

A PRELIMINARY SURVEY OF AQUATIC MACROINVERTEBRATES COLLECTED FROM CROOKED LAKE FEN NATURE SANCTUARY IN SOUTHEASTERN SASKATCHEWAN

DALE PARKER, AquaTax Consulting, 1204 Main Street, Saskatoon, SK S7H 0L2
E-mail: dale.parker@sasktel.net

Introduction

Crooked Lake Fen Nature Sanctuary is located on the north bank of the Qu'Appelle River Valley at the junction of Highways 47 and 247 (102°-50'-27" W; 50°-38'-57" N).²⁰ Surveys of the birds, vegetation and lichens have been conducted previously for the sanctuary.^{4,7} The present research focuses on the aquatic macroinvertebrates— invertebrates that live in water for at least part of their life cycle and are retained by a net with mesh openings of 0.2 to 0.5 mm.²²

In the sanctuary, mineral-rich ground water seeps and at least two cold-water springs have formed a complex of wetland habitats⁷ (Figures 1 and 2). Three tiny streams flow through the wetlands. Water from the wetlands and small streams flows down into a larger stream (#12 in Figure 1) that follows the edge of the sanctuary and ultimately empties into the Qu'Appelle River. On the east margin of the sanctuary (#4a in Figure 1, Figure 3) is a series of clear shallow pools with mineral deposits (marl) in and around them.

Methods

Samples were collected from the sanctuary on seven occasions from June 2000 to April 2005 (June 21, 2000, May 13 and September 28, 2001, July 23, 2002, August 13, 2003, October 10, 2004, April 23, 2005). Visits were timed to optimize the probability of collecting new macroinvertebrate taxa (distinct taxonomic groups) and different life

stages to aid in identification. Habitats sampled included shallow pools, saturated soil and peat, and streams. Most of the sampling effort was concentrated on the stream (#12) and adjacent wetlands (#18, #19 and #20 in Figure 1).

Macroinvertebrate collections were made by sweeping a strainer with 0.5 mm mesh openings through the water and along bottom substrates (Figure 4). An aquarium net with 0.13 mm mesh openings was used as a drift net in the streams to collect dislodged macroinvertebrates. Submerged leaf litter, rocks and branches were examined for adhering macroinvertebrates. Collected material was placed in white pans and the macroinvertebrates were picked out and preserved in jars of 100% denatured ethanol. Adult aquatic insects were captured by sweeping with an aerial net. These were killed with ethyl acetate.

In the lab, a series of specimens of each type was picked from the samples and preserved in labeled vials of 75% denatured ethanol. Adult beetles, flies, and dragonflies were pinned. Genitalia of male beetles were dissected and mounted on points. Specimens of Chironomidae were dissected and mounted on microscope slides. Identifications were made with the aid of a stereomicroscope and a phase-contrast compound microscope while referring to the taxonomic literature. (See reference section for list of taxonomic references used.)

