Species Status Assessment

Common Name: Alewife floater **Date Updated:** 1/16/2024

Scientific Name: *Utterbackiana implicata* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

The scientific name for alewife floater was recently changed from *Anodonta implicata* to *Utterbackiana implicata* (Williams et al. 2017). *Utterbackiana implicata* belongs to the subfamily Unioninae, diagnosed by the presence of subtriangular glochidia with large, medial hooks, and the tribe Anodontini, which includes 17 extant New York species of the genera Alasmidonta, Anodonta, Anodontoides, Lasmigona, Pyganodon, Simpsonaias, Strophitus, and Utterbackia (Haag 2012, Graf and Cummings 2011). U. implicata can be distinguished by its subelliptical shell, toothless hinge, pink to purple nacre, and its double looped beak sculpture (Strayer and Jirka 1997).

In New York, this species is restricted mainly to the Hudson River estuary as well as the Lower Delaware River and is currently found in five water bodies. Since the invasion of zebra mussels in its range, the population number has declined dramatically (Strayer and Jirka 1997), but is expected to stabilize at 4% of its pre-invasion densities. Due to this decline, it is ranked as “critically imperiled” in New York, although its population is “secure” range-wide (NatureServe 2013). Unlike other Anodonta species, implicata prefers strong currents in the tidal Hudson River and can be found among cobbles in the Neversink River (Strayer and Ralley 1993, Strayer et al. 1994).

I. Status

a. Current legal protected Status

i. **Federal:** None **Candidate:** No

ii. **New York:** None, Proposed Threatened (2019)

b. Natural Heritage Program

i. **Global:** G5 - Secure

ii. **New York:** S1 – Critically imperiled **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Least Concern (2015)

-Northeast Regional SGCN: No

- American Fisheries Society Status: Currently Stable (1993)

Status Discussion:

Due to this decline following the arrival of zebra mussels in the Hudson River, it is ranked as “critically imperiled” in New York. This wide-ranging Atlantic slope species is considered relatively common and secure throughout most of its range, but is limited to only the coastal areas of the

North Atlantic Slope from North Carolina to Maine, with disjunct populations in North Carolina (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable			Choose an item.
Northeastern US	Yes	Choose an item.	Choose an item.			No
New York	Yes	Choose an item.	Choose an item.		Proposed Threatened (2019), S1	Yes
Connecticut	Yes	Choose an item.	Choose an item.		S4	No
Massachusetts	Yes	Choose an item.	Choose an item.		SU	No
New Jersey	Yes	Choose an item.	Choose an item.		S4	No
Pennsylvania	Yes	Choose an item.	Choose an item.		S3	Yes
Vermont	Yes	Choose an item.	Choose an item.		S1	Yes
Ontario	No	Choose an item.	Choose an item.			(blank)
Quebec	Yes	Choose an item.	Choose an item.		S1	(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

No regular surveys are being conducted for this species at this time. Regulatory surveys may be conducted in known or likely habitat as part of the project review process.

Trends Discussion *(insert map of North American/regional distribution and status):*

As of 1991-1992, the only location in New York where U. implicata had maintained a large population was in the Hudson River estuary (approximately 400 million individuals). Following the arrival of zebra mussels, this population has declined sharply with an annual decline rate of 57% per year from 1993 to 1999. Populations have since recovered slightly and are expected to stabilize at 4% of their pre-invasion densities (Strayer and Malcom 2007).

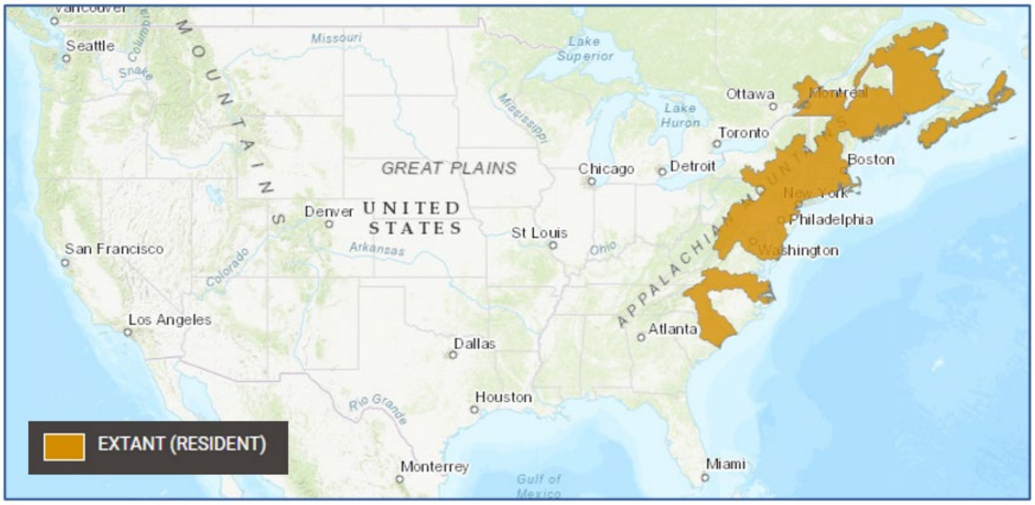

Figure 1. Alewife floater distribution (IUCN Redlist 2024)

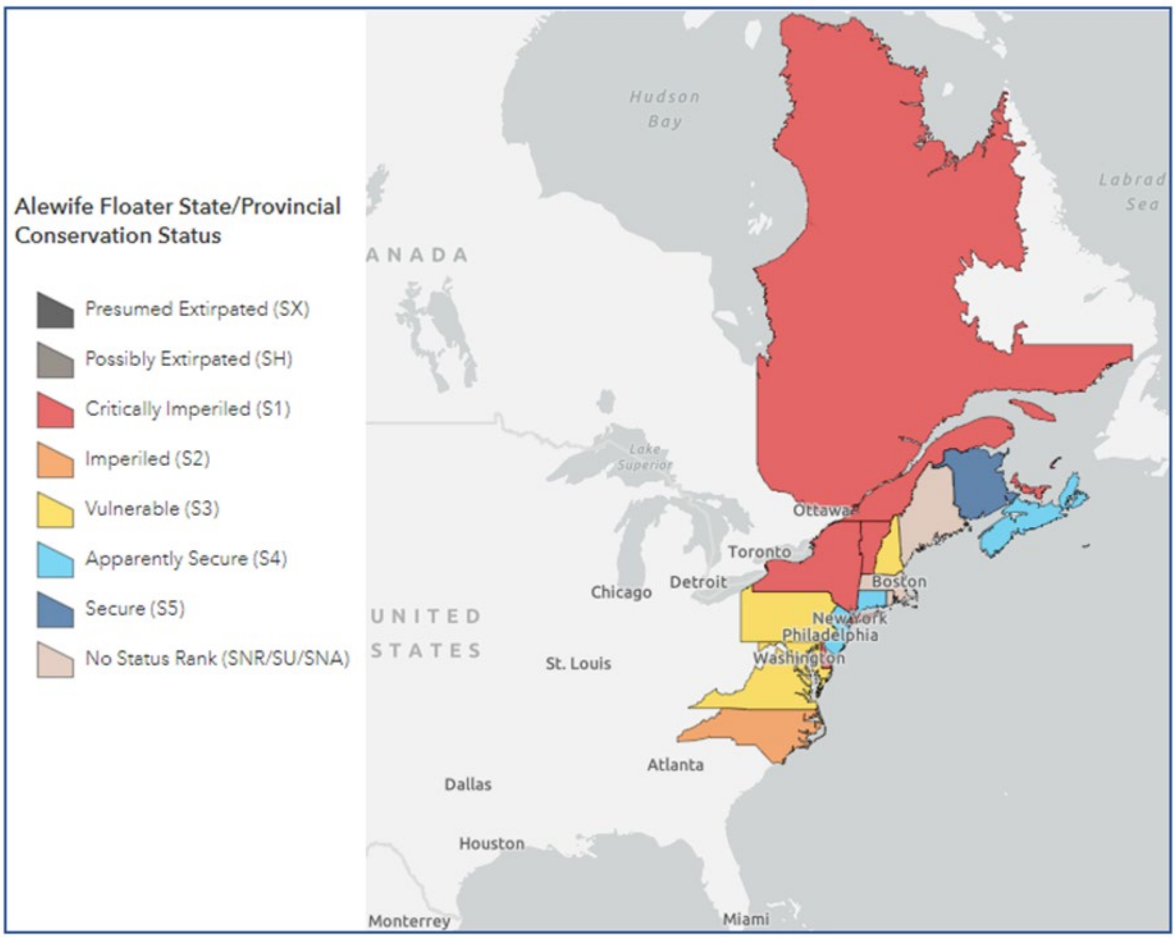

Figure 2. Alewife floater status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

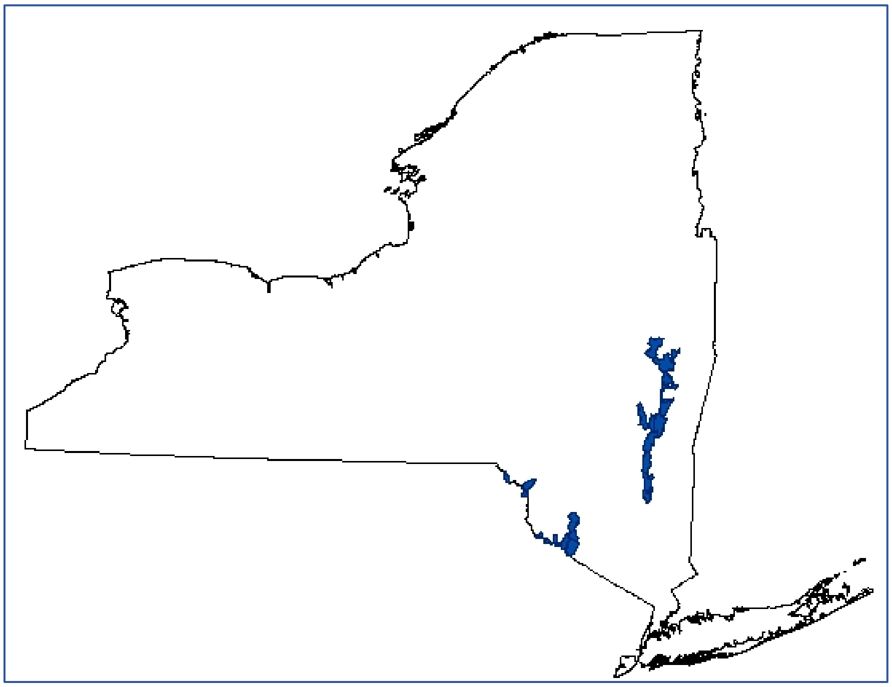

Figure 3. Records of Alewife floater in New York (NYSDEC 2022)

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1970	_______	1	1 of 1802 HUC 12
1970-2004	_______	4	12 of 1802 HUC 12
2005-2023	_______	4	9 of 1802 HUC 12
	_______	_______	_______

Table 1. Records of Alewife floater in New York.

Details of historic and current occurrence:

2024: U. implicata has been found in six NY waterbodies: Delaware, Hudson, Neversink, Catskill Creek, Mohawk, Bronx River and in a total of 17 of 1802 HUC 12watersheds = 0.01% of NY's HUC 12 watersheds.

U. implicata was historically found in an almost continuous stretch of the freshwater tidal Hudson River from Troy downstream to Margarette Lewis Norris State Park (White et al. 2011), from the lower Mohawk River/Erie Canal at Schenectady, and in the Delaware River basin, including the Neversink and the Delaware Rivers (Strayer and Jirka 1997, NY Natural Heritage Program 2013).

Since 1970, U. implicata has been found in five New York State waterbodies (Figure 2), including the Hudson, Mohawk, Neversink, and Delaware Rivers, and Catskill Creek, a Hudson River tributary (NY Natural Heritage Program 2013, White et al. 2011). Current occurrences are the same as historic occurrences (NY Natural Heritage Program 2013). In 2010, live specimens were found in the South Bay Creek and marsh area near the City of Hudson (NY Natural Heritage Program 2013). As of 1991-1992, the only location in New York where U. implicata had maintained a large population was in the Hudson River estuary (approximately 400 million individuals). Following the arrival of zebra mussels, this population has declined sharply with an annual decline rate of 57% per year from 1993 to 1999. Populations have since recovered slightly and are expected to stabilize at 4% of their pre-invasion densities (Strayer and Malcom 2007).

In the Delaware basin, in 1997, five individuals were found in the Neversink River in the vicinity of The Nature Conservancy Preserve and Cuddlebackville Dam. In 1991, the Neversink population was estimated at 20,000 individuals (NY Natural Heritage Program 2013). Between 2001 and 2002, at least 290 individuals were found in the Delaware River, with occurrences in every river mile within the continuous 76.9-mile stretch of river, extending from just south of Hancock to Port Jervis, except at 4 locations where the distance of the gap ranged from 1 to 1.8 miles (NY Natural Heritage Program 2013).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Core	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. **Size/Waterbody Type:** Medium to Large/Great River

b. **Geology:** Assume Moderately Buffered(Size 3+ rivers)

c. **Temperature:** Warm to Transitional Cool

d. **Gradient:** Low to Moderate-High gradient

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

Across its range, high densities of U. implicata are found in coastal ponds with a direct unimpeded connection to rivers that support yearly runs of alewife. In lakes, they are found in shallow areas with high wave intensity and in deep areas (>30 ft) below the thermocline. It may be more tolerant of mud and silt than many other species, and is abundant in tidal-depositional environments were aquatic plant growth is high. This species also exists in small streams and large rivers, without clear preference for substrate, depth, or flow conditions. Habitat use and population density seems to be more strongly tied to where its host fish are likely to spawn or congregate. It occurs in gravel and cobble substrate in small rivers with fairly strong flows (Nedeau 2008). Although Anodonta species are usually said to prefer quiet waters, in New York, U. implicata lives in the strong currents of the tidal Hudson River and among cobbles in the Neversink River (Strayer and Jirka 1997).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, U. implicata must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable habitat, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

This species has an opportunistic life history strategy. This strategy is often characterized by short life span, early maturity, high fecundity achieved soon after maturation, and, to a lesser extent, moderate to large body size. Species in this group have the fastest growth rates and highest reproductive effort. Nearly all opportunistic species are long-term brooders. This life history strategy is considered an adaptation for rapid colonization and persistence in disturbed and unstable but productive habitats (Haag 2012).

U. implicata is bradytictic with fertilization occurring in late summer or early fall and glochidia released the following spring. Timing of release is thought to coincide with the spawning migration of its three fish hosts: alewife (Alosa pseudoharengus), blueback herring (Alosa aestivalis), and American shad (Alosa sapidissima) (Nedeau 2008). Striped bass (Morone saxatilis) white sucker (Catostomus commersoni), threespine stickleback (Gasterosteus aculeatus), pumpkinseed (Lepomis gibbosus), and white perch (Morone americana) are additional potential host species (Nedeau 2008, Davenport and Warmuth 1965, Wiles 1975). Fecundity is not known, but is probably low because U. implicata glochidia are large and there is usually a tradeoff between offspring size and fecundity (Bauer 1994).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations (COSEWIC 2003). Since U. implicata's hosts fish are migratory, mussels may be dispersed more than 100 miles during the three to four week period over which the glochidia remain attached to their hosts (Nedeau 2008).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Other Ecosystem Modifications (levees and flood walls, channelization, navigational dredging, culverts)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (zebra mussels, didymo)
4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)
5. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, other regulated discharges)
6. Pollution	Household Sewage & Urban Waste Water (waste water treatment effluent, sewer and septic overflows)
7. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (die offs from unknown disease)
8. Natural System Modifications	Dams & Water Management/Use (water withdrawal for NYC)
9. Climate Change & Severe Storms	Storms & Flooding (severe storms)
10. Invasive & Other Problematic Species & Genes	Problematic Native Species (loss of host fish species including shad and herrings?)

The banks of the Hudson are bordered by a mix of developed/urban land, roads, forested land, wetlands, and agriculture, including pasture and row crops (New York State Landcover 2010). When vegetated buffers of adequate width are not present, downstream mussel populations are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in western and central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar and Landry 2013), indicating that runoff is a major threat to resident mussel populations.

Runoff from Developed Land

Lands adjacent to U. implicata habitat along the Upper Hudson and Mohawk River are highly urbanized, and include the municipalities of Cohoes and Waterford on the Mohawk River and Troy, Watervliet, Rensselaer, Albany and their suburbs on the Upper Hudson. A. implicata sites between

Albany and Margaret Lewis Norrie State Park, are likely impacted by the stormwater runoff from Catskill, East Greenbush, Germantown, Saugerties, and Kingston (New York State Landcover 2010).

Although the Delaware watershed is mostly forested in the area where U. implicata has been found, roads and a railroad run adjacent to the Delaware River. Hancock, Callicoon, Narrowsburg, and Port Jarvis are likely sources of stormwater runoff. On the Neversink at Myers Grove residential development is located adjacent to U. implicata habitat (New York State Landcover 2010).

These developed areas are likely sources of storm-water runoff containing metals and road salts. Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller and Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner and Pynnonen 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller and Zam 1991, Liqouri and Insler 1985, Pandolfo et al. 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Agricultural Runoff

Cultivated cropland is present adjacent to several U. implicata occurrences. These include the south bank of the Mohawk River at Crescent Station, immediately adjacent to U. implicata occurrences on Neversink River, and at the Delaware River between Callicoon and Cochectcon. A. implicata habitat in the lower Hudson River is likely impacted to some degree by agriculture, although most agriculture in this region is in pasture or hay (New York State Landcover 2010).

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into aquatic systems (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al., 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit mussel respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer run-off is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag 2012). In addition, ammonia adsorbs to sediment particles, resulting in higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Treated and Untreated Wastewater

Multiple combined sewer overflows (CSOs) discharge into known U. implicata habitat ("Combined Sewer Overflow" 2012, NY Natural Heritage Program 2013), including six CSOs that discharge into the Mohawk River and 49 that discharge into the Hudson River. In addition, dozens of CSO outflows discharge to the Hudson River into known A. implicata habitat between Troy and Saugerties, from municipalities such as the City of Hudson near the South Bay Creek, Catskill upstream of the Bristol Beach State Park, and Kingston upstream of the Margaret Lewis Norrie State Park site. In addition, U. implicata habitat receives treated wastewater from adjacent municipalities including Waterford on the Mohawk River; Rensselaer, East Greenbush, Germantown, and Kingston on the Hudson River; and Hancock, Callicoon, Narrowsburg, and Port Jarvis on the Delaware River (SPDES 2007).

Recent studies show that mussel richness and abundance decrease with increased proximity to sewage effluent (Wildenberg 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al. 1978). Endocrine disrupters from pharmaceuticals are also present in municipal sewage effluents and are increasingly common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012). It should be noted that in the Susquehanna Basin, Harman and Lord (2010) found no evidence that wastewater treatment plants were responsible for reductions in mussel species of greatest conservation need.

Invasive Species

Since the arrival of the zebra mussel, the population of U. implicata in the freshwater tidal Hudson River declined considerably (Strayer and Smith 1996). Invasive zebra mussels (Dreissena polymorpha) have been repeatedly cited as a threat to native mussel populations (Strayer and Jirka 1997, Watters et al. 2009). En masse, Dreissenids outcompete native mussels by efficiently filtering food and oxygen from the water. They reduce reproductive success by filtering native mussel male gametes from the water column and they can foul the shells of the native mussels to the point that their valves can no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury (USFWS 1994).

U. implicata was known from the Hudson River at the time of the zebra mussel invasion and was abundant enough to appear regularly in samples. This species declined steeply after the zebra mussel invasion, with an annual decline rate of 57 percent per year in 1993– 1999. By 1999, population densities had fallen to 100% from their pre-invasion values, with A. implicata not collected at all in 1998 or 1999. Populations recovered slightly in 2000–2005. Recruitment and growth of young unionids recovered to pre-invasion levels. Nevertheless, the body condition of unionids in 2000– 2005 was no better than in 1993–1999. Simple exponential decay models based on the entire 1990–2005 data set suggest that A. impliata populations will stabilize at 4% of their pre-invasion densities, rather than disappearing from the Hudson River (Strayer and Malcom 2007).

Didymo (Didymosphenia geminata), a filamentous diatom, can form extensive mats that can smother stream bottom and occlude habitat for mussels (Spaulding and Elwell 2007) This invasive has been found in the East Branch of the Delaware River. If it becomes as abundant in the Delaware basin as it has elsewhere, it could have enormous negative consequences for mussels, including U. implicata (Nedeau 2008).

Habitat Modifications

In the Hudson River, the US Army Corps of Engineers is authorized to perform maintenance navigation dredging under the Rivers and Harbors Act of 1899 and the Federal Clean Water Act. The total length of the existing navigation project (NYC to Waterford) is about 155 miles, and includes channel maintenance with shoal removal, maintenance of channel widths and depths, widening at bends, and widening in front of the cities of Troy and Albany to form harbors ("Introduction To The Hudson River" 2012).

Maintenance, navigational dredging, and other ecosystem modifications such as instream work associated with bridge replacement and vegetation removal, kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting "dredge" had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000).

Climate Change

In a recent assessment of the vulnerability of at-risk species to climate change in New York, Schesinger et al. (2011) ranked this species as "moderately vulnerable." This indicates that abundance and/or range extent within New York is likely to decrease by 2050.

Impoundments – Range wide

Range wide, impoundments likely contributed to the reduced distribution that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery and King 1983, ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓__ **No:**_____ **Unknown:**_____

If yes, describe mechanism and whether adequate to protect species/habitat:

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any “protected stream”, its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York’s mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Priority conservation efforts for this species should focus on, but not be limited to, the freshwater tidal Hudson River, the Neversink River, and the Delaware River.
- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under Environmental Conservation Law (ECL). Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.
- The shad-restoration program on the Connecticut River increased the range of A. implicata in the Connecticut River (Smith 1985). Such native fish restoration programs may be beneficial in historic New York waters.
- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).
- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.
- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis 2012).
- Update wastewater treatment facilities in Troy, Albany, Coxsackie, Hudson, and Catskill to eliminate combined sewer outflows.
- Work with Army Corps of Engineers to reduce the impacts of Hudson River dredging activities on native mussels.
- Establish a protocol whereas DEC staff work closely with state and local highway departments to reduce impacts to native mussels during maintenance and construction projects.
- Replace culverts that disrupt aquatic habitat connectivity to allow for passage of small fish species.
- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g., point and nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application

of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under Environmental Conservation Law (ECL). Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.
- Develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2. (need recommended conservation actions for Alewife floater).

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
First revision	February 25, 2014 (Samantha Hoff)
Latest revision	January 16, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Banded physa **Date Updated:**

Scientific Name: *Physella vinosa* **Updated By:**

Class: Gastropoda

Family: Physidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

The banded physa is a small sinistral, or left-coiled, freshwater snail in the family Physidae. The family Physidae is comprised of 47 species within 5 genera, occupying a holarctic distribution with extensions into Central and South America. The Physidae are the most abundant and widespread of the freshwater gastropods, occurring in a variety of freshwater habitats such as ditches, ponds, lakes, small streams, and rivers. The banded physa occurs in Ontario, Canada and the Great Lake states of the United States (Minnesota, Montana, Wisconsin, New York, and Michigan) and is most abundant on hard surfaces and aquatic vegetation (Mackie et al. 1980). The only records for New York are from museum lots for Mohawk, Herkimer County, likely the easternmost records for the species.

I. Status

a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Not listed; SGCN

b. Natural Heritage Program

i. **Global:** G5Q

ii. **New York:** S1 **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List:

-Northeast Regional SGCN:

American Fisheries Society: CS – Currently Stable

Status Discussion:

The banded physa is ranked secure globally and critically imperiled in New York. Little is known about its status within the state or throughout its whole range. Physella are currently undergoing taxonomic revision and this species may not be recognized in the future.

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Unknown	Unknown			Choose an item.
Northeastern US	Yes	Unknown	Unknown			Choose an item.
New York	Yes	Unknown	Unknown			Yes
Connecticut	No	Choose an item.	Choose an item.			Choose an item.
Massachusetts	No	Choose an item.	Choose an item.			Choose an item.
New Jersey	No	Choose an item.	Choose an item.			Choose an item.
Pennsylvania	Yes	Unknown	Unknown		Not listed	No
Vermont	No	Choose an item.	Choose an item.			Choose an item.
Ontario	Yes	Unknown	Unknown			Choose an item.
Quebec	No	Choose an item.	Choose an item.			Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

None.

Trends Discussion *(insert map of North American/regional distribution and status):*

Trend information for this species is unknown.

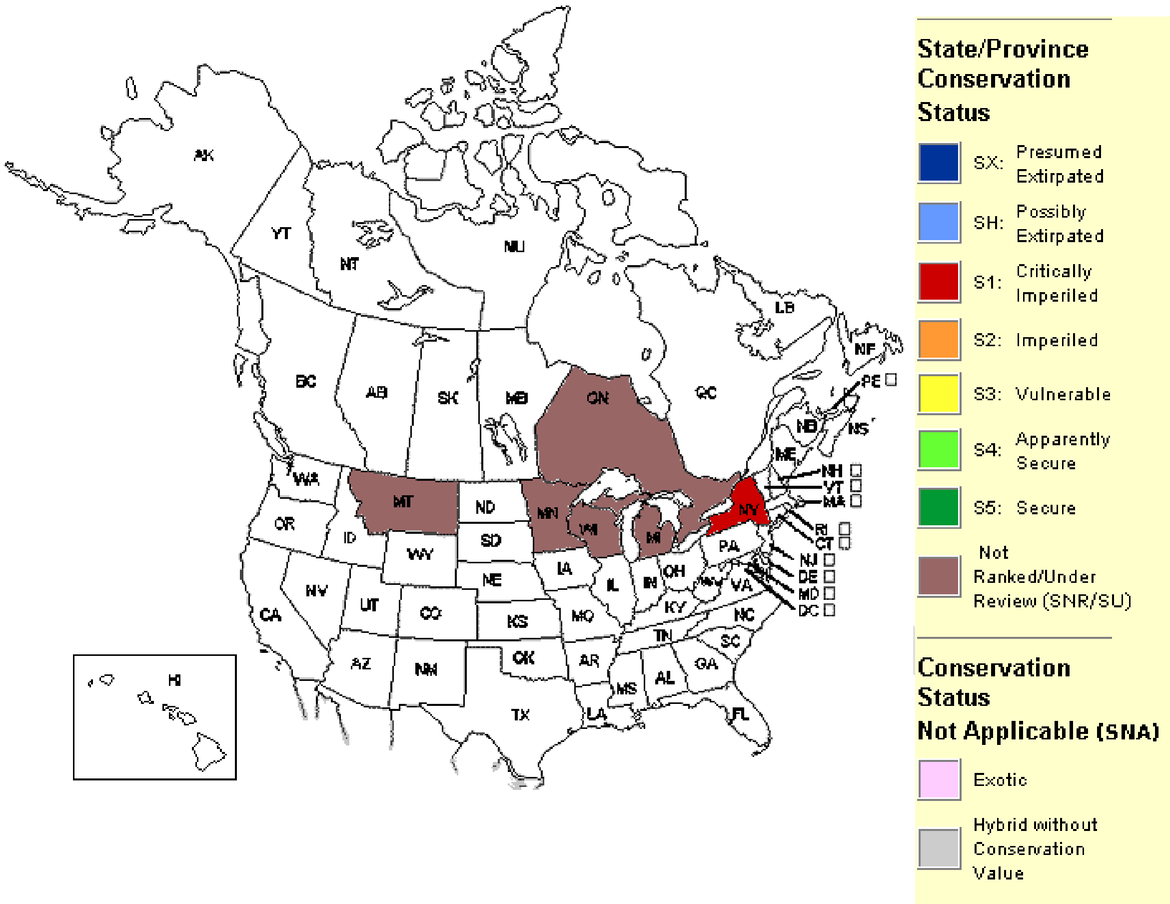

Figure 1. Conservation status of the banded physa in North America (NatureServe 2013).

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	_______	_______	_______
1995-2004	_______	_______	_______
2005-2014	_______	_______	_______
2015- 2023	_______	_______	_______

Table 1. Records of banded physa in New York.

Details of historic and current occurrence:

There are two records for this species in New York from museum lots near Mohawk, Herkimer County (UMMZ 43096 and 119165).

There are no current occurrence records available for this species in New York. Rarity in New York is unknown due to lack of occurrence records.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Core	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Lacustrine

b. Riverine

c. Freshwater

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Stable	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

Species of this family are most often found in lentic environments, although some are restricted to rivers and springs. The banded physa was first identified from Lake Superior in 1847. Most freshwater gastropods are restricted to waters with calcium concentrations greater than 3 mg/liter and limiting factors and specific localities may include hardness, acidity, dissolved oxygen, salinity, high temperatures, and food availability associated with depth (NatureServe 2013).
Aquatic gastropods are frequently used as bioindicators because they are sensitive to water quality and habitat alteration (Callil and Junk 2001, Salanki et al. 2003).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	Choose an item.	Choose an item.	Yes	Yes	Choose an item.

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Very little is known regarding the life history of this species. The banded physa is hermaphroditic and capable of self-fertilization. Members of the family Physidae generally lay large gelatinous egg masses during warmer months. Juveniles mature rapidly and multiple generations can be produced in a single year, but species from northern latitudes commonly live two years or more (Dillon et al. 2011).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Residential & Commercial Development	Housing & Urban Areas (habitat loss/degradation)
2. Natural System Modifications	Dams & Water Management/Use (dams, channelization)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (New Zealand mud snail)
4. Pollution	Industrial & Military Effluents (metals)
5. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers)
6. Pollution	Household Sewage & Urban Wastewater (untreated sewage)
7. Climate Change & Severe Weather	Habitat Shifting & Alteration

Threats not evaluated; experts agree too little is known. Threats to this specific species are not discussed in the literature. Known threats to freshwater gastropods include habitat loss and destruction and introduction of non-indigenous species. Causes of habitat destruction include dams, impounded reaches, development of riparian areas, channelization, erosion, excess sedimentation, groundwater withdrawal and associated impacts on surface streams (flows, temperature, dissolved oxygen levels), multiple forms of pollution (salt, metals, untreated sewage, agricultural runoff, pesticides/fertilizers), changes in aquatic vegetation and invasive species.

