NEW YORK
FISH & AQUATIC INVERTEBRATE INVASIVENESS RANKING FORM

Scientific name:	Neogobius melanostomus
Common names:	Round Goby
Native distribution:	Eurasia including Black Sea, Caspian Sea, and Sea of Azov and tributaries
Date assessed:	6/10/2013
Assessors:	E. Schwartzberg
Reviewers:	
Date Approved:	Form version date: 3 January 2013

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

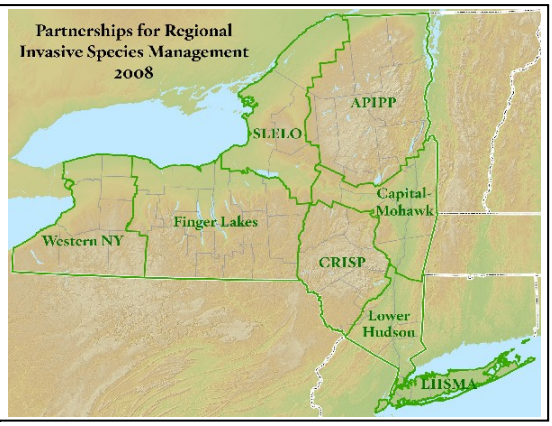
Distribution and Invasiveness Rank (*Obtain from PRISM invasiveness ranking form*)			
	Status of this species in each PRISM:	Current Distribution	PRISM Invasiveness Rank
1	Adirondack Park Invasive Program	Not Assessed	Not Assessed
2	Capital/Mohawk	Not Assessed	Not Assessed
3	Catskill Regional Invasive 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 (20)	14
2	Biological characteristic and dispersal ability	30 (30)	23
3	Ecological amplitude and distribution	30 (24)	22
4	Difficulty of control	10 (10)	7
	Outcome score	100 (84)[b]	66[a]
	Relative maximum score †		78.57
	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 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:
iMapInvasives 2013, Fuller et al. 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)

Not Assessed	Adirondack Park Invasive Program
Not Assessed	Capital/Mohawk
Not Assessed	Catskill Regional Invasive Species Partnership
Very Likely	Finger Lakes
Not Assessed	Long Island Invasive Species Management Area
Not Assessed	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):
iMapInvasives 2013.

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	Common
Long Island Invasive Species Management Area	Not Assessed
Lower Hudson	Not Assessed
Saint Lawrence/Eastern Lake Ontario	Common
Western New York	Common

Documentation:
Sources of information:
iMapInvasives 2013, Fuller et al. 2013.

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:
Salt water marshes and estuaries are a possible habitat, where condiitonss are appropriate (Kornis et al. 2012).

Documentation:
Sources of information:
Kornis et al. 2012, Fuller et al. 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 information available, however round goby are expected to influence the trophic cascade and may influence bioaccumulation of toxins to upper levels in the food chain (Kornis et al. 2012)..
Sources of information:
Kornis et al. 2012.

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: 7

Documentation:
Identify type of impact or alteration:
Round goby have been reported to compete with native fishes for nesting sites, as fish and egg predators, and as competition for food (French and Jude 2001, Kornis et al. 2012, Fuller et al. 2013 and references within). Alternatively, round goby have been associated with greater species richness as compared to streams without round goby present (Kornis et al. 2013), or no significant effect (Balshine et al. 2005), although this may be because round gobies prefere these streams (Kornis et al. 2013). Because there is evidence that they affect other species, albeit less of an affect on species richness, I have selected "C".
Sources of information:
Balshine et al. 2005, Kornis et al. 2012, Kornis et al. 2013, French and Jude 2001, Fuller et al. 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:
A recent study failed to document negative influences of round goby on native fishes, and conversely, were associated with greater species richness (Kornis et al. 2013), however round goby populations have been shown to influence recruitment in mottled sculpin populaitons (Janssen and Jude 2001), darters, perch, and molluscs (Kornis et al. 2012) in the Great Lakes. Round goby is also known to vector avian botulism (Kornis et al. 2012). Due to limited information on the influence of rond goby on populaiton decline of specific native organisms, this question has been scored "B".
Sources of information:
Janssen and Jude 2001, Kornis et al. 2012, Kornis et al. 2013.

Total Possible 20
Section One Total 14

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 reporduciton and lifespan is 3-4 years and spawn multiple times per season (Kornis et al. 2012.
Sources of information:
Kornis et al. 2012, Sapota 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:
Non-migratory.
Sources of information:
Sapota 2012.

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 1

Documentation:
Identify dispersal mechanisms:
Can migrate several kilometers in autumn and early spring, but otherwise do not disperse.
Sources of information:
Sapota 2012.1

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:
Means of introduciton is via ship ballasts, bait release, intentional introduciton (kornis et al. 2012).
Sources of information:
Kornis et al. 2012, Fuller et al. 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 8

Documentation:
Evidence of competitive ability:
High tolerance to varying salinity, temperature, and low dispolved oxygen (Kornis et al. 2012).
Sources of information:
Kornis et al. 2012.

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:
High fecundity, producing 89-3841 eggs per female, agressive (Sapota 2012).
Sources of information:
Sapota 2012.

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:
Neogobius fluviatilis invasive in Europe.

