A PRELIMINARY INVENTORY OF EARTHWORMS (ANNELIDA, CLITELLATA) OF THE NACHUSA GRASSLANDS AREA, LEE AND OGLE COUNTIES, ILLINOIS, USA

— FINAL REPORT FOR 2015 —

SUBMITTED TO

FRIENDS OF NACHUSA GRASSLANDS
8772 LOWDEN ROAD
FRANKLIN GROVE, ILLINOIS 61301

AND

THE NATURE CONSERVANCY

PREPARED BY

MARK J. WETZEL
URBANA, IL 61801

AND

DR. JOHN W. REYNOLDS
OLIGOCHAETOLOGY LAB
KITCHENER, ONTARIO, CANADA

30 JUNE 2016

TABLE OF CONTENTS

LIST OF TABLES, FIGURES, AND APPENDICES INCLUDED IN THIS REPORT

INTRODUCTION

This June 2016 final report summarizes the results of our research during 2015 focusing on the distribution of terrestrial, semi-terrestrial, and limicolous earthworms (Annelida, Clitellata, clitellatous oligochaetes) in habitats located on Nachusa Grasslands [NG] property in Lee and Ogle Counties, Illinois USA. This research is being conducted by Mark J. Wetzel (Urbana, Illinois – and research affiliate of the Illinois Natural History Survey, Prairie Research Institute of the University of Illinois at Urbana-Champaign) and John W. Reynolds (Oligochaetology Lab, Kitchener, Ontario, Canada).

BACKGROUND

An historical perspective and review of published research pertinent to the study of earthworms (megadriles) in Illinois, included in our November 2014 proposal to NG, is presented again here.

At present, 256 species of earthworms (terrestrial oligochaetes, megadriles) representing 59 genera in 10 families are known to occur in North America, inclusive of Canada, continental United States, Hawaii, Mexico, and Bermuda. Of these 256 extant species, 188 are considered native to North America, with the remaining 68 considered to be introductions (Reynolds and Wetzel, 2004, 2008, 2012). Reynolds and Wetzel (2011) published an historical review and current status of earthworm biodiversity in Illinois. In that paper, 38 species representing 18 genera and six families were reported from historical and recent records, including previously unpublished records for 20 species – three of which were new records for the state. Of these 38 species, 18 are native, and 20 are European or Oriental introductions. A web-based annotated checklist of Illinois earthworms is presented by Wetzel and Reynolds (2016).

Wodika et al. (2014) summarized their research at NG – quantifying recovery dynamics of ants and earthworms across a chronosequence of restored prairies, and documenting changes in the abundance and biomass of these two groups to determine if those changes were related to key plant and ecosystem properties. In their paper, they reported the presence of four species (*Aporrectodea trapezoides*, *Aporrectodea tuberculata*, *Bimastos longicinctus*, and *Octolasion tyrtaeum*) and representatives of one additional genus (*Lumbricus* spp.) of earthworms at NG.

During our first visit to NG in 2015 (21 April) Wetzel and K.L. Moss completed surveys for earthworms at four sites. Field conditions were too dry to justify collecting effort on 25 July, when MJW visited TNC headquarters to provide a summary of this research to participants of the annual Friends of NG annual meeting. Wetzel and Reynolds visited NG on 6 and 7 October to complete their survey for earthworms; during that visit, we collected earthworms from 23 sites; we also attempted collection of specimens from 15 additional sites, but they were either too dry, and/or contained marginal substrates (in particular, areas with trees dominated by conifers); locality information for these sites was not recorded nor included in Table 1, and no further discussion of these sites is included in this report.

A map of Nachusa Grasslands noting locations (dots) and site numbers for the 23 sites from which earthworms were collected by M.J. Wetzel and K.L. Moss on 21 April 2015 (sites NG2015-01 through NG2015-04), and by M.J. Wetzel and J.W. Reynolds on 6 and 7 October 2015 (sites NG2015-05 through NG2015-23) is presented in **Figure 1**. Specific locality information for each site is presented in **Table 1** of this report, and photographs of each site are presented in **Appendix 1**.

Geo-Referencing of Sites. All sites surveyed in April and October 2015 (**Table 1)** were geo-referenced in the field using a hand held GPS receiver [Garman Colorado 400t]; coordinates and other locality data were verified by referencing: **1**) USGS 7.5' topographic maps (paper) available via the University of Illinois library system; and **2**) ACME Mapper (v. 2.0 / 2.1) [http://mapper.acme.com/], a web-based mapping interface.

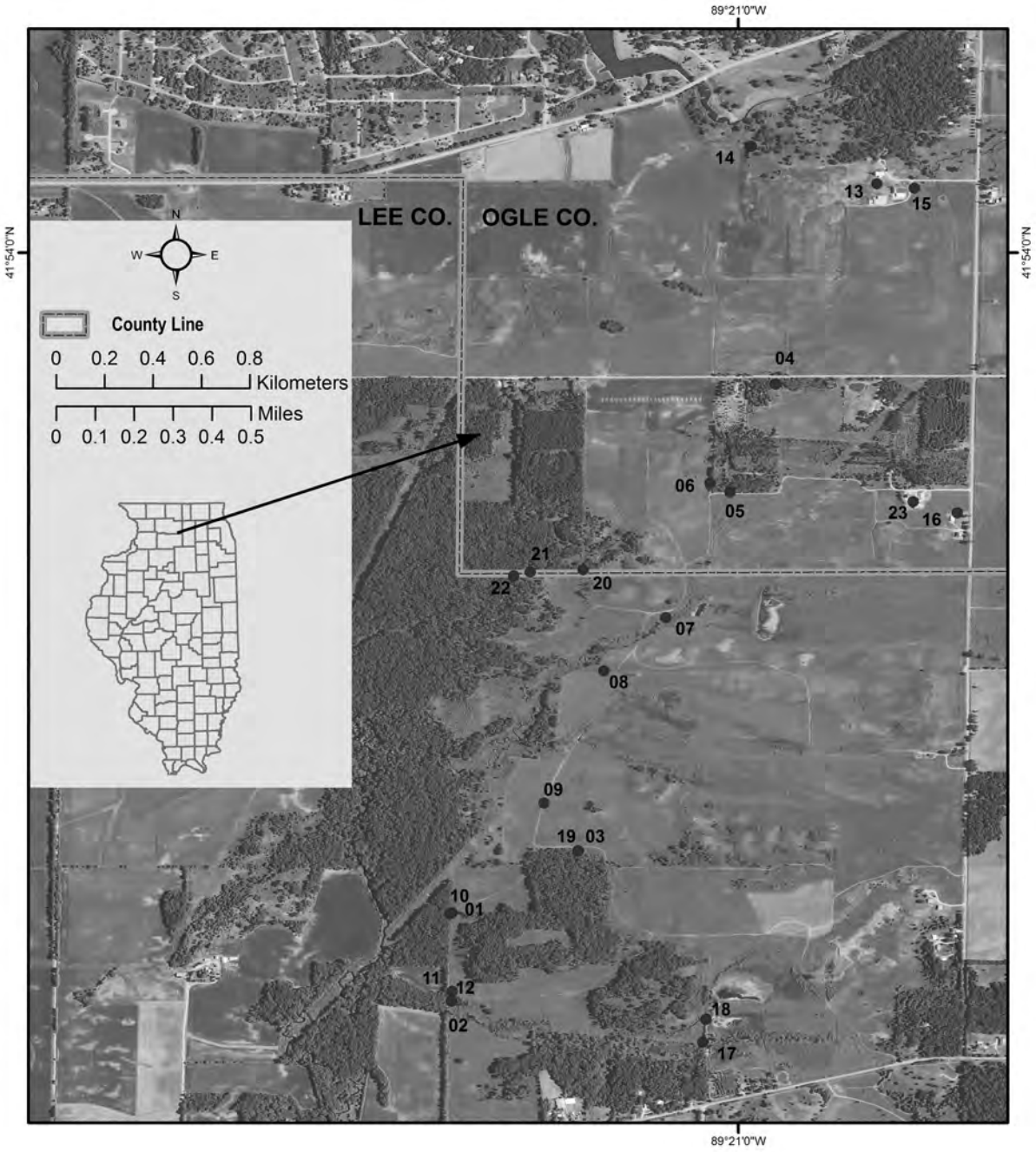

Figure 1. Map of Nachusa Grasslands (Lee and Ogle Counties, Illinois, USA), noting locations (dots) and site numbers for habitats from which earthworms were collected by M.J. Wetzel and K.L. Moss on 21 April 2015 (sites NG2015-01 through NG2015-04), and by M.J. Wetzel and J.W. Reynolds on 6 and 7 October 2015 (sites NG2015-05 through NG2015-23). Specific locality information for all sites is presented in **Table 1** of this report. Photographs of each site are presented in **Appendix 1**. Note that, due to the close proximity (within ~100m) of some sites (01/10; 02/11/12; 03/19), their site dots overlap on this map. [Map created by D.A. Greer, INHS]

Table 1. Specific locality information for 23 terrestrial, semi-terrestrial, and limicolous sites at Nachusa Grasslands (Lee and Ogle Counties, Illinois, USA), where surveys for earthworms were conducted by M.J. Wetzel and K.L. Moss on 21 April 2015, and by M.J. Wetzel and J.W. Reynolds on 6 and 7 October 2015. All sites are indicated (by site number) on **Figure 1**. Values for field measurements (when recorded), and the scientific names, authorities, and maturity levels of specimens [in brackets] [1] collected from these sites are also presented in this table. Pictures of these sites are included in **Appendix 1.** Locality information was initially established from the GPS coordinates taken at each site; this information (including site sketches and notes on field data sheets), then verified / corrected by referencing USGS topographic quadrangle maps (7.5 minute, 1984 provisional editions), and resources presented by **Acme Mapper 2.1** [http://mapper.acme.com/], a web-based (WGS-84 datum) mapping application. Locality information for the 15 additional NG sites we surveyed (noted in the fourth paragraph of the Introduction section) but from which no earthworms were collected has not been included in this table, and will not be discussed further in this report.

