NEW YORK
FISH & AQUATIC INVERTEBRATE INVASIVENESS RANKING FORM

Scientific name:	Didemnum vexillum (Didemnum sp.), Didemnum sp. A. Published species identity depends on location: D. carnulentum (U.S. west coast), D. lutarium or D. vestum (New England), D. lahillei or D. helgolandicum (France and the Netherlands), D. vexillum (New Zealand), D. pardum or D. moseleyi (Japan) (Locke and Carman 2009).
Common names:	Sea Squirt, Ascidian, Colonial Tunicate, Compound Sea Squirt, Carpet Sea Squirt
Native distribution:	Japan (Locke and Carman 2009). Additional species of Didemnum have native ranges that include Africa, Asia, Australasia-Pacific, Europe, and North America and South America. Also documented as "unknown" in origin (Daley and Scavia 2008).
Date assessed:	3/4/2013
Assessors:	E. Schwartzberg
Reviewers:	
Date Approved:	Form version date: 3 January 2013

New York Invasiveness Rank: Moderate (Relative Maximum Score 50.00-69.99)

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 (20)	17
2	Biological characteristic and dispersal ability	30 (30)	18
3	Ecological amplitude and distribution	30 (30)	21
4	Difficulty of control	10 (10)	6
	Outcome score	100 (90)[b]	62[a]
	Relative maximum score †		68.89
	New York Invasiveness Rank §	Moderate (Relative Maximum Score 50.00-69.99)	

* 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 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:
Bullard et al 2007.

A2.0. Is this species listed on the Federal Injurious Fish and Wildlife 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 and/ or Climatch score)

Not Assessed	Adirondack Park Invasive Program
Not Assessed	Capital/Mohawk
Not Assessed	Catskill Regional Invasive Species Partnership
Not Assessed	Finger Lakes
Not Assessed	Long Island Invasive Species Management Area
Not Assessed	Lower Hudson
Not Assessed	Saint Lawrence/Eastern Lake Ontario
Not Assessed	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 survive and reproduce within 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	Not Assessed
Capital/Mohawk	Not Assessed
Catskill Regional Invasive Species Partnership	Not Assessed
Finger Lakes	Not Assessed
Long Island Invasive Species Management Area	Not Assessed
Lower Hudson	Not Assessed
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
☒ Marine	☐ Salt/brackish marshes	☐ Cultivated*
☐ Salt/ brackish waters	☐ Freshwater marshes	☐ Grasslands/old fields
☐ Freshwater tidal	☐ Peatlands	☐ Shrublands

☐ Rivers/streams	☐ Shrub swamps	☐ Forests/woodlands
☐ Natural lakes and ponds	☐ Forested wetlands/riparian	☐ Alpine
☐ Vernal pools	☐ Ditches*	☐ Roadsides*
☐ Reservoirs/ impoundments*	☐ Beaches/or coastal dunes	☐ Cultural*

Other potential or known suitable habitats within New York:
Bays, harbors and coastal waters at salinities above 26 ppt. Off shore in the lower intertidal zone (Bullard et al 2007).

Documentation:
Sources of information:
Bullard et al 2007, GISD 2013.

B. INVASIVENESS RANKING

1. ECOLOGICAL IMPACT

1.1. Impact on Ecosystem Processes and System-wide Parameters (e.g., water cycle, energy cycle, nutrient and mineral dynamics, light availability, or geomorphological changes (erosion and sedimentation rates).

A.	No perceivable impact on ecosystem processes based on research studies, or the absence of impact information if a species is widespread (>10 occurrences in minimally managed areas), has been well-studied (>10 reports/publications), and has been present in the northeast for >100 years.	0
B.	Influences ecosystem processes to a minor degree, has a perceivable but mild influence	3
C.	Significant alteration of ecosystem processes	7
D.	Major, possibly irreversible, alteration or disruption of ecosystem processes	10
U.	Unknown	

Score: U

Documentation:
Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the absence of impact information)
Very little informaiton available.
Sources of information:

1.2. Impact on Natural Habitat/ Community Composition

A.	No perceived impact; causes no apparent change in native populations	0
B.	Influences community composition (e.g., reduces the number of individuals of 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: 10

Documentation:
Identify type of impact or alteration:
Blankets seafloor, smothering bivalves and decreases seafloor structual complexity (Bullard et at 2007). Also known to overgrow tunicates, sponges, macroalgae, hydroids, anemones, bryozoans, scallops, mussels, oysters, seaweeds, limpets, barnacles, and other species of sea squirts (GISD 2013).
Sources of information:
Bullard et at 2007, Dijkstra 2007, GISD 2013.

