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**REDESCRIPTION AND TRANSFER OF *HOLOCENTROPUS*
TIMESIS (DENNING) NEW COMBINATION (TRICHOPTERA:
POLYCENTROPODIDAE)**

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Abstract.—Denning described the apparently uncommon species *Polycentropus timesis* (Denning, 1948) based on a single male specimen from Massachusetts. Since its original description, additional specimens of *P. timesis* have been collected from New Hampshire and Michigan. The previous description and illustration of the species are inadequate. Here, the male of the species is redescribed and re-diagnosed, the female is described and diagnosed for the first time, the wing venation and the genitalia of both sexes are figured, and the species is transferred to the genus *Holocentropus*, resulting in *Holocentropus timesis* (Denning, 1948), **new combination**.

Key Words: Annulipalpia, caddisfly, female, Nearctic, taxonomy

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The caddisfly family Polycentropodidae (Trichoptera: Annulipalpia) contains more than 800 nominal species in 14 genera (Morse 2021). Larvae of this family inhabit lentic and lotic habitats in which they construct variously formed fixed silken retreats (Wiggins 1996, 2004). Characters of the male genitalia are crucial for diagnosing and identifying taxa in the family, so are necessary in descriptions of new species.

The family exhibits a complex taxonomic history with numerous transfers of species among genera. Exemplifying this fact are the genera *Holocentropus* McLachlan 1878, *Plectrocnemia* Stephens 1836, and *Polycentropus* Curtis 1835, which together constitute the *Polycentropus sensu lato* (e.g., Chamorro and Holzenthal 2011). Prior to 1944, these three genera were universally treated as independent taxa. In Ross's (1944)

treatment of Illinois caddisflies, however, he effectively synonymized the former two genera with *Polycentropus* based on overall morphological similarity of the genera across life stages, particularly evident in the few described larvae. This led to a rift in taxonomic treatment between European and New World workers, wherein European workers continued using the pre-1944 classification and those in the Americas adopted Ross's scheme (see Chamorro and Holzenthal 2011, Orfinger 2019, and Gerth et al. 2020 for detailed discussions).

These generic synonymies were subsequently reversed by Chamorro and Holzenthal (2011) based on the first robust phylogenetic investigation of the family derived from morphological characters of all life stages. Species that had been transferred from *Holocentropus* or *Plectrocnemia* by Ross

were returned to their original generic assignment. Additionally, Chamorro and Holzenthal (2011) transferred species of *Polycentropus sensu lato* described post-1944 to either *Holocentropus* or *Plectrocnemia* based on their morphological examinations. However, Orfinger (2019) noted that Chamorro and Holzenthal inadvertently overlooked transferring *Plectrocnemia harpi* Moulton and Stewart, 1993. This work addresses an additional overlooked species that merits redescription and transfer to another genus, the Nearctic caddisfly *Polycentropus timesis* (Denning, 1948).

Polycentropus timesis was originally assigned to the genus *Neureclipsis* McLachlan, 1864 by Denning based on a single male specimen collected in Massachusetts. Denning figured the male genitalia and concluded that *P. timesis* was most similar to *Neureclipsis crepuscularis* (Walker, 1852), differing based on several aspects of the genitalia. In their North American atlas, Armitage and Hamilton (1990) reiterated the findings of Denning. Based on examination of wing venation and genitalia of the holotype and newly collected material, Weaver (1995) transferred the species to the genus *Polycentropus sensu lato*. Weaver (1995) noted the similarity of the species to *Holocentropus picicornis* (Stephens, 1836) (then *Polycentropus picicornis*), exemplified by specimens of *P. timesis* from New Hampshire that had previously been misidentified as *H. picicornis* by Blickle and Morse (1955).

Illustrations of the male genitalia of *P. timesis* are available in the works of Denning (1948) and Armitage and Hamilton (1990). Only lateral views of the male genitalia are provided in each case, and the species is in need of redescription. Illustrations of the male genitalia of *H. picicornis* have been provided by Tobias and Tobias (1981), Nimmo (1986), Armitage and Hamilton (1990), Nógrádi

and Uherkovic (2002), and Houghton (2012). In addition, the male genitalia of *H. picicornis* and the morphologically similar Palearctic *Holocentropus insignis* Martynov, 1924 are also available for comparison in the atlas by Malicky (2012). Illustrations of the female genitalia of *H. picicornis* have been provided by Nimmo (1986), Armitage and Hamilton (1990), and Nógrádi and Uherkovic (2002).

