

NEW YORK FISH & AQUATIC INVERTEBRATE INVASIVENESS RANKING FORM

Scientific name: Carassius auratus
 Common names: Goldfish
 Native distribution: Eastern Asia, including China and perhaps adjacent regions (Japan, Republic of Korea); also possibly parts of Europe if C. auratus gibelio is a valid subspecies and not just a feral introduction (Raicu et al. 1981) Native to central Asia, China and Japan (ISSG 2013).
 Date assessed: 6/17/2013
 Assessors: E. White
 Reviewers: _____
 Date Approved: _____ Form version date: 3 January 2013

New York Invasiveness Rank: Very High (Relative Maximum Score >80.00)

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

Invasiveness Ranking Summary (see details under appropriate sub-section)		Total (Total Answered*) Possible	Total
1	Ecological impact	30 (30)	21
2	Biological characteristic and dispersal ability	30 (28)	22
3	Ecological amplitude and distribution	30 (30)	30
4	Difficulty of control	10 (10)	7
	Outcome score	100 (98) ^b	80 ^a
	Relative maximum score [†]		81.63
	New York Invasiveness Rank [§]	Very High (Relative Maximum Score >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)		
<input checked="" type="checkbox"/>	Yes – continue to A1.2	
<input type="checkbox"/>	No – continue to A2.1; Yes <input type="checkbox"/> NA; Yes <input type="checkbox"/> USA	
A1.2. In which PRISMs is it known (see inset map)?		
<input checked="" type="checkbox"/>	Adirondack Park Invasive Program	
<input checked="" type="checkbox"/>	Capital/Mohawk	
<input checked="" type="checkbox"/>	Catskill Regional Invasive Species Partnership	
<input checked="" type="checkbox"/>	Finger Lakes	

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<input checked="" type="checkbox"/>	Long Island Invasive Species Management Area
<input checked="" type="checkbox"/>	Lower Hudson
<input checked="" type="checkbox"/>	Saint Lawrence/Eastern Lake Ontario
<input checked="" type="checkbox"/>	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)

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)

Adirondack Park Invasive Program	Distribution
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
<input type="checkbox"/> Marine	<input type="checkbox"/> Salt/brackish marshes	<input type="checkbox"/> Cultivated*
<input checked="" type="checkbox"/> Salt/ brackish waters	<input type="checkbox"/> Freshwater marshes	<input type="checkbox"/> Grasslands/old fields
<input type="checkbox"/> Freshwater tidal	<input type="checkbox"/> Peatlands	<input type="checkbox"/> Shrublands
<input checked="" type="checkbox"/> Rivers/streams	<input type="checkbox"/> Shrub swamps	<input type="checkbox"/> Forests/woodlands
<input checked="" type="checkbox"/> Natural lakes and ponds	<input type="checkbox"/> Forested wetlands/riparian	<input type="checkbox"/> Alpine
<input type="checkbox"/> Vernal pools	<input checked="" type="checkbox"/> Ditches*	<input type="checkbox"/> Roadsides*
<input type="checkbox"/> Reservoirs/ impoundments*	<input type="checkbox"/> Beaches/or coastal dunes	<input type="checkbox"/> Cultural*

Other potential or known suitable habitats within New York:
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Documentation:
Sources of information:

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

Documentation:

Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the absence of impact information)

Goldfish have been shown to increase water turbidity, deplete aquatic vegetation and stimulate cyanobacterial growth and algal blooms. Richardson et al. (1995) suggested that high turbidity should reduce the success of predators feeding on goldfish, and may decrease the foraging success of other competitors.

