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Prepared for:
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Introduction

The Roaring Brook Mayfly (*Epeorus frisoni*) is a rare stream species that appears to be restricted to high elevation streams within the northern Appalachian Mountain Range. It is currently listed as a threatened species under the Maine Endangered Species Act (MESA). *E. frisoni* has only been collected in cold, high elevation streams that remain watered during the summer, although water levels may be low.

E. frisoni was first collected from Roaring Brook on Mt. Katahdin in 1939 and has since been found in the mountains of western and central Maine, the White Mountains of New Hampshire, and Vermont.

Tetra Tech Inc. contracted with Lotic Inc. to conduct *E. frisoni* surveys at the Big Squaw Mountain ski are in Greenville Junction, Maine. Seven streams within the survey area met the criteria for E. frisoni habitat and were included in the survey effort. *Epeorus* nymphs were collected at two sites. A single nymph at site C1 could not be accurately identified below the genus level, and of the 12 nymphs collected at site G1 none could be positively identified as *E. frisoni*.

Epeorus frisoni nymph. Photo from Swartz, 2020.

Survey Methods and Location

The Maine Department of Inland Fisheries and Wildlife (MDIFW) developed a detailed survey protocol for *E. frisoni*, which outlines site selection, collection techniques and data analysis. Sampling was conducted September 27-30, 2021. Seven stream reaches were identified in the development area with suitable *E. frisoni* habitat, which consists of areas of moderate to fast flow between pools, substrate of cobble and boulder with a minimum of silt and woody debris, and dense canopy cover. Representative habitat photos are shown in Figures 2-8. Between 1 and 6 sampling locations were selected for each reach, depending on the presence of suitable habitat. A one-meter square kick sample was collected at each location, and an additional 4 kick samples, 2 upstream and 2 downstream of the initial location, were collected at intervals of at least 50 feet. Streams were explored from an elevation of 1200' up to the elevation where habitat was no longer suitable for Epeorus, which varied from 1291' to 1836'. Samples were collected by placing a 30cm D-frame net against the stream substrate, and gently cleaning the upstream rocks and cobble by hand to dislodge clinging organisms. Approximately 1 square meter of substrate was included in each sample. Sample material was transferred to a white plastic pan and examined for the presence of *Epeorus*. Leaf pack material was included in the sample. Any *Epeorus* found were transferred to a vial with 95% alcohol. *Epeorus* specimens were sent to Dr. Steven Burian for identification to species. The sample locations are shown in Figure 1. Sample location data is shown in Table 1. The collected stream reaches were largely free of road crossings or culverts, with the exception of G1, which is below a dam and pump house.