Here, *P. timesis* is redescribed, re-diagnosed, transferred to another genus, and the female of the species described and diagnosed for the first time. Wing venation and male and female genitalia are illustrated.

MATERIALS AND METHODS

Specimens were observed under a Unitron Z10 stereomicroscope with magnifications up to 120x. Measurements were obtained using a calibrated ocular micrometer. Reported lengths were measured from the anterior of the head (excluding antennae) to the tip of the forewing. To evaluate internal morphology, genitalia were cleared with a heated solution of 85% lactic acid following Blahnik et al. (2007), then rinsed with ethanol. Some genitalia (e.g., of the holotype) were previously cleared. Genitalia were viewed in glycerine, and then stored in a microvial within a vial of 80% ethanol with the rest of each respective specimen. The phallus was excised from some specimens for illustration. Line drawings were produced using a 10 x 10 gridded ocular lens in conjunction with a gridded guide and pencil. Drawings were then scanned and used as templates for the final illustrations using Adobe Illustrator® version 24.3. Photographs of genitalia and the habitus photograph were taken with a Levenhuk M1400 Plus Digital Camera mounted to a Unitron Z10 and focus-stacked using Helicon Focus version 7.7.4. Genitalia photographs were useful in adding details during final illustration

rendering. Morphological terminology follows Chamorro and Holzenthal (2011), Hoffman and Morse (1990), and Orfinger and Moulton (2021).

Institutional abbreviations where specimens examined for this study are housed are as follows: California Academy of Sciences, San Francisco, California (CAS); Florida State Collection of Arthropods at Florida A&M University, Tallahassee, Florida (FAMU); Hillsdale College Insect Collection, Hillsdale, Michigan (HCIC); University of New Hampshire Don Chandler Entomological Collection, Durham, New Hampshire (UNHC).

Initial association of sexes was based on the fact that the female specimen was collected with males of *P. timesis* and looked nearly identical to males, exhibiting similar size, coloration, and the same wing venation. The wing venation agrees with *Holocentropus*. From multiple sampling events at the site where the putative female of *P. timesis* was collected and numerous nearby sites of the Huron Mountains in northern Michigan during the Summer of 2019, the only other species of *Holocentropus* recovered were *H. flavus* Banks, 1908 (n = 11, none of which were collected at same site as *P. timesis*) and *H. interruptus* Banks, 1914 (n = 9, 1 of which was collected at same site as *P. timesis*; D. Houghton, personal communication). Examination of the genitalia of the presumed *P. timesis* female specimen proved that the genitalic morphology of the specimen was distinct from both *H. flavus* and *H. interruptus*. Therefore, it is concluded that the female specimen described herein represents *P. timesis*.

RESULTS

Holocentropus timesis (Denning)

new combination

(Figs. 1–9)

Neureclipsis timesis Denning, 1948: 119.

Type locality: USA, Massachusetts,

Hampshire County, Amherst. Holotype ♂ by original designation (CAS). New combination *Polycentropus* (Weaver 1995); recorded from Michigan (Houghton et al. 2011); recorded from Michigan (Houghton et al. 2018).

Description.—*General Structure* (Figs. 1, 2): Length of male 6.75–7.25 mm (n = 3). Length of female 7.1 mm (n = 1). Body coloration dark brown. Wings lighter brown; forewing with forks I, II, III, IV, V; hindwing with forks II and V; discoidal cell closed; nygma present at base of fork II of both forewing and hindwing, and at about 2/3 length of thyridial cell of forewing. Spur formula 3, 4, 4.

