Some Pheretimoid Resources

**Bolded articles a must read.**

Classification and Identification of Pheretimoids

Blakemore, R.J., 2012. Japanese earthworms revisited a decade on: (Oligochaeta: Megadrilacea). *Zoology in the Middle East*, *58*(sup4), pp.15-22. <https://www.researchgate.net/profile/Robert_Blakemore/publication/263218866_Japanese_earthworms_revisited_a_decade_on_Oligochaeta_Megadrilacea/links/590b35aea6fdcc49617aad77/Japanese-earthworms-revisited-a-decade-on-Oligochaeta-Megadrilacea.pdf>

**CHANG, C.H., SNYDER, B.A. and SZLAVECZ, K., 2016. Asian pheretimoid earthworms in North America north of Mexico: An illustrated key to the genera Amynthas, Metaphire, Pithemera, and Polypheretima (Clitellata: Megascolecidae). *Zootaxa*, *4179*(3), pp.495-529.**

<https://www.uvm.edu/~entlab/Forest%20IPM/Worms/Chang_et_al_2016_Zootaxa.pdf>

Gates, E.G. and J.W. Reynolds. 2017. Preliminary Key to North American Megadriles (annelida, Oligochaeta), based on external charcteristcs, insofar as possible. Megadrilogica 22.

Distribution of Pheretimoids in the USA

Callaham Jr, M.A., Hendrix, P.F. and Phillips, R.J., 2003. Occurrence of an exotic earthworm (Amynthas agrestis) in undisturbed soils of the southern Appalachian Mountains, USA: The 7th international symposium on earthworm ecology· Cardiff· Wales· 2002. *Pedobiologia*, *47*(5-6), pp.466-470. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.417.5277&rep=rep1&type=pdf>

**Chang, C.H., Johnston, M.R., Görres, J.H., Dávalos, A., McHugh, D. and Szlavecz, K., 2017. Co-invasion of three Asian earthworms, Metaphire hilgendorfi, Amynthas agrestis and Amynthas tokioensis in the USA. *Biological Invasions*, pp.1-6.**

<https://link.springer.com/article/10.1007/s10530-017-1607-x>

**Hendrix, P.F., Callaham Jr, M.A., Drake, J.M., Huang, C.Y., James, S.W., Snyder, B.A. and Zhang, W., 2008. Pandora's box contained bait: the global problem of introduced earthworms. *Annual Review of Ecology, Evolution, and Systematics*, *39*, pp.593-613.** <http://www.jstor.org/stable/pdf/30245178.pdf?refreqid=excelsior%3A296de2ac0edce3d235de9af4a15770cb>

**Keller, R.P., Cox, A.N., Van Loon, C., Lodge, D.M., Herborg, L.M. and Rothlisberger, J., 2007. From bait shops to the forest floor: earthworm use and disposal by anglers. *The American Midland Naturalist*, *158*(2), pp.321-328.** <http://www.jstor.org/stable/pdf/4500662.pdf?refreqid=excelsior%3A7061e6b389bd6ea9d0e4dcf151f48553>

Moore, J.D., Görres, J. and Reynolds, J.W., 2017. Exotic Asian pheretimoid earthworms (Amynthas spp., Metaphire spp.): Potential for colonisation of south-eastern Canada and effects on forest ecosystems. *Environmental Reviews*. <https://www.researchgate.net/profile/Jean_David_Moore/publication/321636493_Exotic_Asian_pheretimoid_earthworms_Amynthas_spp_Metaphire_spp_Potential_for_colonisation_of_south-eastern_Canada_and_effects_on_forest_ecosystems/links/5a2ffdd9458515a13d852766/Exotic-Asian-pheretimoid-earthworms-Amynthas-spp-Metaphire-spp-Potential-for-colonisation-of-south-eastern-Canada-and-effects-on-forest-ecosystems.pdf>

Reynolds, J.W., Görres, J.H. and Knowles, M.E., 2015. A checklist by counties of earthworms (Oligochaeta: Acanthodrilidae, Lumbricidae and Megascolecidae) in the states of Maine, New Hampshire and Vermont, USA. *Megadrilogica*, *17*(9), pp.125-140.

