NEW YORK
TERRESTRIAL INVERTEBRATES INVASIVENESS RANKING FORM

Scientific name:	Amynthas spp.
Common names:	Asian Earthworms
Native distribution:	Eastern Asia
Date assessed:	7/12/13
Assessors:	J. Soto
Reviewers:	
Date Approved:	Form version date: 3 January 2013

New York Invasiveness Rank: High (Relative Maximum Score 70.00-80.00)

Distribution and Invasiveness Rank (*Obtain from PRISM invasiveness ranking form***)**			
	Status of this species in each PRISM:	Current Distribution	PRISM Invasiveness Rank
1	Adirondack Park Invasive Program	Not Assessed	Not Assessed
2	Capital/Mohawk	Not Assessed	Not Assessed
3	Catskill Regional Invasive Species Partnership	Not Assessed	Not Assessed
4	Finger Lakes	Not Assessed	Not Assessed
5	Long Island Invasive Species Management Area	Not Assessed	Not Assessed
6	Lower Hudson	Not Assessed	Not Assessed
7	Saint Lawrence/Eastern Lake Ontario	Not Assessed	Not Assessed
8	Western New York	Not Assessed	Not Assessed

Invasiveness Ranking Summary (see details under appropriate sub-section)		Total (Total Answered*) Possible	Total
1	Ecological impact	30 (30)	24
2	Biological characteristic and dispersal ability	30 (30)	17
3	Ecological amplitude and distribution	30 (30)	25
4	Difficulty of control	10 (10)	5
	Outcome score	100 (100)[b]	71[a]
	Relative maximum score †		71
	New York Invasiveness Rank §	High (Relative Maximum Score 70.00-80.00)	

* For questions answered "unknown" do not include point value in "Total Answered Points Possible." If "Total Answered Points Possible" is less than 70.00 points, then the overall invasive rank should be listed as "Unknown."
†Calculated as 100(a/b) to two decimal places.
§Very High >80.00; High 70.00−80.00; Moderate 50.00−69.99; Low 40.00−49.99; Insignificant <40.00

A. DISTRIBUTION (KNOWN/POTENTIAL): Summarized from individual PRISM forms

A1.1. Has this species been documented to persist without cultivation in NY? (reliable source; voucher not required)	
☒	Yes – continue to A1.2
☐	No – continue to A2.1; Yes ☐ NA; Yes ☐ USA
A1.2. In which PRISMs is it known (see inset map)?	
☒	Adirondack Park Invasive Program
☒	Capital/Mohawk
☒	Catskill Regional Invasive Species Partnership
☐	Finger Lakes
☒	Long Island Invasive Species Management Area
☒	Lower Hudson
☐	Saint Lawrence/Eastern Lake Ontario
☐	Western New York

Documentation:
Sources of information:

A2.0. Is this species listed on the Federal Injurious Fish and Wildlife, Noxious Weed or PPQ Action Required list?

☐ Yes – the species will automatically be listed as Prohibited, no further assessment required.
☒ No – continue to A2.1.

A2.1. What is the likelihood that this species will occur and persist given the climate in the following PRISMs? (obtain from PRISM invasiveness ranking form)

Moderately Likely	Adirondack Park Invasive Program
Moderately Likely	Capital/Mohawk
Moderately Likely	Catskill Regional Invasive Species Partnership
Moderately Likely	Finger Lakes
Moderately Likely	Long Island Invasive Species Management Area
Moderately Likely	Lower Hudson
Moderately Likely	Saint Lawrence/Eastern Lake Ontario
Moderately Likely	Western New York

Documentation:
Sources of information (e.g.: distribution models, literature, expert opinions):

If the species does not occur and is not likely to occur with any of the PRISMs, then stop here as there is no need to assess the species.

