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The Plecoptera and Trichoptera of the Arctic North Slope of Alaska

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Climate change is currently altering ecosystem structure and function in Arctic ecosystems, where temperatures are rising due to the polar amplification of greenhouse warming (Hinzman et al. 2005, Chapin et al. 2006, Martin et al. 2009). This warming trend has already resulted in significant changes in the seasonality of freshwater habitats in Arctic and Boreal North America, where the spring breakup of winter river ice has showed successively earlier dates over the past 6 decades (White et al. 2007, de Rham et al. 2008, Tape et al. 2011). Increasing temperatures are highly correlated with the range extensions of many insect species (Chen et al. 2011), and it is thus likely that populations of freshwater insects in the Arctic are undergoing range adjustments in response to climate warming (ACIA 2005). Similarly, it is anticipated that lower-latitude species will eventually expand their ranges into the Arctic (ACIA 2005). Thorough inventories of freshwater insect communities are thus required to provide benchmarks for the detection of range shifts in response to a warming climate. Unfortunately, records documenting the
distributions of freshwater insect species of the Arctic regions of Alaska are limited. The distribution of the Ephemeroptera (McCafferty 1985, Randolph and McCafferty 2005), Plecoptera (Stewart and Oswood 2006), and Trichoptera (Nimmo 1986) in Alaska have been documented at the statewide level. Few studies, however, have focused exclusively on the Arctic. Weber (1950), for example, is the only relatively comprehensive source that includes records for the occurrence of freshwater insect taxa while specifically treating the North Slope, where changes in the ranges of Alaskan insects as a result of climate warming are anticipated to be most significant.

Herein we provide an updated synopsis of new and historical distribution records of the Plecoptera and Trichoptera of the Arctic North Slope (including the Noatak River basin) of Alaska. It is our intent that this synopsis will provide a readily available benchmark for the detection of future changes in the ranges of freshwater invertebrates in this region.

**Methods**

We conducted this study on the central and eastern North Slope of Arctic Alaska. The North Slope is a relatively large region with an area roughly equal to that of Nebraska (~200,000 km²) and is bounded on the north by the Arctic Ocean and on the south by the Brooks Range. It is subject to average monthly air temperatures of −30 to −27 °C in January (warmer temperatures near the coast of the Arctic Ocean; colder temperatures inland) and 5 to 13 °C in July (colder temperatures near the coast; warmer temperatures inland). The North Slope typically receives a minimum of 150 mm of annual precipitation near the coast and 550 mm of precipitation in some areas of the Brooks Range; snowfall is possible on any day of the year (Huryn and Hobbie 2012). This treeless tundra region is underlain by a continuous layer of permafrost and is covered by vegetation dominated by cottongrass (*Eriophorum*), dwarf birches (*Betula*), willows (*Salix*), mosses (primarily *Sphagnum*), sedges (*Carex*), and lichens (Huryn and Hobbie 2012). Stoneflies (Plecoptera) and caddisflies (Trichoptera) were collected during the summer periods of 2001–2012. Adults were collected by hand and aerial net along rivers, streams, springs, wetlands, ponds, and lakes in habitats ranging from alpine to coastal plain from locations primarily in the Kuparuk, Sagavanirktok, Ivishak and Noatak River drainages of the central and eastern North Slope (Table 1). Larvae were collected in the same habitats and locations by use of kicknets and other sampling devices. Light traps, which are extremely effective for collecting adult caddisflies, could not be used due to continuous daylight during summer. As a consequence, sticky traps (n = 12) were deployed in the riparian zones of 8 streams along the North Slope section of the Dalton Highway (30 June–9 August 2011) and recovered at ~1-week intervals. These traps consisted of standard overhead projector transparencies that were coated with Tanglefoot® (The Tanglefoot Company, Grand Rapids, MI). Voucher specimens from this collection will be available through Brigham Young University’s insect collection (R. Baumann personal communication).

**Species List**

New and historical records documenting the occurrence of Plecoptera and Trichoptera are provided in the following list. The family-level structure of the list follows Stewart and Oswood (2006) for the Plecoptera and Wiggins (1996) for the Trichoptera. Records taken from the literature, and not from our 2001–2012 collections, are indicated by the following superscripts:

- Stewart and Oswood 2006
- Nimmo 1986
- Weber 1950
- Wiggins and Richardson 1986
- Schmid 1964
- Wiggins 1998
- Glesne and Deschermeier 1984
- Hershey et al. 1997
- Zenger and Baumann 2004
- Stewart and Ricker 1997
- Wiggins and Parker 1997

Previously undocumented Alaskan North Slope records are preceded by an asterisk (*), while new Alaska state records are preceded by 2 asterisks (**). Date format is dd/mm/yyyy, and specimens are characterized as “m” for males and “f” for females. Names of species documented from the Arctic north slope drainages of the Yukon Territory, Canada are preceded by a double dagger (‡) and are included for reference, but only Alaska specimens are included in further analyses.
Table 1. Location of collection sites inventoried from 2001 to 2012. Sites where sticky traps were deployed are indicated by an asterisk (*).

