

Status Survey for Special Concern and Endangered Dragonflies of Minnesota: Population Status, Inventory and Monitoring Recommendations

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by

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Abstract

Status determination surveys for Hine's emerald dragonfly (*Somatochlora hineana*), Saint Croix snaketail (*Ophiogomphus susbehcha*), and extra-striped snaketail (*O. anomalus*) were conducted throughout eastern, central, and northern Minnesota. Threats to these rare species were evaluated, and conservation and population status recommendations for Minnesota dragonflies are presented. Baseline data on other dragonflies in under-surveyed habitats are reported, including several state records and numerous county records. Several collections of damselflies are also reported along with county distribution information, and recommendations for future Odonata surveys and monitoring are offered.

Introduction

Our surveys were initiated to better determine the biological status of the Special Concern dragonflies of Minnesota (Minnesota Dept. Nat. Resources, 1996), the Saint Croix snaketail (*Ophiogomphus susbehcha*) and extra-striped snaketail (*O. anomalus*) plus the federally endangered Hine's emerald dragonfly (*Somatochlora hineana*), to identify threats and management concerns, and to continue the lengthy process of filling the many gaps in our understanding of Minnesota dragonfly distribution and habitat needs.

Research on the dragonflies of MN has been sporadic, and most surveys of lotic species have been restricted to the east. Several studies have been restricted to primarily lentic genera (Miller et. al. 1964; Hamrun et. al. 1965; Boole et. al. 1974) or limited geographic areas (Haarstad 1980). Rith (1996, 1998) has surveyed in the Mississippi headwaters region and north central Minnesota upstream of Grand Rapids. In 1971 Hamrun et. al. published a comprehensive list of MN Anisoptera, with notes on habitats and distribution. At that time, only 76 species were known from the state, five of which were being reported for the first time. Haarstad (1994) undertook a survey of lotic dragonflies in eastern MN rivers. He surveyed 25 rivers, and made recommendations for future surveys, some of which were incorporated into this project. He located 6 sites for *O. susbehcha* in the St. Croix watershed. Carroll and Gunderson (1995) summarized the distribution of the known species at that time, but overlooked the *Aeshna sitchensis* reported by Walker (1912).

Somatochlora hineana was first discovered in Ohio (Williamson 1931), but after the 1950's it was not reported anymore and was believed by some to be extinct. In 1987, Tim Vogt identified a specimen of *S. hineana* which had been collected and mis-identified several years earlier in northern IL (Tim Vogt pers. comm.). Subsequent surveys identified seven small populations in northern IL. Also in 1987, the junior author collected a specimen in Door County WI, which was later identified by Tim Vogt. Surveys in WI have turned up 7 sites in Door County (WI Natural Heritage Inventory, 1998). Individuals have also been found in Indiana (Montgomery 1953), and K.

Tennessee discovered a mis-identified specimen at Auburn University in Alabama (Vogt and Cashatt 1994), but these have not been associated with breeding populations. All verified breeding sites are alkaline (pH 7.2-8.3), spring or seep-fed wetlands and small order, calcareous streams, which suggests that water chemistry plays an important role in the species distribution (Vogt & Cashatt 1994). Many of the *S. hineana* sites vary in other respects, ranging from *Typha* wetlands in IL to marly conifer swamp/fens with high microsite diversity in MI.

On January 26, 1995 *S. hineana* was designated a federally Endangered species, and statewide surveys were recommended. Wisconsin and IL list the species as endangered as well.

Surveys in upper Michigan in 1997-98 found 7 new sites in alkaline, spring and seep-fed fen/swamps, and literature review revealed the presence of remarkably similar plant communities in groundwater-fed, alkaline fen/swamps in northern MN (Steffens 1997, 1999).

During the course of 1989 *Ophiogomphus* surveys in WI, a previously undescribed species was discovered by the junior author, and later described by Vogt & Smith (1993) as *O. susbehcha*. Fairly exhaustive status surveys have been conducted for *Ophiogomphus* species since in WI and to date breeding populations of *O. susbehcha* have been verified on only two rivers, including the St. Croix River along the MN border and the Chippewa River in NW WI. The Saint Croix snaketail has also been reported sporadically from the Snake River in MN at its confluence with the Saint Croix River and from the Flambeau River, a tributary to the WI Chippewa River. In 1997 *O. susbehcha* was declared Endangered in WI, and is listed as a Special Concern species in MN. *Ophiogomphus susbehcha* has been incorrectly reported in some publications (Haarstad 1994, Carroll and Gunderson 1995) as *O. sabrinus*.

Ophiogomphus searches in WI have so far revealed only 7 WI waterbodies to have populations of *O. anomalus* (WI NHI, 1998; unpublished data, Smith, 1994) which again include the St. Croix River. Some of the St. Croix River sites found in WI are directly adjacent to Minnesota, but specimens of the St. Croix River population had yet to be found in MN. Only 3 apparently viable populations are known in WI. Though this species is listed as Special Concern in MN, it had not been confirmed in Minnesota prior to this project.

The U.S. Fish and Wildlife Service considers *O. anomalus* and *O. susbehcha* as species of concern in region 3 (Refsneider, pers. comm.) indicating their potential conservation importance and vulnerability. The status surveys in WI over the past decade have not only confirmed the rarity of the two species, they have also resulted in the discovery of yet another undescribed and apparently rare species of *Ophiogomphus* (Tennessee and Vogt in prep.).

Our specific objectives for this project were the following:

- 1) Complete the Minnesota part of regional status determinations for three of the Midwest's potentially rarest invertebrates. These include the federally endangered Hine's Emerald dragonfly (*Somatochlora hineana* Williamson), and two species now referred to as "federal species of concern", the extra-striped Snaketail (*Ophiogomphus anomalus* Harvey) and the Saint Croix snaketail (*Ophiogomphus susbehcha* Vogt & Smith).
- 2) Identify threats, and develop conservation and management recommendations for Minnesota's rare dragonflies.
- 3) Gather baseline data on other Anisoptera of MN

The following sections of this report are generally discussed in two parts; one for the *S. hineana* and other non-river surveys, and another for the *Ophiogomphus* and other exuviae sampling along major rivers.

Methods and Materials

Potential habitats for *S. hineana* surveys were identified using soil maps, county biological survey maps, aerial photographs, and consultation with various soil scientists, botanists and ecologists. Circumneutral to alkaline fens with groundwater seeps or springs were targeted. All known *S. hineana* sites occur over dolomite bedrock (Vogt and Cashatt 1994, Steffens 1997, Steffens 1999). The survey sites were selected for their similarity to some of the other known sites, but lack dolomite bedrock. The full methods and results of the *S. hineana* surveys are reported elsewhere (Steffens 1999), this report describes the other species collected incidental to *S. hineana* surveys. Several sites, mostly bogs, were selected for the sole purpose of sampling undersurveyed habitats.

All odonate species that were encountered during *S. hineana* surveys were collected to provide baseline information on these undersurveyed habitats. Adult odonates were collected with aerial nets and preserved using the acetone-drying method.

Stream species targeted here are considered "spring species" (Corbet, 1962) in that they all show strongly synchronized emergence. Most of the individuals in an annual cohort of a spring species leave the water within a week or less. The larvae of most clubtails, including the genus *Ophiogomphus* targeted here, are burrowers and can be distributed wherever suitable substrate occurs in a stream bottom. Prior to emergence individuals must move to one shore or the other where they then crawl out of the water onto the bank and molt into the adult. Within a few days nearly the entire cohort of individuals recently spread out over many square feet of stream bottom are now in evidence by the exuviae left in a narrow zone on either bank. A survey methodology has been developed by the junior author to take advantage of this period of relatively easy detectability. Sample sites were chosen based on easy access for collectors and such that they were distributed over as much river as feasible. The procedure at each sample site was to select 50 feet of protected shoreline and to then collect all Anisoptera exuviae found in that section of shoreline. Occasionally sample effort was increased when few specimens were found in the initial 50ft and conversely effort was decreased to no less than 25ft when specimens were particularly numerous. Specimens were preserved in 70% ethyl alcohol for later

species determination An attempt was made to conduct collections a few days after emergence began.

The choice of streams was driven by known habitat preference of target *Ophiogomphus* species and gaps in coverage of previous workers. Large streams in forested watersheds were generally chosen. The Mississippi R. was sampled below the area sampled by Rith (1996, 1998) downstream to where habitat no longer appeared suitable. A concerted attempt was made to locate *O. anomalus* on the MN side of the St. Croix R.

Larvae were collected at several sites using standard aquatic D-nets, and preserved in 70% ethanol. Specimens were identified by both authors using appropriate taxonomic keys (Louton 1982, Needham 1955, Walker 1958, Walker and Corbet 1975, Westfall and May 1996) and binocular microscope. These data plus data from previous years sampling efforts were entered into a Paradox for Windows database for further analysis.

Results and Discussion

Data were gathered for over 8,600 adults, larvae, and exuviae from 90 sites on 23 waterbodies, representing nine Families, 28 Genera, and 62 species of Odonata. We also include here data gathered by Gary Montz (MN DNR) over the past decade. Sample sites and associated species for all *S. hineana* surveys and all other undersurveyed habitats are shown in Table 1. *Somatochlora hineana* was not found in Minnesota. Results for the river surveys for *O. susbehcha* and *O. anomalus* are shown in tables that accompany a short discussion of each river.

Emergence in 1998 was the earliest ever noted by authors, which limited the effectiveness of the exuviae methodology because specimens had ample opportunity to be washed away or destroyed before they could be collected.

Several species in the tables represent new state records, including *Aeshna subarctica*, *O. anomalus*, *Stylurus scudderi*, and *Coenagrion interrogatum* (Zygoptera). *Aeshna sitchensis* has been reported only once before (Walker 1912). *Lestes forcipata* (Zygoptera) may also represent a state record; it was reported as questionable by Westfall and May (1996).

Numerous county records were also documented. These are reported in Appendix A. There is no published literature documenting damselfly distribution north of the Mississippi River Valley, therefore all damselflies reported in Table 1 probably represent county records.

Non-River surveys (also see Table 1)

Beltrami County.

HWY 72 Bog/fen- Red Lake SNA. This site was chosen for it's potential for *S. hineana* habitat and because it is one of the few easily accessible portions of the huge Red Lake

SNA. A forested bog island lies adjacent to a huge water track/fen, and the site is accessed via a bridge over the drainage ditch about 9 miles north of Red Lake. A second ditch must be then be crossed on foot to gain access to the bog island. On July 16, only *Leucorrhinia hudsonica* and *Somatochlora franklini* were collected and a single *Libellula* was observed. On August 17, *Aeshna canadensis*, *A. constricta*, *A. subarctica*, *Sympetrum danae*, *S. obtrusum*, and *S. vicinum* were collected. Several possible *A. sitchensis* were observed in the water track, but none could be approached close enough to capture.

Only a small portion of this huge peatland was surveyed, and there are probably at least several other species waiting to be documented here. The fen should be surveyed again for *Aeshna*, and the bog is probably a good site for several other species of *Somatochlora*. This is probably the most easily accessed site for *A. subarctica*, and would be a good place to study this state record species.

Red Lake Ditch. This site is the ditch that parallels Highway 72, at the bridge that crosses to the “HWY 72 Bog/Fen” site mentioned above. The ditch is about 10 feet wide, and 3 feet deep, with a fairly rapid flow rate. Two larvae were collected from the ditch, *Aeshna umbrosa* and *Somatochlora minor*.

Dakota County/Scott County

Black Dog Preserve and Savage Fen were surveyed in these two counties, respectively. Both are calcareous seepage fens and were selected for potential *S. hineana* habitat. No *Somatochlora* were observed at either site, but *Celithemis eponina* and *Sympetrum obtrusum* were collected at Savage Fen and both were observed at Black Dog Preserve. Both fens are probably too fragmented and disturbed to support populations of *S. hineana*, but workers who live in proximity to these sites are encouraged to survey them again.

Koochiching County

Holstrum Road Bog. This is a forested bog off of the Holstrum Forest Road, and was selected as an undersurveyed habitat type. The overstory is predominantly black spruce, with many small *Sphagnum* pools and ericaceous shrubs as groundcover. The uncommon *Somatochlora forcipata* and was collected here, along with *S. walshii* and a *Dorocordulia libera* that was released. This site and other habitats like it should be surveyed more thoroughly in the future for other species of *Somatochlora*.

Lost River Spring Fen. This site was selected for potential *S. hineana* habitat, and though lacking dolomite bedrock, portions of the fen strongly resemble *S. hineana* sites in Upper Michigan. However, *Somatochlora* were scarce here, possibly due to the dry summer. Only a few notable species are mentioned here, for a complete list see Table 1. A single *S. franklini* was collected in a spring fen channel, as were 2 *S. walshii*. *Aeshna sitchensis* and *Sympetrum danae* were also collected, along with the damselflies *Lestes disjunctus*, *L. unguiculatus*, and *Nehellenia irene*. This site requires a 3 mile hike on a boggy winter trail to access, but is definitely worth surveying again. An early season visit may turn up

species not found in these surveys. The raised bog just east of the spring fen would also be worth surveying, but would be extremely difficult to access.

Table 1. Survey results for all non-river sites. State=Lifestage, A=Adult and L=larvae, T=Teneral
A blank “#” column indicates adults were observed only

COUNT	SITENAME	SPECIES	Stage	#	DATE	TOWNRAN	SEC	1/4
BELTRA	HWY 72 AT HUDEC'S RESORT	AESHNA INTERRUPTA	A	1	7/16/98	155N031W	31	
BELTRA	RED L SNA/HWY 72 BOG/FEN	LEUCORRHINIA HUDSONICA	A	1	7/16/98	156N030W	18	NW4
BELTRA	RED L SNA/HWY 72 BOG/FEN	LIBELLULA QUADRIMACULATA	A		7/16/98	156N030W	18	NW4
BELTRA	RED L SNA/HWY 72 BOG/FEN	SOMATOCHLORA FRANKLINI	A	1	7/16/98	156N030W	18	NW4
BELTRA	RED L SNA/HWY 72 BOG/FEN	AESHNA CANADENSIS	A	1	8/17/98	156N030W	18	N2
BELTRA	RED L SNA/HWY 72 BOG/FEN	AESHNA CONSTRICTA	A	1	8/17/98	156N030W	18	N2
BELTRA	RED L SNA/HWY 72 BOG/FEN	AESHNA SUBARCTICA	A	2	8/17/98	156N030W	18	N2
BELTRA	RED L SNA/HWY 72 BOG/FEN	SYMPETRUM DANAE	A	2	8/17/98	156N030W	18	N2
BELTRA	RED L SNA/HWY 72 BOG/FEN	SYMPETRUM OBTRUSUM	A	1	8/17/98	156N030W	18	N2
BELTRA	RED L SNA/HWY 72 BOG/FEN	SYMPETRUM VICINUM	A	1	8/17/98	156N030W	18	N2
DAKOT	BLACK DOG SNA	CELITHEMIS EPONINA	A	1	7/10/98	027N024W	27,34	
DAKOT	BLACK DOG SNA	SYMPETRUM OBTRUSUM	A	1	7/10/98	027N024W	27,34	
ITASCA	SQUAW LAKE AREA/HWY 46	AESHNA CANADENSIS	A	1	8/17/98	148N027W	29	
KOOCHI	HOLSTRUM RD BOG	AESHNA CANADENSIS	A	1	7/19/98	063N024W	18	NW4NW
KOOCHI	HOLSTRUM RD BOG	DOROCORDULIA LIBERA	A	1	7/19/98	063N024W	18	NW4NW
KOOCHI	HOLSTRUM RD BOG	LIBELLULA PULCHELLA	A		7/19/98	063N024W	18	NW4NW
KOOCHI	HOLSTRUM RD BOG	SOMATOCHLORA FORCIPATA	A	1	7/19/98	063N024W	18	NW4NW
KOOCHI	HOLSTRUM RD BOG	SOMATOCHLORA WALSHII	A	1	7/19/98	063N024W	18	NW4NW
KOOCHI	LOST RIVER SPRING FEN	AESHNA CANADENSIS	A	1	8/18/98	155N029W	35	
KOOCHI	LOST RIVER SPRING FEN	AESHNA SITCHENSIS	A	2	8/18/98	155N029W	35	
KOOCHI	LOST RIVER SPRING FEN	LESTES UNGUICULATUS	A	1	8/18/98	155N029W	35	
KOOCHI	LOST RIVER SPRING FEN	SYMPETRUM COSTIFERUM	A	2	8/18/98	155N029W	35	
KOOCHI	LOST RIVER SPRING FEN	SYMPETRUM OBTRUSUM	A	2	8/18/98	155N029W	35	
KOOCHI	LOST RIVER SPRING FEN	AESHNA CANADENSIS	A	1	7/16/98	155N029W	35	
KOOCHI	LOST RIVER SPRING FEN	AESHNA INTERRUPTA	A	1	7/16/98	155N029W	35	
KOOCHI	LOST RIVER SPRING FEN	AESHNA SITCHENSIS	A	1	7/16/98	155N029W	35	
KOOCHI	LOST RIVER SPRING FEN	LESTES DISJUNCTUS	A	1	7/16/98	155N029W	35	