NG2015-01. Illinois, Lee County, in soil, under log pieces, at edge of tree line along W side of access road, by old fence post ("25"), 2.2 km SW (220 degrees) TNC/NG Hdqtrs, 4.8 km SE Grand Detour (town); latitude 41.87550°, longitude -089.36064°; 4th Principal Meridian: township 22N, range 10E, W/2, SW/4, SW/4, section 21; elevation 214m; sampling date: 21 April 2015, 13:10; collectors: M.J. Wetzel (2015-08) & K.L. Moss.

Values for field measurements – air temperature: 14.6°C*;* soil temperature: 9.1°C; soil *p*H: 6.1; soil moisture, relative saturation: 59%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea turgida (Eisen, 1873) [38-0-1]; *Lumbricus rubellus* Hoffmeister, 1843 [0-0-1]; *Lumbricus terrestris* Linnaeus, 1758 [8-2-1].

NG2015-02. Illinois, Lee County, along stream banks, riparian area/soils in riparian area & along banks of small unnamed tributary stream to Franklin Creek, in small depression ('shelf') on S side of and immediately downstream (WNW) road culvert (corrugated ~1m dia); 2.75 km SSW TNC/NG Hdqtrs, 5.0 km ESE Grand Detour (town); latitude 41.87222°, longitude -089.36066°; 4th Principal Meridian: township 22N, range 10E, NW/4, NW/4, section 28; elevation 208m; sampling date: 21 April 2015, 13:45; collectors: M.J. Wetzel (2015-09) & K.L. Moss.

Values for field measurements – air temperature: 14.9°C*;* soil temperature: 10.8°C; soil *p*H: 6.4; soil moisture, relative saturation: 63%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea tuberculata (Eisen, 1874) [5-2-4]; *Lumbricus rubellus* Hoffmeister, 1843 [2-0-0]; *Octolasion tyrtaeum* (Savigny, 1826) [6-0-4].

Note: This same site was surveyed a second time on 6 October 2015 (see information, below, for site NG2015-12).

NG2015-03. Illinois, Lee County, moist soil, in depression (shallow, natural ditch), in light woods, brush, scrub, 5-10 m S access road, along N edge of wood lot, 1.8 km SW (214 degrees) TNC/NG Hdqtrs, 5.1 km ESE Grand Detour (town); latitude 41.87787°, longitude -089.35566°; 4th Principal Meridian: township 22N, range 10E, center, SW/4, section 21; elevation 220m; sampling date: 21 April 2015, 14:05; collectors: M.J. Wetzel (2015-10) & K.L. Moss.

Values for field measurements – air temperature: 12.6°C*;* soil temperature: 8.7°C; soil *p*H: 6.0; soil moisture, relative saturation: 69%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Lumbricus terrestris Linnaeus, 1758 [2-0-3]; *Aporrectodea rosea* (Savigny, 1826) [0-0-1]; *Aporrectodea turgida* (Eisen, 1873) [49-0-3]; *Bimastos welchi* Smith, 1917 [0-0-1].

Note: This same site was surveyed a second time on 6 October 2015, specifically to attempt collection of additional specimens of *Bimastos welchi*, a new state record first collected from this site this date. No earthworms were collected from this site on 6 October, so no data were recorded, and no additional information pertinent to that collection has been included in this report.

Table 1 continued on following page

Table 1 (continued).

NG2015-04. Illinois, Ogle County, in soil under detritus and from under old cut and uncut log pieces at homeowners log cutting area along W side of grassy lane to open field, just south of Stone Barn Road, 0.6 km NW (317 degrees) TNC/NG Hdqtrs barn; 5.2 km E Grand Detour (town); [note: Stone Barn Road (E/W) is the county line at this point (Ogle Co. to the north, Lee Co. to the south)]; latitude 41.89507°, longitude -089.34846°; 4th Principal Meridian: township 22N, range 10E, NE/4, NW/4, SE/4, section 16, elevation 232m; sampling date: 21 April 2015, 15:05; collectors: M.J. Wetzel (2015-11) & K.L. Moss.

Values for field measurements – air temperature: 12.2°C*;* soil temperature: 9.0°C; soil *p*H: 6.5; soil moisture, relative saturation: 51%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Lumbricus terrestris Linnaeus, 1758 [0-0-1]; *Aporrectodea turgida* (Eisen, 1873) [32-0-4].

NG2015-05. Illinois, Ogle County, in dry soil from under decaying log ~ 8m N Sandy Lane, in light, large wooded area, 615 m W TNC/NG Hdqtrs barn; 5.1 km E Grand Detour (town); latitude 41.89111°, longitude -089.35031°; 4th Principal Meridian: township 22N, range 10E, NW/4, SW/4, SE/4, section 16; elevation 227m; sampling date: 6 October 2015, 09:05; collectors: M.J. Wetzel (2015-30) & J.W. Reynolds.

Values for field measurements – air temperature: 17.3°C*;* soil temperature: 15.7°C; soil *p*H: 7.0; soil moisture, relative saturation: 60%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea tuberculata (Eisen, 1874) [0-1-0].

NG2015-06. Illinois, Ogle County, in moist soil under Osage orange log at base of large brush & log pile, along west side of N/S sandy lane, 680 m W TNC/NG Hdqtrs barn, 5.1 km E Grand Detour (town); latitude 41.89144°, longitude -089.35104°; 4th Principal Meridian: township 22N, range 10E, NE/4, SE/4, SW/4, section 16, elevation 226m; sampling date: 6 October 2015, 09:40; collectors: M.J. Wetzel (2015-31) & J.W. Reynolds.

Values for field measurements – air temperature: 19.9°C*;* soil temperature: 15.0°C; soil *p*H: 5.95; soil moisture, relative saturation: 72%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea tuberculata (Eisen, 1874) [19-1-4].

NG2015-07. Illinois, Lee County, in wet soil, mud, along north edge of ponded creek, dammed by beavers (recent activity), 17 km SW TNC/NG Hdqtrs barn; latitude 41.88646°, longitude-089.35268°; 4th Principal Meridian: township 22N, range 10E, center, NE/4, NW/4, elevation 215m; sampling date: 6 October 2015, 10:05; collectors: M.J. Wetzel (2015-32) & J.W. Reynolds.

Values for field measurements – air temperature: 20.3°C*;* soil temperature: 16.2°C; soil *p*H: 6.0; soil moisture, relative saturation: 78%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea tuberculata (Eisen, 1874) [7-0-0]; *Lumbricus terrestris* Linnaeus, 1758 [1-0-0].

NG2015-08. Illinois, Lee County, in soil of muddy rut and rut bank along SE edge of road, 1.3 km SW TNC/NG Hdqtrs barn, 4.9 km ESE Grand Detour (town); latitude 41.88448°, longitude -089.35499°; 4th Principal Meridian: township 22N, range 10E; SW/4, NE/4, NW/4, section 21, elevation 216m; sampling date: 6 October 2015, 10:31; collectors: M.J. Wetzel (2015-33) & J.W. Reynolds.

Values for field measurements – soil temperature: 16.2°C; soil *p*H: 6.3; air temperature: 19.9°C soil moisture, relative saturation: 79%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea turgida (Eisen, 1873) [8-1-7].

Table 1 continued on following page

Table 1 (continued).

NG2015-09. Illinois, Lee County, in mud and moist soil in/alongside road rut, along E side of road, 1.8 km SW TNC/NG Hdqtrs barn, 4.9 km ESE Grand Detour (town); latitude 41.87957°, longitude -089.35722°; 4th Principal Meridian: township 22N, range 10E; center, NW/4, SW/4, section 21, elevation 214m; sampling date: 6 October 2015, 10:55; collectors: M.J. Wetzel (2015-34) & J.W. Reynolds.

Values for field measurements – air temperature: 19.2°C*;* soil temperature: 18.4°C; soil *p*H: 6.5; soil moisture, relative saturation: 62%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea trapezoides (Dugès, 1828) [1-0-1].

NG2015-10. Illinois, Lee County, hard pack soil under light covering with wood chips, along (1.5m east of) new fence line, along east edge with wood lot/woods; 2.45 km SW TNC/NG Hdqtrs barn, 4.8 km ESE Grand Detour (town); latitude 41.87546°, longitude -089.36070°; 4th Principal Meridian: township 22N, range 10E; W/2, SW/4, SW/4, section 21; elevation 211m; sampling date: 6 October 2015, 11:16; collectors: M.J. Wetzel (2015-35) & J.W. Reynolds.

Field measurements recorded from this site on this date – air temperature: 19.3°C*;* soil temperature: 15.7°C; soil *p*H: 5.8; soil moisture, relative saturation: 70%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea tuberculata (Eisen, 1874) [16-3-0-1].

NG2015-11. Illinois, Lee County, in soil, under 2 of 3 logs, 2.7 km SSW TNC/NG Hdqtrs barn, 4.9 km ESE Grand Detour (town); along west side of road in grasses; latitude 41.87257°, longitude -089.36062°; 4th Principal Meridian: township 22N, range 10E; NW/4, NW/4, NW/4, section 28; elevation 209m; sampling date: 6 October 2015, 11:36; collectors: M.J. Wetzel (2015-36) & J.W. Reynolds.