<https://www.researchgate.net/profile/John_Reynolds16/publication/274084321_Reynolds_JW_JH_Gorres_and_ME_Knowles_2015_A_checklist_by_counties_of_earthworms_Oligochaeta_Acanthodrilidae_Lumbricidae_and_Megascolecidae_in_the_states_of_Maine_New_Hampshire_and_Vermont_USA_Megadril/links/5515e6510cf2d70ee272d3c7/Reynolds-JW-JH-Goerres-and-ME-Knowles-2015-A-checklist-by-counties-of-earthworms-Oligochaeta-Acanthodrilidae-Lumbricidae-and-Megascolecidae-in-the-states-of-Maine-New-Hampshire-and-Vermont-USA-Me.pdf>

Ecology of Pheretimoids

**Bellitürk, K., Görres, J.H., Kunkle, J. and Melnichuk, R.D.S., 2015. Can commercial mulches be reservoirs of invasive earthworms? Promotion of ligninolytic enzyme activity and survival of Amynthas agrestis (Goto and Hatai, 1899). *Applied Soil Ecology*, *87*, pp.27-31.**

Burtelow, A.E., Bohlen, P.J. and Groffman, P.M., 1998. Influence of exotic earthworm invasion on soil organic matter, microbial biomass and denitrification potential in forest soils of the northeastern United States. *Applied Soil Ecology*, *9*(1-3), pp.197-202. <https://s3.amazonaws.com/academia.edu.documents/45367909/Influence_of_exotic_earthworm_invasion_o20160505-19994-19dzicy.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1520519915&Signature=ZFzpzKeHUZvFbSZ22yaUMVVgwWY%3D&response-content-disposition=inline%3B%20filename%3DInfluence_of_exotic_earthworm_invasion_o.pdf>

Chang, C.H., Szlavecz, K. and Buyer, J.S., 2017. Amynthas agrestis invasion increases microbial biomass in Mid-Atlantic deciduous forests. *Soil Biology and Biochemistry*, *114*, pp.189-199.

Gates, G.E., 1956. Reproductive organ polymorphism in earthworms of the oriental Megascolecine genus Pheretima Kinberg 1867. *Evolution*, *10*(2), pp.213-227.

<http://www.jstor.org/stable/2405895?casa_token=HJCFd4BW3lkAAAAA:XC-aPp6N5zPr0GhhzdLPFMlMf6VzaNsHzac3cmk5v3zvlZdqwweU4Hy1LxsFMYmBtEz01eXhJOU4DUi1wmhBMOUX_kni7he-C3aGADhpXETYsCuUR-I&seq=1#page_scan_tab_contents>

Görres, J.H. and Melnichuk, R.D., 2012. Asian invasive earthworms of the genus Amynthas Kinberg in Vermont. *Northeastern Naturalist*, *19*(2), pp.313-322.

<http://www.jstor.org/stable/pdf/41684238.pdf?casa_token=Pn3eJJX4uD8AAAAA:KJHXq_NZw702ZPpYeuleZfhGYtWTzM-09zqRYdeqZNGuo2IztDvCLmAPksq-BB_yZDNH4C5tsoKgZ-EZA066m0sIHRdtuM376-MrgZBytzmvOTYKUFA>

Görres, J.H., Connolly, S.T., Chang, C.H., Carpenter, N.R., Keller, E.L., Nouri-Aiin, M. and Schall, J.J., Winter hatching in New England populations of invasive pheretimoid earthworms Amynthas agrestis and Amynthas tokioensis: a limit on population growth, or aid in peripheral expansion?. *Biological Invasions*, pp.1-5.

**Greiner, H.G., Kashian, D.R. and Tiegs, S.D., 2012. Impacts of invasive Asian (Amynthas hilgendorfi) and European (Lumbricus rubellus) earthworms in a North American temperate deciduous forest. *Biological Invasions*, *14*(10), pp.2017-2027.** <https://link.springer.com/article/10.1007/s10530-012-0208-y>

Hiller, B.J. and Barclay, J.S., 2011. Concentrations of heavy metals in American Woodcock harvested in Connecticut. *Archives of environmental contamination and toxicology*, *60*(1), pp.156-164. Not directly related to Amynthas, but compare with Richardson et al., 2015.

