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THE EARTHWORMS OF MINNESOTA (OLIGOCHAETA: ACANTHODRILIDAE LUMBRICIDAE AND MEGASCOLECIDAE).

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ABSTRACT

This survey of the earthworms from 51 of the 87 counties of Minnesota recorded 15 species of terrestrial Oligochaeta, five of which are reported for the first time from the state: Acanthodrilidae (*Diplocardia riparia*), Lumbricidae (*Allolobophora chlorotica*, *Bimastos parvus*, and *Eiseniella tetraedra*) and Megascolecidae (*Amyntas loveridgei*). The distribution of the earthworm species appears to be mildly influenced by the three physiographic regions found within the state: 1) Northern Lakes States Forest and Forage Subdivision, 2) Central Feed Grains and Livestock Subdivision and 3) Northern Great Plains Spring Wheat Subdivision.

Key words: Minnesota, earthworms, distribution.

RÉSUMÉ

Cet inventaire des vers de terre des 51 comtés sur la 87 que compte la Caroline du Sud, a recensé 15 espèces d'Oligochètes terrestres, dequelles, cinq le sont pour la première fois dans cet état: Acanthodrilidae (*Diplocardia riparia*), Lumbricidae (*Allolobophora chlorotica*, *Bimastos parvus*, and *Eiseniella tetraedra*) and Megascolecidae (*Amyntas loveridgei*). La répartition de ces espèces de vers de terre apparaît influencée doucement par les trois régions physiographiquées que l'on trouve dans cet état: 1) la subdivision de forage des états des lacs du nord, 2) la subdivision centrale de bétails et de cereals et 3) la subdivision de blé printanier des grandes plaines.

Clé mots: Minnesota, vers de terre, répartition.

INTRODUCTION

The history of the presence of earthworms in Minnesota is relatively recent when compared to other states, e.g. Arkansas (Causey, 1952, 1953), Missouri (Olsen, 1936), Ohio (Olson, 1928) and more recently Reynolds *et al.* (1973) and Reynolds (2001a, 2001b). In 1942, Gates presented the first checklist or bibliography of North American earthworms which brought together in one paper the results of over 100 papers

published during the previous 121 years. That paper (Gates, 1942) mentioned no earthworm records for Minnesota.

The first earthworm species recorded from Minnesota was *Eisenia foetida* as an incidental record in a parasitological study which gave little insight to this species distribution within the state, "At St. Paul, Minn., found only in compost heaps and then not commonly" (Mickel, 1925). It was almost 50 years

before any new verifiable earthworm records were reported for Minnesota (Gates, 1972a). In his important paper on the *trapezoides* complex, Gates reported three species of *Allolobophora* (now *Aporrectodea*): *trapezoides*, *tuberculata* and *turgida*. This brought the state list to four species. In that same year Gates (1972b) reported *Lumbricus terrestris* from Minnesota as a new record without any details; these appeared six years later in Gates (1978).

The year 1973 saw the number of earthworm species recorded from Minnesota rise from five to six with the addition of *Octolasion tyrtaeum* (see Gates, 1973).

The next year, Gates (1974a) added *Eisenia rosea* (now *Aporrectodea rosea*) to the state records bringing the list to seven species. In his paper (Gates, 1974b) on *Dendrobaena octaedra*, he did not include this species from Minnesota. It was not until Reynolds (1977) that *D. octaedra* was reported from Minnesota.

rubellus were added to the state list. But it has remained until now for the collection details to be published. Thus, until now there have been ten earthworm species reported from Minnesota.

The results of this paper brings the state list to 15 species with the addition of *Allolobophora chlorotica*, *Amyntas loveridgei*, *Bimastos parvus*, *Diplocardia riparia*, and *Eiseniella tetraedra* species not reported previously from Minnesota.

COLLECTIONS

In presenting the considerable amount of data obtained for the state of Minnesota, we have followed the original format as used in Reynolds *et al.* (1974) for the state of Tennessee and continued through more recent earthworm surveys (Reynolds, 2001a, 2001b). The TF or USNM designation after the collection, refers to the field/collection number of Tall Timbers Research Station, collector, or museum. Any author reference after the location represents a collection which has in total, or in part, been reported previously.

In that same paper (Reynolds, 1977), *Dendrodrilus rubidus* and *Lumbricus*



Fig. 1. The geographical locations of the counties in the state of Minnesota.

Many of the specimens are deposited in the University of Minnesota collections, St.

Paul, MN.

During his early travels with Schneider National Carriers, Inc., the senior author was able to revisit Minnesota on several occasions and make additional observations and collections on the earthworms present in the state. He is also indebted to several of his colleagues at Schneider National who made collections during their travels throughout the state.

The geographical locations of the counties in the state of Minnesota are presented in Figure 1.

Collection Sites

Aitkin Co. - no records

Anoka Co. [AN]

- 01 Rt 24, Bethel, Cedar Creek Nature Center, 21 May 68, E.V. Komarek Sr. (USNM 382788)
- 02 Blaine, Blaine Bros. Maintenance Yard, under lumber and debris, 15 June 01, B. Cox.

Becker Co. [BK]

- 01 Hwy 10, south of Detroit Lakes, on shore of Detroit Lake, under logs and rocks, 20 June 99, W. London.

Beltrami Co. [BL]

- 01 Hwy 2, Bemidji, shore of Lake Bemidji, digging and under logs, 4 Oct 94, J.W.R. & P. N. Mayville.

Benton Co. - no records

Big Stone Co. - no records

Blue Earth Co. - no records

Brown Co. - no records

Carlton Co. [CA]

- 01 Cloquet Forestry Center, 7.5 km w of Cloquet, various plots, 11 July - 17 Sep 73, R.O. Morgenweck.
- 02 Cloquet Forestry Center, 5 km west of Cloquet, (Twp 49N, Range 17W, Sect. 29-32, mixed hardwoods and pine (*Populus tremuloides*, *Acer rubrum*, *Pinus strobus*, *P. resinosa*), digging and mustard extraction, August 2001, C.M. Hale.