Values for field measurements – air temperature: 19.1°C*;* soil temperature: 15.6°C; soil *p*H: 6.0; soil moisture, relative saturation: 56%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea tuberculata (Eisen, 1874) [10-0-0]; *Lumbricus terrestris* Linnaeus, 1758 [1-0-0].

NG2015-12. Illinois, Lee County, in moist soil, in riparian area & along banks of small unnamed tributary stream to Franklin Creek, in small depression ('shelf') on S side of and immediately downstream (WNW) road culvert (corrugated ~1m dia); 2.75 km SSW TNC/NG Hdqtrs, 5.0 km ESE Grand Detour (town); latitude 41.87222°, longitude -089.36066°; 4th Principal Meridian: township 22N, range 10E, NW/4, NW/4, section 28, elevation 208m; sampling date: 6 October 2015, 12:05; collectors: M.J. Wetzel (2015-37) & J.W. Reynolds.

Values for field measurements – air temperature: 21.2°C*;* soil temperature: 15.8°C; soil *p*H: 5.3; soil moisture, relative saturation: 85%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Lumbricus terrestris Linnaeus, 1758 [3-0-0]; *Aporrectodea tuberculata* (Eisen, 1874) [6-1-2].

Note: This same site was first surveyed on 21 April 2015 (see information, above, for site NG2015-02).

NG2015-13. Illinois, Ogle County, in dry soil, under large boulder at rock outcropping "shelf" area, along S side of road near bison corral, 1.4 km N TNC/NG Hdqtrs barn, 5.6 km E Grand Detour (town); latitude 41.90256°, longitude -089.34485°; 4th Principal Meridian: township 22N, range 10E, NW/4, NE/4, NE/4, section 16, elevation 222m; sampling date: 6 October 2015, 13:32; collectors: M.J. Wetzel (2015-38) & J.W. Reynolds.

Values for field measurements – air temperature: 23.3°C*;* soil temperature: 15.9°C; soil *p*H: 7.0; soil moisture, relative saturation: 55%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea tuberculata (Eisen, 1874) [1-0-0-1].

Table 1 continued on following page

Table 1 (continued).

NG2015-14. Illinois, Ogle County, in soil, under log pieces, along tree line, 4m W of N/S road, 1.7 km NNW TNC/NG Hdqtrs barn, 5.2 km E Grand Detour (town); latitude 41.90395°, longitude -089.34952°; 4th Principal Meridian: township 22N, range 10E, center, SW/4, SE/4, section 9, elevation 216m; sampling date: 6 October 2015, 13:50; collectors: M.J. Wetzel (2015-39) & J.W. Reynolds.

Values for field measurements – air temperature: 21.1°C*;* soil temperature: 15.4°C; soil *p*H: 5.8; soil moisture, relative saturation: 80%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea tuberculata (Eisen, 1874) [11-2-4].

NG2015-15. Illinois, Ogle County, under treated fence post pile (unused), ~50m NE long pole barn (SSE of Holland barn), in bison compound area, 1.38 km N TNC/NG hdqtrs barn, 5.7 km E Grand Detour (town); latitude 41.90240°, longitude -089.34346°; 4th Principal Meridian: township 22N, range 10E, NW/4, NW/4, NE/4, NE/4, section 16, elevation 221m; sampling date: 6 October 2015, 14:20; collectors: M.J. Wetzel (2015-40) & J.W. Reynolds.

Values for field measurements – air temperature: 23.6°C*;* soil temperature: 16.7°C; soil *p*H: 6.4; soil moisture, relative saturation: 73%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Lumbricus terrestris Linnaeus, 1758 [1-0-0]; *Aporrectodea turgida* (Eisen, 1873) [17-1-3-1].

NG2015-16. Illinois, Ogle County, in soil, under old logs, along north side of mowed yard of 1st residential home SE (160m) TNC/NG Hdqtrs, 5.8 km E Grand Detour (town); latitude 41.89034°, longitude -089.34187°; 4th Principal Meridian: township 22N, range 10E, NE/4, SE/4, SE/4, section 16; sampling date: 6 October 2015, 15:05; collectors: M.J. Wetzel (2015-41) & J.W. Reynolds.

Values for field measurements – air temperature: 25.7°C*;* soil temperature: 16.6°C; soil *p*H: 6.15; soil moisture, relative saturation: 78%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea turgida (Eisen, 1873) [1-1-0].

NG2015-17. Illinois, Lee County, in moist soil, along E side and bank of road rut, along W edge of new fence line (posts recently set, but wire fencing not yet in place), 2.55 km SSW TNC/NG Hdqtrs barn, 5.8 km ESE Grand Detour (town); latitude 41.87069°, longitude -089.35131°; 4th Principal Meridian: township 22N, range 10E, SW/4, SW/4, NW/4, NE/4, section 28, elevation 217m; sampling date: 7 October 2015, 09:20; collectors: M.J. Wetzel (2015-42) & J.W. Reynolds.

Values for field measurements – air temperature: 19.0°C*;* soil temperature: 15.7°C; soil *p*H: 5.6; soil moisture, relative saturation: 70%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea turgida (Eisen, 1873) [0-0-3]; *Octolasion tyrtaeum* (Savigny, 1826) [0-0-1].

NG2015-18. Illinois, Lee County, in soil, in road rut and in ditch along E side of road, wedge w/ new fence line (posts recently set, but wire fencing not yet in place), ~20m S road crossing by rivulette, 2.42 km SSW TNC/NG Hdqtrs barn, 5.7 km ESE Grand Detour (town); latitude 41.87154°, longitude -089.35120°; 4th Principal Meridian: township 22N, range 10E, SW/4, NW/4, NW/4, NE/4, section 28; elevation 215m; sampling date: 7 October 2015, 09:38; collectors: M.J. Wetzel (2015-43) & J.W. Reynolds.

Field measurements recorded from this site on this date – air temperature: 18.9°C*;* soil temperature: 15.1°C; soil *p*H: 6.2; soil moisture, relative saturation: 70%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea turgida (Eisen, 1873) [4-1-3].

Table 1 concluded on following page

Table 1 (concluded).

NG2015-19. Illinois, Lee County, in soil, in depression, in grasses, shrub thicket along N side wood lot, along S side of E/W road, 1.95 km SE TNC/NG Hdqtrs, 5.1 km ESE Grand Detour (town); latitude 41.87793°, longitude -089.35617°; 4th Principal Meridian: township 22N, range 10E, center, SW/4, section 21, elevation ~220m; sampling date: 7 October 2015, 10:05; collectors: M.J. Wetzel (2015-44) & J.W. Reynolds.

Values for field measurements – air temperature: 20.8°C*;* soil temperature: 15.1°C; soil *p*H: 5.9; soil moisture, relative saturation: 80%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea tuberculata (Eisen, 1874) [18-0-0]; *Lumbricus terrestris* Linnaeus, 1758 [1-0-0].

NG2015-20. Illinois, Ogle County, in recently disturbed soil and detritus, along W side of road, in soil disturbed by recent tree and brush removal associated with new fence line (posts in place, but wire fencing not yet added), ~110m S limestone outcropping, 1.15 km WSW TNC/NG Hdqtrs barn, 4.7 km E Grand Detour (town); latitude 41.88824°, longitude -089.35577°; 4th Principal Meridian: township 22N, range 10E, SW/4, SE/4, SW/4, section 16, elevation 220m; sampling date; 7 October 2015, 11:10; collectors: M.J. Wetzel (2015-45) & J.W. Reynolds.

Values for field measurements – air temperature: 24.0°C*;* soil temperature: 15.4°C; soil *p*H: 6.0; soil moisture, relative saturation: 74%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Lumbricus terrestris Linnaeus, 1758 [2-0-0]; *Aporrectodea turgida* (Eisen, 1873) [9-3-4]; *Octolasion tyrtaeum* (Savigny, 1826) [0-2-0].

NG2015-21. Illinois, Ogle County, in soil and under bark of older log pieces (15" long, 15-20" diameter), 1.35 km WSW TNC/NG Hdqtrs barn, 4.6 km ESE Grand Detour (town). Along north side of east/west road (the county line here); latitude 41.88815°, longitude -089.35773°; 4th Principal Meridian: township 22N, range 10E, SW/4, SE/4, SW/4, SW/4, section 16, elevation 222m; sampling date: 7 October 2015, 11:30; collectors: M.J. Wetzel (2015-46) & J.W. Reynolds.

Values for field measurements – air temperature: 23.0°C*;* soil temperature: 18.3°C; soil *p*H: 6.2; soil moisture, relative saturation: 45%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Lumbricus terrestris Linnaeus, 1758 [8-1-1]; *Aporrectodea tuberculata* (Eisen, 1874) [29-0-0].

NG2015-22. Illinois, Lee County, in soil, under old segmented log (from partial saw cuts), along W side of road, just after it turns south; 1.4 km WSW TNC/NG Hdqtrs barn, 4.5 km ESE Grand Detour (town); latitude 41.88801°, longitude -089.35835°; 4th Principal Meridian: township 22N, range 10E, NE/4, NW/4, NW/4, section 21, elevation 220m; sampling date: 7 October 2015, 12:01; collectors: M.J. Wetzel (2015-47) & J.W. Reynolds.

Values for field measurements – air temperature: 22.7°C*;* soil temperature: 15.4°C; soil *p*H: 5.0; soil moisture, relative saturation: 45%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea tuberculata (Eisen, 1874) [15-0-0]; *Lumbricus terrestris* Linnaeus, 1758 [1-0-0].