<table>
<thead>
<tr>
<th>Site name</th>
<th>Latitude</th>
<th>Longitude</th>
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<tbody>
<tr>
<td>Barrow Environmental Observatory</td>
<td>71.277075°</td>
<td>−156.639441°</td>
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<td>Cobblestone River aufeis</td>
<td>68.6404°</td>
<td>−150.59554°</td>
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<td>Dan Creek</td>
<td>69.098067°</td>
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<td>Echoooka Spring</td>
<td>69.260944°</td>
<td>−147.203956°</td>
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<td>Franklin Bluffs near Dalton Highway Milepost 386</td>
<td>69.75396°</td>
<td>−148.654533°</td>
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<td>Galbraith Lake</td>
<td>68.465235°</td>
<td>−149.434191°</td>
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<td>Galbraith Lake “west” aufeis</td>
<td>68.454833°</td>
<td>−149.455083°</td>
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<td>Galbraith Lake “campground spring”</td>
<td>68.4529°</td>
<td>−149.480367°</td>
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<tr>
<td>Happy Valley Creek</td>
<td>69.15065°</td>
<td>−148.835333°</td>
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<td>Hershey Creek</td>
<td>68.644399°</td>
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<td>Holden Creek</td>
<td>68.406117°</td>
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<td>Innavaat Creek</td>
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<td>Ivishak Hot Spring</td>
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<td>Krugurak Spring</td>
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<td>Kuparuk River (Dalton Highway bridge)</td>
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<td>Kuparuk River “lower” aufeis</td>
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<td>Kuparuk River “upper” aufeis</td>
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<td>Lake E-1 outlet* near Toolik Lake</td>
<td>68.6359°</td>
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<td>Lake E5 near Toolik Lake</td>
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<td>Lake I-3 outlet stream near Toolik Lake</td>
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<td>Lake I-6 headwater outlet stream near Toolik Lake</td>
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<td>Lupine Creek*</td>
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<td>May Creek spring and aufeis</td>
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<td>Mosquito Lake</td>
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<td>Oil Spill Hill, Dalton Highway</td>
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<td>Roche Moutonnee Creek</td>
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<td>Sagavanirktok River “glacier tributary”</td>
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<td>Sadlerochit Spring</td>
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<td>Tea Lake</td>
<td>68.423106°</td>
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<td>Toolik River aufeis</td>
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<td>Wolf Creek*</td>
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<td>−149.127583°</td>
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</table>

*aufeis are spring-associated ice fields (see discussion).

PLECOPTERA

Capniidae

*Capnia confusa* Claassen, 1936

NEW RECORDS.—Toolik Lake, 1f, 28/6/2001; Ivishak Hot Spring stream, 1m & 2f, 15/7/2002, 1m & 4f, 23–28/6/2002; Ivishak River, main stem near Ivishak Hot Spring, 2m, 28/5/2008; Cobblestone River aufeis, 1m, 8/6/2012; May Creek aufeis, 1m & 1f, 8/6/2012.

HISTORICAL RECORDS.—Anaktuvuk River, 1949a,c; Shublik Spring, 1966a; Echooka Spring, 1971a; Canning River, unnamed spring, 1972a.

*Capnia nearctica* Banks, 1918

NEW RECORDS.—Toolik Lake, 1m & 6f, 29/6/2001, 1f, 21/7/2001; May Creek spring, 1f, 8/7/2001; Toolik River aufeis, 1f, 11/7/2001; Kuparuk River “upper” aufeis, 2m & 7f, 29/6/2007; Ivishak River near Ivishak Hot Spring, 4f, 28/5/2008; Ivishak River, main stem near Ivishak Hot Spring, 8m, 28/5/2008; Galbraith Lake “west” aufeis, 1 brachypterous 1m & 3f, 3/6/2012; Kuparuk River “lower” aufeis, 1m & 8f, 8/6/2012; May Creek spring, 1f, 1/6/2012, 5m, 8/6/2012; Toolik River aufeis, 1 brachypterous male, 8/6/2012; Kuparuk River (Dalton Highway bridge), 1 brachypterous male, 22/6/2012; Kuparuk River “lower” aufeis, 1 brachypterous male, 10/8/2012.

HISTORICAL RECORDS.—Umiat, 1948a; Anaktuvuk River, 1949a,c; Toolik Lake, 1970a.

