U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Lednia tumana

Common Name:

Meltwater Lednian stonefly

Lead region:

Region 6 (Mountain-Prairie Region)

Information current as of:

05/30/2012

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

_X_ Continuing Candidate

___ Candidate Removal

> ___ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status
>
> ___ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species
>
> ___ Range is no longer a U.S. territory
>
> ___ Insufficient information exists on biological vulnerability and threats to support listing
>
> ___ Taxon mistakenly included in past notice of review
>
> ___ Taxon does not meet the definition of "species"
>
> ___ Taxon believed to be extinct
>
> ___ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 07/30/2007

90-Day Positive:08/18/2009

12 Month Positive:04/05/2011

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Yes**

Explanation of why precluded:

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current CNOR (http://endangered.fws.gov/) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: Montana
- **US Counties**: Flathead, MT, Glacier, MT
- **Countries**: Canada

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: Montana
- **US Counties**: Flathead, MT, Glacier, MT
- **Countries**:Country information not available

Land Ownership:

All known occurrences are from 16 streams within the boundary of Glacier National Park managed by the National Park Service.

Lead Region Contact:

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Lead Field Office Contact:

MT ESFO, Shawn Sartorius, 4064495225, shawn_sartorius@fws.gov

Biological Information

Species Description:

The meltwater lednian stonefly is a small insect that begins life as an aquatic nymph and later matures into a winged adult that lives on land. The nymph, or aquatic juvenile stage, of the meltwater lednian stonefly is dark red-brown on its dorsal surface and pink on the ventral surface, with light grey-green legs (Baumann and Stewart 1980, p. 658). Mature nymphs can range in size from 4.5 to 6.5 millimeters (mm) (0.18 to 0.26 in.) (Baumann and Stewart 1980, p. 655). Nymphs mature into the adult terrestrial phase that has wings and body sizes ranging from 4 to 6 mm (0.16 to 0.24 in.) (Baumann 1975, p. 79).

Taxonomy:

The genus *Lednia* belongs to the phylum Arthropoda, class Insecta, order Plecoptera (stoneflies), family Nemouridae, and subfamily Nemourinae (Baumann 1975, p. 19; Stewart and Harper 1996, p. 263; Stark *et al*. 2009, entire). The type specimens (specimens on which the original species description was based) for the meltwater lednian stonefly were collected in the Many Glaciers area of Glacier National Park (NP), Montana (Baumann 1982, pers. comm.). The species was originally described by Ricker in 1952 (Baumann 1975, p. 18) and, our recent review of the available literature indicates that the species is recognized as a valid species by the scientific community (Baumann 1975, p. 18; Baumann *et al*. 1977, pp. 7, 34; Newell *et al.* 2008, p. 181; Stark *et al*. 2009, entire; Baumann and Kondratieff 2010, p. 315). The meltwater lednian stonefly was considered the only member of the Lednia genus (monotypic genus) until 2010 when stonefly specimens discovered in the Sierra Nevada Mountains of California and Mount Rainier and North Cascades National Parks were formally described as two additional species in this genus (Baumann and Kondratieff 2010, entire).

Habitat/Life History:

Plecopterans (stoneflies) are primarily associated with clean, cool, running waters (Stewart and Harper 1996, p. 217). Nemourids are usually the dominant Plecoptera family in mountain-river ecosystems, both in terms of total biomass and in numbers of species present (Baumann 1975, p. 1). Most aquatic invertebrates in stream environments in the northern Rocky Mountains exhibit very strong elevation and therefore temperature gradients in their distribution (Fagre *et al.* 1997, p. 763; Lowe and Hauer 1999, pp. 1637, 1640, 1642; Hauer *et al*. 2007, p. 110), and the meltwater lednian stonefly exhibits a similar distribution pattern. The meltwater lednian stonefly is restricted to short sections of cold, high-elevation alpine streams directly below glaciers, permanent snowfields, and springs (Muhlfeld *et al*. 2011, pp. 341-342). The species is a cold-water stenotherm (capable of surviving within a limited range of temperatures) because of its absence at sites with mean and maximum temperatures exceeding 10 degrees Centigrade (°C) and 18 °C (50 and 64.4 °Fahrenheit (F)), respectively (Muhlfeld 2011 *et al.* 2011, p. 342). Larval densities decrease with increased distance from a cold water source (Muhlfeld 2011 *et al*., p. 342).