1.3. Impact on other species or species groups, including cumulative impact of this

species on other organisms in the community it invades. (e.g., interferes with native predator/ prey dynamics; injurious components/ spines; reduction in spawning; hybridizes with a native species; hosts a non-native disease which impacts a native species)

A.	Negligible perceived impact	0
B.	Minor impact (e.g. impacts 1 species, <20% population decline, limited host damage)	3
C.	Moderate impact (e.g. impacts 2-3 species and/ or 20-29% population decline of any 1 species, kills host in 2-5 years, ,)	7
D.	Severe impact on other species or species groups (e.g. impacts >3 species and/ or ≥30% population decline of any 1 species, kills host within 2 years, extirpation)	10
U.	Unknown	

Score: 7

Documentation:
Identify type of impact or alteration:
While only minor impacts on native species abundance and composition have been reorted (Valentine et al 2007, Mercer 2009), due to its shared ecological traits with other invasive species (Daley and Scavia 2008) and reletively little resaerch done, it is of high concern ecologically. Described as an aggressive competitor for space (Harris and Dijkstra 2007).
Sources of information:
Harris and Dijkstra 2007, Osman 2007, Valentine et al 2007, Daley and Scavia 2008, Mercer 2009.

Total Possible: 20
Section One Total: 17

2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

2.1. Mode and rate of reproduction (provisional thresholds, more investigation needed)

A.	No reproduction (e.g. sterile with no sexual or asexual reproduction).	0
B.	Limited reproduction (e.g., intrinsic rate of increase <10%, low fecundity, complete one life cycle)	1
C.	Moderate reproduction (e.g., intrinsic rate of increase between 10-30%, moderate fecundity, complete 2-3 life cycles)	2
D.	Abundant reproduction (e.g., intrinsic rate of increase >30%, parthenogenesis, large egg masses, complete > 3 life cycles)	4
U.	Unknown	

Score: 2

Documentation:
Describe key reproductive characteristics:
Sexual reproduction, and broods its larvae. can form new colonies asexually by fragmentation.
Sources of information:
Ballard et al 2007.

2.2. Migratory behavior

A.	Always migratory in its native range	0
B.	Non-migratory or facultative migrant in its native range	2
U.	Unknown	

Score: 2

Documentation:
Describe migratory behavior:

Sources of information:

2.3. Biological potential for colonization by long-distance dispersal/ movement (e.g., veligers, resting stage eggs, glochidia)

A.	No long-distance dispersal/ movement mechanisms	0
B.	Adaptations exist for long-distance dispersal, but studies report that most individuals (90%) establish territories within 5 miles of natal origin or within a distance twice the home range of the typical individual, and tend not to cross major barriers such as dams and watershed divides	1
C.	Adaptations exist for long-distance dispersal, movement and evidence that offspring often disperse greater than 5 miles of natal origin or greater than twice the home range of typical individual and will cross major barriers such as dams and watershed divides	2
U.	Unknown	

Score: 0

Documentation:
Identify dispersal mechanisms:

Sources of information:

2.4. Practical potential to be spread by human activities, both directly and indirectly – possible vectors include: commercial bait sales, deliberate illegal stocking, aquaria releases, boat trailers, canals, ballast water exchange, live food trade, rehabilitation, pest control industry, aquaculture escapes, 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)	4
U.	Unknown	

Score: 4

Documentation:
Identify dispersal mechanisms:
Ability to regenerate mats from fragments resulting from scallop dredging is likely to cause increased dispersal at the local scale (Bullard et al 2007). Spread via attachment to boat hulls (GISD 2013, USDA 2013), as well as potentially from shellfish stock or aquaculture equipment (GISD 2013).
Sources of information:
Bullard et al 2007, GISD 2013, USDA 2013.

2.5. Non-living chemical and physical characteristics that increase competitive advantage (e.g., tolerance to various extremes, pH, DO, temperature, desiccation, fill vacant niche, charismatic species)

A.	Possesses no characteristics that increase competitive advantage	0
B.	Possesses one characteristic that increases competitive advantage	4
C.	Possesses two or more characteristics that increase competitive advantage	8
U.	Unknown	

Score: 4

Documentation:
Evidence of competitive ability:
Didemnum sp. possess chemicl defenses including lowered surface pH, see (Bullard et al 2007) and references within.