Carver Co. - no records

Cass Co. [CS]

- 01 Hwy 2, 19 km east of Cass Lake, to Sucker Bay Road, (Twp 144N, Range 29W, Sect. 19), 100-150 year hardwood forest east side of the road, dominated by sugar maple (*Acer saccharum*) with yellow birch (*Betula alleghaniensis*) and basswood (*Tilia americana*), digging and mustard extraction, Sep 1998, 1999, 2000, C.M. Hale.
- 02 Same as above only west side of the road.
- 03 South of Bena, 22.5 km, west on Blackpoint Road, (Twp 142N, Range 28W, Sect. 8), 100-150 year hardwood forest east side of the road, dominated by sugar maple (*Acer saccharum*) with yellow birch (*Betula alleghaniensis*) and basswood (*Tilia americana*), digging and mustard extraction, Sep 1998, 1999, 2000, C.M. Hale.
- 04 Hwy 2, 19 km east of Cass Lake, to Sucker Bay Road, (Twp 143N, Range 30W, Sect. 12), 100-150 year hardwood forest east side of the road, dominated by sugar maple (*Acer saccharum*) with yellow birch (*Betula alleghaniensis*) and basswood (*Tilia americana*), digging and mustard extraction, Sep 1999, 2000, C.M. Hale.

Chippewa Co. - no records

Chisago Co. [CH]

- 01 I-35, rest area north of exit 152 near Harris, under logs and rocks, 10 Jun 98, J.W.R.

Clay Co. [CY]

- 01 I-94, exit 6 near Glyndon, truck stop, under rocks and lumber, 3 Apr 98, J.W.R.

Clearwater Co. [CL]

- 01 Itasca State Park, University of Minnesota, 24-28 July 68, L.W. Eberley and D.T. Sanwick. (USNM 382788)

Cook Co. - no records

Cottonwood Co. - no records

Crow Wing Co. - no records

Dakota Co. [DK]

- 01 Hwy 52, Vermillion River, banks under logs,
5 May 01, S. Andersen.

Dodge Co. [DG]

- 01 Hwy 14, Claremont, ditch under logs, 9 May
01, S. Andersen

Douglas Co. [DO]

- 01 Satterlie Farm (20-129N-40W), soybean-oats-
barley, 29 Jun 87, D.J. Fuchs & D.R. Linden.

Faribault Co. [FA]

- 01 I-90E, rest area mm 118, near Blue Earth,
under rocks and logs, 16 June 00, G. van
Speybroeck.

Fillmore Co.[FL]

- 01 Hwy 16, Whalen on banks of Root River, 26
May 00, S. Andersen.

Freeborn Co. [FR]

- 01 I-90W, rest area mm 170 near Oakland, under
rocks and logs, 12 June 00, G. van
Speybroeck.

Goodhue Co. - no records**Grant Co. [GR]**

- 01 Hwy 9, north of Norcross at Mustinka River,
under debris, 10 Sep 00, L. Carrigan.

Hennipin Co. [HN]

- 01 CR 18, Rice Lake, bank of the Minnesota R.
at water's edge, 19 Jun 57, W.R. Murchie.
(USNM 280138)
- 02 I-94, 5 km w of Jct I-494, rest area near
Enfield, under logs, rocks and debris, 30 Apr
98, J.W.R.
- 03 Hwy 12, west of Minneapolis in Wayzata,
Wood Rill Scientific and Natural Area, (Twp
118N, Range 23W, Sect. 36), old growth
(>>120 years) Maple -Basswood forest,

digging and mustard extraction, Sep 2000,
C.M. Hale.

Houston Co. [HO]

- 01 Hwy 44, north side of Hokah at Root River,
under logs and rocks, 26 May 00, S.
Andersen.

Hubbard Co. - no records**Isanti Co. - no records****Itasca Co. [IT]**

- 01 Hwy 2, La Prairie, bank of Mississippi River,
under logs and rocks, 10 June 98, D. Hess.

Jackson Co. [JA]

- 01 I-90E, rest area mm 72 near Clear Lake, under
rocks and logs, 16 June 00, G. van
Speybroeck.

Kanabec Co. - no records**Kandiyohi Co. - no records****Kittson Co. [KT]**

- 01 Hwy 11, at county line, South Branch Two
River, digging in ditch and under logs, 4 Oct
94, J.W.R. & P. N. Mayville.

Koochiching Co. [KO]

- 01 Hwy 11, Indus, digging in ditch, 4 Oct 94,
J.W.R. & P. N. Mayville.
- 02 Hwy 11, Smokey Bear State Forest, 8 km w of
Pelland, in and under logs, 4 Oct 94, J.W.R. &
P.N. Mayville.

Lac Qui Parle Co. - no records**Lake [LK]**

- 01 Finland, Wolf Ridge Environmental Learning
Center (Twp 57N, Range 7W, Sect. 34),
young disturbed maple forest (*Acer sac-*
charum), digging an mustard extraction, June
2000, C. Johnson-Grow.
- 02 Finland, Wolf Ridge Environmental Learning
Center (Twp 57N, Range 7W, Sect. 27),
mature aspen stand (*Populus tremuloides*),
digging and mustard extraction, June 2000, C.
Johnson-Grow.

03 Finland, Wolf Ridge Environmental Learning Center (Twp 57N, Range 7W, Sect. 27), mature spruce/fir stand (*Picea glauca*, *Abies balsamea*), digging and mustard extraction, June 2000, C. Johnson-Grow.

04 Tettegouche State Park, west side of Mic Mac Lake, mature old growth hardwood forest, digging and mustard extraction, June 2000 & 2001, C. Johnson-Grow.

05 Tettegouche State Park, south side of Mic Mac Lake (Twp 56N, Range 7W, Sect. 8), old-growth northern hardwood forest, mustard extraction, June, July, August 2001, C.M. Hale.

Lake of the Woods Co. [LW]

01 Hwy 11, Baudette, Winter Road River, digging in river bank and under logs, 9 Oct 94, J.W.R. & P. N. Mayville.

Le Sueur Co. - no records

Lincoln Co. - no records

Lyon Co. - no records

McLeod Co. - no records

Mahnomen Co. [MH]

01 Hwy 200, east of Mahnomen at Wild River, under logs on river bank, 15 June 99, F. Bartley

Marshall Co. [MA]

01 Hwy 59, Newfolden at Middle River, digging in ditch and under logs, 4 Oct 94, J.W.R. & P. N. Mayville.

02 Hwy 75, Stephen, Tarnarac River, under logs and digging, 4 Apr 98, J.W.R.

Martin Co. - no records

Meeker Co. - no records

Mille Lacs Co. - no records

Morrison Co. - no records

Mower Co. [MW]

01 I-90W, rest area mm 204 south of High Forest, 16 June 00, G. van Speybroeck.

Murray Co. - no records

Nicollet Co. - no records

Nobles Co. [NO]

01 I-90E, rest area mm 35 near Adrian, under rocks and logs, 16 June 00, G van Speybroeck.

Norman Co. [NR]

01 Hwy 9 south of Ada at Rice River, under logs and rocks, 15 June 99, F. Bartley.

Olmstead Co. [OL]

01 Lawler Farm, soil cores on corn-soybean-corn crops, 18 Apr 87, D.J. Fuchs & D.R. Linden.

02 I-90W, mm 222, rest area near Eyota, under debris, 12 June 00, G. van Speybroeck.

Otter Tail Co. [OT]

01 I-94E, mm 60, north of exit 61, rest area near Fergus Falls, under rocks, logs and debris, 29 Apr 98, J.W.R.

Pennington Co. [PN]

01 Hwy 59, Thief River Falls at Red Lake River, digging in ditch and stream bank, under logs, 4 Oct 94, J.W.R. & P. N. Mayville.