NG2015-23. Illinois, Ogle County, in soil, under two short log pieces, on end at hose/water spigot by small shed, outhouse in driveway on south side of TNC/NG Hdqtrs barn, 5.7 km E Grand Detour (town); latitude 41.89076°, longitude -089.34350°; 4th Principal Meridian: township 22N, range 10E, center, N/4, SE/4, SE/4, section 16, elevation 230m; sampling date: 7 October 2015, 13:01: M.J. Wetzel (2015-48) & J.W. Reynolds.

Values for field measurements – air temperature: 25.7°C*;* soil temperature: 17.0°C; soil *p*H: 7.0; soil moisture, relative saturation: 45%.

Scientific name and authority, and maturity levels of earthworm specimens [in brackets] [1]

Aporrectodea turgida (Eisen, 1873) [9-0-3].

[1] Maturity levels – The polynomial in brackets '[#-#-#]' following the scientific names of listed taxa refers to the number of juvenile - aclitellate adult - clitellate adult specimens of that taxon collected from that site on that date. A fourth number, if included in the polynomial, e.g. '[#-#-#-#]', refers to the number of postclitellate adult specimens in that collection.

Field and Laboratory Methodologies. Disturbance of collection areas was kept to a minimum, and non-target taxa were returned live to their original habitat. All tenets of the NG researcher information and policies concerning appropriate field methods and taking of organisms were followed during this research.

Field methodologies. Earthworms were collected from diverse habitats by digging – most commonly using small hand garden pick-forks (pick blade on one end, 3-4 tines on the other); shovels, spades, large garden forks, hand trowels were used occasionally, as well as a peavey to temporarily roll large logs and branches. Clods of moist soil were broken apart by hand and by using the shovels and forks, and hand pick-forks; earthworms were removed from the dirt by hand. Earthworms were collected from under logs, branches, rocks, stones, and other natural as well as anthropogenic materials. Mud and muck at the edges of aquatic habitats was sampled using D-ring dip nets, shovels, or hand pick-forks, followed by rinsing in nets in the water – to attempt collection of earthworms (*Eiseniella tetraedra, Sparganophilus* spp., and a few other species) commonly present in limicolous habitats.

Live specimens were immediately placed into small bags or Nalgene bottles with moist dirt from their habitus; the containers with specimens were then placed in a cooler for live transport to laboratory facilities to complete initial specimen processing each evening on the day of collection. To avoid any possibility of accidental contamination, hazardous fluids (specimen preservatives and fixatives, e.g., ethanol, Kahle's fluid, formalin) were not taken to collecting sites.

Our 'leave-no-trace' protocol during earthworm surveys was implemented prior to leaving each collecting site: rolled logs, branches, posts, and stones were placed back to the areas from which they were moved, and areas exposed by digging and scraping were re-covered with the soil, leaves, pads of mosses, bark, twigs, and other detritus that had been moved aside during the collecting process.

Field parameters measured at each site included ambient temperature {measured with a red liquid or digital thermometer}, soil temperature {measured with a soil probe digital thermometer at a depth of 10cm}, and soil *p*H and moisture {both measured using a Kelway HB-2 soil acidity and moisture meter}. Values for these field measurements are presented after the locality information for each site in **Table 1**., Photographs taken during our site visits are presented in **Appendix 1.**

Supplemental locality and habitat information presented on topographic maps was also incorporated into our site descriptions. Latitude and longitude coordinates were established at each site using a hand held GPS receiver (see *Geo-Referencing of Sites* section, above); vetted locality information was then transferred using GIS software to a map for inclusion in this project report (**Figure 1**).

Laboratory methodologies. Earthworm specimens were processed each evening after collection, either in the INHS Annelida lab in Champaign (April), or in the motel during our stay near NG (October). Processing included rinsing of specimens with tap water to remove excess soil adhering to their bodies, relaxation in 5–10% ethanol for 10–20 min (or until all movement and response to touching had ceased), then preserved in 80% ethanol. Specimens collected in April and October 2015 were then identified, straightened, rolled up (with locality and ID labels) in paper towels, placed in capped plastic centrifuge tubes or in quart or gallon zip lock bags until later transfer to permanent storage containers.

Specimen Identifications. Identifications, maturity levels, and nomenclature of earthworms follow Reynolds (1977), Reynolds and Cook (1976, 1981, 1989, and 1993), Reynolds et al. (1974), Reynolds and Wetzel (2004, 2008, 2012), and information available via *Nomenclatura Oligochaetologica – Editio Secunda* (Reynolds and Wetzel (2016) – a web-based nomenclator.

Specimen Deposition and Documentation. Earthworm specimens collected and identified during this research are deposited in the INHS Annelida Collection, Champaign, with representative specimens of some species deposited in Reynolds' Oligochaetology Lab in Kitchener, Ontario, Canada. Data generated through this research has been incorporated into a FileMaker Pro (v.14) database.

After acceptance of this final report, we will present the results of this survey for earthworms at Nachsa Grasslands in a paper to be published in the peer-reviewed journal, *Megadrilogica*.

Permits. This research was conducted under of the tenets of collecting permits issued to MJW by TNC and INPC.

RESULTS

During visits to NG in April and again in October, 426 earthworms were collected from 23 sites by M.J. Wetzel, K.L. Moss and J.W. Reynolds. Specimens identified from these 23 sites represent eight species in four genera and a single family, Lumbricidae (**Table 2**).

One mature specimen of *Bimastos welchi* (Smith, 1917) (Family Lumbricidae) collected on 21 April 2015 from one site, NG2015-03, represents a new state record for Illinois; this species was not collected from any of the other NG sites during this survey; a second visit to this site on 6 October did not yield additional specimens of this species, perhaps because of less moisture in the soil at that time.

Table 2. Earthworms (Annelida, Clitellata) identified from specimens in samples collected from 23 terrestrial, semi-terrestrial, and limicolous sites terrestrial, semi-terrestrial, and limicolous sites at Nachusa Grasslands (Lee and Ogle Counties, Illinois, USA by M.J. Wetzel and K.L. Moss on 21 April 2015, and by M.J. Wetzel and J.W. Reynolds (Oligochaetology Lab, Kitchener, Ontario, Canada) on 6 and 7 October 2015.

FAMILY LUMBRICIDAE	
Bimastos welchi (Smith, 1917) *	*Lumbricus rubellus* Hoffmeister, 1843
Aporrectodea rosea (Savigny, 1826)	*Lumbricus terrestris* Linnaeus, 1758
Aporrectodea trapezoides (Dugès, 1828)	*Octolasion tyrtaeum* (Savigny, 1826)
Aporrectodea tuberculata (Eisen, 1874)	
Aporrectodea turgida (Eisen, 1873)	*** = new record for the State of Illinois**

Table 3 presents a classification and listing (including number of individuals and maturity levels) of earthworm taxa (Annelida, Clitellata) identified from samples collected from terrestrial, semi-terrestrial, and limicolous habitats on Nachusa Grassland property (Lee and Ogle Counties, Illinois USA) by M.J. Wetzel and K.L. Moss on 21 April 2015, and by M.J. Wetzel and J.W. Reynolds (Oligochaetology Lab, Kitchener, Ontario, Canada) on 6 and 7 October 2015.

DISCUSSION

Eight species of earthworms, all in the family Lumbricidae, were collected during this present study (**Table 2, Table 3**); of these, one – *Bimastos welchi* (Smith, 1917) – represents a new state record. Two species – *Dendrodrilus rubidus* and *Eisenia foetida* – previously reported from Lee County (Reynolds and Wetzel, 2011), were not collected from NG during this present study, nor reported by Wodika et al. (2014). Six species – *Diplocardia communis* (Family Acanthodrilidae), *Bimastos parvus*, *Dendrobaena octaedra*, *Eiseniella tetraedra* (Family Lumbricidae), and *Sparganophilus eiseni* (Family Sparganophilidae) –previously reported from one or more counties adjacent to Lee and Ogle Counties (Reynolds and Wetzel, 2011), were not collected from NG during this present study, nor reported from NG by Wodika et al. (2014). One species reported by Wodika et al. (2014) – *Bimastos longicinctus* Smith & Gittens, 1915, was not collected from any of our 23 sites at NG during 2015, although it had previously been reported from nine other counties in Illinois – all of which are south of Lee County (Reynolds and Wetzel, 2011).

Several species collected during this study represent new county records for Lee County (n=2: *Aporrectodea rosea* and *Octolasion tyrtaeum*), and Ogle County (n=4: *Aporrectodea tuberculata, Aporrectodea tuberculata, Lumbricus terrestris,* and *Octolasion tyrtaeum*) (**Table 2, Table 3**).

Table 3. Classification and listing (including number of individuals and maturity levels) of of earthworm taxa (Annelida, Clitellata) identified from samples collected from terrestrial, semi-terrestrial, and limicolous habitats on Nachusa Grassland property (Lee and Ogle Counties, Illinois USA) by M.J. Wetzel and K.L. Moss on 21 April 2015, and by M.J. Wetzel and J.W. Reynolds (Oligochaetology Lab, Kitchener, Ontario, Canada) on 6 and 7 October 2015. Specific site locality information is presented in Table 1 of this report.

