

## THE EPHEMEROPTERA OF ALASKA<sup>1</sup>

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*Abstract.*—A synopsis of the Ephemeroptera known from Alaska is provided. New collections from the north slope of the Brooks Range are reported and include new records of the genus *Heptagenia*, *Cinygmula subaequalis*, and *Ephemerella lacustris*. Mayfly data concur with the generalized pattern of Arctic fauna being represented by relatively few, widespread species, and having a strong circumpolar component. More species are expected to be Holarctic or at least have sister species in the Palearctic than can now be accounted for on the basis of present systematic knowledge. Zoogeography suggests that the fauna was present in a glacial refugium and is now composed of low-vagility species expressed by widely disjunct continental distributions and more easily dispersed species expressed by more continuous widespread distributions. Ephemeroptera known from Yukon drainage systems contiguous with Alaska are also treated and should eventually be found in Alaska.

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The mayfly fauna of Alaska has been poorly known but of considerable recent interest because of the development and maintenance of a trans-Alaska pipeline corridor and its potential environmental impact. Freshwater ecological studies incorporating benthos (e.g., Watson et al., 1966; Nauman and Kernodle, 1974; Craig and McCart, 1975; Slack et al., 1977, 1979) have involved mainly the Brooks Range and Beaufort Sea drainage areas. Unfortunately, such studies have not provided much species-level information and therefore are of limited value for interpreting Alaskan mayfly faunistics.

Southern Alaskan distributions were indicated by range maps for nine Ephemeroptera genera by Allen and Brusca (1973). Edmunds et al. (1976) listed eight nominal species and at least seven other unidentified species among 12 genera reported from Alaska. Slack et al. (1977) added two genera to this in their study of the Dietrich River. Lehmkuhl (1979) reported one more nominal species and genus, and Harper and Harper (1981) reported an additional five nominal species and one genus from Umiat. Table 1 provides a taxonomic listing of the presently known mayfly fauna of Alaska and is based in part on the above references, beginning with Edmunds et al. (1976).

A list of species that are very likely to be eventually found in Alaska can be generated on the basis of records from the adjacent Yukon Territory of Canada, particularly the Yukon River System-Pacific Drainage Basin, which is shared by Alaska and the Yukon. Records for this area are provided generally by Harper

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and Harper (1981) and for the Porcupine River drainage subsystem by Wiens et al. (1975). Table 1 incorporates these records; however, taxa presently known to occur in the Yukon but as yet unreported from Alaska are bracketed.

#### NEW COLLECTIONS

Recent collections from the north slope of the Brooks Range were provided to me by T. L. Harris of Athens, Georgia. New Alaskan records for one genus and two species were represented in these collections. Female adults of *Rhithrogena* sp., male and female adults and subimagos of *Ephemerella lacustris*, and larvae of *Serratella tibialis* were taken at the Kuparuk River, 5 miles northeast of Toolik Lake, on August 6, 1979. Male adults of *Cinygma lyriforme* and *Cinygmula subaequalis*, and female adults of *Heptagenia* sp. were taken at Bonanza Creek, 12 miles north of Old Man Camp, on August 4, 1979. These taxa are treated below and included in Table 1.

*Rhithrogena futilis* is well known from western North America and was reported from Umiat, Alaska, and the Yukon Territory by Harper and Harper (1981). The females of *Rhithrogena* I have could possibly be *R. futilis* since they agree in color with males of that species. Other workers have seen *Rhithrogena* from Alaska (Table 1) but have been unable to identify them to species.

*Ephemerella lacustris* has been known previously only from Yellowstone Lake, Wyoming, where larvae develop in up to 2 feet of water (Allen and Edmunds, 1965). Even though the fact that adults were taken at the Kuparuk River strongly suggests a lotic habitat for *E. lacustris* larvae in Alaska, lentic habitats within flight range of this site cannot be entirely ruled out. Alaskan congeners, *E. aurivillii* and *E. inermis*, have wider ranges in western North America but with continuous rather than disjunct distribution patterns.

*Serratella tibialis* is a common boreal western North American species known from British Columbia and Alberta in Canada (Allen and Edmunds, 1963) but not from the Northwest or Yukon Territories (Cobb and Flannagan, 1980; Harper and Harper, 1981). Edmunds et al. (1976) listed it as occurring in Alaska but gave no specifics. The mature larvae I have are not typical of *S. tibialis*. Instead they lack any indication of a median longitudinal stripe on the head, thoracic nota, or abdominal terga, and they are brown with only a few pale markings on the dorsal abdomen and head. Several of them have 8 or 9 claw denticles rather than the 5–7 reported for the species. Their abdominal armature is typical of *S. tibialis*, however, and the Alaskan larvae are therefore presumed to represent a population variant of the species.