COUNT	SITENAME	SPECIES	Stage	#	DATE	TOWNRAN	SEC	1/4
KOOCHI	LOST R SPRING FEN	LEUCORRHINIA HUDSONICA	A	1	7/16/98	155N029W	35	
KOOCHI	LOST R SPRING FEN	NEHALENNIA IRENE	A	2	7/16/98	155N029W	35	
KOOCHI	LOST R SPRING FEN	SOMATOCHLORA FRANKLINI	A	1	7/16/98	155N029W	35	
KOOCHI	LOST R SPRING FEN	SOMATOCHLORA WALSHII	A	2	7/16/98	155N029W	35	
KOOCHI	LOST R SPRING FEN	SYMPETRUM DANAE	A	1	7/16/98	155N029W	35	
KOOCHI	LOST R SPRING FEN	SYMPETRUM OBTRUSUM	A	1	7/16/98	155N029W	35	
KOOCHI	PINE ISLAND RD BOG	AESHNA UMBROSA	A	1	8/21/98	155N029W	05	E2
KOOCHI	RED LAKE DITCH	AESHNA UMBROSA	L	1	6/3/98	156N030W	18	NW4NW
KOOCHI	RED LAKE DITCH	SOMATOCHLORA MINOR	L	1	6/3/98	156N030W	18	NW4NW
KOOCHI	LOST R. SNA TRAIL	LESTES UNGUICULATUS	A	2	7/15/98	155N029W	33	NW4
KOOCHI	LOST R SNA TRAIL	SYMPETRUM OBTRUSUM	A	1	7/15/98	155N029W	33	NW4
LAKE	SAND LAKE SNA	COENAGRION INTERROGATUM	A	3	6/12/98	059N011W	35	
LAKE	SAND LAKE SNA	ENALLAGMA EBRIUM	A	1	6/12/98	059N011W	35	
LAKE	SAND LAKE SNA	EPITHECA SPINIGERA	A	1	6/12/98	059N011W	35	
LAKE	SAND LAKE SNA	LEUCORRHINIA HUDSONICA	T	1	6/12/98	059N011W	35	
LAKE	SAND LAKE SNA	LEUCORRHINIA HUDSONICA	A	2	6/12/98	059N011W	35	
LAKE	SAND LAKE SNA	LEUCORRHINIA PROXIMA	A	1	6/12/98	059N011W	35	
LAKE	SAND LAKE SNA	LIBELLULA QUADRIMACULATA	A	1	6/12/98	059N011W	35	
LAKE	SAND LAKE SNA	NEHALENNIA IRENE	A	1	6/12/98	059N011W	35	
LAKE	HWY 2 BOG	LEUCORRHINIA HUDSONICA	L	1	6/12/98	058N011W	13	E2
LAKE	HWY 2 BOG	SOMATOCHLORA FRANKLINI	L	1	6/12/98	058N011W	13	E2
LOTW	LOST LAKE TRAIL	AESHNA INTERRUPTA	A	1	8/21/98	159N035W	29	
LOTW	LOST LAKE TRAIL	AESHNA SUBARCTICA	A	2	8/21/98	159N035W	29	
LOTW	LOST LAKE TRAIL	LESTES CONGENER	A	2	8/21/98	159N035W	29	
LOTW	LOST LAKE TRAIL	SYMPETRUM DANAE	A	1	8/21/98	159N035W	29	
LOTW	LOST LAKE TRAIL	SYMPETRUM OBTRUSUM	A	2	8/21/98	159N035W	29	
LOTW	PITT RD NR RAPID R	AESHNA INTERRUPTA	A	1	7/17/98			
LOTW	WINTER LAKE RD SNA	AESHNA UMBROSA	L	1	7/18/98	160N035W	04	SE4
LOTW	WINTER LAKE RD SNA	EPITHECA CANIS	L	6	7/18/98	160N035W	04	SE4
LOTW	WINTER LAKE RD SNA	EPITHECA SPINIGERA	L	1	7/18/98	160N035W	04	SE4

COUNT	SITENAME	SPECIES	Stage	#	DATE	TOWNRAN	SEC	1/4
LOTW	WINTER LAKE RD SNA	SOMATOCHLORA MINOR	L	3	7/18/98	160N035W	04	SE4
LOTW	WINTER LAKE RD SNA	AESHNA SITCHENSIS	A	1	8/21/98	160N035W	04	E2
LOTW	WINTER LAKE RD SNA	ANAX JUNIUS	A	1	8/21/98	160N035W	04	E2
PINE	BELDON BOG	AESHNA CANADENSIS	A	1	6/23/98	044N016W	12	
PINE	BELDON BOG	DOROCORDULIA LIBERA	A	2	6/19/98	044N016W	12	
PINE	BELDON BOG	EPITHECA **UNIDENTIFIED**	A		6/19/98	044N016W	12	
PINE	BELDON BOG	LEUCORRHINIA HUDSONICA	A	1	6/19/98	044N016W	12	
PINE	BELDON BOG	LEUCORRHINIA PROXIMA	A	1	6/19/98	044N016W	12	
PINE	BELDON BOG	LIBELLULA QUADRIMACULATA	A		6/19/98	044N016W	12	
PINE	BELDON BOG	SOMATOCHLORA FRANKLINI	A	1	6/19/98	044N016W	12	
PINE	BELDON BOG	SOMATOCHLORA KENNEDYI	A	1	6/23/98	044N016W	12	
PINE	BLACK LAKE SNA	AESHNA CANADENSIS	A	1	9/17/98	045N016W	24	
ROSEAU	MINNESOTA HILL	AESHNA CONSTRICTA	A	2	8/19/98	1164N040	31	
ROSEAU	MINNESOTA HILL	SYMPETRUM COSTIFERUM	A	1	8/19/98	1164N040	31	
ROSEAU	MINNESOTA HILL RD	AESHNA CANADENSIS	A	3	7/17/98	164N040W	31	
ROSEAU	PINE CREEK SNA	AESHNA CANADENSIS	A	4	8/20/98	164N041W	25	
ROSEAU	PINE CREEK SNA	AESHNA SITCHENSIS	A	1	8/20/98	164N041W	25	
ROSEAU	PINE CREEK SNA	AESHNA SUBARCTICA	E	1	8/20/98	164N041W	25	
ROSEAU	PINE CREEK SNA	AESHNA SUBARCTICA	A	1	8/20/98	164N041W	25	
ROSEAU	PINE CREEK SNA	LESTES CONGENER	A	2	8/20/98	164N041W	25	
ROSEAU	PINE CREEK SNA	LESTES FORCIPATUS	A	1	8/20/98	164N041W	25	
ROSEAU	PINE CREEK SNA	LESTES UNGUICULATUS	A	1	8/20/98	164N041W	25	
ROSEAU	PINE CREEK SNA	SYMPETRUM COSTIFERUM	A	1	8/20/98	164N041W	25	
ROSEAU	PINE CREEK SNA	SYMPETRUM DANAE	A	2	8/20/98	164N041W	25	
ROSEAU	PINE CREEK SNA	SYMPETRUM OBTRUSUM	A	6	8/20/98	164N041W	25	
ROSEAU	SPRAGUE CR SP FEN	AESHNA SITCHENSIS	L	1	6/2/98	164N040W	34	NE4SE4
ROSEAU	SPRAGUE CR SP FEN	AESHNA SUBARCTICA	L	3	6/2/98	164N040W	34	NE4SE4
ROSEAU	SPRAGUE CR DITCH	AESHNA CONSTRICTA	A	3	8/19/98	163N039W	18	
ROSEAU	SPRAGUE CR DITCH	AESHNA INTERRUPTA	A	1	8/19/98	163N039W	18	
ROSEAU	SPRAGUE CR DITCH	AESHNA UMBROSA	A	1	8/19/98	163N039W	18	

COUNT	SITENAME	SPECIES	Stage	#	DATE	TOWNRAN	SEC	1/4
ROSEAU	SPRAGUE CR SP FEN	AESHNA CONSTRICTA	A	1	7/17/98	164N040W	34	E2
ROSEAU	SPRAGUE CR SP FEN	AESHNA INTERRUPTA	A	1	7/17/98	164N040W	34	E2
ROSEAU	SPRAGUE CR SP FEN	AESHNA SITCHENSIS	A	2	7/17/98	164N040W	34	E2
ROSEAU	SPRAGUE CR SP FEN	LESTES UNGUICULATUS	A	2	7/17/98	164N040W	34	E2
ROSEAU	SPRAGUE CR SP FEN	LEUCORRHINIA INTACTA	A	1	7/17/98	164N040W	34	E2
ROSEAU	SPRAGUE CR SP FEN	SYMPETRUM OBTRUSUM	A	3	7/17/98	164N040W	34	E2
ROSEAU	SPRAGUE DITCHES	AESHNA VERTICALIS	L	1	6/1/98	164N040W	36	SW4
ROSEAU	SPRAGUE DITCHES	EPITHECA CANIS	L	3	6/1/98	164N040W	36	SW4
ROSEAU	SPRAGUE DITCHES	LIBELLULA QUADRIMACULATA	L	6	6/1/98	164N040W	36	SW4
ROSEAU	SPRAGUE DITCHES	SYMPETRUM VICINUM	L	1	6/1/98	164N040W	36	SW4
SCOTT	SAVAGE FEN	CELITHEMIS EPONINA	A	1	7/10/98	115N021W	17	
SCOTT	SAVAGE FEN	SYMPETRUM OBTRUSUM	A	1	7/10/98	115N021W	17	
ST LOU	RD 694 PEATLAND	LEUCORRHINIA HUDSONICA	A	1	5/21/98	051N018W	24	NE4
ST LOU	RD 694 PEATLAND	LIBELLULA QUADRIMACULATA	A	1	5/21/98	051N018W	24	NE4
ST LOU	ANDY LAKE BOG	CORDULIA SHURTLEFFI	A	1	5/21/98	050N017W	04	NE4NW4
ST LOU	ANDY LAKE BOG	ENALLAGMA CYATHIGERUM	A	1	5/21/98	050N017W	04	NE4NW4
ST LOU	ANDY LAKE BOG	LEUCORRHINIA HUDSONICA	A	1	5/21/98	050N017W	04	NE4NW4

Pine Island Road Bog. A single *Aeshna umbrosa* was collected near Sphagnum filled ditch after it collided with the vehicle.

Lake County

Sand Lake SNA. This site was selected as an undersurveyed habitat, and was surveyed on June 12 for about two hours. The area surveyed was along the railroad grade that leads into the Cougar Lake area. Most specimens were collected in a semi-open swamp/fen south of the railroad grade at Cougar Lake. Most notable among these was the damselfly *Coenagrion interrogatum*, a new state record, along with *Nehellenia irene* and *Enallagma ebrium*. Several common *Leucorrhinia* and *Epitheca spinigera* were also collected, along with *Libellula quadrimaculata*. There are several other habitat types in this SNA that should be sampled again, especially the large areas of bog and bog forest.

Lake County HWY 2 Bog. This is a sparsely treed bog a short distance northwest of the Greenwood Lake boat landing, on the west side of the highway. Two larvae were collected in a shallow *Sphagnum*-lined pool, reared to adulthood, and determined to be *Leucorrhinia hudsonica* and *Somatochlora franklini*. This site is easily accessed and could be sampled again in other seasons to determine if it harbors other less common *Somatochlora* or *Aeshna* species.

Lake of the Woods County

Lost Lake Trail. This trail leads into the area of patterned fens at Mulligan Lake SNA, which was selected as possible *S. hineana* habitat. The approach of poor weather cut short the long hike that would have been necessary to reach the fens, so the trail itself was surveyed for feeding adults. *Aeshna subarctica*, *A. interrupta*, *Sympetrum danae*, *S. obtrusum*, and *Lestes congener* were collected where the trail passes a tamarack-black spruce bog.

Winter Lake Road SNA. This is a large fen/water track, but appears to be greatly disrupted by several drainage ditches that bisect it. There appears to be faint evidence of “patterning” in the fen. The fen was extremely dry during survey visits on July 18 and August 21. On the former day, no dragonflies were active so larvae were collected from the nearby drainage ditch. Once again, the lotic *S. minor* was collected, a species that probably would not occur in unditched peatlands. *Epitheca canis*, *E. spinigera*, and *A. umbrosa* larvae were also collected. On August 21, *A. sitchensis* were fairly plentiful but were difficult to capture due to wind. One partial specimen was finally brought down, sans head. *Anax junius* was also captured after a long stalk, and 2 pairs of *Sympetrum obtrusum* were gathered. This is one of the easiest *A. sitchensis* sites to access, and would be a good location for further study of that species. Only a very small portion of the huge water track was surveyed.

Pine County

Beldon Bog. This site was selected for its similarity to known *Somatochlora* sites in adjacent Douglas County Wisconsin. It is a forested spruce-tamarack bog with numerous *Sphagnum* pools, located just west of the old railroad grade several miles south of the

abandoned town of Beldon. This site yielded the 3 county records; *Somatochlora franklini*, *S. kennedyi*, and *Leucorrhinia hudsonica*, as well as *L. proxima*, *Aeshna canadensis*, and *Dorocordulia libera*. Other bog habitats in this area should be surveyed, especially the bogs at the Black Lake SNA to the north

Roseau County

Minnesota Hill Road and area. This upland site is situated between the two large wetland SNA's, Pine Creek and Sprague Creek. It was chosen as a good potential site for finding feeding *Somatochlora* originating in the wetland complexes on either side. No *Somatochlora* were seen in the area, but huge swarms of feeding *Aeshna* were seen on several occasions lining the roads and drainage ditches for many miles. These swarms consisted largely of *Aeshna interrupta lineata*, with some *A. canadensis* and *A. constricta*, and were the densest and most prolific swarms the senior author has ever seen. This would be an excellent site to collect *Aeshna interrupta lineata* and others for genetics research and other purposes, as numerous roadkills can be collected in a short time.

Pine Creek SNA. This site was surveyed for *S. hineana*, and Dr. James Duncan of Manitoba Natural Resources assisted with surveys. Polaris Industries of Roseau provided guides and vehicles to reach this huge, remote spring fen along the international border. The most interesting finds were *Aeshna subarctica* (1 adult, 1 exuvia), collected along the west edge of the spring fen, and *A. sitchensis*, which appeared to be common in the fens. A single *Lestes forcipatus* was also collected. This species is listed as questionable for MN (Westfall and May 1996), and probably represents a state record. We only surveyed a small corridor of habitat both north and south of the international border cut, so most of this large, unique, and undisturbed wetland remains unexplored. Our visit was in late August; this site should be sampled again earlier in the season. However, early season access may be extremely difficult, as wet conditions may preclude the use of ATV's along the border cut.

Sprague Creek Feeder Ditches. *Aeshna constricta* and *Aeshna i. lineata* were collected near these ditches that feed into Sprague Creek several miles northeast of Roseau.

Sprague Creek SNA/Sprague ditches. This is one of the least developed, but most easily accessed of the Minnesota spring fens. *Aeshna subarctica* and *A. sitchensis* larvae were collected from a spring fen channel on June 2, and *A. sitchensis* adults were collected on July 17. *Aeshna constricta* and *A. i. lineata* were also collected in July, and two small Corduliidae were observed but not captured. These may have been *Dorocordulia libera*, *Somatochlora minor*, or some other species. The ditches that were sampled intersect sections 34 and 35 near the east edge of the SNA. The county record *Aeshna verticalis* was collected here, along with several more common species. The ditch has a moderate flow rate, mucky substrate, and is vegetated with Sphagnum mosses and grasses. Although the spring fen is relatively easy to access compared with others, it is a huge sprawling complex covering most of Section 34, with many narrow, linear fens. The area

is difficult to navigate through due to dense vegetation even in the fens, and only a small portions of the total area was surveyed.

St. Louis County

County Road 694 Peatland. This is a large, mostly treeless bog that is bisected by County Road 694. Most of the bog was quite dry, possibly due to drainage ditches.

Leucorrhinia hudsonica and *Libellula quadrimaculata* were collected along the county road..

Andy Lake Bog. This boggy wetland is on the north side of US Highway 2, across the road from Andy Lake. It is quite small (several hectares), and only the relatively common species *Cordulia shurtleffi*, *L. hudsonica*, and *Enallagma cyathigerum* were collected.

The other sites in Table 1 not listed here, HWY 72 at Hudec's Resort (Beltrami County), Squaw Lake Area (Itasca County), Pitt Road Near Rapid River (LOTW County) are sites where single specimens of common species were collected.