Site Number: NG(2015) –	01	02	03	04	05	06	07	08	09	10	11	12	13
Oligochaetous Clitellata [= 'Oligochaeta']													
Opisthopora (megadrile oligochaetes)													
Family Lumbricidae													
Aporrectodea rosea (Savigny, 1826) **– *L**			**0-0-1**										
Aporrectodea trapezoides (Dugès, 1828)									**1-0-1**				
Aporrectodea tuberculata (Eisen, 1874) – ***O**		**5-2-4**			**0-1-0**	**19-1-4**	**7-0-0**			**16-3-0-1**	**10-0-0**	**6-1-2**	**1-0-0-1**
Aporrectodea turgida (Eisen, 1873)	**38-0-1**		**49-0-3**	**32-0-4**				**8-1-7**					
Bimastos welchi (Smith, 1917) **– StR**			**0-0-1**										
Lumbricus rubellus Hoffmeister, 1843	**0-0-1**	**2-0-0**											
Lumbricus terrestris Linnaeus, 1758 **– *O**	**8-2-1**		**2-0-3**	**0-0-1**			**1-0-0**				**1-0-0**	**3-0-0**	
Octolasion tyrtaeum (Savigny, 1826) **– *L, *O**		**6-0-4**											
No. individuals / No. taxa:		**23/3**	**59/4**	**37/2**	**1/1**	**24/1**	**8/2**	**16/1**	**2/1**	**20/1**	**11/2**	**13/2**	**2/1**

Site Number: NG(2015) –	14	15	16	17	18	19	20	21	22	23		+ +
												total #
Oligochaetous Clitellata [= 'Oligochaeta']												Sites
Opisthopora (megadrile oligochaetes)												
Family Lumbricidae												
Aporrectodea rosea (Savigny, **1826) – *L**												**1**
Aporrectodea trapezoides (Dugès, 1828)												**1**
Aporrectodea tuberculata (Eisen, 1874) **– *O**	**11-2-4**					**18-0-0**		**29-0-0**	**15-0-0**			**12**
Aporrectodea turgida (Eisen, 1873)		**17-1-3-1**	**1-1-0**	**0-0-3**	**4-1-3**		**9-3-4**			**9-0-3**		**10**
Bimastos welchi (Smith, 1917) **– StR**												**1**
Lumbricus rubellus Hoffmeister, 1843												**2**
Lumbricus terrestris Linnaeus, 1758 **– *O**		**1-0-0**				**1-0-0**	**2-0-0**	**8-1-1**	**1-0-0**			**11**
Octolasion tyrtaeum (Savigny, 1826) **– *L, *O**				**0-0-1**			**0-2-0**					**3**
No. individuals / No. taxa:	**17/1**	**23/2**	**2/1**	**4/2**	**8/1**	**19/2**	**20/3**	**39/2**	**16/2**	**12/1**		

footnotes:

Maturity levels and number of specimens of species collected from each site are presented in respective cells of this table;
the polynomial #-#-# refers to the number of **juvenile - aclitellate adult - clitellate adult** specimens that were collected from that site;
a fourth number, if included in the polynomial, e.g. #-#-#-#, refers to the number of **postclitellate adult** specimens in that collection.

Species followed by an asterisk are reported here as new records for Lee (***L**) and/or Ogle (***O**) Counties in Illinois

StR – *Bimastos welchi* represents a new state record for Illinois

Additional information is presented in the Species Accounts section in this report.

+ + *= total number of Nachusa Grasslands study sites (out of 23) from which the species was collected in 2015*

Endangered and threatened species. None of the species collected during our 2015 survey for earthworms at NG are listed as endangered or threatened at the federal or state level, nor are any under consideration for such listing (Illinois Endangered Species Protection Board, 2011; Mankowski 2010, 2012; U.S. Department of the Interior, Fish and Wildlife Service, 1996, 1997, 1999).

Additional information for each species discussed in this report is presented in the **Species Accounts** subsection, below.

SPECIES ACCOUNTS

Family Lumbricidae

Twenty-eight species representing 10 genera in the family Lumbricidae occur in the nine states (and their 860 counties) comprising the American Midwest. Of these 28 species, 10 are considered rare, to date having been reported from fewer than 10 of the 860 counties (Reynolds, 2011). One of these is *Bimastos welchi*, noted in this report as a new record for the state of Illinois. Prior to our collection *of B. welchi* from one site at NG, it had been reported by Reynolds (2011) from limited collections in four other states – only two (Indiana and Missouri) of which are in the American Midwest.

More specific information for each species collected during this study, and for species previously reported from NG, from Lee and Ogle Counties, and from elsewhere in Illinois, is presented below.

***Aporrectodea rosea* (Savigny, 1826) –** is a very small (25-85 mm) soil dwelling (endogeic) European introduction to North America. Although considered to be unpigmented, this species often appears pinkish in colour when alive. An amphimictic species, some limited parthenogenetic populations have also been documented (Gates, 1972; Reynolds, 1974, 1977; Reynolds *et al.* (1974). This species has been collected from all continents; its distribution in North America is illustrated in Reynolds and Wetzel (2008, 2012), and in Reynolds (2011) for the midwestern U.S. states.

First reported (as *Allolobophora mucosa*) from Illinois by Garman (1888) and later (as *Helodrilus roseus*) by Smith (1917), *Aporrectodea rosea* is known to occur in the adjacent states of Wisconsin, Indiana, Kentucky, Missouri, and Iowa (Reynolds and Wetzel, 2011). Reynolds and Wetzel (2011) documented the occurrence of *Aporrectodea rosea* in 39 Illinois counties, excluding Lee and Ogle Counties; it was collected from only one NG site, NG2015-03 in Lee County, during our 2015 survey, thus representing a new county record (**Table 3**).

***Aporrectodea trapezoides* (Dugès, 1828) –** is a medium sized (80-140 mm) soil dwelling (endogeic) European introduction to North America. Colour variable, often lighter behind the clitellum until near the tail end, where it is a deeper varying colour slate, brown, brownish, reddish brown, and occasionally almost reddish, but not purple.

Both amphimictic and parthenogenetic populations of *Aporrectodea trapezoides* have been documented, with some instances of pseudogamy observed; male sterility is also common (Reynolds, 1974, 1977). This species has been collected from cultivated soil, gardens, pastures, woodlands, and is abundant in soils bordering rivers and lakes, and has been reported from all continents (Reynolds, 1977). *Aporrectodea trapezoides* has been reported from 48 U.S. states and nine Canadian provinces (Reynolds and Wetzel 2004, 2008, 2012).

First reported (as Allolobophora iowana) from Illinois by Harman (1960), *Aporrectodea trapezoides* is known to occur in the adjacent states of Wisconsin, Indiana, Kentucky, Missouri, and Iowa (Reynolds and Wetzel, 2011). Reynolds and Wetzel (2011) documented the occurrence of *Aporrectodea trapezoides* in 56 Illinois counties, including Lee County; it was collected from only one NG site, NG2015-09 in Lee County, during our 2015 survey (**Table 3**).

***Aporrectodea tuberculata* (Eisen, 1874) –** is a common and widely distributed medium sized (90-150 mm) soil dwelling (endogeic), obligatorily amphimictic European introduction to North America. It is unpigmented and appears pale brown or grayish in colour. In many cases it may be difficult to distinguish it from *Aporrectodea turgida*. It has been reported from all continents, but in North America it is more commonly collected in Canada and from northern U.S. states (see Reynolds and Wetzel, 2008, 2012). Although just recently reported for the first time from Illinois, it has been present in the state for years based upon the collecting information associated with numerous specimens (and 17 collecting events) recently identified as *Ap. tuberculata*. This species had previously been reported from the adjacent states of Wisconsin, Indiana, Kentucky, and Iowa (Reynolds and Wetzel, 2011). Reynolds and Wetzel (2011) documented the occurrence of *Aporrectodea tuberculata* in 16 Illinois counties, including Lee County; it was collected from 12 NG sites during our 2015 survey – the most commonly collected species. The *Aporrectodea tuberculata* specimens collected from five sites in Ogle County represent new county records for this species (**Table 3**).

***Aporrectodea turgida* (Eisen, 1873) –** is a common and widely distributed medium sized (60-85 mm) species soil dwelling (endogeic), obligatorily amphimictic European introduction to North America. It is unpigmented and appears pale brown or pale gray in colour. In many cases it may be difficult to distinguish it from *Aporrectodea tuberculata*. It has been reported from all continents, but in North America it is concentrated in the middle U.S. states and Quebec, which can be seen in Reynolds and Wetzel (2008). First reported from Illinois in 1888, *Aporrectodea turgida* is known to occur in the adjacent states of Wisconsin, Indiana, Kentucky, Missouri, and Iowa (Reynolds and Wetzel, 2011). Reynolds and Wetzel (2011) documented the occurrence of *Aporrectodea turgida* in 32 Illinois counties, including Lee County; it was collected from 10 NG sites during our 2015 survey – the third most commonly collected species. The *Aporrectodea turgida* specimens collected from four sites in Ogle County represent new county records for this species (**Table 3**).

***Bimastos longicinctus* (Smith & Gittins, 1915**) – is regularly found in the southeastern U.S. and north to southern Michigan west of the Appalachian Mountains (Reynolds & Wetzel, 2012). It is a medium sized (65-92 mm) parthenogenetic species. Its pigmentation is rose-red antero-dorsally, paler elsewhere.

Bimastos longicinctus was described as new to science by Smith and Gittins (1915) from Urbana, Illinois. It is known to occur in the adjacent states of Indiana, Kentucky, and Missouri (Reynolds and Wetzel, 2011). Although *Bimastos longicinctus* was not collected from any of our 23 sites during 2015, it had been reported by Wodika et al. (2014) from NG. This species had previously been reported from nine other counties in Illinois – all of which are south of Lee County (Reynolds and Wetzel, 2011).

