NEW YORK
FISH & AQUATIC INVERTEBRATE INVASIVENESS RANKING FORM

Scientific name:	Tinca tinca
Common names:	Tench
Native distribution:	Eurasia (widely distributed between the British isles and Iberian peninsula to central Siberia), introduced elsewhere
Date assessed:	6/20/2013
Assessors:	D. Adams & J. Corser
Reviewers:	
Date Approved:	Form version date: 3 January 2013

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

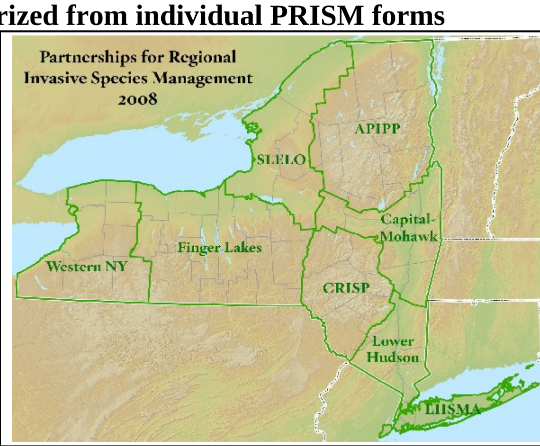
Distribution and Invasiveness Rank (*Obtain from PRISM invasiveness ranking form*)			
	Status of this species in each PRISM:	Current Distribution	PRISM Invasiveness Rank
1	Adirondack Park Invasive Program	Restricted	Not Assessed
2	Capital/Mohawk	Unknown	Not Assessed
3	Catskill Regional Invasive Species Partnership	Unknown	Not Assessed
4	Finger Lakes	Unknown	Not Assessed
5	Long Island Invasive Species Management Area	Unknown	Not Assessed
6	Lower Hudson	Unknown	Not Assessed
7	Saint Lawrence/Eastern Lake Ontario	Unknown	Not Assessed
8	Western New York	Unknown	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)	26
3	Ecological amplitude and distribution	30 (30)	22
4	Difficulty of control	10 (10)	5
	Outcome score	100 (100)[b]	77[a]
	Relative maximum score †		77
	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:
www.nas.er.usgs.gov and www.fishbase.org

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

Documentation:
Sources of information (e.g.: distribution models, literature, expert opinions):
www.nas.er.usgs.gov and www.fishbase.org. Kolar & Lodge, 2002; DeVaney et al., 2009.

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	Restricted
Capital/Mohawk	Unknown
Catskill Regional Invasive Species Partnership	Unknown
Finger Lakes	Unknown
Long Island Invasive Species Management Area	Unknown
Lower Hudson	Unknown
Saint Lawrence/Eastern Lake Ontario	Unknown
Western New York	Unknown

Documentation:
Sources of information:
www.nas.er.usgs.gov and www.fishbase.org

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:
Freshwater, brackish, demersal, potamodromous. Typically found in shallow densely vegetated lakes and backwaters. A warmwater species, Tench favors calm waters, shallow ponds and abundant vegetation and a soft mud substrate, avoiding high gradient streams where the maximum velocity exceeds 0.3 m/s. Shallow coastal (including tidal brackish) environments can serve as breeding areas such as seagrass in slow flowing

rivers such as the St. Lawrence.

Documentation:
Sources of information:
Masson 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: 7

Documentation:
Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the absence of impact information)
Known to stir up bottom sediments possibly affecting water quality. In a field experiment in Sweden, Tench dramatically reduced the biomass of snails and bivalves fostering a cascading effect on the biomass of algae through a reduction in grazing pressure by snails. Further, the growth of the dominant submerged macrophyte was also reduced. In areas where zebra mussles are perceived to be a problem, this could be viewed as a positive development.
Sources of information:
Bronmark, 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: 7

Documentation:
Identify type of impact or alteration:
In nearby Quebec, Tench is believed to disrupt fish communities and food webs. Tench have been associated with yellow perch declines and have been implicated as a major threat to the threatened copper redhorse. At the same time this species might serve as an important prey tem for larger piscivorous predators.
Sources of information:
Marcogliese et al., 2009; Masson 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: 10