Male Genitalia (Figs. 3–7): Abdominal segment VIII annular. Segment IX sternum semi-ovoid in lateral view, wider ventrally and narrowing dorsally, slightly produced ventroposteriorly below inferior appendage. Tergum X fused to and indistinct from intermediate appendage, the two forming a single structure (X + int. app.); tergum X + intermediate appendages bifid in lateral view, with slender ventroposterior arm subparallel to phallus, broader dorsobasal lobe directed posterodorsad, bearing several setae; in dorsal aspect forming two parallel processes with broad, emarginate bases laterally, each tapered apically and with ‘V’-shaped notch separating apices, apices with several setae. Preanal appendages (pre. app.) produced posteroventrad in lateral view, elongate, with sinuous margin, apex decurved and broadly rounded; in dorsal view appearing as rounded lobes produced posteriorly, bearing several setae. Inferior appendages (inf. app.) in lateral view each broad, with ventral portion straight for half of length before sharply turning dorsad; dorsal margin with very small basodorsal projection, curving dorsad for about half of length before plateauing, apex forming a narrow blunt point; in ventral view,



Fig. 1. Lateral habitus of a male *Holocentropus timesis* Denning, 1948 collected in Marquette County, MI.

medial margin straight posteriorly for half of length, then abruptly curving outward toward apex, the curved second half of the medial margin with many small spine-like setae, lateral margin nearly straight before terminating in rounded apex. Phallus in lateral view tubular, basal portion broad

for 1/5 length before narrowing to consistent height, terminating in rounded dorsal apex with embedded, heavily sclerotized phallic hook (ph. h.) produced posterodorsally above ventral lip of phallus (v. l.), ventral lip produced posteroventrally, terminating in acute apex; phallotremal