Larval deformities. Dragonfly exuviae showed obvious signs of larval deformity in 11 of our river samples. The Rainy River was by far the worst both in numbers and the severity of the deformities, with 4.5-38% *Ophiogomphus* abnormalities in samples of greater than ten exuviae taken between International Falls and Baudette. Deformities even showed up in the small samples taken at Baudette on August 19, where 22% (2/9) *Stylurus notatus* and 100% (1/1) *O. colubrinus* were deformed. Other rivers with deformities were the Big Fork (2 sites), Rapid River (1 site), Cloquet River (1 site) and Mississippi River (2 sites). Deformities consisted of abnormal dorsal or lateral hooks, misshapen mouthparts antennae or terminal appendages, and in several Rainy River specimens, a "clubbed" leg with greatly shortened proximal and missing distal segments. Deformities were found in *Ophiogomphus colubrinus*, *O. rupinsulensis*, *Gomphurus fraternus*, *G vastus*, and *Stylurus notatus*. Although some of the deformities were of a relatively minor nature, some were quite severe. The severe nature of some of the Rainy River watershed deformities and the high occurrence rate leads us to suspect that there are many deformed individuals that do not survive long enough to emerge as adults.

Most of the rivers we sampled did not show these signs of deformity, so it is probable that the problem is localized to the specific rivers or sample sites rather than a more widespread phenomenon. This phenomenon has not been reported in dragonfly literature. There is literature linking contaminated sediments with deformities in midges (Warwick 1985), which can be a common food source for dragonflies. We want to stress that while we do not know the cause of the deformities, we offer the following possibilities. The Rainy River has suffered from serious pollution problems in the past, originating from industrial discharges in International Falls-Fort Frances. This pollution affected the entire length of the river at one time, and our samples showed a problem along the entire river. Pollution of some kind seems to be the most likely cause of the

deformities on the Rainy River, although other possible explanations should not be ruled out.

The International Joint Commission (IJC) described some of the wastes being dumped into the Rainy River several decades ago as "...pulp thickener, waste from the woodroom and bark recovery plant, overflow from the ash pond which receives the main boiler plant ashes, waste water from the sulphite screens and wet room, diluted spent sulphite liquor, bleach plant wastes, kraft mill wastes including lime sludge, wastes from the insulite mill, sewage wastes from the paper mill, backwash from the filtration plant and cooling water from the asphalt rodding mill. The Fort Frances plant discharged waste from the Tyler screens, waste from the sulphite deckers, lean white water overflow and sewage from the paper mill". They also reported that "benthos development was impeded...distribution of benthic animals was affected...the waters of the Rainy River are polluted to such a degree that they are unsatisfactory for recreation...unsafe for bathing..." and that "the waters of Rainy River are being polluted on each side of the international boundary to an extent that is injurious to property and a hazard to the health on the other side of the boundary" (IJC 1965).

The upper Mississippi River may have had some similar, though less serious, point source discharge problems at some of the populated areas like Bemidji, Brainerd, and possibly other locations. However, not all sample sites on the river showed deformities. Additional surveys on the river may help to determine the extent of the problem, and help narrow down problem areas. The small number (but high percentage) of deformities at only one site on the Cloquet River are difficult to speculate on. Other sample sites on the river did not reveal deformities, and there are no known (to us) sites of industrial discharge upstream of this site. The site itself is located at a railroad overpass, part of which is probably constructed of chemically treated wood that could conceivably leach contaminants into the river. This site should be sampled again more thoroughly, as should other sites on the Cloquet River, to determine if the deformities are an artifact of the small sample size and if they are indeed restricted to the one site.

The Rainy River is obviously a problem, and an international one. We recommend qualified scientists from state, federal, and/or provincial agencies or universities investigate the cause of these deformities and their implications for the river's health, and even human health. The International Rainy River Water Pollution Board and the International Joint Commission should be informed of our findings.

Exuviae and/or larval surveys on other U.S. and Canadian streams in the Rainy River watershed, or even Lake of the Woods, may provide insight into the geographic extent of the problem. Exuvia surveys are probably the most effective way to gather a large quantity of specimens in a short time, and exuviae could potentially be analyzed for possible toxins. Larval collection and rearing may be necessary to determine if there are severely deformed individuals that do not survive until emergence. Although we found deformities at 3 sites on 2 tributaries of the river (Rapid R. and Big Fork R.), 2 of these 3 sites are near the respective river's mouth on the Rainy and the deformed specimens may have originated from either water body. The third site was many miles inland on the

upper Big Fork, and the low incidence of deformity (1.3%) there might be due to random mutation or natural trauma. Additional surveys on the lower Big Fork may be helpful, but the Rapid River probably does not have suitable *Ophiogomphus* habitat upstream from its mouth. We did not survey the lower Littlefork River, another tributary to the Rainy, due to a lack of public access.

List of deformed exuviae:

Big Fork HWY 11 (near mouth), 1/20, 5% *O. rupinsulensis*
 Big Fork HWY 1 (upper Big Fork), 1/78, 1.3% *O. rupinsulensis*
 Cloquet River at Road 694. 2/12, 17 % *O. rupinsulensis*
 Rainy R. at I-Falls. 11/241, 4.6% *O. colubrinus*, 2/61, 3.3% *G. fraternus*
 Rainy River Between Little and Big fork River mouths 1/41 2.4% *G. fraternus*, 11/176,
 6.25% *O. colubrinus*, 1/41, 2.4% *G. vastus*
 Rainy River, Wayside west of birchdale, 64/718, 8.9% *O. colubrinus*, 5/13, 38% *O.*
rupinsulensis
 Rainy River, Vidas Landing, 8/164, 4.9% *O. colubrinus*
 Rainy at Baudette 2/9 22% *Stylurus notatus*, 1/1, 100% *O. colubrinus*
 Rapid River mouth at HWY 11, 1/13, 7.7% *G. fraternus*
 Mississippi R, Fort Ripley, 8/124, 6.5% *O. rupinsulensis*
 Mississippi R, Crow Wing State Park, 3/49, 6.1% *O. rupinsulensis*

River surveys

Note on tables-Sites with multiple table entries for the same species and lifestage on a given day indicate samples taken in different habitats, e.g. pool, run, riffle etc. Habitat data is available on request.

Big Fork River. The Big Fork River at our sample sites ranged from 120-250 feet wide, 3-8 feet deep, and all had a moderate current. Substrate was generally poor for Ophiogomphus, with downstream sites having a very high percentage of clay. The site at Hwy 1 in Itasca County has the best substrate. Unfortunately by the time this site was sampled most exuviae had been dislodged and were partially decayed. The Hwy 1 site may be worth sampling again, with better timing. The 3 specimens of the uncommon species *Gomphurus ventricosus* collected at the Hwy 11 site on 5/31 were morphologically ambiguous; they may have been either *G. ventricosus* or the closely related and more common *G. fraternus*.

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNITAS	HWY 1	6/3/98	DROMOGOMPHUS SPINOSUS	26	E	062N025W	23	SW4
MNITAS	HWY 1	6/3/98	DROMOGOMPHUS SPINOSUS	1	A	062N025W	23	SW4
MNITAS	HWY 1	6/3/98	GOMPHUS VIRIDIFRONS	31	E	062N025W	23	SW4
MNITAS	HWY 1	6/3/98	HAGENIUS BREVISTYLUS	5	E	062N025W	23	SW4
MNITAS	HWY 1	6/3/98	MACROMIA ILLINOIENSIS	1	E	062N025W	23	SW4
MNITAS	HWY 1	6/3/98	O. RUPINSULENSIS	78	E	062N025W	23	SW4
MNITAS	HWY 1	6/3/98	PHANOGOMPHUS LIVIDUS	1	E	062N025W	23	SW4
MNITAS	HWY 6	6/3/98	CALOPTERYX MACULATA	2	E	149N025W	01	SE4SE4
MNITAS	HWY 6	6/3/98	DROMOGOMPHUS SPINOSUS	71	E	149N025W	01	SE4SE4
MNITAS	HWY 6	6/3/98	ENALLAGMA **UNIDENTIFIED**	1	A	149N025W	01	SE4SE4
MNITAS	HWY 6	6/3/98	PHANOGOMPHUS GRASLINELLUS	1	A	149N025W	01	SE4SE4
MNKOOC	HWY 11	5/31/98	CALOPTERYX MACULATA	1	E	070N026W	32	NE4NW4
MNKOOC	HWY 11	5/31/98	GOMPHURUS FRATERNUS	62	E	070N026W	32	NE4NW4
MNKOOC	HWY 11	5/31/98	GOMPHURUS VASTUS	13	E	070N026W	32	NE4NW4
MNKOOC	HWY 11	5/31/98	GOMPHURUS VENTRICOSUS	3	E	070N026W	32	NE4NW4
MNKOOC	HWY 11	5/31/98	GOMPHUS VIRIDIFRONS	17	E	070N026W	32	NE4NW4
MNKOOC	HWY 11	5/31/98	MACROMIA ILLINOIENSIS	1	E	070N026W	32	NE4NW4
MNKOOC	HWY 11	5/31/98	O. RUPINSULENSIS	20	E	070N026W	32	NE4NW4
MNKOOC	HWY 11	7/18/98	GOMPHURUS FRATERNUS	1	E	070N026W	32	NE4NW4
MNKOOC	HWY 11	7/18/98	HAGENIUS BREVISTYLUS	2	E	070N026W	32	NE4NW4
MNKOOC	HWY 11	7/18/98	MACROMIA ILLINOIENSIS	1	E	070N026W	32	NE4NW4

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNKOOC	HWY 11	7/18/98	STYLURUS NOTATUS	3	E	070N026W	32	NE4NW4
MNKOOC	HWY 11	7/18/98	STYLURUS SPINICEPS	12	E	070N026W	32	NE4NW4

Cloquet River. The Cloquet River appears to be a very high quality, clean stream with moderate current at all sample sites. Substrate is generally quite good for *Ophiogomphus*, with abundant gravel, cobble, and sand at most locations. The Cloquet had a relatively high number of the uncommon *G. ventricosus*. A high percent of *O. rupinsulensis* with deformities were found in a small sample at the 694 Road sample site, and this site and others should be monitored again. The upper Cloquet River and its tributaries above Highway 53 have probably never been sampled and needs survey work. The total number of taxa on the river is probably greater than that indicated, as we only surveyed in May. Summer surveys are needed to document late emergers such as *Stylurus*.

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNSTLO	HWY 53	5/22/98	BASIAESCHNA JANATA	1	E	052N017W	26	NW4NE4
MNSTLO	HWY 53	5/22/98	CALOPTERYX MACULATA	1	E	052N017W	26	NW4NE4
MNSTLO	HWY 53	5/22/98	CORDULEGASTER MACULATA	1	E	052N017W	26	NW4NE4
MNSTLO	HWY 53	5/22/98	GOMPHUS VIRIDIFRONS	2	E	052N017W	26	NW4NE4
MNSTLO	HWY 53	5/22/98	OPHIOGOMPHUS RUPINSULENSIS	159	E	052N017W	26	NW4NE4
MNSTLO	HWY 53	5/22/98	OPHIOGOMPHUS RUPINSULENSIS	15	E	052N017W	26	NW4NE4
MNSTLO	HWY 53	5/22/98	PHANOGOMPHUS LIVIDUS	21	E	052N017W	26	NW4NE4
MNSTLO	HWY 7	5/21/98	GOMPHURUS FRATERNUS	1	E	051N017W	16	SW4
MNSTLO	HWY 7	5/21/98	GOMPHURUS VENTRICOSUS	1	E	051N017W	16	SW4
MNSTLO	HWY 7	5/21/98	GOMPHUS VIRIDIFRONS	1	E	051N017W	16	SW4
MNSTLO	HWY 7	5/21/98	OPHIOGOMPHUS RUPINSULENSIS	59	E	051N017W	16	SW4
MNSTLO	HWY 7	5/21/98	PHANOGOMPHUS LIVIDUS	19	E	051N017W	16	SW4
MNSTLO	HWY 7	5/26/98	CALOPTERYX MACULATA	1	E	051N017W	16	SW4
MNSTLO	HWY 7	5/26/98	GOMPHURUS FRATERNUS	5	E	051N017W	16	SW4
MNSTLO	HWY 7	5/26/98	GOMPHURUS VENTRICOSUS	6	E	051N017W	16	SW4
MNSTLO	HWY 7	5/26/98	GOMPHUS VIRIDIFRONS	1	E	051N017W	16	SW4
MNSTLO	HWY 7	5/26/98	OPHIOGOMPHUS RUPINSULENSIS	90	E	051N017W	16	SW4
MNSTLO	HWY 7	5/26/98	PHANOGOMPHUS LIVIDUS	1	E	051N017W	16	SW4
MNSTLO	HWY 8	5/26/98	EPITHECA **UNIDENTIFIED**	1	E	051N017W	04	SE4SE4

MNSTLO	HWY 8	5/26/98	EPITHECA **UNIDENTIFIED**		A	051N017W	04	SE4SE4
MNSTLO	HWY 8	5/26/98	EPITHECA SPINIGERA	1	A	051N017W	04	SE4SE4
MNSTLO	HWY 8	5/26/98	GOMPHURUS FRATERNUS	1	E	051N017W	04	SE4SE4
MNSTLO	HWY 8	5/26/98	GOMPHURUS VENTRICOSUS	7	E	051N017W	04	SE4SE4
MNSTLO	HWY 8	5/26/98	GOMPHUS ADELPHUS	2	E	051N017W	04	SE4SE4
MNSTLO	HWY 8	5/26/98	OPHIOGOMPHUS RUPINSULENSIS	319	E	051N017W	04	SE4SE4
MNSTLO	HWY 8	5/26/98	PHANOGOMPHUS LIVIDUS	8	E	051N017W	04	SE4SE4
MNSTLO	ROAD 694	5/21/98	GOMPHURUS FRATERNUS	1	E	051N017W	17	SE4
MNSTLO	ROAD 694	5/21/98	OPHIOGOMPHUS COLUBRINUS	1	E	051N017W	17	SE4
MNSTLO	ROAD 694	5/21/98	OPHIOGOMPHUS RUPINSULENSIS	12	E	051N017W	17	SE4
MNSTLO	ROAD 694	5/21/98	PHANOGOMPHUS LIVIDUS	2	E	051N017W	17	SE4

Crow Wing River. The Crow Wing was sampled in the lower portion where it was 300-400 ft. wide with moderate current, sand and gravel substrate and looked very suitable for *Ophiogomphus*. Below Motley to the mouth at the Mississippi River two large impoundments greatly reduce the habitat for *Ophiogomphus*. The water quality appeared to be good at Motley, but odonate diversity was low and density was as low as one specimen per 10,000 sq. ft of river bottom.. Montz sampled at least one site in this segment and taxonomic data are included below, but habitat and legal descriptions were not available. Sites above Motley were not sampled and probably have little promise, as a significant portion of the headwaters is not forested.

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNCASS	AT IRON CREEK	5/12/98	GOMPHURUS VASTUS	2	L			
MNCASS	AT IRON CREEK	5/12/98	OPHIOGOMPHUS RUPINSULENSIS	13	L			
MNCASS	AT IRON CREEK	5/26/98	GOMPHURUS FRATERNUS	1	E			
MNCASS	AT IRON CREEK	5/26/98	GOMPHURUS VASTUS	14	E			
MNCASS	AT IRON CREEK	5/26/98	OPHIOGOMPHUS RUPINSULENSIS	21	E			
MNCASS	AT IRON CREEK	6/11/98	GOMPHURUS VASTUS	3	L			
MNCASS	AT IRON CREEK	6/11/98	OPHIOGOMPHUS RUPINSULENSIS	14	L			
MNMOR	MOTLEY	5/27/98	BASIAESCHNA JANATA		A	133N031W	18	
MNMOR	MOTLEY	5/27/98	EPITHECA SPINIGERA	1	A	133N031W	18	
MNMOR	MOTLEY	5/27/98	GOMPHURUS FRATERNUS	5	E	133N031W	18	
MNMOR	MOTLEY	5/27/98	OPHIOGOMPHUS COLUBRINUS	2	E	133N031W	18	
MNMOR	MOTLEY	5/27/98	OPHIOGOMPHUS RUPINSULENSIS	62	E	133N031W	18	

Kettle River. The Kettle was sampled in the lower reaches as Haarstad had earlier covered the middle portion. Density was at least 1exuvia/100 sq. ft. of river bottom. Four of the 11 species found in this study are rare in MN. Sample sites ranged from 120-220 ft wide and were shallow with abundant gravel. The Maple Island site also had an abundance of large rocks and high numbers of *Neurocordulia yamaskanensis*. Both sites sampled in this segment had specimens of *O. howei* while the closest site (ca.7 RM) sampled upstream by Haarstad had none. This comprises the only confirmed breeding population in MN away from the St. Croix R.