The New Zealand mud snail (*Potamopyrgus antipodarum*) is a highly invasive species that was introduced in Idaho in the 1980s. It can have devastating consequences to aquatic ecosystems, reducing or eliminating native snail species (Benson et al. 2013). This snail was found established in Lake Ontario in 1991 (Zaranko et al. 1997) and in Lake Erie in 2005 (Levri et al. 2007).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓_ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Environmental Conservation Law, however this may not be sufficient enough to protect this species and its required microhabitat conditions.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Basic biological information is lacking for most taxa of freshwater gastropods and there is a strong need for surveys and biological studies given the strong evidence of decline and extinction.

Determine the current status of the banded physa through surveys including population trends, develop a specific management plan for this species or appropriate suite of freshwater gastropods that details status, threats, actions necessary to reverse declines or maintain stable populations, identify habitat requirements of all life stages of the banded physa and identify threats.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	

Table 2. Recommended conservation actions for banded physa.

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Originally prepared by	Samantha Hoff
Date first prepared	June 17, 2013
First revision	February 20, 2014 (Samantha Hoff)
Latest revision	Transcribed March 2024

Species Status Assessment

Common Name: Black sandshell **Date Updated:** 1/16/2024

Scientific Name: *Ligumia recta* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Ligumia recta belongs to the subfamily Ambleminae and the tribe Lampsilini, which includes 17 extant and 6 likely extirpated New York species of the genera Actinonaias, Epioblasma, Lampsilis, Leptodea, Ligumia, Obovaria, Potamilus, Ptychobranchus, Toxolasma, Truncilla, and Villosa (Haag 2012, Graf and Cummings 2011). L. recta is grouped in the Ligumia genus, which means seed or pod of a legume, referring to its long and pod-shaped structure. The species name recta, which means straight, refers to the elongated shape and parallel dorsal margins (Watters et al. 2009).

Since 1970, L. recta has been found in ten New York waterbodies. This species has three ranges in New York: the Allegheny basin, the Erie-Ontario basin, and the St. Lawrence-Champlain basin, reflecting its three routes of entry into the state. L. recta lives in large creeks, rivers, and large shallow lakes (Strayer and Jirka 1997).

In New York, L. recta is ranked as imperiled, although it is apparently secure throughout its range (NatureServe 2013). In North America, approximately ⅔ to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993, Stein et al.2000). While population trends in New York are unknown, based on sparse historical information, it is assumed that they too are declining due to a myriad of environmental stressors.

I. Status

a. Current legal protected Status

i. **Federal:** None **Candidate:** No

ii. **New York:** None, Proposed Special Concern listing (2019)

b. Natural Heritage Program

i. **Global:** G4G5 – Apparently secure/Secure

ii. **New York:** S2 - Imperiled **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Near Threatened (2015)

-Northeast Regional SGCN: No

-Midwest Regional SGCN: Yes

-American Fisheries Society Status: Special Concern (1993)

Status Discussion:

L. recta is widespread in eastern and central U.S. and Canada, occurring from the Great Lakes basin south into Mississippi River drainage, to Louisiana and in some Gulf Coast drainages. There have been some declines throughout its range. Lately it has become increasingly more difficult to find with many occurrences represented by few individuals, often without evidence of recruitment. Declines appear to be localized and the species continues to maintain a wide distribution with many stable populations (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Declining	Declining		Unlisted	(blank)
Northeastern US	Yes	Unknown	Unknown			No
New York	Yes	Choose an item.	Choose an item.		Proposed Special Concern	Yes
Connecticut	No	N/A	N/A			No
Massachusetts	No	N/A	N/A			No
New Jersey	No	N/A	N/A			No
Pennsylvania	Yes	Unknown	Unknown		S4	No
Vermont	Yes	Declining	Declining		Endangered, S1	Yes
Ontario	Yes	Stable	Stable	2003-2013	S3	(blank)
Quebec	No	Stable	Stable		S3	(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

As part of a 2009 to 2020 State Wildlife Grant funded project, NYSDEC Region 8 Fish and Wildlife staff conducted a native freshwater mussel baseline inventory of tributaries in central and western New York where this species might be found. No regular surveys are being conducted for this species at this time. Regulatory surveys may be conducted in known or likely habitat as part of the project review process.

Trends Discussion *(insert map of North American/regional distribution and status):*

Trends for New York populations are difficult to determine as most historic data comes from opportunistic naturalist collections, as opposed to more comprehensive baseline surveys. For example, mussels were documented for the first time in 50 of the 106 streams surveyed to date by the Southern Lake Ontario mussel inventory project (Mahar and Landry 2013). This is because many of these streams had never before been surveyed for mussels, not because mussel distribution has dramatically increased. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993, Stein et al. 2000). Based on New York's Natural Heritage S-rank, sparse historical data, and the plight of North America's freshwater mussels, it is assumed that trends are declining due to a myriad of environmental stressors.

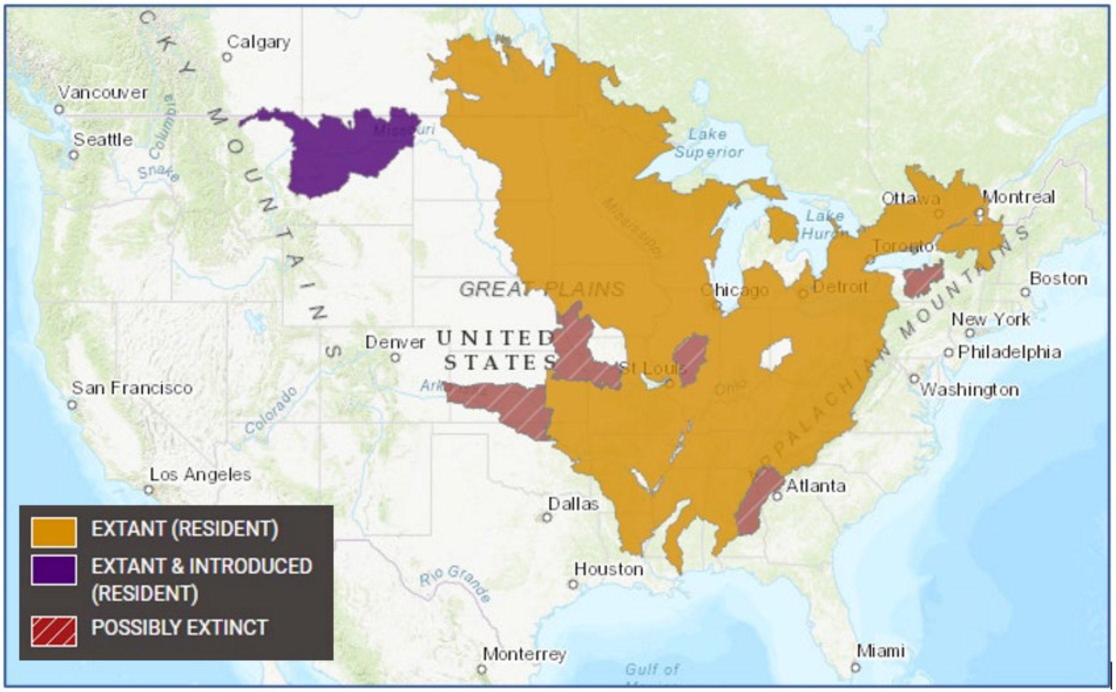

Figure 1. Black sandshell distribution (IUCN Redlist, 2024)

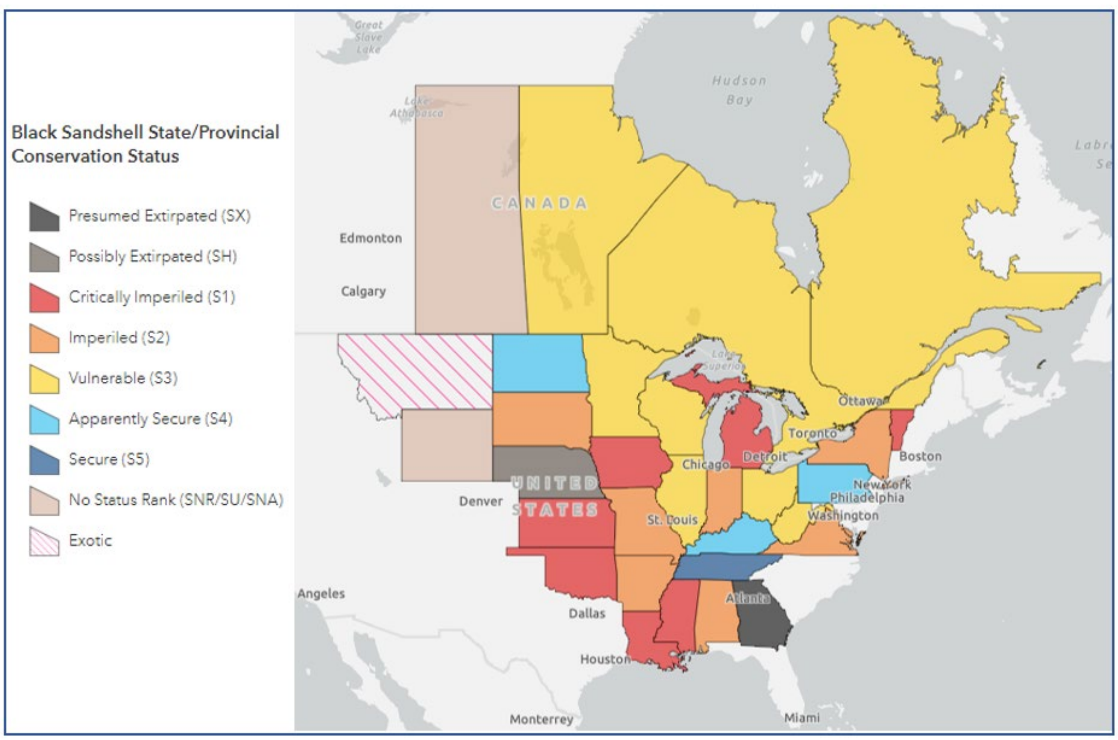

Figure 2. Black sandshell status (NatureServe, 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

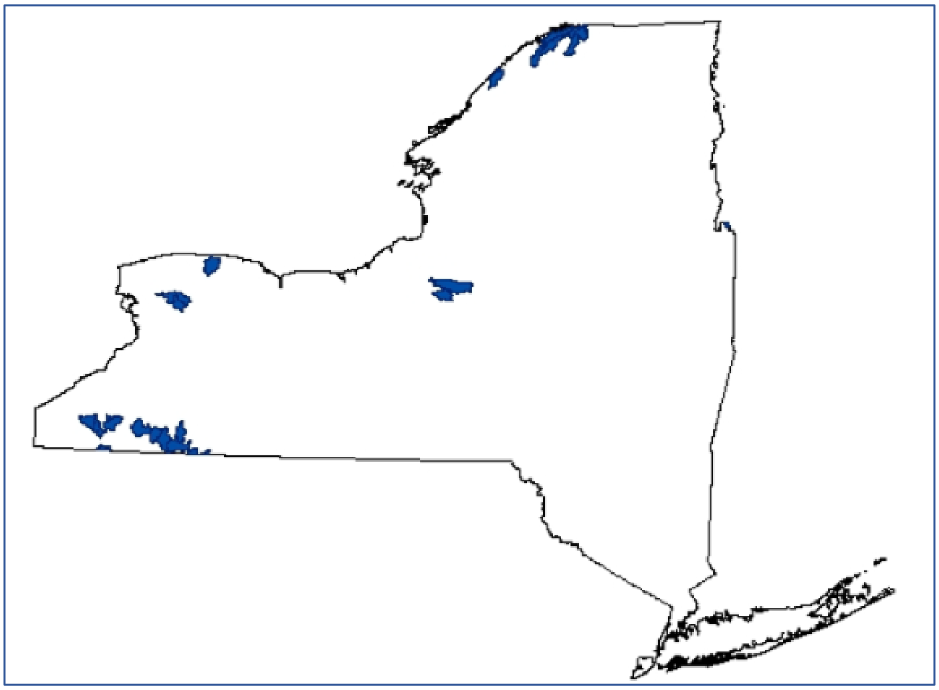

Figure 3. Records of black sandshell in New York (NYSDEC 2022)

Years	# of Records	# of Distinct Waterbodies	% of State
	______	______	______
	______	______	______
	______	______	______
Total	______	16	1.28%

Table 1. Records of black sandshell in New York .

Details of historic and current occurrence:

2024: 23 of 1802 HUC 12 watersheds (1.28%) and 16 waterbodies (not counting waterbodies in which only highly weathered shells "fossil shells" were found) (Figure 2).

L. recta has three ranges in New York: the Allegheny basin, the Erie-Ontario basin, and the St. Lawrence-Champlain basin, reflecting its three routes of entry into the state. In the Allegheny basin, it was historically known from the Allegheny River and Cassadaga Creek (Strayer and Jirka 1997). It has been recorded from Lakes Erie and Oneida, and in rivers and large creeks in between these lakes. In the St. Lawrence-Champlain basin, there are scattered records from the St. Lawrence River and its tributary, the Grass River, Lake Champlain, and the Poultney River (Strayer and Jirka 1997), which flows into Lake Champlain.

A 2009 survey of the Allegheny basin by The Nature Conservancy found 80 live L. recta, with populations at most sites in the Allegheny River between Portville and Salamanca, and in the lower sections of Conewango and Cassadaga Creeks, and in Oswayo Creek. Shells were also found in

Olean Creek. The greatest catches (up to 3.3 per hr) were in the Allegheny River near and upstream of Olean, NY. L. recta were considered viable at 13% (5 of 38 sites) of the sites where they were found (The Nature Conservancy 2009).

In 2010, an old weathered shell of this species was found in lower Oak Orchard Creek, a first record for this species in the Western Lake Ontario basin. In the Erie basin, more than 35 live specimens were confirmed at four locations on Tonawanda Creek between the towns of Pendleton and Alabama (Mahar and Landry 2013, NY Natural Heritage Program 2013). Additional recent occurrences include the Poultney River at the southern end of Lake Champlain, and in the St. Lawrence basin the Grass River and the Oswegatchie River (fossil) (Strayer and Jirka 1997, NY Natural Heritage Program 2013). Although widespread in New York, L. recta is usually seen in small numbers. It has not recently been found at historic sites between Rochester and Syracuse (Mahar and Landry 2013).

In 2011 and 2012 Zanatta, Burlakova, Karatayev et al. surveyed 6 locations (9 sites) in Lake Erie, and 54 sites at 33 locations in Lake Ontario (2012 only), and did not found L. recta at any of NYS locations.) Three live and 10 shells of L. recta were collected in 2012 at Chittenango Creek, a tributary of Oneida Lake (Bridgeport, Onondaga Co., State Hw 31 crossing), and 9 live L. recta were found in Tonawanda Creek in 2011-2013 (Burlakova, Karatayev, Karatayev, unpublished data).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	700 km

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Size/Waterbody Type: Medium River

b. Geology: Assume Moderately Buffered (Size 3+ rivers)

c. Temperature: Warm to Transitional Cool

d. Gradient: Low gradient to Low-Moderate gradient

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

L. recta is typically found in medium to large rivers (Cummings and Mayer 1992, McMurry et al. 2012, Metcalfe-Smith et al. 2005, Watters et al. 2009). It can also be found in large creeks, and some large, shallow lakes (Strayer and Jirka 1997). It is commonly cited that this species is associated with gravel or firm sand substrate (Parmalee 1967, Watters et al. 2009, McMurry et al. 2012, Metcalfe-Smith et al. 2005), but can occasionally be found in mud, silt, or cobbles (Parmalee and Bogan 1998, Metcalfe-Smith et al. 2005, NatureServe 2013). It is typically found in locations with strong current (riffles or raceways) in water depths from several inches to six feet or more (Metcalfe-Smith et al. 2005, Parmalee and Bogan 1998).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, this species must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable habitat, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely to be a slow process for mussels which use resident fishes with limited home ranges as their hosts (COSEWIC as cited in NatureServe 2013).

It has a periodic life history strategy, characterized by moderate to high growth rate, low to intermediate life span, age at maturity, and fecundity, but generally smaller body size than opportunistic species. Most species are long-term brooders. This life history strategy is considered an adaptation to allow species to persist in unproductive habitats or habitats that are subject to large-scale, cylindrical environmental variation or stress (Haag 2012).

Individuals of this species may live to be at least 30 years old, with female shell characteristics becoming apparent in the third year. L. recta is thought to be bradytictic, with eggs found in August, glochidia developing by September, and overwintering in the female until the following July (Watters et al. 2009).

L. recta glochidia have been shown to transform on rock bass (Ambloplites rupestris), central stoneroller (Campostoma anomalum), banded killifish (Fundulus diaphanus), redbreast sunfish (Lepomis auritus), green sunfish (Lepomis cyanellus), pumpkinseed (Lepomis gibbosus), orangespotted sunfish (Lepomis humilis), bluegill (Lepomis macrochirus), longear sunfish (Lepomis megalotis), largemouth bass (Micropterus salmoides), white perch (Morone americana), rosyface shiner (Notropis rubellus), yellow perch (Perca flavescens), white crappie (Pomoxis annularis), black crappie (Pomoxis nigromaculatus), sauger (Stizostedion canadense), and walleye

(Stizostedion vitreum) (Watters et al. 2009). Khym and Layzer, (2000), found 10 times more juveniles metamorphising on sauger than any other fish tested, including largemouth bass, bluegill, white crappie, black crappie. Other potential hosts include American eel (Anguilla rostrata) and common carp (Cyprinus carpio) (Watters et al. 2009).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Dams & Water Management/Use (levees and flood walls, channelization, dredging, impassable culverts)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (zebra mussels)
4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)
5. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, other regulated discharges)
6. Pollution	Household Sewage & Urban Waste Water (waste water treatment effluent, sewer and septic overflows)
7. Climate Change & Severe Weather	Droughts
8. Natural System Modifications	Dams & Water Management/Use (lowering of water table from agriculture, etc…, causing drying of habitat
9. Climate Change & Severe Weather	Storms & Flooding (extreme Storms)
10. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (die offs from unknown disease)

Agricultural Runoff
The watershed upstream of Olean in the Allegheny River where some of New York's largest populations of *L. recta* has been found is primarily a forested landscape (New York State Landcover 2010). However, cultivated cropland is present adjacent to the Allegheny River in portions of this area, as well as in important downstream habitat between Olean and Salamanca, and in streams with *L. recta* populations in the Conewango basin, Grass River, and Tonawanda Creek. Recently harvested

forest land was also prevalent upstream of and adjacent to *L. recta* habitat on the Grass River (New York State Landcover 2010). Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in western and central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar and Landry 2013), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer runoff is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag 2012). In addition, ammonia adsorbs to sediment particles, resulting in higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Runoff from Developed Land

All eight New York waterbodies that host *L. recta* populations are intermittently bordered by interstate highways, state routes, and/or local roads. *L. recta* habitat receives stormwater runoff from the municipalities of Olean, Portville, Salamanca and Allegany on the Allegheny River, Jamestown through a tributary to Conewango Creek, and Madrid on the Grass River. Residential development along Tonawanda Creek also contributes to the non-point source pollution received into *L. recta* habitat. These waterbodies are likely threatened by stormwater runoff containing metals and road salts (Gillis 2012). Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller and Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner and Pynnonen 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller and Zam 1991, Liquori and Insler 1985, Pandolfo et al. 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Treated Wastewater

L. recta habitat treated wastewater from the municipalities of Olean and Portville on the Allegheny River, Jamestown through a tributary to Conewango Creek, and Madrid on the Grass River (SPDES 2007). Recent studies show that mussel richness and abundance decrease with increased proximity to sewage effluent (Wildenberg 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al. 1978). Endocrine disrupters from pharmaceuticals are also present in municipal sewage effluents and are increasingly common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012). It should be noted that in the Susquehanna Basin, Harman and Lord (2010) found no evidence that wastewater treatment plants were responsible for reductions in mussel species of greatest conservation need.

Flood Control Projects
In the Upper Allegheny basin, large stretches of *L. recta* habitat has been found within or adjacent to stream reaches shaped by levee and/or floodwall flood control projects in Olean and Salamanca on the Allegheny River, and in Portville on the Allegheny River and Oswayo Creek ("New York State Flood Protection" 2013). These structures confine larger rivers, preventing the river from inundating its natural floodplains and wetlands to minimize flood damage. Additionally, many smaller streams have been channelized and bermed by landowners and highway departments to protect farm fields and other structures. Channelization and dredging associated with flood control projects are catastrophic to mussels and have been implicated in the decline of some populations (Watters et al. 2009). The result of these projects is altered seasonality of flow and temperature regimes, increased stream velocities, unstable substrates, changed patterns of sediment scour and deposition, including streambank erosion, altered transport of particulate organic matter (the food base for mussels), and a general degradation of stream habitat (Benke 1999, Yeager 1993, Nedeau 2008).

Other Habitat Modifications
In addition to channelization and regular channel dredging for maintenance of flood control structures, other ecosystem modifications such as instream work associated with bridge replacement, gravel mining, and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting "dredge" had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000).

Invasive Species
Invasive mussels are a potential threat to *L. recta* populations in the Conewango basin and in the Poultney River. Zebra mussels (*Dreissena polymorpha*) are present in *L. recta* habitat in the lower reaches of Cassadaga and Conewango Creeks (The Nature Conservancy 2009). They have also been detected in the Champlain Canal, approximately 2 miles downstream of *L. recta* habitat in the Poultney River (iMapInvasives 2013). Zebra mussels have been repeatedly cited as a threat to native mussel populations and have effectively eliminated native mussels from the western basin of Lake Erie (Strayer and Jirka 1997, Watters et al. 2009). En masse, Dreissenids outcompete native mussels by efficiently filtering food and oxygen from the water. They reduce reproductive success by filtering native mussel male gametes from the water column and they can foul the shells of the native mussels to the point that their valves can no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury (USFWS 1994).

In addition, the regular use of lampricide in the Poultney River to reduce sea lamprey populations was identified by Natural Heritage Program as a possible threat to *L. recta* populations in this waterbody (NY Natural Heritage Program 2013).

Climate Change

In a recent assessment of the vulnerability of at-risk species to climate change in New York, Schesinger et al. (2011) ranked this species as “extremely vulnerable.” This indicates that abundance and/or range extent within New York is extremely likely to substantially decrease or disappear by 2050.

Impoundments – Range wide

Range wide, impoundments likely contributed to the reduced distribution that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery and King 1983, ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓_ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any “protected stream”, its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York’s mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Priority conservation efforts for this species should focus on, but not be limited to, Tonawanda Creek and the Allegheny River near and upstream of Olean.

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley and Tank 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis 2012).
- Establish a protocol where as DEC staff work closely with flood control management to reduce or impacts to native mussels during maintenance flood control projects.
- Establish a protocol whereas DEC staff work closely with state and local highway departments to reduce impacts to native mussels during maintenance and construction projects.
- Replace culverts that disrupt aquatic habitat connectivity to allow for passage of small fish species.
- Develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.
- Within the Great Lakes and Champlain watersheds, lamprey control efforts should consider specific, potentially adverse, impacts to native freshwater mussels when determining methods, including selection of lampricide formulations and concentrations.

  Lampricide treatment managers should use caution when using the combination of TFM and niclosamide in streams with known mussel populations and every effort should be made to maintain lampricide concentrations at or near the MLC for sea lamprey to minimize the risk to this important faunal group (Boogaard 2006).
- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g., point and nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.
- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated

subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2. (need recommended conservation actions for black sandshell).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.

- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
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Species Status Assessment

Common Name: Brook floater **Date Updated:** 1/16/2024

Scientific Name: *Alasmidonta varicosa* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Alasmidonta varicosa belongs to the subfamily Unioninae, diagnosed by the presence of subtriangular glochidia with large, medial hooks, and the tribe Anodontini, which includes 16 extant and 1 likely extirpated New York species of the genera Alasmidonta, Anodonta, Anodontoides, Lasmigona, Pyganodon, Simpsonaias, Strophitus, and Utterbackia (Haag 2012, Graf and Cummings 2011). A. varicosa is closely related to and is often confused with Alasmidonta marginata (Simpson 1914). Systematics of the genus have not been reviewed genetically.

A. varicosa is one of the most endangered mussels in Northeastern America. It is listed as endangered in Massachusetts, Connecticut, New Hampshire, and New Jersey, threatened in Vermont and New York, and ranked as vulnerable throughout its range (Nedeau 2008). Since 1970, it has been found in 17 New York waterbodies in the Susquehanna and Delaware basins, and to a limited extent in the Connecticut coastal basin (Jirka 1991, Strayer and Jirka 1997). It is more commonly found in nutrient poor streams with low to moderate flow velocities and good water quality (Strayer and Jirka 1997, Nedeau 2008). Where it is found, it is usually uncommon (Strayer and Jirka 1997).

I. Status

a. Current legal protected Status

i. **Federal:** Not warranted (2019) **Candidate:** No

ii. **New York:** Threatened, Proposed for Endangered listing (2019)

b. Natural Heritage Program

i. **Global:** G3 - Vulnerable

ii. **New York:** S1 – Critically imperiled **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Vulnerable

-Northeast Regional SGCN: Yes

-COSEWIC: Special Concern (2009)

-American Fisheries Society Status: Threatened (1993)

Status Discussion:

Significant declines have been noted in Massachusetts, New York, Pennsylvania, New Jersey, Rhode Island, Virginia, North Carolina, and South Carolina. Approximately 70-90 site extirpations (of 150 or more known historically) have occurred globally with only a portion of the remaining sites holding healthy, viable populations. Although precise area of occupancy is not known and precise extent of decline is not known with accuracy, the loss of historical sites is indicative of a significant decline in area of occupancy over the last century (likely greater than 50% area of occupancy and range). Some good populations are known in the north (Vermont, and particularly Maine and a very large population just discovered in New Hampshire plus nine new populations in New Brunswick and Nova Scotia) where the species is stable but declining even in the more stable portions of its range (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Declining	Declining			(blank)
Northeastern US	Yes	Declining	Declining			Yes
New York	Yes	Declining	Declining		Threatened; proposed Endangered S1	Yes
Connecticut	Yes	Declining	Declining		Endangered, S1	Yes
Massachusetts	Yes	Declining	Declining		Endangered, S1	Yes
New Jersey	Yes	Declining	Declining		Endangered, S1	Yes
Pennsylvania	Yes	Declining	Declining	Since 1980	S2	Yes
Vermont	Yes	Declining	Declining		Endangered, S1	Yes
Ontario	No	N/A	N/A			(blank)
Quebec	No	N/A	N/A			(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

As part of a State Wildlife Grant, from 2009 to 2020, NYSDEC Region 8 Fish and Wildlife staff conducted a native freshwater mussel baseline inventory of tributaries in central and western New York.

In 2015, as a mitigation project, brook floater rapid assessment protocols were tested at sites in the Upper Susquehanna basin. (E. Nedeau).

Trends Discussion *(insert map of North American/regional distribution and status):*

Trends for New York populations are difficult to determine as most historic data comes from opportunistic naturalist collections, as opposed to more comprehensive baseline surveys. For example, mussels were documented for the first time in 50 of the 106 streams surveyed to date by the Southern Lake Ontario mussel inventory project (Mahar and Landry 2013). This is because many of these streams had never before been surveyed for mussels, not because mussel distribution has dramatically increased. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993, Stein et al.2000). Based on New York's Natural Heritage S-rank, sparse historical data, and the plight of North America's freshwater mussels, it is assumed that trends are declining due to a myriad of environmental stressors.