‡*Capnia pileata* Jewett, 1966

HISTORICAL RECORDS.—Philip Creek, Arctic slope of Yukon Territory, Canada (no date).
Isocapnia abbreviata Frison, 1942

Isocapnia crinita (Needham & Claassen, 1925)
New record.—Cobblestone River aufeis, 2f, 8/6/2012.

Isocapnia grandis (Banks, 1907)
New records.—Ribdon River spring, 2m, 1/7/2001; Cobblestone River aufeis, 1f, 8/6/2012.
Historical records.—Canning River, spring tributary, 1972.

*Isocapnia cf. integra Hanson, 1943
New records.—Cobblestone River aufeis, 1f, 8/6/2012.

Mesocapnia oenone (Neave, 1929)
Historical records.—Anaktuvuk Pass, 1949.

Mesocapnia variabilis (Klapálek, 1920)
New records.—Echooka Spring, 1f, 4/7/2001; Kuparuk River (Dalton Highway bridge), 3f, 20/7/2001, 2m & 3f, 3/8/2001; Sadlerochit Spring, 2f, 22/7/2002; Kuparuk River (Dalton Highway bridge), 2f, 3/8/2012; Galbraith Lake “west” aufeis, 1f, 22/8/2012; Kuparuk River “upper” aufeis, 5m, 10/8/2012; Toolik River aufeis, 2m & 5f, 10/8/2012.

Historical records.—Anaktuvuk River, 1945; Cape Thompson, 1960; Canning River, 1972; Cache Creek, 1972; Atigun Pass, 1980; Atigun River, 1980; Pump Station 4, Dalton Highway, 1980; Teshekpuk Lake, 1980; Oksrukuyik Creek, 1980; Roche Moutonnee Creek, 1980; Okerokovic River, 1982; Jago River, 1982; Kaktovik, 1982; Aichilik Creek, 1982; Angun River, 1982; Oksrukuyik Creek, 1982; Storke son Point, 1982; Peters Lake, 1982; Nuvgapak Point, 1982; VABM Mars, 1982; Roche Moutonnee Creek, 1986; Toolik River, no date; Philip Creek, Arctic slope of Yukon Territory, Canada (no date).

Nemoura normani (Ricker, 1952)
Historical records.—Anaktuvuk River, 1949.

Podmosta decepta (Frison, 1942)
Historical records.—Umiat, 1959.

Podmosta weberi (Ricker, 1952)
New records.—Kuparuk River “lower” aufeis, 1m & 1f, 11/6/2001, 1f, 19/6/2004; Galbraith Lake “campground spring,” 1m & 3f, 24/6/2007, 10m & 8f, 29/6/2007; Kuparuk River “lower” aufeis, 1m & 1f, 10/8/2012.

Historical records.—Anaktuvuk Pass, 1949; Anaktuvuk River, 1949.

Soyedina sp.

Zapada columbiana (Claassen, 1923)
Historical records.—Shublik Spring, 1968, 1969; Echooka Spring, 1971; Ribdon...
River, spring tributary, 1971a; Canning River, 1972a; Shublik Spring, 1982a.

Zapada haysi (Ricker, 1952)

NEW RECORDS.—Echooka Spring, 1f, 4/7/2001, 1f, 18/7/2004; Ivishak Hot Spring stream, 2f, 9/7/2001, 3m & 8f, 23–28/6/2002, 1m & 1f, 30/7/2002 [Dolly Varden char (Salvelinus malma) gut contents]; Ivishak River tributary nr. Ivishak Hot Spring, 19m, 28/5/2008; Ivishak River nr. Ivishak Hot Spring, 10m & 11f, 28/5/2008; Ivishak Hot Spring, 14m & 6f, 26/5/2008.

HISTORICAL RECORDS.—Anaktuvuk River 1949c; Shublik Spring, 1966a; Lupine River, spring tributaries, 1971a; Echooka Spring, 1971a, 1972a; Echooka Spring, 1971a; Marsh Fork 1972a; Echooka River, 1971a; Shublik Spring, 1972a; Canning River, spring tributaries, 1972a, 1973a; Oskrucky Creek, 1980a; Shublik Spring, 1982a; Philip Creek, Arctic slope of Yukon Territory, Canada (no date).

Succellia autumna (Hoppe, 1938)

HISTORICAL RECORDS.—Sadlerochit Spring, 1974a.

Succellia starki Alexander & Stewart 1999

NEW RECORDS.—Cobblestone River aufeis, 2m, 8/6/2012; Kuparuk River “lower” aufeis, 1m, 10/8/2012.