Eggs and larvae of all North American species of stoneflies, including the meltwater lednian stonefly, are aquatic (Stewart and Harper 1996, p. 217). Nemourid stonefly larvae are typically herbivores or detritivores, and their feeding mode is generally that of a shredder or collector-gatherer (Baumann 1975, p. 1; Stewart and Harper 1996, pp. 218, 262). There is no information on the longevity of the meltwater lednian stonefly, but in general stoneflies can complete their life cycles within a single year or in 2 to 3 years (Stewart and Harper 1996, pp. 217-218). Meltwater lednian stoneflies are thought to emerge from their aquatic environments in August and September to mature to adulthood and breed (Baumann and Stewart 1980, p. 658; Giersch 2010a,

pers. comm.).

Historical Range/Distribution:

The species was previously reported from the Waterton River system in Alberta, Canada (Donald and Anderson 1977, p. 114). Surveys conducted in Waterton Lakes NP (Canada) during 2007 and 2008 did not detect the species (Langor 2010, pers. comm.), although it is unclear if the proper habitat was surveyed (Johnston 2010, pers. comm.). Within the last 14 years, the meltwater lednian stonefly has been observed in 16 streams or hydrological drainages within the boundaries of Glacier NP, Montana (Muhlfeld et al. 2011, p. 341).

Current Range Distribution:

The current known distribution and range of the meltwater lednian stonefly is restricted to 16 streams or hydrological drainages just to the east and west of the Continental Divide within Glacier NP (Newell *et al*. 2008, p. 181; National Park Service (NPS) 2009, entire; Muhlfeld *et al*. 2011, p. 341) (Figure 1; Table 1). Occurrences range in elevation from 1,610 to 2,332 meters (m)(5,282 to 7,651 feet (ft)) (Muhlfeld *et al*. 2011, p. 341). Occurrences occupy short stream segments 507 ± 245 m (1,663 ± 804 ft) with 86 percent of occurrences found within 408 ± 305 m (1,339 ± 1,000 ft) of a glacier or permanent snowfield (Muhlfeld *et al*. 2011, p. 341). Fourteen percent of occurrences were found immediately below alpine springs (Muhlfeld *et al*. 2011, p. 341).

Figure 1. Range of meltwater lednian stonefly (Lednia tumana)