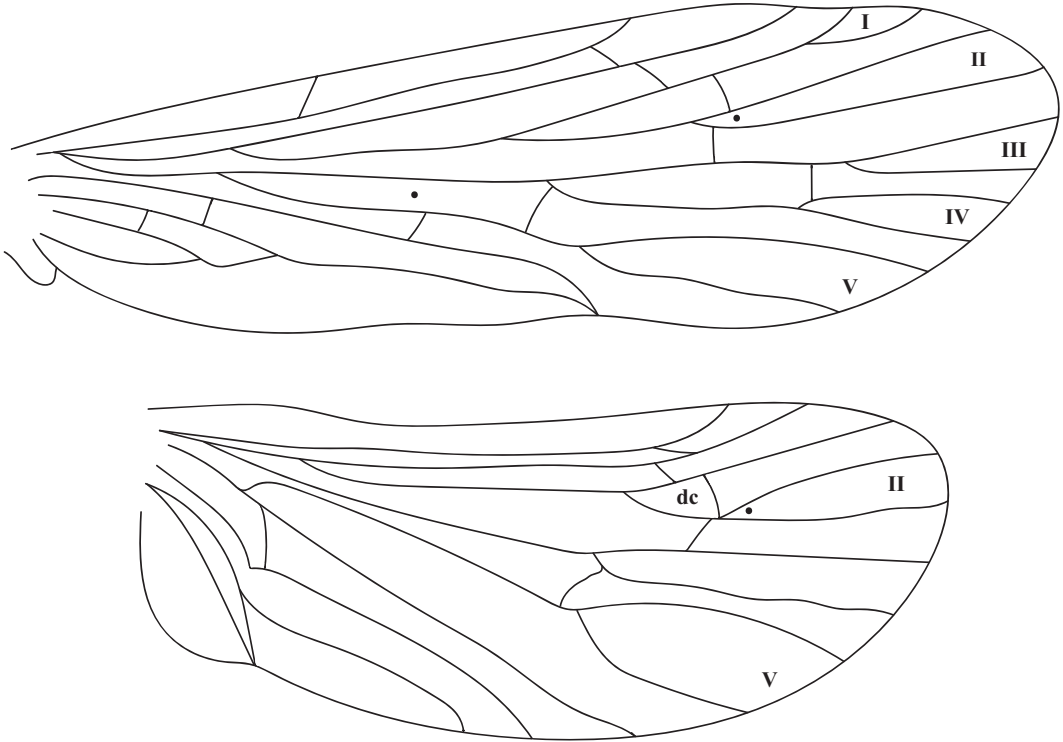
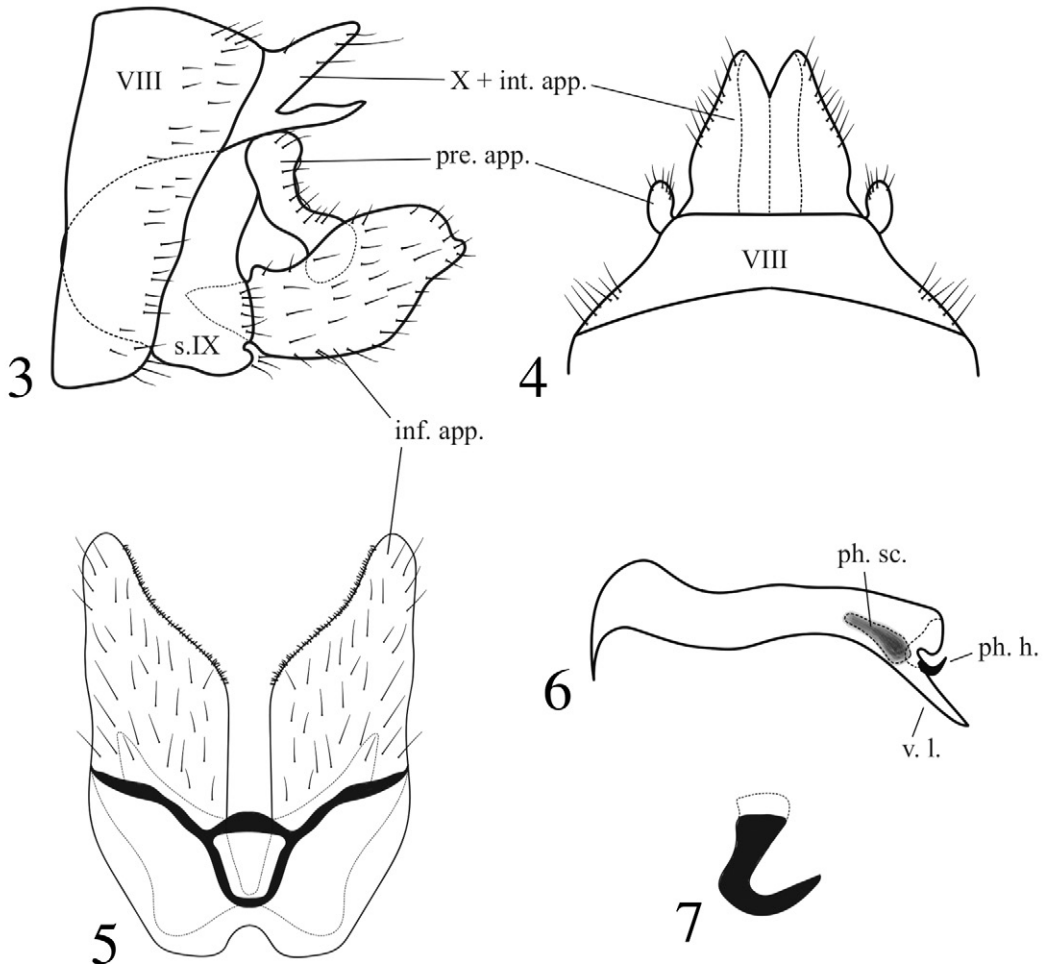


Fig. 2. Wing venation of *Holocentropus timesis* Denning, 1948. Abbreviations: I, II, III, IV, V = Forks I to V, respectively; dc = discoidal cell.

sclerite (ph. sc.) club-shaped, positioned anterior to phallic hooks, oriented poster-oventrally. Phallic hook strongly recurved in dorsolateral aspect, paired with one hook obscured by other in lateral and dorsolateral views.

