

## THE LARVAL STAGE OF *HEPTAGENIA ADAEQUATA* (EPHEMEROPTERA: HEPTAGENIIDAE)<sup>1</sup>

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**ABSTRACT:** Larvae of the poorly known western North American species *Heptagenia adaequata* are described for the first time based on material reared from the Saskatchewan River system. Diagnoses are provided for differentiating larvae of *H. adaequata* from other species of *Heptagenia* within its range, especially the common *H. solitaria* and *H. elegantula*, with which it might be confused.

*Heptagenia adaequata* McDunnough is an historically unfamiliar North American mayfly species that was originally described from Alberta (McDunnough 1924) and shortly thereafter reported from Saskatchewan (McDunnough 1925). It had not been reported again until recently, when it was found in Idaho and Oregon (based on study of adult material, including the type) (Jacobus and McCafferty 2002). The larva has not previously been described, and larvae alluded to as *H. adaequata* by Bednarik and Edmunds (1980) from the Salmon River in Idaho have proven, upon our examination, to be larvae of *H. solitaria* McDunnough. Specimens recently collected from the Saskatchewan River system by JMW match those of *H. adaequata* that the late E. Whiting collected and reared from the Saskatchewan River system some years ago while at the University of Saskatchewan. We herein provide a description and diagnosis of larvae of *H. adaequata*.

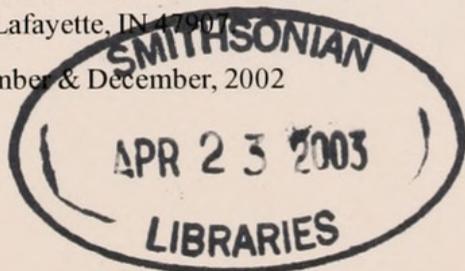
### *Heptagenia adaequata* McDunnough, 1924

**Mature larvae.** Body length 8.5-11.5 mm; caudal filament length 1.25-1.75 times body length. Coloration generally light to medium brown with extensive light markings. Head capsule (Fig. 1) with white markings; frons with large, round to ovate white spot medially at anterior margin and with large, sharply demarcated, somewhat pentagonal white marking between antennal bases and margined posteriorly by medial ocellus; medial, pentagonal marking pointed anteriorly and laterally, with anterior point sometimes extending by thin line to anteromedian spot; white areas anterior to compound eyes extending along lateral margins of head capsule. Galealaciniae with 9-11 pectinate, spinelike setae and submedian row of hairlike setae. Thoracic notum with extensive white markings. Femora with two transverse, brown bands dorsally (basal brown band sometimes broken into two large spots as in Figure 1), and with sparse row of stout, medium-length setae and dense fringe row of long hairlike setae along posterior edge, and with numerous spiculi on dorsal surface. Tibiae (Fig. 1) without basal brown band. Tarsal claws with single large denticle. Abdomen (Fig. 1) with tergum 1 mostly pale. Terga 2-7 with large, white, sublateral and submedian markings; submedian markings often somewhat ovate to somewhat lunate, with those on tergum 4 largest, usually reaching posterior margin (occasionally submedian and sublateral spots coalescing to form large rectangular markings on tergum 4). Terga 8 and 9 pale dorsally with only small, anteromedian area and far lateral areas brown. Tergum 10 mostly brown, with pair of longitudinal, submedian, white bars extending from anterior margin to approximately midlength of tergum. Abdominal sterna pale and unmarked. Caudal filaments light brown.

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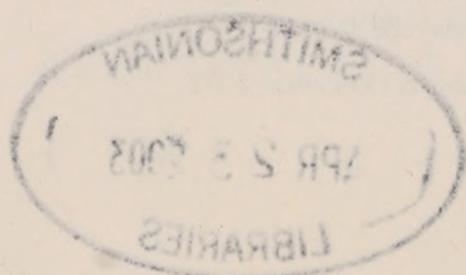


**Diagnosis.** The ranges of five North American species of *Heptagenia*, *H. diabasia* Burks, *H. elegantula* (Eaton), *H. flavescens* (Walsh), *H. pulla* (Clemens), and *H. solitaria* (see e.g. McCafferty and Randolph 1998), overlap with the known range of *H. adaequata*. Of these, *H. flavescens* and *H. pulla* are primarily Eastern and Midwestern species (Randolph and McCafferty 1998) and are not expected to be found in Alberta, Idaho, or Oregon (the other known locales of *H. adaequata*).