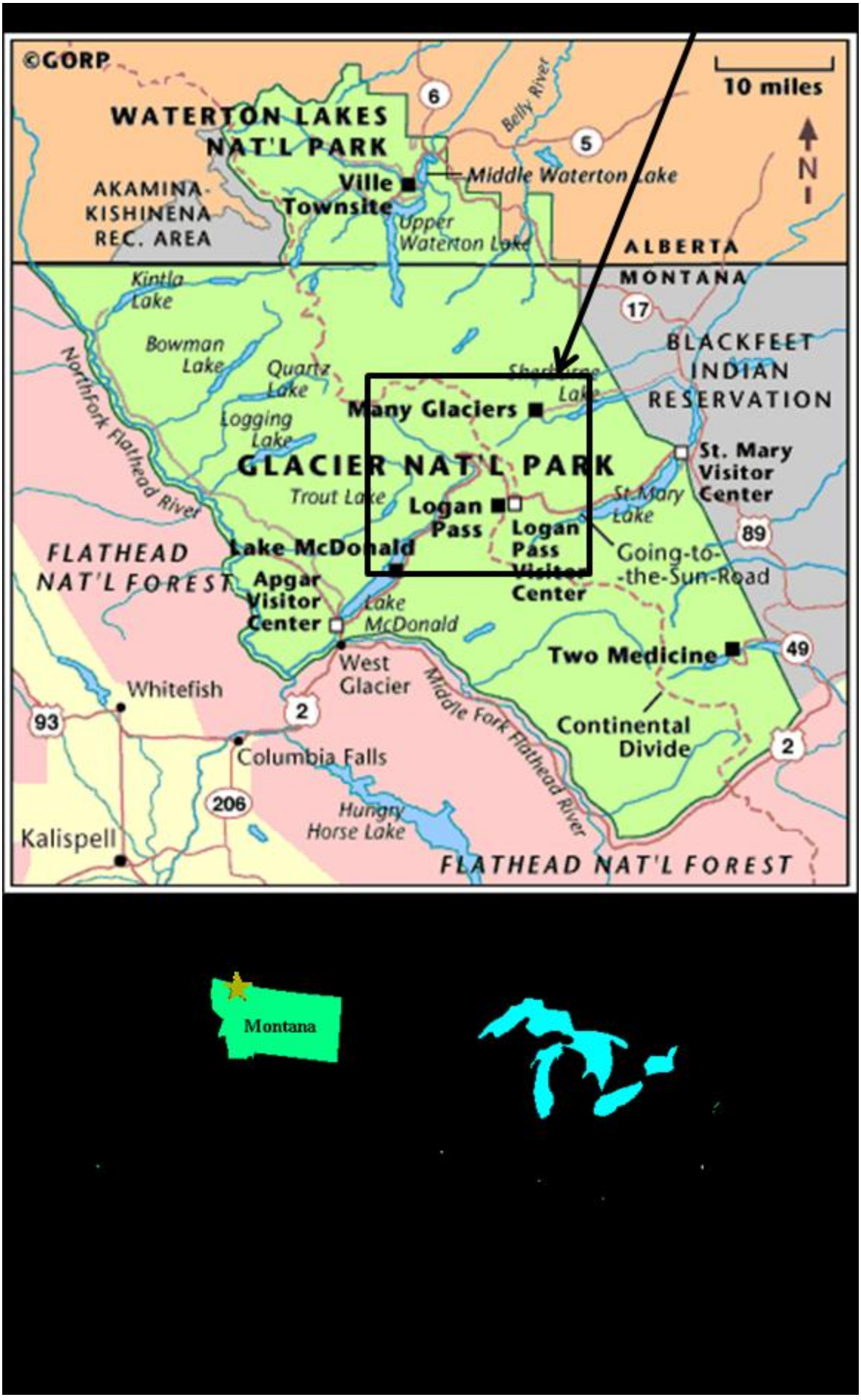
©GORP
10 miles
N
WATERTON LAKES NAT'L PARK
AKAMINA-KISHINENA REC. AREA
Ville Townsite
Middle Waterton Lake
Upper Waterton Lake
Belly River
ALBERTA
MONTANA
Kintla Lake
Bowman Lake
Quartz Lake
Logging Lake
NorthFork Flathead River
Many Glaciers
GLACIER NAT'L PARK
Trout Lake
Logan Pass
Logan Pass Visitor Center
Going-to-the-Sun-Road
St. Mary Visitor Center
St. Mary Lake
BLACKFEET INDIAN RESERVATION
FLATHEAD NAT'L FOREST
Lake McDonald
Apgar Visitor Center
Lake McDonald
West Glacier
Whitefish
Columbia Falls
Kalispell
Hungry Horse Lake
Middle Fork Flathead River
Two Medicine
Continental Divide
FLATHEAD NAT'L FOREST
6
5
17
89
49
2
93
206
Montana

Table 1. Documented occurrence of meltwater lednian stonefly (*Lednia tumana*) from 1997 to 2010 in Glacier National Park, Montana from Muhlfeld *et al.* 2011		
Stream or drainage	**Date**	**Elevation (meters/feet)**
East of the Continental Divide (Glacier County, Montana)		
Baring	7/7/1998	2,250/7,382
	9/13/2010	1,770/5,807
	9/13/2010	1,807/5,929
	9/13/2010	1,821/5,974
	9/13/2010	1,824/5,984
	9/13/2010	1,842/6,043
Bullhead	8/5/2000	1,610/5,282
Cataract	9/11/2010	2,222/7,290
Clements	10/6/1998	2,168/7,113
	7/15/1998	2,043/6,703
Cracker	8/23/2000	1,891/6,204
Gunsight	7/19/1997	2,055/6,742
Lunch	8/27/2010	2,189/7,182
	8/27/2010	2,016/6,614
	8/27/2010	2,097/6,880
	8/27/2010	2,284/7,493
Preston Park	8/14/2005	2,234/7,329
Reynolds	10/16/1997	2,200/7,218
	8/6/2000	2,332/7,651
	9/18/1997	2,166/7,106
	7/13/1998	2,113/6,932
	7/29/1998	2,074/6,805
Siyeh	8/25/2010	1,870/6,135
	9/11/2010	1,948/6,391
	9/11/2010	1,968/6,457
Tunnel	10/6/2010	1,825/5,988
West of the Continental Divide (Flathead County, Montana)		
Ahern	8/12/1997	2,038/6,686
Hidden	7/28/1998	2,165/7,103
	8/21/2010	2,025/6,644
	9/7/2010	2,139/7,018
	9/7/2010	2,147/7,044
Logan	9/29/1998	2,051/6,729
	09/29/1998	2,116/6,942
McDonald	9/3/2010	1,962/6,437
Mineral	8/8/1997	2,009/6,591