Female Genitalia (Figs. 8, 9): Venter VIII in ventral view with ventral plates (v. pl.) boot-shaped, “toes” oriented basolaterally and “heels” oriented medially in line with posterior apex of posterior part of genital chamber (g. ch. p.), medial margin concave, lateral margin slightly convex, meeting posteriorly at rounded apex; in lateral view with broad base, gradually tapering to acute posterior apex. Posterior apex of external parts of gonopods VIII (p. ap. e. gon. VIII) with posterior margin

slightly triangular and rounded mesally in ventral view; in lateral view extending subparallel to ventral plates in acute process (e. gon. VIII); internal parts of gonopods VIII (i. gon. VIII) in ventral view visible through venter VIII, lightly sclerotized, walking cane-shaped, decurved “handle” posterad, laterally oriented, with single membranous arc originating at decurved margins and produced posteriorly subparallel to apices of ventral plates, “shaft” descending straight anteriorly, terminating at posterior part of genital chamber (g. ch. p.); in ventral view anterior part of genital chamber (g. ch. a.) sclerotized, ‘V’-shaped; posterior part of genital chamber (g. ch. p.) in ventral view sclerotized, ‘u’-shaped, resupinate;



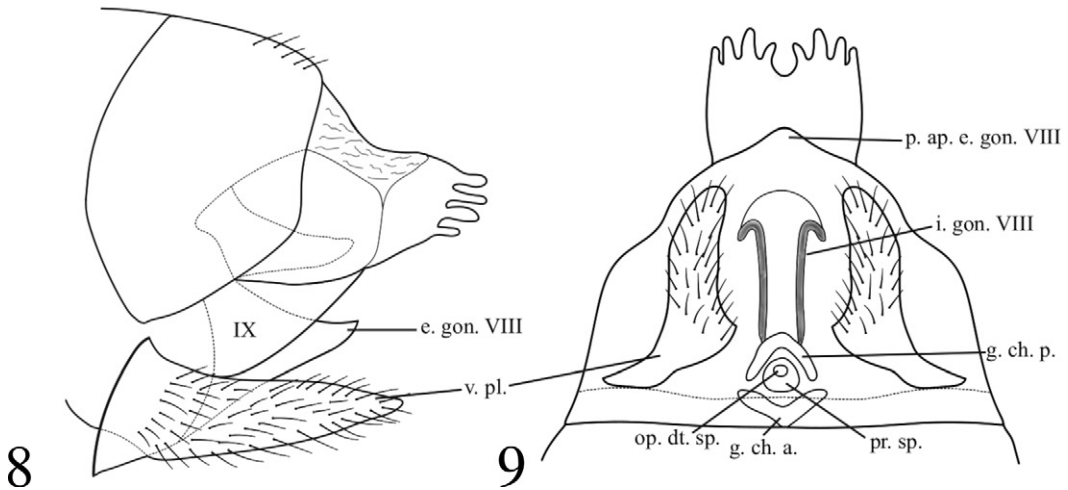
Figs. 3–7. Male genitalia of *Holocentropus timesis* Denning, 1948 (holotype). 3, Left lateral (with phallus removed). 4, Dorsal. 5, segment IX and inferior appendages, ventral. 6, phallus, left lateral. 7, phallic hook, dorsolateral. Abbreviations: inf. app. = inferior appendage (paired); ph. h. = phallic hook (paired); ph. sc. = phallosclerite; pre. app. = preanal appendage (paired); s.IX = sternum IX; v. l. = ventral lip of phallus; X+ int. app. = fused tergum X and intermediate appendage (paired).

processus spermathecae (pr. sp.) subovoid with central elevation bearing opening of ductus spermathecae (op. dt. sp.) in ventral view.

Larva and Pupa: Unknown.

Material Examined.—*Holotype:* USA: Massachusetts: Hampshire County, Amherst, Light Trap, Denning coll., 22/VI/1941, 1 male [in ethanol] (CAS). *Non-type material:* USA. Michigan: Marquette County, Inflow into Ives Lake, Southwest

Shore, Huron Mountains Club, UV Light, [46.8390, -87.8537], Houghton et al. coll., 5/VII/2019, 1 male, 1 female [in ethanol] (FAMU), same data except 2 male (HCIC2100254). Lake County, Fairbanks Creek, Cedar Site, GH Gordon BioStation, [44.0481, -85.6586], 11/VI/2021, 1 male [in ethanol] (HCIC2100173). Same data except 9/VI/2021, 1 male [in ethanol] (HCIC2100266). Same data except Fairbanks Creek, Meadow Site,



Figs. 8–9. Female genitalia of *Holocentropus timesis* Denning, 1948. 8, left lateral. 9, ventral. Abbreviations: IX = segment IX; e. gon. VIII = external parts of gonopods VIII; g. ch. a. = anterior part of genital chamber; g. ch. p. = posterior part of genital chamber; i. gon. VIII = internal parts of gonopods VIII; op. dt. sp. = opening of ductus spermathecae; p. ap. e. gon. VIII = posterior apex of external parts of gonopods VIII; pr. sp. = processus spermathecae; v. pl. = ventral plate.