HISTORICAL RECORDS.—Anaktuvuk River, 1949d; Shublik Spring, 1966a; Lupine River, spring tributaries, 1971a; Echooka Spring, 1971a; Shublik Spring, 1972a; Echooka River, 1972a; Shublik Spring, 1972a; Canning River, spring tributary, 1972a, 1973a.

*Paraperla frontalis* (Banks, 1902)

NEW RECORDS.—Ribdon River spring, 3m, 1/7/2001, 1m, 15/7/2001.

Perlodidae

Isoperla decolorata (Walker, 1852)

HISTORICAL RECORDS.—Umiat, 1959a; Eechooka Spring, 1971a.

Isoperla petersoni Needham & Christenson 1927

NEW RECORDS.—Eechooka Spring, 5m & 7f, 4/7/2001; Ivishak Hot Spring stream, 1m, 9/7/2001, 1f, 6/8/2001, 1m, 15/7/2002, 2m & 2f, 23–28/6/2002; Sadlerochit Spring, 9m, 22/7/2002; Ivishak Hot Spring stream, 1m, 26/5/2008; Ivishak Hot Spring, hillslope source, 2 larvae, 26–29/5/2008.

HISTORICAL RECORDS.—Shublik Spring and Creek, 1969a; Eechooka Spring, 1971a; Eechooka Spring, 1971a; Ribdon spring tributaries, 1971a; Marsh Fork of Canning River, 1972a; Sadlerochit Spring, 1972a; Shublik Spring and Creek, 1972a; Canning River, spring tributary, 1972a, 1973a.

Arcynopteryx dichroa (McLachlan, 1872) (= A. compacta McLachlan, 1872)

NEW RECORDS.—Ribdon River spring, 1m, 1/7/2001; Echooka Spring, 2m & 3f, 4/7/2001; Lake E5 near Toolik Lake, 1m, 11/7/2001; Toolik Lake, 5f, 21/7/2001; Kuparuk River “lower”
aufeis, 4m & 8f, 19/6/2004; Galbraith Lake "campground spring," 10m, 24/6/2007; Ivishak Hot Spring, hillslope source, 6m, 26–29/5/2008; Kuparuk River (Dalton Highway bridge), 1f, 26/6/2012; Kuparuk River “lower” aufeis, 23/6/2012, 3m, 1f & 2 larvae, 10/8/2012; Toolik Lake, 1 brachypterous m, 30/6/2012, 1f, 1/7/2012.

**Historical records.**—Anaktuvuk River, 1949a,c; Kukpuk River, 1961a; Sadlerochit Spring, 1966a; Shublik Spring, 1966a; Echoooka River, 1971a; Ribdon spring tributary, 1971a; Echoooka Spring, 1971a, 1972a; Canning River, 1972a; Marsh Fork of Canning River, 1972a; Shublik Spring, 1972a; Canning River, spring tributaries, 1972a, 1973a; Feniak Lake, 1973a; Shrader and Peters Lakes, 1973a; Toolik Lake, 1976a; Atigun River, 1977a; “Oil Spill Lake” near Toolik Lake, 1978a; Toolik Lake, 1979a.

**Trichoptera**

**Glossosomatidae**

*Glossosoma intermedium* (Klapálek, 1892)

**New records.**—Ivishak Hot Spring stream, 1m, 23–28/6/2002, 2m & 2f, 26–29/5/2008; Ivishak Hot Spring, hillslope source, 3m & 10f, 26–29/5/2008.

*Glossosoma sp.*

**New records.**—Sadlerochit Spring, numerous larvae and pupae, 22/7/2002; Kuparuk River (Dalton Highway bridge), larvae, 2/8/2012, 27/8/2012.

**Hydroptilidae**

**Agraylea cognatella** McLachlan, 1880

**New records.**—Toolik Lake, 18m & 4f, 21/7/2001, numerous m & f, 6/7/2012; Dan Creek, 2m, 30/6/2012.

**Notes.**—The range of *Agraylea cognatella* is restricted to the Yukon, Alaska, and Asia (Wiggins and Parker 1997).

*Ochrotrichia logana* (Ross, 1941)

**New records.**—Krugurak Spring, Noatak River drainage, many mf metamorphotypes, 18/7/2003.

**Notes.**—Ruiter (1999) first reported *O. logana* from southern Alaska (Katmai Peninsula). Our Noatak River drainage record establishes the presence of this wide-ranging species (northern Mexico to Alaska; Ruiter 1999, Bueno-Soria 2009), in the North American Arctic.

**Oxyethira sp.**

**New records.**—Toolik Lake, Lake I-3 outlet stream near Toolik Lake, larvae, 15/7/2005; Lake I-6 Headwater outlet stream near Toolik Lake, larvae, 15/7/2005.