Population Estimates/Status:

The meltwater lednian stonefly can attain moderate to high abundance in certain locations (e.g., Logan Creek: NPS 2009); however, a more thorough understanding of the species' distribution and abundance is needed. The best available survey information indicates that the meltwater lednian stonefly is a narrow endemic found only in Glacier NP.

Distinct Population Segment(DPS):

Not applicable.

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Climate Change

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Significant trends in water temperature and stream flow have been observed in the western United States (Stewart *et al*. 2005, entire; Kaushal *et al*. 2010, entire), and increased air temperatures and changes in precipitation are partially responsible. During the past 50 to 100 years in the western United States, the timing of runoff from snowmelt has shifted to occur 1 to 4 weeks earlier (Regonda *et al*. 2005, p. 380; Stewart *et al*. 2005, pp. 1136, 1141; Hamlet *et al*. 2007, p. 1468), presumably as a result of increased temperatures (Hamlet *et al.* 2007, p. 1468), increased frequency of melting (Mote *et al*. 2005, p. 45), and decreased snowpack (Mote *et al*. 2005, p. 41). Trends in decreased water availability also are apparent across the Pacific Northwest (Luce and Holden 2009, entire). The western United States appears to be warming faster than the global average. In the Pacific Northwest, regionally averaged temperatures have risen 0.8 °C (1.5 °F) over the past century and as much as 2 °C (4 °F) in some areas. Since 1900, the mean annual air temperature for Glacier NP and the surrounding region has increased 1.33 °C (2.39 °F), which is 1.8 times the global mean increase (U.S. Geological Survey (USGS) 2010, p. 1). Mean annual air temperatures are projected to increase by another 1.5 to 5.5 °C (3 to 10 °F) over the next 100 years (Karl *et al.* 2009, p. 135). Warming also appears to be pronounced in alpine regions globally (e.g., Hall and Fagre 2003, p. 134 and references therein).

The effects of projected climate change are considered the most significant threats to the suitability and persistence of habitat for the meltwater lednian stonefly. The environmental changes resulting from climate change may affect the meltwater lednian stonefly through two primary mechanisms: (1) Loss of glaciers and

(2) changes in hydrology and increased water temperatures. Anticipated environmental changes were considered for the next 40-year period (to approximately 2050) based on the consistent agreement of various climate change models and emissions scenarios within that timeframe (Ray *et al*. 2010, p. 11).

Loss of Glaciers and Permanent Snowfields

Environmental changes resulting from climate change are assumed to be directly related to the documented loss of glaciers in Glacier NP (e.g. Hall and Fagre 2003, entire; Fagre 2005, entire). Glacier NP contained approximately 150 glaciers larger than 0.1 square kilometer (25 acres) in size when established in 1910, but presently only 25 glaciers larger than 0.1 square kilometer (25 acres) remain (Fagre 2005, pp. 1–3; USGS 2010, entire). Between 1966 and 2006, the 25 largest glaciers in Glacier NP shrank by an average of 26.4 percent, whereas smaller glaciers shrank at a quicker rate of 59.7 percent (USGS 2010, entire). Shrinking rates also vary by topography (e.g., Key *et al*. 2002, p. J370; Hall and Fagre 2003, p. 136). However, given the relative rate of shrinkage observed in smaller glaciers, nearly all glaciers should be gone from Glacier NP by 2030 (USGS 2010, entire; Hall and Fagre 2003, p. 138).