Sources of information:

2.6. Biological characteristics that increase competitive advantage (e.g., high fecundity, generalist/ broad niche space, highly evolved defense mechanisms, behavioral adaptations, piscivorous, etc.)

A.	Possesses no characteristics that increase competitive advantage	0
B.	Possesses one characteristic that increases competitive advantage	4
C.	Possesses two or more characteristics that increase competitive advantage	8
U.	Unknown	
	Score	4

Documentation:
Evidence of competitive ability:
Didemnum sp. are often strong spatial competitors and rapid colonizers, see (Bullard et al 2007) and references within.

Sources of information:
Bulard et al 2007.

2.7. Other species in the family and/ or genus invasive in New York or elsewhere?

A.	No	0
B.	Yes	2
U.	Unknown	
	Score	2

Documentation:
Identify species:
Many Didemnum sp. (see Kott 2004).

Total Possible	30
Section Two Total	18

3. ECOLOGICAL AMPLITUDE AND DISTRIBUTION

3.1. Current introduced distribution in the northern latitudes of USA and southern latitude of Canada (e.g., between 35 and 55 degrees).

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

Documentation:
Identify states and provinces:
ME, NH, MA, RI, CT, and NY, Specifically, from Eastport, Maine to Shinnecock Bay, New York. On west coast, present in CA, WA, and British Columbia, Canada.
Sources of information:

- See known introduced range at www.usda.gov, and update with information from states and Canadian provinces.

Bullard et al 2007.

3.2. 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 1

Documentation:
Describe distribution:
Long Island.
Sources of information:
Daley and Scavia 2008.

3.3. Number of known, or potential (each individual possessed by a vendor or consumer), individual releases and/ or release events

A.	None	0
B.	Few releases (e.g., <10 annually).	2
C.	Regular, small scale releases (e.g., 10-99 annually).	4
D.	Multiple, large scale (e.g., ≥100 annually).	6
U.	Unknown	

Score 2

Documentation:
Describe known or potential releases:
Likely introduced via shipping on boat hulls (USDA 2013).
Sources of information:
USDA 2013.

3.4. Current introduced population density, or distance to known occurrence, in northern USA and/ or southern Canada.

A.	No known populations established.	0
B.	Low to moderate population density (e.g., ≤1/4 to < 1/2 native population density) with few other invasives present and/ or documented in 1 or more non-adjacent state/ province and/ or 1 unconnected waterbody.	1
C.	High or irruptive population density (e.g., ≥1/2 native population density) with numerous other invasives present and/ or documented in 1 or more adjacent state/ province and/ or 1 connected waterbody.	2
U.	Unknown	

Score 2

Documentation:
Describe population density:
Rapidly growing populations in multiple adjacent states ranging from Eastport, Maine to Shinnecock Bay, New York (Bullard et al. 2007), however populations are disjunct (Daley and Scavia 2008).
Sources of information:
Bullard et al 2007, Daley and Scavia 2008.

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 or 2 natural habitat(s).	2

C.	Known to occur in 4 or more of the habitats given at A2.3, with at least 3 natural habitats.	3
U.	Unknown.	

Score: 2

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

Sources of information:

3.6. Role of anthropogenic (human related) and natural disturbance in establishment (e.g. water level management, man-made structures, high vehicle traffic, major storm events, etc).

A.	Requires anthropogenic disturbances to establish.	0
B.	May occasionally establish in undisturbed areas but can readily establish in areas with natural or anthropogenic disturbances.	2
C.	Can establish independent of any known natural or anthropogenic disturbances.	3
U.	Unknown.	

Score: 3

Documentation:
Identify type of disturbance:
Physical disturbances mentioned as a possible reason for establishment at Georges Bank, hoever this is not a requirement for establishment (Daley and Scavia 2008).

Sources of information:
Daley and Scavia 2008.

3.7. Climate in native range (e.g., med. to high, ≥5, Climatch score; within 35 to 55 degree latitude; etc.)

A.	Native range does not include climates similar to New York (e.g., <10%).	0
B.	Native range possibly includes climates similar to portions of New York (e.g., 10-29%).	4
C.	Native range includes climates similar to those in New York (e.g., ≥30%).	8
U.	Unknown.	