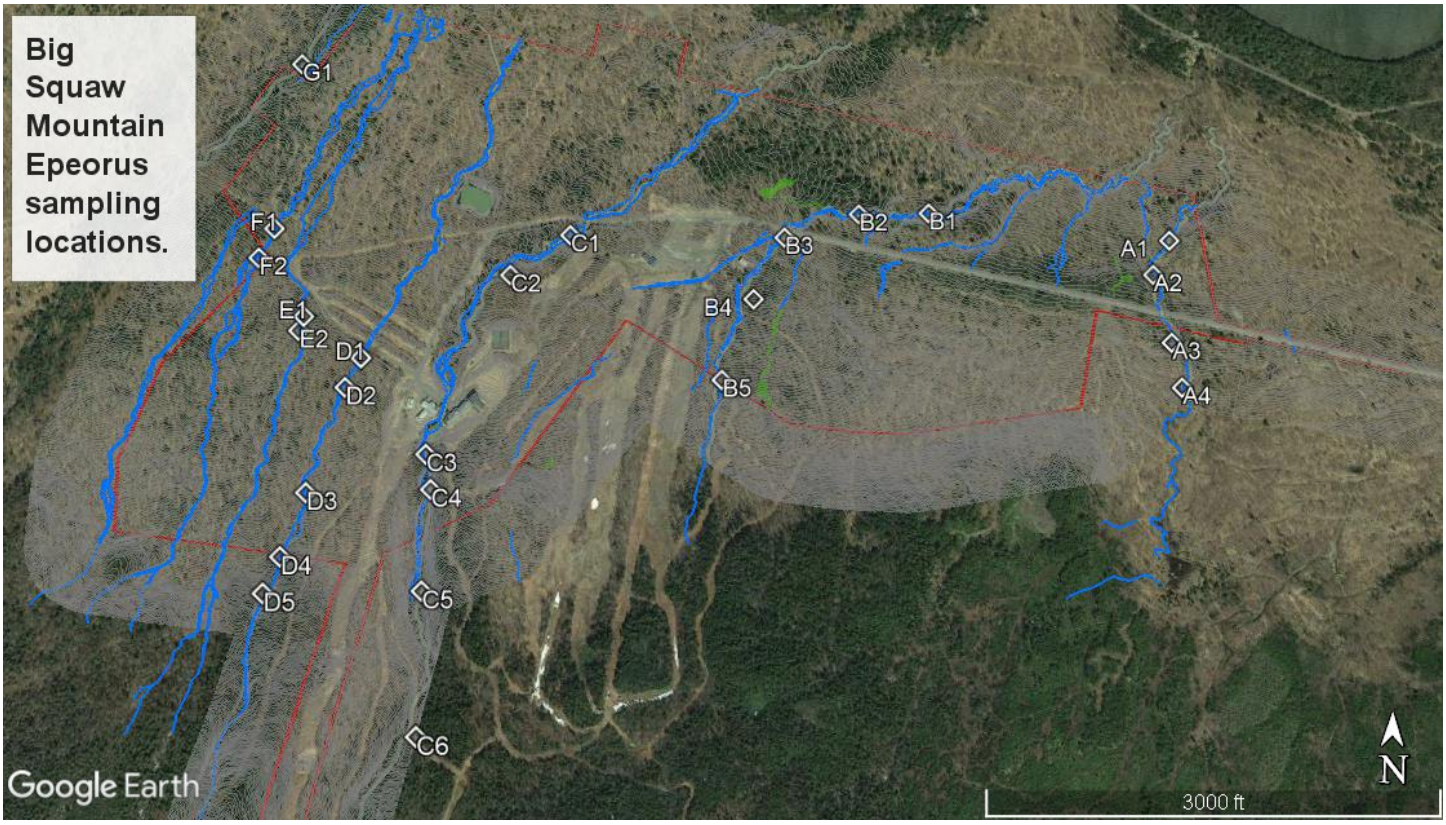

Figure 1. Big Squaw Mountain sample locations. *Epeorus* nymphs were collected at C4 and G1.

Table 1. Sample location data.

Lotic Sample Location	Tetra Tech Reach Designation	Latitude	Longitude	Elevation (ft.)	Total Reach Length (ft.)
A1	S-MR-3	45.507349	-69.688483	1212	1117
A2	S-MR-3	45.506700	-69.688934	1231	
A3	S-MR-3	45.505454	-69.688494	1265	
A4	S-MR-3	45.504637	-69.688269	1291	
B1	S-MR-5	45.507745	-69.694797	1229	2267
B2	S-SK-16	45.507686	-69.696629	1241	
B3	S-SK-16	45.507208	-69.698561	1272	
B4	S-SK-16	45.506049	-69.699331	1334	
B5	S-SK-16	45.504563	-69.700099	1412	
C1	S-SK-6	45.507131	-69.704084	1343	3571
C2	S-SK-6	45.506356	-69.705556	1392	
C3	S-SK-6	45.503118	-69.107414	1540	
C4	S-SK-6	45.50251	-69.707231	1581	
C5	S-SK-6	45.500785	-69.707281	1657	
C6	S-SK-6	45.498434	-69.707123	1836	

Table 1 cont.

Lotic Sample Location	Tetra Tech Reach Designation	Latitude	Longitude	Elevation (ft.)	Total Reach Length (ft.)
D1	N/A	45.50479	-69.7092	1491	1685
D2	N/A	45.50426	-69.7095	1520	
D3	N/A	45.50241	-69.7103	1622	
D4	N/A	45.50132	-69.7107	1710	
D5	N/A	45.50071	-69.711	1789	
E1	N/A	45.5055	-69.7107	1481	151
E2	N/A	45.50524	-69.7108	1501	
F1	N/A	45.50708	-69.7116	1438	248
F2	N/A	45.50653	-69.7119	1460	
G1	N/A	45.51016	-69.7112	1342	103

Figure 2. Site A1, upstream view.