Figure 1. Brook floater distribution (IUCN Redlist 2023)

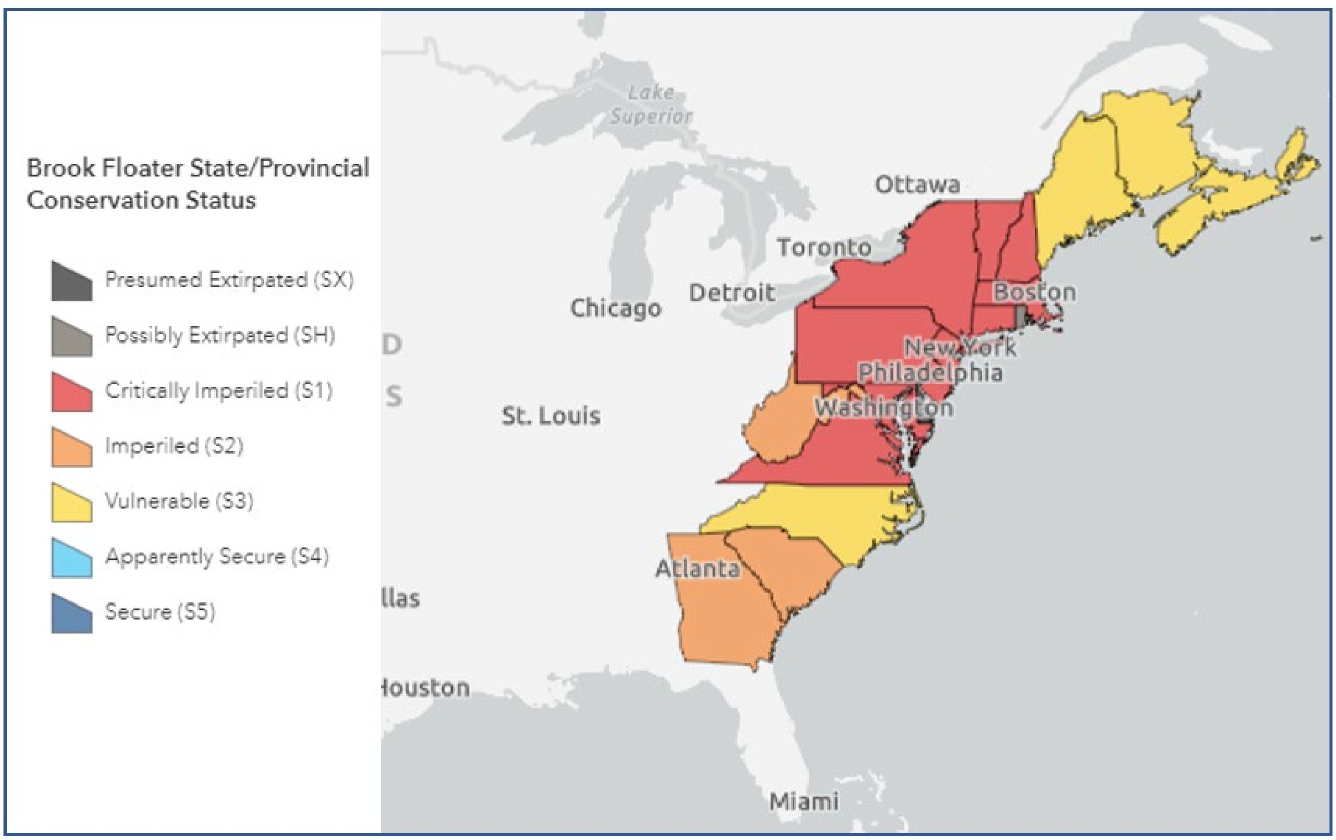

Figure 2. Brook floater status (NatureServe 2023)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

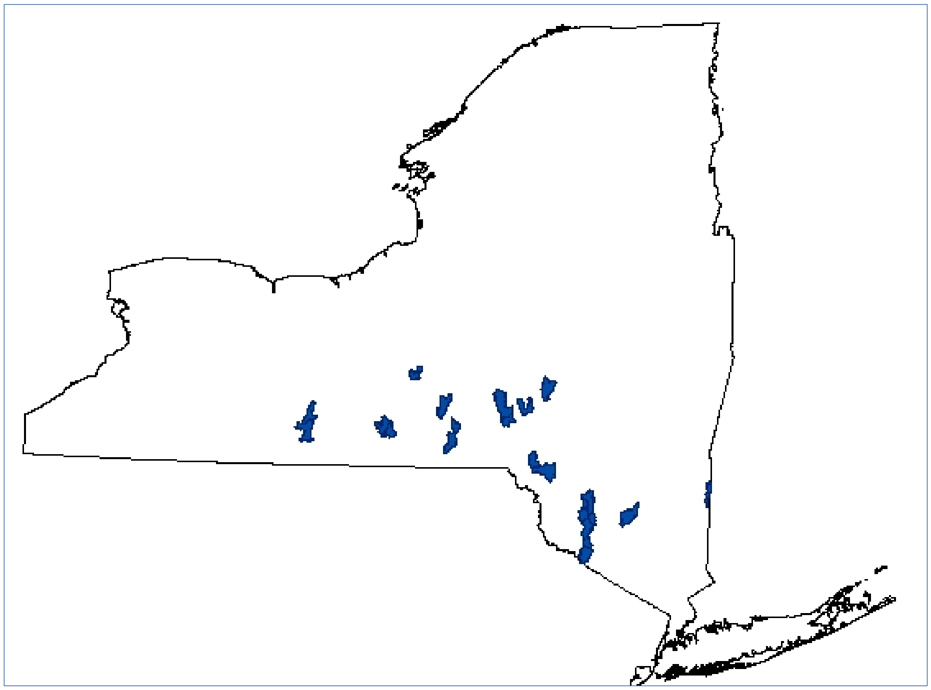

Figure 3. Records of brook floater in New York (NYSDEC 2022)

Years	# of Records	# of Distinct Waterbodies	% of State
	______	______	______
	______	______	______
	______	______	______
Total	______	14	**1.17%**

Table 1. Records of brook floater in New York.

Details of historic and current occurrence:

2024 – 21 of 1802 HUC 12 watersheds (1.17%) and 14 waterbodies.

In New York, populations in the Housatonic and Passaic basins have apparently disappeared and surveys of eleven historic populations in the Susquehanna basin in 1991 and 1995 turned up only one living animal (Jirka, 1991; Strayer and Jirk, 1997). New York Natural Heritage Program (2013) reported that A. varicosa was found in the Unadilla River in late 1960s and in Oaks Creek Index prior to 1935, but in recent surveys no evidence of this species was found in these streams. Populations in the upper Delaware basin and in the Shawangunk Kill in the Hudson basin were sparse and limited in extent (Strayer and Jirka 1997).

A. varicosa exists in 14 different waterbodies in New York State (Figure 3).

Since 1970, A. varicosa has been found in the Susquehanna basin in Sangerfield River (2 sites: 6 live 2008), Chenango River (at least 5 sites: live 2008), Tioughnioga River (live 1996), Otselic

River above Whitney Point Dam (1 site: 1 live 1996), and Catatonk Creek (7 sites: at least 18 live 1996) (NY Natural Heritage Program, 2013). In a recent survey of the Susquehanna basin, Harman and Lord (2010) also found live A. varicosa in the main stem of the Susquehanna River (at least 5 sites: 23 live), Chenango River, Chemung River (at least 5 sites: 5 live), and West Branch Tioughnioga River (1 site: 2 live).

In the Delaware basin, A. varicosa has been found in the Lower Beaver Kill East Branch (1 site: 1 live 2011), East Branch of the Delaware River (1 site: 2 live), its tributary, Twadell Brook, Delaware River from Hancock to Jarvis Point (7 sites: 9 live 2002), and the Neversink River between Woodbridge and Huguenot (13 sites, 129 live 2002), as well as its tributary, Sheldrake Stream (NY Natural Heritage Program 2013). In New York, only the Neversink River population is large, at approximately 100,000 animals (Strayer and Jirka 1997).

This species has also been found in Upper Hudson basin at Shawangunk Kill (3 sites: 4 live 1992, but not since), the Lower Hudson basin at Mahwah River (old shell 1994), and in the Connecticut coastal basin at Waebatuck and Wassaic Creeks (old shell 2010) (NY Natural Heritage Program 2013).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	145 miles

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Size/Waterbody Type: Small to Medium River

b. Geology: Moderately Buffered

c. Temperature: Transitional Cool to Warm

d. Gradient: Low Gradient to Moderate-High Gradient

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Yes	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

A. varicosa is strictly a running-water species and never occurs in lakes or reservoirs. It is said to favor gravelly riffles, sandy shoals, and stable habitats such as coarse sand and gravel in creeks and small rivers (Clarke 1981, Nedeau et al. 2000, Strayer and Jirka 1997), although Strayer and Ralley (1993) found no consistent substrate preference. It is thought to prefer low to moderate flow velocities. In fast water, they often will be found clustered in protected areas such as behind boulders and near banks (Nedeau 2008).

In general, A.varicosa is more common in upper portions of large watersheds with intact upland forest but is absent from headwater streams and high-gradient river reaches prone to scour (Nedeau 2008). It is found most frequently in nutrient-poor streams with low calcium levels, low nutrients, and good water quality (Nedeau 2008, Strayer and Jirka 1997). This species may be intolerant of the many stressors related to dams, urban areas, and other land uses that affect the quality of water and habitat (Nedeau 2008). Where it occurs, it is usually uncommon (Strayer and Jirka 1997).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, A.varicosa must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable habitat, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

While passive movement downstream may occur, in the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely to be a slow process for mussels which use resident fishes with limited home ranges as their hosts (COSEWIC as cited in NatureServe 2013).

This species has a periodic life history strategy, characterized by moderate to high growth rate, low to intermediate life span, age at maturity, and fecundity, but generally smaller body size than opportunistic species. Most species are long-term brooders. This life history strategy is considered an adaptation to allow species to persist in unproductive habitats or habitats that are subject to large-scale, cylindrical environmental variation or stress (Haag 2012).

This species is bradytictic, with fertilization occurring in the summer (August) and glochidia released the following spring (May) (Nedeau 2008, Clarke, 1981, Ortmann 1919). In Maine, release of glochidia occurs from April to June (and possibly later) (Nedeau et al. 2000). Probable hosts include long-nose dace (Rhinichthys cataractae), black-nose dace (Rhinichthys atratulus), slimy sculpin (Cottus cognatus), golden shiner (Notemigonus crysoleucas), pumpkinseed (Lepomis gibbosus), yellow perch (Perca flavescens), margined madtom (Noturus insignis), and tessellated darter (Nedeau, 2008, Strayer and Jirka 1997). No studies, however, have confirmed glochidial host transformation under natural conditions (NatureServe 2013). The life span of A. varicosa may be similar to that of Alasmidonta marginata, 12 years.

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Other Ecosystem Modifications (levees and flood walls, channelization, dredging, culverts)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (rusty crayfish, zebra mussel)
4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)
5. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, other regulated discharges)
6. Pollution	Household Sewage & Urban Waste Water (waste water treatment effluent, sewer and septic overflows)
7. Climate Change & Severe Weather	Droughts
8. Natural System Modifications	Dams & Water Management/Use (lowering of water table from agriculture, NYC water use, etc…, causing drying of habitat)
9. Climate Change & Severe Weather	Storms & Flooding (extreme storms)
10. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (die offs from unknown disease)
11. Invasive & Other Problematic Species & Genes	Problematic Native Species (hybridization with elktoe)
12. Energy Production & Mining	Oil & Gas (hydraulic fracturing)

Agricultural Runoff

Agricultural practices in the basins with *A. varicosa* populations may be sources of siltation and pollution. Although only 27 percent of the land in the New York portion of the Susquehanna basin is agriculture (Homer et al. 2007) the large majority of this agriculture is located adjacent to streams, many of which are identified as *A. varicosa* habitat. While this holds for most streams in the basin, it is particularly true of the Chenango River, and Catatonk Creek, and portions of the Susquehanna River (New York State Landcover 2010). Most of the Delaware basin is in forest land, however, land adjacent to the lower reaches of the Neversink River, where New York's largest *A. varicosa* populations are found, is dominantly cultivated cropland. The land adjacent to where *A. varicosa* has been found in the Shawangunk Kill, Lower Hudson, is a mix of cultivated crops, pasture, and developed land (New York State Landcover 2010). Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in Western and Central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar and Landry, 2013), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer runoff is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag 2012). In addition, ammonia adsorbs to sediment particles, resulting in higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Runoff From Developed Land

All 17 New York waterbodies that host *A. varicosa* populations are intermittently bordered by interstate highways, state routes, and/or local roads, and residences (New York State Landcover 2010). *A. varicosa* habitat receives storm water runoff from the municipalities of Corning, Painted Post, Cortland, Endicott, Waverly, Binghamton and its suburbs, Whitney Point, Green, and Norwich in the Susquehanna basin; Callicoon and Port Jarvis in the Delaware basin; and Crawford in the lower Hudson Basin (New York State Landcover 2010). These developed areas are likely sources of stormwater runoff containing metals and road salts (Gillis 2012). Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller and Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner and Pynnonen 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller and Zam 1991, Liqouri and Insler 1985, Pandolfo et al. 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Treated and Untreated Wastewater

In the Susquehanna basin, known *A. varicosa* sites are located downstream from nine City of Binghamton combined sewer outflow (CSO) outfalls ("Combined Sewer Overflow" 2012). In addition, *A. varicosa* habitat receives storm water runoff and treated wastewater from the municipalities of Corning, Painted Post, Cortland, Endicott, Waverly, Binghamton and its suburbs, Whitney Point, Green, and Norwich in the Susquehanna basin; Callicoon and Port Jarvis in the Delaware basin; and Crawford in the lower Hudson basin (SPDES 2007). Recent studies show that mussel richness and abundance decrease with increased proximity to sewage effluent (Wildenberg 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al. 1978). Endocrine disrupters from pharmaceuticals are also present in municipal sewage effluents and are increasing common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012). It should be noted that in the Susquehanna Basin, Harman and Lord (2010) found no evidence that wastewater treatment plants were responsible for reductions in mussel species of greatest conservation need.

Flood Control Projects

In the Susquehanna basin, large stretches of *A. varicosa* habitat has been found within or adjacent to stream reaches shaped by levee and/or floodwall flood control projects in Gang Mills on the Tioga River, Corning/Painted Post on the Chemung River, Nichols on the Susquehanna River, Vestal on the Susquehanna River, Binghamton on the Susquehanna and Chenango Rivers, Port Dickinson and Oxford on the Chenango River, and Whitney Point on the Tioughnioga River ("New York State Flood Protection" 2013). Additionally, many smaller streams have been channelized and bermed by landowners and highway departments to protect farm fields and other structures. These structures confine larger rivers, preventing the river from inundating its natural floodplains and wetlands to minimize flood damage. Channelization and dredging associated with flood control projects are catastrophic to mussels and have been implicated in the decline of some populations (Watters et al. 2009). The result of these projects is altered seasonality of flow and temperature regimes, increased stream velocities, unstable substrates, changed patterns of sediment scour and deposition, including streambank erosion, altered transport of particulate organic matter (the food base for mussels), and a general degradation of stream habitat (Benke, 1999, Yeager, 1993, Nedeau 2008).

Other Habitat Modifications

In addition to channelization and regular channel dredging for maintenance of flood control structures, other ecosystem modifications such as instream work associated with bridge replacement and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting "dredge" had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000).

Invasive Species

Invasive zebra mussels (*Dreissena polymorpha*) pose a threat to *A. varicosa* populations in the Chenango River, particularly downstream of Eastonbrook Reservoir in Madison County, the West Branch of the Tioughnioga River near Cortland, and in the Susquehanna River at Binghamton and south of Copperstown (Harman and Lord 2010, iMapInvasives, 2013). Harman and Lord (2010) note that zebra mussels are moving downstream from these headwater areas on the Susquehanna and are fouling and killing native pearly mussels. Zebra mussels have been repeatedly cited as a threat to native mussel populations (Strayer and Jirka 1997, Watters et al. 2009). En masse, Dreissenids outcompete native mussels by efficiently filtering food and oxygen from the water. They reduce reproductive success by filtering native mussel male gametes from the water column and they can foul the shells of the native mussels to the point that their valves can no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury (USFWS 1994).

Didymo (*Didymosphenia geminata*), a filamentous diatom, can form extensive mats that can smother stream bottoms and occlude habitat for mussels (Nedeau 2008).This invasive has been found in the East Branch of the Delaware River. If it becomes as abundant in the Delaware Basin as it has elsewhere, it could have enormous negative consequences for mussels, including *A. varicosa* (Nedeau 2008).

Water Temperature Changes

Temperature induced changes in fish communities could have a profound influence on the availability of hosts for freshwater mussels. Mussels, like *A. varicosa*, that inhabit small streams and rivers and rely on fish adapted for cooler water, such as several species of dace, minnows, sculpins, and darters, might be most affected by factors such as climate change or the removal of shaded buffers (Nedeau 2008). Pandolfo (2008) preformed a study in which the upper and lower temperature thresholds from several species of mussels, including *A. varicosa*, were determined. It was discovered that, compared to the other species tested, *A. varicosa*, seemed to be the most thermally tolerant, however, in a recent assessment of New York's at-risk species to climate change, Schlesinger et al. (2011) ranked *A. varicosa* as "extremely vulnerable". This indicates that abundance and/or range extent within New York is extremely likely to substantially decrease or disappear by 2050. Gailbreth et al. (2010) recently showed how regional climate patterns coupled with changing local water regimes and management strategies have shifted mussel populations from thermally sensitive species to thermally tolerant species.

Impoundments – Range wide

Range wide, impoundments likely contributed to the reduced distribution that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery and King 1983, ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

New York State Environmental Conservation Law, § 11-0535. 6 NYCRR Part 182: Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern; Incidental Take Permits

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any "protected stream", its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York's mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis 2012).

- Establish a protocol where as DEC staff work closely with Flood control management to reduce or impacts to native mussels during maintenance flood control projects.

- Update wastewater treatment facilities in Binghamton to eliminate combined sewer outflows.

- Monitor the Delaware River system for the spread of Didymo.

- Replace culverts that disrupt aquatic habitat connectivity to allow for passage of small fish species.

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g., point and nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

- Develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - ***https://www.iucnredlist.org/resources/conservation-actions-classification-scheme***

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2. (need recommended conservation actions for brook floater).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

- Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
First revision	February 25, 2014 (Samantha Hoff)
Latest revision	January 16, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Buffalo pebblesnail **Date Updated:**

Scientific Name: *Gillia altilis* **Updated By:**

Class: Gastropoda

Family: Hydrobiidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

The buffalo pebblesnail is native to the Atlantic coastal drainage of North America, occurring from New York and Vermont southward to South Carolina. Hydrobiidae is one of the most common and diverse gastropod families, with 185 species in 14 genera typically found in springs, creeks and small to medium rivers in temperate, subtropical and tropical regions of the world. The first record of the buffalo pebblesnail in the Great Lakes drainage was from Oneida Lake, New York around 1915-1918, however, in subsequent years it was likely extirpated from this water body and later recorded from Niagara-on-the-Lake, Lake Ontario, Lake Erie, and multiple locations in the Erie Canal. The buffalo pebblesnail was able to colonize Lake Ontario through the Erie Canal, extending its range westward, and is now considered established in the Lake Ontario drainage (Thompson 1984). It is usually found in freshwater stream environments and has adapted to inhabiting both stagnant waters in lakes and streams as well as rapidly moving waters.

I. Status

a. Current legal protected Status

i. Federal: Not listed **Candidate:** No

ii. New York: Special Concern; SGCN

b. Natural Heritage Program

i. Global: G5

ii. New York: S1 **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List:

-Northeast Regional SGCN:

American Fisheries Society: CS - Currently Stable

Status Discussion:

In some regions where this species is native, populations are declining or not very abundant (Kipp et al. 2013). In Vermont, this species is considered to be in greatest conservation need, and it is listed as a species of special concern in New York (unprotected but of special concern due to increasing evidence of vulnerability). Its state NatureServe rank is S1 (critically imperiled) because it is very vulnerable due to low abundance of species or required habitat (Kipp et al. 2013). It has a wide distribution, presumed large population, occurrence in a number of protected areas, tolerance of a broad range of habitats, tolerance to habitat modification, lack of substantial immediate threats, and because it is not in decline or is unlikely to be declining fast enough to qualify for global listing in a more threatened category (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable			Choose an item.
Northeastern US	Yes	Unknown	Unknown			Choose an item.
New York	Yes	Unknown	Unknown		SC	Yes
Connecticut	No	Choose an item.	Choose an item.			Choose an item.
Massachusetts	No	Choose an item.	Choose an item.			Choose an item.
New Jersey	No data	Unknown	Unknown	Not specified	Not listed	No
Pennsylvania	No data	Choose an item.	Choose an item.	Not specified	Not listed	No
Vermont	Yes	Declining	Declining		Not listed	Yes
Ontario	Yes	Unknown	Unknown			Choose an item.
Quebec	No	Choose an item.	Choose an item.			Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

None.

Trends Discussion *(insert map of North American/regional distribution and status):*

Short and long-term trends are unknown. In New York this species is vulnerable due to low abundance. Very few populations have been found in recent years throughout its range, but this could be due to either low abundances or lack of sampling (NatureServe 2013). The relative abundance of buffalo pebblesnail throughout its range is unknown and more information about this species habitat requirements and population trends is needed to determine specific challenges to its conservation.

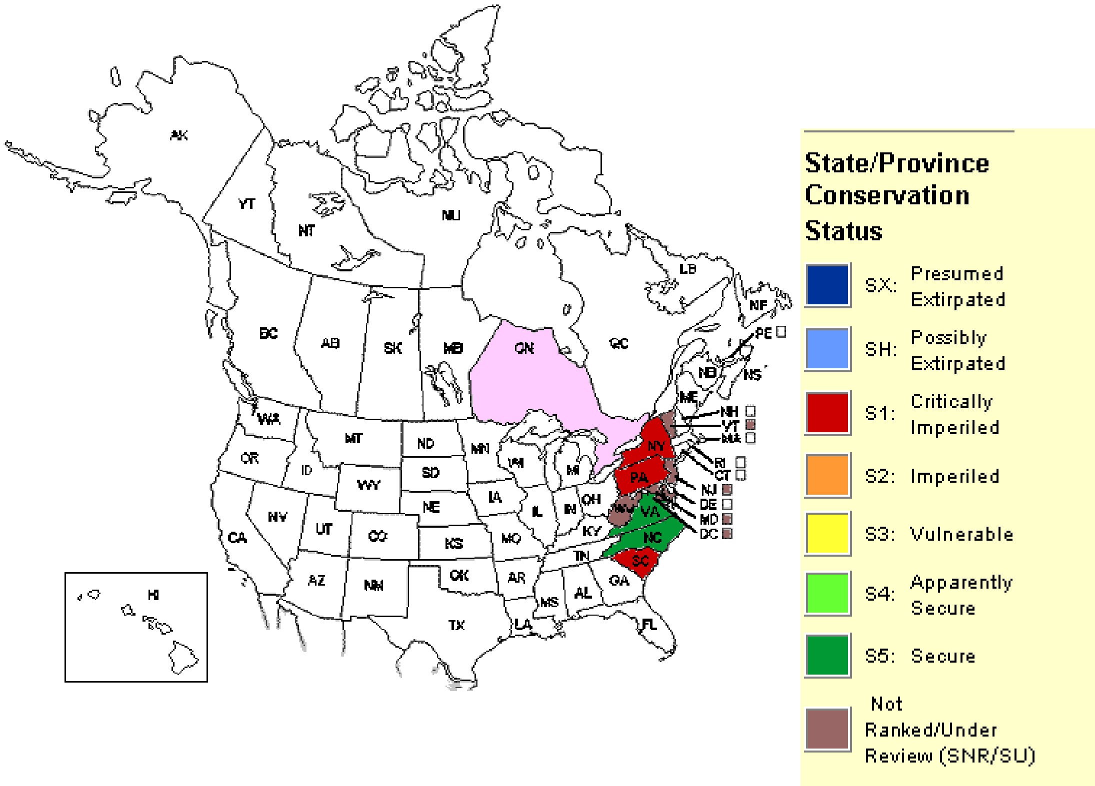

Figure 1. Conservation status of the buffalo pebblesnail in North America (NatureServe 2013).

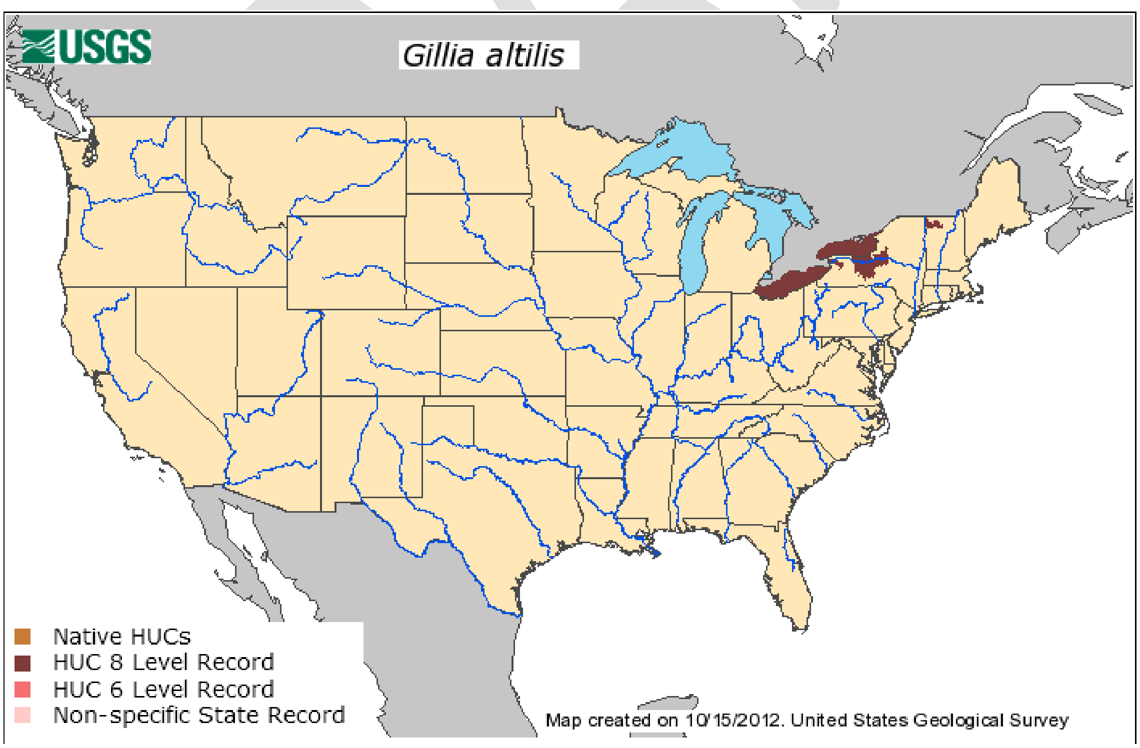

Figure 2. Distribution of buffalo pebblesnail by watershed in North America (Kipp et al. 2013).

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

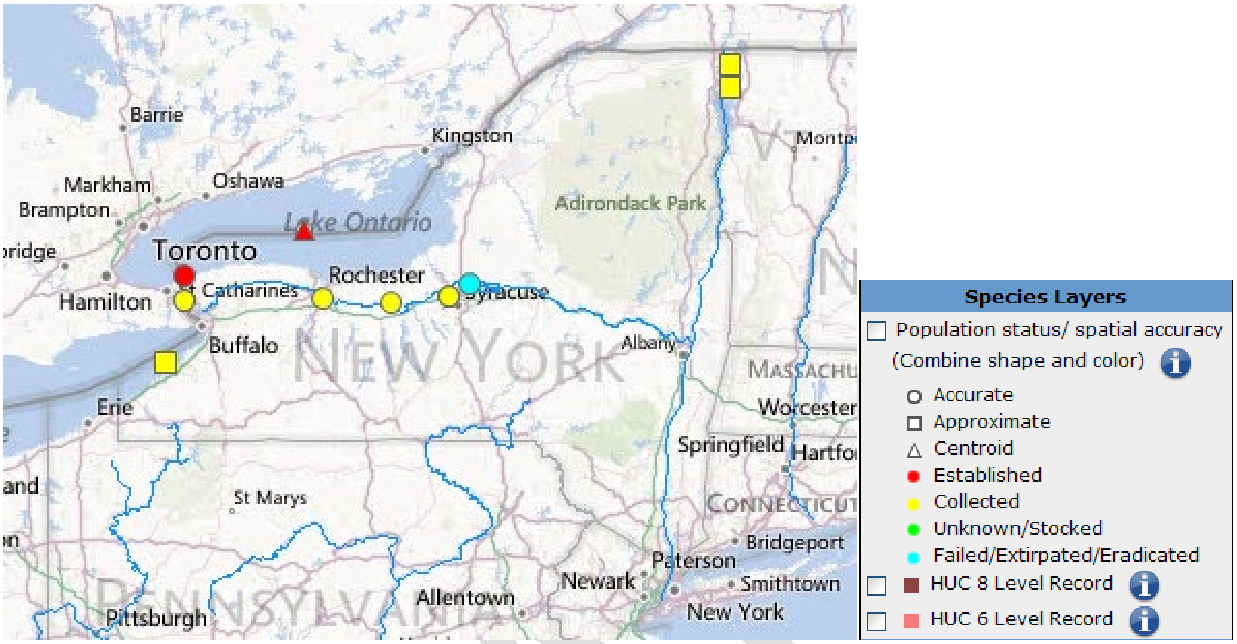

Figure 3. Distribution of buffalo pebblesnail depicting population status of collections (Kipp et al. 2013).

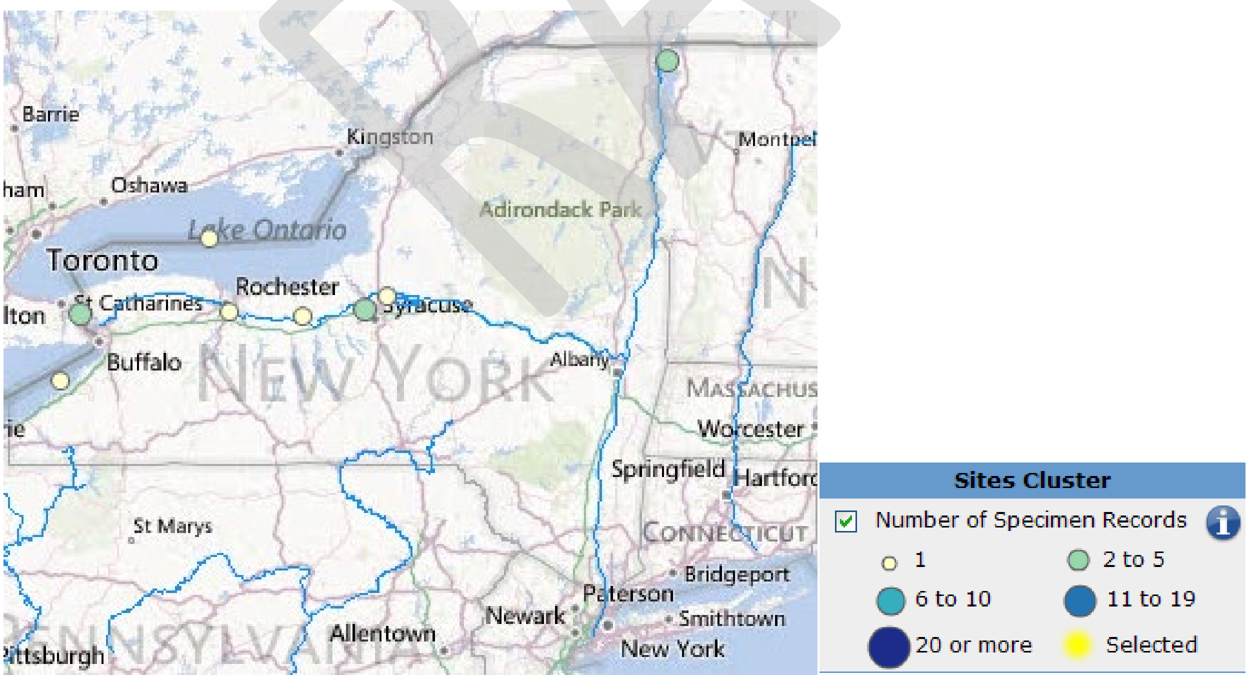

Figure 4. Distribution of buffalo pebblesnail depicting number of specimen records at each location (Kipp et al. 2013).