COUNT	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNPINE	KBL ST. CROIX S.P.*	5/26/98	CALOPTERYX MACULATA	1	A	040N019W	33	SW4SW4
MNPINE	KBL ST. CROIX S.P.*	5/26/98	GOMPHURUS VENTRICOSUS	1	E	040N019W	33	SW4SW4
MNPINE	KBL ST. CROIX S.P.*	5/26/98	GOMPHUS ADELPHUS	2	E	040N019W	33	SW4SW4
MNPINE	KBL ST. CROIX S.P.*	5/26/98	GOMPHUS VIRIDIFRONS	34	E	040N019W	33	SW4SW4
MNPINE	KBL ST. CROIX S.P.*	5/26/98	N. YAMASKANENSIS	2	E	040N019W	33	SW4SW4
MNPINE	KBL ST. CROIX S.P.*	5/26/98	OPHIOGOMPHUS HOWEI	19	E	040N019W	33	SW4SW4
MNPINE	KBL ST. CROIX S.P.*	5/26/98	OPHIOGOMPHUS RUPINSULENSIS	67	E	040N019W	33	SW4SW4
MNPINE	KBL ST. CROIX S.P.*	5/26/98	PHANOGOMPHUS QUADRICOLOR	1	E	040N019W	33	SW4SW4
MNPINE	MAPLE I., ST. CROIX	5/26/98	BASIAESCHNA JANATA		A	040N020W	24	NE4NE4
MNPINE	MAPLE I., ST. CROIX	5/26/98	CORDULEGASTER MACULATA	2	E	040N020W	24	NE4NE4
MNPINE	MAPLE I., ST. CROIX	5/26/98	GOMPHURUS FRATERNUS	1	E	040N020W	24	NE4NE4
MNPINE	MAPLE I., ST. CROIX	5/26/98	GOMPHUS VIRIDIFRONS	21	E	040N020W	24	NE4NE4
MNPINE	MAPLE I., ST. CROIX	5/26/98	HAGENIUS BREVISTYLUS	11	E	040N020W	24	NE4NE4
MNPINE	MAPLE I., ST. CROIX	5/26/98	MACROMIA ILLINOIENSIS	1	E	040N020W	24	NE4NE4
MNPINE	MAPLE I., ST. CROIX	5/26/98	N. YAMASKANENSIS	27	E	040N020W	24	NE4NE4
MNPINE	MAPLE I., ST. CROIX	5/26/98	OPHIOGOMPHUS HOWEI	2	E	040N020W	24	NE4NE4
MNPINE	MAPLE I., ST. CROIX	5/26/98	OPHIOGOMPHUS RUPINSULENSIS	7	E	040N020W	24	NE4NE4

*KBL=Kennedy Brook Landing, St Croix State Park

Littlefork River. The Littlefork River had poor *Ophiogomphus* substrate at all sample sites, consisting largely of clay. The river ranged from 65-90 feet wide, and 2-8 feet deep, with a moderate to fast current. Few exuviae were collected at each site, and diversity at each site was quite low. An interesting find was an exuviae of *Somatochlora minor* at the Dentaybow Canoe Access. This species is usually found in much smaller stream, and may have washed out of a tributary to the Littlefork. Additional surveys on the Littlefork should concentrate on the relatively few sites with rocky substrate, most of which are accessible only by canoe.

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNKOOC	DENTAYBOW	5/29/98	CALOPTERYX MACULATA	1	E	155N024W	18	NW4NW4
MNKOOC	DENTAYBOW	5/29/98	GOMPHURUS FRATERNUS	1	E	155N024W	18	NW4NW4
MNKOOC	DENTAYBOW	5/29/98	GOMPHUS VIRIDIFRONS	7	E	155N024W	18	NW4NW4
MNKOOC	DENTAYBOW	5/29/98	OPHIOGOMPHUS COLUBRINUS	3	E	155N024W	18	NW4NW4
MNKOOC	DENTAYBOW	5/29/98	OPHIOGOMPHUS RUPINSULENSIS	16	E	155N024W	18	NW4NW4
MNKOOC	DENTAYBOW	5/29/98	SOMATOCHLORA MINOR	1	E	155N024W	18	NW4NW4
MNKOOC	SAMUELSON PARK	5/29/98	GOMPHURUS FRATERNUS	1	E	063N022W	13	NW4
MNKOOC	SAMUELSON PARK	5/29/98	GOMPHUS VIRIDIFRONS	3	E	063N022W	13	NW4
MNKOOC	SAMUELSON PARK	5/29/98	N. YAMASKANENSIS	3	E	063N022W	13	NW4
MNKOOC	SAMUELSON PARK	5/29/98	OPHIOGOMPHUS RUPINSULENSIS	26	E	063N022W	13	NW4
MNSTLO	HWY 1	6/3/98	DIDYMOPS TRANSVERSA	1	E	062N020W	16	NW4NE4
MNSTLO	HWY 1	6/3/98	DROMOGOMPHUS SPINOSUS	6	E	062N020W	16	NW4NE4
MNSTLO	HWY 1	6/3/98	HAGENIUS BREVISTYLUS	1	E	062N020W	16	NW4NE4
MNSTLO	HWY 1	6/3/98	N. YAMASKANENSIS	3	E	062N020W	16	NW4NE4
MNSTLO	HWY 1	6/3/98	OPHIOGOMPHUS RUPINSULENSIS	1	E	062N020W	16	NW4NE4
MNSTLO	HWY 1	6/3/98	PHANOGOMPHUS LIVIDUS	3	E	062N020W	16	NW4NE4

Long Prairie River. This stream wasn't initially targeted for rare Ophiogomphus surveys because of the high proportion of non-forested land in the watershed. One sample was taken at Motley where it was about 100 ft. wide, and shallow with sand and gravel predominant. Minimum density was about one per 100 sq. foot. The odonate fauna was typical of a warmwater stream with some perturbations in the watershed. Summer sampling for *Stylurus* might be worth the effort.

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT
MNMORR	S OF MOTLEY	5/27/98	GOMPHURUS FRATERNUS	22	E	133N031W	19
MNMORR	S OF MOTLEY	5/27/98	GOMPHURUS VASTUS	2	E	133N031W	19
MNMORR	S OF MOTLEY	5/27/98	OPHIOGOMPHUS RUPINSULENSIS	21	E	133N031W	19
MNMORR	S OF MOTLEY	5/27/98	PHANOGOMPHUS **UNIDENTIFIED**	3	E	133N031W	19

Mississippi River. The Mississippi was sampled at 11 sites starting at just below Grand Rapids downstream to just above St. Cloud. This segment had been little sampled previously and had the greatest potential for target species. Sample site widths ranged from 120-952 ft. wide. Heavy shoreline clay was apparent because of low water levels, but most sites had moderate current, deep water and riffles, and apparently had gravel substrate away from shore, based on the presence of *O. rupinsulensis* at all sites. Both odonate diversity and density at all sites was much lower than expected for a large stream in a forested watershed. Apparently the clay plain which the river drains, several significant land -use problems and a pollution history combine to limit odonate diversity in this part of the Mississippi River. Slight dragonfly deformities/abnormalities were noted at two sites. The site with the greatest diversity including a specimen of *O. howei* was the uppermost one sampled and further samples in the Grand Rapids area are needed. Below the Twin Cities downstream to the Iowa border the Mississippi R. hold promise for several species including new state records and rare species such as *Macromia taeniolata*, *Neurocordulia molesta*, *N. yamaskanensis*, *Stylurus amnicola*, *S. notatus*, and *S. plagiatus*.

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT
MNAITK	BELOW WALDECK	5/28/98	GOMPHURUS FRATERNUS	1	E	048N026W	14
MNAITK	BELOW WALDECK	5/28/98	GOMPHURUS VASTUS	37	E	048N026W	14
MNAITK	BELOW WALDECK	5/28/98	OPHIOGOMPHUS RUPINSULENSIS	72	E	048N026W	14
MNAITK	JACOBSON	5/28/98	GOMPHURUS FRATERNUS	14	E	052N023W	09
MNAITK	JACOBSON	5/28/98	GOMPHURUS VASTUS	18	E	052N023W	09
MNCRWG	CROW WING S. P.	5/27/98	BASIAESCHNA JANATA	1	A	044N032W	24
MNCRWG	CROW WING S. P.	5/27/98	GOMPHURUS FRATERNUS	17	E	044N032W	24
MNCRWG	CROW WING S. P.	5/27/98	GOMPHURUS VASTUS	102	E	044N032W	24
MNCRWG	CROW WING S. P.	5/27/98	OPHIOGOMPHUS RUPINSULENSIS	49	E	044N032W	24
MNCRWG	CTH 6	5/28/98	GOMPHURUS FRATERNUS	5	E	047N029W	24
MNCRWG	CTH 6	5/28/98	GOMPHURUS VASTUS	29	E	047N029W	24
MNCRWG	CTH 6	5/28/98	OPHIOGOMPHUS RUPINSULENSIS	31	E	047N029W	24
MNCRWG	FORT RIPLEY	5/13/98	OPHIOGOMPHUS RUPINSULENSIS	6	L		
MNCRWG	FORT RIPLEY	6/11/98	OPHIOGOMPHUS RUPINSULENSIS	14	L		
MNCRWG	FORT RIPLEY	5/27/98	GOMPHURUS FRATERNUS	2	E	043N032W	27
MNCRWG	FORT RIPLEY	5/27/98	GOMPHURUS VASTUS	32	E	043N032W	27
MNCRWG	FORT RIPLEY	5/27/98	OPHIOGOMPHUS RUPINSULENSIS	124	E	043N032W	27
MNITAS	BEERS LANDING	5/28/98	DROMOGOMPHUS SPINOSUS	1	E	054N024W	28
MNITAS	BEERS LANDING	5/28/98	GOMPHURUS FRATERNUS	11	E	054N024W	28
MNITAS	BEERS LANDING	5/28/98	GOMPHURUS VASTUS	13	E	054N024W	28

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT
MNITAS	BEERS LANDING	5/28/98	OPHIOGOMPHUS HOWEI	1	E	054N024W	28
MNITAS	BEERS LANDING	5/28/98	OPHIOGOMPHUS RUPINSULENSIS	5	E	054N024W	28
MNITAS	BEERS LANDING	5/28/98	PHANOGOMPHUS LIVIDUS	1	E	054N024W	28
MNMORR	BELLE PRAIRIE	5/27/98	GOMPHURUS FRATERNUS	2	E	041N032W	14
MNMORR	BELLE PRAIRIE	5/27/98	GOMPHURUS VASTUS	19	E	041N032W	14
MNMORR	BELLE PRAIRIE	5/27/98	OPHIOGOMPHUS RUPINSULENSIS	15	E	041N032W	14
MNMORR	BELOW MCDUGAL I.	5/27/98	BASIAESCHNA JANATA	1	A	039N032W	32
MNMORR	BELOW MCDUGAL I.	5/27/98	GOMPHURUS FRATERNUS	2	E	039N032W	32
MNMORR	BELOW MCDUGAL I.	5/27/98	GOMPHURUS VASTUS	16	E	039N032W	32
MNMORR	BELOW MCDUGAL I.	5/27/98	OPHIOGOMPHUS RUPINSULENSIS	56	E	039N032W	32
MNMORR	WAYSIDE SITE	5/27/98	GOMPHURUS VASTUS	13	E		
MNMORR	WAYSIDE SITE	5/27/98	OPHIOGOMPHUS RUPINSULENSIS	58	E		
MNSTEA	GILLIGANS LANDING	5/27/98	GOMPHURUS FRATERNUS	17	E	126N028W	20
MNSTEA	GILLIGANS LANDING	5/27/98	GOMPHURUS VASTUS	4	E	126N028W	20
MNSTEA	GILLIGANS LANDING	5/27/98	OPHIOGOMPHUS RUPINSULENSIS	1	E	126N028W	20
MNSTEA	MISSISSIPPI CO PARK	5/27/98	GOMPHURUS FRATERNUS	2	E	126N028W	16
MNSTEA	MISSISSIPPI CO PARK	5/27/98	GOMPHURUS VASTUS	10	E	126N028W	16
MNSTEA	MISSISSIPPI CO PARK	5/27/98	OPHIOGOMPHUS RUPINSULENSIS	18	E	126N028W	16
MNSTEA	RIGHT OF WAY	5/27/98	GOMPHURUS FRATERNUS	22	E	127N029W	36
MNSTEA	RIGHT OF WAY	5/27/98	GOMPHURUS VASTUS	18	E	127N029W	36
MNSTEA	RIGHT OF WAY	5/27/98	OPHIOGOMPHUS RUPINSULENSIS	85	E	127N029W	36

Pigeon River. Description based on Montz, (1993), no legal descriptions available. A medium-sized, cool-warmwater, high gradient stream with several rapids, falls, and gorges in a mostly forested watershed. Bottom materials contained boulder/cobble mixture over a sand or sand/gravel bottom. In sections the substrate was bedrock with small amounts of sand. Occasional patches of silt and clay were found below Middle Falls. Overall macroinvertebrate diversity was high and included several rare MN insects and many taxa intolerant to organic pollution. So far this is the only MN stream known to harbor a population of *O. anomalus*. Large portions of the Pigeon have not been sampled for odonates and exuviae sampling has not been conducted anywhere on the river. Protection of this intact aquatic community and further inventory are a high priority.

RIVER	COUNTY	SITENAME	DATE	SPECIES	#	STAGE
PIGEON R	MNCOOK	1-4	7/27/92	OPHIOGOMPHUS ANOMALUS	2	L
PIGEON R	MNCOOK	1-4	7/27/92	OPHIOGOMPHUS RUPINSULENSIS	1	L
PIGEON R	MNCOOK	10-3	6/22/92	OPHIOGOMPHUS ANOMALUS	1	L
PIGEON R	MNCOOK	10-3	6/22/92	OPHIOGOMPHUS RUPINSULENSIS	1	L
PIGEON R	MNCOOK	13-2	6/23/92	OPHIOGOMPHUS ANOMALUS	1	L
PIGEON R	MNCOOK	15-4	6/23/92	OPHIOGOMPHUS RUPINSULENSIS	1	L
PIGEON R	MNCOOK	16-4	8/1/92	OPHIOGOMPHUS COLUBRINUS	1	L
PIGEON R	MNCOOK	16-4	8/1/92	OPHIOGOMPHUS RUPINSULENSIS	1	L
PIGEON R	MNCOOK	18-1	6/23/92	OPHIOGOMPHUS ANOMALUS	1	L
PIGEON R	MNCOOK	18-1	6/23/92	OPHIOGOMPHUS RUPINSULENSIS	1	L
PIGEON R	MNCOOK	6-1	6/22/92	OPHIOGOMPHUS ANOMALUS	1	L
PIGEON R	MNCOOK	7-4	7/23/93	OPHIOGOMPHUS ANOMALUS	1	L
PIGEON R	MNCOOK	7-4	7/23/93	OPHIOGOMPHUS RUPINSULENSIS	1	L
PIGEON R	MNCOOK	SITE # 3-4	7/27/93	OPHIOGOMPHUS RUPINSULENSIS	1	L

Rainy River. The Rainy River is a wide deep river that runs only about 85 miles from it's source in International Falls to Lake of The Woods. The river width ranges from 600-1000 feet (estimated), and depths run to 20 feet in some places. The current is moderate, and though most areas have a significant amount of clay substrate, there is also ample gravel, sand and rubble that should provide adequate *Ophiogomphus* habitat. Dragonfly abundance was extremely high on the river and *O. colubrinus* were extremely abundant, but diversity was quite low, even with summer sampling, for a large river with suitable substrate. A significant amount of dragonfly deformities were noted along the entire length of the river, especially in the genus *Ophiogomphus*. The low diversity despite summer sampling for late emergers, coupled with the deformities, may indicate that the river has significant problems. Drawdown at upstream sites is significant. The health of the Rainy River watershed, it's dragonflies and other aquatic fauna should be investigated.