Figure 3. Site B1, upstream view.

Figure 4. Site C4, upstream view.

Figure 5. Site D2, downstream view.

Figure 7. Site F2, downstream view.

Figure 8. Site G1, upstream view. This location is below the dam and pumphouse.

Survey results

Epeorus nymphs were found at 2 sample locations and were sent to Dr. Steven Burian for identification. One nymph was collected at C4 and could not be identified below the level of genus.

Twelve nymphs were collected at location G1. Six nymphs were early instars and could not be identified below the level of genus. Five nymphs were identified as a spring emerging species based on wing pad development. *E. frisoni* is a fall emerging species, so it was determined that these nymphs were possible *E. pleuralis*, but not likely *E. frisoni*.

The twelfth specimen was a female with well developed wing pads. Based on comparison with female nymphs of both species it was determined that it was more likely *E. fragilis* than *E. frisoni*.

During the course of the survey, observations were made of other species of macroinvertebrates. The presence of several species of Ephemeroptera, Plecoptera and Trichoptera indicate that these communities are typical of clean mountain stream habitats. Site G1 has a much higher community richness and abundance due to the presence of the pump house dam and impoundment, which is increasing nutrient levels downstream.

NORTHEAST EPHEMEROPTERA LABORATORY

Dr. Steven K Burian, 9 Molsick Rd., Seymour, Connecticut, USA 06483 203-888-2138

January 17, 2022

Beth I. Swartz, Wildlife Biologist
Reptile, Amphibian, and Invertebrate Group
Maine Department of Inland Fisheries and Wildlife
106 Hogan Rd., Suite 1
Bangor, ME 04401

Re: Final Report on *Epeorus* specimens as part of **Big Moose Ski Resort Expansion.**

Dear Beth,

Please accept this as my final report concerning the 2 vials of *Epeorus* specimens recently collected from the sites listed below from western Maine. Determinations were made using a combination of published diagnostic characters (Burian et al. 2008) for nymphs; comparison with nymphal exuviae from reared adults of *E. frisoni*;, nymphs of *E. frisoni* collected during past surveys, and nymphs of *E. fragilis* collected from sites where *E. frisoni* were found as well as other areas in western Maine.

1 Vial – Greenville Junct., upstream of condos, 27 – IX – 2021, **1** nymph [**det.** = ***Epeorus* sp**.]

1 Vial – Greenville Junct., below pump house, 29 – IX – 2021, **12** nymphs

6 nymphs – Early instars [**det**. = ***Epeorus* sp**.]

5 nymphs – Slightly larger (later) instars [**det.** = ***Epeorus* sp**. Based on wing pad development these specimens would not likely have been able to complete development and emerge before winter – hence most likely a spring emerging species, possibly *E. pleuralis*, but not likely *E. frisoni*]

1 nymph – Black wing pad female, [**det.** = ***Epeorus* cf. *fragilis*** A better fit to *E. fragilis* than *E. frisoni* based on comparison with female nymphs of both species, but as noted below female nymphs are more difficult to positively determine]

[Abbreviations of "cf" are considered tentative qualifiers, but specimens compare closely with the concept of the species listed.]

Specimens noted above that were listed as tentative determinations either need to be more well-developed **or** need to be male individuals (female nymphs are often more variable and difficult to determine). Among life stages, the adult male imago is the gold-standard for making positive species determinations for many species of *Epeorus*. Differences between *E. frisoni* and *E. fragilis* male imagoes are definitive. I would recommend any future sampling efforts attempt to collect male imagoes or rear any black wing pad male nymphs to get the adult stage. That would produce the best assessment possible of the *Epeorus* species present at sampling sites.

Charges For Taxonomic Work: 2 vial containing a total of 13 specimens identified as listed above– Work Time 2hr. – Heptageniidae rate Total = $**160.00**

[Since it seems there is no interest in returning the specimens and they don't seem to be useful for future comparative work, they will not be retained with other Maine Inland Fisheries and Wildlife Material currently housed here]

Please let me know if you have any questions concerning this report and charges for taxonomic work.

Best regards, Steve

Steven K. Burian, Ph.D., Professor