*Cinygma lyriforme* was first reported from Alaska (near Fairbanks, July 4, 1968) by Lehmkuhl (1979). Except for this and the more northern location in Alaska reported herein, the species is known only from Oregon and Alberta. The larval stage remains unknown and may prove difficult to place to genus because of our lack of knowledge of *Cinygma* with respect to its exact affinities with some Palearctic species classified in other heptageniid genera.

*Cinygmula subaequalis* was known previously only from eastern North America. My male adults from Alaska have both genitalia and color patterns typical of this distinctive species, and I therefore have no reason to describe them as a new species at this time. The apparent vicariant distribution of this species is most probably a result of glaciation.

*Heptagenia pulla* and *H. sp.* have been reported from the Yukon by Harper



Table 1. Families, genera, and species of Ephemeroptera reported from Alaska and adjacent areas of the Yukon Territory. Taxa reported only from the Yukon are in brackets. Generic names followed by sp. indicate one or more species (based on unidentifiable stages, sexes, or conditions) that may or may not be conspecific with listed nominal species. Notes: 1, Alaskan records from Edmunds et al. (1976); 2, Yukon records from Wiens et al. (1975); 3, Alaskan records from Slack et al. (1977); 4, Alaskan and/or Yukon records from Harper and Harper (1981); 5, Possibly misidentified *B. insignificans* McDunnough; 6, Alaskan record from Lehmkuhl (1979); 7, Alaskan records reported herein.

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	Siphonuridae
<i>Ameletus validus</i> McDunnough <sup>1</sup>	[ <i>Siphonurus alternatus</i> (Say)] <sup>4</sup>
<i>Ameletus</i> sp. <sup>2,3</sup>	[ <i>Siphonurus occidentalis</i> Eaton] <sup>4</sup>
<i>Parameletus chelifera</i> Bengtsson <sup>4</sup>	<i>Siphonurus</i> sp. <sup>1,2</sup>
<i>Parameletus</i> sp. <sup>1,4</sup>	
	[Metretopodidae]
[ <i>Metretopus borealis</i> Eaton] <sup>2,4</sup>	[ <i>Siphloplecton</i> sp.] <sup>2</sup>
	Baetidae
<i>Acentrella lapponica</i> Bengtsson <sup>4</sup>	<i>Callibaetis</i> sp. <sup>1,2</sup>
<i>Baetis macani</i> Kimmins <sup>4</sup>	<i>Centroptilum</i> sp. <sup>1,2</sup>
[ <i>Baetis propinquus</i> (Walsh)] <sup>2,5</sup>	[ <i>Cloeon</i> sp.] <sup>2,4</sup>
<i>Baetis</i> sp. <sup>2,3</sup>	<i>Pseudocloeon</i> sp. <sup>2,3</sup>
[ <i>Callibaetis</i> cf. <i>coloradensis</i> Banks] <sup>4</sup>	
	Heptageniidae
<i>Cinygma lyriforme</i> (McDunnough) <sup>6,7</sup>	[ <i>Epeorus</i> sp.] <sup>2,3</sup>
<i>Cinygmula par</i> (Eaton) <sup>4</sup>	[ <i>Heptagenia pulla</i> (Clemens)] <sup>4</sup>
<i>Cinygmula subaequalis</i> (Banks) <sup>7</sup>	<i>Heptagenia</i> sp. <sup>2,7</sup>
<i>Cinygmula</i> sp. <sup>1,2,3</sup>	<i>Rhithrogena futilis</i> McDunnough <sup>4</sup>
<i>Epeorus longimanus</i> (Eaton) <sup>1</sup>	<i>Rhithrogena</i> sp. <sup>1,2,4,7</sup>
	Leptophlebiidae
[ <i>Leptophlebia nebulosa</i> (Walker)] <sup>4</sup>	[ <i>Paraleptophlebia moerens</i> (McDunnough)] <sup>4</sup>
[ <i>Leptophlebia</i> sp.] <sup>4</sup>	<i>Paraleptophlebia</i> sp. <sup>1</sup>
	Ephemerellidae
<i>Drunella coloradensis</i> (Dodds) <sup>1</sup>	<i>Ephemerella lacustris</i> Allen & Edmunds <sup>7</sup>
<i>Drunella doddsi</i> (Needham) <sup>1</sup>	[ <i>Ephemerella mucronata</i> (Bengtsson)] <sup>4</sup>
<i>Drunella grandis</i> (McDunnough) <sup>1</sup>	[ <i>Ephemerella</i> sp.] <sup>2</sup>
<i>Ephemerella aurivillii</i> (Bengtsson) <sup>1</sup>	<i>Serratella tibialis</i> (McDunnough) <sup>1,7</sup>
<i>Ephemerella inermis</i> Eaton <sup>1</sup>	<i>Serratella</i> sp. <sup>3</sup>
	[Caenidae]
[ <i>Caenis</i> sp.] <sup>2</sup>	
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and Harper (1981) and Wiens et al. (1975), respectively. The genus (sensu Edmunds et al., 1976), however, has not been known previously from Alaska. Wiens et al. (1975) also reported several other species of *Heptagenia* from the Mackenzie River Watershed, Northwest Territories. These are eastern and south-central North American species with either northwestern disjunctions or continuous patterns via Manitoba (Flannagan and Flannagan, 1982).

