

NEW YORK FISH & AQUATIC INVERTEBRATE INVASIVENESS RANKING FORM

Scientific name: Salmo trutta (S. trutta fario)
 Common names: Brown Trout, von Behr Trout, Loch Leven Trout, German Brown Trout
 Native distribution: Europe, including Scandinavia and Great Britain (Aquamaps, 2013)
 Date assessed: 1/4/2013, 9/16/2013
 Assessors: E. Schwartzberg
 Reviewers: _____
 Date Approved: _____ Form version date: 3 January 2013

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

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

Invasiveness Ranking Summary (see details under appropriate sub-section)		Total (Total Answered*) Possible	Total
1	Ecological impact	30 (30)	10
2	Biological characteristic and dispersal ability	30 (30)	22
3	Ecological amplitude and distribution	30 (30)	24
4	Difficulty of control	10 (10)	4
	Outcome score	100 (100) ^b	60 ^a
	Relative maximum score [†]		60.00
	New York Invasiveness Rank [§]	Moderate (Relative Maximum Score 50.00-69.99)	

* For questions answered "unknown" do not include point value in "Total Answered Points Possible." If "Total Answered Points Possible" is less than 70.00 points, then the overall invasive rank should be listed as "Unknown."

[†] Calculated as 100(a/b) to two decimal places.

[§] Very High >80.00; High 70.00–80.00; Moderate 50.00–69.99; Low 40.00–49.99; Insignificant <40.00

A. DISTRIBUTION (KNOWN/POTENTIAL): Summarized from individual PRISM forms

A1.1. Has this species been documented in NY? (reliable source; voucher not required)		
<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	
<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	

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<input checked="" type="checkbox"/>	Western New York
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Documentation:

Sources of information:
NAS, 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 |
|---|---|--|
| <input type="checkbox"/> Marine | <input type="checkbox"/> Salt/brackish marshes | <input type="checkbox"/> Cultivated* |
| <input 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 type="checkbox"/> Ditches* | <input type="checkbox"/> Roadsides* |
| <input checked="" type="checkbox"/> Reservoirs/ impoundments* | <input type="checkbox"/> Beaches/or coastal dunes | <input type="checkbox"/> Cultural* |

Other potential or known suitable habitats within New York:

Morph S. trutta morpha trutta (Sea Trout) found in marine habitat, but excluded from above. Observaiton of Brown Trout made in freshwater tidal section of Hudson, but not sure if that meets criteria of freshwater tidal classification above.

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Sources of information:
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

Documentation:

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

Limited studies on effects of brown trout on ecosystem processes or system-wide parameters. Most studies focus on effects of these parameters on brown trout. Some studies mention possible effects of brown trout on organic matter (Flecker and Townsend, 1994) or effects of brown trout in New Zealand on system-wide parameters via affecting insect communities (Bison and Bilby, 1998), but again, this is in New Zealand with other New Zealand native fish. Similar studies on rainbow trout state similar (Baxter et al., 2004). No direct evidence for brown trout, but possible if more research was conducted.

Sources of information:

Baxter et al., 2004; Bison and Bilby, 1998; Flecker and Townsend, 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

Documentation:

Identify type of impact or alteration:

Can affect native species dietary habits (McHugh and Budy, 2006). Stocking of large brown trout likely to result in decline of other nongame species (Garmon and Nielson, 1982), however stocking not shown to result in extirpation of other species (Penczak, 1999).

Sources of information:

Garmon and Nielson, 1982; McHugh and Budy, 2006; Penczak, 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

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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 3

Documentation:

Identify type of impact or alteration:

Compete with brook trout over preferred habitat (favorable water velocity, resting positions, and shade). Brown trout also prey upon brook trout (Fausch and White, 1981). Brown trout have a strong negative effect on cutthroat trout and mottled sculpin performance and in Western North America (McHugh and Budy, 2006; Meredith, 2013). although this is not applicable to NY.

Sources of information:

Fausch and White, 1981; McHugh and Budy, 2006; Meredith, 2013.

Total Possible 30
Section One Total 10

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:

Produces up to 150 eggs per season.

Sources of information:

Elliott. 1984.

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, but spawn up river.

Sources of information:

Nova Scotia Fisheries and Aquaculture, 2013

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

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- 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

Documentation:

Identify dispersal mechanisms:

Sources of information:

Nova Scotia Fisheries and Aquaculture, 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

Documentation:

Identify dispersal mechanisms:

Aquaculture escape can occur (McDermott, 2007). Stocked for recreational fishing (Boland, 2001).

Sources of information:

Boland, 2001; McDermott, 2007.

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

Documentation:

Evidence of competitive ability:

More tolerant of warm temperatures and turbidity than native trout and can withstand heavy fishing pressure, fills vacant niche, and is a charismatic species.

Sources of information:

NYSDEC, 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

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- 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:

Flexible migratory behavior (Valiente et al., 2012). Grow larger than brook trout, better abling them to compete for spawning sites and resistant to the parasite which causes whirling disease giving them a competitive advantage over brook and rainbow trout (MDDNR 2013). Competitive advantages may not be widely observed in NY, however these characteristics warrant a score of 8.

Sources of information:

Valiente et al., 2012; MDDNR, 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:

Several in same Genus: Atlantic salmon (*Salmo salar*) are invasive to the western US, tiger trout (*Salmo x Salvelinus trutta x fontinalis*) although rare, Ohrid trout (*Salmo letnica*).

Total Possible 30
 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

Score 3

Documentation:

Identify states and provinces:

Throughout much of North America

Sources of information:

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

NAS, 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

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- D. Established in 4 or more PRISMs 5
- U. Unknown

Score

Documentation:
Describe distribution:
Present throughout New York State
Sources of information:
NAS, 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:
Stocked for sport fishing.
Sources of information:
Boland, 2001.

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

Documentation:
Describe population density:
Can displace spawning salmon and brook trout.
Sources of information:
Boland, 2001; NAS, 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:
Rivers, streams, and natural lakes. Also farmed.

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Sources of information:
Boland, 2001.

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:
Boland, 2001.

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 8

Documentation:
Describe known climate similarities:
49/63 stations in NY = or >5 Climatch score.
Sources of information:
ADAFF, 2013.

Total Possible	30
Section Three Total	24

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 1

Documentation:
Identify source/ vectors:
Stocked for sport fishing, but regulated.
Sources of information:
Boland, 2001.

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

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- 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:

Brown trout are actively managed in NY state and in other states where it is invasive, it is managed, ie. reduction of size limit for anglers in Shenandoa National Park (National Park Service, 2013).

Sources of information:

National park Service, 2013a.

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 resources for conservation of brown trout.

Sources of information:

Adams et al., 2007; Belica, 2007

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

Documentation:

Identify types of control methods and time required:

Although eradication is not a goal of current brown trout management, a recent feasibility study of brown trout removal shows significant effort required using weir construction.

Sources of information:

Leibfried, date unknown; National Park Service 2013b.

Total Possible

Section Four Total

Total for 4 sections Possible

Total for 4 sections

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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: *Salmo trutta morpha fario*, *S. trutta morpha lacustris*, and *S. trutta morpha trutta* (Sea Trout).

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: Tiger Trout - (Brown Trout x Brook Trout)

References for species assessment:

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