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	_______	_______	_______
1995-2004	_______	_______	_______
2005-2014	_______	_______	_______
2015- 2023	_______	_______	_______

Table 1. Records of buffalo pebblesnail in New York.

Details of historic and current occurrence:

The first record of this species was from Oneida Lake, Oswego County in 1915, but this population is now thought to be extirpated. This species has been recorded from the Erie Canal, Onondaga, and Herkimer counties; the Albany/Troy area and the Hudson River, Albany and Rensselear counties, and the Hudson River from Barrytown south to Straatsburg, Dutchess County. Shells have been found in beach wash from Lake Ontario, Monroe County; Oneida Lake, Oswego and Onondaga Counties; and the Salmon River, Oswego County (Jokinen 1992).

No populations were located during Jokinen's survey from 1978-1991 or Strayer's 1987 survey, but the USGS reports records from multiple locations in the past 20 years: Erie Canal at Clyde, Syracuse, and Brighton in 1993, Niagara River in Niagara Falls 1993, Erie Canal at Syracuse in 1994, and Lake Erie and Lake Ontario in 2005 (Kipp et al. 2013). Thompson (1984) sites the following localities from museum lots: Hudson River, Albany, Dutchess, and Ulster counties; Erie Canal, Herkimer and Onondaga counties; Champlain Canal, Rensselaer County; Niagara Falls, Niagara County; Monroe County; and Wayne County. The New York State Museum has numerous specimens from the Hudson River, Albany County.

The buffalo pebblesnail is rare due to low abundance in New York and also appears to be quite rare in the southern end of its range. Very few populations have been found in recent years and it is not clear whether reduced sightings are due to a decline in global abundance or to lack of extensive surveys for snails. Only a single population exists in South Carolina and it is also uncommon in Virginia, likely due to erosion and sedimentation of habitat (Dillon et al. 2006).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Core	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Large/Great River

b. Summer-stratified Monomictic Lake

c. Freshwater

d. Canal

e. Headwater/Creek

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Stable	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

Presence of the buffalo pebblesnail in the great lakes indicates it can be found in cold, clear lakes; however, it is usually found in freshwater streams, canals and rivers. Its globose shell is adapted for inhabiting high-velocity lotic environments and it has a large muscular foot used to suction to rocks (Kipp et al. 2013). It is well also well adapted to living on silty substrates as the foot prevents it from sinking, and it has been found to inhabit both stagnant waters in lakes and streams as well as rapidly moving waters (Thompson 1984). In the Hudson River, this species occurred on mud and aquatic plants in shallow water (Townes 1936).

Aquatic gastropods are frequently used as bioindicators because they are sensitive to water quality and habitat alteration (Callil and Junk 2001, Salanki et al. 2003).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	Choose an item.	Choose an item.	Yes	Yes	Choose an item.

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

As a prosobranch snail, the sexes of this species are dioecious, or separate, with internal fertilization (Dillon et al. 2006). Females lays single or clumps of eggs (up to six at a time) in hemispherical-shaped capsules on solid substrates, including leaves, stems of macrophytes, shells of other gastropods, stones or leave litter in late spring or early summer (Dillon et al, 2006, Kipp et al. 2013). Few detailed life history studies have been completed, but the maximum age of species is thought to be 2 years (AFS 2013).

It is speculated that this species is a generalized grazer, like most Hydrobiidae. It has a specialized radula, adapted for grazing on coarser food particles than those of other related snails (Kipp et al. 2013).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Residential & Commercial Development	Housing & Urban Areas (habitat loss/degradation)
2. Natural System Modifications	Dams & Water Management/Use (dams, channelization)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (New Zealand mud snail)
4. Pollution	Industrial & Military Effluents (metals)
5. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers)
6. Pollution	Household Sewage & Urban Wastewater (untreated sewage)
7. Climate Change & Severe Weather	Habitat Shifting & Alteration

High imperilment rates among freshwater gastropod groups have been linked to alteration, fragmentation and destruction of habitat from the creation of dams and impounded reaches, development of riparian areas, channelization, erosion, groundwater withdrawal and associated impacts on surface streams (flows, temperature, dissolved oxygen), multiple forms of pollution (salt, metals, untreated sewage, agricultural runoff, pesticides/fertilizers), changes in aquatic vegetation, and invasion of exotic species (AFS 2013).

Most gastropod species live in the shallows (depths less than 3 meters), where food abundance is greatest. As a result, drastic water fluctuations, such as draw-downs, may cause declines in snail populations (Hunt and Jones 1972). Strayer (1987) concluded that human activities had destroyed much of the original mollusk fauna in some parts of the Hudson basin, but not in others. Channelization of farmed mucklands and industrial pollution from Beacon were noted as causes for the notably reduced biodiversity of mollusks in the Wallkill River of Orange County and the Fishkill River of Dutchess County, respectively.

The New Zealand mud snail (*Potamopyrgus antipodarum*) is a highly invasive species that was introduced in Idaho in the 1980s. It can have devastating consequences to aquatic ecosystems, reducing or eliminating native snail species (Benson et al. 2013). This snail was found established in Lake Ontario in 1991 (Zaranko et al. 1997) and in Lake Erie in 2005 (Levri et al. 2007).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ **No:** ____ **Unknown:** ____

If yes, describe mechanism and whether adequate to protect species/habitat:

The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Environmental Conservation Law.

The Freshwater Wetlands Act provides protection for regulated wetlands greater than 12.4 acres in size under Article 24 of the NYS Conservation Law. The Adirondack Park Agency has the authority to regulate smaller wetlands within the Adirondack Park. The Army Corps of Engineers has the authority to regulate smaller wetlands in New York State, and the DEC has the authority to regulate smaller wetlands that are of unusual local importance.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Basic biological information is lacking for most taxa of freshwater gastropods and there is a strong need for surveys and biological studies given the strong evidence of decline and extinction.

The following goals and recommended actions are provided in the NY Comprehensive Wildlife Conservation Strategy (NYSDEC 2005):

- Conduct surveys to determine distribution and population trends
- Identify habitat requirements for all life stages
- Develop specific plans for each listed species (or appropriate suite of species) that details status, threats, and actions necessary to reverse declines or maintain stable populations
- Develop fact sheets for each listed species for paper and online distribution

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2. Recommended conservation actions for buffalo pebblesnail.

VII. References

American Fisheries Society (AFS). 2013. Conservation status of freshwater gastropods of Canada and the United States by the Gastropod Subcommittee (Endangered Species Committee). Fisheries 38(6): 247-282.

Callil, T. C. and W. J. Junk. 2001. Aquatic gastropods as mercury indicators in the Pantanal of Pocone region (Mato Grosso, Brasil). Water, Air and Soil Pollution. 319:319-330.

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Hunt, P.C. and J.W. Jones. 1972. The food of brown trout in Ilyn Alaw, Anglesey, North Wales. Journal of Fish Biology, 4: 333-352.

Jokinen, E.H. 1992. The freshwater snails (Mollusca: Gastropoda) of New York State. New York State Museum Bulletin 482: 1-112.

Levri, E. P., A. A. Kelly, and E. Love. 2007. The invasive New Zealand mud snail (*Potamopyrgus antipodarum*) in Lake Erie. Journal of Great Lakes Research 33: 1–6.

Kipp, R.M., A.J. Benson, J. Larson, and A. Fusaro. 2013. Gillia altilis. USGS Nonindigenous Aquatic Species Database, Gainsville, FO. Available: http://nas/er/usgs.gov/queries/FactSheet.aspx?speciesID=1007. Revision Date: 7 June, 2012.

NatureServe. 2013. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available: http:www.natureserve.org/explorer. Accessed: 17 June, 2013.

New York State Department of Environmental Conservation (NYSDEC). 2005. New York State Comprehensive Wildlife Conservation Strategy. Available: http://www.dec.ny.gov/index.html. Accessed: 17 June 2013.

Salanki, J., A. Farkas, T. Kamardina, and K. S. Rozsa 2003. Molluscs in biological monitoring of water quality. Toxicology Letters 140-141: 403-410.

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Townes, Jr., H.K. 1936. Studies of the food organisms of fish. A biological survey of the Lower Hudson watershed. State Of New York Conservation Department Annual Report 26. 217-230.

Zaranko, D.T., D.G. Farara, and F.G. Thompson. 1997. Another exotic mollusk in the Laurentian Great Lakes: the New Zealand native Potamopyrgus antipodarum (Gray 1843) (Gastropoda, Hydrobiidae).

Originally prepared by	Samantha Hoff
Date first prepared	June 17, 2013
First revision	February 20, 2014
Latest revision	Transcribed March 2024

Species Status Assessment

Common Name: Campeloma spire snail **Date Updated:**

Scientific Name: *Cincinnatia cincinnatiensis* **Updated By:**

Class: Gastropoda

Family: Hydrobiidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

The Campeloma spire snail, also referred to as the midland snail, is a midwestern species that probably entered the Hudson basin through the Erie Canal. Its distribution ranges from New York and Pennsylvania west to southern Manitoba, southern Saskatchewan, North Dakota and Utah, and south to Texas, Kansas, and Kentucky. There has been a long term decline in NY since the 1900s but three new locations were discovered at Cayuga Lake in 2013 (Expert meeting).

Authors have determined that *Paludina integra* (Say 1821) is actually *Cincinnatia cincinnatiensis,* and most consider *Cincinnatia integra* (Say 1821) a synonym of *Cincinnatia cincinnatiensis* (Jokinen 1992, NatureServe 2013).

I. Status

a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Not listed; SGCN

b. Natural Heritage Program

i. **Global:** G5

ii. **New York:** S1 **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List:

-Northeast Regional SGCN:

Status Discussion:

The Campeloma spire snail is ranked Secure globally due to its wide distribution, presumed large population, occurrence in a number of protected areas, tolerance of a broad range of habitats, tolerance to habitat modification, lack of substantial immediate threats, and because it is not in decline or is unlikely to be declining fast enough to quality for listing in a more threatened category (NatureServe 2013). In New York this species was found during 2013 at Cayuga Lake, after more than 30 years with no records.

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable			Choose an item.
Northeastern US	Yes	Declining	Declining			Choose an item.
New York	Yes	Unknown	Unknown	1970s-2013		Yes
Connecticut	No	Choose an item.	Choose an item.			Choose an item.
Massachusetts	No	Choose an item.	Choose an item.			Choose an item.
New Jersey	No	Choose an item.	Choose an item.			Choose an item.
Pennsylvania	Yes	Unknown	Unknown		Not listed	Yes
Vermont	Yes	Unknown	Unknown		Not listed	No
Ontario	Yes	Unknown	Unknown		Not listed	Choose an item.
Quebec	Yes	Unknown	Unknown		Not listed	Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

None.

Trends Discussion *(insert map of North American/regional distribution and status):*

Short and long-term trends for this species are unknown. The last records in New York are from the 1970s, but museum data indicates it was once locally abundant.

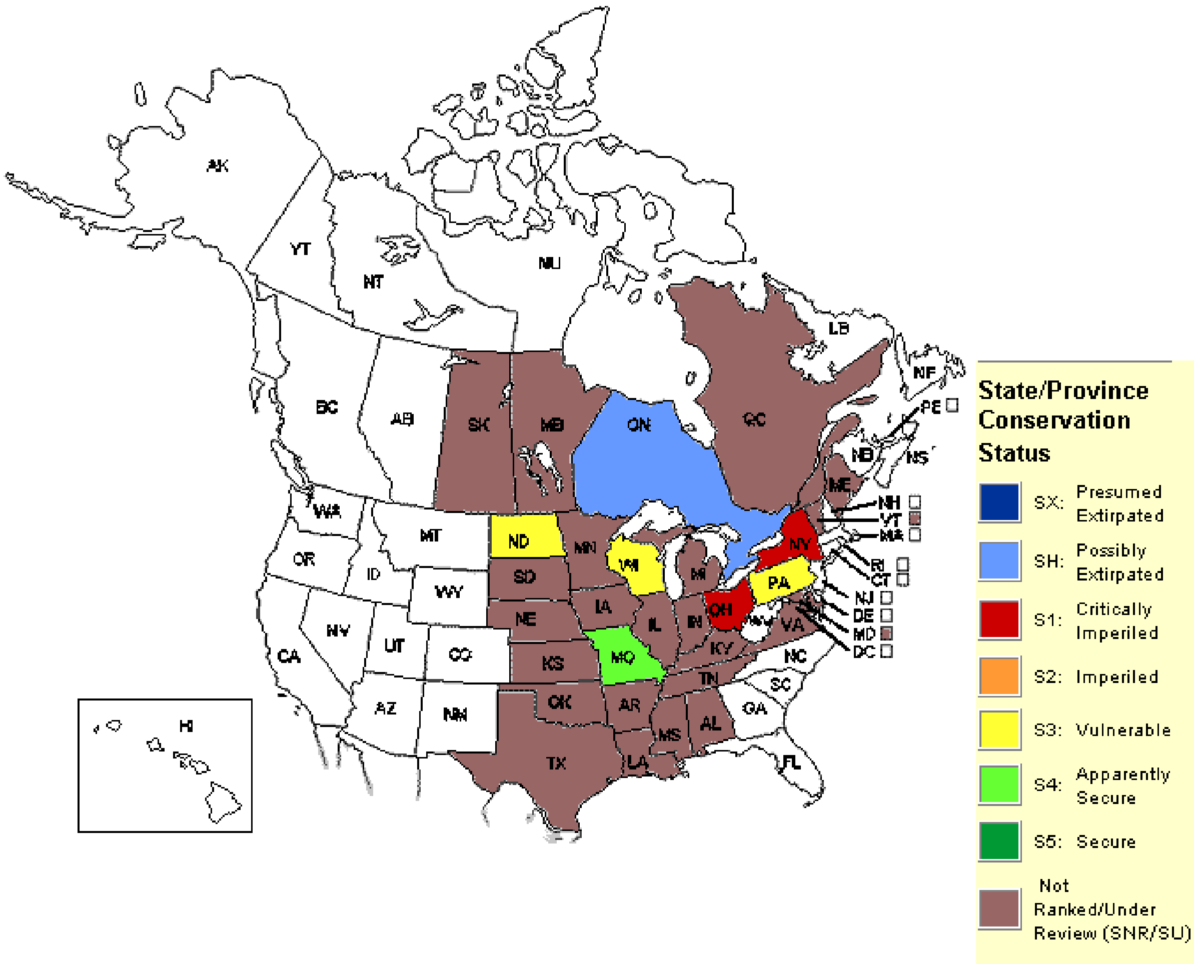

Figure 1. Conservation status of the Campeloma spire snail in North America (NatureServe 2013).

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995			<1%
1995-2004			
2005-2014		3	
2015- 2023			

Table 1. Records of Campeloma spire snail in New York.

Details of historic and current occurrence:

Early records show that this species was found in the Erie Canal, Onondaga County (Beauchamp 1886); in the Canal and Mohawk River at Mohawk, Herkimer County(Lewis 1872, Marshall 1894); the "Mohawk basin", Saratoga County(Aldrich 1869); Park Lake, Buffalo, Erie County (Letson 1909); as beach wash from Lake Ontario, Monroe County (Baker 1900); Sodus Bay, Lake Ontario, Wayne County; and the Salmon River, Oswego County (Burdick 1939) (Jokinen 1992). Museum lots contain dozens to hundreds of individuals, so it was at least locally abundant, and the New

York State Museum has lots from the Erie Canal, Mohawk, Herkimer County, and from Ontario County (Strayer 1987, Jokinen 1992). Jokinen (1992) discusses populations that were found in the Oswego River drainage system in the 1970s. Shells, but no live animals, washed up in Canadarago Lake, Otsego County (Harman 1973). Additional populations were located in the Moose River, Lewis County; Kayuta Lake, Oneida County; inlet of Fifth Lake, Hamilton County, and two sites in Lewis County (Buckley 1977).

No populations were found during Jokinen's surveys of 1978-1991 or Strayer's 1985 survey. In September of 2013 Alexander Karatayev and Lyubov Burlakova found 7 individuals in 3 locations in Cayuga Lake (Y. Karatayev, personal communication).

Rarity in New York state is unknown due to lack of recent occurrence records, but museum records indicate it was once locally abundant.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Headwater/Creek

b. Summer-stratified Monomictic Lake

c. Canal

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Yes	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

The Campeloma spire snail lives on muddy ooze or sand in slow creeks and lakes with little aquatic vegetation. In North Dakota, populations are commonly associated with *Amnicola limosa*, and they inhabit large and small streams and permanent lakes and ponds. It has been noted in mesotrophic lakes as well as a deep littoral resident of large lakes with silt and detritus substrates. Reported habitat pH is 7.9-8.4, and it may be limited to high calcium habitats, but more information is needed to sustain this possibility (Jokinsen 1992).

Aquatic gastropods are frequently used as bioindicators because they are sensitive to water quality and habitat alteration (Callil and Junk 2001, Salanki et al. 2003).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	Choose an item.	Choose an item.	Yes	Yes	Choose an item.

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Little is known regarding species-specific life history information of the Campeloma spire snail. As a member of the subclass Prosobranchia and the clade Caenogastropoda, the Campeloma spire snail is a long-lived dioecious species with internal fertilization and slow maturation (Dillon 2006, AFS 2013). They require at least a year to mature and have retained the ancestral gilled respiration (Dillon 2006). Females generally attach eggs to firm substrates in late spring and early summer (AFS 2013). Diatoms are its main food source (Berry 1943).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Residential & Commercial Development	Housing & Urban Areas (habitat loss/degradation)
2. Natural System Modifications	Dams & Water Management/Use (dams, channelization)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (New Zealand mud snail)
4. Pollution	Industrial & Military Effluents (metals)
5. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers)
6. Pollution	Household Sewage & Urban Wastewater (untreated sewage)
7. Climate Change & Severe Weather	Habitat Shifting & Alteration

Species-specific threats are not discussed in the literature, however high imperilment rates among freshwater gastropods have been linked to alteration, fragmentation, and destruction of habitat and introduction of non-indigenous species. Causes of habitat degradation and loss include creation of dams, impounded reaches, development of riparian areas, channelization, erosion, excess sedimentation, groundwater withdrawal and associated impacts on surface streams (flows, temperature, dissolved oxygen), multiple forms of pollution (salt, metals, untreated sewage, agricultural runoff, pesticides/fertilizers), changes in aquatic vegetation, and invasion of exotic species (AFS 2013).

Most gastropod species live in the shallows (depths less than 3 meters), where food abundance is greatest. As a result, drastic water fluctuations, such as draw-downs, may cause declines in small populations (Hunt and Jones 1972). Strayer (1987) concluded that human activities had destroyed much of the original mollusk fauna in some parts of the Hudson basin, but not in others. Channelization of farmed mucklands and industrial pollution from Beacon were noted as causes for the notably reduced biodiversity of mollusks in the Wallkill River of Orange County and Fishkill Creek of Dutchess County, respectively.

The New Zealand mud snail (*Potamopyrgus antipodarum*) is a highly invasive species that was introduced in Idaho in the 1980s. It can have devastating consequences to aquatic ecosystems, reducing or eliminating native snail species (Benson et al. 2013). This snail was found established in Lake Ontario in 1991 (Zaranko et al. 1997) and in Lake Erie in 2005 (Levri et al. 2007).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ **No:**_____ **Unknown:**_____

If yes, describe mechanism and whether adequate to protect species/habitat:

The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Environmental Conservation Law.

The Freshwater Wetlands Act provides protection for regulated wetlands greater than 12.4 acres in size under Article 24 of the NYS Conservation Law. The Adirondack Park Agency has the authority to regulate smaller wetlands within the Adirondack Park. The Army Corps of Engineers has the authority to regulate smaller wetlands in New York State, and the DEC has the authority to regulate smaller wetlands that are of unusual local importance.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Basic biological information is lacking for most taxa of freshwater gastropods and there is a strong need for surveys and biological studies given the strong evidence of decline and extinction.

The following goals and recommended actions are provided in the NY Comprehensive Wildlife Conservation Strategy (NYSDEC 2005):

- Conduct surveys to determine distribution and population trends
- Identify habitat requirements for all life stages
- Develop specific plans for each listed species (or appropriate suite of species) that details status, threats, and actions necessary to reverse declines or maintain stable populations
- Develop fact sheets for each listed species for paper and online distribution

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - ***https://www.iucnredlist.org/resources/conservation-actions-classification-scheme***

Conservation Actions

Action Category	Action
1.	
2.	

Table 2. Recommended conservation actions for Campeloma spire snail.

VII. References

American Fisheries Society (AFS). 2013. Conservation assessment of freshwater gastropods (snails) from Canada and the United States by the Gastropod Subcommittee (Endangered Species Committee). Fisheries 38: 247-282.

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Hunt, P.C. and J.W. Jones. 1972. The food of brown trout in Ilyn Alaw, Anglesey, North Wales. Journal of Fish Biology 4: 333-352.

Jokinen, E.H. 1992. The freshwater snails (Mollusca: Gastropoda) of New York State. New York State Museum Bulletin 482.

Levri, E. P., A. A. Kelly, and E. Love. 2007. The invasive New Zealand mud snail (*Potamopyrgus antipodarum*) in Lake Erie. Journal of Great Lakes Research 33: 1–6.

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Salanki, J., A. Farkas, T. Kamardina, and K. S. Rozsa 2003. Molluscs in biological monitoring of water quality. Toxicology Letters 140-141: 403-410.

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Zaranko, D.T., D.G. Farara, and F.G. Thompson. 1997. Another exotic mollusk in the Laurentian Great Lakes: the New Zealand native Potamopyrgus antipodarum (Gray 1843) (Gastropoda, Hydrobiidae).

Originally prepared by	Samantha Hoff
Date first prepared	June 18, 2013
First revision	February 20, 2014 (Samantha Hoff)
Latest revision	Transcribed March 2024

Species Status Assessment

Common Name: Canadian duskysnail **Date Updated:**

Scientific Name: *Lyogyrus walkeri* **Updated By:**

Class: Gastropoda

Family: Hydrobiidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

The distribution of the Canadian duskysnail ranges across the St. Lawrence River and Great Lakes drainages, upper Mississippi drainage, through the Canadian interior basin in the Albany and Winnipeg River systems, and in Lake Winnipeg. In the United States, it occurs from central New York west to Wisconsin and south to the upper Mississippi River Basin, with an extant population in Lake St. Catherine, Vermont. In 1991 the Canadian duskysnail was elevated from the status of a subgenus of *Amnicola* to full generic rank, and is now placed in the genus *Lyogyrus* (NatureServe 2013). Old records show its presence in scattered areas of the state, with the earliest populations recorded in 1843 from Cayuga Lake, Cayuga, Seneca and Tomkins Counties, and from streams entering Lake Champlain, Clinton County. No living snails were found in Jokinen's 1978-1991 surveys and the last record was from 1971.

I. Status

a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Not listed; SGCN

b. Natural Heritage Program

i. **Global:** G3G4

ii. **New York:** SNR **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List:

-Northeast Regional SGCN:

Status Discussion:

The Canadian duskysnail is globally ranked Vulnerable by NatureServe due to its limited distribution and lack of recent population records. It is in decline in Manitoba and there are only a few widely scattered records in western and northern Michigan. In Vermont, it is only known from Lake St. Catherine. Although it has not been state ranked in New York, there are no records after 1971.

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Declining	Declining			Choose an item.
Northeastern US	Yes	Declining	Declining			Choose an item.
New York	Yes	Unknown	Unknown	1970-2013		Choose an item.
Connecticut	No	Choose an item.	Choose an item.			Choose an item.
Massachusetts	No	Choose an item.	Choose an item.			Choose an item.
New Jersey	No	Choose an item.	Choose an item.			Choose an item.
Pennsylvania	Yes	Unknown	Unknown		Not listed	Yes
Vermont	Yes	Unknown	Unknown		Not listed	Yes
Ontario	Yes	Unknown	Unknown		Not listed	Choose an item.
Quebec	Yes	Unknown	Unknown		Not listed	Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

None.

Trends Discussion *(insert map of North American/regional distribution and status):*

Short and long-term trends for the Canadian duskysnail are unknown. Populations are declining throughout much of its range or have disappeared from some locations.

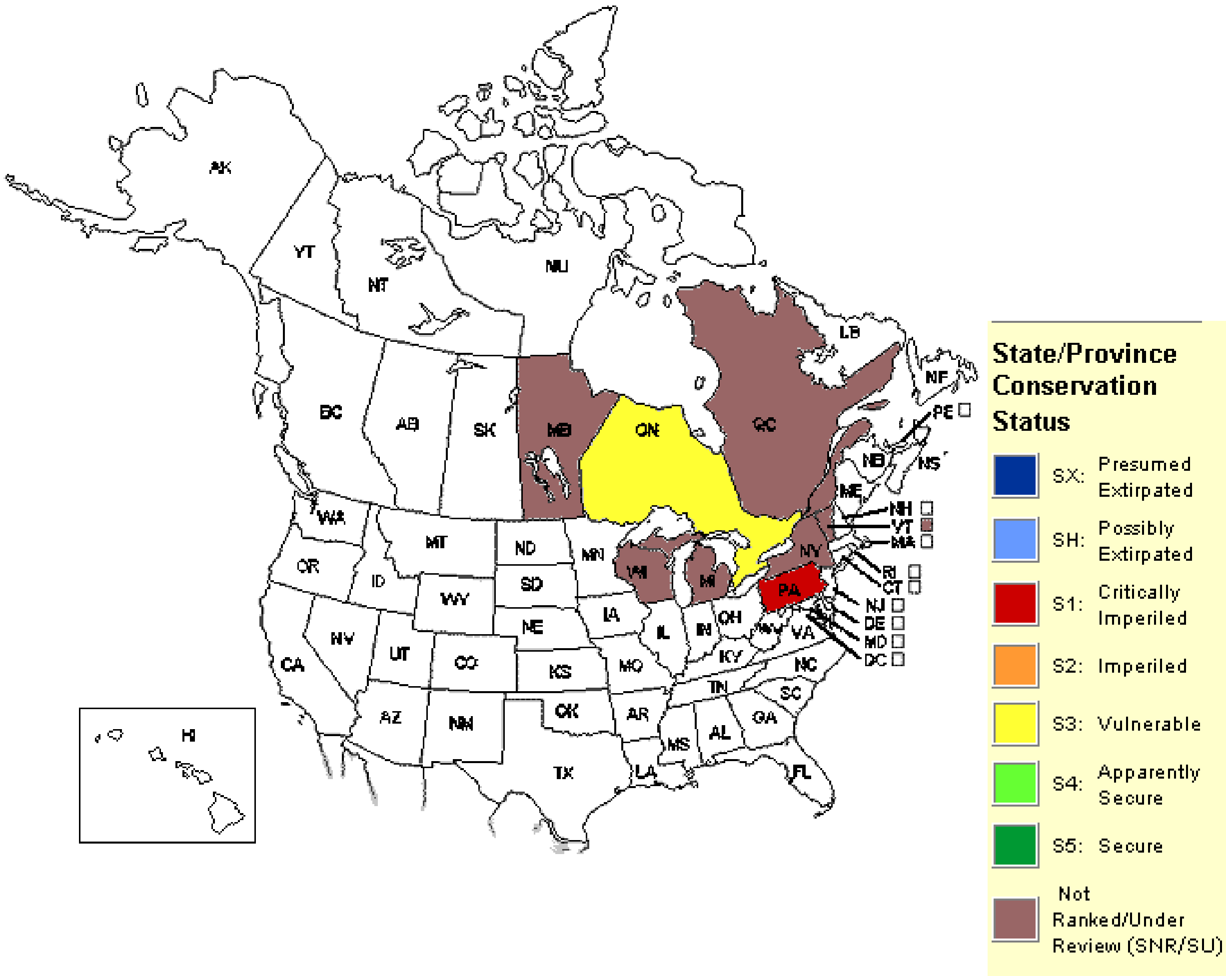

Figure 1. Conservation status of the Canadian duskysnail in North America (NatureServe 2013).

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	_______	_______	_______
1995-2004	_______	_______	_______
2005-2014	_______	_______	_______
2015- 2023	_______	_______	_______

Table 1. Records of Canadian duskysnail in New York.

Details of historic and current occurrence:

Old records from scattered areas in the state document the presence of *L. walkeri*, then known as *Amnicola lustrica*. The earliest record is from De Kay (1843) who reported populations from Cayuga Lake, Cayuga, Seneca and Tompkins Counties, and from streams entering Lake Champlain, Clinton County. Lewis (1860, 1872) noted this species in the Erie Canal, Mohawk River, Little Lakes and Smiths Pond, Herkimer County; and in Schuyler Lake, Otsego County. Additional early records are from Chautauqua Lake, Chautauqua County (1898 and 1928); Onondaga County (1886); Niagara River, Niagara County (1909); Upper Cassadaga Lake, Canandaigua County (1936); Sodus Bay, Wayne County; and Little Sodus Bay, Cayuga County; Lake Ontario; and South Pond, Oswego County (1939).

Harman and Berg (1971) found three populations: two from the western Otsego drainage and one from the Genesee River watershed. No living snails were found in Jokinen's surveys during 1978, 1981, and 1984-1991 of 346 aquatic habitats in New York State and parts of Lake Champlain in Vermont.

