ALASKA ENDEMIC MAYFLY

TAXONOMY

Scientific name: *Rhithrogena ingalik* Randolph and McCafferty, 2005
Common name: Alaska endemic mayfly
Family: Heptageniidae
Taxonomic comments:
Recently described species (Randolph and McCafferty 2005); known only from Birch Creek in the Yukon-Koyukuk region of Alaska. Distinguished from all known North American *Rhithrogena* by the unique shape of the male genitalia (species determination can only be made with adult specimens). Most closely related to Siberian congeners *R. baikovae* (Sowa) and *R. lepnevae* (Brodsky), suggesting allopatric speciation in Alaska (Randolph and McCafferty 2005).

Photo by Peter Maihöfer

DESCRIPTION

Basic description: A mayfly.

General description:
A mayfly with gray-brown head and compound purple eyes (adult stage). Thorax is light or olive brown, forewing with stigma is clouded with white and has no anastomosed veins. Abdomen is light grey with 8-10 gray-brown segments lacking any distinct color patterning. Male subgenital plate with relatively broad, shallow emargination; posterolateral lobes extend posteriorly to a level subequal to level of distal margin of basal forceps segment; penes broadly rounded distally, extending posteriorly beyond base of medially directed spine. Caudal filaments missing from abdomen (Randolph and McCafferty 2005). Larvae are dorso-ventrally flattened to reduce drag in flowing water.
Length (mm): 7.6

Reproduction:
Reproductive information specific to this species is lacking; however, mayflies as a group share similar reproductive habits. During late summer and fall, generally at dusk or dawn, mature adult males form swarms; an individual female enters the swarm where she is seized from below by a male; mating takes place in flight (McCafferty 1998). The female then oviposits fertilized eggs on water surface or under water within an hour. Egg development is highly dependent upon a narrow temperature range for survival, with maximum hatching rates at 15.8 °C and 1.9 - 5.2 °C for two other *Rhithrogena* species (Humpesch and Elliott 1980). Hatching success for *Rhithrogena* is probably low in general (Humpesch and Elliott 1980). At high latitudes, eggs or larvae have seasonal

periods of non-development (McCafferty 1998). Mayflies are unique among insects in having two winged stages: a fully-winged terrestrial stage (known as subimago) precedes the sexually mature adult stage (imago; McCafferty 1998). Most species have one or two generations per year and larval development ranges anywhere from a few weeks to as long as two years (McCafferty 1998).

Ecology:
Mayflies are routinely used for monitoring water quality because their presence and diversity can be valuable indicators of the health of the aquatic environment. They are a vital link in the food web of freshwater ecosystems, as an important food source to many freshwater fish and insects (Essig 1934, Borror and White 1970, Williams and Feltmate 1992, McCafferty 1998). Other predators include birds, spiders, dragonflies, damselflies, and insectivorous biting midges (McCafferty 1998).

Migration:
Many species of mayfly have failed to cross relatively minor physiographic barriers such as small plains; this is thought to be the result of poor dispersal abilities (Williams and Feltmate 1992).

Food:
Mayfly larvae are detritivores and/or herbivores, feeding on algae and organic matter associated with the substrate; adults do not feed (McCafferty 1998).

Habitat:
Mayflies live at the bottoms of unpolluted streams, pools, lakes and rivers (Essig 1934, Williams and Feltmate 1992). Most are limited to small flowing waterbodies and by temperature and pH constraints. *Rhithrogena* spp., in particular, cling to rocks or wood in areas of moderate to fast current (Merritt and Cummins 1996). Reduced abundance and diversity of aquatic insects is often associated with shifting sand and mud, although a few species of mayfly apparently prefer this substrate (Resh and Rosenberg 1984). In Glacier Bay National Park, Alaska, percent contribution of mayflies to benthic stream communities increased significantly with stream age and the amount of coarse benthic organic matter (Milner et al. 2000).