A2.2. What is the current distribution of the species in each PRISM? (obtain rank *from PRISM invasiveness ranking forms*)

	Distribution
Adirondack Park Invasive Program	Restricted
Capital/Mohawk	Common
Catskill Regional Invasive Species Partnership	Common
Finger Lakes	Not Assessed
Long Island Invasive Species Management Area	Common
Lower Hudson	Common
Saint Lawrence/Eastern Lake Ontario	Not Assessed
Western New York	Not Assessed

Documentation:
Sources of information:

A2.3. Describe the potential or known suitable habitats within New York. Natural habitats include all habitats not under active human management. Managed habitats are indicated with an asterisk.

Aquatic Habitats	Wetland Habitats	Upland Habitats
☐ Salt/brackish waters	☐ Salt/brackish marshes	☒ Cultivated*
☐ Freshwater tidal	☐ Freshwater marshes	☒ Grasslands/old fields
☐ Rivers/streams	☐ Peatlands	☒ Shrublands
☐ Natural lakes and ponds	☐ Shrub swamps	☒ Forests/woodlands
☐ Vernal pools	☐ Forested wetlands/riparian	☐ Alpine
☐ Reservoirs/impoundments*	☒ Ditches*	☒ Roadsides*
	☐ Beaches and/or coastal dunes	

Other potential or known suitable habitats within New York:

Documentation:
Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

B. INVASIVENESS RANKING

1. ECOLOGICAL IMPACT

1.1. Impact on Ecosystem Processes and System-wide Parameters (e.g., energy cycle, nutrient and mineral dynamics, light availability, or fire regime.

A.	No perceivable impact on ecosystem processes based on research studies or the absence of impact if a species is widespread and/or has been present in the northeast for > 50 years.	0
B.	Influences ecosystem processes to a minor degree	3
C.	Significant alteration of ecosystem processes	7
D.	Major, possibly irreversible, alteration or disruption of ecosystem processes	10
U.	Unknown	

Score 10

Documentation:
Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the absence of impact information)
Alteration of Carbon, Nitrogen, and Calcium cycling.
Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

1.2. Impact on Terrestrial Community Composition (species specific)

A.	No perceived impact; causes no apparent change in native populations	0
B.	Influences community composition (e.g., reduces the number of individuals in one or more native species in the community)	3
C.	Significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community)	7
D.	Causes major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community composition towards species exotic to the natural community)	10
U.	Unknown	

Score 7

Documentation:
Identify type of impact or alteration:
Significantly alters other native/non-native worm species, competes with other soil macroinvertibrates for resources.
Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

1.3. Impact on other species or species groups (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades.

A.	Negligible perceived impact – no host damage	0
B.	Minor impact – limited host damage (aesthetics or restricts commercial trade)	3
C.	Moderate impact - extensive damage – kills host in 2-5 years (prohibits commercial trade)	7
D.	Severe impact on other species or species groups – kills or predisposed host within 2 years (prohibits commercial trade)	10
U.	Unknown	

Score 7

Documentation:
Identify type of impact or alteration: (control methods and time-term required)
Shown to alter communities to the point of vegetation change.
Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

Total Possible	30
Section One Total	24

2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

2.1. Mode and rate of reproduction (population dynamic - fecundity)

A.	No reproduction (does not complete life cycle)	0
B.	Limited reproduction (minimal population expansion - able to complete only 1 life cycle)	3
C.	Moderate reproduction (mod. population expansion - able to complete 2 or 3 life cycles)	5
D.	Abundant and/or asexual reproduction (high population expansion – able to complete more than 3 lifecycles)	8
U.	Unknown (life cycle information is not available)	

Score: 8

Documentation:
Describe key reproductive characteristics:
Parthenogenesis and sexual reproduction
Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

2.2. Innate potential for long-distance dispersal (e.g. under it's own power)

A.	Does not occur (no long-distance dispersal mechanisms)	0
B.	Infrequent or inefficient long-distance dispersal (little or no flight capacity)	2
C.	Moderate capabilities for long-distance dispersal (up to 5 miles)	4
D.	High capabilities for long-distance dispersal (5 miles or greater)	6
U.	Unknown	

Score: 0

Documentation:
Identify dispersal mechanisms:
No long distance dispersal methods, populations travel ~1km per 100 years
Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

2.3. Potential to be spread by human activities (both directly and indirectly – possible mechanisms include: commercial sales, spread along highways, transport on cargo, contaminated firewood, compost, land and vegetation management equipment such as mowers and excavators, soil, etc.)