Rarity in New York is unknown due to lack of recent occurrence records.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Core	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Headwater/Creek
b. Oligotrophic Pond
c. Large/Great River
d. Canal
e. Summer-stratified Monomictic Lake
f. Marl Pond

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Yes	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

This species lives in sluggish streams and quite ponds where dead aquatic plants have accumulated. Populations occur in a range of lentic habitats, including oligotrophic lakes and marl ponds. Mackie et al. (1980) reported that this species is most common in dense masses of aquatic macrophytes and also is present in open areas protected from strong wave action and currents.
Aquatic gastropods are frequently used as bioindicators because they are sensitive to water quality and habitat alteration (Callil and Junk 2001, Salanki et al. 2003).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	Choose an item.	Choose an item.	Yes	Yes	Choose an item.

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Little is known about species-specific life history information for the Canadian duskysnail. As a member of the subclass Prosobranchia and the clade Caenogastropoda, the Canadian duskysnail is a long-lived dioecious species with internal fertilization and slow maturation (Dillon 2006, AFS 2013). They require at least a year to mature and have retained the ancestral gilled respiration (Dillon 2006). Females generally attach eggs to firm substrates in late spring and early summer (AFS 2013).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Residential & Commercial Development	Housing & Urban Areas (habitat loss/degradation)
2. Natural System Modifications	Dams & Water Management/Use (dams, channelization)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (New Zealand mud snail)
4. Pollution	Industrial & Military Effluents (metals)
5. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers)
6. Pollution	Household Sewage & Urban Wastewater (untreated sewage)
7. Climate Change & Severe Weather	Habitat Shifting & Alteration

Threats to the Canadian duskysnail are not discussed in the literature, but high imperilment rates to freshwater gastropods have been linked to alteration, fragmentation, and destruction of habitat and introduction of non-indigenous species. Causes of habitat degradation and loss include dams, impounded reaches, development of riparian areas, channelization, erosion, excess sedimentation, groundwater withdrawal and associated impacts to surface streams (flows, temperature, dissolved oxygen), multiple forms of pollution (salt, metals, untreated sewage, agricultural runoff, pesticides/fertilizers), changes in aquatic vegetation, and invasion of exotic species (AFS 2013).

Most species live in shallows (depths less than 3 meters), where food abundance is greatest. As a result, drastic water fluctuations, such as draw-downs, may cause declines in snail populations (Hunt and Jones 1972). Strayer (1987) concluded that human activities had destroyed much of the original mollusk fauna in some parts of the Hudson basin, but not in others. Channelization of farmed mucklands and industrial pollution from Beacon were noted as causes for the notably reduced biodiversity of mollusks in the Wallkill River of Orange County and the Fishkill Creek of Dutchess County, respectively.

The New Zealand mud snail (*Potamopyrgus antipodarum*) is a highly invasive species that was introduced in Idaho in the 1980s. It can have devastating consequences to aquatic ecosystems, reducing or eliminating native snail species (Benson et al. 2013). This snail was found established in Lake Ontario in 1991 (Zaranko et al. 1997) and in Lake Erie in 2005 (Levri et al. 2007).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ **No:**_____ **Unknown:**_____

If yes, describe mechanism and whether adequate to protect species/habitat:

The Freshwater Wetlands Act provides protection for regulated wetlands greater than 12.4 acres in size under Article 24 of the NYS Environmental Conservation Law. The Adirondack Park Agency has the authority to regulate smaller wetlands within the Adirondack Park. The Army Corps of Engineers has the authority to regulate smaller wetlands in New York State, and the DEC has the authority to regulate smaller wetlands that are of unusual local importance.

The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Conservation Law. However, these laws may not provide the necessary protection of required microhabitat conditions necessary to sustain Canadian duskysnail populations.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Basic biological information is lacking for most taxa of freshwater gastropods and there is a strong need for surveys and biological studies given the strong evidence of decline and extinction.

The following goals and recommended actions are provided in the NY Comprehensive Wildlife Conservation Strategy (NYSDEC 2005):

- Conduct surveys to determine distribution and population trends
- Identify habitat requirements for all life stages
- Develop specific plans for each listed species (or appropriate suite of species) that details status, threats, and actions necessary to reverse declines or maintain stable populations
- Develop fact sheets for each listed species for paper and online distribution

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	

Table 2. Recommended conservation actions for Canadian duskysnail.

VII. References

American Fisheries Society (AFS). 2013. Conservation status of freshwater gastropods (snails) of Canada and the United States by the Gastropod Subcommittee (Endangered Species Committee). Fisheries 38(6): 247-282.

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Strayer, D. 1987. Ecology and zoogeography of the freshwater mollusks of the Hudson River basin. Malacological Review 20:1-68.

Zaranko, D.T., D.G. Farara, and F.G. Thompson. 1997. Another exotic mollusk in the Laurentian Great Lakes: the New Zealand native Potamopyrgus antipodarum (Gray 1843) (Gastropoda, Hydrobiidae).

Originally prepared by	Samantha Hoff
Date first prepared	June 18, 2013
First revision	February 20, 2014
Latest revision	Transcribed March 2024

Species Status Assessment

Common Name: Chittenango ovate amber snail **Date Updated:**

Scientific Name: *Novisuccinea chittenangoensis* **Updated By:**

Class: Gastropoda

Family: Succineidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

The Chittenango ovate amber snail (COAS) is an endemic terrestrial snail only known from a single location in Chittenango State Park of Madison County, New York. It is federally listed as a threatened species because of its rarity, narrow habitat range and population declines, and although protection measures have been implemented since listing, its status remains precarious. It's only known habitat is comprised of a ravine at the base of a 167-foot waterfall due to its requirement for cool, mild temperatures and misty conditions. This taxon was reportedly abundant when it was first discovered at Chittenango Falls in 1905 but declined severely due to competition with an invasive snail *Succinea* sp. B and human disturbance of its critical habitat. The population appears to be increasing since the start of a mark-release-recapture study in 2002 and the average population size over the last five survey years is estimated between 400 and 500 individuals (NYNHP 2013).

I. Status

a. Current legal protected Status

i. **Federal:** Threatened **Candidate:**

ii. **New York:** Endangered; SGCN

b. Natural Heritage Program

i. **Global:** G1

ii. **New York:** S1 **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List:

-Northeast Regional SGCN:

Status Discussion:

This species is state-ranked Critically Imperiled due to its extremely narrow range and small population size, although the single extant location is protected and located in a state park. It was originally proposed to be listed as a federally endangered species in 1976 due to its apparent declining population and limited range, but was ultimately listed as threatened in 1978 because of the presumed existence of a second colony in Tennessee and North Carolina. Since listing, it has been determined that the Tennessee/North Carolina snails are not the same species and the Chittenango Falls colony is the only known population in the world. Its recovery priority number is 5 (high of 1C to a low of 18), based on a high degree of threat, low recovery potential and taxonomic standing as a species. It was state-listed as endangered in 1977 by the NYSDEC.

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable			Choose an item.
Northeastern US	Yes	Stable	Stable	2002-2007		Choose an item.
New York	Yes	Stable	Stable	2002-2013		Yes
Connecticut	No	Choose an item.	Choose an item.			Choose an item.
Massachusetts	No	Choose an item.	Choose an item.			Choose an item.
New Jersey	No	Choose an item.	Choose an item.			Choose an item.
Pennsylvania	No	Choose an item.	Choose an item.			Choose an item.
Vermont	No	Choose an item.	Choose an item.			Choose an item.
Ontario	No	Choose an item.	Choose an item.			Choose an item.
Quebec	No	Choose an item.	Choose an item.			Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

The NYSDEC and SUNY ESF have conducted mark-release –recapture studies almost every year from 2002-2007. Empty shells and *Succinea* sp. B individuals were removed during the surveys.

Trends Discussion *(insert map of North American/regional distribution and status):*

Accurate population trends are not available for this species due to infrequent surveys, difficulty of surveying the falls habitat, and confusion of identification due to similarities with *Succinea* sp. B. and *Novisuccinea ovalis*. The COAS was described as abundant when it was first discovered at Chittenango Falls in 1905. Prior to 1982, no estimates were made on the size or status of the population. After conducting a mark-recapture study in a patch of watercress where the snails appeared most densely, Aloi and Ringler (1982) estimated a population of about 300 snails with a density of four snails per square meter of watercress habitat. In 1984, the counts indicated a population of about 100 adults, whereas the population of *Succinea* sp. B expanded rapidly to an estimated 3,000 or greater snails. The recovery plan was completed in 2006 and full protection of the snail's habitat has been achieved and a captive population program is underway, but the status of this species is still precarious.

By 1990, the population had declined to fewer than 25 individuals and in the following years no more than 5 living animals were found during any surveys (NYNHP 2013). The short term trend is thought to be relatively stable (10% change) while the long term trend shows a decline of 70-90% (NatureServe 2013). Data from more recent mark-recapture studies shows the population is steadily increasing since no adults were observed in 1995 and the average population size is now estimated to be between 400 and 500 individuals (NYNHP 2013). Inter-year comparison of COAS captures shows decreasing trends as the season progressed, but this is likely due to the life history of the species and represents emergence from hibernation in the spring, peak activity during the highest food availability, and its movement back into protected areas in preparation for fall/winter hibernation (Whiteleather 2007).

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

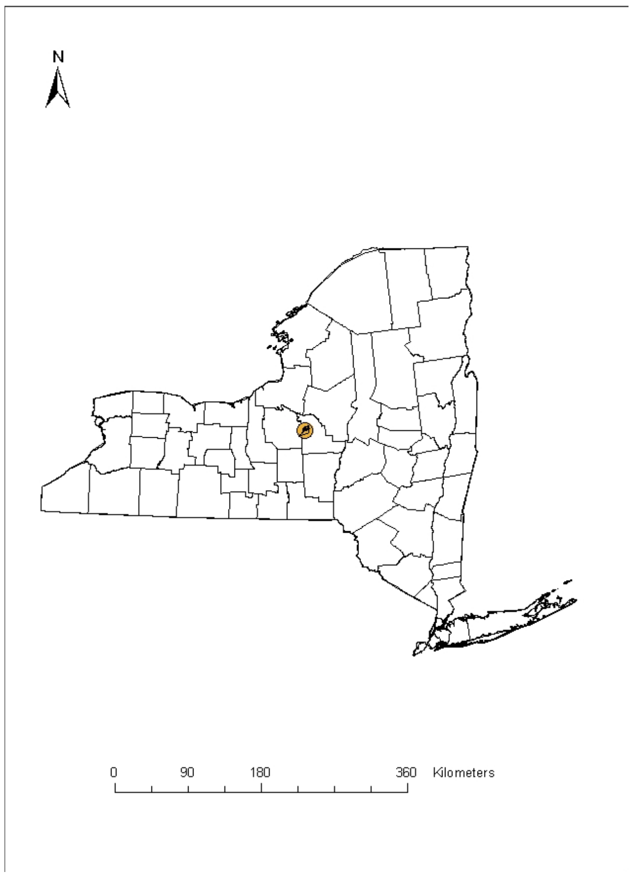

Figure 1. Location of the Chittenango Falls State Park colony of the Chittenango ovate amber snail, Madison County, New York (USFWS 2003).

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	~500	1	
1995-2004			
2005-2014			
2015- 2023			

Table 1. Records of Chittenango ovate amber snail in New York.

Details of historic and current occurrence:

The population in 1974 was estimated to be about 500 individuals. In 1984, about 100 snails were observed; in 1986 4 were observed during one survey and 2 during a later survey; in 1989 10 individuals were observed, in 1991 2-3 snails, and 4 snails in 1992 using a careful invasive searching technique. Founders were collected in 1992 for a captive breeding population. No snails were found in 1995; 1 was found in 1999, and 12 were observed in 2001.

Recent occurrences are as follows: 2001- 12 snails observed; 2002- 106 snails captured, 43 recaptured; 2003- 100 snails captured, 37 recaptured; 2004- 329 snails captured with 93 recaptured, an additional 61 juveniles were captured but not tagged and 28 snails were captured and tagged during a secondary search; 2005- 463 snails captured and an additional 48 juveniles captured but not tagged; 2006- not surveyed; 2007- 282 snails captured, 52 additional juveniles captured and not tagged.

At the time of its discovery in 1905, it was considered abundant, but is now extremely rare due to its single extant location.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
100% (endemic)	Core	

Column options

Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item

Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Vegetated Slope/Cliff Wall

b. Headwater/Creek

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Yes	Yes	Declining	

Column options

Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item

Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

Summarized from USFWS (2003):

The habitat of the COAS lies within the ravine at the base of the 167 foot waterfall formed by Chittenango Creek as it flows north from Cazenovia Lake toward Oneida Lake. This north-south oriented ravine forms a deep gorge that is shaded or partially shaded throughout most of the growing season, resulting in a relatively cool summer microclimate, and a relatively warm winter microclimate.

The COAS prefers cool, partially sunlit areas of lush herbaceous growth within the spray zone of the Falls. They occur on the vegetated slopes adjacent to the waterfall, preferring the moderate climate and high humidity. Spring thaws and periodic major rainfall events tend to remove vegetation from significant portions of the primary habitat. The only sloping weedy talus is on the east side of the falls and therefore individuals are not present on the west side.

Five parameters have significance in habitat considerations: humidity, substrate, temperature, vegetation, and water quality. They require a substrate, either derived from limestone dolomite or rich in calcium carbonate from other sources; the dynamic nature of the habitat does not allow for the development of soil. They require sustained, very high humidity, and active snails were only found where relative humidity approached 100%. The COAS has a narrow thermal niche, requiring cool, mild-temperatures, and relatively changing conditions provided by the waterfalls and mist. During warmer periods, individuals tend to retreat to cool areas provided by the moist rock and moss, or aestivate in vegetation, while during cold winter temperatures individuals are believed to retreat into the rocks, cracks, or fissures and remain inactive. They are generally found at temperatures from 12 – 20˚C. Most of the spray zone is covered with patches of various mosses, liverworts, and other low herbaceous vegetation including *Eupatorium purpureum*, *Angelica atropurpurea, Nasturtium officianale,* and *Aster* spp. The actual affect of water pollutants on this species is unclear since it is a terrestrial snail, but it is presumed that clean water is necessary to maintain essential habitat and a healthy population.

Aquatic gastropods are frequently used as bioindicators because they are sensitive to water quality and habitat alteration (Callil and Junk 2001, Salanki et al. 2003).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	Choose an item.	Choose an item.	Yes	Yes	Choose an item.

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Summarized from USFWS (2003):

The COAS mates from May through July, ovipositing from June through July. They are hermaphroditic, however it is unclear if selfing is possible. Eggs clusters of about 8-14 eggs are deposited at the base of plants, under matted vegetation, or in loose wet soil. The young snails hatch in two to three weeks and are believed to reach maturity in five to eight months, or the spring following hatching. Their life span is approximately two and a half years, similar to those in captive populations.

The COAS feeds on microflora and must obtain high levels of calcium carbonate from their environment for proper shell formation. Predators include carabid, staphylinid and lampyrid beetles, and sciomyzid larvae, many of which specialize in feeding upon snails. Other predators may include the northern two-lined, northern dusky, and Allegheny mountain dusky salamanders, which are common in the talus and on the ledges, and various small mammals or birds which are often seen in or near the habitat.

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (non-native *Succinea*)
2. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (black swallow-wort)
3. Human Intrusions & Disturbance	Recreational Activities (visitors to waterfall)
4. Pollution	Agricultural & Forestry Effluents (fertilizers, herbicides, pesticides)
5. Climate Change & Severe Weather	Temperature Extremes
6. Climate Change & Severe Weather	Storms & Flooding

The primary threat to this species is its small population size and extremely limited range. Its existence at only one site makes it extremely vulnerable to a catastrophic event that would destroy the whole population. Factors thought to adversely affect the snail population include water pollution, inadvertent habitat disturbance by humans, environmental sensitivity, and the introduction of a closely related pest species. Most of the Chittenango Creek watershed is used for agriculture, with fertilizers, herbicides and pesticides entering the drainage.
Road salt also causes high salinity in the watershed. Although water quality appears to be high overall, short pulses of polluted runoff could be detrimental to the small population.

Although destruction of habitat due to development is not an issue at Chittenango Falls State Park, habitat has been modified by human disturbance. Over 100,000 visitors come to the Park annually to engage in outdoor recreational activities; dislodged rocks, talus, and vegetation from anglers or hikers can cause serious harm to individuals and their eggs or can seriously degrade the habitat. Park managers direct visitors away from the critical habitat and the immediate area of the falls is relatively inaccessible but despite these safeguards, some trampling and overturned rocks are observed and may be severely affecting reproductive success.

In 1984, the *Succinea* sp. b snail was found at Chittenango Falls, probably introduced by accident from Europe. It is outcompeting the COAS for food, breeding or wintering habitat and recent censusing of the snails indicates that the pest species outnumbers the COAS by at least 50 to 1. Succinea sp. B has become widespread throughout Chittenango Creek drainage basin both upstream and downstream, including habitat that might otherwise be suitable for the COAS. It is not clear whether the two species have the potential for hybridization and genetic studies are needed to determine their taxonomic relationship and whether any hybridization is occurring. Data indicates these species are capable of coexisting at the falls as long as the ratio of sp. B to COAS doesn't increase 3-6 times over current levels due to spatial portioning at very local scales through differential use of living and dead plant material and differential selection of plant species (Campbell et al. 2010).

The Chittenango ovate amber snail was classified as "extremely vulnerable" to predicted climate change in an assessment of vulnerability conducted by the New York Natural Heritage Program (Schlesinger et al. 2011). Because it has a limited range and narrow ecological niche, it is more vulnerable and stressed by change than wider-ranging species. Spring thaws and periodic major rainfall events tend to remove vegetation from significant portions of the primary habitat, so more frequent and intense storms due to climate change may have detrimental effects on the primary habitat and the snails themselves. Because the COAS relies on the humid and moist environment provided by the falls, temperature extremes could desiccate individuals in the summer or not provide enough warmth in the winter. It is likely intolerant of large fluctuations in light, temperature, and humidity.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ **No:**_____ **Unknown:**_____

If yes, describe mechanism and whether adequate to protect species/habitat:

The Chittenango ovate amber snail is listed as an endangered species in New York and is protected by Environmental Conservation Law (ECL) section 11-0535 and the New York Code of Rules and Regulations (6 NYCRR Part 182). A permit is required for any proposed project that may result in a take of a species listed as Threatened or Endangered, including, but not limited to, actions that may kill or harm individual animals or result in the adverse modification, degradation or destruction of habitat occupied by the listed species.

It is also protected as a federally-listed threatened species. In 1983 the U.S. Fish and Wildlife Service approved the Chittenango Ovate Amber Snail Recovery Plan, providing a detailed outline of activities essential to the protection of a self-sustaining colony.

The Freshwater Wetlands Act provides protection for regulated wetlands greater than 12.4 acres in size under Article 24 of the NYS Conservation Law. The Army Corps of Engineers has the authority to regulate smaller wetlands in New York State, and the DEC has the authority to regulate smaller wetlands that are of unusual local importance. The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Environmental Conservation Law.

The only globally known location of this species, Chittenango Falls State Park, is fully protected as a state park administered by the New York State Office of Parks, Recreation and Historic Preservation.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Management is necessary to sustain the only known population of the COAS; without intervention it will become extinct. The primary strategy for recovery of this species is to stabilize the extant population at Chittenango Falls. Two necessary conditions for stabilization are: maintaining (or increasing) the baseline population size of the natural colony, and maintaining multiple captive populations.
Actions Needed (USFWS 2006):

1- Continue to protect the population and its habitat at Chittenango Falls
2- Conduct genetics research
3- Expand data on the biological and environmental requirements of the COAS
4- Research techniques for the removal of *Succinea* sp. B from the habitat at the Falls
5- Increase the population size and broaden the distribution of the COAS as feasible
6- Review and track progress

Recovery of this species in part requires strict protection of its habitat (restrict access to the immediate population area) and a reduction of contaminants entering the creek. Removal of *Succinea* sp. B is likely assisting in the population rebounding and should be continued.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) -
https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2. Recommended conservation actions for Chittenango ovate amber snail.

VII. References

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U.S. Fish and Wildlife Service (USFWS). 2006. Chittenango ovate amber snail (*Novisuccinea chittenangoensis*) recovery plan, first revision. Hadley, Massachusetts. 55p.

Whiteleather, K. 2007. Mark-release-recapture study of the Chittenango ovate amber snail (*Novisuccinea chittenangoensis* Pilsbury), June-September 2007. Final report to the State University of New York College of Environmental Science and Forestry, Syracuse, NY.

Originally prepared by	Samantha Hoff
Date first prepared	June 27, 2013
First revision	February 20, 2014 (Samantha Hoff)
Latest revision	Transcribed March 2024

Species Status Assessment

Common Name: Clam shrimp **Date Updated:**

Scientific Name: *Cyzicus gynecia* **Updated by:**

Class: Branchiopoda

Family: Cyzicidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

North American clam shrimps have few eastern representatives. They are mostly animals of temporary waters and have a bivalve shell that opens to allow slow swimming by means of crustacean appendages. *Cyzicus gynecia*, so far as known, normally occurs only in long-lasting rain pools on dirt roads and ATV trails. The global range comprises New York, New Jersey, Massachusetts, Pennsylvania, and Ohio. Very few confirmed localities exist although New York may have more known localities than the other four states. Clam shrimp was first discovered in New York in 1994.

This may be an annual species, and it survives drying of the pools and perhaps the winter as a resting egg in the sediments. The shell is about 5-10 mm in the long dimension. *C. gynecia* may be found moving slowly along the bottom in a kind of slow-motion saltation, or along the underside of the surface film. Because the habitat is often very turbid and the animals are cryptically colored, it may be necessary to dipnet suitable pools (in summer) to discover them. The artificial habitat, and the possibility that this species evolved in the Midwest and was transported by human agency (e.g., wagon wheels) to the East has caused some biologists to discount its importance as an element of New York's biodiversity. However, it is a unique genetic entity and is the only known hermaphroditic clam shrimp in the family Cyzicidae.
C. gynecia is under a high level of threat range-wide from drainage or filling of pools. The rarity of this species (as currently known) in New York, the genetic and ecological uniqueness, and the high level of threat justify SGCN designation. Designation would stimulate further field surveys and research as well as detection and protection in situations where land use or environmental management is changing.

I. Status

a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Not listed

b. Natural Heritage Program

i. **Global:** G2Q

ii. **New York:** SNR **Tracked by NYNHP?:** No

Other Ranks:

Northeast Regional SGCN: RSGCN

Status Discussion:

This species was first described in 1949 and first discovered in New York in 1994. There are few confirmed localities and they are under a high level of threat. It's very easy to destroy the habitat.

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Unknown	Unknown	Since described in 1949		Choose an item.
Northeastern US	Yes	Unknown	Unknown	Since 1949*		Choose an item.
New York	Yes	Unknown	Unknown	Since discovery in 1994		Yes
Connecticut	No	Choose an item.	Choose an item.			Choose an item.
Massachusetts	Yes	Unknown	Unknown		Not listed	No
New Jersey	Yes	Unknown	Declining		Not listed	No
Pennsylvania	Yes	Unknown	Unknown		Not listed	No
Vermont	No	Choose an item.	Choose an item.			Choose an item.
Ontario	No	Choose an item.	Choose an item.			Choose an item.
Quebec	No	Choose an item.	Choose an item.			Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

No regular surveys or consistent monitoring in NY.

Trends Discussion *(insert map of North American/regional distribution and status):*

Massachusetts: Two sites known in the Berkshires of western MA. Jonelle Orridge (2011) studied one or both a few years ago and may have some notion of trend.

New Jersey: Original very high-quality site discovered in 2001 was completely destroyed (E.Kiviat pers comm) in 2010 during a wetland mitigation banking project (this site contained approximately 40 pools in 1 km of gas pipeline service road). In 2013 an apparently smaller population was discovered 5 km away also in the New Jersey Meadowlands (Kiviat unpublished). A second site is on an aqueduct service road owned or managed by a private water company; level of interest in conservation and threat level undetermined.

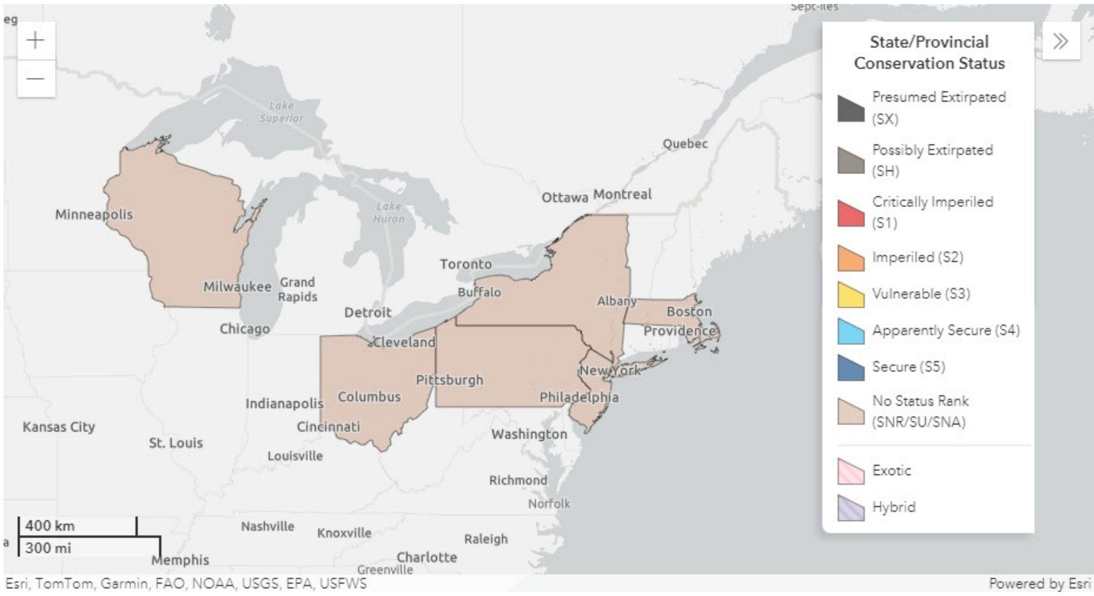

Figure 1. Conservation status of clam shrimp in North America (NatureServe 2023)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

New York is one of five states in the global range; however, New York appears to support more extant sites for this species than any other state and may well support a larger population overall.

There can be hundreds of individuals in a pool at times, and the species seems to occur where there are series of pools along a road or trail. However, because all habitat at an entire site (or a large portion of one) can be destroyed (filled, drained, polluted) at once, this species should be assessed based on the number of extant confirmed sites rather than the numbers of pools or individuals.

Figure 2: (need map of clam shrimp range in New York).

Years	# of Records	# of Distinct Waterbodies/Locations	% of State
Pre-1995	0		
1995-2004	0		
2005-2014	Unknown		
2015-2023	Unknown		

Table 1: Records of clam shrimp in New York.

Details of historic and current occurrence:

First documentation (NY) in 1994 (Town of Rhinebeck, Dutchess County; single shell collected in larval amphibian sample but not identified to species at that time). Another site discovered in 2002 (Town of Hyde Park, Dutchess Co.), and another in 2007 (Town of Saugerties, Ulster Co.). Several sites have been reported in southern Orange County and two of these were confirmed in 2013; others remain to be confirmed.

The Town of Rhinebeck site has not been accessible for re-survey. The Town of Hyde Park site was partly destroyed by a development project although a portion of the habitats may persist. The Town of Saugerties site is largely or entirely in Bristol Beach State Park and may be secure. Status of the Orange County sites is uncertain. Trends in population numbers are unknown. Sites described in Schmidt and Kiviat (2008) and Orridge (2011).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
76-99%	Choose an item.	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Intermittent pool

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Yes	Choose an item.	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

Many apparently suitable pool complexes apparently do not support this species. Unknown if this is due to dispersal limitation, frequent “winking out” of local populations, or habitat factors that are not apparent. The pools are created and maintained by a particular level of vehicular traffic (i.e., road vehicles, off-road vehicles). Too little traffic might result in pools filling with sediment whereas too much traffic might result in many *C. gynecia* being crushed or splashed out of the pools. Schmidt and Kiviat (2008) hypothesized that this species evolved in buffalo wallows or pools created by horse-drawn wagons. Dispersal probably occurs in mud stuck to vehicle wheels and large animals. There are numerous sites that have apparently suitable habitat where the species seems not to be present.

V. Species Demographics and Life History

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	(blank)	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Life history: In the laboratory, larvae hatched from the eggs 5-33 days after hydration of soil samples from dried pools (Orridge 2011). The larval stage lasted ca 20-30 days (Orridge 2011). Lab-hatched individuals lived a maximum of 48 days after hatching, and wild-caught individuals a maximum of 89 days after capture (Orridge 2011).

Mortality: Potential predators, such as snapping turtle and various birds, occur at the clam shrimp pools. Many adult clam shrimp die episodically when pools dry.

Dispersal: This species is thought to disperse by movement of eggs in mud stuck to vehicles (Schmidt & Kiviat 2008) or by movement with water or wind (Orridge 2011).

Systematics: Orridge (2011) found meristic data different between NJ and NY populations and suggested the NJ population should be placed in the genus Caenestheriella and the NY population in Cyzicus. However, NatureServe considers both populations to belong in Cyzicus gynecia. Reports of large, reddish individuals in Orange County, NY (Jay Westerveld, pers. comm.) also raise questions about classification (Robert Schmidt, pers. comm.). However, it is possible that differing degrees of redness are due to geochemical pigments in the pools or to dissolved oxygen levels (see Orridge 2011).