Documentation:
Identify type of impact or alteration:
Potential competitor for food with sport fish and native cyprinids. May contribute to eutrophication, can cause cascading food web effects by preferentially harvesting snails which can lead to algal blooms and a reduction in sumerged macrophytes. Carries novel parasites which could infect native sport fishes and imperiled species.
Sources of information:
Masson et al., 2013; Marcogliese et al., 2009

Total Possible: 30
Section One Total: 24

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:
The number of eggs/kg of body weight varies from 300,00--600,00; sexual maturity reached in 3-5 years, considered to have high fertility.
Sources of information:
Masson et al., 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:

Sources of information:
www.nas.er.usgs.gov and www.fishbase.org

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:
www.nas.er.usgs.gov and www.fishbase.org

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:
The species was imported into North America from Germany by the US Fish Commission in 1877. However, a hybrid strain of Tench have escaped from commercial ponds in southern Quebec and subsequently spread over 30 years throughout the Richeliue River system both north and south of the release site. Since the relase in 1986 they have made it to the northern bays of Lake Champlain and to the St. Lawrence River from Quebec City and Montreal. During this relatively slow expansion they have bypassed several dams and used canal systems to disperse. Smaller individuals could be used as baitfish.
Sources of information:
Masson et al., 2013; Lajbner et al., 2011.

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:
Tolerates low oxygen saturation. Sport fish. Utilized as fodder for bass. Utilized as a food

fish fresh and frozen. Ornamental fish. The hybrid Quebec strain might well be filling vacant niches in the Champlain/St. Lawrence system. Tolerant of wide range of salinity.
Sources of information:
www.nas.er.usgs.gov and www.fishbase.org; Masson et al., 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: 8

Documentation:
Evidence of competitive ability:
An opportunistic species, tench can apparently survive drying for long periods by burying itself in mud. Tench is a widely tolerant generalist that, based on it's life history traits, is expected to establish and spread throughout the Great Lakes region. It may just be exiting its ~ 30 year establishment phase and passing into the expansion phase, especially the hybrid Quebec strain now entering NYS from both Lake Champlain and the St. Lawrence River. The rate of spread in Quebec has evidently accelerated greatly since 2011 and large numbers of fish of all size classes have been caught in seines as a part of a detection network. This may have been due to extensive flooding in 2011.
Sources of information:
Baughman, 1947; Kolar & Lodge 2002; Masson et al., 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: 2

Documentation:
Identify species:
Eurasian Cyprinids are some of the most problematic invasive fishes in North America (DeVaney et al., 2009)

Total Possible: 30
Section Two Total: 26

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:

Documented in 38 states, possibly established in Long Island NY, NJ, MD, DE, CT. An escaped hybrid strain in Quebec has apparently entered an expansion phase and has now spread to northern Lake Champlain in NY/VT. On the St. Lawrence River it has reached Montreal and given its past slow colonization rates, could make it up-river to the border of NYS in less than a decade.
Sources of information:

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

Masson 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 1

Documentation:
Describe distribution:
Statewide fisheries database query resulted in records for the Great Chazy River and Lake Champlain. Historically introduced to lowland lacustribe habitats in Delaware, Long Island and the Housatonic drainages.
Sources of information:
www.nas.er.usgs.gov and www.fishbase.org

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., $\geq$100 annually).	6
U.	Unknown	

Score 2

Documentation:
Describe known or potential releases:
Most releases historical.
Sources of information:
www.nas.er.usgs.gov and www.fishbase.org

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., $\leq$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., $\geq$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:
It was formerly thought that the presence of centrarchids prevented more widespread establishment especially in the Great Lakes region. A more recent theory is that because Tench is composed of two widely divergent eastern and western phylogroups (clades) in Eurasia, the heavy historical introductions probably failed in certain areas because the wrong group was introduced and was maladapted to its environment.
Sources of information:
Baughman, 1947; Lajbner et al.,. 2011; DeVaney et al., 2009

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:
The hybrid strain approaching NYS from two directions from Quebec has apparently broadened its niche, allowing it to occupy a wider range of habitats including estuaries, slow sections of rivers, canals, ponds, lakes, and reservoirs.
Sources of information:
Masson et al., 2013; Marsden & Hauser, 2009.

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:
Most populations are a result of deliberate introduction by state governments in the past, although flooding of ponds has resulted in some established populations from aquaculture, namely the hybrid strain in Quebec.
Sources of information:
www.nas.er.usgs.gov and www.fishbase.org; Masson et al., 2013.