Pine Co. [PI]

01 I-35, rest area north of exit 195, near Askov, under logs and rocks, 10 Jun 98, J.W.R.

Pipestone Co. - no records

Polk Co. [PO]

01 Crookston, spring wheat, 10 Jun 87, D.J. Fuchs & D.R. Linden.

02 Hwy 59, at Poplar River, digging in ditch and under logs, 4 Oct 94, J.W.R. & P. N. Mayville.

Pope Co. [PP]

01 Westport, 7A, corn-corn-oats, 23 Apr 87, D.J. Fuchs & D.R. Linden.

02 Westport, 7B, established grasses, 23 Apr 87, D.J. Fuchs & D.R. Linden.

Ramsey Co. [RA]

- 01 St. Paul. Various compost heaps. (Mickel, 1925).
- 02 St. Paul, 15 Sep 59, H.L. Osborne. (USNM 125921)
- 03 Roseville, near St. Paul, 21 May 68, E.V. Komerek Sr. (USNM 382788)
- 04 St. Paul, parking lot of Paul Bunyan Motel, 22 May 68, E.V. Komarek Sr. (USNM 382788)

Red Lake Co. [RL]

- 01 Hwy 59, 2 km n of Plummer at Clearwater River, digging in ditch and under logs, 4 Oct 94, J.W.R. & P. N. Mayville.

Redwood Co. [RW]

- 01 Lamberton Swaes, sites 4A, B, soybeans, corn, 9 Apr 87, D.J. Fuchs & D.R. Linden.
- 02 Lamberton Swaes, sites 4C, established grasses, 9 Apr 87, D.J. Fuchs & D.R. Linden.

Renville Co. - no records

Rice Co. [RI]

- 01 I-35N, rest area mm 68 near Dakota Co. line, under rocks and logs, stream bank, 15 May 00, B. Cox.
- 02 County Rd 40, 1.5 km west of Nerstrand, Nerstrand State Park, (Twp 110N, Range 19W, Sect. 9), mature maple-basswood forest, mustard extraction, 27 Oct 00, Amanda Ista.
- 03 Nerstrand State Park, similar to above only (Twp 110N, Range 19W, Sect. 16).
- 04 Norway Valley, similar to above only (Twp 111N, Range 20W, Sect. 35).
- 05 Health Creek, similar to above only (Twp 111N, Range 20W, Sect. 35).
- 06 similar to above mature maple-basswood forest, west side Cannon River Wilderness Area (Twp 110N, Range 20W, Sect. 16).

- 07 similar to above mature maple-basswood forest, east side Cannon River Wilderness Area (Twp 110N, Range 20W, Sect. 16).

Rock Co. [RC]

- 01 I-90E, Welcome Center, under barrel, 16 June 00, G. van Speybroeck.

Roseau Co. [RO]

- 01 Baudette, birdsfoot trefoil, 18 Jun 87, D.J. Fuchs & D.R. Linden.

Saint Louis Co. [SL]

- 01 Duluth Experimental Station, 10, established grasses, 8 July 87, D.J. Fuchs & D.R. Linden.
- 02 Hwy 53, Virginia, parking lot under concrete, 8 May 99, J.W.R.

Scott Co. [SC]

- 01 I-35S, south of exit 76, rest area near Elko, under rocks, logs and debris, 4 Apr 98, J.W.R.

Sherburne Co. - no records

Sibley Co. - no records

Stearns Co. [ST]

- 01 Kimball, corn-corn-soybean crops, 15 Apr 87, D.J. Fuchs & D.R. Linden.

Steele Co. [SE]

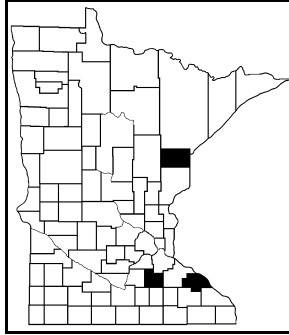
- 01 I-35N, rest area mm 33 near Steele Corner, under rocks and logs, 15 May 00, B. Cox

Stevens Co. [SV]

- 01 Morris NC Experimental Station, 6A, corn, 30 June 87, D.R. Fuchs & D.R. Linden.
- 02 Morris NC Experimental Station, G alfalfa, 30 June 87, D.J. Fuchs & D.R. Linden.
- 03 Morris NC Experimental Station, B, C, D, F, G corn, 30 June 87, D.J. Fuchs & D.R. Linden.

- 04 Morris NC Experimental Station, E small grains, 30 June 87, D.J. Fuchs & D.R. Linden.

Swift Co. - no records
Todd Co. - no records



Traverse Co. [TR]

- 01 Hwy 9, south of Tintah, in ditch, under debris, 10 Sep 00, L. Carrigan.

Wabasha Co. [WB]

- 01 Kottshack Farm, sites 3A, B, C, corn-soybean-corn crops, 17 Apr 87, D.J. Fuchs & D.R. Linden.
- 02 Kottshack Farm, sites 3D, A, B, C, corn-soybeans-soybeans, 17 Apr 87, D.J. Fuchs & D.R. Linden.
- 03 Kottshack Farm, sites 3E, F, corn-soybean-corn crops, 17 Apr 87, D.J. Fuchs & D.R. Linden.

Wadena Co. - no records
Waseca Co. - no records

Washington Co. [WA]

- 01 I-94W, Welcome Center, just west of Wisconsin state line, under logs and rocks, 10 June 98, J.W.R.

Watonwan Co. - no records

Wilkin Co. [WL]

- 01 Hwy 9, north of Doran at Otter Tail River, river bank, under debris, 10 Sep 00, L. Carrigan.