The consequences of glacier shrinking, i.e. loss of permanent snowfields and loss to aquatic systems inhabited by the meltwater lednian stonefly, are expected to be significant (e.g., Fagre 2005, p. 8). Glaciers and permanent snowfields act as water banks, whose continual melt helps regulate stream water temperatures and maintain streamflows during late summer or drought periods (Hauer *et al*. 2007, p. 107; USGS 2010, entire). Loss of these sources and may lead to direct dewatering of headwater stream reaches, thus desiccating habitats currently occupied by the meltwater lednian stonefly in close proximity to glaciers and permanent snowfields (Baumann and Stewart 1980, p. 658; Muhlfeld *et al*. 2011, p. 341). Permanent desiccation from loss of glaciers is expected to result directly in the loss of suitable habitat for the species and the extirpation of populations that are directly dependent on surface runoff from melting glaciers. The loss of glaciers and permanent snowfields may reduce the species' range by 80 percent (Muhlfeld *et al*. 2011, p. 343) with the remainder living in small reaches of cold water not fed by glaciers.

In some cases, streams could change from perennial (always flowing) to ephemeral (only flowing seasonally) as glaciers disappear (Hauer *et al*. 1997, p. 909). The meltwater lednian stonefly is adapted to reproduce in a narrow ecological window of terrestrial emergence and reproduction in August and September. If the stream only flows seasonally, the species may still be able to complete its lifecycle if the nymph stage can withstand seasonal stream drying. However, at this time it is not known whether the meltwater lednian stonefly can complete its lifecycle in one year or more. Therefore, we consider the change from perennial to ephemeral flow to be a loss of habitat for this species.

Loss of glaciers also may indirectly affect alpine streams by changing the riparian vegetation and nutrient cycling in stream ecosystems. For example, the reduced snowpacks that lead to glacier recession are predicted to allow high elevation trees to become established above the current treeline and in subalpine meadows, and thus to reduce the diversity of herbaceous plants (Hall and Fagre 2003, pp. 138–139). Changes in riparian vegetation (such as a shift from deciduous to coniferous vegetation) may affect nutrient cycling in headwater streams and the quality of food resources available to herbivorous aquatic insects (e.g., Hisabae *et al*. 2010, pp. 5–7) such as the meltwater lednian stonefly and other aquatic macroinvertebrates.

Changes to Streamflow and Water Temperature

Reduced water volume of snowmelt runoff from glaciers (Fagre 2005, p. 7), combined with earlier runoff (Fagre 2005, p. 1) and increases in ambient temperatures expected under climate change (Karl *et al*. 2009, p. 135), may result in water temperatures above the physiological limits for survival or optimal growth for the meltwater lednian stonefly. Given the strong temperature gradients that influence the distribution of aquatic invertebrates (Fagre *et al.* 1997, p. 763; Lowe and Hauer 1999, pp. 1637, 1640, 1642; Hauer *et al*. 2007, p. 110) and the restricted distribution of the meltwater lednian stonefly to short sections of cold, high-elevation alpine streams (Muhlfeld *et al*. 2011, pp. 341-342), it is expected that there will be major changes in

invertebrate communities with projected climate change scenarios. Species that currently occupy more downstream reaches may shift their distribution to higher elevations to track changing thermal regimes (Fagre 2005, p. 7). Displacement or extirpation or both could occur of stenothermic species that occupy headwater stream reaches (such as the meltwater lednian stonefly) due to thermal conditions that become unsuitable, encroaching aquatic invertebrate species that may be superior competitors, or changed thermal conditions that favor the encroaching species in competitive interactions between species. Consequently, the changes in timing and volume of streamflow coupled with increased summer water temperatures will likely reduce the extent of suitable habitat and result in the extirpation of some meltwater lednian stonefly populations.

Fourteen percent of known meltwater lednian stonefly occurrences were found immediately below alpine springs (Muhlfeld *et al.* 2011, p. 341). Effects on populations found in spring habitats may lag behind those found in stream habitats directly associated with melting glaciers or snowfields. Chemical, hydrological and thermal conditions of both habitat types are ultimately influenced by melting snow and ice, but conditions in spring habitats are more stable (e.g., Hauer *et al.* 2007, p. 107; Giersch 2010b, pers. comm.) and should change more slowly because their groundwater sources are storing water from melted snow and ice. Although potentially less susceptible to streamflow and water temperature changes associated with climate change, spring habitats for the meltwater lednian stonefly may ultimately dry as their groundwater sources are depleted and not replenished by glacial meltwater.