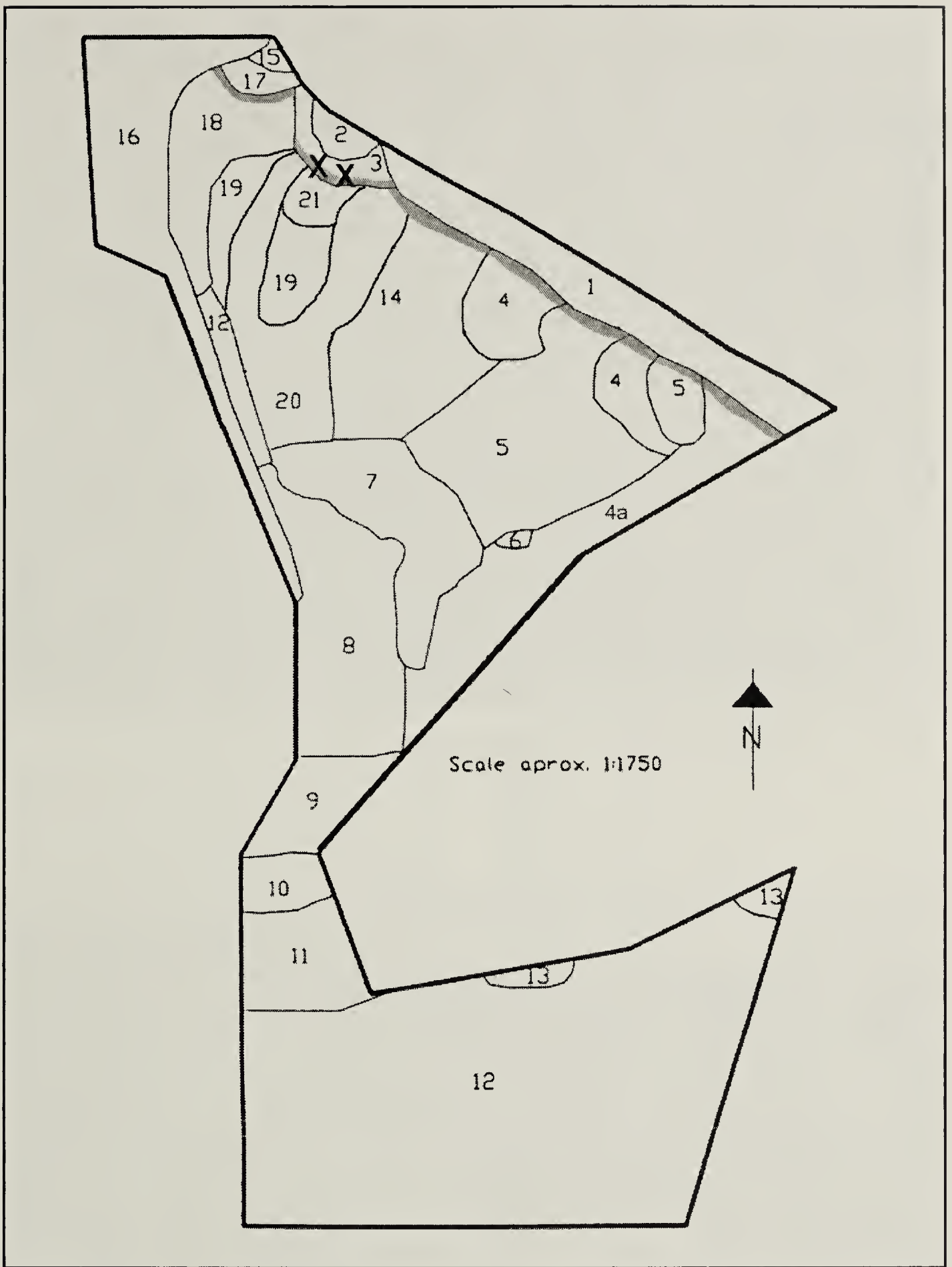


Figure 1: Ecological land classification and vegetation map of Crooked Lake Fen Sanctuary after Golder Associates⁷. Gray areas indicate zone of numerous ground water seeps. "X" indicates distinct springs. #1-Hardwood Forest, #2-Grassland, #3-Trembling Aspen Bluffs, #4 & #4a-Wet Marsh with calcareous pools, #5-Wet Marsh, #6-Damp Marsh, #7-Dry Marsh Edge, #8-Wet Meadow, #9-Wet Drainage Corridor, #10-Wet Meadow, #11-Wet Meadow, #12-Stream/Wet Marsh, #13-Wet Meadow, #14-River Birch Stand, #15-Brome Grass Meadow, #16-Manitoba Maple Forest, #17-Tall Shrub, #18-Wet Sedge (Carex) Fen, #19-Wet Cattail (Typha) Marsh, #20-Wet Giant Reed Grass (Phragmites) Marsh, #21-Wet Sedge Marsh with mineral soils below springs.



Figure 2: Vegetation immediately around a spring.

Air and water temperatures were measured on each visit. On October 10, 2004, stream water was tested for pH and conductivity using a Hanna HI98129 pH/EC/TDS meter.