The dorsal abdominal markings of *H. adaequata* larvae are generally similar to those of *H. solitaria* and *H. elegantula*, two very common Western species of *Heptagenia* Walsh, and *H. pulla*, a common Midwestern species. These patterns, for example, all have the mostly pale terga 8 and 9, and extensive light areas on tergum 4 (Fig. 1) (Figs. 6 and 7 in Bednarik and Edmunds [1980]). Unfortunately, in some older fluid-preserved material, the abdominal patterns often are lost or are diffuse. Mature larvae of *H. adaequata* are similar to *H. solitaria* in having caudal filaments considerably longer than the body (we have found filaments nearly twice the length of the body in some). In contrast, *H. elegantula* larvae have caudal filaments subequal to the body length (Bednarik and Edmunds 1980). (It is important to use mature or nearly mature larvae when judging relative tail lengths because all young *Heptagenia* larvae will have relatively long caudal filaments.) *H. adaequata* larvae differ from those of *H. solitaria* by having extensive and conspicuous white markings on the head capsule (Fig. 1), by lacking an ovate light spot that often appears in the anterior half of the femora dorsally, and in lacking brown banding at the base of the tibiae (Fig. 1). *H. elegantula* larvae are more apt to have more extensive white areas on the head, thoracic notum, and legs, similar to those in *H. adaequata* larvae, and often include a pentagonal type marking between the antennal bases. We have not seen *H. elegantula* larvae with the large anteromedial spot on the frons (Fig. 1) together with a pair of light submedian bars on abdominal tergum 10 extending from the anterior margin (Figs. 1). At this time, this particular combination of characteristics would appear to be confined to *H. adaequata*.

In the key to mature larvae of *Heptagenia* in the Rocky Mountain region given by Bednarik and Edmunds (1980), *H. adaequata* could be added by modifying couplet 2 as follows:

2. Caudal filaments subequal to body length . . . . . *H. elegantula*  
 Caudal filaments 1.25-1.75 times length of body . . . . . 2a
- 2a. Anteromedian white spot on head capsule; tibiae without brown band basally;  
 abdominal tergum 10 usually with pair of submedian white bars extending  
 from anterior margin . . . . . *H. adaequata*
- Head capsule without anteromedian white spot; tibiae usually with brown band  
 basally; abdominal tergum 10 usually solid brown, never with submedian white  
 bars extending from anterior margin . . . . . *H. solitaria*



