes at University of Utah; 2 male, 2 female, 7 nymphal paratypes at University of Florida; 1 male, 2 female, 2 nymphal paratypes at U.S. National Museum.

Etymology. *brunnea*, L. meaning brown.

Biology. Adults of *Macdunnoa brunnea* emerge from May to early June at Rocky Comfort Creek and during this period they commonly come to light. Nymphs live in rotting leaves among rocks in deep areas where the current is swift. When living nymphs are placed in still water, they move their gills in a wave-like motion, beginning with the first pair. This behavior is also characteristic of *Stenacron* and *Stenonema* but not of *Heptagenia, Leucrocuta* or *Nixe*.

Discussion. *Macdunnoa brunnea* can be distinguished from *M. persimplex* in the male imago by the lack of lateral minute spines on the penes (Fig. 13) and in the egg by small crescent-shaped micropyles (Fig. 15). Nymphs of *M. brunnea* can be distinguished from those of *M. nipawinia* by the lack of a distinct emargination on the front margin of the head capsule (Fig. 11).

Macdunnoa persimplex (McDunnough) n. comb.
Heptagenia persimplex McDunnough (1929:179)
Non *Heptagenia persimplex*: McCafferty (1977)
(Figs. 8, 10, 14, 16)

The external features of the imagos have been described elsewhere (Burks 1953, Needham et al. 1935). During examination of the male genitalia slide of the holotype, minute spines were observed on the lateral margins of the penes below the terminal lobes (Fig. 14). This character was also found on specimens of *M. persimplex* from Tennessee in the University of Florida collection. The condition is visible only under high magnification but it is the only reliable way to separate male imagos of *M. persimplex* from *M. brunnea*. There appears to be no reliable way of separating females of these two species.

The egg of *M. persimplex* (Fig. 16) is distinguished from that of *M. brunnea* by the presence of broad crescent-shaped furrows at the micropyles.

The nymph of *M. persimplex* is still unknown. Nymphs of *Macdunnoa* collected from the Ohio River probably represent the nymph of *persimplex*, but reared specimens are needed for confirmation. The Ohio nymphs differ from *M. brunnea* nymphs in having an obtuse projection at the base of gill 7 (Fig. 8), pointed denticles on the posterior margin of the abdominal terga (Fig. 10), and a lighter body color.

Macdunnoa nipawinia Lehmkuhl
(Fig. 12)

This species has been described from nymphs and female imagos. In the nymphal description no mention is made of gill 7 but subsequent communication confirmed that this gill is present and vestigial, as in the other species (Lehmkuhl, pers. comm.).

Key to the species of *Macdunnoa* Lehmkuhl

Male imagos.

1. Penes with minute lateral spines (Fig. 14) ..... *M. persimplex* (McD)
1′. Penes with lateral spines lacking (Fig. 13) ..... *M. brunnea* n. sp.

Mature nymphs.

1. Head capsule with distinct emargination on front margin (Fig. 12) .... *M. nipawinia* Lehmkuhl
1′. Head capsule with front margin nearly straight (Fig. 11) 2
2(1′). Body color dark brown; spine on each side of abdominal gill 7 (Fig. 7) denticles on posterior margin of abdominal terga distinctly spatulate (Fig. 9) .... *M. brunnea* n. sp.

2′. Body color light brown; spine only on outside of abdominal gill 7 (Fig. 8); denticles on posterior margin of abdominal terga pointed (Fig. 10) .... *M. persimplex* (McD) (?)

Discussion. Lehmkuhl (1979), relying on Tshernova's (1976) key to heptageniid nymphs, placed *Macdunnoa* close to the Asian genera *Compsoneuria, Compsoneuriella* and *Ecdyonuroides*. However, in grouping heptageniid genera, Tshernova emphasized the presence of a third segment of the maxillary palpi. While this character may be useful to group Oriental Heptageniidae, it is not particularly useful when applied to the Nearctic fauna. The maxillae of many North American genera (including *Stenacron, Stenonema* and *Macdunnoa*) have a small third segment present even if discernible only by an indistinct suture line.

Based on adult and nymphal morphology discussed by Jensen (1974), Bogoescu and Tabacaru (1962) and Flowers (1980a, b), *Macdunnoa* should be placed in the same phyletic complex as *Stenacron* and *Stenonema*. These three genera share the following characters. In the imagos: (1) eyes widely separated; (2) basal fore tarsal segment greater than 1/2 times length of segment 2; and (3) lateral spines present on penes; or if absent, apex of penes expanded and apical spines minute or absent. In the nymphs; (1) maxillae with ventral setae of galea-lacinia in a submedian row (Fig. 5); (2) superlingua of hypopharynx with lateral arms well developed (Fig. 4); and (3) abdominal gill 7 reduced and different in shape from the preceeding gills (Figs. 7, 8). The developed lateral arms of the superlingua, and the reduced seventh gill are shared derived nymphal characters which delineate the *Stenacron-Stenonema-Macdunnoa* phyletic complex and distinguished it from other complexes in the Heptageniidae.

No attempt is made at this time to specify the exact phylogenetic relationship of *Macdunnoa* to *Stenacron* and *Stenonema*. *Macdunnoa* has characters in common with both the latter genera as well as unique characters of its own. More research is needed, particularly on the species of *Stenonema (McCaffertium)*, before the evolutionary development of the *Stenacron-Stenonema-Macudunnoa* complex can be determined.

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