NEW YORK
FISH & AQUATIC INVERTEBRATE INVASIVENESS RANKING FORM

Scientific name:	Corbicula fluminea
Common names:	Asian Clam, Golden Clam, Good Luck Clam
Native distribution:	*C. fluminea* is native to southeastern China, Korea, southeastern Russia, and the Ussuri Basin (ISSG 2013)
Date assessed:	1/26/2013, 1/30/2013
Assessors:	E. White
Reviewers:	
Date Approved:	Form version date: 3 January 2013

New York Invasiveness Rank: High 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 (10)	7
2	Biological characteristic and dispersal ability	30 (30)	20
3	Ecological amplitude and distribution	30 (26)	20
4	Difficulty of control	10 (10)	7
	Outcome score	100 (76)[b]	56[a]
	Relative maximum score †		73.68
	New York Invasiveness Rank §	HighHigh (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 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:

(The Nature Conservancy 2013, U.S. Geological Survey 2013)

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)

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

Documentation:
Sources of information:
(Robinson and Wellborn 1988, Invasive Species Specialist Group (ISSG) 2013, U.S. Geological Survey 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 7

Documentation:
Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the absence of impact information)
C. fluminea affect water quality negatively during mass mortality events and excretion causes growth of nuisance algae and macrophytes (Menninger n.d., Phelps 1994). Phelps (1994) suggested that *C. fluminea* triggered system-level changes in biota of one system.
Sources of information:
(Menninger n.d., Phelps 1994)

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 U

Documentation:
Identify type of impact or alteration:
This species is known to deplete phytophlankton and sediment particles that are important food sources for native species, impact water quality negatively during mass die-offs, and ingest large numbers of native bivalve larvae and juveniles, but these roles in affecting native bivalves is unresolved (Strayer 1999). Strayer (1999) suggests that there is good evidence that *Corbicula* can have strong effects on other bivalves, but it is not clear which mechanisms in these interactions causes these effects and studies are needed on the density and recruitment of native bivalves before and after *Corbicula* invasion before this can be determined. Menninger (n.d.) indicates that the spent shells of *C. fluminea* can promote the growth of zebra mussels, which prefer a hard substrate. The degree of impact is uncertain and appears to vary from B to C depending on the site.
Sources of information:
(Menninger n.d., Strayer 1999)

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 U

Documentation:
Identify type of impact or alteration:
This species is known to deplete phytophlankton and sediment particles that are important food sources for native species, impact water quality negatively during mass die-offs, and ingest large numbers of native bivalve larvae and juveniles, but these roles in affecting native bivalves is unresolved (Strayer 1999). Strayer (1999) suggests that there is good evidence that *Corbicula* can have strong effects on other bivalves, but it is not clear which mechanisms in these interactions causes these effects and studies are needed on the density and recruitment of native bivalves before and after *Corbicula* invasion before this can be determined. Menninger (n.d.) indicates that the spent shells of *C. fluminea* can promote the growth of zebra mussels, which prefer a hard substrate. The degree of impact is uncertain and appears to vary from B to C depending on the site. It certainly has an impact on phytoplankton and sediment particles.
Sources of information:
(Menninger n.d., Strayer 1999)

Total Possible 10
Section One Total 7

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 4

Documentation:
Describe key reproductive characteristics:
Corbicula fluminea has high fecundity and they can reproduce 2 times per year, with a single individual capable of starting a new population (Menninger n.d.).
Sources of information:
(Menninger n.d., Invasive Species Specialist Group (ISSG) 2013)

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:
No migratory behavior noted in the literature.
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 2

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

U. Unknown

Score 2

Documentation:
Identify dispersal mechanisms:
Water currents spread juveniles throughout a water body (ISSG 2013).
Sources of information:
(Invasive Species Specialist Group (ISSG) 2013)

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: A number of vectors are described as means of *C. fluminea* spread: attachment to boats, carried in ballast water of ships, use as fishing bait, release from aquarium trade (ISSG 2013).
Sources of information:
(Invasive Species Specialist Group (ISSG) 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: *C. fluminea* are known to be less tolerant to oxygen and temperature extremes than native mussels and prone to mass die-offs (Menninger n.d.); however, they do have some salinity tolerance (up to 13 ppt for short periods), unlike many native freshwater mussels (ISSG 2013).
Sources of information:
(Menninger n.d., Invasive Species Specialist Group (ISSG) 2013)

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: *C. fluminea* is hermaphroditic and does not need to rely on host fish for reproduction; they have high fecundity (Menninger n.d., ISSG 2013). Whether they negatively impact native populations of mussels is yet to be determined and more studies on competition with native mussels are needed (Strayer 1999).
Sources of information:

(Menninger n.d., Strayer 1999, Invasive Species Specialist Group (ISSG) 2013)

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 0

Documentation: No
Identify species:

Total Possible 30
Section Two Total 20

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: AL, AZ, AR, CA, CO, CT, DE, DC, FL, GA, FL, ID, IL, IN, IA, KY, KS, LO, MI, MI, MO, MS, NE, NV, NJ, NM, NY, OH NC, OK, OR, PA, RI, SC, TN, UT, WI, TX, VA, WA, WV, WY, Puerto Rico and Hawaii
LO, FL, TX may be south of 35 latitude.
Sources of information:

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

(U.S. Geological Survey 2013)

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 5

Documentation:
Describe distribution:
This species has been documented in at least one location in all NYS PRISMs.
Sources of information:
(The Nature Conservancy 2013, U.S. Geological Survey 2013)

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 U

Documentation:
Describe known or potential releases:
I did not find specific reference to the number of release events, but this is probably either C or D due to the multiple vectors of introduction possible.
Sources of information:

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:
Populations have been described as dense and they are present in 38 adjacent states.
Sources of information:
(Invasive Species Specialist Group (ISSG) 2013, U.S. Geological Survey 2013)

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:
It is known from lakes/ponds and streams as well as brackish habitats throughout its non-native range.
Sources of information:
(Robinson and Wellborn 1988, Invasive Species Specialist Group (ISSG) 2013, U.S. Geological Survey)

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 2

Documentation:
Identify type of disturbance:
It is known to establish in disturbed habitats, but is not limited to these habitats.
Sources of information:
(Robinson and Wellborn 1988, Invasive Species Specialist Group (ISSG) 2013, U.S. Geological Survey)

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:
62% of NY stations are >5 in Climatch
Sources of information:
(Austrailian Department of Agriculture, Fisheries, and Forestry (ADAFF) 2013)

Total Possible 24
Section Three Total 22

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: A number of vectors are described as means of *C. fluminea* spread: attachment to boats, carried in ballast water of ships, use as fishing bait, release from aquarium trade (ISSG 2013). Also, larvae can travel for distances in the water column.
Sources of information:
(Invasive Species Specialist Group (ISSG) 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 1

Documentation:
Describe protocols: Management resources are available for CT and Lake Tahoe, as well as a decision support tool kit for aquatic invasives (ISSG and Wittmena et al. 2008).
Sources of information:
(Wittmann *et al.* 2008, Invasive Species Specialist Group (ISSG) 2013)

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 are available for CT and Lake Tahoe, as well as a decision support tool kit for aquatic invasives (Wittmann et al. 2008, ISSG 2013).
Sources of information:
(Wittmann *et al.* 2008, Invasive Species Specialist Group (ISSG) 2013)

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:
Eridication is unlikely and containment and prevention of spread is the emphasis in control methods (Menninger n. d.). *Corbicula fluminea* populations have been also controlled by a variety of mechanical and chemical methods, while people are moving away from chemical control methods (ISSG 2013). Fish predation can prevent them from establishing in high densities (Robinson and Wellborn 1988).
Sources of information:
(Menninger n.d., Robinson and Wellborn 1988, Invasive Species Specialist Group (ISSG) 2013)

Total Possible	10
Section Four Total	7
Total for 4 sections Possible	74
Total for 4 sections	56

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:

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:

Austrailian Department of Agriculture, Fisheries, and Forestry (ADAFF). 2013. Climatch Mapping Tool [Online]. Available: http://adl.brs.gov.au:8080/Climatch/. [Accessed: 23-Jan-2013].

Invasive Species Specialist Group (ISSG). 2013. Global Invasive Species Database. [Online]. Available: http://www.issg.org/database/species/ecology.asp?si=217&fr=1&sts=sss&lang=EN. [Accessed: 11-Jan-2013].

Menninger, H. (n.d.). The Asian Clam, Corbicula Fluminea: A Brief Review of the Scientific Literature. Vital Signs. Available at: http://*vitalsignsme.org/sites*

Phelps, H. L. 1994. The Asiatic clam (Corbicula fluminea) invasion and system-level ecological change in the Potomac River estuary near Washington, DC. Estuaries and Coasts 17:614–621.

Robinson, J. V., and G. A. Wellborn. 1988. Ecological resistance to the invasion of a freshwater clam, Corbicula fluminea: fish predation effects. Oecologia 77:445–452.

Strayer, D. L. 1999. Effects of alien species on freshwater mollusks in North America. Journal of the North American Benthological Society:74–98.

The Nature Conservancy. 2013. iMapInvasives: An Online Mapping Tool for Invasive Species Locations [Online]. Available: iMapInvasives.org. [Accessed: 03-Jan-2013].

U.S. Geological Survey. 2013. Nonindigenous Aquatic Species Database. Gainesville, Florida. [Online]. Available: http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=214. [Accessed: 03-Jan-2013].

Wittmann, M., J. Reuter, G. Schladow, S. Hackley, B. Allen, S. Chandra, and A. Caires. 2008. Asian clam (Corbicula fluminea) of Lake Tahoe: Preliminary scientific findings in support of a management plan.

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.

International Conference on Marine Bioinvasions. 2007. The Massachusetts Institute of Technology, Cambridge, Massachusetts.

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.

Long Island Sound Interstate Aquatic Invasive Species Management Plan. 2007. Balcom, N. editor, New England Interstate Water Pollution Control Commission.

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.