VI. Threats *(from NY 2015 SWAP or newly described)*

Threats to NY Populations	
Threat Category	**Threat**
1. Residential & Commercial Development	Housing & Urban Areas (loss/degradation of habitat)
2. Transportation & Service Corridors	Roads & Railroads (too much or too little ATV or service vehicle traffic)
3. Natural Systems Modification	Dams & Water Management/Use (pools on dirt roads)
4. Pollution	Air-Borne Pollutants (mosquito insecticides)
5. Pollution	Agricultural & Forestry Effluents (overspray or drift of herbicides from wetland mitigation)
6. Climate Change & Severe Weather	Temperature Extremes (warmer summers causing pools to dry faster)

Threats are filling and drainage of pools for road maintenance; too little or too much vehicle traffic; and pollution of pools from contaminant spills, direct application or wind drift of pesticides (e.g., mosquito insecticides potentially including bacterial larvicides such as Bti and juvenile hormone analogs such as methoprene; herbicides used for control of environmental weeds). Perhaps the greatest threat (based on experience in NY and NJ) is wholesale destruction of habitat in connection with infrastructure for residential development, wetland mitigation, or other purposes.

It is unclear whether climate change threatens this species. Although precipitation is currently increasing in eastern NY, significant future decrease in spring and summer precipitation could result in shorter pool hydroperiods and an increased threat. Summer temperature increases might result in faster drying of pools in summer and fall. The known global range of the species lies within a relatively narrow climatic (latitudinal) belt. It cannot currently be discerned whether further temperature increases might force the geographic range to shift northward into environments that might be less favorably geochemically or ecologically.

Threats other than climate change perhaps can be reduced by education and protection of various kinds. The habitat and hypothesized dispersal modes suggest that habitat could be created, and the species introduced by translocation. To date, there are no known successful threat reductions in New York or New Jersey, nor any attempt to create habitat or new populations.

Additional notes regarding known or potential threats to clam shrimp:

Threat 1. Large scale destruction of habitat (pool) complexes for development, infrastructure, habitat restoration, etc.

Threat 2. Small or large-scale destruction of pools in a complex (anywhere from one pool to all pools in complex) by filling or draining of pools for road maintenance. This threat has not yet been observed in NY but is strongly inferred; threat has been observed in NJ.

Threat 3. Chemical pollution from pesticides (e.g., mosquito insecticides applied directly to the habitat [larvicides] or from overspray or drift of adulticides applied nearby; overspray or drift of herbicides applied nearby). A quick literature search on clam shrimp toxicology was inconclusive and it's unlikely that any research has been done on *C. gynecia*. For now, it must be assumed that pesticides are a threat based on toxicology of Crustacea in general. An advantage is that puddles with *C. gynecia* do not seem to support larval mosquitoes, but mosquito control operators may well treat these habitats reflexively.

Threat 4. Too much or too little vehicle use of dirt roads and trails supporting habitat pools. The pools observed in NY and NJ are almost certainly created and maintained by ATVs, maintenance vehicles, and other wheeled motor vehicles. Jonelle Orridge (pers comm) observed disturbance of habitat pools in NJ by heavy vehicle use that appeared to be splashing clam shrimp out of the pools and killing them, thus reducing population densities. Cessation of vehicle use is likely to result in sediment deposition and infilling of some habitat pools.

Threat 5. Collecting for science or hobby seems a minor threat, although potentially could be a concern if a single individual seined pools and collected large numbers of clam shrimp.

Threat 6. Impacts of climate change. Pools observed, especially at the Kane Natural Area site in NJ, held sufficient water to support this species most of the time; drying of pools with the death of clam shrimp (other than resting eggs) seems infrequent. If climate change causes summers to be drier in the Northeast, pool hydroperiods would become shorter and *C. gynecia* would be adversely affected.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes:_____ **No:** ✓ **Unknown:**_____

If yes, describe mechanism and whether adequate to protect species/habitat:

The habitat does not seem to be protected by any wetland regulations. It is unclear whether the habitat would be considered "vernal pools" although spotted salamander larvae were found with this clam shrimp at the Staatsburg NY site in 1994.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

It seems, based on current (limited) knowledge, that creating habitat pool complexes for this species, and stocking created habitats, would be relatively simple. However, this approach needs to be tried under controlled conditions. Threats 1-5 to extant populations (see above) could be reduced or eliminated with explicit protection and management of populations on public lands. Three extant, confirmed sites are on public lands (Bristol Beach State Park in Ulster County, Glenmere – Black Meadow county water supply lands [not a formal title] on the east side of Glenmere Lake in Orange Co., and Cascade Lake Town Park, Town of Warwick, Orange Co.). The State Office of Parks, Recreation and Historic Preservation does not manage clam shrimp in Bristol Beach State Park. Clam shrimp have not been discussed with the Town of Warwick or Orange County.

Conservation Action: Research throughout the species range; Threat Addressed: Lack of knowledge about the species.

Conservation Action: Experimental habitat creation on public lands; Threat Addressed: Destruction of extant habitats.

Conservation Action: Management of extant sites throughout the species range; Threat Addressed: Destruction of extant habitats.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection):
https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2: (need recommended conservation actions for clam shrimp).

VII. References

Brantner, J. 2011. Mating system inferences from representatives from two clam shrimp families (Limnadidae and Cyzicidae) using histological and cellular observations. MS thesis, University of Akron.

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Orridge, J.I. 2011. Genetic, morphological, and ecological relationships among populations of the clam shrimp *Caenestheriella gynecia*. PhD thesis, City University of New York.

Schmidt, R.E. & E. Kiviat. 2007 (2008). State records and habitat of clam shrimp, *Caenestheriella gynecia* (Crustacea: Conchostraca), in New York and New Jersey. Canadian Field-Naturalist 121:128-132.

(Also see references cited within these documents.)

Originally prepared by	Erik Kiviat
Date first prepared	November 15, 2013
First revision	March 3, 2014 (K. Corwin)
Latest revision	

Species Status Assessment

Common Name: Clubshell **Date Updated:** 1/16/2024

Scientific Name: *Pleurobema clava* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Pleurobema clava belongs to the subfamily Ambleminae and the tribe Pleurobemini, which includes four extant and one likely extirpated New York species in the genera Elliptio, Fusconaia, and Pleurobema (Haag 2012). In general, the shells are of this tribe are unsculptured and larvae are brooded only in the outer demibranchs (with exceptions) (Graf and Cummings 2011). *Pleurobema clava* is the only member of the Pleurobema genus with an orange viscera and foot. The genus name pleurobema, meaning step, refers to the ribs found between the shell annulae. The species name, clava, means club and refers to the general shape of the shell (Watters et al. 2009).

P. clava prefers small, gravelly riffles of creeks and is commonly found burrowed deep into sediment (Strayer and Jirka 1997). It is known from Cassadaga Creek, in the Allegheny basin where four individuals were found at two sites during recent surveys by The Nature Conservancy (2009). Historically, the species may have been scattered through the upper Allegheny basin (Strayer and Jirka 1997). P. clava is listed as endangered at both the Federal and State levels. New York populations are thought to be declining, as no new recruits have been found during recent surveys.

I. Status

a. Current legal protected Status

i. **Federal:** Endangered **Candidate:** No

ii. **New York:** Endangered

b. Natural Heritage Program

i. **Global:** G1G2 – Critically Imperiled/Imperiled

ii. **New York:** S1 – Critically Imperiled **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Critically Endangered (1996)

-Northeast Regional SGCN: Yes

-Midwest Regional SGCN: Yes

-American Fisheries Society Status: Endangered (1993)

Status Discussion:

P. clava was once found from Michigan to Alabama, and from Illinois to West Virginia. Extirpated from Alabama, Illinois and Tennessee, it occurs today in portions of only 12 streams (USFWS 1994). This species has been extirpated from most of its range in this century. It is thought that less than 20% of historical range remains. Continued loss of habitat and water quality deterioration threatens the remaining populations (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Choose an item.	Choose an item.			(blank)
Northeastern US	Yes	Choose an item.	Choose an item.			Yes
New York	Yes	Stable	Stable	2005-2014	Endangered, S1	Yes
Connecticut	No	N/A	N/A			No
Massachusetts	No	N/A	N/A			No
New Jersey	No	N/A	N/A			No
Pennsylvania	Yes	Unknown	Unknown	2005 - 2014	Endangered, S2	No
Vermont	No	N/A	N/A			No
Ontario	No	N/A	N/A			(blank)
Quebec	No	N/A	N/A			(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

Monitoring of the clubshell population at an Allegheny basin augmentation site is conducted at regular intervals by NYSDEC and USFWS staff.

Trends Discussion *(insert map of North American/regional distribution and status):*

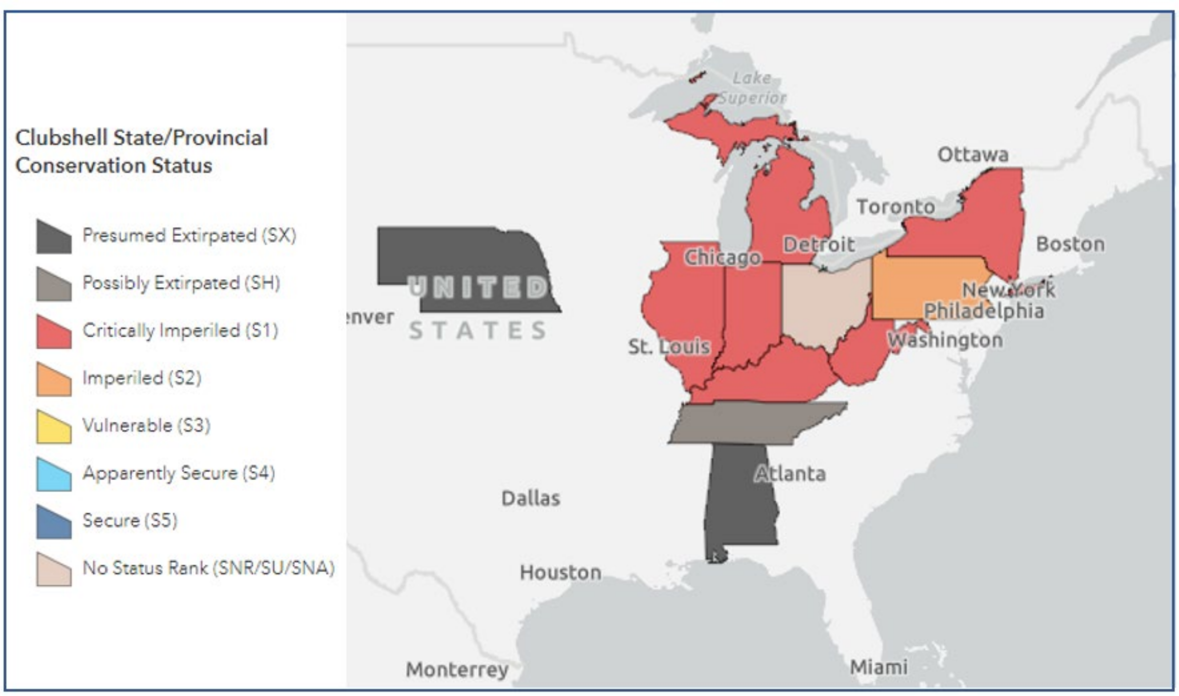

Figure 1. Clubshell distribution and status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

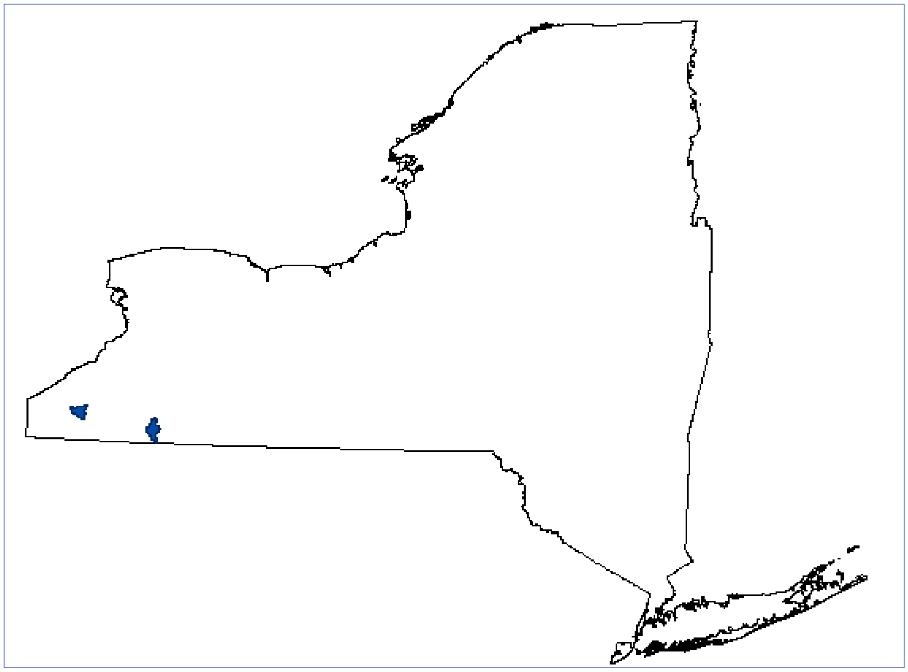

Figure 2. Records of clubshell in New York (NYSDEC 2022)

Years	# of Records	# of Distinct Waterbodies	% of State
Total		2	0.1%

Table 1. Records of clubshell in New York.

Details of historic and current occurrence:

2024: Clubshell is found in two waterbodies in New York State. Both have received donor individuals: reintroduction at one Seneca Nation site, augmentation of an existing population at a second site. This species is found in 2 of 1802 HUC 12 watersheds (0.1%).

Historically, P. clava may have been scattered throughout the upper Allegheny basin in New York (Ortmann 1919), although prior to 1970, only a single record of this species, from Cassadaga Creek, exists (Strayer and Jirka 1997).

P. clava currently exists in only one waterbody in New York State (Figure 2). In a recent survey of the Allegany basin, The Nature Conservancy documented P. clava at only one of the 105 excavation survey sites. At the site, two live individuals were found in Cassadaga Creek at a rate of 0.4 per hour. Two additional individuals were found alive during quantitative sampling of a site further downstream on Cassadaga Creek. Unfortunately, at both sites, no recently recruited individuals were found. Given the very low numbers of only older animals, the long-term viability of this species remained in question (The Nature Conservancy 2009) and Cassadaga Creek was selected for augmentation with individuals relocated from a salvage project in the Pennsylvania portion of the Allegheny drainage.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	55 miles

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. **Size/Waterbody Type:** Small River

b. **Geology:** Moderately Buffered, Neutral

c. **Temperature:** Transitional Cool

d. **Gradient:** Low Gradient

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Yes	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

The habitat of P. clava has been reported as creeks and small rivers (Strayer and Jirka 1997), small to medium-sized rivers and streams (USFWS 1994), and medium to large rivers (Cummings and Mayer 1992). This species is generally found in clean, coarse sand and gravel or cobble, where it may live several inches beneath the surface of the substrate (USFWS as cited in NatureServe 2013, Cummings and Mayer 1992, Watters et al. 2009, Strayer and Jirka 1997). It is most common in the current at downstream ends of riffles and islands (Watters et al. 2009) or in riffles (Strayer and Jirka 1997), or runs, often just downstream of a riffle (USFWS 1994). It cannot tolerate mud or slackwater conditions, and is very susceptible to siltation (USFWS 1994). Because it deeply buries itself beneath the substrate, living animals may be hard to find even in places where it is believed to occur in some numbers (Strayer and Jirka 1997, USFWS 1994).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options

First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, P. clava must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable habitat, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely to be a slow process for mussels which use resident fishes with limited home ranges as their hosts (COSEWIC as cited in NatureServe 2013).

This species has an equilibrium life history strategy, characterized primarily by long life span, mostly short term brooding, low to moderate growth rate, and late maturity, with low reproductive effort and fecundity that increases slowly after maturation. This life history strategy is considered to be favored in stable, productive habitats (Haag 2012).

Virtually nothing is known specifically for P. clava. This species may live to be over 20 years old (Watters et al. 2009), with some individuals thought to live over 30 years of age (NatureServe 2013). It is not known at what age reproductive maturity begins and ends. Because of the rarity of live material, it is not known if existing populations are reproductively active, and because of their small size, it is not known if juveniles are present in any of the populations (NatureServe 2013).

This species is thought to be tachytictic, with eggs appearing in May, and glochidia present in June and July. In Ohio, glochidia had been released by the end of June (Watters et al. 2009). Glochidia are reported to have transformed on central stoneroller (Campostoma anomalum), striped shiner (Luxilus chrysocephalus), logperch (Perca caprodes), and blackside darter (Percina maculate) (Watters and O'Dee (1997) and O'Dee and Watters (2000) in Watters et al. 2009).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Other Ecosystem Modifications (levees, channelization, dredging, impassable culverts)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (zebra mussels)
4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)
5. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, other regulated discharges)
6. Pollution	Household Sewage & Urban Waste Water (septic overflows)
7. Climate Change & Severe Weather	Droughts
8. Natural System Modifications	Dams & Water Management/Use (lowering of water table from agriculture, etc., causing drying of habitat)
9. Climate Change & Severe Weather	Storms & Flooding (extreme storms)
10. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (die offs from unknown disease)
11. Invasive & Other Problematic Species & Genes	Problematic Native Species (beaver dams influencing hydrology)

P. clava's decline in the upper Ohio and Wabash watersheds has been principally due to pollution from agricultural run-off and industrial wastes, and extensive impoundments for navigation (USFWS 1997, Roley et al. 2012). These, along with channelization, siltation, in-stream sand and gravel mining, and zebra/quagga mussel infestation, are thought to be responsible for its decline across its range (USFWS 1994).

Because there are only two known locations for *P. clava* in New York, both of which are located in a single stream, in close proximity to each other, a single disturbance could decimate the entire population of this species in the state. Land use in this reach of Cassadaga Creek is mostly forest cover with some, limited agriculture (New York State Landcover 2010). Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in western and central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar and Landry 2013), indicating that runoff is a major threat to resident mussel populations.

Agricultural Runoff
The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007b, 2007c in Haag 2012) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009 in Haag 2012). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer run-off is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag 2012). In addition, ammonia adsorbs to sediment particles, resulting in higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for both *P. clava* and mussels in general (Roley et al. 2012).

Runoff from Developed Land
Several roads cross and run adjacent to Cassadaga Creek; these are likely sources of runoff containing metals and road salts (New York State Landcover 2010). Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller and Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner and Pynnonen 1992 as cited in Watters et al. 2009), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller and Zam 1991, Liqouri and Insler 1985 as cited in Watters et al. 2009, Pandolfo et al., 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Habitat Modifications
Ecosystem modifications, such as in-stream work associated with bridge replacements or gravel mining kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting "dredge" had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). These habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000). The impact of such activities on a species with limited distribution, such as *P. clava,* would be devastating.

It has been noted that this species is intolerant of impoundments (USFWS 2004). While it is highly unlikely that new impoundments will be constructed in this area, culverts and bridge crossings should be properly maintained so that water does not collect upstream of the structures, due to debris build up or an inadequate sized installation.

Invasive Species
Zebra mussels (*Dreissena polymorpha*) are present in the lower reaches of Cassadaga and Conewango Creeks and may threaten upstream *P. clava* populations and their habitat. Chautauqua Lake's connection to Cassadaga Creek, Chadakoin Creek, is the main source of this exotic invasive. In free-flowing, relatively shallow rivers, zebra mussels do not appear to be as devastating to native mussels as they are in impounded rivers or lake environments largely because their planktonic larval stage combined with downstream flow of rivers continually depletes populations and prevents establishment (Haag 2012). However, in slower, more lentic waters, native mussel populations were virtually eliminated in much of the Great Lakes, St. Lawrence River system, and the Hudson River, where greater than 90 percent declines in mussel abundance occurred typically within four years of *Dreissena* colonization (Ricciardi et al. 1998 in Haag 2012). Invasive zebra and quagga mussels (*Dreissena polymorpha* and *Dreissena bugenis*) have been repeatedly cited as a threat to native mussel populations (Strayer and Jirka 1997, Watters et al. 2009). En masse, Dreissenids outcompete native mussels by efficiently filtering food and oxygen from the water. They reduce reproductive success by filtering native mussel male gametes from the water column and they can foul the shells of the native mussels to the point that their valves can no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury (USFWS 1994). Although zebra mussels will continue to cause problems for Chautauqua Lake, they currently appear to have minimal impact downstream. However, precautions should be taken to avoid invasions by zebra mussels to upstream locations, especially the headwater lakes in the Cassadaga system. Monitoring for zebra mussels in these lakes may provide early detection of this invader (The Nature Conservancy 2009).

Climate Change
The NatureServe Climate Change Vulnerability Index has been used in several states to help identify species that are particularly vulnerable to the effects of climate change. While *P. clava* vulnerability was not evaluated for New York, the populations within West Virginia are ranked as "highly vulnerable" to climate change (2013) and Michigan populations were considered "extremely vulnerable" to climate change (Hoving et al. 2013).

Impoundments – Range wide
Across its range, impoundments likely contributed to the reduced distribution of mussels that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery and King 1983, ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ **No:**_____ **Unknown:**_____

If yes, describe mechanism and whether adequate to protect species/habitat:

New York State Environmental Conservation Law, § 11-0535. 6 NYCRR Part 182: Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern; Incidental Take Permits

Section 7(a) of the Federal Endangered Species Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as Federally endangered or threatened. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR Part 402. Section 7(a)(4) requires federal agencies to confer informally with the Service on any action that is likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, Section 7(a)(2) requires Federal agencies to ensure that any activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of such a species or to destroy or adversely modify its critical habitat. If a federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Service.

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any “protected stream”, its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York’s mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Conservation efforts for this species should focus on Cassadaga Creek.

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.

- Opportunities for population augmentation of *P. clava* exist just a few dozens of miles to the south. The Allegheny River and significant tributaries in Pennsylvania such as French Creek, contain viable populations that would seemingly be the best sources of supplemental individuals. A single bridge replacement project on the Allegheny River will yield 1,000s of *P. clava* which must be translocated out of the construction footprint. The future restoration of clubshell in New York appears promising due to both a large potential supply of animals from nearby basins, and *P. clava*'s only known habitat in New York, Cassadaga Creek, which continues to support a diverse and healthy mussel population (The Nature Conservancy 2009).

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for both *P. clava* and mussels in general (Roley and Tank 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis 2012).

- Establish a protocol whereas DEC staff work closely with state and local highway departments to reduce impacts to native mussels during maintenance and construction projects.

- In areas subject to tree harvest, promote best forestry practices to reduce/eliminate sedimentation and to ensure that substantial woody vegetation in areas directly adjacent to streams continue to provide temperature-moderating shade to the stream.

- Replace culverts that disrupt aquatic habitat connectivity to allow for passage of small fish species.

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g., point and nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) -
https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**

1.	
2.	

Table 2. (need recommended conservation actions for clubshell).

The New York State Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g., Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g., mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g., black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

- Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
First revision	February 25, 2014 (Samantha Hoff)
Latest revision	January 16, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Coldwater pond snail **Date Updated:**

Scientific Name: *Stagnicola woodruffi* **Updated By:**

Class: Gastropoda

Family: Lymnaeidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Freshwater gastropods (snails) are an important and diverse component of aquatic ecosystems worldwide. They have diversified into every available aquatic habitat, including springs, small streams, large rivers, ponds, lakes, and ephemeral to permanent wetlands. Most graze on algae, aquatic plants and biofilms, though some are suspension or deposit feeders, and they can play a vital role in the processing of detritus and decaying organic matter. Freshwater snails are not predatory, unlike some of their terrestrial or marine counterparts and they often dominate benthic stream communities, regularly exceeding 50% of the invertebrate biomass (Johnson et al 2013). Gastropods are important dietary components of many North American fishes, and also are consumed by a variety of aquatic-associated birds and mammals such as the snail kite and the muskrat (Johnson et al. 2013).

The coldwater pond snail is known only from five states (IL, IN, MI, WI, NY) and one province (ON) (NatureServe 2012). This Lymnaeid is one of the most abundant species in Lake Michigan, the shore from Michigan to Illinois sometimes strewn with its bleached shells. There is little variation from the typical form and it appears to be one of the most distinct species of the genus. The few specimens found in Pleistocene deposits have shown a longer spire and somewhat resemble some forms of *catascopium*. It is possible that *woodruffi* is a descendant of *catascopium* but the latter species has not yet been found in fossil deposits in Illinois nor does it occur living in the rivers of the state (Baker 1930). There are no records of the coldwater pond snail in New York and it may be the same as *S. catascopium* (a common, widely distributed species) (SGCN Expert Meeting).

I. Status

a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Not listed

b. Natural Heritage Program

i. **Global:** G2G3

ii. **New York:** SNR **Tracked by NYNHP?:** yees

Other Ranks:

-IUCN Red List:

-Northeast Regional SGCN:

American Fisheries Society: CS – Currently Stable

Status Discussion:

The coldwater pond snail is ranked "Imperiled" globally and its status is unknown (not ranked/ under review) in New York. Little is known about its status within the state or throughout its whole range (NatureServe 2012).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Unknown	Unknown			Choose an item.
Northeastern US	Yes	Unknown	Unknown			Choose an item.
New York	No data	Unknown	Unknown		Not listed	Choose an item.
Connecticut	No	Choose an item.	Choose an item.			Choose an item.
Massachusetts	No	Choose an item.	Choose an item.			Choose an item.
New Jersey	No	Choose an item.	Choose an item.			Choose an item.
Pennsylvania	No	Choose an item.	Choose an item.			Choose an item.
Vermont	No	Choose an item.	Choose an item.			Choose an item.
Ontario	Yes	Unknown	Unknown		Not listed	Choose an item.
Quebec	No	Choose an item.	Choose an item.			Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

None.

Trends Discussion *(insert map of North American/regional distribution and status):*

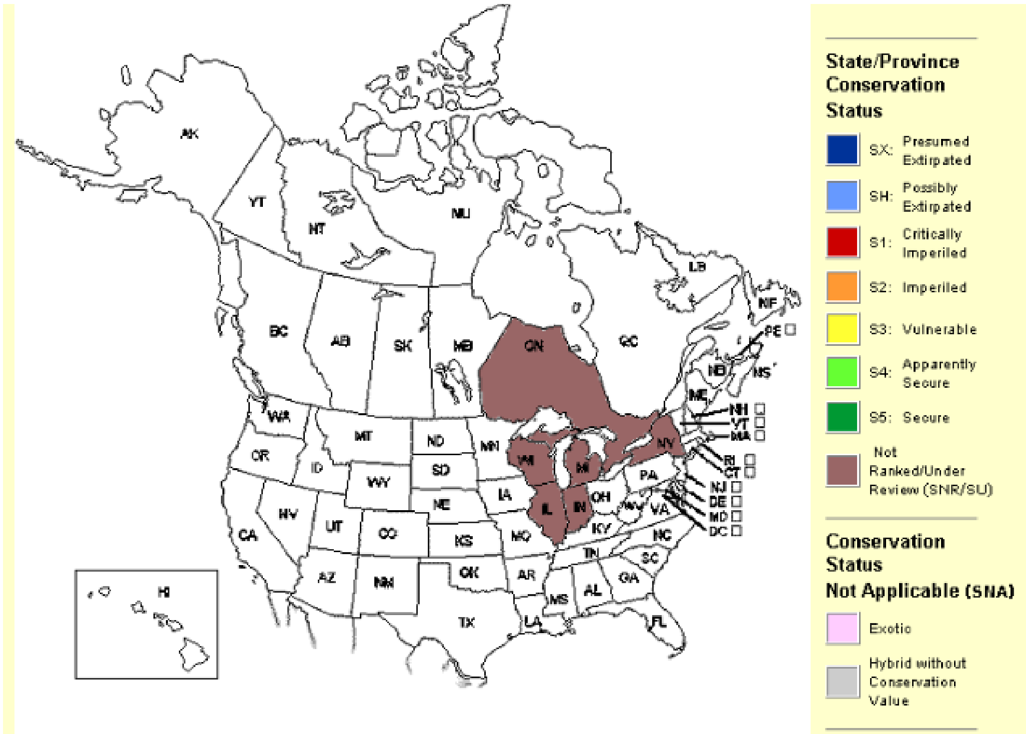

Figure 1. Conservation status of the coldwater pond snail in North America (NatureServe 2012).

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	______	______	______
1995-2004	______	______	______
2005-2014	______	______	______
2015- 2023	______	______	______

Table 1. Records of coldwater pond snail in New York.

Details of historic and current occurrence:

There are no historic occurrence records available for this species in New York. There are no current occurrence records available for this species in New York. Rarity in New York State is unknown due to lack of occurrence records.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
26-50%	Peripheral	~800 miles

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Freshwater

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Choose an item.	Choose an item.	Choose an item.	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	Choose an item.	Choose an item.	Yes	Yes	Choose an item.

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Very little is known regarding the life history of this species.

Most Gastropods belong to the clade Caenogastropoda, in which individuals mature slowly (requiring at least a year), are long-lived dioecious species with internal fertilization, and females generally attach eggs to firm substrates in late spring and early summer. Many species are narrow endemics associated with lotic habitats, often isolated in a single spring, river reach, or geographically restricted river basin (Johnson et al. 2013). In contrast, members of the clade Heterobranchia are hermaphroditic, mature quickly, and generally have shorter generation times (Johnson et al. 2013).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Residential & Commercial Development	Housing & Urban Areas (habitat loss/degradation)
2. Natural System Modifications	Dams & Water Management/Use (dams, channelization)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (New Zealand mud snail)
4. Pollution	Industrial & Military Effluents (metals)
5. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers)
6. Pollution	Household Sewage & Urban Wastewater (untreated sewage)
7. Climate Change & Severe Weather	Habitat Shifting & Alteration

Insufficient information to assess threats.

High imperilment rates among freshwater gastropods have been linked to alteration, fragmentation and destruction of habitat and introduction of non-indigenous species. Causes of habitat degradation and gastropod species loss include dams, impounded reaches, development of riparian areas, channelization, erosion, excess sedimentation, groundwater withdrawal and associated impacts on surface streams (flows, temperature, dissolved oxygen), multiple forms of pollution (salt, metals such as Cu, Hg, Zn, untreated sewage, agricultural runoff, pesticides/fertilizers), changes in aquatic vegetation, and invasion of exotic species (Johnson et al. 2013). Most gastropod species live in the shallows (depths less than 3 m), where food abundance is greatest. As a result, drastic water fluctuations, such as draw-downs, may cause declines in snail populations (Hunt and Jones 1972).