Results and Discussion

Crooked Lake Fen Sanctuary habitats

Water temperature at the stream (#12, Figure 1), recorded approximately at noon on each visit, ranged from 11°C to 16°C and averaged 11°C cooler than the air temperature. On October 10, 2004, the stream water pH was 8.2 and conductivity was 2044 microsiemens/cm (1225 ppm dissolved solids). The alkaline pH and high conductivity of the water, the presence of marl and a peaty layer coupled with a high diversity of water loving plants⁷ indicate areas #18, #19, #20 and #21 (Figure 1) have characteristics of 'extreme-rich' fens and marshes.

Fens and marshes are two of five classes of wetlands distinguished on the basis of

water dynamics (fluctuations, flow, chemistry) and its influence on vegetation growth.^{38,39} The other classes are shallow open waters, swamps and bogs.^{38,39} Shallow open waters are characterized by aquatic plants that either float or live submersed in the water.³⁹ They occur in depressions in which large seasonal water fluctuations may occur. Swamps are well treed, with large fluctuations in water levels and water flow.³⁹ Marshes typically occur in poorly drained areas around sloughs and lakes or adjacent to flowing water. They may have extreme water fluctuations during the year. The substrate is mineral based but some marshes have a thin layer of partially decomposed vegetation or peat. The nutrient rich water produces lush vegetation including sedges (*Carex*), cattails (*Typha*) and bulrushes (*Scirpus*). Trees are generally absent.^{38,39}

Bogs and fens are sometimes referred to as peatlands as they typically have a thick (>40 cm) peat layer.^{38,39} Bogs are usually

associated with standing water. In some cases they receive only atmospheric water and have no ground water or surface water inputs.³⁹ They are very acidic (pH<4.7) and nutrient poor. The dominant vegetation is *Sphagnum* moss.^{38,39}

Fens share characteristics of both bogs and marshes.^{38,39} Fens usually have mineral-rich water flowing slowly through them. Three fen types—poor, moderate-rich, and extreme-rich—have been recognized based on water chemistry and vegetation characteristics.³⁹ Poor fens are most similar to bogs. They are acidic (pH<5.5), nutrient poor and dominated by *Sphagnum* moss. Due to limited decomposition, thick layers of moss-based peat develop, restricting water flow. Moderate-rich fens are not as acidic as poor fens (pH 5.5 to 7.0). Water flow is less restricted and decomposition is more complete than in poor fens, so more nutrients are available for plant growth. Usually sedges and brown mosses (*Amblystegiaceae*) are abundant. Extreme-rich fens are most similar to marshes. The water is alkaline (pH > 7.0)

and may have high levels of dissolved minerals that form marl deposits. Decomposition occurs relatively quickly, slowing peat formation, improving water flow and increasing the amount and movement of nutrients. This results in extensive growths of vascular plants such as sedges (*Carex*), willows (*Salix*) and river and swamp birch (*Betula occidentalis*, *B. glandulifera*).^{38,39}

Fens and cold streams are usually found in the boreal region and are not typical of the Saskatchewan prairies where aquatic habitats generally consist of temporary ponds, small marshy sloughs, man-made reservoirs, saline lakes, and warm meandering rivers and streams.³⁸ Thus the Crooked Lake Fen Sanctuary represents an unusual mix of habitats for the Saskatchewan prairies.

Macroinvertebrates

A total of 63 macroinvertebrate taxa were collected from the sanctuary during the study (Table 1). All but seven were insects. Flies (Diptera) made up 65% of the



Figure 3: Mineral pools in area # 4a.



Figure 4: Sampling stream in area # 20.

macroinvertebrates collected. The most diverse group was the non-biting midges (Diptera: Chironomidae) represented by 21 different taxa. Fifty-eight of the macroinvertebrates can be considered residents, as each was collected in the aquatic habitats or was likely “breeding” in the sanctuary. Five insect taxa were collected only as adults in aerial sweeps, suggesting they may be transients originating from the Qu’Appelle River or nearby ponds. The cumulative resident count graph, shown in Figure 5, has reached a plateau indicating the majority of macroinvertebrate taxa have been recorded based on the sampling methods used.