In summary, we expect environmental changes resulting from climate change to affect the meltwater lednian stonefly through loss of glaciers, which can lead to the permanent or seasonal drying of currently occupied habitats, and through interrelated alterations to existing hydrologic and thermal regimes, which will reduce the extent of habitat suitable for this species because it has very specific thermal requirements (i.e., it is a cold-water obligate). Environmental changes resulting from climate change are ongoing based on the documented shrinking of glaciers in Glacier NP, and are expected to continue in the foreseeable future in Glacier NP (e.g., Fagre and Hall 2003, entire) and across western North America (USGS 2010, p.1; Karl *et al* . 2009, p. 135).

Consequently, we conclude that the threat of current and future environmental changes resulting from climate change occurs over the entire range of the species. This threat has likely reduced the amount of suitable habitat for the meltwater lednian stonefly, based on the documented extent of glacial melting. However, data on the species is sparse and limited to a handful of observations (e.g., see Table 1 above). Thus, we have no empirical basis for evaluating whether there are any trends in the occurrence or abundance of the species, nor can we speak to whether environmental changes resulting from climate change have actually affected populations. We reason that future environmental changes resulting from climate change will likely result in the extirpation of populations of the meltwater lednian stonefly because of stream drying and increased water temperatures, and that there will be substantial reductions in the amount of suitable habitat for the species relative to its current range. Effects on populations found in spring habitats may lag behind those found in stream habitats directly associated with melting glaciers or snowfields due to the potential for some persistence of cold water flows in these streams. Chemical, hydrologic, and thermal conditions of both habitat types are ultimately influenced by melting snow and ice, but conditions in spring habitats are more stable (e.g., Hauer *et al*. 2007, p. 107; Giersch 2010c, pers. comm.) and should change more slowly because their groundwater sources are storing water from melted snow and ice. Ultimately, spring habitats might also dry as their groundwater sources are depleted, and not replenished by glacial meltwater. The impacts of environmental changes resulting from climate change will likely continue within the foreseeable future (40 years). Due to the magnitude and extent of the effects of the environmental changes resulting from climate change, we conclude that the environmental changes resulting from climate change constitute a significant threat to the meltwater lednian stonefly in the foreseeable future.

Infrastructure Maintenance and Improvement

The relatively pristine landscape within Glacier NP is managed to protect natural and cultural resources.

However, the Park does include a number of human-built facilities and structures and numerous visitor centers, trailheads, overlooks, and lodges (NPS 2003, pp. S3, 11). Maintenance and improvement of these facilities and structures could lead to disturbance of the natural environment; however, most documented occurrences of meltwater lednian stonefly are in remote locations upstream from human-built structures.

The Going-to-the-Sun Road improvement is one major project initiated in 2003 and is ongoing in 2012 (NPS 2003, entire; Federal Highway Administration 2012, entire). This road parallels or bisects numerous streams in Glacier NP from which the meltwater lednian stonefly has been documented including McDonald, Logan, Lunch, Siyeh, and Baring Creeks (NPS 2003, p. 134; Muhlfeld *et al*. 2011, p. 341). However, the collection sites for the meltwater lednian stonefly in streams adjacent to or bisected by the road are all upstream from the road, and any disturbance to aquatic habitat from construction would occur in the immediate vicinity of the construction and downstream (i.e. sedimentation). Therefore, the road construction and maintenance does not constitute a threat to the species.

Glacier National Park Visitor Impacts

The impacts to the meltwater lednian stonefly and its habitat from public visitation in Glacier NP do not and are not foreseen to constitute a threat to the species. From 2000 to 2011, Glacier NP averaged more than 1.9 million visitors annually (NPS 2012, entire). Some collection sites for the meltwater lednian stonefly (e.g., Logan and Reynolds Creeks) are near visitor centers or adjacent to popular hiking trails. The occupied sites most accessible to visitors are in Logan Creek near the Logan Pass Visitor Center and the Going-to-the-Sun Road. These occupied sites are closed to public use and entry to protect resident vegetation (NPS 2010, pp. J5, J24; NPS 2011). Human activity (wading) in streams by anglers or hikers could disturb stonefly habitat. However, it is unlikely that many Glacier NP visitors would actually wade in stream habitats where the species has been collected because the sites are small and difficult to access due to high-elevation and rugged terrain. Most sites would not be suitable for angling. In addition, the sites are typically snow covered except for a few months of the year (Giersch 2010c, pers. comm.). Therefore, we do not find that visitor impacts are a threat to this species.