**Notes.**—*Oxyethira araya* Ross, 1941 has been recorded from the northern Yukon Territory, Canada (Wiggins and Parker 1997).

**Rhyacophilidae**

**Rhyacophila mongolica** Schmid, Arefina & Levaničová 1993

**New records.**—Kuparuk River (Dalton Highway bridge), larvae, 20/7/2001, larvae, 11/7/2001, 22m, 14/7/2001; Oskrukuyik Creek, 1m from arctic grayling (*Thymallus arcticus*) gut content, 8m, 21/7/2003; Oskrukuyik Creek, 1m, 9/6/2011; Hershey Creek, 9m, 15/7/2011, 13m, 9/7/2012, 3m, 27/7/2012; Dan Creek, 25m, 7/7/2012, 6m, 21/7/2012, 2m, 29/7/2012; Happy Valley Creek, 5m, 7/7/2012, 1m, 29/7/2012; Kuparuk River (Dalton Highway bridge), 10m, 2/7/2012, 1m, 15/7/2012, 1m, 27/7/2012.

**Notes.**—*Rhyacophila mongolica* has been reported from the Yukon (Wiggins and Parker 1997). Prior to that record, this species was only reported for Europe, northeastern Asia, and Mongolia (Chuluunbat and Morse 2007).

**Apataniidae**

*Apatania zonella* (Zetterstedt, 1840)


**Historical records.**—Anaktuvuk Pass, 1949b,c; Point Barrow, 1949b,c.

*Apatania stigmatella* (Zetterstedt, 1840)

**New records.**—Lupine Creek, 1m, 11/8/2011; Franklin Bluffs at Dalton Highway Milepost 386, 1m, 12/8/2012.

**Notes.**—*Apatania stigmatella* (Zetterstedt, 1840)
Brachycentridae

*Brachycentrus americanus* (Banks, 1899)

**NEW RECORDS.**—Kuparuk River (Dalton Highway bridge), 5m & 3f, 20/7/2001; Sadlerochit Spring, larvae, 5m & 1f, 22/7/2002; Dan Creek, 2m, 7/7/2012, 1m, 30/6/2012.

**HISTORICAL RECORDS.**—Atigun River, 1979b; Kuparuk River, 1984–1986h.

‡*Micrasema gelidum* McLachlan, 1876

**NEW RECORDS.**—Kuparuk River (Dalton Highway bridge), 21m & 12f, 20/7/2001; Lake E-1 outlet near Toolik Lake, 1m, 9/6/2011; Kuparuk River (Dalton Highway bridge), 3m, 2/7/2011, 1m, 15/7/2011, 1m, 4/7/2012; Hershey Creek, 2m, 15/7/2011, 3m, 9/7/2012; Dan Creek, 1m, 7/7/2012; Wolf Creek, 1m, 21/7/2012.

**HISTORICAL RECORDS.**—Nanushuk River, 1949b,c; Pt. Barrow, 1949b,c (as *M. scissum* McLachlan); Pt. Barrow, 1975b, 1979b; Arctic slope of Yukon Territory, Canada (no date)k.

Leptoceridae

*Mystacides sepulchralis* (Walker, 1852)

**NEW RECORDS.**—Toolik Lake, 3m, 12/7/2011; Dan Creek, 1m, 7/7/2012, 2m, 21/7/2012.

**HISTORICAL RECORD.**—3.2 km above mouth of Kuguroruk River, 5/8/1981b.

Limnephilidae

*Arctopora trimaculata* (Zetterstedt, 1840)

**HISTORICAL RECORD.**—Symbol on distribution map (Fig. 19, Wiggins and Parker 1997) indicates a record from the vicinity of the lower Colville River; exact location not reported.

**Asynarchus aldinus** (Ross, 1941)

**NEW RECORDS.**—Imnavait Creek, 1m, 27/7/2011; Happy Valley Creek, 1m, 29/7/2012; Lupine Creek, 1m, 11/8/2012.

**NOTE.**—*Asynarchus aldinus* is widely distributed along the Rocky Mountains (Wiggins and Parker 1997) from the foothills of the North Slope of Alaska south to Utah.

*Asynarchus lapponicus* (Zetterstedt, 1840)

**NEW RECORDS.**—Wolf Creek, 3m, 4/8/2011, 1m, 10/8/2011; Kuparuk River (Dalton Highway bridge), 1m, 31/7/2012.

**HISTORICAL RECORDS.**—Arctic slope of Yukon Territory, Canada (no date)k.

*Asynarchus montanus* (Banks, 1907)

**NEW RECORDS.**—Dan Creek, 1m, 29/7/2012.

*Dicosmoecus obscuripennis* Banks, 1938

**NEW RECORDS.**—May Creek spring, larvae, 8/7/2001; Kuparuk River (Dalton Highway bridge), 1m, 20/7/2001, 1m, 9/8/2001; Kuparuk River “lower” aufeis, pupal aggregation (photographed), 19/6/2004; Hershey Creek, 2m, 9/7/2012, 1m, 15/7/2012; Kuparuk River (Dalton Highway bridge), 1m, 15/7/2012, 4m, 27/7/2012; Dan Creek, 3m, 21/7/2012; Wolf Creek, 1m, 21/7/2012, 1m, 9/7/2012, 3m, 7–14/7/2012.