Winona Co. [WI]

- 01 I-90E, mm 243, rest area, under debris and log and stream bank, 16 June 00, G. van Speybroeck.

Wright Co. [WR]

- 01 I-94, south of exit 183, rest area near Enfield, 30 Apr 98, J.W.R.

Yellow Medicine Co. - no records

RESULTS

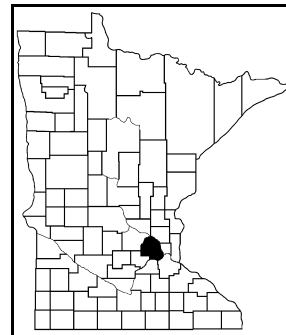
The format for reporting the collection data for Minnesota is the same as was used for Tennessee and the other southeastern states (Reynolds *et al.*, 1974, Reynolds, 1994a-e). The site codes, *e.g.* AN-01, refer to the county, using the letters followed by the collection number for that county. The polynomial which follows refers to the number of juveniles-aclitellate adults-clitellate adults-postclitellate adults (if a fourth is used).

ACANTHODRILIDAE

Diplocardia riparia Smith, 1895

HN-01, 0-0-4;

No. of collections: 1; No. of specimens: 0-0-4.



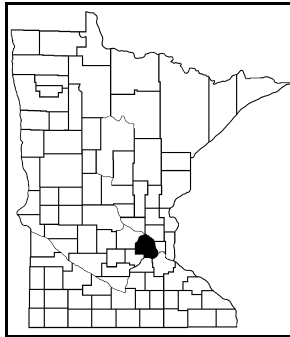
LUMBRICIDAE

Allolobophora chlorotica (Savigny, 1826)

CA-01, 0-1-0; RI-01, 0-0-1; WI-01, 0-0-1.

No. of collections: 3;

No. of specimens: 0-1-2.

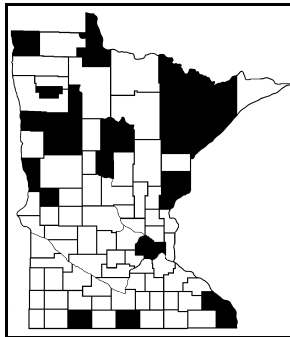


Aporrectodea rosea
(Savigny, 1826)

BK-01, 0-0-2; CS-01,
259-7-208; CL-01, 0-0-
5; FA-01, 0-0-1; GR-01,
0-1-4; HN-03, 0-0-13;
HO-01, 0-1-1; JA-01, 0-
0-1; KT-01, 0-0-2; LK-

02, 57-0-2; LW-01, 0-0-4; MN-01, 1-0-2; NR-01, 1-0-
1; PI-01, 0-0-1; PP-01, 0-0-1; RA-0-1, 0-0-1; RL-01, 0-
0-1; SL-01, 10-0-3; WL-01, 1-0-1.

No. of collections: 19;
No. of specimens: 329-
9-254.

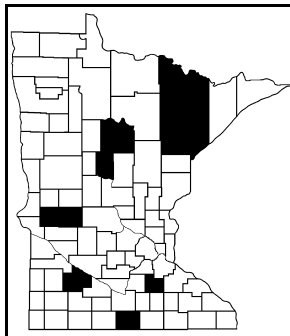


Aporrectodea
trapezoides (Dugès,
1828)

CS-04, 0-0-1; FA-01, 0-
0-1; PP-01, 4-0-1; PP-
02, 1-0-2; RW-01, 60-0-
36; RI-02, 7-0-3; RI-03,
0-0-7; RI-04, 0-0-3; RI-
05, 0-0-2; RI-07, 4-0-3; SL-01, 314-0-34; SV-04, 2-0-2.

No. of collections: 12; No. of specimens:
392-0-95.

Aporrectodea tuberculata (Eisen, 1874)



AN-01, 7-10-7; AN-02,
0-0-2; BK-01, 0-0-1;
BL-01, 1-0-1; CA-01, 8-
1-1; CA-02, 10-0-3; CS-
01 892-20-10; CS-02,
667-0-30; CS-03, 18-3-
53; CS-04, 0-0-167;
CH-01, 0-0-1; CY-01,
0-0-2; CL-01, 210-44-
145-2; DK-01, 0-0-
1; DG-01, 0-0-1; DO-01,
105-0-14; FA-01, 0-0-1;
FL-01, 0-0-1; FR-01, 0-

0-1; GR-01; 2-2-2; HN-02, 0-0-1; HN-03, 182-0-5; IT-
01, 0-2-1; JA-01, 0-0-1; KT-01, 1-0-1; KO-01, 1-0-1;

LK-01, 75-0-3; LK-03,
7-0-2; LW-01, 1-0-2;
MH-01, 2-0-2; MA-01,
1-0-1; MA-02, 0-0-1;
MW-01, 0-0-1; NO-01,
0-0-2; NR-01, 2-2-2;
OL-01, 200-0-24; OL-
02, 0-0-1; OT-01, 0-0-2;
PN-01, 1-0-2; PI-01, 0-
0-1; PO-01, 5-0-9; PO-
02, 1-0-2; PP-01, 12-0-1;
PP-02, 150-0-40; RA-02,
0-0-1; RA-03, 0-0-56;
RA-04, 1-3-10; RL-01,

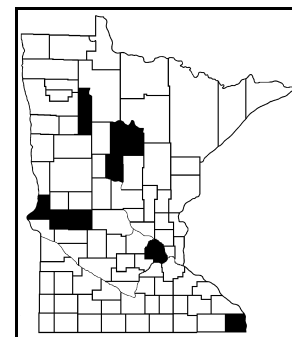
1-0-1; RW-01, 34-0-58; RW-02, 200-0-50; RI-01, 0-0-
1; RI-03, 9-0-5; RI-04, 19-0-1; RI-05, 12-0-2; RI-06, 1-
0-1; RC-01, 0-0-1; RO-01, 51-0-10; SL-01, 314-0-34;
SL-02, 0-0-2; SC-01, 0-0-3; ST-01, 302-0-34; SE-01, 0-
0-1; SV-01, 16-0-16; SV-02, 781-0-46; SV-03, 930-0-
101; SV-04, 12-0-12; WB-01, 589-0-85; WB-02, 245-
0-41; WB-03, 340-0-23; WA-01, 0-0-1; WI-01, 0-0-2;
WR-01, 0-0-3.

No. of collections: 72;
No. of specimens: 6,418-87-1,153-2.