Sources of information:

(Richardson et al. 1995, Morgan and Beatty 2004)

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

Documentation:

Identify type of impact or alteration:

Goldfish prey on all life stages of native fishes and have been shown to increase water turbidity, deplete aquatic vegetation and stimulate cyanobacterial growth and algal blooms. Richardson et al. (1995) suggested that high turbidity should reduce the success of predators feeding on goldfish, and may decrease the foraging success of other competitors. They also hybridize with carp (Froese and Pauly 2011). At some sites they outcompete native fish or disturb sport fish habitat, but at other sites they are unable to compete with native fishes and are not considered a pest in most US states. They eat aquatic plants, algae, detritus, crustaceans, worms, small insects, and snails (Froese and Pauly 2011).

Sources of information:

(Moyle 1976, Richardson et al. 1995, Laird and Page 1996, Morgan and Beatty 2004, Froese and Pauly 2011, U.S. Geological Survey 2013)

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

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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:

Goldfish prey on all life stages of native fishes and have been shown to increase water turbidity, deplete aquatic vegetation and stimulate cyanobacterial growth and algal blooms. Richardson et al. (1995) suggested that high turbidity should reduce the success of predators feeding on goldfish, and may decrease the foraging success of other competitors. They also hybridize with carp (Froese and Pauly 2011). At some sites they outcompete native fish or disturb sport fish habitat, but at other sites they are unable to compete with native fishes and are not considered a pest in most US states.

Sources of information:

(Moyle 1976, Richardson et al. 1995, Laird and Page 1996, Morgan and Beatty 2004, Froese and Pauly 2011, U.S. Geological Survey 2013)

Total Possible

30

Section One Total

21

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:

Goldfish spawn in shallow waters and lay up to several hundred thousand small eggs at a time; eggs hatch in a week (ISSG 2013). Females can spawn more than once per spawning period (Froese and Pauly 2011).

Sources of information:

(Froese and Pauly 2011, 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

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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 U

Documentation:

Identify dispersal mechanisms:

I did not locate specific information on the distance they can disperse in the wild. Fish are very mobile and capable of dispersing distances as larvae or adults, but their home range can vary, so I assume either B or C.

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:

This species is already wide-spread throughout all US states except for Alaska. However, their widespread use in the pet trade and intentional and unintentional releases suggest colonization of new habitats still occur, including private ponds for ornamental use. There have also been reports of escapes from hatcheries and ponds, escapes and releases of baitfish, and aquarium releases.

Sources of information:

ISSG 2013, U.S. Geological Survey 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

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- C. Possesses two or more characteristics that increase competitive advantage 8
 U. Unknown

Score 8

Documentation:

Evidence of competitive ability:

C. auratus can withstand exposure to salinity of 15ppt, high levels of turbidity, temperature fluctuations, some level of pollution, and low dissolved oxygen levels.

Sources of information:

(Froese and Pauly 2011, Invasive Species Specialist Group (ISSG) 2013, U.S. Geological Survey 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:

The species has a varied diet, including native fish and have outcompeted native fish in at least some cases.

Sources of information:

(Moyle 1976, Richardson et al. 1995, Laird and Page 1996, Morgan and Beatty 2004, Froese and Pauly 2011, Invasive Species Specialist Group (ISSG) 2013, U.S. Geological Survey 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:

Carassius carassius, Carassius auratus x Cyprinus carpio, Carassius auratus x C. carassius.

Many other Cyprinids of different genera are also listed as nonindigenous.

Total Possible 28
 Section Two Total 22

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

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Score

Documentation:

Identify states and provinces:

AL, AZ, AR, CA, CO, FL, CT, DE, DC, GA, IL, ID, IN, IO, KS, KY, LO, ME, MD, MA, MI, MS, MO, MN, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY and Puerto Rico and Hawaii. It is also known from British Columbia and Quebec in Canada.

Sources of information:

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

(Invasive Species Specialist Group (ISSG) 2013, 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

Documentation:

Describe distribution:

This species is currently established 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

Documentation:

Describe known or potential releases:

While no specific estimates of numbers of release events were in the literature, this is estimated to be very high due to the prevalence and availability of the species in the pet trade and associated releases, as well as potential bait releases.