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNKOOC	BET LITTLE/BIG FORK	5/30/98	GOMPHURUS FRATERNUS	207	E	070N026W	35	NW4
MNKOOC	BET LITTLE/BIG FORK	5/30/98	GOMPHURUS VASTUS	120	E	070N026W	35	NW4
MNKOOC	BET LITTLE/BIG FORK	5/30/98	GOMPHURUS VENTRICOSUS	4	E	070N026W	35	NW4
MNKOOC	BET LITTLE/BIG FORK	5/30/98	GOMPHUS VIRIDIFRONS	3	E	070N026W	35	NW4
MNKOOC	BET LITTLE/BIG FORK	5/30/98	OPHIOGOMPHUS **UNIDENTIFIED**	1	E	070N026W	35	NW4
MNKOOC	BET LITTLE/BIG FORK	5/30/98	OPHIOGOMPHUS COLUBRINUS	772	E	070N026W	35	NW4

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNKOOC	BET LITTLE/BIG FORK	5/30/98	OPHIOGOMPHUS RUPINSULENSIS	19	E	070N026W	35	NW4
MNKOOC	INTERNATIONAL FALLS	5/29/98	GOMPHURUS FRATERNUS	61	E	071N024W	32	SE4
MNKOOC	INTERNATIONAL FALLS	5/29/98	OPHIOGOMPHUS COLUBRINUS	241	E	071N024W	32	SE4
MNKOOC	MANITOU RAPIDS	5/31/98	GOMPHURUS FRATERNUS	3	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	GOMPHURUS FRATERNUS	18	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	GOMPHURUS VASTUS	2	A	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	GOMPHURUS VASTUS	63	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	GOMPHURUS VASTUS	51	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	GOMPHURUS VENTRICOSUS	1	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	GOMPHUS VIRIDIFRONS	1	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	GOMPHUS VIRIDIFRONS	1	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	MACROMIA ILLINOIENSIS	1	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	NEUROCORDULIA YAMASKANENSIS	4	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	OPHIOGOMPHUS COLUBRINUS	283	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	OPHIOGOMPHUS COLUBRINUS	310	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	OPHIOGOMPHUS COLUBRINUS	1	A	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	OPHIOGOMPHUS RUPINSULENSIS	5	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	5/31/98	OPHIOGOMPHUS RUPINSULENSIS	4	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	7/18/98	STYLURUS AMNICOLA	1	E	160N026W	36	S2
MNKOOC	MANITOU RAPIDS	7/18/98	STYLURUS NOTATUS	6	E	160N026W	36	S2
MNKOOC	VIDAS LANDING	6/1/98	GOMPHURUS FRATERNUS	25	E	161N029W	06	NE4
MNKOOC	VIDAS LANDING	6/1/98	GOMPHURUS VASTUS	38	E	161N029W	06	NE4
MNKOOC	VIDAS LANDING	6/1/98	OPHIOGOMPHUS COLUBRINUS	164	E	161N029W	06	NE4
MNKOOC	VIDAS LANDING	7/18/98	GOMPHURUS VASTUS	3	E	161N029W	06	NE4
MNKOOC	VIDAS LANDING	7/18/98	OPHIOGOMPHUS COLUBRINUS	6	E	161N029W	06	NE4
MNKOOC	VIDAS LANDING	7/18/98	STYLURUS AMNICOLA	1	E	161N029W	06	NE4
MNKOOC	VIDAS LANDING	7/18/98	STYLURUS NOTATUS	5	E	161N029W	06	NE4
MNKOOC	WAYSIDE W. OF HWY 4	5/31/98	GOMPHURUS FRATERNUS	99	E	160N027W	30	SE4
MNKOOC	WAYSIDE W. OF HWY 4	5/31/98	GOMPHURUS VASTUS	103	E	160N027W	30	SE4
MNKOOC	WAYSIDE W. OF HWY 4	5/31/98	OPHIOGOMPHUS COLUBRINUS	713	E	160N027W	30	SE4
MNKOOC	WAYSIDE W. OF HWY 4	5/31/98	OPHIOGOMPHUS RUPINSULENSIS	13	E	160N027W	30	SE4
MNKOOC	WAYSIDE W. OF HWY 4	7/18/98	GOMPHURUS VASTUS	3	E	160N027W	30	SE4

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNKOOC	WAYSIDE W. OF HWY 4	7/18/98	OPHIOGOMPHUS COLUBRINUS	5	E	160N027W	30	SE4
MNKOOC	WAYSIDE W. OF HWY 4	7/18/98	STYLURUS NOTATUS	17	E	160N027W	30	SE4
MNKOOC	WAYSIDE W. OF HWY 4	7/18/98	STYLURUS SPINICEPS	1	E	160N027W	30	SE4
MNLOTW	BAUDETTE	8/19/98	ANAX **UNIDENTIFIED**	1	E	161N031W	35	
MNLOTW	BAUDETTE	8/19/98	GOMPHURUS VASTUS	1	E	161N031W	35	
MNLOTW	BAUDETTE	8/19/98	OPHIOGOMPHUS COLUBRINUS	1	E	161N031W	35	
MNLOTW	BAUDETTE	8/19/98	STYLURUS NOTATUS	9	E	161N031W	35	
MNLOTW	WHEELER POINT	6/1/98	GOMPHURUS FRATERNUS	1	E	162N032W	34	
MNLOTW	WHEELER POINT	6/1/98	GOMPHURUS VASTUS	2	E	162N032W	34	
MNLOTW	WHEELER POINT	6/1/98	OPHIOGOMPHUS COLUBRINUS	2	E	162N032W	34	

Rapid River. We only sampled one site, at the mouth of the river at its confluence with the Rainy River. Upstream of this site the Rapid River probably does not have quality *Ophiogomphus* habitat, as it flows through a clay plain. The most notable thing we saw at this site was one *G. fraternus* that had a severely deformed ligula (mouthpart).

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNLOTW	AT MOUTH	6/11/98	GOMPHURUS FRATERNUS	13	E	160N030W	12	
MNLOTW	AT MOUTH	6/11/98	GOMPHURUS VENTRICOSUS	1	E	160N030W	12	
MNLOTW	AT MOUTH	6/11/98	OPHIOGOMPHUS COLUBRINUS	2	E	160N030W	12	
MNLOTW	AT MOUTH	6/11/98	OPHIOGOMPHUS RUPINSULENSIS	4	E	160N030W	12	

Snake River. The Snake was only sampled at its mouth as it was previously well sampled by Haardstad, 1994. The mouth of the river is somewhat braided and is subject to occasional flow from the St Croix River when its running high. The high diversity and rare species found here undoubtedly have to do with specimens that originated in the St. Croix being washed into the lower few feet of the Snake.

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNPINE	SNAKE R LANDING	5/22/98	CALOPTERYX MACULATA	1	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	DIDYMOPS TRANSVERSA	5	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	EPITHECA CANIS	2	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS FRATERNUS	3	E	039N019W	31	NE4SW4

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS VASTUS	3	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS VENTRICOSUS	12	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHUS ADELPHUS	1	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHUS VIRIDIFRONS	53	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	MACROMIA ILLINOIENSIS	1	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	OPHIOGOMPHUS HOWEI	8	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	OPHIOGOMPHUS RUPINSULENSIS	5	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	OPHIOGOMPHUS SUSBEHCHA	1	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	PHANOGOMPHUS QUADRICOLOR	3	E	039N019W	31	NE4SW4

St. Croix River. The St. Croix River is the premier large non-wadeable warmwater stream in the Midwest, harboring rich aquatic insect, mussel and fish communities. Good populations of many rare species of aquatic animals are found here. The upper MN portion of the St. Croix is notable for its relatively stable flow, abundant gravel, cobble, sand and boulder substrate with numerous springs and seeps along its banks. This segment contains one of only two healthy populations of *O. susbehcha* known anywhere, plus healthy populations of *O. howei*, *Gomphurus lineatifrons*, *G. ventricosus*, *Neurocordulia yamaskanensis*, and *Stylurus amnicola*. Occasionally *O. anomalus* is found on the WI side. Downstream the Indianhead Flowage, formed by the power dam at St. Croix Falls, reduces or obliterates habitat for most of these lotic species. Below the dam is Interstate Park with its large rocky gorge and bedrock substrate (marginal habitat). Just below the gorge the river has several miles of moderate current and gravel and sand substrate and it again harbors several rare odonate species, although in much lower numbers. Size ranged from 170 ft. wide in the upper MN reaches to 570 ft wide at Marine-on-the-St. Croix. The immediate river corridor is well protected by the National Park Service. Tributaries with watersheds outside of the protective corridor are probably the biggest threat to long-term survival of the St. Croix biota. The Snake R was noted to be running very muddy after a rainfall event in contrast to the St. Croix. Nonpoint pollution control on the Snake should be a priority of the MN DNR

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNCHIS	FRANCONIA	5/20/98	DIDYMOPS TRANSVERSA	1	E	033N019W	02	SW4SW4
MNCHIS	FRANCONIA	5/20/98	GOMPHURUS FRATERNUS	2	E	033N019W	02	SW4SW4
MNCHIS	FRANCONIA	5/20/98	GOMPHURUS VASTUS	5	E	033N019W	02	SW4SW4
MNCHIS	FRANCONIA	5/20/98	GOMPHURUS VENTRICOSUS	1	E	033N019W	02	SW4SW4
MNCHIS	FRANCONIA	5/20/98	GOMPHUS VIRIDIFRONS	5	E	033N019W	02	SW4SW4
MNCHIS	FRANCONIA	5/20/98	OPHIOGOMPHUS RUPINSULENSIS	2	E	033N019W	02	SW4SW4

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNCHIS	FRANCONIA	5/20/98	OPHIOGOMPHUS SUSBEHCHA	1	E	033N019W	02	SW4SW4
MNCHIS	OSCEOLA LANDING	5/20/98	DIDYMOPS TRANSVERSA	1	E	033N019W	28	NE4NE4
MNCHIS	OSCEOLA LANDING	5/20/98	GOMPHURUS FRATERNUS	3	E	033N019W	28	NE4NE4
MNCHIS	OSCEOLA LANDING	5/20/98	GOMPHURUS VASTUS	4	E	033N019W	28	NE4NE4
MNPINE	ACROSS FROM PL**	5/28/98	BASIAESCHNA JANATA		A	042N016W	36	SW4SW4
MNPINE	ACROSS FROM PL**	5/28/98	DIDYMOPS TRANSVERSA	2	E	042N016W	36	SW4SW4
MNPINE	ACROSS FROM PL**	5/28/98	GOMPHURUS LINEATIFRONS	9	E	042N016W	36	SW4SW4
MNPINE	ACROSS FROM PL**	5/28/98	GOMPHURUS VENTRICOSUS	1	E	042N016W	36	SW4SW4
MNPINE	ACROSS FROM PL**	5/28/98	GOMPHUS ADELPHUS	12	E	042N016W	36	SW4SW4
MNPINE	ACROSS FROM PL**	5/28/98	GOMPHUS VIRIDIFRONS	3	E	042N016W	36	SW4SW4
MNPINE	ACROSS FROM PL**	5/28/98	HAGENIUS BREVISTYLUS	5	E	042N016W	36	SW4SW4
MNPINE	ACROSS FROM PL**	5/28/98	OPHIOGOMPHUS HOWEI	92	E	042N016W	36	SW4SW4
MNPINE	ACROSS FROM PL**	5/28/98	OPHIOGOMPHUS RUPINSULENSIS	62	E	042N016W	36	SW4SW4
MNPINE	ACROSS FROM PL**	5/28/98	PHANOGOMPHUS EXILIS	1	E	042N016W	36	SW4SW4
MNPINE	ACROSS FROM PL**	5/28/98	PHANOGOMPHUS LIVIDUS	1	E	042N016W	36	SW4SW4
MNPINE	ACROSS FROM PL**	5/28/98	PHANOGOMPHUS QUADRICOLOR	17	E	042N016W	36	SW4SW4
MNPINE	CHENGWATANA S. F.	5/29/98	BASIAESCHNA JANATA		A	039N019W	30	NE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	BASIAESCHNA JANATA	2	E	039N019W	17	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	DIDYMOPS TRANSVERSA	1	E	039N019W	30	NE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	DIDYMOPS TRANSVERSA	2	E	039N019W	08	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	DROMOGOMPHUS SPINOSUS	1	E	039N019W	08	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	DROMOGOMPHUS SPINOSUS	8	E	039N019W	30	NE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	DROMOGOMPHUS SPINOSUS	1	E	039N019W	17	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	GOMPHURUS FRATERNUS	1	E	039N019W	30	NE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	GOMPHURUS LINEATIFRONS	1	E	039N019W	30	NE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	GOMPHURUS LINEATIFRONS	1	E	039N019W	08	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	GOMPHURUS VASTUS	10	E	039N019W	30	NE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	GOMPHURUS VENTRICOSUS	2	E	039N019W	30	NE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	GOMPHUS ADELPHUS	4	E	039N019W	17	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	GOMPHUS ADELPHUS	13	E	039N019W	30	NE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	GOMPHUS ADELPHUS	9	E	039N019W	08	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	GOMPHUS VIRIDIFRONS	26	E	039N019W	08	SE4SE4

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNPINE	CHENGWATANA S. F.	5/29/98	GOMPHUS VIRIDIFRONS	50	E	039N019W	30	NE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	GOMPHUS VIRIDIFRONS	24	E	039N019W	17	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	HAGENIUS BREVISTYLUS	8	E	039N019W	08	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	HAGENIUS BREVISTYLUS	1	E	039N019W	30	NE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	HAGENIUS BREVISTYLUS	10	E	039N019W	17	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	MACROMIA ILLINOIENSIS	2	E	039N019W	08	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	OPHIOGOMPHUS HOWEI	3	E	039N019W	30	NE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	OPHIOGOMPHUS HOWEI	5	E	039N019W	08	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	OPHIOGOMPHUS HOWEI	36	E	039N019W	17	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	OPHIOGOMPHUS RUPINSULENSIS	40	E	039N019W	08	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	OPHIOGOMPHUS RUPINSULENSIS	86	E	039N019W	30	NE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	OPHIOGOMPHUS RUPINSULENSIS	74	E	039N019W	17	SE4SE4
MNPINE	CHENGWATANA S. F.	5/29/98	PHANOGOMPHUS LIVIDUS	1	E	039N019W	08	SE4SE4
MNPINE	HWY 70	6/5/98	DROMOGOMPHUS SPINOSUS	3	E	038N020W	13	SW4SE4
MNPINE	HWY 70	6/5/98	GOMPHURUS VASTUS	1	E	038N020W	13	SW4SE4
MNPINE	HWY 70	6/5/98	GOMPHURUS VENTRICOSUS	3	E	038N020W	13	SW4SE4
MNPINE	HWY 70	6/5/98	GOMPHUS VIRIDIFRONS	38	E	038N020W	13	SW4SE4
MNPINE	HWY 70	6/5/98	OPHIOGOMPHUS HOWEI	2	E	038N020W	13	SW4SE4
MNPINE	HWY 70	6/5/98	OPHIOGOMPHUS RUPINSULENSIS	5	E	038N020W	13	SW4SE4
MNPINE	HWY 70	6/5/98	PHANOGOMPHUS QUADRICOLOR	1	E	038N020W	13	SW4SE4
MNPINE	HWY 70	6/5/98	STYLURUS AMNICOLA	1	E	038N020W	13	SW4SE4
MNPINE	HWY 70	7/21/98	GOMPHURUS LINEATIFRONS	3	E	038N020W	13	SW4SW4
MNPINE	HWY 70	7/21/98	GOMPHUS VIRIDIFRONS	4	E	038N020W	13	SW4SW4
MNPINE	HWY 70	7/21/98	HAGENIUS BREVISTYLUS	3	E	038N020W	13	SW4SW4
MNPINE	HWY 70	7/21/98	MACROMIA ILLINOIENSIS	1	E	038N020W	13	SW4SW4
MNPINE	HWY 70	7/21/98	OPHIOGOMPHUS RUPINSULENSIS	2	E	038N020W	13	SW4SW4
MNPINE	HWY 70	7/21/98	STYLURUS SPINICEPS	3	E	038N020W	13	SW4SW4
MNPINE	HWY 70	5/19/98	GOMPHURUS FRATERNUS	2	E	038N020W	13	SW4SE4
MNPINE	HWY 70	5/19/98	GOMPHURUS LINEATIFRONS	4	E	038N020W	13	SW4SE4
MNPINE	HWY 70	5/19/98	GOMPHURUS VASTUS	15	E	038N020W	13	SW4SE4
MNPINE	HWY 70	5/19/98	GOMPHURUS VENTRICOSUS	7	E	038N020W	13	SW4SE4
MNPINE	HWY 70	5/19/98	GOMPHUS **UNIDENTIFIED**	3	E	038N020W	13	SW4SE4