The macroinvertebrate list for the sanctuary includes the predatory leech (*Percymoorensis marmoratis* (Say)), the marsh pond snail (*Stagnicola elodes* (Say)), pea clams (*Pisidium sp* and *Sphaerium sp*) and scuds (*Gammarus lacustris* Sars), as well as skimmer dragonflies (Libellulidae), and many non-biting midges (Chironomidae)

all of which are widespread in aquatic habitats of the Saskatchewan prairies. A number of insects were, however, unexpected. The stonefly, *Amphinemum linda* (Ricker), is distributed throughout the boreal forest of Saskatchewan and Canada.^{5,6} The mayfly, *Baetis brunneicolor* McDunnough, also inhabits streams in the boreal forest and Cypress Hills of Saskatchewan.³³ The caddisflies *Limnephilus rossi* Leonard and Leonard and *Hesperophylax designatus* (Walker) are found throughout northern Saskatchewan in springs and cold headwater streams.²⁸ *H. designatus* has also been collected from streams in the Cypress Hills and a spring south of Saskatoon.²⁸ The beetle, *Sanfilippodytes pseudovilis* (Young), is reported from across Canada usually in association with cold springs.¹¹ In Saskatchewan, it is recorded only from the boreal forest and Cypress Hills.¹¹ In addition to the above species, three non-biting midges, *Brillia retifinis* Saether, *Chaetocladius sp*, and *Diplocladius cultriger* Kieffer, collected at