<https://link.springer.com/article/10.1007/s00244-010-9525-2>

**Loss, S.R. and Blair, R.B., 2011. Reduced Density and Nest Survival of Ground‐Nesting Songbirds Relative to Earthworm Invasions in Northern Hardwood Forests. *Conservation Biology*, *25*(5), pp.983-992. This is not a pheretimoid paper but these wildlife effects are likely to occur with Amynthas too.**

<http://www.jstor.org/stable/41315175?casa_token=hNF3Bf3BNdsAAAAA:MxRAuSIJHBBs3IMFn3xXYlK_caHevjrf-CdEP1eMnTN_0vO9VqhVn5Rx9zvFvRELru4FAyM8HmYrULX2OzHamVsujbo6crIpK3Ho2o8KDigqH0ZC5CE&seq=1#page_scan_tab_contents>

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Reynolds, J.W., 1974. Are oligochaetes really hermaphroditic amphimictic organisms. *Biologist*, *56*(2), pp.90-99. <https://www.researchgate.net/profile/John_Reynolds16/publication/288940049_Are_oligochaetes_really_hermaphroditic_amphimictic_organisms/links/571f6fcb08aead26e71b632f.pdf>

Richardson, D.R., Snyder, B.A. and Hendrix, P.F., 2009. Soil moisture and temperature: tolerances and optima for a non-native earthworm species, Amynthas agrestis (Oligochaeta: Opisthopora: Megascolecidae). *Southeastern Naturalist*, *8*(2), pp.325-334. <http://www.jstor.org/stable/pdf/25599323.pdf?casa_token=oP1sK1wYTPQAAAAA:C02U7eWALSG2O_ZHuxMhLPaY2nPIkVdYiFcNHIWKHbVClGOjL309LH53iHepULRt5ugFrf-KO1Q8v7OlUdOiTu9WknKFgNTXMhsoVRQFxxcwPcfU6cY>

Richardson, J.B., Görres, J.H., Jackson, B.P. and Friedland, A.J., 2015. Trace metals and metalloids in forest soils and exotic earthworms in northern New England, USA. *Soil Biology and Biochemistry*, *85*, pp.190-198.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4395857/>

**Snyder, B.A., Boots, B. and Hendrix, P.F., 2009. Competition between invasive earthworms (Amynthas corticis, Megascolecidae) and native North American millipedes (Pseudopolydesmus erasus, Polydesmidae): effects on carbon cycling and soil structure. *Soil Biology and Biochemistry*, *41*(7), pp.1442-1449.**

Snyder, B.A., Callaham Jr, M.A., Lowe, C.N. and Hendrix, P.F., 2013. Earthworm invasion in North America: food resource competition affects native millipede survival and invasive earthworm reproduction. *Soil Biology and Biochemistry*, *57*, pp.212-216. <http://krex.k-state.edu/dspace/bitstream/handle/2097/15956/SnyderSoilBioBiochem2013.pdf;sequence=1>

Snyder, B.A., Callaham, M.A. and Hendrix, P.F., 2011. Spatial variability of an invasive earthworm (Amynthas agrestis) population and potential impacts on soil characteristics and millipedes in the Great Smoky Mountains National Park, USA. *Biological Invasions*, *13*(2), pp.349-358.[**https://link.springer.com/article/10.1007/s10530-010-9826-4**](https://link.springer.com/article/10.1007/s10530-010-9826-4)

Zhang, W., Hendrix, P.F., Snyder, B.A., Molina, M., Li, J., Rao, X., Siemann, E. and Fu, S., 2010. Dietary flexibility aids Asian earthworm invasion in North American forests. *Ecology*, *91*(7), pp.2070-2079. <http://www.jstor.org/stable/25680460?casa_token=3VSkD9lsDQAAAAAA:Jeka1DaMbVkU2GG6HFMq_ptr78Mh4g_tHZoILNSU01dCf_wpGo05jpPM-0xsNwYEjDQNaAkXyOX3YLlhx5aTKZkEr7_VKu72SV6QrYXfflMYSpW_M0c&seq=1#page_scan_tab_contents>

Ziemba, J.L., Hickerson, C.A.M. and Anthony, C.D., 2016. Invasive Asian Earthworms Negatively Impact Keystone Terrestrial Salamanders. *PloS one*, *11*(5), p.e0151591. <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0151591>