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNPINE	HWY 70	5/19/98	GOMPHUS ADELPHUS	1	E	038N020W	13	SW4SE4
MNPINE	HWY 70	5/19/98	GOMPHUS VIRIDIFRONS	77	E	038N020W	13	SW4SE4
MNPINE	HWY 70	5/19/98	N. YAMASKANENSIS	1	E	038N020W	13	SW4SE4
MNPINE	HWY 70	5/19/98	OPHIOGOMPHUS HOWEI	31	E	038N020W	13	SW4SE4
MNPINE	HWY 70	5/19/98	OPHIOGOMPHUS RUPINSULENSIS	111	E	038N020W	13	SW4SE4
MNPINE	HWY 70	5/19/98	OPHIOGOMPHUS SUSBEHCHA	13	E	038N020W	13	SW4SE4
MNPINE	HWY 70	5/19/98	PHANOGOMPHUS LIVIDUS	1	E	038N020W	13	SW4SE4
MNPINE	HWY 70	5/19/98	PHANOGOMPHUS QUADRICOLOR	19	E	038N020W	13	SW4SE4
MNPINE	SNAKE R LANDING	5/22/98	ARGIA **UNIDENTIFIED**	1	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	ARGIA **UNIDENTIFIED**	1	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	DIDYMOPS TRANSVERSA	1	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	DIDYMOPS TRANSVERSA	1	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS FRATERNUS	2	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS FRATERNUS	3	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS FRATERNUS	4	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS FRATERNUS	2	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS LINEATIFRONS	1	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS LINEATIFRONS	1	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS VASTUS	1	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS VENTRICOSUS	5	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS VENTRICOSUS	2	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS VENTRICOSUS	1	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHURUS VENTRICOSUS	3	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHUS VIRIDIFRONS	20	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHUS VIRIDIFRONS	19	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHUS VIRIDIFRONS	31	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	GOMPHUS VIRIDIFRONS	39	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	N. YAMASKANENSIS	2	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	OPHIOGOMPHUS HOWEI	4	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	OPHIOGOMPHUS HOWEI	5	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	OPHIOGOMPHUS HOWEI	12	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	OPHIOGOMPHUS HOWEI	3	E	039N019W	31	NE4SW4

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNPINE	SNAKE R LANDING	5/22/98	OPHIOGOMPHUS RUPINSULENSIS	39	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	OPHIOGOMPHUS RUPINSULENSIS	45	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	OPHIOGOMPHUS RUPINSULENSIS	10	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	OPHIOGOMPHUS RUPINSULENSIS	73	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	OPHIOGOMPHUS SUSBEHCHA	1	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	PHANOGOMPHUS QUADRICOLOR	2	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	PHANOGOMPHUS QUADRICOLOR	2	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	PHANOGOMPHUS QUADRICOLOR	12	E	039N019W	31	NE4SW4
MNPINE	SNAKE R LANDING	5/22/98	PHANOGOMPHUS QUADRICOLOR	10	E	039N019W	31	NE4SW4
MNPINE	ST CROIX S. P.	7/11/98	DROMOGOMPHUS SPINOSUS	2	E	040N018W	14	NW4SW4
MNPINE	ST CROIX S. P.	7/11/98	OPHIOGOMPHUS RUPINSULENSIS	1	E	040N018W	14	NW4SW4
MNPINE	ST CROIX S. P.	7/11/98	STYLURUS SPINICEPS	14	E	040N018W	14	NW4SW4
MNPINE	ST CROIX S. P.	5/26/98	BASIAESCHNA JANATA	2	E	040N019W	34	SW4SW4
MNPINE	ST CROIX S. P.	5/26/98	BASIAESCHNA JANATA		A	040N019W	34	SW4SW4
MNPINE	ST CROIX S. P.	5/26/98	DIDYMOPS TRANSVERSA	6	E	040N019W	34	SW4SW4
MNPINE	ST CROIX S. P.	5/26/98	DROMOGOMPHUS SPINOSUS	40	E	040N019W	34	SW4SW4
MNPINE	ST CROIX S. P.	5/26/98	GOMPHURUS FRATERNUS	1	E	040N019W	34	SW4SW4
MNPINE	ST CROIX S. P.	5/26/98	GOMPHURUS LINEATIFRONS	1	E	040N019W	34	SW4SW4
MNPINE	ST CROIX S. P.	5/26/98	GOMPHUS ADELPHUS	30	E	040N019W	34	SW4SW4
MNPINE	ST CROIX S. P.	5/26/98	GOMPHUS VIRIDIFRONS	65	E	040N019W	34	SW4SW4
MNPINE	ST CROIX S. P.	5/26/98	HAGENIUS BREVISTYLUS	1	E	040N019W	34	SW4SW4
MNPINE	ST CROIX S. P.	5/26/98	OPHIOGOMPHUS RUPINSULENSIS	2	E	040N019W	34	SW4SW4
MNPINE	ST CROIX S. P.	5/26/98	PHANOGOMPHUS QUADRICOLOR	1	E	040N019W	34	SW4SW4
MNPINE	ST CROIX S. P.	5/29/98	BASIAESCHNA JANATA	1	E	039N019W	04	SE4SE4
MNPINE	ST CROIX S. P.	5/29/98	DIDYMOPS TRANSVERSA	2	E	039N019W	04	SE4SE4
MNPINE	ST CROIX S. P.	5/29/98	DROMOGOMPHUS SPINOSUS	2	E	039N019W	03	SE4NW4
MNPINE	ST CROIX S. P.	5/29/98	DROMOGOMPHUS SPINOSUS	29	E	039N019W	04	SE4SE4
MNPINE	ST CROIX S. P.	5/29/98	GOMPHURUS FRATERNUS	1	E	039N019W	04	SE4SE4
MNPINE	ST CROIX S. P.	5/29/98	GOMPHURUS LINEATIFRONS	2	E	039N019W	04	SE4SE4
MNPINE	ST CROIX S. P.	5/29/98	GOMPHURUS VENTRICOSUS	4	E	039N019W	04	SE4SE4
MNPINE	ST CROIX S. P.	5/29/98	GOMPHUS ADELPHUS	3	E	039N019W	04	SE4SE4
MNPINE	ST CROIX S. P.	5/29/98	GOMPHUS ADELPHUS	13	E	039N019W	03	SE4NW4

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNPINE	ST CROIX S. P.	5/29/98	GOMPHUS VIRIDIFRONS	29	E	039N019W	04	SE4SE4
MNPINE	ST CROIX S. P.	5/29/98	GOMPHUS VIRIDIFRONS	9	E	039N019W	03	SE4NW4
MNPINE	ST CROIX S. P.	5/29/98	HAGENIUS BREVISTYLUS	4	E	039N019W	03	SE4NW4
MNPINE	ST CROIX S. P.	5/29/98	MACROMIA ILLINOIENSIS	1	E	039N019W	03	SE4NW4
MNPINE	ST CROIX S. P.	5/29/98	OPHIOGOMPHUS HOWEI	63	E	039N019W	04	SE4SE4
MNPINE	ST CROIX S. P.	5/29/98	OPHIOGOMPHUS HOWEI	24	E	039N019W	03	SE4NW4
MNPINE	ST CROIX S. P.	5/29/98	OPHIOGOMPHUS RUPINSULENSIS	126	E	039N019W	03	SE4NW4
MNPINE	ST CROIX S. P.	5/29/98	OPHIOGOMPHUS RUPINSULENSIS	15	E	039N019W	04	SE4SE4
MNPINE	ST CROIX S. P.	5/29/98	PHANOGOMPHUS QUADRICOLOR	1	E	039N019W	03	SE4NW4
MNPINE	ST CROIX S. P.	5/29/98	PHANOGOMPHUS QUADRICOLOR	17	E	039N019W	04	SE4SE4
MNWASH	MARINE ON ST CROIX	5/20/98	DIDYMOPS TRANSVERSA	6	E	031N019W	06	SW4NE4
MNWASH	MARINE ON ST CROIX	5/20/98	GOMPHURUS FRATERNUS	15	E	031N019W	06	SW4NE4
MNWASH	MARINE ON ST CROIX	5/20/98	GOMPHURUS VASTUS	27	E	031N019W	06	SW4NE4
MNWASH	MARINE ON ST CROIX	5/20/98	GOMPHURUS VENTRICOSUS	1	E	031N019W	06	SW4NE4
MNWASH	MARINE ON ST CROIX	5/20/98	GOMPHUS VIRIDIFRONS	2	E	031N019W	06	SW4NE4
MNWASH	MARINE ON ST CROIX	5/20/98	OPHIOGOMPHUS SUSBEHCHA	1	E	031N019W	06	SW4NE4
MNWASH	WILLIAM O'BRIEN S. P.	5/20/98	GOMPHURUS VASTUS	20	E	032N019W	31	SW4NE4
MNWASH	WILLIAM O'BRIEN S. P.	5/20/98	GOMPHUS ADELPHUS	1	E	032N019W	31	SW4NE4
MNWASH	WILLIAM O'BRIEN S. P.	5/20/98	GOMPHUS VIRIDIFRONS	10	E	032N019W	31	SW4NE4
MNWASH	WILLIAM O'BRIEN S. P.	5/20/98	N. YAMASKANENSIS	10	E	032N019W	31	SW4NE4
MNWASH	WILLIAM O'BRIEN S. P.	5/20/98	OPHIOGOMPHUS RUPINSULENSIS	1	E	032N019W	31	SW4NE4

**PL=Pansy Landing

St Louis River. The St Louis River ranged from 80 to 5-600 feet wide and 5-10(?) feet deep with moderate current at most of our sample sites. Substrate in the upper river above Brookston is largely silt/clay and was adequately sampled by Haarstad, but gravel, sand, and boulders increase at sites downstream from Brookston. Dragonfly diversity was higher on the St Louis than on any river outside the St Croix watershed, and relatively high numbers of the uncommon *G. ventricosus* were found above Carlton. The St Louis and the Cloquet rivers stand out as the highest quality streams that we sampled in NE MN, and their watersheds deserve ample protection and additional population monitoring. If additional populations of *O. susbehcha* are ever found, they will probably be on the lower St Louis between Carlton and the Cloquet River. This part of the river may also have potential for additional populations of *O. anomalus* and *O. howei*. We intended to sample additional sites on this river, but the early emergence dates in 1998 made it imperative to survey other target rivers before exuviae were destroyed. The stretch of river between US Highway 2 and Carlton had

the greatest diversity, and should be a priority for additional sampling and monitoring. Sites below the dams (Hwy 61 and West Duluth) show very low diversity, although a limited amount of time was spent sampling these sites.

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNCARL	ABOVE HWY 33	5/27/98	BASIAESCHNA JANATA	1	E	049N017W	03	
MNCARL	ABOVE HWY 33	5/27/98	GOMPHURUS FRATERNUS	143	E	049N017W	03	
MNCARL	ABOVE HWY 33	5/27/98	GOMPHURUS VASTUS	8	E	049N017W	03	
MNCARL	ABOVE HWY 33	5/27/98	GOMPHURUS VENTRICOSUS	19	E	049N017W	03	
MNCARL	ABOVE HWY 33	5/27/98	GOMPHUS VIRIDIFRONS	38	E	049N017W	03	
MNCARL	ABOVE HWY 33	5/27/98	MACROMIA ILLINOIENSIS	1	E	049N017W	03	
MNCARL	ABOVE HWY 33	5/27/98	OPHIOGOMPHUS COLUBRINUS	1	E	049N017W	03	
MNCARL	ABOVE HWY 33	5/27/98	OPHIOGOMPHUS RUPINSULENSIS	17	E	049N017W	03	
MNCARL	AT HWY 33	5/25/98	GOMPHURUS FRATERNUS	13	E	049N017W	14	
MNCARL	AT HWY 33	5/25/98	GOMPHURUS VASTUS	2	E	049N017W	14	
MNCARL	AT HWY 33	5/25/98	GOMPHUS **UNIDENTIFIED**	2	E	049N017W	14	
MNCARL	AT HWY 33	5/25/98	GOMPHUS VIRIDIFRONS	9	E	049N017W	14	
MNCARL	AT HWY 33	5/25/98	OPHIOGOMPHUS RUPINSULENSIS	3	E	049N017W	14	
MNCARL	HWY 61	5/27/98	GOMPHURUS **UNIDENTIFIED**	1	E	049N016W	30	
MNCARL	HWY 61	5/27/98	GOMPHURUS FRATERNUS	13	E	049N016W	30	
MNCARL	HWY 61	5/27/98	GOMPHUS **UNIDENTIFIED**	1	E	049N016W	30	
MNCARL	HWY 61	5/27/98	OPHIOGOMPHUS RUPINSULENSIS	2	E	049N016W	30	
MNCARL	HWY 61	5/27/98	PHANOGOMPHUS LIVIDUS	2	E	049N016W	30	
MNSTLO	BROOKSTON	5/21/98	GOMPHURUS FRATERNUS	1	T	051N018W	27	
MNSTLO	BROOKSTON	5/21/98	GOMPHUS VIRIDIFRONS	6	E	051N018W	27	
MNSTLO	HWY 16	5/28/98	GOMPHURUS FRATERNUS	1	E	057N017W	33	
MNSTLO	HWY 16	5/28/98	GOMPHUS **UNIDENTIFIED**	1	E	057N017W	33	
MNSTLO	HWY 16	5/28/98	GOMPHUS VIRIDIFRONS	3	E	057N017W	33	
MNSTLO	HWY 16	5/28/98	OPHIOGOMPHUS COLUBRINUS	15	E	057N017W	33	
MNSTLO	HWY 16	5/28/98	OPHIOGOMPHUS RUPINSULENSIS	1	E	057N017W	33	
MNSTLO	HWY 16	5/28/98	PHANOGOMPHUS LIVIDUS	1	E	057N017W	33	
MNSTLO	HWY 2	5/21/98	GOMPHURUS FRATERNUS	6	E	050N018W	01	SW4
MNSTLO	HWY 2	5/21/98	GOMPHURUS VENTRICOSUS	1	E	050N018W	01	SW4
MNSTLO	HWY 2	5/21/98	GOMPHUS VIRIDIFRONS	48	E	050N018W	01	SW4

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT	1/4
MNSTLO	HWY 2	5/21/98	NEUROCORDULIA YAMASKANENSIS	1	E	050N018W	01	SW4
MNSTLO	HWY 2	5/21/98	OPHIOGOMPHUS RUPINSULENSIS	2	E	050N018W	01	SW4
MNSTLO	HWY 2	5/21/98	PHANOGOMPHUS LIVIDUS	3	E	050N018W	01	SW4
MNSTLO	HWY 2	5/25/98	CALOPTERYX MACULATA	1	E	050N018W	01	SW4
MNSTLO	HWY 2	5/25/98	GOMPHURUS FRATERNUS	43	E	050N018W	01	SW4
MNSTLO	HWY 2	5/25/98	GOMPHURUS VASTUS	1	E	050N018W	01	SW4
MNSTLO	HWY 2	5/25/98	GOMPHURUS VENTRICOSUS	1	E	050N018W	01	SW4
MNSTLO	HWY 2	5/25/98	GOMPHUS ADELPHUS	1	E	050N018W	01	SW4
MNSTLO	HWY 2	5/25/98	GOMPHUS VIRIDIFRONS	26	E	050N018W	01	SW4
MNSTLO	HWY 2	5/25/98	NEUROCORDULIA YAMASKANENSIS	1	E	050N018W	01	SW4
MNSTLO	HWY 2	5/25/98	OPHIOGOMPHUS COLUBRINUS	1	E	050N018W	01	SW4
MNSTLO	HWY 2	5/25/98	OPHIOGOMPHUS RUPINSULENSIS	20	E	050N018W	01	SW4
MNSTLO	HWY 2	5/25/98	PHANOGOMPHUS LIVIDUS	1	E	050N018W	01	SW4
MNSTLO	HWY 2	5/25/98	STYLURUS NOTATUS	1	E	050N018W	01	SW4
MNSTLO	HWY 2	6/15/98	DROMOGOMPHUS SPINOSUS	1	E	050N018W	01	SW4
MNSTLO	HWY 2	6/15/98	GOMPHURUS FRATERNUS	1	E	050N018W	01	SW4
MNSTLO	HWY 2	6/15/98	GOMPHUS VIRIDIFRONS	1	E	050N018W	01	SW4
MNSTLO	HWY 2	6/15/98	STYLURUS AMNICOLA	2	E	050N018W	01	SW4
MNSTLO	HWY 2	6/15/98	STYLURUS NOTATUS	1	E	050N018W	01	SW4
MNSTLO	HWY 2	6/15/98	STYLURUS SPINICEPS	6	E	050N018W	01	SW4
MNSTLO	WEST DULUTH	5/22/98	BASIAESCHNA JANATA	1	E	048N015W	10	
MNSTLO	WEST DULUTH	5/22/98	DIDYMOPS TRANSVERSA	2	E	048N015W	10	
MNSTLO	WEST DULUTH	5/22/98	GOMPHURUS FRATERNUS	19	E	048N015W	10	

Stony Brook. This small, swift, rocky stream south of Brookston was a random sample site, and only 5-10 minutes were spent collecting 7 *O. rupinsulensis* exuviae. This was not an attempt at a comprehensive survey, but these types of streams are virtually unsurveyed in northern MN, and deserve additional work.

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT
MNSTLO	S. OF BROOKSTON	5/21/98	OPHIOGOMPHUS RUPINSULENSIS	7	E	051N018W	34

Sturgeon River. This was another random, unplanned survey, and a very fortuitous one. The state record *Stylurus scudderi* was discovered. The Sturgeon River at this site is about 60 feet wide, 2 feet deep, with a rocky/sandy/clay substrate. More surveys are needed on other streams like this one in northern MN.