***Bimastos welchi* (Smith, 1917)** – is a rare, medium sized (110-135 mm) parthenogenetic soil dwelling (endogeic) species native to North America. Pigmentation is lacking but often appears pinkish anteriorly due to vascularization, and brown flecks may be present in the setal areas of segments V to XV.

The collection of *B. welchi* from site NG2015-03 (**Table 3**) represents a new record for Illinois, although Reynolds (2011) and Reynolds and Wetzel (2012) reported it from four other states in the U.S.: Colorado, Kansas, Missouri, and Indiana. As noted above, we were unsuccessful in our attempt to collect additional *B. welchi* specimens from site NG2015-03 (or any other sites) during our October 2015 site visit – most likely because the moisture content of the soil at that site was lower in October.

Bimastos welchi, one of nine in the genus occurring in North America, was described as new to science by Frank Smith in 1917 (originally in the genus *Helodrilus*), based upon one specimen collected (by Paul S. Welch) from a site near Manhattan, Kansas. Smith was a renowned zoologist who worked at the University of Illinois and with researchers at the INHS, and one who conducted surveys for earthworms and many other invertebrates; he was an author / coauthor on papers in which five other earthworms

(three in the genus *Bimastos*) and five microdrile oligochaetes (Family Enchytraeidae) were described as new to science. So it is a fitting, if belated (98 years later) tribute to Smith that a species he described as new to science was finally discovered in his personal and professional home state.

***Lumbricus rubellus* Hoffmeister, 1843** – is a moderately sized (50-150 mm, generally > 60 mm in length), surface-dwelling (epi-endogeic) species. It is red in colour and an obligatorily amphimictic European introduction to North America. The juveniles of *Lumbricus rubellus* are difficult to distinguish from *Lumbricus terrestris*. This species has a global distribution; its known distribution in North America is illustrated in Reynolds and Wetzel (2008, 2012).

First reported from Illinois in 1928, *Lumbricus rubellus* is known to occur in the adjacent states of Wisconsin, Indiana, Kentucky, and Missouri (Reynolds and Wetzel, 2011). Reynolds and Wetzel (2011) documented the occurrence of *Lumbricus rubellus* in 26 Illinois counties, including Lee County; it was collected from only two NG sites during our 2015 survey, both in Lee County (**Table 3**).

***Lumbricus terrestris* Linnaeus, 1758 –** the night crawler, is a very large (90-300 mm in length), deep-dwelling (anecic) species, red-brown in colour, and an obligatorily amphimictic European introduction to North America. It is commonly used as a fish-bait, and the textbook example of an earthworm studied primary and secondary schools. It is the only large lumbricid in North America. This species has a global distribution, but in North America it is found infrequently south of the Mason-Dixon line (and as 'extended' west across the continent), as illustrated in Reynolds and Wetzel (2008, 2012). *Lumbricus terrestris* is the most commonly recognized earthworm species due to its historical use as the textbook example for megadriles; in actuality, however, it is not as widespread in the United States as many other species. First reported from Illinois in 1917, *Lumbricus terrestris* is known to occur in the adjacent states of Wisconsin, Indiana, Kentucky, Missouri, and Iowa (Reynolds and Wetzel, 2011). Reynolds and Wetzel (2011) documented the occurrence of *Lumbricus terrestris* in 25 Illinois counties, including Lee County; it was collected from 11 NG sites during our 2015 survey – the second most commonly collected species. The *Lumbricus terrestris* specimens collected from four sites in Ogle County represent new county records for this species (**Table 3**).

***Octolasion tyrtaeum* (Savigny, 1826) –** is a moderate-sized (25-130 mm in length) European soil-dwelling (endogeic) species and is frequently found in woodlots or forested habitats, often associated with decaying logs and leaf mould. It is unpigmented and appears white in colour. An amphimictic species, limited parthenogenetic populations have also been documented (Jaenike et al., 1980), which may be responsible for its limited distributional pattern. This species has been collected from all continents; its distribution in North America is illustrated in Reynolds and Wetzel (2008, 2012).

First reported from Illinois in 1917, *Octolasion tyrtaeum* is known to occur in the adjacent states of Wisconsin, Indiana, Kentucky, Missouri, and Iowa (Reynolds and Wetzel, 2011). Reynolds and Wetzel (2011) documented the occurrence *Octolasion tyrtaeum* in 42 Illinois counties, but it had not been reported from Lee or Ogle Counties prior to our collection of this species from three NG sites in 2015 – NG2015-02 (a new Lee County record), and NG2015-17, -20 (new Ogle County records) (**Table 3**).

Family Sparganophilidae

Species in the genus *Sparganophilus* are restricted to water areas (lake shores, streams, etc.) sometimes referred to as aquatic but limicolous is more accurate. Their morphology restricts them to this type of habitat: lacking calciferous glands, dorsal pores, gizzard, and typhlosole. S*parganophilus eiseni* (= *S. tamesis*), an obligatorily amphimictic species, has been collected in many states and three Canadian provinces (Reynolds and Wetzel, 2012). We did survey suitable habitats in the NG; however, neither *Sp.*

eiseni nor other species frequently found in these habitats – e.g., A*llolobophora chlorotica* and *Eiseniella tetraedra* were collected, likely due to the dry warm conditions. There are no climatic or geographical barriers to restrict these three species from residing in the NG.

The distribution and habitat preferences of species in the family Sparganophilidae, in North America and elsewhere, was presented in Reynolds (1980, 2001, 2008), and in Reynolds and Wetzel (2004, 2008, 2012).

Reynolds and Wetzel (2011) documented *Sparganophilus eiseni* in 21 collecting events in 15 Illinois counties, including Bureau, Putnam, and Marshall Counties, all located south of Lee County. Additional collecting in limicolous habitats associated with the Franklin Creek drainage and the lake near the south end of NG may yield one or more specimens of this taxon.

Other pertinent information

As noted in our proposal, our intention was to contact Ben Wodika for access to the 1,500+ specimens that he and is collaborators documented during their research at NG (Wodika et al. 2014) – specifically to provide positive species-level identifications for the *Lumbricus* spp. specimens referred to in their paper, and if possible, to provide positive identification (and maturity level) for at least some of the immature / otherwise unidentified earthworm specimens they collected, and to document any morphological aberrances in their specimens. I have since communicated with Mr. Wodika, and will be visiting Southern Illinois University (% Dr. Sara Baer, Department of Plant Biology and Center for Ecology, SIU, Carbondale, IL 62901 [SIU-C] – the current disposition of specimens he collected from NG) to access those specimens, then complete identifications to be included in our final report to FoNG, and our publication of results.

We decided to finalize this report for work conducted in 2015, but hope to secure the specimens from SIU-C for review later this year; once we have had the opportunity to review the specimens, we will submit a revised final report if substantive information results from our review of those specimens.

Native species and introductions. With the exception of *Bimastos welchi*, all earthworms collected during this survey are European introductions, and common elsewhere in Illinois. As noted in the Introduction section of this report – of the 39 species now know to occur in Illinois (inclusive herein of the new state record of the native *Bimastos welchi* we collected from NG in April 2015), 20 are considered to be introductions and 19 are considered native. None of the three Asian introductions previously reported in Illinois (Reynolds, 2014; Reynolds and Wetzel, 2011) – *Amynthas diffringens* (Baird, 1869), *Amynthas hawayensis* (Rosa, 1891) or *Amynthas hupeiensis* (Michaelsen, 1895) (all in the family Megascolecidae) – have yet been reported from Lee or Ogle Counties, nor any adjacent counties.

Prognosis for additional earthworm species occurring at Nachusa Grasslands.

Eight species in the genus *Diplocardia* (Family Acanthodrilidae) occur in Illinois (Reynolds, 2011; Reynolds and Wetzel, 2011) yet none were collected from NG during our 2015 survey, and have yet been reported from Lee or Ogle Counties; only one, *D. communis*, has been reported from an adjacent county (LaSalle). Since Lee and Ogle Counties were subject to glaciation, this may account for the lack or limited distribution of *Diplocardia* in the area.

Other earthworms in the family Acanthodrilidae (two introduced species), and the families Glossoscolecidae (one introduced species) and Komarekionidae (one native species) occurring in Illinois (Reynolds, 2011; Reynolds and Wetzel, 2011) are, to date, considered rare in Illinois (each reported from 1-2 localities in the state) and unlikely to occur at NG.

The availability of diverse habitats at sites can greatly influence the number of species collected from any given site. Limicolous species such as *Allolobophora chlorotica* (Savigny, 1826), *Eiseniella tetraedra* (Savigny, 1826) and *Sparganophilus eiseni* Smith 1895 are only going to be obtained in wet soils and substrates associated with lotic and lentic habitats (e.g., streams, ponds, lakes, wetlands, springs, low lying areas that retain water for periods of time). Continued sampling at NG and in adjacent areas in Lee and Ogle Counties will likely yield additional species – but successful results will be dependent upon

moisture content of habitats, forest and soil types, canopy, and collector effort. Reynolds (2014) summarized the association of earthworms with physiographic regions, soil orders, and forest regions in the Midwest – a great reference when developing the scope of future studies of earthworms, anywhere.

PRESENTATIONS

During 2015, MJW presented several talks at professional meetings focusing on the surveys for terrestrial and aquatic oligochaetes in North America and elsewhere, including our preliminary survey for earthworms at Nachusa Grasslands. The title of each of these talks (with only slight modification) is as follows: "Current status of a survey for earthworms at Nachusa Grasslands in Illinois." All talks were presented by MJW; each was coauthored with J.W. Reynolds and M.A.P. Morgan. The names of the organizations, venues, and dates for these oral presentations follow:

> **Society for Freshwater Science**, Milwaukee Convention Center, Milwaukee, Wisconsin (63rd annual meeting, 22 May 2015).