*Dicosmoecus sp.*

**HISTORICAL RECORDS.**—Jago River, larvae, 1982–1983g.

Ecclisomyia conspersa* Banks, 1907

**NEW RECORDS.**—Echooka Spring, 1m, 4/7/2001; Ivishak River tributary nr. Ivishak Hot Spring, 1m, 23–28/6/2002; Sadlerochit Spring, 1m, 22/7/2002; Toolik Lake, 1m, 26/6/2001, 1m, 29/6/2001, 1m, 28/6/2001; Ivishak Hot Spring stream, 1m, 2–6/7/2007, 1m, 22/4/2008, 1m, 26/5/2008; Ivishak River tributary nr. Ivishak Hot Spring, 1m, 28/5/2008; Ivishak River, main stem nr. Ivishak Hot Spring, 1m, 28/5/2008; Ivishak Hot Spring, hillslope source, 1m, 26–29/5/2008; Kuparuk River, “lower” aufeis, 1m, 8/6/2012; Cobblestone Spring, 1m, 8/6/2012; Galbraith Lake, 1m, 15/6/2012.

**HISTORICAL RECORDS.**—Wrench Creek, Noatak River drainage, 4/8/1981b.

*Ecclisomyia* sp.

**HISTORICAL RECORDS.**—Jago River, larvae, 1982–1983g.

Grammotaulius alascensis Schmid, 1964 (= *G. subborealis* Schmid, 1964)

**NEW RECORDS.**—Percy Pingo, 1m, 31/7/2011.

**HISTORICAL RECORDS.**—Umiat, 31/7/1959e; Jago Lake, 1m, 2/8/1957e.

Grammotaulius sp.

**NEW RECORDS.**—Toolik River at Dalton Highway, 1 larva, 3/7/2001.
**Grensia praeterita** (Walker, 1852)

**NEW RECORDS.**—Toolik Lake, 1m, 28/6/2001; Kuparuk River “upper” aufeis, 1f, 29/6/2007; Barrow Environmental Observatory, 2m & 1f, 18/6/2011; Toolik Lake, 1m, 3/6/2012; Lupine Creek, 2m, 6/6/2012; Gulkana River, 1m, 6/6/2012; May Creek aufeis, 2f, 8/6/2012; Kuparuk River (Dalton highway bridge), 5m, 10/6/2012; Tea Lake, 1m, 26/6/2012; Dalton Highway Mile Post 386, 3m, 4/9/2012.

**HISTORICAL RECORDS.**—Anuktuvuk Pass, 1948b,c; Meade River, 1950b; Ogutoruk Creek, Cape Thompson, 1966b; Inaru River, 28/9/no yearb,c; Prudhoe Bay, no yearb.

‡**Lenarchus expansus** Martynov, 1914

**HISTORICAL RECORDS.**—Point Barrow, 1898b, 1958b; Arctic slope of Yukon Territory, Canada (no date)k.

*Hydatophylax variabilis* (Martynov, 1910)

**NEW RECORDS.**—Kuparuk River, “lower” aufeis, 2f, 8/6/2012; May Creek aufeis, 1m, 8/6/2012.

**NOTES.**—*Hydatophylax variabilis* has been previously reported from Sweden to eastern Siberia in Eurasia, as well in the coastal regions of southeastern Alaska. It is thus the only essentially Palearctic trichopteran species also known to occur in southern Alaska but nowhere else in North America (Nimmo 1986, Wiggins and Parker 1997). Our record from the North Slope is the first to document the presence of *H. variabilis* in Beringia.

*Limnephilus argenteus* Banks, 1914

**NEW RECORDS.**—Oksrukuyik Creek, 1m, 9/6/2011.

**Limnephilus diphyes** McLachlan, 1880

**NEW RECORDS.**—Kuparuk River (Dalton highway bridge), 1m, 4/7/2012.

**NOTE.**—*Limnephilus diphyes* has previously been reported from Scandinavia eastward through northwestern Siberia to the Yukon Territory, Canada (Wiggins and Parker 1997).