Summary of Factor A:

Climate change, and the associated effects of glacier loss, reduced streamflows, and increased water temperatures, is expected to significantly reduce the occurrence of populations and extent of suitable habitat for the meltwater lednian stonefly in Glacier NP in the foreseeable future. Nearly all known recent occurrences of the meltwater lednian stonefly are in close proximity to glaciers that are projected to disappear during the next 20 years. Consequently, we expect that the environmental changes resulting from climate change will significantly alter the habitat of all extant populations of the meltwater lednian stonefly, and we conclude that the loss of glaciers represents a high-intensity threat (i.e., one that results in dramatic changes to the species' habitat and distribution) and that this threat is, and will continue to be, large in scope (most, if not all, known populations will be affected) now and into the foreseeable future. The significant reduction in glacier size observed during the past 40 years is evidence that the environmental changes resulting from climate change also may represent a current threat to this species, but we do not have any information on trends in the occurrence of meltwater lednian stonefly populations or changes in densities of specific populations to confirm this. In addition, we anticipate that effects of the environmental changes resulting from climate change on the species will become more pronounced, or that they will accelerate in the foreseeable future, as glaciers melt and eventually disappear in Glacier NP. In conclusion, we find that the meltwater lednian stonefly is likely to become in danger of extinction in the foreseeable future because of the environmental changes resulting from climate change.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

There are no known threats to the meltwater lednian stonefly from overutilization or collection at this time. Specimens are occasionally collected for scientific purposes to determine its distribution and abundance (e.g.,

Baumann and Stewart 1980, pp. 655, 658; NPS 2009, entire); however, the species is observed to be relatively abundant in preferred habitats (NPS 2009, entire; Giersch 2010b, pers. comm.). We have no information that suggests that collections have or will result in population-level effects to the species. Therefore, we do not consider overutilization for commercial, recreational, scientific, or educational purposes to be a threat to the meltwater lednian stonefly.

C. Disease or predation:

There is currently no scientific evidence to indicate that the meltwater lednian stonefly is affected by any diseases or that predation constitutes an abnormal predator-prey interaction likely to have adverse population-wide affects. The nymph and adult meltwater lednian stoneflies may occasionally be subject to predation by bird species such as the American dipper (*Cinclus mexicanus*). The American dipper prefers to feed on aquatic invertebrates in fast-moving, clear, alpine streams, and the species is native to Glacier NP (Montana Natural Heritage Program 2012, entire). Predation by the American dipper on the meltwater lednian stonefly would represent a natural ecological interaction. There is no evidence to the extent of such predation, if it occurs, or that it represents any population-level threat to the meltwater lednian stonefly. Therefore, we do not find disease or predation to be threats to the meltwater lednian stonefly.

D. The inadequacy of existing regulatory mechanisms:

As discussed under Factor A, habitat loss and modification resulting from the environmental changes due to climate change constitute the primary threat to the species. The United States is only beginning to address global climate change through the regulatory process (e.g., Clean Air Act (42 U.S.C. 7401)). There is no information at this time on what regulations may eventually be adopted, and when implemented, if they would address the changes in meltwater lednian stonefly habitat likely to occur in the foreseeable future. Therefore, the existing regulatory mechanisms are not adequate to address the threat of habitat loss and modification resulting from the environmental changes due to climate change.

However, at a local or regional level we have no evidence that regulatory mechanisms are inadequate to protect the species or its habitat. The existing regulatory mechanisms affecting the meltwater lednian stonefly, especially the National Park Service Organic Act (16 U.S.C. 1), appear to adequately protect the relatively pristine nature of Glacier NP and high-alpine streams inhabited by the species. Therefore, it is expected that the meltwater lednian stonefly habitat in Glacier NP will be generally protected from direct human disturbance.

E. Other natural or manmade factors affecting its continued existence:

The meltwater lednian stonefly is considered to be a narrow endemic found only within Glacier NP. The species' restricted range makes it vulnerable to extirpation by localized disturbances or environmental conditions, such as fire, flood, and drought. The species' restricted range does not constitute a threat in itself, especially as it occupies habitats that are generally considered pristine and should be comparatively resistant and resilient to disturbance compared to more intensively managed landscapes. However, the restricted range in concert with the threat of habitat loss and modification resulting from the environmental changes due to climate change is expected to increase the vulnerability of the species and is a threat in concert with climate change.