> **Florida Association of Benthologists**, St. Petersburg College, Clearwater Campus, Clearwater, Florida (29th annual meeting, 4-6 November 2015).

> **13th International Symposium on Aquatic Oligochaeta**, Masaryk University, Brno, Czech Republic (7-11 September 2015).

IN-KIND CONTRIBUTIONS / LEVERAGED SUPPORT ASSOCIATED WITH THIS 2015 RESEARCH

An itemized accounting for in-kind and leveraged support was not determined for this project, since it was conducted independently outside of an institutional setting (which would have required inclusion fringe benefits (FB) of ~31% of researcher salary, and unrecovered facilities and administration costs (UFAC) of ~59% in the budget). Projected compensation for Wetzel and Reynolds for their time commitment to this project during 2015, at their current daily rate of compensation (salary or hourly rate, excluding FB and UFAC, noted above) is estimated to be $3,700.

COLLABORATIVE RESEARCH

No collaborative research associated with surveys during 2015 was anticipated or realized. However, the distributional information resulting from our survey for earthworms at NG and ancillary collections for earthworms in counties adjacent to Lee and Ogle Counties and elsewhere in mid-state during our travels to and from NG will be included in a subsequent publication, an update of our first paper on the earthworms of Illinois (Reynolds and Wetzel, 2014) and soon after in our fourth update (following Reynolds and Wetzel, 2004, 2008, 2012) summarizing the distribution of earthworms in North America.

ACKNOWLEDGMENTS

The direct and indirect assistance of many people have contributed to the continuing success of this research. We thank the professional and management personnel affiliated with Friends of Nachusa Grasslands and The Nature Conservancy for the valued assistance, guidance, and recommendations during the planning and conduct of this research – Mary Vieregg, Bill Kleiman, Cody Considine, Jeffery W. Walk, Ben R. Wodika, Sara G. Baer, Kelly L. Neal, the Friends of Nachusa Grasslands Science Committee and benefactors, The Nature Conservancy, Illinois Nature Preserves Commission, the Illinois Department of Natural Resources, the Illinois Natural History Survey, and the Prairie Research Institute at the University of Illinois at Urbana-Champaign. We extend our appreciation to Kristi L. Moss for her assistance in the field (April 2015) and in the lab when processing specimens and databasing project information. We also thank Diane Greer (INHS) for preparing the map in **Figure 1**.

REFERENCES AND LITERATURE CITED

Dugès, A. 1828. Recherche sur la circulation, la respiration et la reproduction des Annélides abranches sétigères. Ann. Sci. Nat. 15(1): 284-336. [*Aporrectodea trapezoides* n. sp.]

Eisen, G. 1873. Om Skandinaviens Oligochaeter. Öfv. Vet-Akad. Förh. Stockholm 30(8): 43-56. [*Aporrectodea turgida* n. sp.]

Eisen, G. 1874. New Englands och Canadas Lumbricider. Öfv. Vet-Akad. Förh. Stockholm 31(2): 41-49. [*Aporrectodea tuberculata* n. sp. and *Bimastos parvus* n. sp.]

Gates, G.E. 1972. 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. No. 12: 1-146.

Garman, H. 1888. On the anatomy and histology of a new earthworm (*Diplocardia communis*, gen. et sp. nov.). Bull. Illinois St. Lab. Nat. Hist. 3: 47-77 + 5 plates.

Harman, W.J. 1960. Studies on the taxonomy and musculature of the earthworms of central Illinois. Urbana, IL: University of Illinois, Ph.D. thesis, 107 pp.

Hoffmeister, W. 1843. Beiträge zur Kenntnis deutscher Landanneliden. Arch. Naturg. 9(1): 183-198. [*Lumbricus rubellus* n. sp.]

Illinois Endangered Species Protection Board (IESPB). 2011. Checklist of Endangered and Threatened Animals and Plants of Illinois. Illinois Endangered Species Protection Board, Springfield, IL. 18 pp.

Jaenike, J., F.D. Parker Jr. and R.K. Selander. 1980. Clonal niche structure in the parthenogenetic earthworm *Octolasion tyrtaeum*. Amer. Nat. 116: 196-205.

Linnaeus, C. 1758. Systema naturae per regna tris naturae, secundum classes, ordines, genera, species cum characteribus, differentiis, synonymis, locis, Edition decima, reformata. Tom I. Laurentii Salvii, Holmiae, 824 pp. [*Lumbricus terrestris* n. gen., n. sp.]

Mankowski, A., editor. 2010. Endangered and Threatened Species of Illinois: Status and Distribution, Volume 4 - 2009 and 2010 Changes to the Illinois List of Endangered and Threatened Species. Illinois Endangered Species Protection Board, Springfield, Illinois. iii + 38 pp.

Mankowski, A. 2012. The Illinois Endangered Species Protection Act at Forty: a review of the Act's provisions and the Illinois List of Endangered and Threatened Species. Illinois Endangered Species Protection Board, Springfield, IL 152 pp. http://www.dnr.illinois.gov/ESPB/Pages/default.aspx.

Reynolds, J.W. 1974. Are oligochaetes really hermaphroditic amphimictic organisms? *Biologist* 56(2): 90-99.

Reynolds, J.W. 1977. The earthworms (Lumbricidae and Sparganophilidae) of Ontario. *Life Sci. Misc. Publ., Royal Ontario Museum*, Toronto, Ontario, Canada. xi + 141 pp.

Reynolds, J.W. 1980. The earthworm family Sparganophilidae (Annelida, Oligochaeta) in North America. *Megadrilogica* 3(12): 189-204.

Reynolds, J.W. 2001. Sparganophilidae — are terrestrial oligochaetologists missing the habitat in North America! *Megadrilogica* 8(11): 84-86.

Reynolds, J.W. 2008. Sparganophilidae (Annelida, Oligochaeta) distribution in North America and elsewhere, revisited. *Megadrilogica* 12(9): 125-143.

Reynolds, J.W. 2011. The earthworms (Oligochaeta: Acanthodrilidae, Glossoscolecidae, Komarekionidae, Lumbricidae, Megascolecidae, and Sparganophilidae) of the midwestern United States. *Megadrilogica* 15(5): 69-139.

Reynolds, J.W., E.E.C. Clebsch and W.M. Reynolds. 1974. The earthworms of Tennessee (Oligochaeta). I. Lumbricidae. *Bulletin of the Tall Timbers Research Station*, No. 17, *vii* + 133 pp

Reynolds, J.W., and D.G. Cook. 1976. *Nomenclatura oligochaetologica. A catalogue of names, descriptions and type specimens of the Oligochaeta.* Univ. New Brunswick, Fredericton, New Brunswick. x + 217 pp.

Reynolds, J.W., and D.G. Cook. 1981. *Nomenclatura oligochaetologica. Supplementum primum. A catalogue of names, descriptions and type specimens of the Oligochaeta*. Univ. New Brunswick, Fredericton, New Brunswick. v + 39 pp.

Reynolds, J.W., and D.G. Cook. 1989. *Nomenclatura oligochaetologica. Supplementum secundum. A catalogue of names, descriptions and type specimens of the Oligochaeta*. New Brunswick Museum Monograph. Series (Natural Science) No. 8. v + 37 pp.

Reynolds, J.W., and D.G. Cook. 1993. *Nomenclatura oligochaetologica. Supplementum tertium. A catalogue of names, descriptions and type specimens of the Oligochaeta.* New Brunswick Museum Monograph Series (Natural Science) No. 9. vi + 33 pp.

Reynolds, J.W. and M.J. Wetzel. 2004. Terrestrial Oligochaeta (Annelida: Clitellata) in North America north of Mexico. *Megadrilogica* 9(11): 71-98.

Reynolds, J.W. and M.J. Wetzel. 2008. Terrestrial Oligochaeta (Annelida: Clitellata) in North America, including Mexico, Puerto Rico, Hawaii, and Bermuda. *Megadrilogica* 12(12): 167-208.

Reynolds, J.W. and M.J. Wetzel. 2011. The earthworms (Oligochaeta: Acanthodrilidae, Glossoscolecidae, Komarekionidae, Lumbricidae, Megascolecidae, and Sparganophilidae) of Illinois, USA. *Megadrilogica* 15(4): 35-67.

Reynolds, J.W. and M.J. Wetzel. 2012. Terrestrial Oligochaeta (Annelida: Clitellata) in North America, including Mexico, Puerto Rico, Hawaii, and Bermuda. III. *Megadrilogica* 15(8): 191-211.

Reynolds, J.W., and M.J. Wetzel. 2014. A checklist by counties of earthworms (Oligochaeta: Acanthodrilidae, Lumbridicae, Megascolecidae, and Sparganophilidae) in Michigan, USA. *Megadrilogica* 17(5): 51-72.

Reynolds, J.W., and M.J. Wetzel. 2016. *Nomenclatura oligochaetologica. A catalogue of names, descriptions and type specimens of the Oligochaeta, Editio Secunda*. Available on-line: < http://wwx.inhs.illinois.edu/people/mjwetzel/nomenoligo >; accessed: 25 June 2016.

Reynolds, J.W., E.E.C. Clebsch and W.M. Reynolds. 1974. The earthworms of Tennessee (Oligochaeta). I. Lumbricidae. *Bulletin of the Tall Timbers Research Station*, No. 17, *vii* + 133 pp.

Rosa, D. 1891. Die exotischen terricolen des K.K. naturhistorischen Hofmuseums. Ann. Hofmus. Wien 6: 399-406. [*Amynthas hawayanus* n. sp.]