*Limnephilus femoralis* Kirby, 1937

**NEW RECORDS.**—Lake E-1 outlet near Toolik Lake, 1m, 9/6/2011.

*Limnephilus fenestratus* (Zetterstedt, 1840)

**NEW RECORDS.**—Franklin Bluffs near Dalton Highway Milepost 386, 1m, 12/8/2012; Dalton Highway Milepost 355, 1m, 12/8/2012.

§**Limnephilus kennicotti** Banks, 1920

**HISTORICAL RECORDS.**—Arctic slope of Yukon Territory, Canada (no date)k.

*Limnephilus nigriceps* (Zetterstedt, 1840)

**NEW RECORDS.**—Dan Creek, 2m, 23/8/2012; Kuparuk River (Dalton highway bridge), 1m, 24/8/2012.

‡**Limnephilus pallens** Banks, 1920

**HISTORICAL RECORDS.**—Arctic slope of Yukon Territory, Canada (no date)k.

‡**Limnephilus picturatus** McLachlan, 1875

**NEW RECORDS.**—Sadlerochit Spring, numerous larvae and adults, 22/7/2002.

**HISTORICAL RECORDS.**—Wrench Creek, Noatak River drainage, 4/8/1981b; Noatak River near confluence with Kuguroruk River, 31/7/1981b; Sadlerochit Spring, 1/8/2012.

**Onocosmoecus unicolor** (Banks, 1897)

**NEW RECORDS.**—Sadlerochit Spring, numerous larvae and adults, 22/7/2002.

**HISTORICAL RECORDS.**—Wrench Creek, Noatak River drainage, 4/8/1981b; Noatak River near confluence with Kuguroruk River, 31/7/1981b; Sadlerochit Spring, 1/8/2012.

*Molannidae*

*Molannodes tinctus* (Zetterstedt, 1840)

**NEW RECORDS.**—Dan Creek, 1m, 29/7/2012.

**Phryganeidae**

‡**Agrypnia obsoleta** (Hagen, 1864)

**HISTORICAL RECORDS.**—Arctic slope of Yukon Territory, Canada (no date)k.

‡**Agrypnia pagetana** Curtis, 1835

**HISTORICAL RECORDS.**—Noatak River, 1m & 1f, 25/6/1973f; Arctic slope of Yukon Territory, Canada (no date)k.

**Agrypnia sahlbergi** (McLachlan, 1880)

**HISTORICAL RECORD.**—Noatak River, 1m, 2/8/1973f.
Agrypnia sp.
NEW RECORDS.—Percy Pingo, 1 larva, 31/7/2011.

Banksiola crotchii Banks, 1944
HISTORICAL RECORDS.—Noatak River near confluence with Charley River, 1f, 14/6/1974f.

Banksiola sp.
HISTORICAL RECORDS.—Point Barrow 1949b,c.

Oligotricha lapponica (Hagen, 1864)

HISTORICAL RECORDS.—Pt. Barrow, 1f, 29/7/1949f.

DISCUSSION

Previous studies have summarized reported occurrences of Trichoptera and Plecoptera from the entire state of Alaska (Nimmo 1986, Stewart and Oswood 2006). Here we update these lists for the North Slope region of Alaska with 2 new species records of Plecoptera and 19 new records of Trichoptera (4 new state records). New state records for Trichoptera include Agraylea cognatella, Rhyacophila mongolica, Asynarchus aldinus, and Limnephilus diphyes. New records of Trichoptera for the North Slope include Glossosoma intermedium, Oxytrechus logana, Oxyethira sp., Apatania stigmatella, Asynarchus lapponicus, A. montanus, Dicosmoecus obscuripennis, Hydatophylax variabilis, Limnephilus argenteus, L. femoralis, L. fenestratus, L. nigriceps, L. picturatus, L. sansonii, and Molannodes tinctorus. New records for Plecoptera on the North Slope include Isocapnia cf. integra and Parapetra frontalis.

Our species list for the North Slope contains a total of 24 and 33 species of Plecoptera and Trichoptera, respectively. If records from the physiographically equivalent area of the Yukon Territory are included (Wiggins and Parker 1997), the total richness of this region is 25 species of stoneflies and 36 species of caddisflies. Compared to the “north slope” of the Yukon, which includes the northward flowing drainages of the Arctic Coastal Plain, the British Mountains, and the Arctic Plateau (Wiggins and Parker 1997), the North Slope region of Alaska has a substantially higher species richness of these groups. Alaska North Slope richness is 24 for Plecoptera and 33 for Trichoptera, compared to richness on the Yukon “north slope,” which is 3 for Plecoptera and 8 for Trichoptera. Because a significant investment in biotic inventories has been made in the Yukon Territory (e.g., Wiggins and Parker 1997, Stewart and Ricker 1997), we attribute this difference to factors such as greater habitat diversity due to a much greater geographical area on Alaska’s North Slope rather than to differences in collecting effort in the different regions.