Total Possible 30
Section Two Total 23

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:
Quebec, Ontario, NY, PA, OH, MI, IN, IL, WI, MN
Sources of information:
- See known introduced range at www.usda.gov, and update with information from states and Canadian provinces.

Fuller et al. 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 3

Documentation:
Describe distribution:
SLELO, Finger Lakes, and Western New York.
Sources of information:
Fuller et al. 2013, iMapInvasives 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:

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:
Densitis can be as high as 20 per square meter (Marsden and Jude 1995) and have been reported in more than 1 adjacent state (Fuller et al. 2013) and can be the dominant species of presence (Kornis et al. 2013).
Sources of information:
Marsden and Jude 1995, Fuller et al. 2013, Kornis et al. 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 3

Documentation:
Identify type of habitats where it occurs and degree/type of impacts:
Rivers, lakes, brackish waters, watercourses, and potentially saltwater marshes.
Sources of information:
Kornis et al. 2012, Fuller et al. 2013.

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:

Sources of information:

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:
25 of 52 stations scored 5 or greater.
Sources of information:
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 2

Documentation:
Identify source/ vectors:
Vecors include ship ballasts, bait release, intentional introduciton.
Sources of information:
Kornis et al. 2012.

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 protocols have been developed.
Sources of information:
Clapp et al. 2001, Diana et al. 2006,

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 2

Documentation:
Describe resources:

Sources of information:

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:
Round goby populations are widespread and eradication would be impossible.Slowing the spread techniques are the only available control measures. Eradicaiton using rotenone has been uneffective in small areas.
Sources of information:
Kornis et al. 2012, GISD 2013.

Total Possible	10
Section Four Total	7
Total for 4 sections Possible	84
Total for 4 sections	66

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: Yes: Neogobius fluviatilis and Neogobius melanostomus (Lindner et al. 2013)

References for species assessment:

Austrailian Department of Agriculture, Fisheries, and Forestry (ADAFF). 2013. Climatch Mapping Tool. <http://adl.brs.gov.au:8080/Climatch/climatch.jsp>; [Accessd on June 10, 2013].

Balshine, S., Verma, A., Chant, V., & Theysmeyer, T. (2005). Competitive interactions between round gobies and logperch. Journal of Great Lakes Research, 31(1), 68-77.

Clapp, D. F., Schneeberger, P. J., Jude, D. J., Madison, G., & Pistis, C. (2001). Monitoring Round Goby (< i> Neogobius melanostomus</i>) Population Expansion in Eastern and Northern Lake Michigan. Journal of Great Lakes Research, 27(3), 335-341.

Diana, C. M., Jonas, J. L., Claramunt, R. M., Fitzsimons, J. D., & Marsden, J. E. (2006). A comparison of methods for sampling round goby in rocky littoral areas. North American Journal of Fisheries Management, 26(3), 514-522.

French, J.R.P, III and D.J. Jude. 2001. Diets and diet overlap of nonindigenous gobies and small benthic native fishes co-inhabiting the St. Clair River, Michigan. Journal of Great Lakes Research 27(3):300-311.

Fuller, P., A. Benson, E. Maynard, M. Neilson, J. Larson, and A. Fusaro. 2013. Neogobius melanostomus. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. <http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=713>; [Accessed on June 8, 2013].

Global Invasive Species Database (GISD) 2013. Oreochromis aureus. <http://www.issg.org/database/species/management_info.asp?si=657&fr=1&sts=&lang=EN>; [Accessed on June 10, 2013].

iMapInvasives: An Online Mapping Tool for Invasive Species Locations. 2013. <iMapInvasives.org>; [Accessd on June 7, 2013].

Janssen, J., & Jude, D. J. (2001). Recruitment Failure of Mottled Sculpin< i> Cottus bairdi</i> in Calumet Harbor, Southern Lake Michigan, Induced by the Newly Introduced Round Goby< i> Neogobius melanostomus</i>. Journal of Great Lakes Research, 27(3), 319-328.

Kornis, M. S., Mercado□Silva, N., & Vander Zanden, M. J. (2012). Twenty years of invasion: a review of round goby Neogobius melanostomus biology, spread and ecological implications. Journal of Fish Biology, 80(2), 235-285.

Kornis, M. S., Sharma, S., & Jake Vander Zanden, M. (2013). Invasion success and impact of an invasive fish, round goby, in Great Lakes tributaries.Diversity and Distributions, 19(2), 184-198.

Lindner, K., Cerwenka, A. F., Brandner, J., Gertzen, S., Borcherding, J., Geist, J., & Schliewen, U. K. (2013). First evidence for interspecific hybridization between invasive goby species Neogobius

fluviatilis and Neogobius melanostomus (Teleostei: Gobiidae: Benthophilinae). Journal of Fish Biology.

Marsden, J.E., and D.J. Jude. 1995. Round gobies invade North America. Fact sheet produced by Sea Grant at Ohio State University, Columbus, OH. <http://iisgcp.org/Catalog/downlds_09/mars_jude_rg.pdf>; [Accessed on June 8, 2013].

Sapota, M.R. 2012. NOBANIS – Invasive Alien Species Fact Sheet – Neogobius melanostomus. Online Database of the European Network on Invasive Alien Species <http://www.nobanis.org/files/factsheets/Neogobius_melanostomus.pdf>; [Accessed on June 10, 2013].

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.