Molecular Ecology

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<http://biodiversitygenomics.net/site/wp-content/uploads/2016/01/2009%20-%20Chang%20-%20Identifying%20earthworms%20through%20DNA%20barcodes.pdf>

Keller, E., J. Schall, J. Görres. 2017. Genetic Structure of Two Invasive Earthworms, Amynthas agrestis and Amynthas tokioensis (Oligochaeta, Megascolecidae) and a molecular method for species identification. Megadrilogica 22: 140-149 <https://erinlkeller.files.wordpress.com/2017/12/keller-et-al-mega-226.pdf>

Schult, N., Pittenger, K., Davalos, S. and McHugh, D., 2016. Phylogeographic analysis of invasive Asian earthworms (Amynthas) in the northeast United States. *Invertebrate Biology*, *135*(4), pp.314-327.

<http://onlinelibrary.wiley.com/doi/10.1111/ivb.12145/full>

Pheretimoid Control

Ikeda, H., Callaham Jr, M.A., O'Brien, J.J., Hornsby, B.S. and Wenk, E.S., 2015. Can the invasive earthworm, Amynthas agrestis, be controlled with prescribed fire?. *Soil Biology and Biochemistry*, *82*, pp.21-27. <https://pdfs.semanticscholar.org/ef8c/ca7ad245e22373e33dbef0c2cc84748aad43.pdf>

Colleagues in Wisconsin and my lab are working on this.

European Invasive Earthworm Resources

Adverse effects of Lumbricus terrestris in agriculture

Domínguez, J., Bohlen, P.J. and Parmelee, R.W., 2004. Earthworms increase nitrogen leaching to greater soil depths in row crop agroecosystems. *Ecosystems*, *7*(6), pp.672-685.

Joschko M, Söchtig W and Larink O. 1992. Functional relationship between earthworm burrows and soil water movement in column experiments Soil Biology and Biochemistry 24: 1545-1547.

Shipitalo MJ, Nuutinen V and Butt KR. 2004. Interaction of earthworm burrows and cracks in a clayey, subsurface-drained, soil Applied Soil Ecology 26: 209-217.

Shipitalo, M.J. and Gibbs, F., 2000. Potential of earthworm burrows to transmit injected animal wastes to tile drains. *Soil Science Society of America Journal*, *64*(6), pp.2103-2109.

Shuster, W.D., Shipitalo, M.J., Subler, S., Aref, S. and McCoy, E.L., 2003. Earthworm additions affect leachate production and nitrogen losses in typical midwestern agroecosystems. *Journal of environmental quality*, *32*(6), pp.2132-2139.

Lumbricidae in Forest Ecosystems

Bohlen PJ, Scheu S, Hale CM, et al. 2004. Non-native invasive earthworms as agents of change in northern temperate forests Frontiers in Ecology and the Environment 2: 427-435.

Hale, C., L. Frelich, P. Reich and J. Pastor, 2008: Exotic earthworm effects on hardwood forest floor, nutrient availability and native plants: a mesocosm study. Oecologia 155, 509-518.

Hale, C. M., L. E. Frelich and P. B. Reich, 2005: Exotic European Earthworm Invasion Dynamics in Northern Hardwood Forests of Minnesota, USA. Ecological Applications 15, 848-860.

Holdsworth AR, Frelich LE and Reich PB. 2007. Effects of earthworm invasion on plant species richness in northern hardwood forests. Conservation Biology 21: 997-1008.

Greenhouse Gases

Speratti, A. B. and J. K. Whalen, 2008: Carbon dioxide and nitrous oxide fluxes from soil as influenced by anecic and endogeic earthworms. Applied Soil Ecology 38, 27-33.

Compiled by …

Josef Görres, [jgorres@uvm.edu](mailto:jgorres@uvm.edu), Plant and Soil Science Department, Jeffords Hall, University of Vermont, Burlington, Vermont 05405.

Maryam Nouri-Aiin, [Maryam.Nouri-Aiin@uvm.edu](mailto:Maryam.Nouri-Aiin@uvm.edu), Plant and Soil Science Department, Jeffords Hall, University of Vermont, Burlington, Vermont 05405.

We concentrated on the literature on Asian earthworms, but included some resources on European earthworms as wel.. More on European earthworms upon request.