Sources of information:

(Invasive Species Specialist Group (ISSG) 2013, U.S. Geological Survey 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 | 2 |

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- connected waterbody.
U. Unknown

Score

Documentation:

Describe population density:

This species is known to occur in all US states except for Alaska.

Sources of information:

(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

Documentation:

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

Known to occur in lakes, ponds, streams, ditches, and brackish waters.

Sources of information:

(ISSG 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

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., $\geq 30\%$). 8
- U. Unknown.

Score

Documentation:

Describe known climate similarities:

92% of NY stations are ≥ 5 , 80% > 5

Sources of information:

(Australian Department of Agriculture, Fisheries, and Forestry (ADAFF) 2013)

Total Possible	30
Section Three Total	30

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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

Documentation:

Identify source/ vectors:

Pet releases, biological supplies, aquaculture facilities, connecting waters corridors. This species seems well-established at this point.

Sources of information:

(Invasive Species Specialist Group (ISSG) 2013, U.S. Geological Survey 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

Documentation:

Describe protocols:

Management protocols exist, especially for New Zealand and Australia (ISSG 2013). Many methods include electrofishing and netting goldfish in areas with high densities. Winter (2005) suggested controlling populations with predator fish when other options are not possible.

Sources of information:

(Winter 2005, 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

Documentation:

Describe resources:

Management protocols exist, especially for New Zealand and Australia (ISSG 2013). Many methods include electrofishing and netting goldfish in areas with high densities. Winter (2005) suggested controlling populations with predator fish when other options are not possible. Identification is straightforward and netting and electrofishing equipment for fish is readily available from biological suppliers.

Sources of information:

(Winter 2005, ISSG 2013)

4.4. Level of effort required

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- 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 protocols exist, especially for New Zealand and Australia (ISSG 2013). Many methods include electrofishing and netting goldfish in areas with high densities. Winter (2005) suggested controlling populations with predator fish when other options are not possible. Identification is straightforward and netting and electrofishing equipment for fish is readily available from biological suppliers. Morgan et al. (2005) recommend intensive programs lasting 1-2 weeks each year to control the species in areas of high density. Due to the multiple vectors of further release possible, eradication may be impossible and extensive public education is necessary.

Sources of information:

(Morgan and Beatty 2005, Winter 2005, ISSG 2013)

Total Possible

10

Section Four Total

7

Total for 4 sections Possible

98

Total for 4 sections

80

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: *Carassius auratus* x *Cyprinus carpio*, *Carassius auratus* x *C. carassius*

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References for species assessment:

- Australian Department of Agriculture, Fisheries, and Forestry (ADAFF). 2013. Climatch Mapping Tool [Online]. Available: <http://adl.brs.gov.au:8080/Climatch/>. [Accessed: 23-Jan-2013].
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- Laird, C. A., and L. M. Page. 1996. Non-native fishes inhabiting the streams and lakes of Illinois.
- Morgan, D., and S. Beatty. 2004. Fish fauna of the Vasse River and the colonisation by feral goldfish (*Carassius auratus*).
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- Moyle, P. B. 1976. Fish introductions in California: history and impact on native fishes. *Biological Conservation* 9:101–118.
- Richardson, M., F. Whoriskey, and L. Roy. 1995. Turbidity generation and biological impacts of an exotic fish *Carassius auratus*, introduced into shallow seasonally anoxic ponds. *Journal of Fish Biology* 47:576–585.
- The Nature Conservancy. 2013. iMapInvasives: An Online Mapping Tool for Invasive Species Locations [Online]. Available: iMapInvasives.org. [Accessed: 03-Jan-2013].
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- Winter, T. J. 2005. Population size, growth, and control of exotic goldfish (*Crassius atratus*) in a small impoundment: implications for managing future invasions [Online]. Available: <http://www.d.umn.edu/~wint0190/comp%20page/Gold%20Paper/goldpaper2.2%20FD%20web.htm>. [Accessed: 31-Jan-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.

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