A.	Does not occur	0
B.	Low (human dispersal to new areas occurs almost exclusively by direct means and is infrequent or inefficient)	1
C.	Moderate (human dispersal to new areas occurs by direct and indirect means to a moderate extent)	2
D.	High (opportunities for human dispersal to new areas by direct and indirect means are numerous, frequent, and successful)	3
U.	Unknown	

Score: 3

Documentation:
Identify spread mechanisms:
Popular as bait, vermicomposting and spread in soils, agriculture/silviculture
Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

2.4. Potential to be spread by acts of nature (hurricanes, flooding, storms, etc.), and by other animals (mammals/birds/reptiles/insects).

A.	Does not occur	0
B.	Low (rarely occurs – 5 or more years between occurrences, requires a severe event)	1

C. Moderate (sometimes occurs – less than every 3-5 years, requires a moderate event) 2
D. High (commonly transported by nature and/or animals – may occur every 1-2 years) 3
U. Unknown

Score 2

Documentation:
Identify spread mechanisms:
Possibilty to be spread by flooding/landslide and predators.
Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

2.5. Characteristics that increase competitive advantage such as not being palatable, no primary predator, eats many hosts, has natural or chemical defenses, fills a vacant niche, has tolerance to various extremes such as pH, temperatures, etc., is a generalist, has highly evolved defense mechanisms, has behavioral adaptations, etc.

A. Possesses no characteristics that increase competitive advantage 0
B. Possesses one (1) or two (2) characteristic that increases competitive advantage 2
C. Possesses three (3) or four (4) characteristics that increase competitive advantage 4
D. Possesses five (5) or more characteristics that increase competitive advantage 8
U. Unknown

Score 2

Documentation:
Describe competitive advantages:
Eats abundant leaf litter, fills vacant niche in northern glaciated states.
Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

2.6. Other species in the genus invasive in New York or elsewhere

A. No 0
B. Yes 2
U. Unknown

Score 2

Documentation:
Species:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

Total Possible 30
Section Two Total 17

3. ECOLOGICAL AMPLITUDE AND DISTRIBUTION

3.1. Current introduced distribution in the North America **(which includes: Antigua, Barbuda, Bahamas, Barbados, Belize, Canada, Costa Rica, Cuba, Dominica, Dominican Rep., El Salvador, Granada, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, St. Kitts & Nevis, St. Lucia, St. Vincent, Grenadines, Trinidad and Tobago and the United States)**

A. Not known to be established in North America 0
B. Established as a non-native in one country in North America. 1
C. Established as a non-native in 2 or 3 countries in North America. 2
D. Established as a non-native in 4 or more countries in North America. 3

U. Unknown

Score 3

Documentation:
Identify states and provinces invaded:

Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

3.2. Current introduced distribution in the northeastern USA (CT, DE, ME, MD, MA, NH, NJ, PA, RI, VT, VI, WV) and eastern Canada (In Canada, includes Nova Scotia, Prince Edward Island, New Brunswick, and parts of Quebec and Ontario lying south of the 47th parallel of latitude.)

A. Not known from the northeastern US and adjacent Canada 0
B. Established as a non-native in one northeastern USA state and/or eastern Canadian province. 1
C. Established as a non-native in 2 or 3 northeastern USA states and/or eastern Canadian provinces. 2
D. Established as a non-native in 4 or more northeastern USA states and/or eastern Canadian provinces, and/or categorized as a problem species (e.g., "Invasive") in 1 northeastern state or eastern Canadian province. 4
U. Unknown

Score 4

Documentation:
Identify states and provinces invaded:
NY, VT, CT, Quebec, Ontario
Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