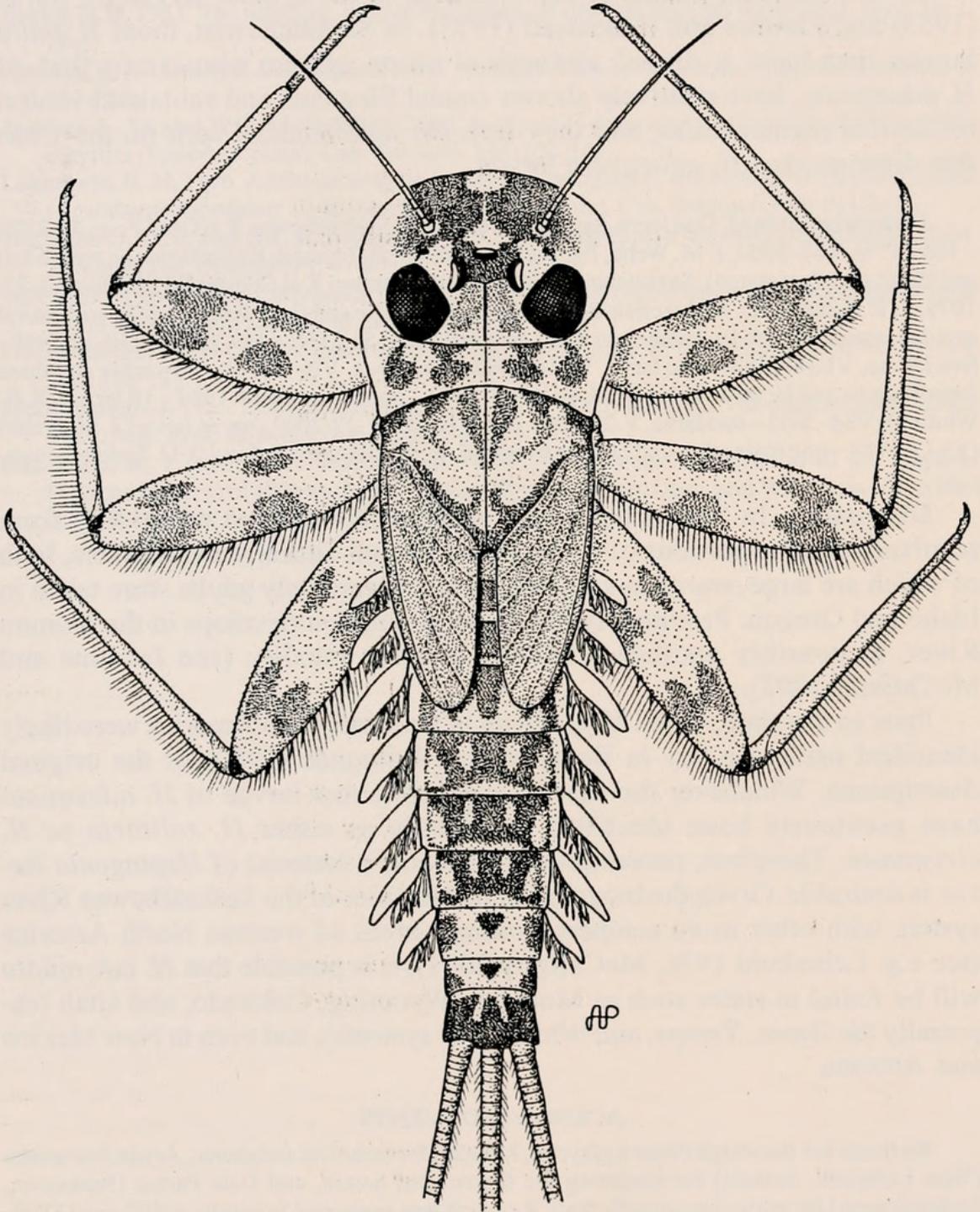


Fig. 1. *Heptagenia adaequata* larva, dorsal habitus.

*H. adaequata* larvae may be distinguished from larvae of additional species of *Heptagenia* that are known to occur in Saskatchewan (*H. diabasia*, *H. flavescens*, *H. pulla*) by comparing the characters given above for *H. adaequata* with, for example, the treatment of those other larvae by Burks (1953) and Flowers and Hilsenhoff (1975). In Saskatchewan, those *H. pulla* larvae that have a dorsal abdominal color pattern similar to that of *H. adaequata*, have relatively shorter caudal filaments and sublateral ventral abdominal pigmentation, and they lack the anteromedial spot on the frons that distinguishes *H. adaequata* larvae.

**Material examined.** One larva, Saskatchewan. North Saskatchewan R at Cecil Ferry 53.23°N – 105.51°W, VI-6-2000, J. M. Webb, Purdue Entomological Research Collection; one male adult and larval exuviae (reared), Saskatchewan, South Saskatchewan R at Chesterfield Bridge, VI-22-1979, E. R. Whiting, U. Saskatchewan; 29 larvae, three male and three female adults with larval exuviae (reared), South Saskatchewan R at Lemsford Ferry, 51.03°N – 109.12°W, (VIII-13-1980 – five larvae, VI-18-1983 – one larva, VI-18-1983 – one larva, VII-1-1984 – two male and three female adults and larval exuviae [reared], VI-12-1980 – one larva, IX-14-1980 – 10 larvae, E. R. Whiting) (VI-6-2001 – one larva, V-23-1998 – three larvae, V-17-2000 – seven larvae, J. M. Webb) (VI-17-1983 – one male adult and larval exuviae, E. R. Whiting and B. Jarvis), U. Saskatchewan.

**Discussion.** In Saskatchewan, *H. aedequata* has been taken only from relatively pristine portions of the North and South Saskatchewan Rivers, both of which are large, warm-in-summer, turbid rivers. Only adults were taken in Idaho and Oregon. Presumably the Idaho population develops in the Salmon River, at possibly another relatively pristine locality (see Jacobus and McCafferty 2002).

Prior to this time, larval *Heptagenia* in western North America were likely identified using the key in Bednarik and Edmunds (1980) or the original descriptions. Whichever the case, it is possible that larvae of *H. adaequata* have previously been identified incorrectly as either *H. solitaria* or *H. elegantula*. Therefore, reexamination of western material of *Heptagenia* larvae is desirable. Given the biogeographic affinities of the Saskatchewan River system with other more southern drainage areas of western North America (see e.g. Lehmkuhl 1976, McCafferty 2001), it is possible that *H. adaequata* will be found in states such as Montana, Wyoming, Colorado, and Utah (especially the Green, Yampa, and White River systems), and even in New Mexico and Arizona.

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