[44.0466, -85.6723], 1 male [in ethanol] (HCIC2100136). New Hampshire: Strafford County, Spruce Hole, 3 miles Southwest of Durham, Malaise Trap, D. Chandler coll., 27/V-10/VI/1987, 1 male [pinned] (UNHC). Same data except UV Light, G. Fortier and D. Chandler coll., 18/VI/1990, 1 male [pinned] (UNHC).

Remarks.—The following specimens of *H. picicornis* were used for comparative purposes.

New Hampshire: Strafford County, Lee, Black Light Trap, Blickle coll., 3/VI/1960, 2 males, 2 females [in ethanol] (Determined as *Holocentropus picicornis*) (UNHC).

DISCUSSION

The genus *Holocentropus* is distinguishable from both *Plectrocnemia* and *Polycentropus* by the lack of fork I (i.e., R2+3 is unbranched) in the hind wing and from *Polycentropus* by possessing a closed discoidal cell (Roy et al. 1980; Armitage and Hamilton 1990). Wing

venation illustrated for the first time here for *P. timesis* agrees with assignment to the genus *Holocentropus*. Corroborating this, the male genitalia of *P. timesis* are very similar to those of *H. picicornis* as noted by Weaver (1995) and expanded upon here. Morphological characters of *P. timesis* are consistent with other *Holocentropus* and demonstrate that *P. timesis* should in fact be placed in *Holocentropus*, resulting in *Holocentropus timesis* (Denning, 1948) new combination.

A single publicly available DNA sequence exists for *H. timesis*. The 407 bp cytochrome oxidase I (COI) mtDNA barcode sequence is deposited under Barcode of Life Database (BOLD) Process ID NECAD304-08. An NCBI nucleotide Basic Local Alignment Search Tool (nucleotide BLAST) query demonstrated highest genetic similarity with *H. picicornis* and *H. insignis* and followed immediately by various other *Holocentropus* species, corroborating the morphological evidence for the generic transfer of the species.

While closely allied to *H. picicornis*, males of *H. timesis* differ from *H. picicornis* in having the intermediate appendages fused basally to tergum X. Males of these species are also separable according to the following aspects of *H. timesis* relative to *H. picicornis*: preanal appendage more slender and overall smaller in lateral aspect, inferior appendages broader in ventral view, phallic hook more recurved in dorsolateral aspect and more heavily sclerotized, and the distinct 'V'-shaped medial emargination of the apices of the fused tergum X and intermediate appendages in dorsal view. Females of *H. timesis* also appear most similar to those of *H. picicornis*, readily separable by the broader base of the ventral plates and distinct shape of the ventral plates in ventral view, as well as the more produced posterior apex of external parts of gonopods VIII in ventral view.

This new combination brings the total number of named Nearctic *Holocentropus* species to nine and reduces the number of nominal Nearctic *Polycentropus* species to 29. Little is known about the biology of this seldom-reported species. *Holocentropus timesis* has been recorded from the U.S. states of Massachusetts, Michigan, and New Hampshire (Rasmussen and Morse 2021). This known distribution suggests that additional populations may yet be found in additional northeastern and northcentral states, as well as eastern Canadian provinces. Despite recent progress in the phylogeny of the family Polycentropodidae (see Chamorro and Holzenthal 2011, Johanson et al. 2012) and for several genera within the family (e.g., see, Chamorro and Holzenthal 2011, Camargos 2020), no robust phylogeny yet exists for *Holocentropus* species. Future regional and global studies examining the species-level phylogeny and historical biogeography of the *Polycentropus sensu lato* will likely uncover additional interesting

relationships and biogeographic patterns within these widespread genera. It is also probable that generic assignment of additional New World species of *Polycentropus sensu lato* described between 1944 and 2011 need to be reassessed.

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