Although taxonomic inventories will almost always be incomplete, our assessment of the stoneflies and caddisflies seems sufficient to support 2 major conclusions about factors underlying the level of biodiversity documented. First, the role of Beringia (i.e., the region encompassing eastern Siberia, the Bering land bridge, and most of present-day Alaska and the Yukon Territory during much of the Pleistocene) as a biogeographic refuge during the Pleistocene has had a significant effect on the taxonomic structure of the freshwater insects of the North Slope. There has been much interest in the role of Beringia in determining patterns of Arctic biodiversity (e.g., Wiggins and Parker 1997, Stewart and Ricker 1997). Because this region remained largely ice-free during the Pleistocene, it functioned as a refuge for taxa that were extirpated by continental glaciers elsewhere. Caddisfly species showing such distributions include Agraylea cognatella, Rhyacophila mongolica, Arctopora trimaculata, Dicosmoecus obscuripennis, Gramnotaulius alascensis, Grensia praeterita, Hydatophylax variabilis, Lenarchus expansus, Limnephilus diphyes, L. fenestratus, Agrypnia obsoleta, A. sahlbergi, and Oligotrichia lapponica (36%). Species of Plecoptera showing ranges that are either Beringian or Palearctic-Beringian include Mesocapnia variabilis, Nemoura normani, Podnosta weberi, and Alaskauperla ovibovis (17%).

Although the contribution of Beringian taxa to the plecopteran fauna of the North Slope is modest, the contribution of such taxa to the trichopteran fauna is substantial. These results can be compared with species lists from Churchill Manitoba, Canada, where 66 species of caddisfly and 16 species of stonefly were found (Zhou et al. 2010). Of the 66 caddisflies found at Churchill, only 17 of the same species
are also found in our list. Of the 16 species of stoneflies found at Churchill, only 3 species are also found in our list. The structure of the trichopteran species diversity of the North Slope therefore represents a little known but relatively unique biogeographic heritage that should be of clear conservation concern given the rapidly changing climate of the Arctic (ACIA 2005).

The second major conclusion about factors underlying the level of plecopteran and trichopteran biodiversity of the North Slope is the critical effect of freshwater habitats associated with perennial springs. A number of spring streams found along the northern foothills of the Brooks Range flow year-round due to winter water temperatures ranging from 4 to 11 °C, whereas other freshwater habitats with depths <1.5 m freeze solid. Although perennial spring streams provide a negligible amount of habitat (<1% of total stream length) on the North Slope, they have important consequences for biodiversity because they provide 100% of flowing stream habitat during winter (Huryn et al. 2005, Huryn and Hobbie 2012). This habitat is critical for stream organisms that occur on the North Slope but which are unable to tolerate freezing, including a number of freshwater insects, the Dolly Varden char (Salvelinus malma), and the American Dipper (Cinclus mexicanus), a semiaquatic songbird. Another important habitat related to the presence of springs is aufeis. An aufeis is a mass of ice formed by the successive freezing of overlying sheets of water that flow from a spring. The volume of an aufeis can be enormous, ranging up to 5+ meters thick and many square kilometers in area. Sediments underlying an aufeis remain saturated with unfrozen water year-round and, like the spring streams, provide significant habitat for aquatic insects. Stonefly species that are closely associated with aufeis fields where their larvae inhabit interstitial habitats (e.g., Stanford and Gaufin 1974) include Copnia confusa, C. nearticca, Isocapnia crinita, I. grandis, I. cf. integra, Plumarperla diversa, Suctacilla autumna, S. starki, and Paraperla frontalis. Stonefly species that are primarily found in association with springs include Podmosta weberi, Zapada columbiana, Z. haysi, T. pacificum, Isoperla decolorata, I. petersoni, and Arcynopteryx dichroa. Although no trichopteran species are specifically associated with aufeis fields, Glossosoma intermedium, Ochrotrichia logana, Hydaphylax variabilis, and Oncosmoeus unicolor have been found only in perennial spring habitats on the North Slope. Although comprising <1% of the total stream length of the North Slope, perennial spring and aufeis habitats contain about 70% of the known stonefly species and 10% of the known caddisfly species.

The 2 major factors contributing to the unique aquatic insect communities of Alaska’s Arctic North Slope include the North Slope as a Beringian refuge from continental ice sheets and the occurrence of spring streams as refuge from seasonal winter ice. The North Slope of Alaska is predicted to undergo changes in climate and extent of industrialization in the coming years. This species list, which represents numerous new records for Alaska’s North Slope, will aid in our understanding of how aquatic insect communities may respond to these predicted, yet unknown, changes on Alaska’s North Slope.

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