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:
Temperate, 4 to 24 degrees C. A temperate, warm water fish, apparently well suited to the

current aquatic environments in the St. Lawrence River and Lake Champlain. Climate in the Great Lakes region is well suited for this species.
Sources of information:
www.nas.er.usgs.gov and www.fishbase.org; Masson et al., 2013; Marsden & Hauser, 2009; DeVaney et al., 2009; Kolar & Lodge, 2002

Total Possible	30
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:
Aquaculture and water garden species, food fish both fresh and frozen, sport fish. Can survive drying by burying in mud sediments; has been illegally imported to nearby Quebec for aqualculture; desirable food, bait fish. Does not do well ("inept" colonizer) if inappropriate phylogroup is released, but hybrid strain in Quebec is established and spreading towards NYS.
Sources of information:
www.nas.er.usgs.gov and www.fishbase.org; Baughman, 1947; Masson et al., 2013; Lajbner et al., 201; deVaney et al., 2009.

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:
Standardized fish surveys conducted in lakes regularly by NYS DEC, so far the species has not spread much beyond the Chazy locale, but is reported more regularly on the VT side. Quebec has used a seine monitoring detection network in the Richelieu River system toward Lake Champlain and the St. Lawrence River documenting the capture of hundreds of individuals of all size classes.
Sources of information:
Masson et al., 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:
Fisheries staff regularly conduct standardized surveys.
Sources of information:
www.nas.er.usgs.gov and www.fishbase.org

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: 2

Documentation:
Identify types of control methods and time required:
The hybrid strain in nearby Quebec has apparently cycled through its establishment phase and is now in its expansion phase. If this expansion front reaches NYS in both the northern Lake Champlain and St. Lawrence systems, it will likely be nearly impossible to eradicate.
Sources of information:
Kolar & Lodge (2002); Labjner et al., 2011

Total Possible	10
Section Four Total	5

Total for 4 sections Possible	100
Total for 4 sections	77

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: Yes, US Fish Commission distributed an orange or reddish variety, the golden tench, as an ornamental. It appears that the hybrid variant that escaped in southern Quebec and is now heading for NYS from multiple directions was a deliberate cross between the eastern and western phylogroups of Tench for commercial purposes. Much more study on this topic is needed for this species, but certain other fishes have been found to increase their adaptive potential and population fitness through this type of deliberate genetic admixture for fish farming (Lajbner et al., 2011)

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: Possibly

References for species assessment:

www.nas.er.usgs.gov

www.fishbase.org

NYS DEC Bureau of Fisheries.

Baughman, J. L. (1947). The tench in America. The Journal of Wildlife Management, 11(3), 197-204.

Brönmark, C. (1994). Effects of tench and perch on interactions in a freshwater benthic food chain. Ecology, 1818-1828.

DeVaney, S. C., McNyset, K. M., Williams, J. B., Peterson, A. T., & Wiley, E. O. (2009). A tale of four "carp": invasion potential and ecological niche modeling. PloS One, 4(5), e5451.

Kolar, C. S., & Lodge, D. M. (2002). Ecological predictions and risk assessment for alien fishes in North America. Science, 298(5596), 1233-1236.

Lajbner, Z., Linhart, O., & Kotlík, P. (2011). Human - aided dispersal has altered but not erased the phylogeography of the tench. Evolutionary Applications, 4(4), 545-561.

Marcogliese, D. J., Gendron, A. D., & Dumont, P. (2009). Parasites of illegally introduced tench (Tinca tinca) in the Richelieu River, Quebec, Canada. Comparative Parasitology, 76(2), 222-228.

Marsden, J. E., & Hauser, M. (2009). Exotic species in Lake Champlain. Journal of Great Lakes Research, 35, 250-265.

Masson, S., de Lafontaine, Y., Pelletier, A. M., Verreault, G., Brodeur, P., Vachon, N., & Massé, H. (2013). Dispersion récente de la tanche au Québec. Le Naturaliste Canadien, 137(2), 55-61. (In French, translated by Google Translate to English).

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.

NEW YORK
FISH & AQUATIC INVERTEBRATE INVASIVENESS RANKING FORM

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.

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