Savigny, J.C. 1826. Analyses des travaux de l'Académie Royale des Sciences pendant l'année 1821, partie physique. Cuvier, M. le Baron G. (ed .) Mém. Acad. Sci. Inst. France 5: 176-184. [*Allolobophora chlorotica* n. sp., *Aporrectodea rosea* n. sp., *Dendrobaena octaedra* n. sp., *Dendrodrilus rubidus* n. sp., *Eisenia foetida* n. sp., *Eiseniella tetraedra* n. sp., *Lumbricus castaneus* n. sp., *Octolasion cyaneum* n. sp., and *Octolasion* tyrtaeum n. sp.]

Smith, F. 1895. A preliminary account of two new Oligochaeta from Illinois. Bull. Illinois St. Lab. Nat. Hist. 4(5): 138-148. [*Diplocardia riparia* n. sp. and *Sparganophilus eiseni* n. sp.]

Smith, F. 1917. North American earthworms of the family Lumbricidae in the collections of the United States National Museum. Proc. United States National Museum 52(2174): 157-182.

Smith, F. and E.M. Gittins. 1915. Two new species of Lumbricidae from Illinois. Bull. Illinois St. Lab. Nat. Hist. 10(7): 545-550.

U.S. Department of the Interior, Fish and Wildlife Service (USDI-FWS). 1996. Endangered and threatened species, plant and animal taxa; proposed rule. Part III. 50 CFR Part 17. Federal Register 61(40): 7596-7613. February 28.

U.S. Department of the Interior, Fish and Wildlife Service (USDI-FWS). 1997. Endangered and threatened wildlife and plants. Federal Register, 50 CFR Part 17.11 and 17.12. October 31, 1996. 46 pp. [This document is a compilation and special reprint, current as of 31 October 1996, then printed by the U.S. Government Printing Office in 1997].

U.S. Fish and Wildlife Service (USDI-FWS). 1999. Endangered and threatened wildlife and plants; review of plant and animal taxa that are candidates or proposed for listing as endangered or threatened; annual notice of findings on recycled petitions; and annual description of progress on listing actions. Federal Register 64: 57534-57547.

Wodika, B.R., R.P. Klopf, and S.G. Baer. 2014. Colonization and recovery of invertebrate ecosystem engineers during prairie restoration. Restoration Ecology 22(4): 456-464. doi: 10.1111/rec.12084.

Appendix 1

Photographs (by site number, with name, brief description, distance/direction from the TNC Hdqrtrs building, and date, time of collection) of terrestrial, semi-terrestrial, and limicolous sites located on Nachusa Grasslands property (Lee and Ogle Counties, Illinois, USA) where surveys for earthworms were conducted by M.J. Wetzel and K.L. Moss (INHS) on 21 April 2015 and by M.J. Wetzel and J.W. Reynolds (Oligochaetology Lab, Kitchener, Ontario, Canada) on 6 and 7 October 2015.

Sampling sites are designated on the map in **Figure 1**. Complete locality information and brief habitat descriptions for these 23 sites are presented in **Table 1**.

NG2015-01. Lee County, in soil, under log pieces, at edge of tree line along W side of access road, by old fence post ("25"), 2.2 km SW (220 degrees) TNC/NG Hdqtrs; 21 April 2015, 13:10. **Above**: hand pick used to collect earthworms from most sites during this study; **below**: facing south – log pieces, and fence post ("25") at upper left.

NG2015-01. Lee County, in soil, under log pieces, at edge of tree line along W side of access road, by old fence post ("25"), 2.2 km SW (220°) TNC/NG Hdqtrs; 21 April 2015, 13:10. Above and below: M.J. Wetzel collecting earthworms.

NG2015-02. Lee County, in moist soil, in riparian area & along banks of small unnamed tributary stream to Franklin Creek, in small depression ('shelf') on S side of and immediately downstream (WNW) road culvert (corrugated ~1m dia); 2.75 km SSW TNC/NG Hdqtrs; 6 October 2015, 12:05. **Note**: This is the same site as NG2015-12, surveyed a second time on 6 October 2015.

NG2015-03. Lee County, moist soil, in depression (shallow, natural ditch), in light woods, brush, scrub, 5-10 m S access road, along N edge of wood lot, 1.8 km SW (214 degrees) TNC/NG Hdqtrs; 21 April 2015, 14:05. Photo of M.J. Wetzel, collecting earthworms from this site. **Note**: This same site was surveyed a second time on 6 October 2015, specifically to attempt collection of additional specimens of *Bimastos welchi*, a new state record first collected from this site this date. No earthworms were collected from this site on 6 October, so no data were recorded, and no additional information pertinent to that collection has been included in this report.

NG2015-04. Ogle County, in soil under detritus and from under old cut and uncut log pieces at homeowners log cutting area along W side of grassy lane to open field, just south of Stone Barn Road, 0.6 km NW (317 degrees) TNC/NG Hdqtrs barn; 21 April 2015, 15:05.

NG2015-05. Ogle County, in dry soil from under decaying log ~ 8m N Sandy Lane, in light, large wooded area, 615 m W TNC/NG Hdqtrs barn; 6 October 2015, 09:05.

NG2015-06. Ogle County, in moist soil under Osage orange log at base of large brush & log pile, along west side of N/S sandy lane, 680 m W TNC/NG Hdqtrs barn; 6 October 2015, 09:40; above below: J.W. Reynolds, collecting earthworms from soil under/adjacent to log pile.

NG2015-07. Lee County, in wet soil, mud, along north edge of ponded creek, dammed by beavers (recent activity), 17 km SW TNC/NG Hdqtrs barn; 6 October 2015, 10:05.

NG2015-08. Lee County, in soil of muddy rut and rut bank along SE edge of road, 1.3 km SW TNC/NG Hdqtrs barn, 6 October 2015, 10:31.

NG2015-09. No photographs taken at this site.

NG2015-10. Lee County, hard pack soil under light covering with wood chips, along (1.5m east of) new fence line, along east edge with wood lot/woods; 2.45 km SW TNC/NG Hdqtrs barn; 6 October 2015, 11:16. Photo with J.W. Reynolds, collected earthworms along fence line at this site.

NG2015-11. Lee County, in soil, under 2 of 3 logs, 2.7 km SSW TNC/NG Hdqtrs barn; 6 October 2015, 11:36.

NG2015-12. Lee County, in moist soil, in riparian area & along banks of small unnamed tributary stream to Franklin Creek, in small depression ('shelf') on S side of and immediately downstream (WNW) road culvert (corrugated ~1m dia); 2.75 km SSW TNC/NG Hdqtrs; 6 October 2015, 12:05. Photo of M.J. Wetzel, recording data at this site. **Note**: This is the same site as NG2015-02, first surveyed on 21 April 2015.

NG2015-13. Ogle County, in dry soil, under large boulder at rock outcropping "shelf" area, along S side of road near bison corral, 1.4 km N TNC/NG Hdqtrs barn; 6 October 2015, 13:32. Site photo with J.W. Reynolds, sitting on boulder.

NG2015-14. Ogle County, in soil, under log pieces, along tree line, 4m W of N/S road, 1.7 km NNW TNC/NG Hdqtrs barn; 6 October 2015, 13:50.

NG2015-15. Ogle County, under treated fence post pile (unused), ~50m NE long pole barn (SSE of Holland barn), in bison compound area, 1.38 km N TNC/NG hdqtrs barn; 6 October 2015, 14:20. Site photo with J.W. Reynolds, after collecting earthworms from soil under posts.

NG2015-16. Ogle County, in soil, under old logs, along north side of mowed yard of 1st residential home SE (160m) TNC/NG Hdqtrs; 6 October 2015, 15:05.

NG2015-17. Lee County, in moist soil, along E side and bank of road rut, along W edge of new fence line (posts recently set, but wire fencing not yet in place), 2.55 km SSW TNC/NG Hdqtrs barn; 7 October 2015, 09:20. Site photo with J.W. Reynolds, collecting earthworms from moist soil.

NG2015-18. Lee County, in soil, in road rut and in ditch along E side of road, wedge w/ new fence line (posts recently set, but wire fencing not yet in place), ~20m S road crossing by rivulette, 2.42 km SSW TNC/NG Hdqtrs barn; 7 October 2015, 09:38.

NG2015-19. Lee County, in soil, in depression, in grasses, shrub thicket along N side wood lot, along S side of E/W road, 1.95 km SE TNC/NG Hdqtrs; 7 October 2015, 10:05.

NG2015-20. Ogle County, in recently disturbed soil and detritus, along W side of road, in soil disturbed by recent tree and brush removal associated with new fence line (posts in place, but wire fencing not yet added), ~110m S limestone outcropping, 1.15 km WSW TNC/NG Hdqtrs barn; 7 October 2015, 11:10. Site photo with J.W. Reynolds, collecting earthworms.

NG2015-21. Ogle County, in soil and under bark of older log pieces (15" long, 15-20" diameter), 1.35 km WSW TNC/NG Hdqtrs barn; 7 October 2015, 11:30. Above: peeled back bark from log; below, broad site picture.

NG2015-22. Lee County, in soil, under old segmented log (from partial saw cuts), along W side of road, just after it turns south; 1.4 km WSW TNC/NG Hdqtrs barn; 7 October 2015, 12:01.

NG2015-23. Ogle County, in soil, under two short log pieces, on end at hose/water spigot by small shed, outhouse in driveway on south side of TNC/NG Hdqtrs barn; 7 October 2015, 13:01. Site photo with J.W. Reynolds, collecting earthworms from under and around rock in moist soil.