Strayer (1987) concluded that human activities had destroyed much of the original mollusk fauna in some parts of the Hudson basin, but not in others. Channelization of farmed mucklands and industrial pollution from Beacon were noted as causes for the notably reduced biodiversity of mollusks in the Wallkill River of Orange County and the Fishkill Creek of Dutchess County, respectively.

The New Zealand mud snail (*Potamopyrgus antipodarum*) is a highly invasive species that was introduced in Idaho in the 1980s. It can have devastating consequences to aquatic ecosystems, reducing or eliminating native snail species (Benson et al. 2013). This snail was found established in Lake Ontario in 1991 (Zaranko et al. 1997) and in Lake Erie in 2005 (Levri et al. 2007).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓_ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Environmental Conservation Law, however this may not be sufficient enough to protect this species.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Basic biological information is lacking for most taxa of freshwater gastropods and there is a strong need for surveys and biological studies given the strong evidence of decline and extinction.

Although not specific to the coldwater pond snail, the NYS Comprehensive Wildlife Conservation Strategy (CWCS) recommends the following actions for the freshwater gastropods (NYSDEC 2005):

- Develop fact sheets for paper distribution and the DEC website
- Determine habitat requirements for all life stages
- Determine threats specific to species
- Determine habitat management techniques
- Determine life history and population dynamics
- Determine distribution

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2. Recommended conservation actions for coldwater pond snail.

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Originally prepared by	Jenny Murtaugh
Date first prepared	June 18, 2013
First revision	February 20, 214 (S. Hoff)
Latest revision	Transcribed March 2024

Species Status Assessment

Common Name: Deertoe **Date Updated:** 1/16/2024

Scientific Name: *Truncilla truncata* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Deertoe

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Truncilla truncata belongs to the subfamily Ambleminae and the tribe Lampsilini, which includes 17 extant and 6 likely extirpated New York species of the genera Actinonaias, Epioblasma, Lampsilis, Leptodea, Ligumia, Obovaria, Potamilus, Ptychobranchus, Toxolasma, Truncilla, and Villosa (Haag 2012, Graf and Cummings 2011). The Truncilla genus is named for its oblique truncation, giving it a sharp posterior ridge and flat posterior slope. This characteristic is typical of T. truncata (Watters et al. 2009).

This species is most commonly found in rivers and lakes, rarely occupying smaller streams. It prefers packed sand and gravel and mud substrates (Strayer and Jirka 1997, Watters et al. 2009). Live specimens have been found in Tonawanda Creek in the Lake Erie basin, as well as Honeoye Creek and the Genesee River in the Genesee River basin. Shells have been found at additional sites on the Genesee River, Oak Orchard Creek, and the Erie Canal (Mahar and Landry 2013).

Although rare and ranked as "critically imperiled" in New York, this edge of range species is considered secure throughout its range. In North America, approximately 2/3 to 3/4 of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993, Stein et al. 2000). While population trends in New York are unknown, based on sparse historical information it is assumed that they too are declining due to a myriad of environmental stressors.

I. Status

a. Current legal protected Status

i. **Federal:** None **Candidate:** No

ii. **New York:** None, Proposed Threatened listing (2019)

b. Natural Heritage Program

i. **Global:** G5

ii. **New York:** S1S2 – Critically Imperiled/Imperiled **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Not included

-Northeast Regional SGCN: No

-American Fisheries Society Status: Currently Stable (1993)

Status Discussion:

This species is found throughout the Mississippi River system, as well as in some tributaries of Lake Erie and St. Clair and is considered stable throughout most of its range (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable			(blank)
Northeastern US	Yes	Stable	Stable			No
New York	Yes	Unknown	Unknown			Yes
Connecticut	No	N/A	N/A			No
Massachusetts	No	N/A	N/A			No
New Jersey	No	N/A	N/A			No
Pennsylvania	Yes	Declining	Declining		S1	Yes
Vermont	No	N/A	N/A			No
Ontario	Yes	Stable	Stable	2003-2013	S3	(blank)
Quebec	No	N/A	N/A			(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

As part of a State Wildlife Grant, NYSDEC Region 8 Fish and Wildlife staff conducted a native freshwater mussel baseline inventory of tributaries in central and western New York, 2009 to 2020.

Trends Discussion *(insert map of North American/regional distribution and status):*

Trends for New York populations are difficult to determine as most historic data comes from opportunistic naturalist collections, as opposed to more comprehensive baseline surveys. For example, mussels were documented for the first time in 50 of the 106 streams surveyed to date by the Southern Lake Ontario mussel inventory project (Mahar and Landry 2013). This is because many of these streams had never before been surveyed for mussels, not because mussel distribution has dramatically increased. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993, Stein et al.2000). Based on New York’s Natural Heritage S-rank, sparse historical data, and the plight of North America’s freshwater mussels, it is assumed that trends are declining due to a myriad of environmental stressors.

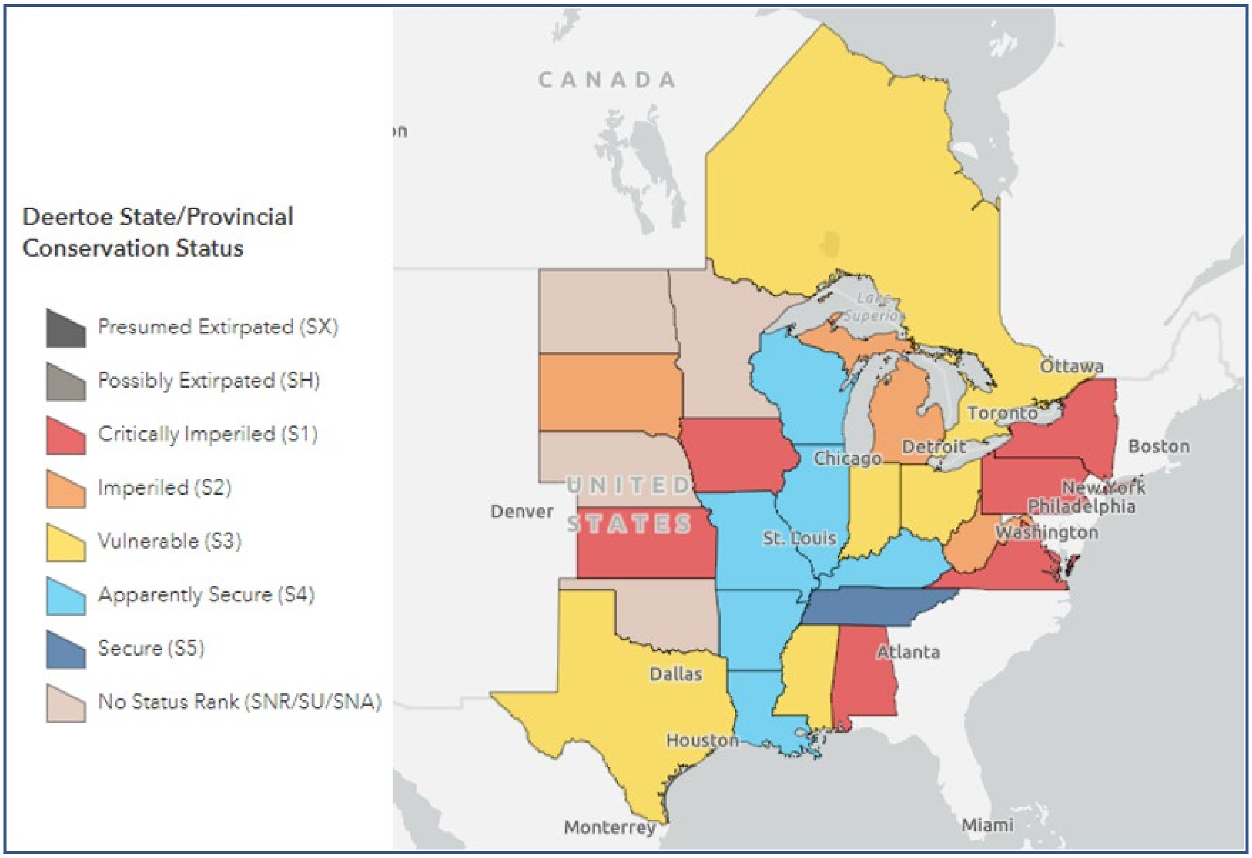

Figure 1. Deertoe distribution and status (NatureServe 2023)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

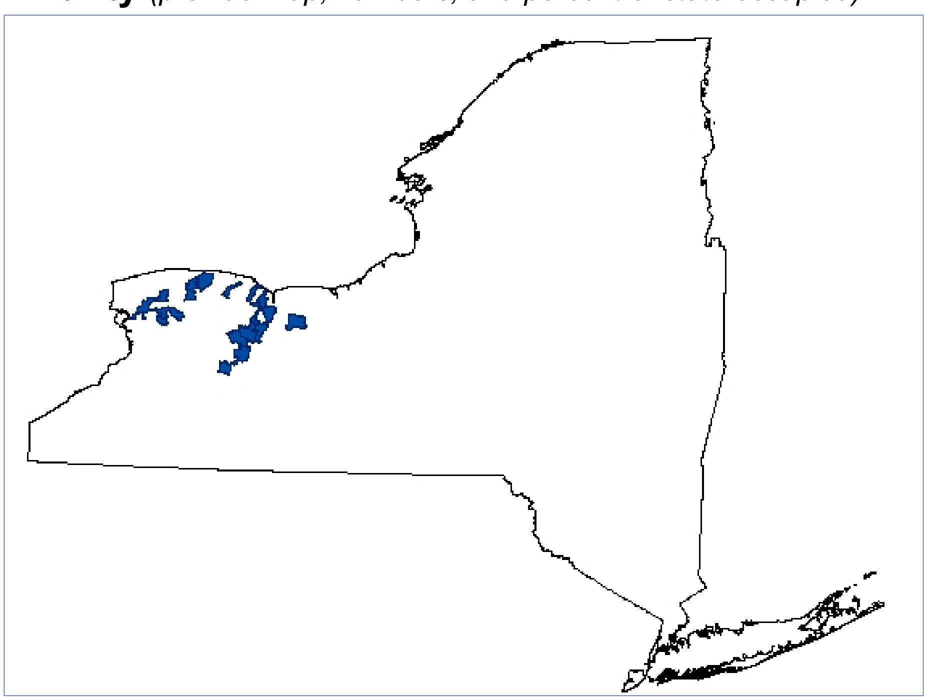

Figure 2. Records of deertoe in New York (NYSDEC 2022)

Years	# of Records	# of Distinct Waterbodies	% of State
	______	______	______
	______	______	______
	______	______	______
Total	______	6	1.1%

Table 1. Records of deertoe in New York.

Details of historic and current occurrence:

2024: T. truncate is found in 19 of 1802 HUC watersheds (1.1%) and in six waterbodies.

There is only a single definite historic record for T. truncata from New York State. In 1948, Blakeslee found three specimens in the Erie basin's lower Tonawanda Creek (Strayer and Jirka 1997).

Since 1970, T. truncata has been found in six New York State waterbodies.

Between 2010 and 2013, T. truncata has been found live in the Erie basin in Tonawanda Creek at Rapids (8 live), and in the Genesee River basin in both lower Honeoye Creek (2 live) and the Genesee River at Mt. Morris (1 live) and Geneseo (at least 1 live). In addition, 238 shells, including fresh and juvenile specimens, were found in the Genesee River between the Honeoye Creek confluence in Rush and Rte 253 Erie Station Rd in Scottsville (Monroe County). Single shells were also found in the Genesee River in Leicester, Geneseo, and York (Livingston County). In the Southwest Lake Ontario basin, three shells were found in Oak Orchard Creek, downstream of the Waterport Reservoir, and one live mussel in Long Pond (Lake Ontario, Monroe Co., near Greece) (Burlakova et al., unpublished data). In addition, 16 shells, including one containing desiccated flesh, were found in the Erie Canal at nine locations between the Sulfur Springs Guard Lock south of Lockport (Niagara County) and Lock 32 in Macedon (Wayne County) (Mahar and Landry 2013).

This species has been found in nearby Presque Isle Bay in Pennsylvania (Masteller et al. 1993) but was later likely extirpated due to dreissenid invasion (Zanatta et al., in preparation). It is unknown whether any individuals remain in Lake Erie and the Niagara River in New York.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	500 miles

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Size/Waterbody Type: Medium River

b. Geology: Assume Moderately Buffered (Size 3+ rivers)

c. Temperature: Warm

d. Gradient: Low Gradient to Moderate-High Gradient

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

T. truncata prefers medium to large rivers and shallow areas of the Great Lakes, where it can live at depths of 12 to 18 feet, rarely straying into smaller streams. It may be locally abundant in packed sand and gravel, but may also be found in mud substrate (Cummings and Mayer 1992, Metcalfe-Smith et al. 2005, McMurray et al. 2012, Parmalee and Bogan 1998, Watters et al. 2009, Strayer, 1997).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, T. truncata must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable habitat, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely to be a slow process for mussels which use resident fishes with limited home ranges as their hosts (COSEWIC as cited in NatureServe 2013).

It has an opportunistic life history strategy. This strategy is often characterized by short life span, early maturity, high fecundity achieved soon after maturation, and, to a lesser extent, moderate to large body size. Species in this group have the fastest growth rates and highest reproductive effort. Nearly all opportunistic species are long-term brooders. This life history strategy is considered an adaptation for rapid colonization and persistence in disturbed and unstable but productive habitats (Haag 2012).

T. truncata is thought to live up to 11 years of age. It is bradytictic, with glochidia overwintering on the female. Gravid females with glochidia were found in May and July; in Ohio they have been found in April (Watters et al. 2009). Sietman et al. (2009) confirmed freshwater drum (Aplodinotus grunniens) as a host species. Sauger (Stizostedion canadense) may also be a host for this species (Watters et al. 2009).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Other Ecosystem Modifications (levees and flood walls, channelization, dredging, impassable culverts)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (zebra mussels, round goby)
4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)
5. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, other regulated discharges)
6. Pollution	Household Sewage & Urban Waste Water (waste water treatment effluent, sewer and septic overflows)
7. Climate Change & Severe Weather	Droughts
8. Natural System Modifications	Dams & Water Management/Use (lowering of water table from agriculture, etc…, causing drying of habitat)
9. Climate Change & Severe Weather	Storms & Flooding (extreme storms)
10. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (die offs from unknown disease)
11. Invasive & Other Problematic Species & Genes	Problematic Native Species (natural predators: muskrat)

Agricultural Runoff
The bulk of New York's *T.truncata* population is found in the Genesee River and Tonawanda Creek, both highly agricultural areas (New York State Landcover 2010). Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in western and central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar and Landry 2013), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer runoff is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag, 2012). In addition, ammonia adsorbs to sediment particles, resulting in higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Treated and Untreated Wastewater
The Genesee River (at Geneseo, Avon, and Gates/Chili/Ogden) and Honeoye Creek (at Honeoye Falls, Honeoye, and Lima) receive treated effluent from sewage treatment plants (SPDES 2007). Illegal dumping of sewage from recreational boats in the Erie Canal may also be a concern. Recent studies show that mussel richness and abundance decreases with increased proximity to sewage effluent (Wildenberg 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al*.,* 1978). Endocrine disrupters from pharmaceuticals are also present in municipal sewage effluents and are increasingly common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012). It should be noted that in the Susquehanna Basin, Harman and Lord (2010) found no evidence that wastewater treatment plants were responsible for reductions in mussel species of greatest conservation need.

Runoff from Developed Land
The Erie Canal and reaches of the Genesee River, which flows through various municipalities from Mt. Morris to Rochester, receive urban stormwater runoff. All five of the New York waterbodies in which live *T. truncata* populations have been found are intermittently bordered by interstate highways, state routes, and/or local roads and lawns, and receive runoff likely containing metals and road salts from these sources (Gillis, 2012; New York State Landcover, 2010). Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller and Zam 1991). Low

levels of metals may interfere with the ability of glochidia to attach to the host (Huebner and Pynnonen 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller and Zam 1991, Liquori and Insler 1985, Pandolfo et al. 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Habitat Modifications
Ecosystem modifications, such as isolated occurrences of canal dredging, instream work associated with bridge replacement, and vegetation removal, kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting "dredge" had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000).

Water Temperature Changes
Gailbreth et al. (2010) recently showed how regional climate patterns coupled with changing local water regimes and management strategies have shifted mussel populations from thermally sensitive species, such as deertoe, to thermally tolerant species.
Sea lamprey control treatments – not certain if this is a threat as most occurrences are well upstream, however unsure if these areas are treated and the sensitivity of this species to lampricides.

Impoundments – Range wide
Across its range, impoundments likely contributed to the reduced distribution of mussels that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery and King 1983, ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓_ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any "protected stream", its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York's mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Conservation efforts for this species should be focused on the Genesee River downstream of Mt. Morris, especially between Rush and Scottsville.
- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.
- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley and Tank 2012).
- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.
- Develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.
- To obtain a better handle on the current status of this species, survey the deep waters of the Genesee River between Mt. Morris and Lake Ontario.
- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis, 2012).
- Establish a protocol whereas DEC staff work closely with state and local highway departments to reduce impacts to native mussels during maintenance and construction projects.
- Replace culverts that disrupt aquatic habitat connectivity to allow for passage of small fish species.
- Within the Great Lakes and Champlain watersheds, lamprey control efforts should consider specific, potentially adverse, impacts to native freshwater mussels when determining methods, including selection of lampricide formulations and concentrations.
  Lampricide treatment managers should use caution when using the combination of TFM and niclosamide in streams with known mussel populations and every effort should be made to maintain lampricide concentrations at or near the MLC for sea lamprey to minimize the risk to this important faunal group (Boogaard USGS 2006).
- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g. point and nonpoint sources, and natural background levels),

seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) -
https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2. (need recommended conservation actions for deertoe).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

- Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Zanta in review

Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
First revision	February 25, 2014 (Samantha Hoff)
Latest revision	January 16, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Devil crawfish **Date Updated:**

Scientific Name: *Cambarus diogenes* **Updated by:**

Class: Malacostraca

Family: Cambaridae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

The devil crawfish is one of the three most widely ranging species of North American crayfishes, occurring from the Rocky Mountains to southern Canada eastward to New Jersey and throughout the Mississippi River basin and Great Lakes. This species is a burrowing crawfish, spending most of its life cycle in individually excavated underground chambers that have several openings at the surface and are surrounded by a chimney of mud pellets (Grow and Merchant 1980). Devil crawfish are a significant component of aquatic ecosystems, maintaining important ecological processes, sustaining bait fisheries, and serving as an important food source in many parts of their range. It contributes to the food web by acting as a predator to control insect populations and by processing vegetation and leaf litter to increase nutrient and organic matter availability for other organisms while maintaining high water quality (Taylor et al. 2007). The larvae of the Hines emerald dragonfly (*Somatochlora hineana*), an endangered species, regularly inhabit devil crawfish burrows in the late summer when their own larval habitats dry up, although the crawfish is also a potential threat as they are known to prey on the dragonfly larvae (Pintor and Soluk 2006). This crawfish occurs in marshy or swampy areas near rivers, streams, or ponds and has been recorded at six locations in three western New York counties, currently limited to the Lake Erie-Lake Ontario lowlands west of the Genesee River (Gall and Jezerinac 1998).

I. Status

a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Not listed

b. Natural Heritage Program

i. **Global:** G5

ii. **New York:** ______ **Tracked by NYNHP?:** yes

Other Ranks:

IUCN Red List: Least Concern

Northeast Regional SGCN: Watchlist (Assessment Priority)

American Fisheries Society: Currently Stable (2007)

Status Discussion:

The devil crawfish is extremely widespread, utilizes a variety of habitat types and is tolerant to varying ecological conditions (Cordeiro et al. 2010). It is stable and secure (millions of individuals with a range > 2,500,000 sq. km) throughout its range with over 300 occurrences (NatureServe 2013). This species has recently expanded into New York and therefore habitat protection will be important for the persistence of populations in the state.

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable	1850-2015		Choose an item.
Northeastern US	Yes	Stable	Stable	1900-2015		Choose an item.
New York	Yes	Stable	Stable	1980-2015	Not listed	Yes
Connecticut	No	Choose an item.	Choose an item.			Choose an item.
Massachusetts	No	Choose an item.	Choose an item.			Choose an item.
New Jersey	Yes	Unknown	Unknown	1900-2015	Not listed	No
Pennsylvania	Yes	Stable	Stable	1900-2015	Not listed	No
Vermont	No	Choose an item.	Choose an item.			Choose an item.
Ontario	Yes	Stable	Stable	1913-2015	Not listed	Choose an item.
Quebec	No	Choose an item.	Choose an item.			Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

The New York Natural Heritage Program has conducted surveys of known occurrences as recently as 2012 for Strawberry Island, 2011 for Woods Creek, 2007 for Oak Orchard Creek, 2007 for Tift Farm Marsh, and 2000 for Niagara Falls Air Force Base and Grand Island (NYNHP 2013).

Trends Discussion *(insert map of North American/regional distribution and status):*

This species was first recorded in New York in 1980 at one site in Erie County and one site in Genesee County, defining the extreme northeastern edge of its range in North America. Since then, four more occurrences have been discovered, all located in the western portion of the state within three counties (Erie, Genesee, and Niagara). Available data suggests that the devil crawfish is limited to the Lake

Erie-Lake Ontario lowlands west of the Genesee River, although there may be more occurrences in similar habitat throughout western New York (Gall and Jezerinac 1998).

All burrows containing the devil crawfish in New York were excavated in wetland remnants of glacial Lake Tonawanda at the Niagara Falls, Buckhorn Island, Iroquois Refuge and Lewiston Road sites; a remnant of a lacustrine wetland at the eastern end of Lake Erie (Tifft Preserve); and wetlands associated with the Niagara River and its tributaries (Strawberry Island and Ransom Road sites) (Gall and Jezerinac 1998). Morphological evidence suggest that these northwestern New York populations are derived from populations in the upper Midwest and dispersal may have occurred along the northern shore of the Lake Erie basin one or more times since the retreat of the Wisconsin ice sheets (Gall and Jezerinac 1998).

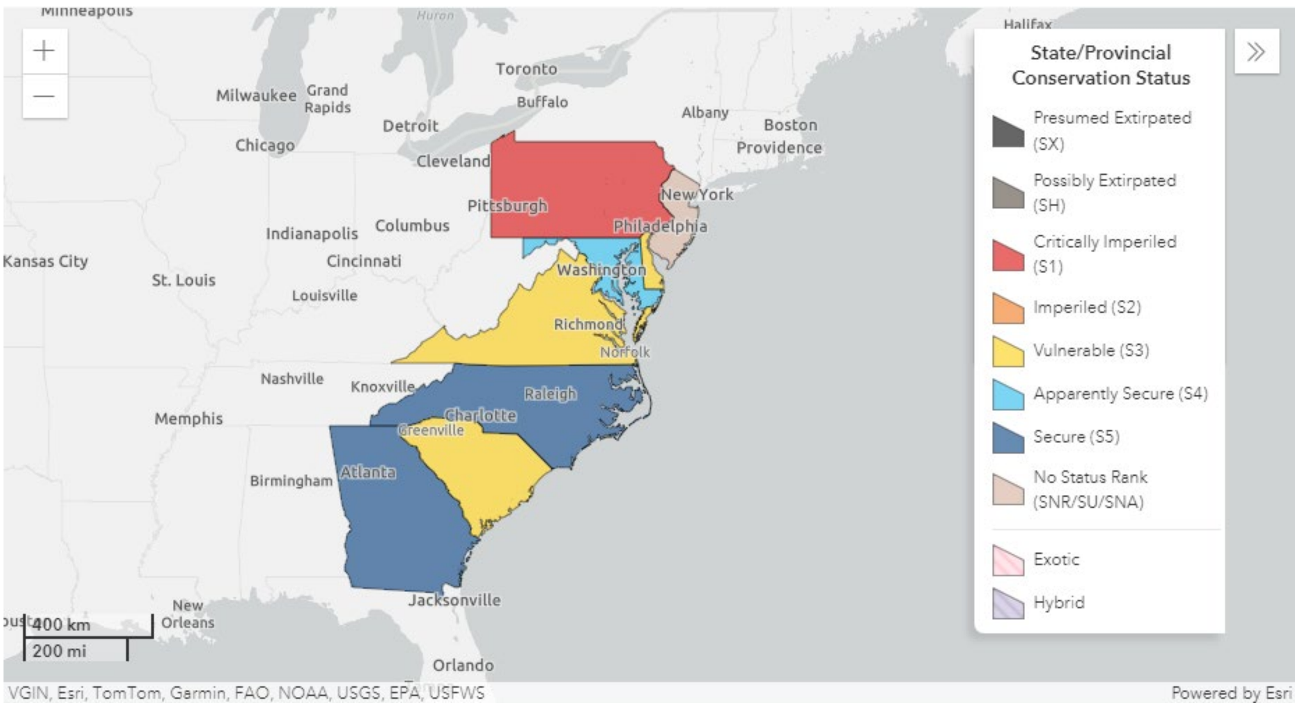

Figure 1. Conservation status of devil crawfish in North America (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

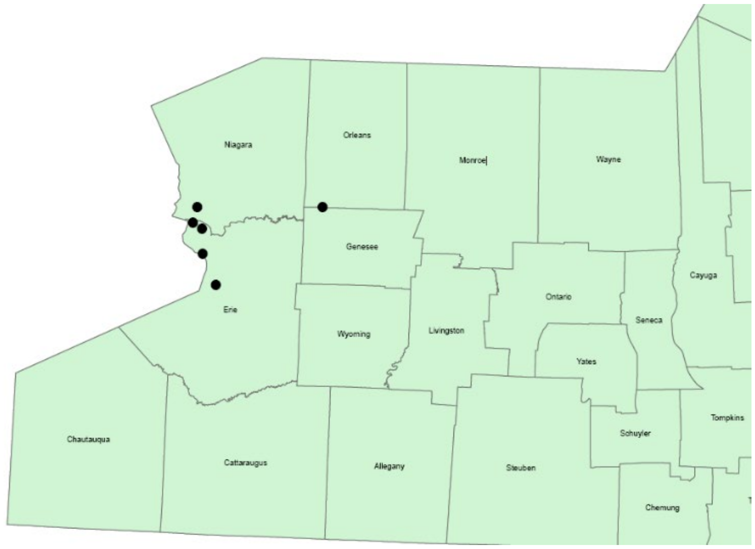

Figure 2: Distribution of devil crawfish in New York (NYNHP 2013).

Years	# of Records	# of Distinct Waterbodies/Locations	% of State
Pre-1995		2	<1%
1996-2014		6	<5%
2015-2023			

Table 1: Records of devil crawfish in New York.

Details of historic and current occurrence:

The first records of this species occurred in 1980 at one location in Erie County: Woods Creek on Buckhorn Island; and one location in Genesee County: Oak Orchard Creek in the town of Shelby (NYNHP 2013).

This species occurs at six locations in western New York: Tifft Farm Marsh, Buffalo, Erie County (2007); Ransom Road Ditch, Grand Island, Erie County (2000); Oak Orchard Creek, Shelby and Alabama, Genesee County (2007); Niagara Falls Air Force Reserve Base, Niagara, Niagara County (2000); Strawberry Island, Tonawanda, Erie County (2012); and Woods Creek on Buckhorn Island, Grand Island, Erie County (2011) (NYNHP 2013).

*Years are dates of last survey

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

Although this species is one of the most widely distributed and successful crayfish species in North America with stable populations, it is considered rare in New York because there are only 6 occurrences with less than 3,000 individuals (Gall and Jezerinac 1998, Cordeiro et al. 2010).

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Freshwater Marsh

b. Riparian

c. Headwater/Creek

d. Wet Meadow/Shrub Swamp

e. Ditch/Artificial Intermittent Stream

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	No	Stable	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

The devil crawfish is a nocturnal primary burrower (remains in its burrow continuously and lives in areas without permanent water except during breeding) occurring in freshwater habitat including wet meadows, along the banks of rivers and streams, shorelines of ponds and lakes, roadside ditches, and other wetlands (NatureServe 2013). Burrows are generally found in clay or sandy soils or in slowly to moderately flowing streams with silt or muck substrates and may be excavated almost anywhere where the water table is near the surface (Hobbs and Pass 1988, Cordeiro et al. 2010). Underground burrows are constructed with several openings at the surface and are usually surrounded by a chimney of mud pellets. The chimneys (which the crayfish constructs with the soil it removes during burrow excavation) can range in height from a low mound to a tower more than 30 cm high and burrows vary from 15 cm to more than 5 m deep (Grow and Merchant 1980). Burrows are not connected and are occupied by a single individual, providing shelter in which the crawfish feed, mate, lay eggs and raise young (Grow and Merchant 1980). This species can survive under nearly anaerobic conditions and studies have showed that most burrows contain very low dissolved oxygen levels, <10% of saturation (Grow and Merchant 1980). Devil crawfish are scavenger and predators; about 60% of their diet is comprised of living or decaying aquatic vegetation while the other 40% is made up of aquatic worms, insects, snails and detritus (Lui 2013).

The following are habitat descriptions of known occurrences in New York from the Natural Heritage Program Element Occurrence Database:

Tifft Farm Marsh: This area is a reclaimed cattail marsh and one of the known locations, Lisa Pond, is likely man-made and appears degraded. Cattails, herbaceous plants, sedges, and shrubs were present and this site is a protected nature preserve.

Strawberry Island: Burrows are located along the downstream shoreline of the island located in the Niagara River. The shoreline has a continuous cover of herbs and shrubby patches, and scattered mature *Salix* sp., *Populus deltoides*, and *Fraxinus* sp. forming a continuous cover in the western central part of the island. This site has been under the jurisdiction of the NYS OPRHP since 1989, but commercial dredging prior to 1960 has greatly reduced the surface area of the island and shoreline erosion threatens its existence.