STATUS

Global rank: G1G3 (15Jun2006)
Global rank reasons:
A recently described species; an Alaskan endemic more closely related to Siberian congeners than to other North American species. Only one known occurrence, which is afforded moderate protection in the Steese National Conservation Area (managed by the BLM). Threats include degradation of water quality and habitat as a result of past mining activities and off-road vehicle usage. Although unknown, the effects of climate change on water temperature and level are of potential concern.

State rank: S1S3 (15Jun2006)
State rank reasons:
A recently described species; an Alaskan endemic more closely related to Siberian congeners than to other North American species. Only one known occurrence, which is afforded moderate protection in the Steese National Conservation Area (managed by the BLM). Threats include degradation of water quality and habitat as a result of past mining activities and off-road vehicle usage. Although unknown, the effects of climate change on water temperature and level are of potential concern.

DISTRIBUTION AND ABUNDANCE

State range:
Only known occurrence is at Birch Creek, near the Steese Highway, northcentral Alaska.

State abundance:
Unknown.

State trend:
Unknown.

EXISTING PROTECTION

State protection:
Known distribution falls along the Birch Creek National Wild River (NWR) corridor within the Steese National Conservation Area (NCA) managed by the Bureau of Land Management (BLM). The Steese NCA was designated to protect wildlife habitat (NLCS 2004). Where it is consistent with land use plans for the area, mineral development may be permitted; all mining claims are subject to regulations prescribed by the Secretary of the Interior to assure that mining is consistent with the protection of scenic, scientific, cultural, and other resources in the area. Although off-road vehicle (ORV) use along the Birch Creek NWR is restricted, the BLM does not have enough staff to patrol this region and illegal vehicle use is extensive (NLCS 2004).

CHALLENGES

State challenges:
Although the single known occurrence of *R. ingalik* is afforded protection within the Birch Creek NWR corridor managed by the BLM, water quality and habitat are at risk of degradation due to the lingering effects of past mining activities and contemporary off-road vehicle usage. Although unknown, the effects of climate change on water temperature and level are of potential concern.

Water contamination: Mayflies are highly sensitive to changes in water quality (e.g., contamination by heavy metals, organic pollutants, and changes in pH, sedimentation and turbidity; Gaufin 1973, Milner and Oswood 1989, McCafferty 1998). Environmental degradation is thought to be responsible for the recent extinction of four species of North

American burrowing mayflies (Mayfly Central 2005). Portions of the Steese NCA were heavily mined in the 1970s and 1980s and again in the early 1900s; abandoned equipment, tanks and other waste remain along Birch Creek (Billingsley 2004). The BLM obtained funding from the Abandoned Mine Lands federal program to clean up the remnants of past mining activities; cleanup commenced in 2002. As of 2004, five sites were partially or completely cleaned (Billingsley 2004). The BLM and the Alaska Department of Fish and Game (ADFG) have also worked to realign and stabilize a segment of the Birch Creek channel (BLM 2003). Gold placer mining in interior Alaska during the 1980s had a profound effect on streams; in the Birch Creek area, mined streams have higher levels of turbidity, settleable solids, percent substrate embeddedness, and nonfilterable residue than unmined streams (Wagener 1984). Wagener (1984) found levels of heavy metals (arsenic, lead, zinc, and copper) were higher and benthic invertebrate density and biomass generally lower in mined stream water.

Off-road vehicle use: Off-road vehicle (ORV) use has expanded exponentially in Alaska over the last twenty years, and has the potential to damage stream banks and promote erosion and sedimentation. Although ORV use along the Birch Creek NWR is restricted, the BLM does not have enough staff to patrol this region and illegal vehicle use is extensive (NLCS 2004). Current impacts of ORV usage on *R. ingalik* habitat are unknown, but potentially threatening.

Climate change: Given mayfly sensitivity to water temperature (see Reproduction comments), even slight changes in temperature and water level related to climate change may be of concern (Milner and Oswood 1989).

RESEARCH AND INVENTORY NEEDS

State research needs:
Due to this species' recent discovery, scant information is available. Baseline data are needed on distribution and abundance. Life history and habitat requirements are unknown and need study.

State inventory needs:
Species was described recently from a collection made in 1973; distribution knowledge is incomplete. Surveys are needed to determine the geographic extent of this species within the state.