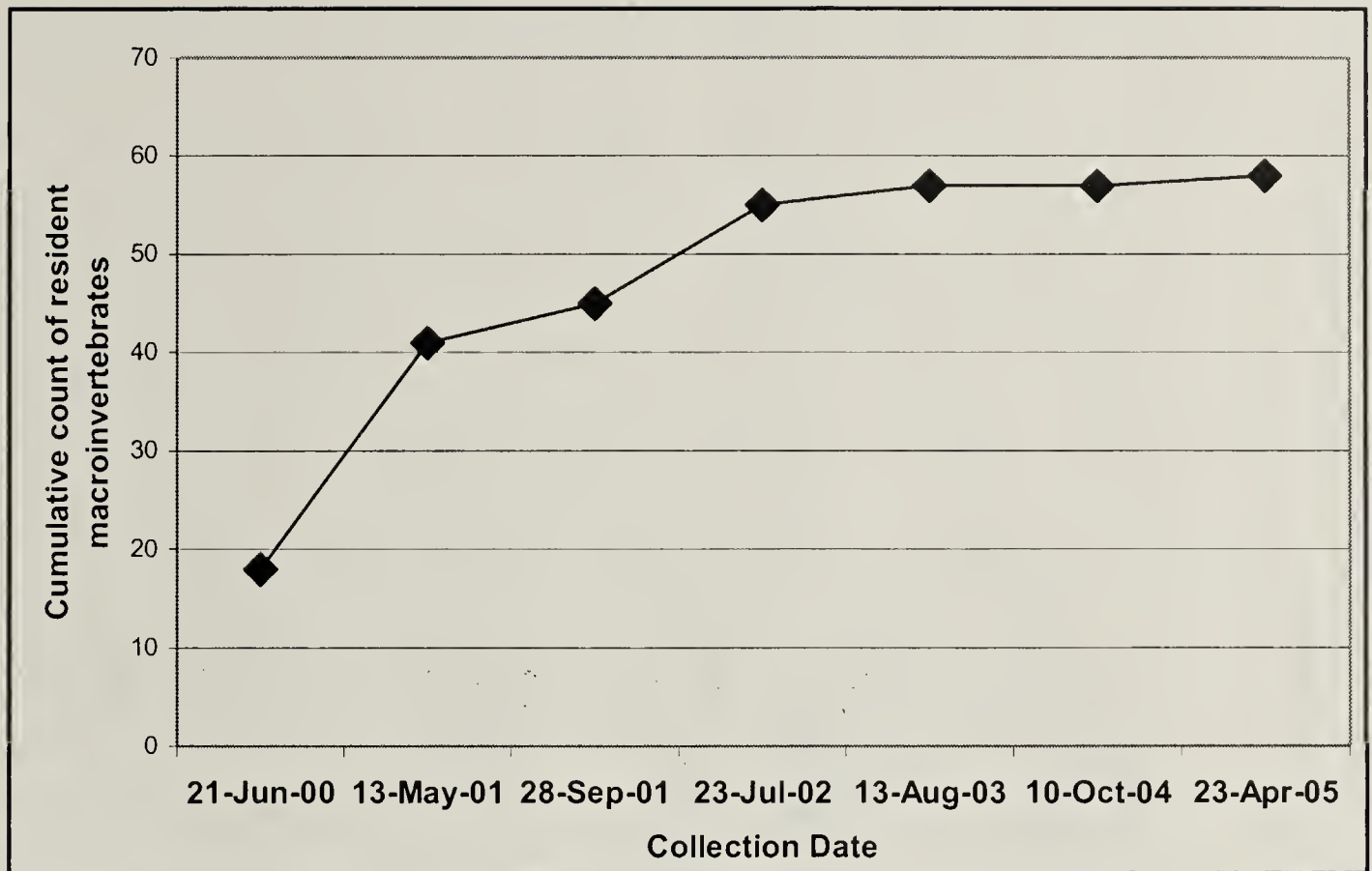


Figure 5: Accumulated resident count of macroinvertebrates collected at Crooked Lake Fen Nature Sanctuary.

the sanctuary have not previously been recorded in the province though their distributions suggested they should be present.^{12,13,16} All are associated with cold springs and small streams.³⁴

The macroinvertebrate communities of peatlands (bogs and fens) and springs have not been well studied in Saskatchewan or in Canada.^{3,36} Most of the information currently available is based on incidental records associated with faunal surveys of various groups rather than studies documenting the entire macroinvertebrate community of a particular site.

Conclusions

Within its boundaries, Crooked Lake Fen Sanctuary contains groundwater seeps, springs, cool streams and areas of extreme-rich fen creating an unusual habitat complex for the southern Saskatchewan prairies. A number of aquatic insects typical of cold boreal forest streams occur here, outside their characteristic ranges. How these boreal insect populations originated at this location is open to speculation. They may be chance

immigrants, although they are not exceptional fliers, or it is possible they are isolated relics of a time when more springs and/or cold-water streams were present in the area and these species were more widely distributed. The presence of these insects makes the sanctuary a significant zoogeographical site and worthy of continued protection.

The current study has attempted to begin documenting the aquatic macroinvertebrate biodiversity at the sanctuary. It is hoped that research will continue at the sanctuary using more intensive collecting methods, quantitative sampling devices and regular physical and chemical measurements. Such research will add new records and provide valuable information on community structure. Unfortunately, lack of species level taxonomic keys for most Saskatchewan aquatic macroinvertebrates continues to hamper such research in the province.

At present, direct risks to the sanctuary come from agricultural practices, acreage developments, or catastrophic events (i.e.

Table 1: Aquatic macroinvertebrates collected at Crooked Lake Fen Sanctuary

^R=Resident, ^T=Transient

Hirudinea (Leeches)	Hemiptera (True Bugs)
Hirudinidae	<i>Gerris buenoi</i> Kirkaldy ^R
<i>Percymoorensis marmoratis</i> (Say) ^R	Plecoptera (Stoneflies)
Mollusca	Capniidae
Gastropoda (Snails)	<i>Capniidae sp^R</i>
Lymnaeidae	Nemouridae
<i>Pseudosuccinea cf columella</i> (Say) ^R	<i>Amphinemura linda</i> (Ricker) ^R
<i>Stagnicola elodes</i> (Say) ^R	Trichoptera (Caddisflies)
Physidae	Hydroptilidae
<i>Aplexa hypnorum</i> (Linnaeus) ^R	<i>Ochrotrichia cf spinosa</i> (Ross) ^R
Pelecypoda (Clams)	Lepidostomatidae
Sphaeriidae	<i>Lepidostoma sp^R</i>
<i>Pisidium sp^R</i>	Limnephilidae
<i>Sphaerium sp^R</i>	<i>Hesperophylax designatus</i> (Walker) ^R
Crustacea	<i>Limnephilus ornatus</i> Banks ^R
Amphipoda (Scuds)	<i>Limnephilus rossi</i> Leonard and Leonard ^R
<i>Gammarus lacustris</i> Sars ^R	Coleoptera (Beetles)
Insecta	Dytiscidae
Ephemeroptera (Mayflies)	<i>Agabus seriatus</i> (Say) ^R
Baetidae	<i>Liodesus obscurellus</i> (LeConte) ^R
<i>Baetis brunneicolor</i> McDunnough ^R	<i>Sanfilippodytes pseudovilis</i> (Young) ^R
Odonata (Dragonflies and Damselflies)	Hydrophilidae
Libellulidae	<i>Crenetis cf digesta</i> (LeConte) ^R
<i>Sympetrum costiferum</i> (Hagen) ^T	
<i>Sympetrum internum</i> Montgomery ^T	