#### DISCUSSION

It is generally accepted that Arctic fauna comprises relatively few, widely distributed species (Downes, 1962). Studies of benthic macroinvertebrates (e.g., Brunskill et al., 1973; Slack et al., 1979) indicate that this segment of the Alaskan



fauna concurs with this generalization. The mayfly fauna of Alaska, particularly in regard to those of the Arctic Seaboard as reported here and by Harper and Harper (1981), would also support this generalization. Species in Table 1, even if more than doubled with possible future records, represent only a small fraction of the approximately 700 North American species of Ephemeroptera (McCafferty, 1981). All known Alaskan species have widespread distributional patterns that can be categorized as having either a) relatively continuous distributions in western, northwestern, or north-central North America, b) widespread eastern U.S. distributions with a northern range continuing through Canada to Alaska, or c) largely disjunct patterns between Alaska and either southwestern U.S. or eastern U.S. and southeastern Canada. No endemic mayfly species are known from Alaska.

Much of Alaska and the Yukon was not glaciated and may have been a glacial refugium, whereas the remainder of Canada, except for a few scattered small refugia, was glaciated during maximum Wisconsin glaciation (Matthews, 1979). This may account for the observed disjunctions, and also for the mayfly fauna of this unglaciated area being richer than those at comparable northern latitudes in other regions (Cobb and Flannagan, 1980). The theory that aerial colonization of aquatic insects is limited to highly developed flying species (Edmunds, 1972; Cobb and Flannagan, 1980) and that other, low-vagility species are restricted to aquatic dispersal and thus relatively limited by present-day watersheds (Ide, 1955; Ross et al., 1967; Scudder, 1979; Flannagan and Flannagan, 1982) would possibly explain the faunal mix of continuously distributed and disjunct elements of Alaskan Ephemeroptera.

Downes (1962) noted that most Arctic insect species may be found in both North America and Eurasia, and Munroe (1956) indicated that circumpolar species outnumber all others in the Arctic area. It remains difficult to determine how well the Alaskan mayfly fauna supports these contentions because ephemeropterists generally have not brought together Nearctic and Palearctic materials for comparative studies. Preliminary knowledge, however, indicates a considerable Holarctic fauna in Alaska.

Alaskan species that are presently known to occur in Eurasia include *Parameletus chelififer*, *Acentrella lapponica* (see Müller-Liebenau, 1981), *Baetis macani* (see Morihara and McCafferty, 1979), and *Ephemerella aurivillii*. Lehmkuhl (1979) indicated that *Ecdyonurus peterseni* Lestage from the Arctic Urals is strikingly similar in detail to *Cinygma lyriforme*. It may be that these Palearctic and Nearctic mayflies are conspecific. When Yukon species in Table 1 are also considered, *Siphonurus alternatus*, *Metretopus borealis* and *Ephemerella mucronata* can be included with the Holarctic Alaskan species. All of the above Holarctic species have Eurasian distributions mainly in Scandinavia and Siberia. I expect more Holarctic species will be found in Alaska, and many other Alaskan species to have sister-species cognates in Eurasia.

This short synopsis and zoogeographic analysis should serve as a base for further developing knowledge of this fauna, and I would suggest that particular emphasis be given to comparing upper boreal Eurasian species with the possibility of resolving intercontinental systematic and zoogeographic relationships in the Ephemeroptera. Several other genera and species may be predicted as possible components of the Alaskan fauna simply on the basis of common zoogeographic patterns



and geological history expressed herein. For example, given the Arcto-Tertiary distribution of *Litobrancha* (McCafferty, 1983), ephemeroïd mayflies may be represented in Alaska by this genus.

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