Aporrectodea turgida (Eisen, 1873)

CS-01, 0-0-1; CS-02, 0-0-37; CS-03, 22-0-2; CL-01, 6-
4-7; HN-01, 0-0-50; HO-01, 0-0-2; PP-02, 4-0-1; SV-
01, 16-0-16; TR-01, 1-1-1.

No. of collections: 9; No. of specimens:
49-5-117.



Bimastos parvus
(Eisen, 1874)

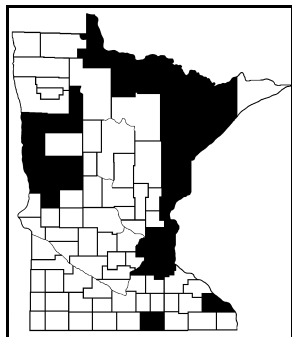
HN-01, 0-0-12.

No. of collections: 1;
No. of specimens:
0-0-12.

Eiseniella tetraedra (Savigny, 1826)*Dendrobaena octaedra* (Savigny, 1826)

AN-01, 0-0-1; BL-01, 0-0-3; CA-01, 217-11-7; CA-02, 10-0-5; CS-01, 1580-0-230; CS-02, 733-0-118; CS-03, 1263-0-304; CS-04, 829-0-63; CH-01, 0-2-1; CY-01, 0-0-1; CL-01, 0-0-10; DK-01, 0-2-1; FR-01, 0-0-1; GR-01, 0-0-1; HN-01, 0-0-1; HN-02, 0-1-3; KO-02, 1-1-1; LK-03, 1-0-1; LK-04, 1680-0-720; LW-01, 0-0-1; MN-01, 1-0-1; NO-01, 0-0-1; NR-01, 1-0-1; OT-01, 0-1-1; PI-01, 0-1-2; RI-02, 0-0-1; RI-05, 0-0-4; SL-02, 0-0-1; SC-01, 0-0-1; WA-01, 0-0-2; WI-01, 0-0-1; WL-01, 2-0-1; WR-01, 0-0-1.

No. of collections: 33;

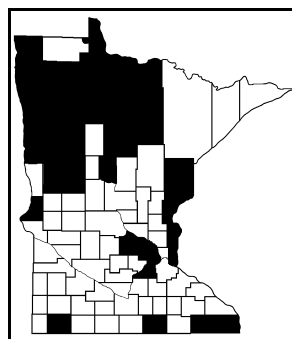


No. of specimens: 6,318-19-1,491.

Dendrodrilus rubidus (Savigny, 1826)

BK-01, 0-1-2; BL-01, 0-0-2; CA-01, 7-0-3; CS-02, 4-0-4; CS-03, 22-0-12; CH-01, 0-1-3; CY-01, 0-0-1; CL-01, 0-0-1; DG-01, 0-1-1; FL-01, 0-1-2; FR-01, 0-0-2; HN-02, 0-0-2; HO-01, 0-0-1; IT-01, 0-0-1; KT-01, 0-0-1; KO-02, 0-0-1; LW-01, 0-0-3; MH-01, 0-0-3; MA-01, 0-0-2; MA-02, 0-0-1; NO-01, 0-0-1; NR-01, 0-0-2; OT-01, 0-0-1; PN-01, 0-0-2; PI-01, 0-0-2; PO-02, 0-0-4; RL-01, 0-0-2; SC-01, 0-0-1; TR-01, 1-1-1; WA-01, 0-0-1; WR-01, 0-0-1.

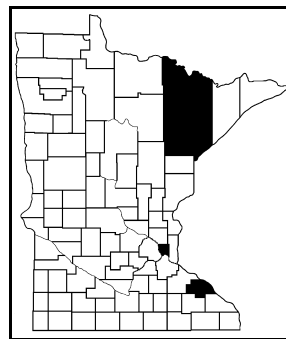
No. of collections: 31; No. of specimens: 34-5-66.

Eisenia foetida (Savigny, 1826)

RA-01, 0-0-1; SL-01, 1-0-1; WB-02, 1-0-1.

No. of collections: 3;
No. of specimens: 1-0-3.

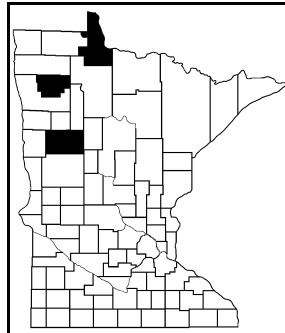
BE-01, 0-2-1; LW-01, 0-0-1; PN-02, 0-0-2; RL-01, 0-0-1.



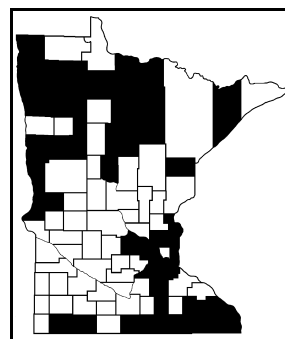
No. of collections: 4;
No. of specimens: 0-2-5.

Lumbricus rubellus Hoffmeister, 1843

AN-02, 0-0-1; BK-01, 0-0-1; BL-01, 1-1-1; CA-01, 105-4-28; CA-02, 40-0-20; CA-01, 86-0-295; CS-02, 129-0-284; CS-04, 86-0-3; CH-01, 2-1-2; CY-01, 0-0-1; CL-01, 3-3-6; DK-01, 0-0-1; FA-01, 0-0-1; FL-01, 1-1-2; FR-01, 0-0-1; GR-01, 0-0-2; HO-01, 0-0-1; HN-02, 0-2-1; IT-01, 0-1-2; JA-01, 0-0-1; KT-01, 1-1-1; KO-01, 1-1-1; LK-01, 38-0-10; LK-02, 56-0-4; LK-03, 10-0-0; LK-04, 3-0-2; LW-01, 1-1-1; MA-01, 1-1-1; NO-01, 0-0-1; OL-01, 0-0-1; OT-01, 0-0-1; PN-01, 1-0-1; PI-01, 0-0-1; PO-02, 1-1-3; RL-01, 1-1-1; RI-01, 0-0-1; RI-02, 2-0-31; RI-03, 0-0-2; RI-04, 4-0-48; RI-05, 18-0-25; RI-07, 21-0-10; SL-02, 0-0-1; SC-01, 0-0-1; SE-01, 0-0-2; TR-01, 1-3-1; WA-01, 0-0-1; WI-01, 0-0-1; WL-01, 0-0-2; WR-01, 0-0-1.