Score: 8

Documentation:
Describe known climate similarities:
Near-shore water temperatures suitable along northeastern US shore (Daley and Scavia 2008).
Sources of information:
Daley and Scavia 2008.

Total Possible: 30
Section Three Total: 21

4. DIFFICULTY OF CONTROL

4.1. Re-establishment potential, nearby propagule source, known vectors of re-introduction (e.g. biological supplies, pets, aquaria, aquaculture facilities, connecting waters/ corridors, mechanized transportation, live wells, etc.)

A.	No known vectors/ propagule source for re-establishment following removal.	0
B.	Possible re-establishment from 1 vector/ propagule source following removal and/ or viable <24 hours.	1
C.	Likely to re-establish from 2-3 vectors/ propagule sources following removal and/ or viable 2-7 days.	2

D.	Strong potential for re-establishment from 4 or more vectors/ propagule sources following removal and/or viable >7 days.	3
U.	Unknown.	

Score 3

Documentation:
Identify source/ vectors:
Spread via attachment to boat hulls (GISD 2013, USDA 2013), as well as potentially from shellfish stock or aquaculture equipment (GISD 2013) and are viable for 12-24 hours out of water (Daley and Scavia 2008). Can be spread locally from regenerating mats as a result of fragments caused by dredging (Bullard 2007).
Sources of information:
Bullard 2007, Daley and Scavia 2008, Denny 2008, USDA 2013.

4.2. Status of monitoring and/ or management protocols for species

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

Score 0

Documentation:
Describe protocols:
Monitoring and managment protocols have been developed that are appropriate to NY.
Sources of information:
Auker and Oviatt 2008, Denny 2008.

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

A.	Established resources are available including commercial and/ or research tools	0
B.	Monitoring resources may be available (e.g. partnerships, NGOs, etc)	1
C.	No known monitoring resources are available	2
U.	Unknown	

Score 0

Documentation:
Describe resources:
Management resources available (Denny 2008). Genetic tools for identificaiton available (Lengyel et al 2009).
Sources of information:
Denny 2008, Lengyel et al 2009.

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 required:
Management efforts iin Australia, including matting, were unsuccessful and costly (GISD 2013).
Sources of information:
GISD 2013.

Total Possible	10
Section Four Total	6
Total for 4 sections Possible	90
Total for 4 sections	62

C. STATUS OF GENETIC VARIANTS AND HYBRIDS:

At the present time there is no protocol or criteria for assessing the invasiveness of genetic variants independent of the species to which they belong. Such a protocol is needed, and individuals with the appropriate expertise should address this issue in the future. Such a protocol will likely require data on cultivar fertility and identification in both experimental and natural settings.

Genetic variants of the species known to exist: Didemnum sp. A

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.

Hybrids of uncertain origin known to exist:

References for species assessment:

Auker, L. A., & Oviatt, C. A. (2008). Factors influencing the recruitment and abundance of Didemnum in Narragansett Bay, Rhode Island. ICES Journal of Marine Science: Journal du Conseil, 65(5), 765-769.

Bullard, S. G., Lambert, G., Carman, M. R., Byrnes, J., Whitlatch, R. B., Ruiz, G., ... & Heinonen, K. (2007). The colonial ascidian Didemnum sp. A: Current distribution, basic biology and potential threat to marine communities of the northeast and west coasts of North America. Journal of Experimental Marine Biology and Ecology, 342(1), 99-108.

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Daley, B. A., & Scavia, D. (2008). An integrated assessment of the continued spread and potential impacts of the colonial ascidian, Didemnum sp. A, in US waters.

Denny, C. M. (2008). Development of a method to reduce the spread of the ascidian Didemnum vexillum with aquaculture transfers. ICES Journal of Marine Science: Journal du Conseil, 65(5), 805-810.

Dijkstra, J., Sherman, H., Harris, L. G., Whitlatch, R. B., & Bullard, S. G. (2007). The role of colonial ascidians in altering biodiversity in marine fouling communities. In Proceedings of the 1st International Invasive Sea Squirt Conference, Woods Hole, Massachusetts, USA, April 21-22, 2005. (Vol. 342, No. 1, pp. 169-171). Elsevier.