3.3. Current introduced distribution of the species in natural areas in the eight New York State PRISMs (Partnerships for Regional Invasive Species Management)

A. Established in none of the PRISMs 0
B. Established in 1 PRISM 1
C. Established in 2 or 3 PRISMs 3
D. Established in 4 or more PRISMs 5
U. Unknown

Score 5

Documentation:
Describe distribution:

Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

3.4. Distance to known occurrences in the northeastern USA and eastern Canada.

A. No population known to be established 0
B. Established population in nonadjacent states/provinces 3
C. Established population in adjacent states/provinces 5
U. Unknown

Score 5

Documentation:

Identify reason for selection, or evidence

Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

3.5. Number of habitats the species may invade

A.	Not known to invade any natural habitats given at A2.3	0
B.	Known to occur in 2 or 3 of the habitats given at A2.3, with at least 1/ 2 a natural habitat.	2
C.	Known to occur in 4 or more of the habitats given at A2.3, with at least 3 a natural habitat.	4
U.	Unknown	

Score 4

Documentation:
Identify type of habitats where it occurs and degree/type of impacts:

Sources of information:

3.6. Role of human and natural disturbance in establishment

A.	Requires human disturbances to establish.	0
B.	May occasionally establish in undisturbed areas but can readily establish in areas with natural or human disturbances.	1
C.	Can establish independent of any known human or natural disturbances.	3
U.	Unknown	

Score 1

Documentation:
Describe distribution:

Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

3.7. Climate in native range (e.g., similar latitudinal range)

A.	Native range does not include climates similar to New York	0
B.	Native range possibly includes climates similar to portions of New York.	3
C.	Native range includes climates similar to those in New York	6
U.	Unknown	

Score 3

Documentation:
Describe what part of the native range is similar in climate to New York:

Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

Total Possible 30
Section Three Total 25

4. DIFFICULTY OF CONTROL & DETECTION

4.1. Re-establishment potential

A.	No known vector for re-establishment following removal	0
B.	Re-establishment from 1 vector following removal	1
C.	Re-establishment from 2-3 vectors following removal	2
D.	Re-establishment from > 3 vectors following removal	3
U.	Unknown	

Score 1

Documentation:
Describe vegetative response:
Over wintering cocoons can survive long periods
Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

4.2. Status of monitoring protocols for species

A.	No known monitoring protocols exist	0
B.	Monitoring protocols are available from other countries or states	1
C.	Monitoring protocols appropriate to New York State are available	2
U.	Unknown	

Score 0

Documentation:
Describe vegetative response:

Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

4.3. Status of monitoring resources (e.g. tools, manpower, travel, traps, lures, ID keys, taxonomic specialists, etc.)

A.	No known monitoring resources are available	0
B.	Monitoring resources may be available	1
C.	Established resources are available including commercial and/ or research tools	2
U.	Unknown	

Score 1

Documentation:
Identify types of control methods and time-term required:

Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

4.4. Level of effort required

A.	Management is not required: e.g., species does not persist without repeated human mediated action.	0
B.	Management is relatively easy and inexpensive; invasive species can be maintained at low abundance causing little or no ecological harm. (e.g., 10 or fewer person-hours of manual effort can eradicate a local infestation in 1 year.)	1
C.	Management requires a major short-term investment, and is logistically and politically challenging; eradication is difficult, but possible. (e.g., 100 or fewer person-hours/year of manual effort, or up to 10 person-hours/ year for 2-5 years to suppress a local infestation.)	2
D.	Management requires a major investment and is logistically and politically difficult; eradication may be impossible. (e.g., more than 100 person-hours/ year of manual effort, or more than 10 person hours/year for more than 5 years to suppress a local infestation.)	3
U.	Unknown	

Score 3

Documentation:
Identify types of control methods and time-term required:
Eradication is likely impossible, management difficult for species living in soil substrate.
Sources of information:
Gorres and Melnichuk 2012, Snyder et al. 2010, Burtelow et al. 1998

Total Possible 10
Section Four Total 5

Total for 4 sections Possible 100

Total for 4 sections 71

C. STATUS OF HYBRIDS:

Hybrids (crosses between different parent species) should be assessed individually and separately from the parent species wherever taxonomically possible, since their invasiveness may differ from that of the parent species. An exception should be made if the taxonomy of the species and hybrids are uncertain, and species and hybrids can not be clearly distinguished in the field. In such cases it is not feasible to distinguish species and hybrids, and they can only be assessed as a single unit.