COUNTY	SITENAME	DATE	SPECIES	#	STAGE	TOWNRANGE	SECT
MNKOOC	HWY 32	8/22/98	OPHIOGOMPHUS COLUBRINUS	1	E	155N026W	26
MNKOOC	HWY 32	8/22/98	STYLURUS SCUDDERI	10	E	155N026W	26

MN Population Status Recommendations – Target Species

Ophiogomphus susbehcha

Existing Data: Breeding populations are only known from the St. Croix River. Stray individuals have been collected from the mouth of the Snake River immediately adjacent to the St. Croix River. The St. Croix River populations are found between RM 105.2 near Norway Point (WI) and RM 35.9 at Marine on the St. Croix. Relative densities range from 0-5% at sample sites from the mouth of the Snake R. (RM 94.5) upstream to Norway Point (RM 105.3) and none have ever been found upstream of Norway Point (RM's sampled: 118-164) in 2,524 odonate specimens collected there. Below the Snake River mouth all sites sampled have between 10-17% *O. susbehcha* until Never's Dam (RM 64.8 where the proportion drops to less than 5%. Below Never's Dam presence is sporadic with samples ranging from 0-4 % downstream to Marine on the St. Croix (RM 35.9). *O. susbehcha* has never been collected below Marine-on-St. Croix, although little odonate sampling has been done in that segment.

Habitat: *O. susbehcha* is known only from stream segments that would be characterized as large warmwater or non-wadable with an average annual flow of 2,300 to 11,000 cfs, with fast current and in largely forested watersheds. Larvae have been collected from clean gravel and cobble substrates in depths near the limit for wading. Stream widths at sample sites range from 180-750 ft. and average 390 ft. Comparative sampling on the Chippewa River population in WI suggests larvae prefer deep runs and pools over riffles. All known *O. susbehcha* sites have apparently intact aquatic biota with high diversity and several rare species. Adults are rarely encountered and probably frequent areas not typically sampled such as tall vegetation and or areas away from the stream's edge. Characterizing the breeding habitat of *O. susbehcha* is problematic, because it is only known from two streams in its entire range. Larger streams, which seldom harbor any members of this genus, and numerous smaller streams with apparent similar habitat and land use have been sampled without success. *O. susbehcha* apparently is restricted to the few remaining stream segments in the upper Midwest that are in a forested watershed, are large, have no pollution history and have rapid enough flow to have abundant gravel and cobble substrate.

Adequacy of Survey Efforts: The streams in MN that could potentially harbor *O. susbehcha* based on physical characteristics similar to known sites include the St. Louis, Little Fork, Rainy, Mississippi, Crow Wing, Kettle, and Snake Rivers. All of these were sampled in 1998 with no breeding populations found. The one specimen found at the Snake River mouth probably originated in the St. Croix R. As a matter of fact, over 180 streams with a broad range of size and habitats have been sampled in the upper Midwest in the past few years yielding over 73,000 odonate exuviae without turning up *O. susbehcha* and it seems unlikely that any other populations will be found. All potential MN streams sampled either had pollution history (Mississippi, Rainy) or were probably too small. Other streams of similar size exist in the state but are in the prairie biome with little forest in their watershed. Monitoring of the St Croix River population has been initiated in in WI in the early 1990's and no trends are apparent.

MN Population Status and Management Recommendations

Population Summary.....One waterbody with viable population.

Additional populations not likely. Imperiled to critically imperiled globally.

SRANK.....S1

Inventory/Monitoring Needs.....Track EO's and monitor populations.

Protection/Management Needs.....List as state Endangered. Develop management plan that addresses land use in the tributaries to the St. Croix R.

Ophiogomphus anomalus

Existing Data: Breeding populations are only known from the Pigeon River in Cook Co. and possibly the St. Croix River. Montz (1993) sampled macroinvertebrates at 10 sites on the Pigeon River in 1992 and 1993 and found *O. anomalus* at six of them distributed over some 15 river miles. Stray individuals have been collected from the WI side of the St. Croix River between RM 140.6 (Burnett Co, WI) downstream to RM 81.4 (across from Rush City Landing, Chisago Co.). St Croix River sites where *O. anomalus* was found had been sampled 64 times with over 6400 odonate specimens collected, yet *O. anomalus* was only in seven samples. Only one of these sites had *O. anomalus* on more than one occasion. There are not enough data to evaluate populations except to say that relative abundance at all known sites is low.

Habitat: In the upper Midwest *O. anomalus* is known from coolwater to warmwater wadable or large non-wadable stream segments ranging in width from 52-600 ft. and averaging 232 ft., with rapid current, and in largely forested watersheds. Substrates are predominantly gravel with sand and cobble. Larvae have been collected in loose clean gravel in a WI stream. Adults are rarely encountered and probably frequent areas not typically sampled such as tall vegetation and or areas away from the stream's edge. *O. anomalus* larvae are apparently particular about substrate composition and unlike other members of the genus, are not always generally distributed in a stream segment.

Adequacy of Survey Efforts: There are many streams in MN that could apparently support *O. anomalus* based on physical characteristics similar to known sites. However, of the 35 streams sampled so far, *O. anomalus* is only known from two. This is similar to the proportion of WI streams occupied and suggests that only a few more populations might be found in MN. Sampling in MN has not been anywhere near adequate to determine population levels or trends.

MN Population Status and Management Recommendations

Population Summary.....One waterbody with possibly viable population; a few more populations possible. Globally vulnerable.

SRANK.....S1S2

Inventory/Monitoring Needs.....Track EO's and monitor populations. Look for additional populations in appropriate habitat.

Protection/Management Needs.....List as state Endangered. Develop management plan that addresses land use in the tributaries to the Pigeon and St. Croix Rivers.

MN Population Status Recommendations – Non-target Species

Neurocordulia molesta

Existing Data: Known in MN from the lower St. Croix R. in Chisago County and the Mississippi River in Winona County. This is one of the least frequently collected lotic dragonflies in MN although it's probably more or less continuous in distribution in the Mississippi River below Hastings in appropriate habitat.

Habitat: Non-wadable warmwater streams and impoundments. The larvae need sites where there is substantial area of underwater cliff or boulders. Breeding sites may be discreet if larval habitat is not generally distributed. This species is not restricted to largely forested landscapes, unlike many MN lotic dragonflies.

Adequacy of Survey Efforts: This species is definitely under detected because of the difficulty in sampling larvae in large deep streams in rock piles and because the adults are crepuscular and are only active for around 30 minutes at a crack.

MN Population Status and Management Recommendations

Population Summary.....Two populations known; a few more are likely; distribution is probably widespread in the streams it does breed in; Globally vulnerable.

SRANK.....S2S3

Inventory/Monitoring Needs.....Track EO's and monitor populations. Look for additional populations in appropriate habitat by sampling exuviae, especially in the Mississippi River below Hastings.

Protection/Management Needs.....List as state Special Concern; Target in County Biological Inventories or initiate odonate survey in large streams.

Stylurus scudderi

Existing Data: Known from only the Sturgeon River in Kooching County. This species is widespread but local in northern WI and MI.

Habitat: Moderate gradient cool to cold water (trout) streams with sandy substrate in forested watersheds. The average size of some 30 WI S. scudderi streams is 50 ft. wide with a range of 7-250ft.

Adequacy of Survey Efforts: A large number of trout streams in MN are unsurveyed for odonates and it would seem likely that a number of additional populations exist. Most recent odonate surveys have targeted warmwater streams. Exuviae surveys done only

during the spring emergence period would not detect *S. scudderi* which doesn't start emerging till late June.

MN Population Status and Management Recommendations

Population Summary.....One waterbody known with several more likely; Apparently globally secure(G3G4).
 SRANK.....S3
 Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat.
 Protection/Management Needs.....List as state Special Concern

Boyeria grafiana

Existing Data: Known from only the Temperance River in Cook County and the Manitou River in Lake County. Outside of MN, this species is found only on Isle Royale in the upper Midwest and isn't known from WI yet.

Habitat: High gradient streams in forested watersheds. Larvae or exuviae have not been found in MN yet, so breeding is not confirmed at the currently known sites. Streams tributary to the north shore of L. Superior or other high gradient streams in forested parts of MN are likely to support breeding populations.

Adequacy of Survey Efforts: A large number of high gradient streams are found in NE MN which are unsurveyed for odonates. This species flies in mid to late summer and adults and exuviae should be searched for beginning in early July.

MN Population Status and Management Recommendations

Population Summary.....Two waterbodies in two counties in far northeastern MN; Breeding populations not confirmed; Globally secure.
 SRANK.....S3
 Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat; confirm breeding at two known sites.
 Protection/Management Needs.....List as state Special Concern

Cordulegaster obliqua

Existing Data: Known only from two MN counties. This species is uncommon and local in the upper Midwest.

Habitat: Sandy pools in very small headwater streams in forested watersheds. Sometimes intermittent streams are used. Most streams in WI occupied by *C. obliqua* range from 1-

5ft. wide. Larvae or exuviae have not been found in MN yet, so breeding is not confirmed at the currently known sites.

Adequacy of Survey Efforts: Streams of the small size utilized by *C. obliqua* are rarely sampled. A very large number of potentially suitable streams are found in portions of MN and. Exuviae are scarce and hard to find and are not reliable indicators of presence. The abundant springs and seeps along the St. Croix River are likely sites for additional populations.

MN Population Status and Management Recommendations

Population Summary.....Two counties known; Breeding populations not confirmed; Several populations are likely to be found; Globally secure.

SRANK.....S3

Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat; confirm breeding at two known sites.

Protection/Management Needs.....List as state Special Concern

Gomphurus lineatifrons

Existing Data: Known from five streams and four MN counties. This species is local in the upper Midwest and is found in about 12-13% of the eastern MN streams sampled.

Habitat: In warmwater wadable streams or non-wadable rivers from 25-675 ft. wide, with moderate to rapid current and in forested watersheds. Has been reported from Cass Lake and Lake Itasca, but the lifestage represented wasn't reported so breeding is not confirmed.

Adequacy of Survey Efforts: Found in about 12% of 32 eastern MN streams sampled and probably will be found in a few additional streams. There is a large gap in the MN distribution between the Cass Lake and Lake Itasca records and the St. Croix R. Basin populations in Pine and Chisago Counties and breeding status should be confirmed in the former area. Not likely in SW half of the state.

MN Population Status and Management Recommendations

Population Summary.....Five streams and four counties; Breeding populations not confirmed in two counties; Some more populations are likely to be found; Apparently globally secure.

SRANK.....S3

Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat; confirm breeding at lake sites reported.

Protection/Management Needs.....List as state Special Concern

Gomphurus ventricosus

Existing Data: Known from nine streams and nine MN counties with breeding confirmed in seven counties. This species is widespread but usually in low numbers the upper Midwest and is found in about 28% of the eastern and northern MN streams sampled.

Habitat: In warmwater wadable streams or non-wadable rivers from 90-600 ft. wide, with moderate to rapid current and in forested watersheds.

Adequacy of Survey Efforts: Probably will be found in a few additional streams. Breeding status should be confirmed in Kanabeck and Winona counties.

MN Population Status and Management Recommendations

Population Summary.....Nine streams and nine counties; Breeding populations not confirmed in two counties; A few more populations are likely to be found; Globally vulnerable.

SRANK.....S3

Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat; confirm breeding in two counties.

Protection/Management Needs.....List as state Special Concern

Ophiogomphus howei

Existing Data: Breeding confirmed in only Chisago and Pine counties. A single exuvia was found in Itasca Co. This species ranges across northern WI and extends into the UP of MI and eastern-most MN. The St. Croix River population is extensive ranging from RM 147 in Douglas Co., WI to RM 52.2 at Interstate Park. The Kettle and Snake River populations are restricted to the lower portions of each stream and may be dependant on the St. Croix R. population. The specimen from the Mississippi River in Itasca Co. may or may not represent a breeding population.

Habitat: In warmwater wadable streams or non-wadable rivers from 50-1,000 ft. wide (average of 309 ft.), with moderate current and in forested watersheds. Larvae have been collected from clean gravel mixed with sand and cobble substrates.

Adequacy of Survey Efforts: Not many more streams seem likely in MN. More sampling should be done on warmwater streams with good diversity like the Big Fork, Cloquet, L. Fork, Sand, and St. Louis rivers for local populations. The nature of the population in the Mississippi River in Itasca County should be determined. Not likely in SW half of the state.

MN Population Status and Management Recommendations

Population Summary.....Breeding confirmed in two counties; Breeding population possible in two additional counties; Few more populations are likely to be found; Globally vulnerable.

SRANK.....S2

Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat; confirm breeding in Mississippi River.
 Protection/Management Needs.....List as state Threatened

Stylogomphus albistylus

Existing Data: This species has not been reported from MN, but the very similar *Lanthus parvulus* is reported from MN from one adult specimen with the following label data: “*Lanthus parvulus* Selys, Mille Lacs Co., Mn., June 3, 1939, H. D. Pratt”. However, *L. parvulus* is an eastern species with the nearest occurrence to MN being Ohio and Pennsylvania. *Stylogomphus albistylus*, a very similar species which formerly was placed in the genus *Lanthus*, is very likely the identity of the MN specimen reported as *L. parvulus*. *S. albistylus* is known from a number of streams in WI and MI.

Habitat: In small to medium sized, warmwater streams with medium to high gradient, abundant gravel substrate, and in forested watersheds. It's often found with *O. carolus*. Larvae have been collected from clean gravel mixed with sand.

Adequacy of Survey Efforts: Many more streams seem likely in MN. More sampling should be done on streams known to harbor *O. carolus* and or are small high gradient warmwater streams in forested watersheds. This species emerges slightly later than most *Ophiogomphus*.

MN Population Status and Management Recommendations

Population Summary.....One likely specimen of this species known.
 Several populations are likely to be found; Globally secure.

SRANK.....S2S3

Inventory/Monitoring Needs.....Determine identity of specimen called *L. parvulus* at U of MN collection. If either *Stylogomphus* or *Lanthus* track EO's; Look for additional populations in appropriate habitat, especially north shore streams; sample Rum R. in Mill Lacs Co. as the likely source of the original specimen.

Protection/Management Needs.....List as state Special Concern if identity turns out to be either *Stylogomphus* or *Lanthus*

Aeshna sitchensis

Existing Data: Known from four MN counties, but not reported from St Louis County since 1912. Breeding confirmed in Koochiching and Roseau counties. Known from upper Michigan but not WI. A boreal species.

Habitat: Known Minnesota habitats are rich fens and spring fens. Known to occur in “seep fed mossy bogs, muskeg” elsewhere.

Adequacy of Survey Efforts: Surveys in appropriate habitat have been inadequate. Possibly common in the remote peatlands of NW MN, and probably localized elsewhere across the northern tier of counties.

MN Population Status and Management Recommendations

Population Summary.....Three recent county records in NW MN, one historical record NE MN; More populations are likely to be found; Globally secure.
 SRANK.....S3
 Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat.
 Protection/Management Needs.....List as state Special Concern

Aeshna subarctica

Existing Data: Known from three NW MN counties. Breeding confirmed in Roseau County. Known from upper Michigan and one county in NW WI. A boreal species.

Habitat: Known Minnesota habitats are rich fens, spring fens, and forested bogs.

Adequacy of Survey Efforts: Surveys in appropriate habitat have been inadequate. Surveys may prove it to be relatively common in the peatlands of NW MN, and probably localized elsewhere in boreal habitats across the northern third of the state.

MN Population Status and Management Recommendations

Population Summary.....Three counties records; More populations are likely to be found; Globally secure.
 SRANK.....S3
 Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat.
 Protection/Management Needs.....List as state Special Concern

Aeshna verticalis

Existing Data: Known from seven MN counties, but two of these are pre-1940. Widespread but localized across upper Midwest. Possibly common in the remote and difficult to survey peatlands of NW MN, and probably localized elsewhere across the northern two-thirds of the state.

Habitat: Spring ponds, marshy lakes, vegetated ditches.

Adequacy of Survey Efforts: Surveys in appropriate habitat have probably been fair to adequate.

MN Population Status and Management Recommendations

Population Summary.....Seven counties. More populations are likely to be found; Globally secure.
 SRANK.....S3
 Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat.
 Protection/Management Needs.....List as state Special Concern

Leuchorrhinia borealis

Existing Data: Reported in literature from one MN county (Cass). One adult (Cass Co., 1991) and one larva not previously reported in the literature (Clearwater Co., 1964) are in the collection at the University of MN Museum. These specimens need to be verified as *L. borealis*. The species is found primarily in northwestern Canada, mountain states, also Manitoba and NW ONT. Not reported from the U.S. east of Minnesota.

Habitat: Bog-holes, shallow, muddy lakes, prairie ponds. The Itasca County larval collection site (Figure 1) is a small (< 0.5 acre) mud/silt bottomed, fishless pond less than 2 feet deep, without emergent vegetation, that dries up at least partially in the summer.