Global Invasive Species Database (GISD). 2013. Didemnum spp. (tunicate). <http://www.issg.org/database/species/ecology.asp?si=946>; [Accessed on March 7, 2013].

Harris, L. G., & Dijkstra, J. A. (2007). Seasonal appearance and monitoring of invasive species in the Great Bay estuarine system. Report to New Hampshire Estuaries Project, US Environmental Protection Agency National Estuaries Program.

Kott, P. (2004). A new species of Didemnum (Ascidiacea, Tunicata) from the Atlantic coast of North America. Zootaxa, 732, 1-10.

Lengyel, N. L., Collie, J. S., & Valentine, P. C. (2009). The invasive colonial ascidian Didemnum vexillum on Georges Bank–Ecological effects and genetic identification. Aquatic Invasions, 4(1), 143-152.

Locke, A., & Carman, M. (2009). Adventures of a sea squirt sleuth: unraveling the identity of Didemnum vexillum, a global ascidian invader. Aquatic Invasions, 4(1), 5-28.

Mercer, J. M., Whitlatch, R. B., & Osman, R. W. (2009). Potential effects of the invasive colonial ascidian (Didemnum vexillum Kott, 2002) on pebble-cobble bottom habitats in Long Island Sound, USA. Aquatic Invasions, 4(1), 133-142.

Osman, R. W., & Whitlatch, R. B. (2007). Variation in the ability of Didemnum sp. to invade established communities. Journal of Experimental Marine Biology and Ecology, 342(1), 40-53.

United States Department of Agriculture (USDA). 2013. Species profile: Sea Squirt. National Agricultural Library. <http://www.invasivespeciesinfo.gov/aquatics/seasquirt.shtml#.UTUJsXw_-nM>; [Accessed on March 4, 2013].

Valentine, P. C., Collie, J. S., Reid, R. N., Asch, R. G., Guida, V. G., Blackwood, D. S., ... & Bullard, S. G. (2007). The occurrence of the colonial ascidian Didemnum sp. on Georges Bank gravel habitat-ecological observations and potential effects on groundfish and scallop fisheries. InProceedings of the 1st International Invasive Sea Squirt Conference, Woods Hole, Massachusetts, USA, April 21-22, 2005. (Vol. 342, No. 1, pp. 179-181). Elsevier.

Citation: The New York Fish & Aquatic 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 Fish and Aquatic 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 at Albany and Plattsburgh*; and Cary Institute of Ecosystem Studies. Those organizations listed with an asterisk comprised the Fish and Aquatic Invertebrate Working Group.

References for ranking form:

Bomford, M. 2008. Risk Assessment Models for Establishment of Exotic Vertebrates in Australia and New Zealand. Invasive Animals Cooperative Research Centre, Canberra.

Broken Screens: The Regulation of Live Animal Imports in the United States. 2007. Defenders of Wildlife, Washington, DC.

Copp, G. H., R. Garthwaite and R. E. Gozlan. 2005. Risk Identification and Assessment of Non-native Freshwater Fishes: Concepts and Perspectives on Protocols for the UK. Sci. Ser. Tech Rep., Cefas Lowestoft, 129: 32pp.

Cooperative Prevention of Invasive Wildlife Introduction in Florida. 2008. The Environmental Law Institute, Washington, DC.

Generic Nonindigenous Aquatic Organisms Risk Analysis Review Process. 1996. Risk Assessment and Management Committee, Aquatic Nuisance Species Task Force.

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Molnar, J., R. Gamboa, C. Revenga, and M. Spalding. 2008 Assessing the Global Threat of Invasive Species to Marine Biodiversity. Front. Ecol. Environ.

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

Preventing Biological Invasions: Best Practices in Pre-Import Risk Screening for Species of Live Animals in International Trade. 2008. Convention of Biological Diversity, Global Invasive Species Programme and Invasive Species Specialist Group of IUCN's Species Survival Commission. University of Notre Dame, Indiana.

Standard Methodology to Assess the Risks From Non-native Species Considered Possible Problems to the Environment. 2005. DEFRA.

Trinational Risk Assessment Guidelines for Aquatic Alien Invasive Species. 2009. Commission for Environmental Cooperation. Montreal, Canada.

Witmer, G., W. Pitt and K. Fagerstone. 2007. Managing Vertebrate Invasive Species. USDA National Wildlife Research Center Symposia, Fort Collins, Colorado.