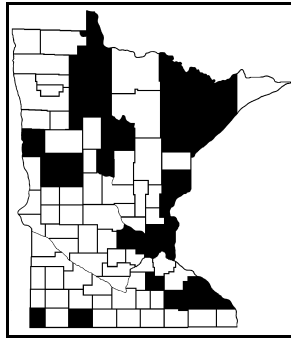
No. of collections: 49;
No. of specimens: 613-21-810.



Lumbricus terrestris Linnaeus, 1758

AN-01, 0-0-1; BL-01, 0-0-1; CS-01, 20-0-29; CS-02, 37-0-38; CS-04, 10-0-30; CH-01, 0-0-1; CY-01, 0-0-1; CL-01, 0-0-3; DG-01, 0-0-1; HN-01, 0-0-1; HN-02, 0-0-1; HN-03, 31-0-10; JA-01, 0-0-1; LK-01, 0-0-1; LW-01, 0-0-1; OL-01, 0-0-1; OT-01, 0-0-1; PI-01, 0-0-1; RA-01, 0-0-1; RI-01, 0-0-1; RI-02, 0-0-3; RI-04, 0-0-9; RI-07, 0-0-5; RC-01, 0-0-1; SL-01, 1-0-1; SL-02, 0-0-1; SC-01, 0-0-1; WB-01, 3-0-5; WA-01, 0-0-1; WI-01, 0-0-1; WR-01, 0-0-1.

No. of collections: 31; No. of specimens: 102-0-154.

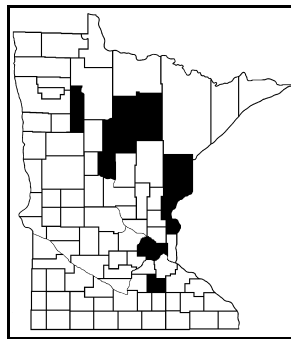
*Octolasion tyrtaeum*
(Savigny, 1826)

CA-01,2-0-4; CS-01, 22-0-15; CS-02, 798-0-316; CS-04, 0-0-1; CH-01, 0-2-4; CL-01, 0-0-2; HN-01, 0-0-2; HN-03, 15-0-23; IT-01, 0-0-1; PI-01, 0-0-1; RA-04, 0-0-1; RI-02, 4-0-15; RI-03, 8-0-18; RI-04, 15-0-13; RI-05, 16-0-15; RI-

06, 5-0-8; RI-07, 2-0-4.

No. of collections: 17;

No. of specimens: 887-2-443.

MEGASCOLECIDAE*Amyntas loveridgei* (Gates, 1968)

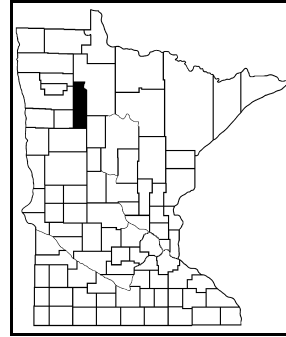
CL-01, 0-0-5;

No. of collections: 1;
No. of specimens: 0-0-5.

DISCUSSION

Modern keys and discussion of the taxonomic characters required to use these keys have been

reported elsewhere: Acanthodrilidae (Gates, 1977), Lumbricidae (Reynolds *et al.*, 1974; Reynolds, 1977) and Megascolecidae (Gates, 1972b).



The state of Minnesota is completely above the southern limit of glaciation in the United States (N 43°30' - 49°23', W 89°30' - 96°30') except for a small section of southeastern portion of the state. Minnesota is divided into three general physiographic regions (Fig. 2): 1] the

Northern Lake States Forest and Forage Sub-division, 2] the Central Feed Grains and Livestock Subdivision and 3] North Great Plains Spring Wheat Subdivision (Merz, 1978). These physiographic regions, with their associated topography, soils, vegetation and climate, do not appear to have a significant influence on the distribution of the recorded earthworm species within the state. This is in contrast to earthworm surveys of the southeastern United States wherein the Coastal Plain, Piedmont, Ridge and Valley Province, *etc.* did have an effect on the earthworm distribution within those states (see Reynolds 1994b-f, 2001a). The number and diversity of earthworm species present in the southeastern states (25-51) was considerably greater than those present in Minnesota (15).

Northern Lakes States Forest and Forage Subdivision

This area was heavily glaciated so that gravel hills and sandy plains remain with many swamps lakes, and streams. Elevations range from 183 m on the shores of Lake Superior to 610 m in the north-eastern part of the state.

The greatest diversity of soils are found in this subdivision of the state: Eutroboralfs, Haplorthods, and Histosols in the north: Eutroboralfs, Udipsamments, Hapludalfs and Histosols in the centre of the subdivision with Borolls, Hapludalfs and Udipsamments in the southern portion.

The forest types are aspen-birch (*Populus tremuloides*-*Betula papyrifera*), spruce-fir (*Picea mariana*, *P. glauca*-*Abies balsamea*) and White-red-jack pine (*Pinus strobus*-*P. resinosa*-*P. banksiana*). There are some Maple-beech-birch (*Acer saccharum*, *A. rubrum*-*Fagus grandiflora*-*Betula papyrifera*) in the

south.

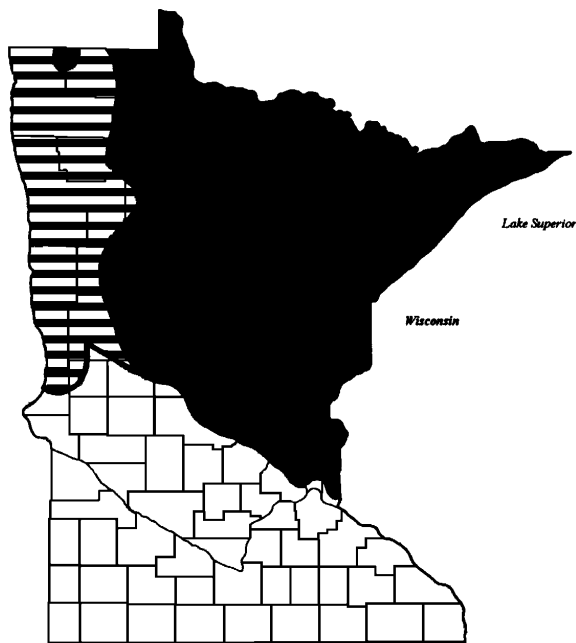
This region has a short growing season with between 610-813 mm mean annual precipitation. The frost free period is approximately 120 days.