Adequacy of Survey Efforts: Bogs are undersurveyed in MN, but small lakes and ponds are common collection sites although extremely small fishless ponds may be undersurveyed. Most *Leuchorrhinia* are well represented in collections, fairly widespread, relatively weak fliers and easy to collect; probably would have been reported more frequently if it were widespread in the state.

MN Population Status and Management Recommendations

Population Summary.....One or two counties; breeding potentially confirmed in Clearwater Co; Globally secure.
 SRANK.....S2S3
 Inventory/Monitoring Needs.....Verify ID of museum specimens. If confirmed, Track EO's; Look for additional populations in appropriate habitat during June to early July.
 Protection/Management Needs.....If verified, list as state SC. The Clearwater Co. site, Icehouse Pond, is in Itasca State Park and is probably secure.

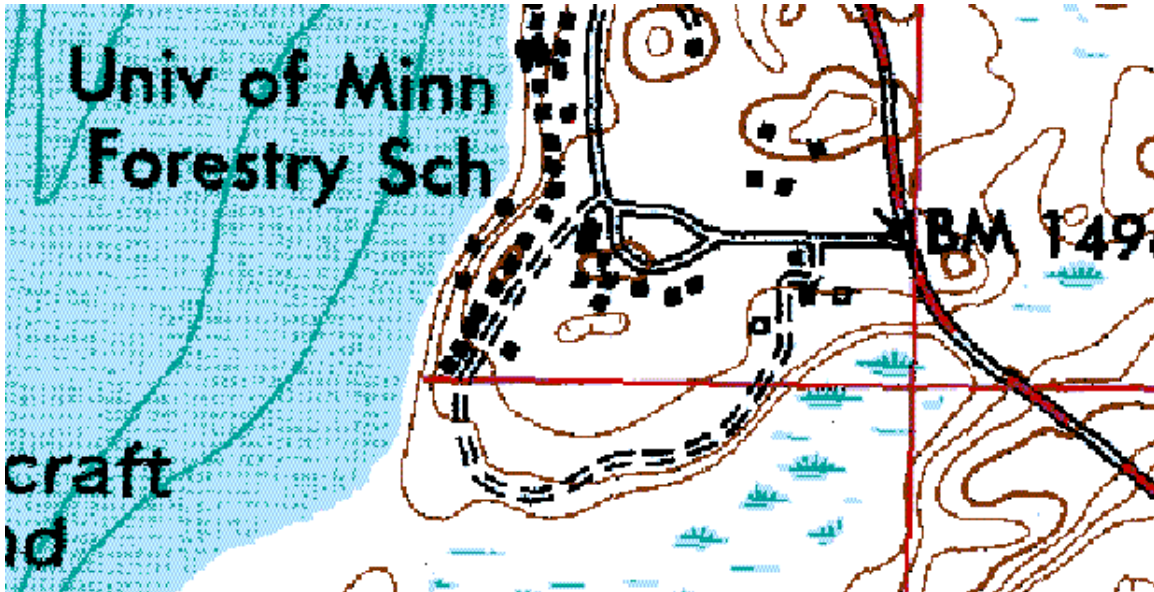


Figure 1. *Leuchorrhinia borealis* larval collection site in Itasca State Park. Icehouse Pond is the oblong hatched depression in the center of the map, behind the University of Minnesota field station.

Somatochlora elongata

Existing Data: Known from four MN counties with breeding status unknown. This species is moderately widespread in the upper Midwest.

Habitat: Smaller forest streams with rapids, outlets of lakes and ponds, headwaters of spring-fed creeks.

Adequacy of Survey Efforts: Smaller streams are undersurveyed in MN; Probably will be found at a few additional sites if more small streams are surveyed during June and July.

MN Population Status and Management Recommendations

Population Summary.....Four counties; A few more populations are likely to be found; Globally secure.

SRANK.....S3

Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat.

Protection/Management Needs.....List as state Special Concern

Somatochlora ensigera

Existing Data: Known from three MN counties and only two in WI, most recent MN records are from 1970. This species is quite rare, localized and found in low numbers in forested areas of the upper Midwest. Relatively common in northwest Iowa, but not yet known from southern MN.

Habitat: Small woodland streams with sandy substrate to open ditches in agricultural areas.

Adequacy of Survey Efforts: The preferred habitats are undersurveyed in MN; Probably will be found at a few additional sites if appropriate habitats are surveyed during June-August. Should be looked for in SW MN and elsewhere statewide.

MN Population Status and Management Recommendations

Population Summary.....Three counties, none from recent decades; A few more populations are likely to be found; Apparently Globally secure (G4).
 SRANK.....S2S3
 Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat, confirm occurrence at historical locations
 Protection/Management Needs.....List as state Special Concern

Somatochlora forcipata

Existing Data: Known from two MN counties. This species is only moderately widespread, usually localized and in low numbers in the upper Midwest. Probably restricted roughly to the northern third of the state.

Habitat: Spring fed boggy streams, bogs and forested bogs with sphagnum pools, occasionally in fens.

Adequacy of Survey Efforts: Bogs are undersurveyed in MN; Probably will be found at a few additional sites if appropriate habitats are surveyed during June to mid-August.

MN Population Status and Management Recommendations

Population Summary.....Two counties; A few more populations are likely to be found; Globally secure.
 SRANK.....S3
 Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat.
 Protection/Management Needs.....List as state Special Concern

Somatochlora franklini

Existing Data: Known from four MN counties with breeding confirmed in at least one (Lake). This species is widespread in upper Michigan but usually localized and in low numbers in the rest of the upper Midwest. Probably restricted roughly to the northern third of the state.

Habitat: Bogs and forested bogs with sphagnum pools, occasionally in northern fens.

Adequacy of Survey Efforts: Bogs are undersurveyed in MN; Probably will be found at additional sites if more bogs are surveyed during June and early July.

MN Population Status and Management Recommendations

Population Summary.....Four counties; A few more populations are likely to be found; Globally secure.

SRANK.....S3

Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat.

Protection/Management Needs.....List as state Special Concern

Somatochlora kennedyi

Existing Data: Known from three MN counties. This species is widespread in upper Michigan but localized and in low numbers elsewhere in the upper Midwest.

Habitat: Bogs and forested bogs with sphagnum pools, slow streams through marshes.

Adequacy of Survey Efforts: Bogs are undersurveyed in MN; Probably will be found at a number of additional sites if more bogs are surveyed during late early June-July.

MN Population Status and Management Recommendations

Population Summary.....Three counties; More populations are likely to be found; Globally secure.

SRANK.....S3

Inventory/Monitoring Needs.....Track EO's; Look for additional populations in appropriate habitat.

Protection/Management Needs.....List as state Special Concern

Conclusions.

Our results indicate that *Ophiogomphus susbehcha* is probably restricted to the St. Croix River in Minnesota, and new populations are unlikely to be found. It was not possible for us to survey all potential sites for *O. anomalus*. There may still be a small number of additional populations of *O. anomalus* and *O. howei* waiting to be found.

We hope that our work contributes to the understanding, appreciation, and protection of Minnesota's dragonflies and damselflies. There are still many undersurveyed areas and habitats in the state, and one-time surveys such as ours tell us nothing about short or long-term population trends of rare species. Long term monitoring is especially important for Minnesota's rare dragonflies and Minnesota's unique rivers, and can provide insight into the overall health of watersheds.

Many small and medium sized streams remain unsurveyed in the northern part of the state; large rivers in the west and south have never been surveyed; we surveyed less than one percent of the vast peatlands in the northwest. The fauna of smaller peatlands throughout the northern half of the state remains essentially unknown, with possibilities for rare and new state record *Aeshna*, *Somatochlora*, and *Williamsonia*. The damselflies of the state have been almost completely overlooked, and the state list of dragonflies will surely grow as more habitats are explored. There is much left to be learned about Minnesota's Odonata.

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APPENDIX A

New County Records for Minnesota Dragonflies, based on Carrol and Gundersen (1995)

County	Species
Aitken	<i>Gomphurus fraternus</i>
Aitken	<i>Gomphurus vastus</i>
Beltrami	<i>Aeshna interrupta lineata</i> *
Beltrami	<i>Aeshna subarctica</i>
Beltrami	<i>Somatochlora franklini</i>
Beltrami	<i>Somatochlora minor</i>
Carlton	<i>Basiaeschna janata</i>
Carlton	<i>Gomphurus fraternus</i>
Carlton	<i>Gomphurus vastus</i>
Carlton	<i>Gomphurus ventricosus</i>
Carlton	<i>Gomphus viridifrons</i>
Carlton	<i>Macromia illinoiensis</i>
Carlton	<i>Phanogomphus lividus</i>
Cass	<i>Gomphurus fraternus</i> *
Cass	<i>Gomphurus vastus</i>
Cass	<i>Ophiogomphus rupinsulensis</i> *
Chisago	<i>Didymops transversa</i>
Cook	<i>Ophiogomphus anomalus</i>
Crow Wing	<i>Basiaeschna janata</i>
Crow Wing	<i>Gomphurus fraternus</i>
Crow Wing	<i>Gomphurus vastus</i>
Crow Wing	<i>Ophiogomphus rupinsulensis</i> *
Itasca	<i>Aeshna canadensis</i> *
Itasca	<i>Dromogomphus spinosus</i>
Itasca	<i>Gomphurus fraternus</i>
Itasca	<i>Gomphurus vastus</i>
Itasca	<i>Gomphus viridifrons</i>
Itasca	<i>Hagenius brevistylus</i> *
Itasca	<i>Ophiogomphus howei</i> **
Itasca	<i>Ophiogomphus rupinsulensis</i> *
Itasca	<i>Phanogomphus graslinellus</i> *
Itasca	<i>Phanogomphus lividus</i>
Kanabec	<i>Phanogomphus graslinellus</i>
Koochiching	<i>Aeshna sitchensis</i>
Koochiching	<i>Dorocordulia libera</i>
Koochiching	<i>Gomphurus ventricosus</i>
Koochiching	<i>Gomphus viridifrons</i>
Koochiching	<i>Leucorrhinia hudsonica</i>
Koochiching	<i>Libellula pulchella</i>

County	Species
Koochiching	<i>Macromia illinoensis</i>
Koochiching	<i>Neurocordulia yamaskanensis</i>
Koochiching	<i>Ophiogomphus colubrinus</i>
Koochiching	<i>Ophiogomphus rupinsulensis</i>
Koochiching	<i>Somatochlora forcipata</i>
Koochiching	<i>Somatochlora minor</i>
Koochiching	<i>Somatochlora walshii</i>
Koochiching	<i>Stylurus amnicola</i>
Koochiching	<i>Stylurus notatus</i>
Koochiching	<i>Stylurus scudderi</i>
Koochiching	<i>Stylurus spiniceps</i>
LOTW	<i>Aeshna sitchensis</i>
LOTW	<i>Aeshna subarctica</i>
LOTW	<i>Aeshna umbrosa</i>
LOTW	<i>Gomphurus fraternus</i>
LOTW	<i>Gomphurus vastus</i>
LOTW	<i>Gomphurus ventricosus</i>
LOTW	<i>Ophiogomphus colubrinus</i>
LOTW	<i>Somatochlora minor</i>
LOTW	<i>Stylurus notatus</i>
LOTW	<i>Sympetrum danae</i>
Morrison	<i>Basiaeschna janata</i>
Morrison	<i>Epithea spinigera</i>
Morrison	<i>Gomphurus fraternus</i>
Morrison	<i>Gomphurus vastus</i>
Morrison	<i>Ophiogomphus colubrinus</i>
Pine	<i>Leucorrhinia hudsonica</i>
Pine	<i>Neurocordulia yamaskanensis</i>
Pine	<i>Phanogomphus exilis</i>
Pine	<i>Somatochlora franklini</i>
Pine	<i>Somatochlora kennedyi</i>
Pine	<i>Stylurus spiniceps</i>
Roseau	<i>Aeshna sitchensis</i>
Roseau	<i>Aeshna subarctica</i>
Roseau	<i>Aeshna verticalis</i>
Roseau	<i>Epithea canis</i>
Roseau	<i>Leucorrhinia intacta</i>
Roseau	<i>Libellula quadrimaculata</i>
Roseau	<i>Sympetrum costiferum</i>
Roseau	<i>Sympetrum danae</i>
Roseau	<i>Sympetrum vicinum</i>
St. Louis	<i>Gomphurus vastus*</i>

County	Species
St. Louis	<i>Gomphurus ventricosus</i>
St. Louis	<i>Gomphus viridifrons</i>
St. Louis	<i>Leucorrhinia hudsonica</i>
St. Louis	<i>Neurocordulia yamaskanensis</i>
St. Louis	<i>Stylurus amnicola</i>
St. Louis	<i>Stylurus notatus</i>
St. Louis	<i>Stylurus spiniceps</i>
Stearns	<i>Gomphurus vastus</i>
Washington	<i>Didymops transversa</i>
Washington	<i>Gomphurus ventricosus</i>
Washington	<i>Ophiogomphus rupinsulensis</i>

*-Also reported by the MN Dragonfly Survey

**--The *O. howei* on the Mississippi River in Itasca Co. needs to be verified

APPENDIX B
The damselflies of Minnesota

Minnesota's damselflies are very poorly known. The most recent publication specific to Minnesota is Whedon (1914). Whedon's work covered only southern MN. Westfall and May (1996) reported a number of species without location information (abbreviated as W&M below). The National Museum of Natural History (NMNH) has a number of specimens in their collection; the senior author has requested location data for those specimens. St. Cloud State University has half a cabinet full of unidentified specimens (Ralph Gundersen, pers. comm), and the University of Minnesota at St Paul has numerous specimens that may or may not be represented in the table below. Substantial survey work is needed on this suborder; several species may warrant SC status. Below is a list of all damselflies reported from the state, their county of occurrence where known, and the source(s) for the data. Data presented earlier in this report is abbreviated S&S (Steffens and Smith).

Species	Counties	Source
<i>Amphiagrion saucium</i>	Blue Earth	W&M, Whedon
<i>Argia apicalis</i>	Goodhue, Washington, Dakota	NMNH, W&M, Whedon
<i>Argia moesta</i>	Dakota, Goodhue, Winona	NMNH, W&M, Whedon
<i>Argia tibialis</i>	Goodhue, Washington	NMNH, W&M, Whedon
<i>Calopteryx aequabilis</i>	Tracked by MN Dragonfly Survey	
<i>Calopteryx maculata</i>	Tracked by MN Dragonfly Survey	
<i>Coenagrion angulatum</i>	Blue earth	W&M, Whedon
<i>Coenagrion interrogatum</i>	Lake	S&S
<i>Coenagrion resolutum</i>		W&M
<i>Enallagma antennatum</i>	Ramsey	NMNH, W&M, Whedon
<i>Enallagma boreale</i>		NMNH(as deserti boreale), W&M
<i>Enallagma carunculatum</i>		NMNH, W&M
<i>Enallagma civile</i>	Blue earth	NMNH, W&M
<i>Enallagma cyathigerum</i>	St. Louis	NMNH, W&M, S&S
<i>Enallagma ebrium</i>	Blue Earth	Whedon
<i>Enallagma ebrium</i>	Lake	NMNH, W&M, S&S
<i>Enallagma geminatum</i>		W&M
<i>Enallagma hageni</i>	"all along Miss. R." (Whedon)	NMNH, W&M, Whedon
<i>Enallagma signatum</i>	Ramsey	NMNH, W&M, Whedon
<i>Enallagma exsulans</i>	?	Haarstad (1994)
<i>Hetaerina americana</i>	Tracked by MN Dragonfly Survey	
<i>Ischnura erratica</i> ?	prob. in error, W. Coast species	NMNH
<i>Ischnura posita</i>	Ramsey, Winona	W&M, Whedon
<i>Ischnura verticalis</i>	Blue earth, Ramsey, Hennepin	NMNH, W&M, Whedon
<i>Lestes congener</i>	LOTW, Roseau	NMNH, W&M, S&S
<i>Lestes disjunctus</i>	Koochiching	W&M, S&S
<i>Lestes dryas</i>	Blue earth, Freeborn	NMNH (as uncatus), W&M, Whedon
<i>Lestes eurinus</i>		W&M
<i>Lestes forcipatus</i>	Blue Earth, Roseau	NMNH, W&M, Whedon, S&S
<i>Lestes inaequalis</i>	Goodhue, Ramsey (?)	NMNH, W&M, Whedon
<i>Lestes rectangularis</i>	Blue earth	NMNH, W&M, Whedon

Species	Counties	Source
<i>Lestes unguiculatus</i>	Blue earth, Koochiching, Roseau	NMNH, W&M, Whedon, S&S
<i>Lestes vigilax</i>	Ramsey, Wabasha	NMNH, W&M, Whedon
<i>Nehalennia irene</i>	Blue Earth, Lake Koochiching,	NMNH, W&M, S&S