CONSERVATION AND MANAGEMENT NEEDS

State conservation and management needs:
Due to the extremely limited understanding of distribution, abundance, and life history, it is difficult to assess the conservation and management needs of this species. Continued cleanup of previously mined areas in the Steese NCA is encouraged to improve water quality and general habitat conditions.

LITERATURE CITED

Billingsley, L. 2004. Abandoned mine land cleanups in Interior Alaska. Yukon Government, Department of Energy, Mines, and Resources. Available online at: http://www.emr.gov.yk.ca/mining/northern_latitudes/abstracts/abandoned.htm. Accessed 06July2005.

Borror, D. J. and R. E. White. 1970. A field guide to the insects of America north of Mexico. Houghton Mifflin Company, Boston, MA.

Bureau of Land Management (BLM). 2003. 2003 Public rewards from public lands: Alaska. Available online at: http://www.blm.gov.nhp/pubs/rewards/2003/ak.htm. Accessed 06July2005.

Essig, E. O. 1934. Insects of western North America. MacMillan Company, New York, NY.

Gaufin, A. R. 1973. Water quality requirements of aquatic insects. EPA-660/3-73-004, prepared for the Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C.

Humpesch, U. H. and J. M. Elliott. 1980. Effect of temperature on the hatching time of eggs of three *Rhithrogena* spp. (Ephemeroptera) from Austrian streams and an English stream and river. J. of Animal Ecology 49:643-661.

Mayfly Central. 2005. The mayflies of North America. Available online at: http://www.entm.purdue.edu/entomology/research/mayfly/why.html. Accessed 03August2005.

McCafferty, W. P. 1998. Aquatic entomology. Jones and Bartlett Publishers, Sudbury, MA.

Merritt, R.W. and K.W. Cummins. 1996. An introduction to the aquatic insects of North America, third edition. Kendall/Hunt, Dubuque, IA.

Milner, A. M. and M. W. Oswood. 1989. Macroinvertebrate distribution and water quality in Anchorage streams. Institute of Arctic Biology, University of Alaska, Fairbanks, AK.

Milner, A. M, E. E. Knudsen, C. Soiseth, A. L. Robertson. D. Schell, I. T. Phillips, and K. Magnusson. 2000. Colonization and development of stream communities across a 200-year gradient in Glacier Bay National Park, Alaska, U.S.A. Can. J. Fish. Aquat. Sci. 57:2319-2335.

National Landscape Conservation System (NLCS) Coalition. 2004. Steese National Conservation Area. Available online at: http://www.discovernlcs.org/TheNLCS/ConservationAreas/Steese.cfm. Accessed 06July2005.

Randolph, R. P. and W. P. McCafferty. 2005. The mayflies (Ephemeroptera) of Alaska, including a new species of Heptageniidae. Proc. Entomol. Soc. Wash. 107:190-199.

Resh, V. H. and D. M Rosenberg. 1984. The ecology of aquatic insects. Praeger Scientific, New York, NY.

Wagener, S. M. 1984. Effects of gold placer mining on stream macroinvertebrates of interior Alaska. M.S. thesis. University of Alaska, Fairbanks, AK.

Williams, D. D. and B. W. Feltmate. 1992. Aquatic insects. CAB International, Wallingford, U.K.

Acknowledgements

State Conservation Status, Element Ecology & Life History Author(s): Gotthardt, T.A. and A. Jansen, Alaska Natural Heritage Program, Environment and Natural Resources Institute, University of Alaska Anchorage, 707 A Street, Anchorage, AK, http://aknhp.uaa.alaska.edu.
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Reviewer(s): Dan Rinella, Environment and Natural Resources Institute, University of Alaska Anchorage, Anchorage, AK.

Life history and Global level information were obtained from the on-line database, NatureServe Explorer (www.natureserve.org/explorer). In many cases, life history and Global information were updated for this species account by Alaska Natural Heritage Program zoologist, Tracey Gotthardt. All Global level modifications will be sent to NatureServe to update the on-line version.

NatureServe Conservation Status Factors Edition Date: 12Jul2005

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