Table 1 Continued

Diptera (Two-winged Flies)	<i>Aedes cinereus</i> Meigen ^T
Ceratopogonidae (Biting midges)	<i>Ochlerotatus spencerii</i> (Theobald) ^R
Atrichopogon sp ^{R?}	Dixidae (Dixid flies)
Chironomidae (Non-biting midges)	<i>Dixa</i> sp ^R
<i>Tanypodinae</i> sp ^R	Empididae (Dance flies)
<i>Procladius culiciformis</i> (Linnaeus) ^{R?}	<i>Chelifera</i> sp ^R
<i>Diamesa</i> sp ^R	<i>Clinocera</i> sp ^R
<i>Prodiamesa olivacea</i> (Meigen) ^R	Ephydriidae (Shore flies)
<i>Orthocladiinae</i> sp ^R	<i>Ephydriidae</i> sp ^R
<i>Brillia retifinis</i> Saether ^R	<i>Parydra</i> sp 1 ^{T?}
<i>Chaetocladius</i> sp ^R	<i>Parydra</i> sp 2 ^{T?}
<i>Corynoneura</i> sp ^R	Psychodidae (Moth flies)
<i>Cricotopus/Orthocladius</i> sp ^R	<i>Pericoma</i> sp 1 ^R
<i>Diplocladius cultriger</i> Kieffer ^R	<i>Pericoma</i> sp 3 ^R
<i>Eukiefferiella</i> sp ^R	<i>Telmatoscopus</i> sp ^R
<i>Orthocladius lignicola</i> Kieffer ^R	Simuliidae (Blackflies)
<i>Parachaeetocladius</i> sp ^R	<i>Simulium vittatum</i> complex Zett. ^R
<i>Parametriocnemus</i> sp ^R	Tabanidae (Horseflies and Deerflies)
<i>Pseudosmittia</i> sp ^{R?}	<i>Chrysops cf frigidus</i> Osten Sacken ^{R?}
<i>Thienemanniella</i> sp ^R	<i>Chrysops fulvaster</i> Osten Sacken ^{R?}
<i>Tvetinia bavarica</i> group ^R	<i>Hybomitra</i> sp ^{R?}
<i>Tvetinia paucunca</i> (Saether) ^R	Tipulidae (Craneflies)
<i>Chironomus atrella</i> (Townes) ^R	<i>Dicranota</i> sp ^R
<i>Micropsectra</i> sp ^R	<i>Limnobia</i> sp ^R
<i>Micropsectra attenuata</i> gr ^R	<i>Limmophila</i> sp ^R
Culicidae (Mosquitoes)	<i>Pedicia</i> sp ^R

oil or chemical truck spills). Unfortunately, the ground water source probably lies well beyond the borders of the sanctuary. Not only does this increase the risk of chemical contamination, but drilling of new water wells in the area could affect the natural flow pattern and chemistry of the sanctuary's ground water source. It may be possible to protect the sanctuary's water supply by monitoring its flow and quality enabling mitigation efforts to begin before impacts are irreversible. A more difficult problem to alleviate will be changes due to global warming which, undoubtedly, will affect the ground water supply and vegetation of the sanctuary.

Acknowledgements

The project was funded by research grants from SaskEnergy to Nature Saskatchewan. Thanks to Nature Saskatchewan and D. Peschken for initiating the research and securing funding. J. Halpin, V. Keeler and J. Webb assisted in field collections. J. Halpin sorted the samples. J. Webb verified the mayfly species and L. Dosedall assisted in the stonefly identifications.

1. CLARKE, A.H. 1981. The Freshwater Mollusks of Canada. National Museum of Canada, Ottawa.
2. CURRIE, D.C. 1986. An annotated list of and keys to the immature blackflies of Alberta (Diptera: Simuliidae). *Memoirs of the Entomological Society of Canada* 134:1-90.
3. DANKS, H.V. and D.M. ROSENBERG. 1987. Aquatic insects of peatlands and marshes in Canada: Synthesis of information and identification of needs for research. *Memoirs of the Entomological Society of Canada* 140:163-174.
4. DE VRIES, B. 2003. Lichen inventory of the Crooked Lake Fen Nature Sanctuary. *Blue Jay* 61:43-50.
5. DOSDALL, L.M. 1992. New records of Saskatchewan stoneflies (Plecoptera). *Proceedings of the Entomological Society of Manitoba*. 48:14-31.
6. DOSDALL, L.M. and D.M. LEHMKUHL. 1979. Stoneflies (Plecoptera) of Saskatchewan. *Quaestiones Entomologicae* 15:3-116.
7. GOLDER ASSOCIATES LTD. 1995. Report on the Crooked Lake Fen Avifauna and Vegetation Survey. Report prepared for SaskEnergy. 20 pp.
8. JOHANNSEN, O.A. 1933. Aquatic Diptera. Part I. Nemocera, exclusive of Chironomidae and Ceratopogonidae. *Cornell University Agricultural Experiment Station Memoir* 164: 70 pp
9. JOHANNSEN, O.A. and H.K. TOWNES. 1952. Guide to the insects of Connecticut. Part IV. The Diptera or true flies. Fifth Fascicle. Midges and gnats Tendipedidae (Chironomidae). *State Connecticut Geological and Natural History Survey Bulletin*. 80:1-147.
10. KLEMM, D.J. 1972. Freshwater Leeches (Annelida: Hirudinea) of North America. U.S. Environmental Protection Agency No. 18050. 53 pp.
11. LARSON, D.J., Y. ALARIE and R.E. ROUGHLEY. 2000. Predaceous Diving Beetles (Coleoptera: Dytiscidae) of the Nearctic Region, with Emphasis on the Fauna of Canada and Alaska. National Research Council Research Press, Ottawa. 982 pp.
12. MASON, P.G., and D.W. PARKER. 1994. Additions and corrections to the list of non-biting midges in Saskatchewan. *Blue Jay* 52:200-202
13. MASON, P.G., D.W. PARKER and P. MORRILL. 1991. An amateur naturalist's guide to non-biting midges in Saskatchewan. *Blue Jay* 49:174-182.
14. MERRITT, R.W. and K.W. CUMMINS. (Ed.) 1996. An Introduction to the Aquatic Insects of North America. 3rd Ed. Kendall Hunt Publishing Company, Dubuque, Iowa. 862 pp.
15. NEEDHAM, J.G., M.J. WESTFALL, Jr., and M.L. MAY. 2000. Dragonflies of North America. Revised Edition. Scientific Publishers, Gainesville. 939 pp.
16. OLIVER, D.R., M.E. DILLON, and P.S. CRANSTON. 1990. A Catalog of Nearctic Chironomidae. Canada Government Publications Centre, Ottawa. 89 pp.
17. OLIVER, D.R. and M.E. ROUSSEL. 1983. Redescription of *Brillia* Kieffer (Diptera: Chironomidae) with descriptions of nearctic species. *Canadian Entomologist* 115:257-279.
18. PARKER, C.R. and G.B. WIGGINS. 1985. The nearctic caddisfly genus *Hesperophylax* Banks (Trichoptera: Limnephilidae). *Canadian Journal of Zoology* 63:2443-2472.
19. PENNAK, R.W. 1989. Freshwater Invertebrates of the United States. 3rd Ed. John Wiley and Sons Inc., New York. 628 pp.
20. PESCHKEN, D.P. 2003. Wilderness preserved: Nature Saskatchewan's sanctuaries. *Blue Jay* 61:68-81.
21. ROBACK, S.S. 1980. The immature chironomids of the eastern United States. IV. Tanypodinae, Procladini.

Proceedings Academy Natural Science Philadelphia. 132:1-63.

22. ROSENBERG, D.M. and V.H. RESH. 1993. Chapter 1: Introduction to freshwater biomonitoring and benthic macroinvertebrates, p. 1-9. In: D.M. Rosenberg and V.H. Resh (eds.) *Freshwater Biomonitoring and Benthic macroinvertebrates*. Chapman and Hall, New York. 488 pp.

23. ROSS, H.H. 1944. The caddis flies, or Trichoptera, of Illinois. *Bulletin of the Natural History Survey Division, IL*. 23:1-326.

24. SAETHER, O.A. 1969. Some nearctic Podonominae, Diamesinae, and Orthoclaadiinae (Diptera: Chironomidae). *Fisheries Research Board of Canada Bulletin* 170:1-154.

25. SAETHER, O.A. and G.A. HALVORSEN. 1981. Diagnoses of *Tvetenia* Keiff. Emend., *Dratnalia* n. gen. and *Eukiefferiella* Thien., with a phylogeny of the *Cardiocladius* group (Diptera: Chironomidae). *Entomologica Scandinavica Supplement* 15:269-285.

26. SAWYER, R.T. 1972. North American freshwater leeches, exclusive of the Piscicolidae, with a key to all species. *Illinois Biological Monographs*.46:1-154.

27. SMETANA, A. 1988. Review of the family Hydrophilidae of Canada and Alaska (Coleoptera). *Memoirs Entomological Society of Canada* 142:1-316.

28. SMITH, D.H., 1984. Systematics of Saskatchewan Trichoptera Larvae with Emphasis on Species from Boreal Streams. Ph. D. Thesis. University of Saskatchewan, Saskatoon. SK. 1302 pp.

29. TESKEY, H.J. 1990. The Insects and Arachnids of Canada: Part 16: The Horseflies and Deerflies of Canada and Alaska. Diptera: Tabanidae. Agriculture Canada Publication 1838:1-381.

30. THORP, J.H. and A.P. COVICH. (Ed.) 2001. *Ecology and Classification of North American Freshwater Invertebrates*. 2nd Ed. Academic Press, New York. 1056 pp.

31. TOWNES, H.K. 1945. The nearctic species of Tendipedini [Diptera, Tendipedidae = Chironomidae]. *American Midland Naturalist* 34:1-206.

32. WALKER, E.M. and P.S. CORBET. 1975. The Odonata of Canada and Alaska. Vol. 3. Anisoptera-Macromiidae, Corduliidae, Libellulidae. University of Toronto Press, Toronto, Ontario. 307 pp.

33. WEBB, J.M. 2002. The Mayflies of Saskatchewan. M. Sc. Thesis. University of Saskatchewan, Saskatoon, SK. 375 pp.

34. WIEDERHOLM, T. (Ed.) 1983. Chironomidae of the holarctic region- Keys and diagnoses. Part 1. Larvae. *Entomologica Scandinavica Supplement* 19:1-457.

35. WIGGINS, G.B. 1977. Larvae of the North American Caddisfly Genera (Trichoptera). University of Toronto Press, Toronto. 401 pp.

36. WILLIAMS, D.D. and H.V. DANKS. 1991. Arthropods of springs: Introduction. *Memoirs of the Entomological Society of Canada* 155:3-5

37. WOOD, D.M., P.T. DANG and R.A. ELLIS. 1979. The Insects and Arachnids of Canada: Part 6: The Mosquitoes of Canada. Diptera: Culicidae. Agriculture Canada Publication 1686:1-390.

38. ZOLTAI, S.C. 1987. Peatlands and marshes in the wetland regions of Canada. *Memoirs of the Entomological Society of Canada* 140:5-13.

39. ZOLTAI, S.C. and D.H. VITT. 1995. Canadian wetlands: Environmental gradients and classification. *Vegetatio* 118:131-137.



“Leafcutters are the dominant herbivores of the Neotropics, consuming far more vegetation than any other group of animals of comparable taxonomic diversity, including mammals, homopterans and lepidopterans.”

Bert Hölldobler and Edward O. Wilson, *The Ants*, p.596.