Some hybrids of the species known to be available:

References for species assessment:

Burtelow, A.E., P.J. Bohlen and P.M. Groffman. 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 (1998) 197-202.

Gorres, J.H. and R.D.S. Melnichuk. 2012 Asian invasisive earthworms of the genus Amynthas Kinberg in Vermont. Northeast Naturalist 19(2):313-322.

Snyder, B.A., M.A. Callaham Jr. and P.F. Hendrix. 2010. Spacial variability of an invasive earthworm population and potential impacts on soil characteristics and millipedes in the Great Smoky Mountains National Park, USA. Biol. Invasions, DOI 10.1007/s10530-010-9826-4.

Citation: The New York Terrestrial Invertebrate Invasiveness Ranking Form is an adaptation of the New York Plant Invasiveness Ranking Form. The original plant form may be cited as: Jordan, M.J., G. Moore and T.W. Weldy. 2008. Invasiveness ranking system for non-native plants of New York. Unpublished. The Nature Conservancy, Cold Spring Harbor, NY; Brooklyn Botanic Garden, Brooklyn, NY; The Nature Conservancy, Albany, NY.

Acknowledgments: The New York Terrestrial Invertebrate Invasiveness Ranking Form incorporates components and approaches used in several other systems, cited in the references below. Valuable contributions by members of the Invasive Species Council and Invasive Species Advisory Committee were incorporated in revisions of this form. Members of the Office of Invasive Species Coordination's Four-tier Team, who coordinated the effort, included representatives of the New York State Department of Environmental Conservation* (Division of Fish, Wildlife and Marine Resources, Division of Lands and Forests, Division of Water); The Nature Conservancy; New York Natural Heritage Program; New York Sea Grant; Lake Champlain Sea Grant; New York State Department of Agriculture and Markets* (Division of Plant Industry and Division of Animal Industry); Cornell University* (Department of Natural Resources and Department of Entomology); New York State Nursery and Landscape Association; New York Farm Bureau; Brooklyn Botanic Garden; Pet Industry Joint Advisory Council; Trout Unlimited; United States Department of Agriculture Animal and Plant Health Inspection Service* (Plant Protection and Quarantine and Wildlife Services); New York State Department of Transportation; State University of New York Albany and Plattsburgh; and Cary Institute of Ecosystem Studies. Those organizations listed with an asterisk comprised the Terrestrial Invertebrate Working Group.

References for ranking form:

The Analytic Hierarchy Process Prioritization Pest List for 2009. 2009. New York State Department of Agriculture, Division of Plant Industry.

Guidelines for the Import of Live Terrestrial Invertebrates. 2004. Commonwealth of Australia, Department of the Environment, Water, Heritage and the Arts.

Guidelines for Pathway-Initiated Pest Risk Assessment. 2000. United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Permits and Risk Assessment, Commodity Risk Analysis Branch, 4700 River Road, Unit 133, Riverdale, MD 20737-1236.

Jordan, M.J., G. Moore and T.W. Weldy. 2008. Invasiveness Ranking System for Non-native Plants of New York. Unpublished. The Nature Conservancy, Cold Spring Harbor, NY; Brooklyn Botanic Garden, Brooklyn, NY; The Nature Conservancy, Albany, New York.

Natural Resources Board Order No. IS-34-06, Invasive Species Identification, Classification and Control. 2008. Wisconsin Department of Natural Resources, Madison, Wisconsin.

List of Specimens taken to be Suitable for Live Import. 1999. Environment Protection and Biodiversity Conservation Act 1999.