Conservation Measures Planned or Implemented :

No conservation measures are being implemented or planned specifically for the meltwater lednian stonefly. The entire known range of the species is within Glacier NP. The habitats occupied by the species remain relatively pristine and are managed to be generally free from direct human impacts.

The U.S. Geological Survey (Northern Rocky Mountain Science Center), National Park Service (Glacier National Park fisheries), and U.S. Forest Service (Flathead National Forest fisheries) were requested to provide information for this review because of their current research efforts, management responsibility or management of lands in proximity to known meltwater stonefly habitat. Information from a collaborative paper (Muhlfeld *et al*. 2011) produced by the USGS, University of Montana, National Park Service and U.S. Fish and Wildlife Service regarding the meltwater lednian stonefly was incorporated into this candidate assessment.

Summary of Threats :

The meltwater lednian stonefly is a narrowly distributed endemic insect presently known to occur in a small number of cold, snowmelt- or glacier-fed, high-alpine streams in Glacier NP, Montana. As discussed under Factor A, the melting of glaciers in Glacier NP is considered a threat to the species, now and within the next 40 years as projected through various global climate models and greenhouse emissions scenarios. The loss of glaciers and permanent snowpack is expected to alter the thermal and hydrologic regimes of high-alpine streams occupied by the species. Higher water temperatures, seasonal or permanent stream dewatering, and changes in the timing and volume of snowmelt may change the existing habitat such that it no longer satisfies the ecological and physiological requirements of the species. Although the existing regulatory mechanisms provide adequate protection for the species and its habitat from direct destruction or modification resulting from most human activities, they do not address the primary threat to the species, which is habitat loss and modification resulting from environmental changes caused by global climate change. The restricted range of the species, while not a threat by itself, is expected to interact with the threat of habitat loss and modification to increase the vulnerability of the species to climate change effects.

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

The entire known range of the species is within Glacier NP. Conservation measures include continued management of these habitats occupied by the species to remain relatively pristine and generally free from direct human impacts.

Continued monitoring and documentation of habitat needs, environmental tolerances and changes in its habitat are needed to evaluate the status, population trends, and vulnerability of the meltwater lednian stonefly.

Priority Table

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	**5**
		Subspecies/Population	6
Moderate to Low	Imminent	Monotype genus	7
		Species	8
		Subspecies/Population	9
	Non-Imminent	Monotype genus	10
		Species	11
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

Not applicable.

Magnitude:

The threats that the meltwater lednian stonefly faces from melting glaciers and other environmental changes that result from climate change are high magnitude because of the recent observations of glacial shrinking and loss in Glacier NP and the projections that all glaciers in Glacier NP may disappear in the next 20 years. All known populations of the meltwater lednian stonefly may be affected by these changes.

Imminence :

The threats as described for this species are non-imminent. Because of its apparent dependence on cold water sources such as glacier meltwater, the meltwater lednian stonefly is intrinsically vulnerable to threats from the environmental changes resulting from climate change. However, we do not have sufficient empirical information on the species to evaluate whether there are any trends in occurrence or abundance nor is there information about the species' response to climate-induced changes. Environmental changes resulting from climate change are reasonably certain to occur, but we have no empirical evidence that the resulting threats to the species are imminent, or ongoing.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

Emergency listing is not warranted at this time because the species is not under immediate threat of extinction. Glaciers still exist in Glacier NP and are expected to be present through the next decade. However, if at any time we determine that issuing an emergency regulation temporarily listing the meltwater lednian stonefly is warranted, we will initiate the action at that time.

Description of Monitoring:

Glacier mass changes are being monitored annually or every 2- to 3- year period depending on glacier size. Glacial outflow steams, including streams occupied by the meltwater lednian stonefly, are monitored throughout the melt season and compared to streams from non-glaciated basins to assess hydrological changes, including temperature variation, associated with glacier melt (USGS 2011, entire).

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

none

Indicate which State(s) did not provide any information or comment:

Montana

State Coordination:

There are no records to indicate that the meltwater lednian stonefly is found anywhere but Federal lands managed by the National Park Service. Cooperation was requested from the Montana Natural Heritage Program (Montana State University System) because of their support and documentation of native species and habitats including native aquatic invertebrates. However, no additional substantive information or comments were provided for this assessment from the requested cooperators. We will continue to seek information and coordinate with our State partners.

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Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:  05/31/2012
Date

Concur: 11/06/2012
Date

Did not concur: _____ _____
Date

Director's Remarks: