

## DISTRIBUTION AND FIRST REPORTS OF BRANCHIOBDELLIDA (ANNELIDA: CLITELLATA) ON CRAYFISH IN THE PRAIRIE PROVINCES OF CANADA

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**ABSTRACT.**—*Orconectes virilis* (northern crayfish) were collected from 67 sites in Alberta, Saskatchewan, Manitoba, and far-western Ontario, Canada, and yielded 2 species of branchiobdellidans, *Cambarincola vitreus* and *Cambarincola chirocephalus*. This is the first report of branchiobdellidans in the Prairie Provinces. *Cambarincola vitreus* was distributed across the study area, but *C. chirocephalus* appeared to be restricted to southeastern Saskatchewan, southern Manitoba, and the site in western Ontario. Neither branchiobdellidan species was observed on crayfish in the Beaver River or the South Saskatchewan River and associated tributaries upstream (west) of Saskatoon, Saskatchewan, despite multiple sampling at these locations.

*Key words:* crayfish worm, *Cambarincola* spp., *Cambarincola vitreus*, *Cambarincola chirocephalus*, *Orconectes virilis*, host-symbiont distribution.

Branchiobdellidans, or crayfish worms, are obligate ectosymbionts primarily of astacoidean crayfishes (Brinkhurst and Gelder 2001). The distribution of branchiobdellidans in North America extends from Costa Rica north to the general area along the Canada–United States border (Gelder et al. 2002). Reports of branchiobdellidans in Canada are restricted to southern British Columbia (Gelder and Hall 1990), the St. Lawrence River drainage extending from Lake Erie and Lake Ontario to the river’s mouth (Gelder et al. 2001) and New Brunswick (Gelder et al. 2009). Although branchiobdellidans have not been reported in the intermediate region (western Ontario and the Prairie Provinces) of Canada, potential hosts (*Orconectes* spp.) have been documented in these areas (Crocker and Barr 1968, Hamr 2002). The dearth of reports of branchiobdellidans from the Prairie Provinces likely results from inadequate targeted sampling (Gelder et al. 2002) or recent westward range expansion of crayfish. Unidentified branchiobdellidans were observed on a newly established population of *Orconectes virilis* (Hagen 1870), the northern crayfish, collected from the North Saskatchewan River in Edmonton, Alberta, in 2002 (H. Proctor personal observation). The historical range of *O. virilis* in Alberta extended along only the Beaver River drainage

near the province’s eastern border with Saskatchewan (Clifford 1991); however, recent collections demonstrate that *O. virilis* is now present in additional Albertan drainage systems in both the south and central parts of the province (Terry Clayton, Alberta Sustainable Resource Development, personal communication).

A recent study investigated and documented the occurrence of branchiobdellidans in New Brunswick for the first time (Gelder et al. 2009), establishing the eastern distributional limit of crayfish worms in North America. We initiated our study to establish the presence and distribution of branchiobdellidans in the Prairie Provinces with the additional intent of delineating the northern limit of branchiobdellidans in North America.

Northern crayfish were collected by “kick-netting” for up to 2 hours per site or in deployed Gee minnow traps (Wildlife Supply Company, Buffalo, NY) baited with salmon (*Oncorhynchus* sp.) and left for 12–24 hours. The minnow traps were modified to accommodate crayfish by increasing the entrance hole size to approximately 60 mm. We sampled 67 sites across Alberta, Saskatchewan, Manitoba, and western Ontario near the border of Manitoba between August 2006 and November 2007 (Fig. 1, Appendix). We preserved each crayfish separately in a container of 95%

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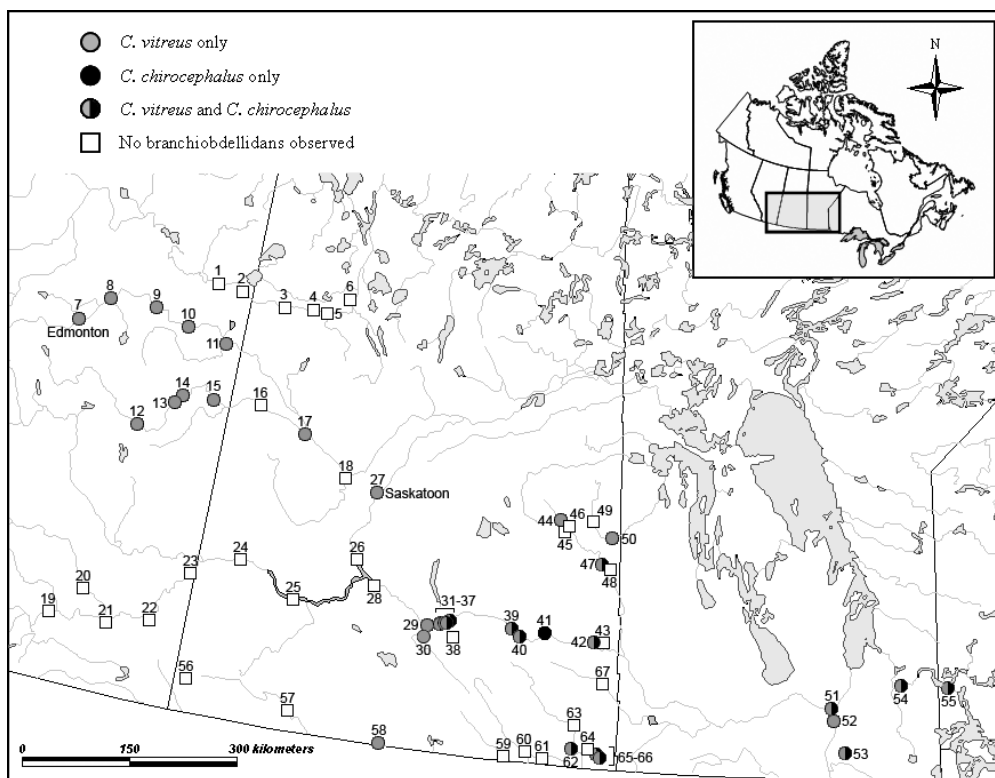


Fig. 1. Sampling locations of *Orconectes virilis* in Alberta, Saskatchewan, Manitoba, and Ontario showing detection or nondetection of 2 branchiobdellidan species, *Cambarincola vitreus* and *C. chirocephalus*. Numbers correspond to site numbers listed in the Appendix.

ethanol. In the laboratory, the external surface and branchial chambers of each crayfish, as well as debris at the bottom of the collection jar, were examined for branchiobdellidians under a dissecting microscope. We then transferred worms to labeled specimen jars containing fresh 95% ethanol. Stored branchiobdellidians were cleared in methyl salicylate, infiltrated with Canada balsam, and individually mounted on glass slides (Brinkhurst and Gelder 2001). We examined branchiobdellidians by using a compound microscope with both bright-field and differential interference contrast (DIC) illumination. Species identifications were made using information in Hoffman (1963).

Northern crayfish were collected from 66 sites across the Prairie Provinces and 1 site in far-western Ontario (Fig. 1; Appendix). We identified 2 species of branchiobdellidians from 35 sites: *Cambarincola vitreus* Ellis 1919 and *Cambarincola chirocephalus* Ellis 1919. *Cam-*

*barincola vitreus* was distributed widely across the study area, whereas *C. chirocephalus* was observed only in southeastern Saskatchewan, southern Manitoba, and far-western Ontario. When *C. vitreus* and *C. chirocephalus* were found on crayfish from the same site, the species usually were cohabitant on a single crayfish. Branchiobdellidians were not detected at 32 sites, including multiple (>5) sampling locations in the Beaver River and in the South Saskatchewan River and its associated tributaries upstream (west) of Saskatoon, Saskatchewan (Bow River, Oldman River). Additional rivers in Saskatchewan yielded no branchiobdellidians but were minimally sampled ( $\leq 2$  sites and/or  $\leq 5$  crayfish).

Branchiobdellidan presence and distribution in the Prairie Provinces and in far-western Ontario, Canada, was unknown prior to this study. This study has established that 2 species of branchiobdellidians, *C. vitreus* and *C. chirocephalus*, inhabit *O. virilis* hosts in the region

as a continuous extension of previously known ranges; *C. vitreus* and *C. chirocephalus* both occur widely throughout the Mississippi River drainage (Hoffman 1963, Gelder et al. 2002) and have been described from the northern Great Lakes and Great Plains states (Gelder et al. 2002).

The northern crayfish was the only crayfish collected during this study, despite records of additional *Orconectes* species in Manitoba and Ontario (Hamr 2002). Branchiobdellidans may exhibit a host preference when more than one host species is present (Brown and Creed 2004). Therefore, examinations of different crayfish species in the region may reveal additional branchiobdellidan species.

Nondetection of branchiobdellidans in many sampled waterways does not necessarily indicate true absence. The number of sampling locations and specimens collected were limited in certain areas. However, the lack of observations in intensively sampled river systems suggests that branchiobdellidan distribution may not be entirely coincident with host distribution. No branchiobdellidans were found on 47 crayfish examined from 6 sites along the Beaver River, the known northern limit of *O. virilis* distribution in Alberta and western Saskatchewan (Clifford 1991; I. Phillips, Saskatchewan Watershed Authority, personal communication). Although additional sampling is needed in the Beaver River and its mainstream, the Churchill River, absence of branchiobdellidans might result from an inability of the ectosymbionts to tolerate environmental conditions of northern latitudes (e.g., low temperatures and short ice-free season). In contrast, absence of branchiobdellidan observations in the South Saskatchewan River and associated tributaries upstream of Saskatoon is possibly related to the presence of 2 dams in central Saskatchewan. *Cambarincola vitreus* occurs on *O. virilis* downstream of the Gardiner Dam in the South Saskatchewan River, and *C. chirocephalus* was found on crayfish downstream of the Qu'Appelle River Dam in the Qu'Appelle River, but neither species was detected on any of the 200 crayfish examined from 9 sites upstream of the dams (Fig. 1).

Distribution patterns of branchiobdellidans can further our understanding of dispersal patterns of crayfish, as branchiobdellidan movement is contingent upon movement of the host. In addition, combined host-symbiont distribu-

tion patterns may provide insight into ecological interactions between the associated organisms (Whiteman et al. 2004). The records we provide in our study will form the basis for future analyses of branchiobdellidan-crayfish relationships, including reasons for concomitant versus crayfish-only westward dispersal.

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#### LITERATURE CITED

- BRINKHURST, R.O., AND S.R. GELDER. 2001. Annelida: Oligochaeta including Branchiobdellidae. Pages 431–463 in J.H. Thorp and A. Covich, editors, Ecology and classification of North American freshwater invertebrates. 2nd edition. Academic Press, New York.
- BROWN, B.L., AND R.P. CREED. 2004. Host preference by an aquatic ectosymbiotic annelid on 2 sympatric species of host crayfishes. *Journal of the North American Benthological Society* 23:90–100.
- CLIFFORD, H.F. 1991. Aquatic invertebrates of Alberta. University of Alberta Press, Edmonton, Alberta, Canada.
- CROCKER, D.W., AND D.W. BARR. 1968. Handbook of the crayfishes of Ontario. University of Toronto Press, Toronto, Ontario, Canada.
- GELDER, S.R., H.C. CARTER, AND D.N. LAUSIER. 2001. Distribution of crayfish worms or branchiobdellidans (Annelida: Clitellata) in New England. *Northeastern Naturalist* 8:79–92.
- GELDER, S.R., N.L. GAGNON, AND K. NELSON. 2002. Taxonomic considerations and distribution of the Branchiobdellida (Annelida: Clitellata) on the North American continent. *Northeastern Naturalist* 9:451–468.
- GELDER, S.R., AND L.A. HALL. 1990. Description of *Xironogiton victoriensis* n.sp. from British Columbia, Canada, with remarks on other species and a Wagner analysis of *Xironogiton* (Clitellata: Branchiobdellida). *Canadian Journal of Zoology* 68:2352–2359.
- GELDER, S.R., L. MCCURRY, AND D.F. MCALPINE. 2009. Distribution and first records of Branchiobdellida (Annelida: Clitellata) from crayfish in the Maritime provinces of Canada. *Northeastern Naturalist* 16: 45–52.
- HAMR, P. 2002. *Orconectes*. Pages 585–608 in D.M. Holdich, editor, Biology of freshwater crayfish. Blackwell Scientific Press, Oxford.

- HOFFMAN, R.L. 1963. A revision of the North American annelid worms of the genus *Cambarincola* (Oligochaeta: Branchiobdellidae). *Proceedings of the United States National Museum* 114:271–371.
- WHITEMAN, N.K., D. SANTIAGO-ALARCON, K.P. JOHNSON, AND P.G. PARKER. 2004. Differences in straggling rates between two genera of dove lice (Insecta: Phthi-

raptera) reinforce population genetic and cophylogenetic patterns. *International Journal for Parasitology* 34:1113–1119.

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APPENDIX. Detection (+) or nondetection (-) of 2 branchiobdellidan species, *Cambarincola vitreus* and *C. chirocephalus*, from *Oreonectes virilis* collection sites in Alberta, Saskatchewan, Manitoba, and Ontario, Canada, with information on the number of hosts examined from each site and date collected (month and year). Site numbers correspond to locations in Figure 1.

Site #	Coordinates	Location	# crayfish examined	Date	<i>C. vitreus</i>	<i>C. chirocephalus</i>
1	54.389°N 110.755°W	Beaver River, Rte. 41, AB	21	Jul-07	-	-
2	54.355°N 110.216°W	Beaver River, Rte. 28, AB	20	Jul-07	-	-
3	54.260°N 109.221°W	Beaver River, Rte. 26, SK	3	Sep-07	-	-
4	54.296°N 108.602°W	Beaver River, Hwy 4, SK	1	Sep-06	-	-
5	54.510°N 107.868°W	Beaver River, Rte. 155, SK	1	Sep-07	-	-
6	54.296°N 108.302°W	Beaver River, Rte. 903, SK	1	Sep-07	-	-
7	53.530°N 113.521°W	North Saskatchewan River, Edmonton, AB	3	Sep-07	+	+
8	53.888°N 112.974°W	North Saskatchewan River, Rte 38, AB	18	Aug-07	+	+
9	53.906°N 111.963°W	North Saskatchewan River, Desjarlais Crossing, AB	16	Aug-07	+	+
10	53.755°N 111.216°W	North Saskatchewan River, Rte. 881, AB	20	Aug-07	+	+
11	53.659°N 110.337°W	North Saskatchewan River, Rte. 897, AB	14	Aug-07	+	+
12	52.409°N 111.810°W	Battle River, Rte. 36, AB	20	Aug-07	+	+
13	52.786°N 111.144°W	Battle River, Wainright, AB	17	Jun-07	+	+
14	52.893°N 111.007°W	Battle River, Fabyan, AB	12	Jun-07	+	+
15	52.918°N 110.334°W	Battle River, Rte. 897, AB	24	Sep-07	+	+
16	52.975°N 109.343°W	Battle River, Lilydale, SK	1	Sep-06	-	-
17	52.718°N 108.310°W	Battle River, N.B., SK	5	Sep-06	+	+
18	52.323°N 107.402°W	Eagle Creek, Hwy. 398, SK	2	Jul-06	-	-
19	49.856°N 112.625°W	Oldman River, Rte. 845, AB	17	Aug-07	-	-
20	50.246°N 112.079°W	Bow River, Rte. 36, AB	20	Sep-07	-	-
21	49.904°N 111.476°W	South Saskatchewan River, Rte. 879, AB	25	Aug-07	-	-
22	50.045°N 110.674°W	South Saskatchewan River, Medicine Hat, AB	16	Aug-07	-	-
23	50.732°N 110.075°W	South Saskatchewan River, Rte. 41, AB	29	Aug-07	-	-
24	51.024°N 109.134°W	South Saskatchewan River, Lemsford Ferry, SK	36	Aug-07	-	-
25	50.656°N 107.975°W	South Saskatchewan River, Saskatchewan Landing Provincial Park, SK	27	Oct-07	-	-
26	51.279°N 106.845°W	South Saskatchewan River, Danielson Park, SK	30	Sep-07	-	-
27	52.137°N 106.646°W	South Saskatchewan River, Saskatoon, SK	12	Jul-06	+	-
28	50.985°N 106.416°W	Qu'Appelle River, Hwy. 14, SK	3	Jul-06	-	-
29	50.570°N 105.281°W	Qu'Appelle River, Buffalo Pound, SK	12	Aug-06	+	-
30	50.436°N 105.304°W	Moosejaw River, Tosbror, SK	16	Sep-06	+	+
31	50.620°N 105.032°W	Qu'Appelle River, HighHill, SK	8	Sep-06	+	+
32	50.630°N 105.008°W	Qu'Appelle River, Disley, SK	5	Sep-06	+	+
33	50.642°N 104.928°W	Qu'Appelle River, Shotgun, SK	14	Sep-06	+	+
34	50.645°N 104.886°W	Qu'Appelle River, west of Lumsden, SK	1	Jul-06	-	-
35	50.645°N 104.886°W	Qu'Appelle River, Wong's Rapids, SK	6	Aug-06	+	+
36	50.651°N 104.874°W	Qu'Appelle River, Lumsden, SK	1	Jun-06	+	+
37	50.675°N 104.831°W	Qu'Appelle River, Market Gardens, SK	14	Aug-06	+	+

## APPENDIX. Continued.

38	50.477°N 104.709°W	Wascona Creek, SK	5	Aug-07	-	-
39	50.661°N 103.600°W	Qu'Appelle River, Katepwa, SK	5	Aug-06	+	+
40	50.573°N 103.412°W	Qu'Appelle River, Range Road 105, SK	5	Aug-06	+	+
41	50.641°N 102.912°W	Qu'Appelle River, Hwy 47, SK	7	Aug-06	-	+
42	50.579°N 101.950°W	Kaposvar Creek, Hazel Cliffe, SK	2	Sep-06	+	+
43	50.590°N 101.740°W	Cut Arm Creek, Hwy. 8, SK	1	Sep-06	-	-
44	52.086°N 102.814°W	Assinaboine River, Ketchim, SK	6	Sep-06	+	-
45	51.940°N 102.719°W	Conjuring Creek, Preeceville, SK	3	Sep-06	-	-
46	52.023°N 102.625°W	Lillian River, Lady Lake, SK	7	Sep-06	-	-
47	51.565°N 101.917°W	Assinaboine River, Kamsack, SK	5	Sep-06	+	+
48	51.521°N 101.713°W	Little Boggy Creek, Rummymeade, SK	1	Sep-06	-	-
49	52.115°N 102.139°W	Swan River, Swan Plain, SK	2	Sep-06	-	-
50	51.907°N 101.719°W	Swan River, Arran, SK	2	Sep-06	+	+
51	49.876°N 097.232°W	Assiniboine River, Assiniboine Park, MB	6	Oct-07	+	+
52	49.723°N 097.173°W	LaSalle River, LaBarriere Park, MB	2	Oct-07	-	-
53	49.317°N 096.945°W	Rat River, St. Malo, MB	12	Sep-07	+	+
54	50.160°N 095.867°W	Pinawa diversion, Pinawa, MB	1	Sep-07	+	+
55	50.120°N 094.944°W	Winnipeg River, ON	6	Oct-06	+	+
56	49.412°N 109.744°W	Battle Creek, Rd. 615, SK	1	Oct-06	-	-
57	49.250°N 107.717°W	Frenchman River, Val Marie, SK	14	Jun-07	-	-
58	49.030°N 105.894°W	Poplar River, Lacordaire, SK	1	Sep-06	+	+
59	49.063°N 103.499°W	Long Creek, Torquay, SK	1	Sep-06	-	-
60	49.145°N 103.091°W	Souris River, Raftery Dam Outflow, SK	8	Aug-06	-	-
61	49.078°N 102.753°W	Souris River, Roche Percee, SK	5	Aug-06	-	-
62	49.231°N 102.226°W	Moose Mountain Creek, Oxbow, SK	5	Aug-06	+	+
63	49.523°N 102.172°W	Moose Mountain Creek, Carlyle, SK	4	Aug-06	-	-
64	49.236°N 101.904°W	Antler River, SK	1	Jul-07	-	-
65	49.193°N 101.711°W	Antler River, Camduff, SK	5	Jul-07	+	+
66	49.141°N 101.654°W	Antler River, south of Camduff, SK	7	Jul-07	+	+
67	50.076°N 101.704°W	Moosomin Reservoir, SK	1	Jul-06	-	-