Fig. 2. The physiographic subdivisions of Minnesota: *Northern Lakes States Forest and Forage Subdivision* (black), *Central Feed Grains and Livestock Subdivision* (white), and *Northern Great Plains Spring Wheat Subdivision* (striped).

Central Feed Grains and Livestock Subdivision

Most of this area was also glaciated, but not as extensively as the previous subdivision.

The soils in this subdivision are predominantly Udalfs (Hapludalfs), Borolls (Agriborolls) and



Udolls.

The forest types are restricted to bottomlands as the majority of the area is agricultural land: Elm-ash-cottowood (*Ulmus americana-Fraxinus americana-Populus deltoides*) and maple-beech-birch.

Growing season is longer than in the other subdivisions with 120-150 frost-free days and a mean annual precipitation between 610-813 mm.

Northern Great Plains Spring Wheat Subdivision

This smallest subdivision in Minnesota was also less glaciated than the Northern Lakes States Forest and Forage Subdivision.

The soils are primarily Aquolls (frequently Caliaquolls) with a limited area of Borolls (primarily Agriborolls) along the southeastern edge.

The area is primarily agricultural with a couple of thin east/west belts of elm-ash-beech.

The mean annual precipitation is between 508-609 mm with about 120 frost-free days.

Although 59 per cent of the counties were sampled in this survey, many counties were represented by only one or two small collections. Based on current earthworm surveys of other states and provinces in glaciated North America, 12-15 species for such a state or province is to be expected when you exclude the rare accidental introductions (see Reynolds, 1976, 1977, 1978, 2000a, 2000b; Reynolds and Clapperton, 1996; Reynolds and Khan, 1999; Reynolds and Mayville, 1994; Reynolds and Reynolds, 1992; Utter *et al.*, 1995). An interesting example is that of the state of Indiana (Reynolds, 1994a), where the southern limit of glaciation cuts across the state so that the southern third of Indiana is unglaciated. This produced a species list similar to those states of the unglaciated southeastern United States and correspondingly higher numbers, *e.g.* 37 species of terrestrial oligochaetes were reported for Indiana.

The small southeastern portion of Minnesota did not receive extensive sampling in this survey. As a result there were no expected species recovered from this unglaciated area. Several species were collected in only one or two isolated locations so that no pattern can be determined regarding their distribution within the state, *i.e.* *Diplocardia riparia*, *Allolobophora chlorotica*, *Bimastos parvus*, *Eisenia foetida*, *Eiseniella tetraedra*, and *Amyntas loveridgei*. Three of these species are probably accidental introductions, not because they were found in single isolated cases, but they are normally restricted to unglaciated southern areas, *e.g.* *Diplocardia riparia*, *Bimastos parvus*, and *Amyntas loveridgei*.

Eisenia foetida has in recent years been distributed widely throughout North America under various names as the species for vermi-composting.

Despite this wide distribution, it has remained essentially in culture and not widely distributed in natural habitats. If we were to sample more often in urban gardens and composting areas, *E. foetida* would become more dominant in our collections.

Aporrectodea trapezoides is reaching its northern range in Minnesota. The distribution of the *Aporrectodea* species group is well illustrated in Reynolds (1995) where it is evident that this species is dominant in the southern United States. Conversely, it is not a surprise to find *Aporrectodea tuberculata* to be the dominant species of this group and of all species within this state. This is equally true for all areas of glaciated North America, except Quebec (Reynolds, 1976). The French influence and connections in that province have shifted the dominant *Aporrectodea* species from *tuberculata* to *turgida*, and also the surprising presence of *Lumbricus festivus*, in contrast to *L. rubellus*, which is the dominant species of this genus in most areas of that province (Reynolds, 1976; Reynolds and Reynolds, 1992).

Lumbricus rubellus is the dominant species of the genus in Minnesota and its absence in the southeastern and south central portions of the state is most likely due to the lack of collection sites rather than the absence of the species. *L. terrestris* is generally present in glaciated states and provinces, but not in as great numbers or frequency as *L. rubellus* (or *L. festivus* in Quebec) unless closely associated with human activity.

Octolasion tyrtaeum is a woodland species and would be expected to be present in the forested portions of Minnesota. Additional collecting in suitable habitats of the Northern Great Lakes Forest and Forage Subdivision and portions of the Central Feed Grains and Livestock Subdivision should increase the distributional pattern of this species within the state.

Thirteen species of Lumbricidae were found within the state of Minnesota. Utter *et al.* (1995) found ten of these in neighbouring North Dakota and no members of other families. They did not find *Allolobophora chlorotica*, *Bimastos parvus* or *Eisenia foetida*. Reynolds (1977) found all of the Minnesota lumbricids in his list of 18 reported from the neighbouring province of Ontario. In a recent limited earthworm survey of the neighbouring province of Manitoba, Reynolds (2000b) reported eight lumbricid species, all of which are included in the Minnesota list. The neighbouring states of South Dakota, Iowa and Wisconsin have not been surveyed extensively for

earthworms, or had significant data published in the literature (see Gates, 1979).

This is a significant earthworm survey, as earthworm surveys go, but it is far from producing a complete picture of the presence and distributional pattern of the earthworm species present within the state. Currently graduate students are working on earthworm projects in Minnesota. Hopefully, this survey will give them the necessary information to help us fill in many of the areas where data are lacking.

ACKNOWLEDGEMENTS

The senior author wishes to thank his colleagues at Schneider National Carriers for assisting him to obtain additional samples from Minnesota. Appreciation is also extended to Dr. Marion Pettibone, Linda Ward and others at the Smithsonian who have given us access to material at their institution for examination over the years. We acknowledge former colleagues at Tall Timbers Research Station, Tallahassee, for sharing their specimens and records, which provided us with a more complete survey for Minnesota. Our gratitude extends to W.M. Reynolds of the Oligochaetology Laboratory for reviewing the manuscript, her comments and suggestions.

LITERATURE CITED

- Gates, G.E. 1942. Check list and bibliography of North American earthworms. *Amer. Midl. Nat.* 27(1): 86-108.
- Gates, G.E. 1972a. Contributions to North American Earthworms (Annelida: Oligochaeta) No. 3. Toward a revision of the family Lumbricidae. IV. The trapezoides species group. *Bull. Tall Timbers Res. Stn.* 12: 1-146.
- Gates, G.E. 1972b. Burmese earthworms. *Trans. Amer. Philos. Soc. (n.s.)* 67(2): 1-321.
- Gates, G.E. 1973. Contributions to North American Earthworms (Annelida) No. 8. The earthworm genus *Octolasion* in America. *Bull. Tall Timbers Res. Stn.* 14: 29-50.
- Gates, G.E. 1974a. Contributions to a revision of the family Lumbricidae. X. *Dendrobaena octaedra* (Savigny, 1826) with special reference to the importance of its parthenogenetic polymorphism for the classification of earthworms. *Bull. Tall Timbers Res. Stn.*, no. 15: 15-57.

- Gates, G.E. 1974b. Contributions to a revision of the family Lumbricidae. XI. *Eisenia rosea* (Savigny, 1826). Bull. Tall Timbers Res. Stn., no. 16: 9-30.
- Gates, G.E. 1977. More on the earthworm genus *Diplocardia*. Megadrilogica 3(1): 1-48.
- Gates, G.E. 1979. South Dakota does have earthworms! Megadrilogica 3(9): 165-166.
- Gates, G.E. 1987. The earthworm genus *Lumbricus* in North America. Megadrilogica 3(6): 81-116.
- Gates, G. E. 1982. Farewell to North American megadriles. Megadrilogica 4(1-2): 12-78.
- Harman, W.J. 1955. Earthworms of commercial importance and their effect on distribution. Proc. La. Acad. Sci. 18: 54-57.
- Merz, R.W. 1978. Forest Atlas of the Midwest. St. Paul: N.C. For. Exper. Stn., 48 pp.
- Mickel, C.E. 1925. Notes on *Zygocystis cometa* Stein, a gregarine parasite of earthworms. J. Parasit. 11: 135-139.
- Murray, G.E. 1961. Geology of the Atlantic and Gulf Coastal Provinces of North America. New York: Harper's Geological Series, 692 p.
- Nelson, T.C. and W.M. Zillgitt. 1969. A forest atlas of the south. Ashville: S.E. For. Exper. Stn., 27 pp. + 1 pl.
- Reynolds, J.W. 1976. Catalogue et clé d'identification des lombricidés du Québec. Naturaliste canadien 103(1): 21-27.
- Reynolds, J.W. 1977. The earthworms (Lumbricidae and Sparganophilidae) of Ontario. Life Sci. Misc. Publ., Roy. Ont. Mus. xi + 141 pp.
- Reynolds, J.W. 1978. A contribution to our knowledge of the earthworm fauna of North Dakota. Megadrilogica 3(8): 148-149.
- Reynolds, J.W. 1994a. The distribution of the earthworms (Oligochaeta) of Indiana: a case for the Post Quaternary Introduction Theory of megadrile migration in North America. Megadrilogica 5(3): 13-32.
- Reynolds, J.W. 1994b. Earthworms of North Carolina (Oligochaeta: Acanthodrilidae, Komarekionidae, Lumbricidae, Megascolecidae, Ocnerodrilidae and Sparganophilidae). Megadrilogica 5(6): 53-72.
- Reynolds, J.W. 1994c. Earthworms of Virginia (Oligochaeta: Acanthodrilidae, Komarekionidae, Lumbricidae, Megascolecidae and Sparganophilidae). Megadrilogica 5(8): 77-94.
- Reynolds, J.W. 1994d. Earthworms of Florida (Oligochaeta: Acanthodrilidae, Eudrilidae, Glossoscolecidae, Lumbricidae, Megascolecidae, Ocnerodrilidae, Octochaetidae and Sparganophilidae). Megadrilogica 5(12): 125-141.
- Reynolds, J.W. 1994e. Earthworms of Mississippi (Oligochaeta: Acanthodrilidae, Lumbricidae, Megascolecidae, Ocnerodrilidae and Sparganophilidae). Megadrilogica 6(3): 21-33.
- Reynolds, J.W. 1994f. Earthworms of Alabama (Oligochaeta: Acanthodrilidae, Eudrilidae, Lumbricidae, Megascolecidae and Sparganophilidae). Megadrilogica 6(4): 35-46.
- Reynolds, J.W. 1995. The status of exotic earthworm systematics and biogeography in North America. Pp. 1-27 In Hendrix, P.F. (ed.), Ecology and Biogeography of Earthworms in North America. Boca Raton, FL: Lewis Publ., 244 pp.
- Reynolds, J.W. 2000a. A contribution to our knowledge of the earthworm fauna of Newfoundland and Labrador, Canada (Oligochaeta, Lumbricidae). Megadrilogica 8(2): 5-8.
- Reynolds, J.W. 2000b. A contribution to our knowledge of the earthworm fauna of Manitoba, Canada (Oligochaeta, Lumbricidae). Megadrilogica 8(3): 9-12.
- Reynolds, J.W. 2001a. The earthworms of South Carolina (Oligochaeta: Acanthodrilidae, Lumbricidae, Megascolecidae, Ocnerodrilidae and Sparganophilidae). Megadrilogica 8(7): 25-36.
- Reynolds, J.W. 2001b. The earthworms of New

Brunswick (Oligochaeta: Lumbricidae).
Megadrilogica 8(8): 37-47.

- Reynolds, J.W. and M.J. Clapperton. 1996. New earthworm records for Alberta (Oligochaeta: Lumbricidae) including the description of a new Canadian species. *Megadrilogica* 6(8): 73-82.
- Reynolds, J.W. and M.N. Khan. 1999. A contribution to our knowledge of the earthworm fauna of Saskatchewan, Canada. *Megadrilogica* 7(12): 81-82.
- Reynolds, J.W. and P.N. Mayville. 1994. New earthworm records from Rainy River District in north western Ontario (Oligochaeta: Lumbricidae). *Megadrilogica* 6(2): 13-16.
- Reynolds, J.W. and K.W. Reynolds. 1992. Les vers de terre (Oligochaeta: Lumbricidae et Sparganophilidae) sur la rive nord du Saint-Laurent (Québec). *Megadrilogica* 4(9): 145-161.
- Reynolds, J.W., E.E.C. Clebsch and W.M. Reynolds. 1974. The earthworms of Tennessee (Oligochaeta). I. Lumbricidae. *Bull. Tall Timbers Res. Stn.*, No. 17, *vii* + 133 pp.
- Utter, R.A., E.J. Deibert and D.P. Schwert. 1995. Earthworms of North Dakota. Jamestown, ND: Northern Prairie Wildlife Res. Cent. [Http://www.npwrc.usgs.gov/resource/distr/invert/wormsnd/wormsnd.htm](http://www.npwrc.usgs.gov/resource/distr/invert/wormsnd/wormsnd.htm)