Ransom Road Ditch: The crawfish were observed in two sections of a ditch approximately 0.5 meters deep and 1.0 meters wide with mowed lawn on both sides. This site is located in front of the Grand Island High School and is subject to highway maintenance activities.

Niagara Falls Air Force Reserve Station: Devil crawfish are found on parts of Cayuga Creek. Individuals were observed in a ditch with cattails, purple loosestrife, watercress, water plantain, curly dock, and duckweed. There is a mowed meadow on both sides of the ditch.

Oak Orchard Creek: Crawfish were found along the bank of the creek and the banks of a nearby channel. The creek is low flow with a deep clay-silt substrate and beds of submerged aquatic vegetation, scattered floating mats of green algae, and scattered emergent beds. The riparian zone alternates between marshy and forested swamps. This site offers protection since it is located in the Iroquois National Wildlife Refuge.

Wood Creek, Buckhorn Island: Individuals were found along the bank of the creek and the banks of a nearby channel. The creek has no obvious flow with a deep clay-silt substrate and beds of submerged aquatic plants, scattered floating mats of green algae, and scattered colonies of *Peltandra virginica* along the bank as emergent beds. The riparian zone is marshy with dense graminoid tussocks, scattered purple loosestrife, goldenrods, *Eupatorium* sp., Iris, and *Peltandra* sp. encroaching on the wet muddy shore between tussocks. The channel runs through a marsh and has areas of bare mud and tussock sedges near its banks. This site offers protection since it is located in Buckhorn Island State Park.

V. Species Demographics and Life History

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	(blank)	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Devil crawfish are solitary animals with annual cycles of reproduction and molting, only meeting with other individuals during mating season. Copulation occurs within the burrow environment during late fall and winter. Egg-laying occurs in spring after temperatures have risen. Females produce between 40-200 eggs, but only 10% typically survive past the first year (Andrews 1907). Eggs are attached to the mothers until hatching via a hardened mass and continue to stay attached to the mother's pleopods during the first larval stage, living in an embryonic-like state (Lui 2013). Larvae molt twice while attached and disconnect only in the third larval stage. Young of the year continue to stay with their mothers for protection until reaching full maturity during mid to late summer, at which time they begin to construct their own burrows (Hobbs and Jass 1988).

Two morphological types of adult males, form I and form II, occur and are associated with the reproductive cycle, usually alternating during the life cycle of an individual. Form I males are in the breeding stages while form II males are not known to mate. Immature males are in form II until the last juvenile molt when it changes to form I and alternates for the remainder of its life. Frequency of form I breeding males is lowest during the summer months, increases and reaches a maximum during the fall, and decreases during the late winter and spring months to the summer minimum (Jegla 1966). Longevity is estimated to be three years or more (Lui 2013).

The devil crawfish is prey to more than 200 predatory species, including various freshwater fishes, raccoons, owls, eastern newts, muskrats, eastern painted turtles, northern water snakes, and red-tailed hawks (Lui 2013). Their burrows, as well as their small size and ability to move quickly, give individuals some protection from predation.

VI. Threats *(from NY 2015 SWAP or newly described)*

The major threats to this species are pollution from runoff and loss and degradation of wetland habitat. Because its range is limited to Lake Erie and SW Lake Ontario watersheds, any loss or degradation of habitat in those regions will lead to population declines (NYSDEC 2005). Introduction of invasive species may cause declines in native populations (NYSDEC 2005). Other threats include water fluctuation in reservoirs and lakes, litter from anglers, channelization, habitat alteration due to changing climatic conditions, and erosion of shorelines (Cordeiro et al. 2010). Only three sites harboring populations in the state offer relatively stable or protected habitat: Buckhorn Island State Park, the Iroquois National Wildlife Refuge, and the Tifft Nature Preserve.

Threats to NY Populations	
Threat Category	**Threat**
Pollution	Agricultural & Forestry Effluents
Pollution	Industrial & Military Effluents
Residential & Commercial Development	Housing & Urban Areas
Natural Ecosystem Modifications	Dams & Water Management/Use
Natural System Modifications	Other Ecosystem Modifications
Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species
Climate Change & Severe Weather	Habitat Shifting & Alteration

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓_ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

The Freshwater Wetlands Act provides protection for wetlands greater than 12.4 acres in size under Article 24 of the NYS Environmental Conservation Law. This only covers a portion of the habitat used by this species and does not protect the habitat, nor the species, enough.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Surveys should be conducted in the counties where devil crawfish has been document, as well as in nearby counties (NYNHP 2013). Habitat management and conservation are necessary to protect devil crawfish populations; although two occurrences are on New York State parks and one is a national wildlife refuge, the other three are vulnerable to various disturbances.

Conservation actions following IUCN taxonomy are categorized in the table.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection):
https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
Land/Water Protection	Site/Area Protection
Land/Water Management	Site/Area Management

Table 2: Recommended conservation actions for devil crawfish.

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2005) includes recommendations for the following actions for freshwater crustaceans, and for devil crawfish in particular.

Habitat monitoring:
____ Investigate the degree of alteration to natural flow regime of waters containing the species.
____ The immediate threats to these populations need to be determined.
Habitat research:
____ The critical habitat needs of both species need to be evaluated.
Life history research:
____ Investigate the impacts of modified flow regime on species life cycle.
Population monitoring:
____ Inventories need to be conducted in their respective historical ranges.

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Originally prepared by	Samantha Hoff
Date first prepared	May 20, 2013
First revision	July 24, 2013 (Samantha Hoff)
Latest revision	

Species Status Assessment

Common Name: Dwarf wedgemussel **Date Updated:** 1/16/2024

Scientific Name: *Alasmidonta heterodon* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Alasmidonta heterodon belongs to the subfamily Unioninae, diagnosed by the presence of subtriangular glochidia with large, medial hooks, and the tribe Anodontini, which includes 16 extant and 1 likely extirpated New York species of the genera Alasmidonta, Anodonta, Anodontoides, Lasmigona, Pyganodon, Simpsonaias, Strophitus, and Utterbackia (Haag 2012, Graf and Cummings 2011).

Never common, A. heterodon is currently known from at least 70 locations in 15 major watersheds, with the largest populations in the Connecticut River watershed in New Hampshire and Vermont (Nedeau 2008). In New York, it is currently found in four waterbodies. It is the only federally endangered mussel in New England and it is listed as endangered in every state where it occurs (Nedeau 2008). A. heterodon lives in running waters of all sizes, from small brooks less than 5 m wide to large rivers more than 100 m wide (United Sates Fish and Wildlife Service 1993). It does not show any preference towards a certain microhabitat (Strayer 1993). This species has shown a 50% – 70% decline in abundance both in the short and long term (NatureServe 2013). It is extant in ten states and likely extirpated from Canada (Hanson and Locke 2000, Metcalfe-Smith and Cadmore-Vokey 2004) and possibly Pennsylvania and is nearly extirpated from Massachusetts and Connecticut.

I. Status

a. Current legal protected Status

i. **Federal:** Endangered **Candidate:** No

ii. **New York:** Endangered

b. Natural Heritage Program

i. **Global:** G1G2 – Critically imperiled / Imperiled

ii. **New York:** S1 - Critically imperiled **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Vulnerable (2011)

-Northeast Regional SGCN: Yes

-Canadian Species at Risk Act (SARA): Extirpated (2003)

-Committee on the Status of Endangered Wildlife in Canada (COSEWIC): Extirpated (2009)

American Fisheries Society Status: Endangered (1993)

Status Discussion:

Historically, this species was widespread, though never common, along the Atlantic Slope from New Brunswick to the Carolinas. The species has experienced significant decline including the regional extirpation of the last remaining population in Canada. Of the small number of extant occurrences remaining, long-term viability is questionable given continuing declines and difficult-to-manage threats. Decline has continued, especially over the last 10 years. A. heterodon currently occupies only 20-25% of its historic sites, with populations severely fragmented. Declines are even more pronounced, in the southern half of its range, from New Jersey south to North Carolina with individual populations numbering only in the tens to hundreds of individuals. The species continues to face significant threats from habitat loss primarily due to human encroachment throughout its range and, without intervention, may decline to the point of critical imperilment soon (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Choose an item.	Choose an item.			(blank)
Northeastern US	Yes	Choose an item.	Choose an item.			Yes
New York	Yes	Choose an item.	Choose an item.		Endangered, S1	Yes
Connecticut	Yes	Choose an item.	Choose an item.		Endangered, S1	Yes
Massachusetts	Yes	Choose an item.	Choose an item.		Endangered, S1	Yes
New Jersey	Yes	Declining	Declining	1970 - present	Endangered, S1	Yes
Pennsylvania	Yes	Unknown	Unknown	2005-2014	Endangered, S1	Yes
Vermont	Yes	Choose an item.	Choose an item.		Endangered, S1	Yes
Ontario	No	N/A	N/A			(blank)
Quebec	No	N/A	N/A			(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

None

Trends Discussion *(insert map of North American/regional distribution and status):*

Trends for New York populations are difficult to determine as most historic data comes from opportunistic naturalist collections, as opposed to more comprehensive baseline surveys. For example, mussels were documented for the first time in 50 of the 106 streams surveyed to date by the Southern Lake Ontario mussel inventory project (Mahar and Landry 2013). This is because many of these streams had never before been surveyed for mussels, not because mussel distribution has dramatically increased. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993, Stein et al.2000).

Based on New York's Natural Heritage S-rank, sparse historical data, and the plight of North America's freshwater mussels, it is assumed that trends are declining due to a myriad of environmental stressors.

Figure 1. Dwarf wedgemussel distribution (IUCN Redlist 2024)

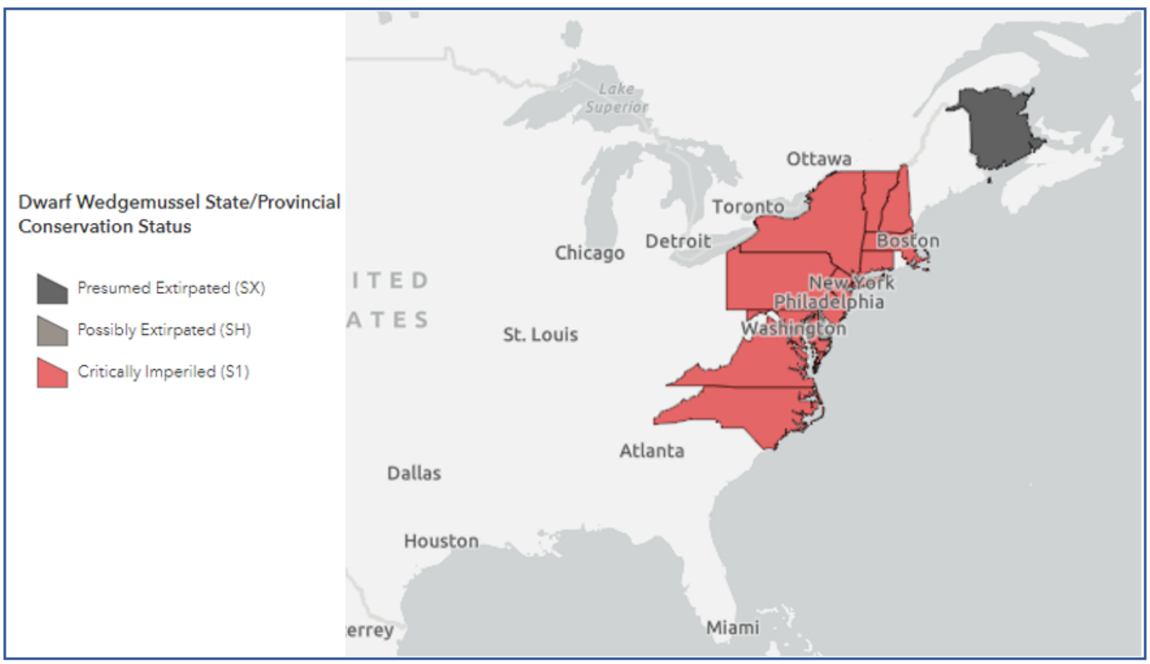

Figure 2. Dwarf wedgemussel status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

Figure 3. Records of dwarf wedgemussel in New York (NYSDEC 2022)

Years	# of Records	# of Distinct Waterbodies	% of State
Total		4	0.4%

Table 1. Records of dwarf wedgemussel in New York.

Details of historic and current occurrence:

2024: A. heterodon has been found in four waterbodies and 7 of 1802 HUC 12 watersheds (0.4%).

Historically, A. heterodon has been found only in the lower Neversink River of the Delaware basin.

Since 1970, A. heterodon has been known to four waterbodies in New York State (Figure 2). It is found from a short reach of the lower Neversink River (1997) and its tributary Basher Kill (2000), where approximately 20,000 animals (Strayer et al. 1996, NY Natural Heritage Program 2013), one of the world's largest populations of this rare species, remain (Strayer and Jirka 1997). It has also been found live in the upper Delaware River as recently as 2002 and a sparse population was found in Webatuck Creek in South Amenia in 2007 (NY Natural Heritage Program 2013).

A. heterodon has been reported from the Passaic River basin in New Jersey and the Housatonic River basin in Connecticut, so it may yet turn up elsewhere in the Atlantic drainage of southeastern New York (Strayer and Jirka 1997).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Core	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. **Size/Waterbody Type:** Medium River

b. **Geology:** Assume Moderately Buffered (Size 3+ rivers)

c. **Temperature:** Warm to Transitional Cool

d. **Gradient:** Low to Moderate-High Gradient

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Yes	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

A . heterodon is a generalist in terms of its preference for stream size, substrate, and flow conditions. It does not show any strong preference for particular habitats or microhabitats and is found in a variety of substrate types including clay, sand, gravel, pebble, and often in depositional areas and banks with large amounts of silt (Nedeau 2008). Other habitats included are amongst submerged aquatic plants, and near stream banks underneath overhanging tree limbs (NatureServe 2013). It inhabits very shallow water along stream banks, but has also been found at depths of 25 feet in the Connecticut River. They do not inhabit lakes or reservoirs, but may occur in small impoundments. Stable flow and stable substrate are critical for this species (Nedeau 2008). This species is relatively sensitive to pollution, siltation, and low dissolved oxygen (McLain and Ross 2005). In New York, A. heterodon's habitat is a small (40m wide), coolwater river, where it lives bedded in the fine sediments that accumulate between cobbles (Strayer and Jirka 1997).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item

Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur (Watters et al. 2009). The low densities (<0.5 per square meter) in which A. hetrodon often occurs is problematical since females need to be in close proximity to a sperm releasing male to be successfully fertilized (Strayer et al. 1996). Eggs are fertilized within the female. Like nearly all North American mussels, A. hetrodon must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable habitat, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

This species has a periodic life history strategy, characterized by moderate to high growth rate, low to intermediate life span, age at maturity, and fecundity, but generally smaller body size than opportunistic species. Most species are long-term brooders. This life history strategy is considered an adaptation to allow species to persist in unproductive habitats or habitats that are subject to large-scale, cylindrical environmental variation or stress (Haag 2012).

The lifespan of the A. heterodon is considered less than 12 years. It has a lower fecundity than most other species. This species is bradytictic, with fertilization occurring in late summer and glochidia released between March and May of the following spring (Nedeau 2008).

In laboratory experiments, Michaelson and Neves (1995) indentified three fish species as possible glochicial hosts: tesselated darter (Etheostoma olmstedti), Johnny darter (Etheostoma nigrum), and mottled sculpin (Cottus bairdi). Slimy sculpin (Cottus cognates) (Schulz and Marbain 1998) and Atlantic salmon (Salmo salar) (Wicklow 1999)were also identified as a host fish. Additional potential hosts include striped bass (Morone saxatilis) and banded killifish (Fundulus diaphanus) (Nedeau 2008). Recent published work indicates that although it has multiple hosts, it prefers the tessellated darter. Darter hosts have been shown to remain close to the area where they were infested with mussel glochidia (order of meters) indicating low dispersal capability (McLain and Ross, 2005; Strayer et al. 2006).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely to be a slow process for mussels which use resident fishes with limited home ranges as their hosts. (COSEWIC 2009). Tesselated darters usually move less than 100 meters during their lives, thus the dispersal ability of A. heterodon is low and the rate at which they might re-colonize former habitat is slow (McLain and Ross 2005).

Short life spans, low fecundity, high degree of host specificity, limited dispersal ability of most of its host species, and low population densities contribute to the endangered status of the A. heterodon (Nedeau 2008).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Other Ecosystem Modifications (levees and flood walls, channelization, dredging, culverts)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (didymo)
4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)
5. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, other regulated discharges)
6. Pollution	Household Sewage & Urban Waste Water (waste water treatment effluent, sewer and septic overflows)
7. Climate Change & Severe Weather	Droughts
8. Natural System Modifications	Dams & Water Management/Use (lowering of water table from agriculture, NYC water use, etc…, causing drying of habitat)
9. Climate Change & Severe Weather	Storms & Flooding (extreme storms)
10. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (die offs from unknown disease)

Agricultural Runoff

Although land use in the Delaware basin is primarily forest, several areas of cultivated cropland are found immediately adjacent to both *A. heterodon* occurrences on Neversink River and to the two southernmost occurrences on the Delaware River between Callicoon and Cochectcon. In addition, extensive agriculture (pasture, hay, and cultivated cropland) borders *A. heterodon* habitat on Webatuck Creek (New York State Landcover 2010). Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in Western and Central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar and Landry 2013), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer run-off is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag 2012). In addition, ammonia adsorbs to sediment particles, resulting in higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Treated Wastewater

Treated wastewater effluent enters the Delaware River near *A. heterodon* occurrences at Callicoon (SPDES 2007). Recent studies show that mussel richness and abundance decrease with increased proximity to sewage effluent (Wildenberg 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al. 1978). Endocrine disrupters from pharmaceuticals are also present in municipal sewage effluents and are increasingly common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012). It should be noted that in the Susquehanna Basin, Harman and Lord (2010) found no evidence that wastewater treatment plants were responsible for reductions in mussel species of greatest conservation need.

Runoff from Developed Land

Residential development is present adjacent to *A. heterodon* habitat on Neversink at Myers Grove. And although the Delaware watershed is mostly forested both a railroad and roads runs adjacent to the Delaware River (Rte 97 and local roads). In addition, in the stretch where *A. heterodon* have been found, there are multiple patches of developed land. This is especially true at Long Eddie, Hankins, and Callicoon (New York State Landcover 2010). These developed lands are likely sources of runoff containing metals and road salts. Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller and Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner and Pynnonen, 1992 as cited in Watters et al. 2009), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller and Zam 1991; Liquori and Insler 1985; Pandolfo et al., 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012)

Habitat Modifications

Ecosystem modifications, such as in-stream work associated with, canal dredging bridge replacements, gravel mining, and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting "dredge" had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000).

Invasives

Didymo (*Didymosphenia geminata*), a filamentous diatom, can form extensive mats that can smother stream bottoms and occlude habitat for mussels (Spaulding and Elwell, 2007). This invasive has been found in the East Branch of the Delaware River. If it becomes as abundant in the Delaware basin as it has elsewhere, it could have enormous negative consequences for mussels, including *A. heterodon* populations (Nedeau 2008).

Range wide, competition with exotic bivalves, both the Asian clam (*Corbicula fluminea*) and zebra mussel (*Dreissena polymorpha*) could pose a threat because these exotics are expected to eventually invade many Atlantic slope watersheds (NatureServe 2013).

Water Temperature Changes

In a recent assessment of the vulnerability of at-risk species to climate change in New York, Schesinger et al. (2011) ranked this species as "extremely vulnerable." This indicates that abundance and/or range extent within New York is extremely likely to substantially decrease or disappear by 2050. Warmer stream temperatures due to the combined effects of land use, such as removal of shaded buffers, and climate change may contribute to the loss of coldwater fisheries and *A. heterodon* populations in some watersheds (Nedeau 2008). Temperature induced changes in fish communities could have a profound influence on the availability of hosts for freshwater mussels. Mussels, like *A. heterodon*, that inhabit small streams and rivers and rely on fish adapted for cooler water, such as several species of sculpins, darters, and salmonids, might be most affected by factors such as climate change or the removal of shaded buffers (Nedeau 2008).

Impoundments – Range wide

Across its range, impoundments likely contributed to the reduced distribution of mussels that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery and King 1983, ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ **No:** ____ **Unknown:** ____

If yes, describe mechanism and whether adequate to protect species/habitat:

New York State Environmental Conservation Law, § 11-0535. 6 NYCRR Part 182: Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern; Incidental Take Permits

Section 7(a) of the Federal Endangered Species Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as Federally endangered or threatened. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR Part 402. Section 7(a)(4) requires Federal agencies to confer informally with the Service on any action that is likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, Section 7(a)(2) requires Federal agencies to ensure that any activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of such a species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Service.

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any “protected stream”, its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York’s mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley and Tank 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis 2012).

- Establish a protocol whereas DEC staff work closely with state and local highway departments to reduce impacts to native mussels during maintenance and construction projects.

- All populations should receive protection through acquisition, easements, registry, and/or working with local, state, and federal government agencies on issues relating to zoning and streamside development, water quality, regulation of water flows, land use practices, etc (NatureServe 2013).

- Replace culverts that disrupt aquatic habitat connectivity to allow for passage of small fish species.

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g. point and nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

- Priority conservation efforts for this federally listed species should focus on any New York stream in the species occurs, especially the Neversink River and the Basherkill.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	

Table 2. (need recommended conservation actions for dwarf wedgemussel).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.

- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

- Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
First revision	February 25, 2014 (Samantha Hoff)
Latest revision	January 16, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Eastern pearlshell **Date Updated:** 1/16/2024

Scientific Name: *Margaritifera margaritifera* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Margaritiferiae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Margaritifera margaritifera, meaning pearl-bearer, is aptly named as this species has been fished for pearls at least since Roman times. M. margaritifera is North America's only native freshwater mussel whose range extends beyond the continent, occurring in New England and the Canadian Maritime Provinces, from eastern Pennsylvania to Newfoundland, Labrador, and Nova Scotia, as well as in northern Europe and Asia, from Spain, the British Isles, and Scandinavia, through central Europe to northern Asia and Japan (Strayer & Jirka, 1997; Watters et al., 2009). Since 1970, M. margaritifera has been documented in 24 New York State waterbodies. It is also the only member of the family Margaritiferidae in New York, and its biology and distribution are unique among the state's unionoids. It uses salmonids as hosts and typically lives in cold, calcium-poor waters where it is often the only unionoid species present (Strayer & Jirka, 1997).

Although not common, and ranked as "Imperiled" in New York, this edge of range species is considered "Apparently secure" throughout its range. In North America, approximately ⅔ to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993, Stein et al. 2000). While population trends in New York are unknown, it is assumed that they too are declining, due to a myriad of environmental stressors.

I. Status

a. Current legal protected Status

i. **Federal:** None **Candidate:** No

ii. **New York:** Threatened listing proposed (2019)

b. Natural Heritage Program

i. **Global:** G4 – Apparently Secure

ii. **New York:** S2S3 - Imperiled/Vulnerable **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Endangered (2010)

-Northeast Regional SGCN: Yes

-American Fisheries Society Status: Special Concern (1993)

Status Discussion:

M. margaritifera has a very large distribution with some very large healthy populations remaining in North America and in some parts of Europe. It has suffered significant widespread declines in occupancy, range extent, and number of occurrence across its entire range in Europe, including several national extirpations. Declines in the U.S. and Canada have been less serious (NatureServe, 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Declining	Declining			(blank)
Northeastern US	Yes	Declining	Choose an item.			Yes
New York	Yes	Choose an item.	Choose an item.		Proposed Threatened, S2S3	Yes
Connecticut	Yes	Choose an item.	Choose an item.		Special Concern	Yes
Massachusetts	Yes	Choose an item.	Choose an item.		SU	Yes
New Jersey	Choose an item.	Choose an item.	Choose an item.	1970 - present	SX – Presumed extinct	No
Pennsylvania	Yes	Unknown	Unknown	2005-2014	Endangered, S1S2	Yes
Vermont	Yes	Choose an item.	Choose an item.		Threatened, S2	Yes
Ontario	No	Choose an item.	Choose an item.			(blank)
Quebec	Yes	Choose an item.	Choose an item.		S3	(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

No regular surveys are being conducted for this species at this time. Regulatory surveys may be conducted in known or likely habitat as part of the project review process.

Trends Discussion *(insert map of North American/regional distribution and status):*

Because these animals are so long-lived, it would be difficult to detect trends in population abundance without long-term monitoring. Trends for New York populations are difficult to determine as most historic data comes from opportunistic naturalist collections, as opposed to more comprehensive baseline surveys. For example, mussels were documented for the first time in 50 of the 106 streams surveyed to date by the Southern Lake Ontario mussel inventory project (Mahar & Landry, 2013). This is because many of these streams had never before been surveyed for mussels, not because mussel distribution has dramatically increased. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993; Stein et al.2000). Based on New York's Natural Heritage S-rank, sparse historical data, and the plight of North America's freshwater mussels, it is assumed that trends are declining due to a myriad of environmental stressors.

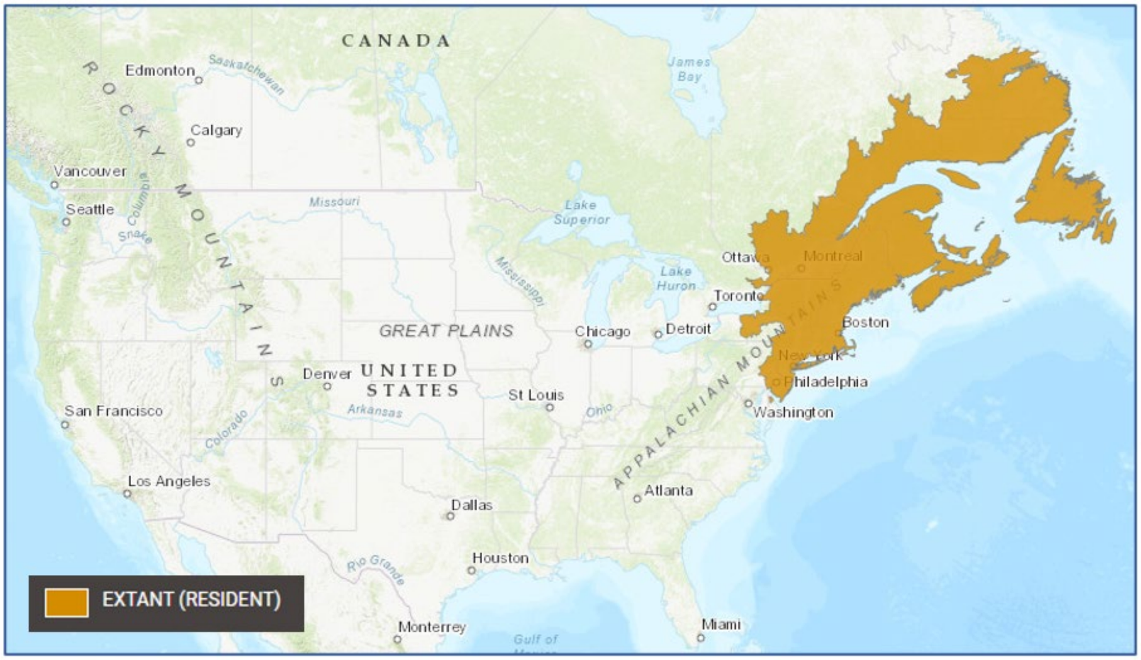

Figure 1. Eastern pearlshell North American distribution (IUCN Redlist 2024)

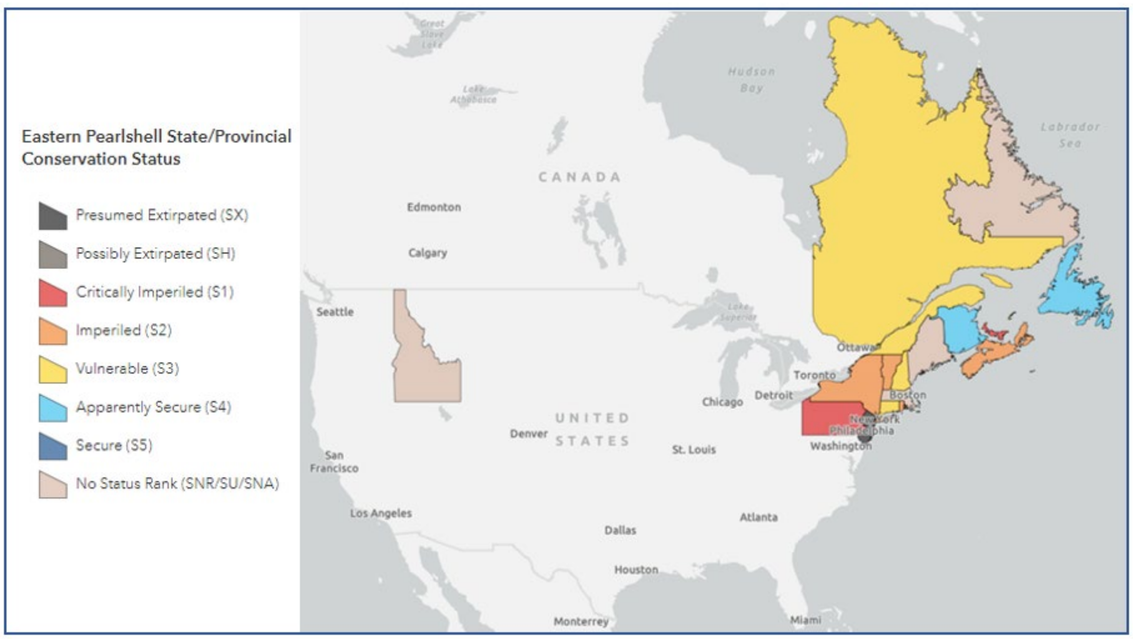

Figure 2. Eastern pearlshell status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

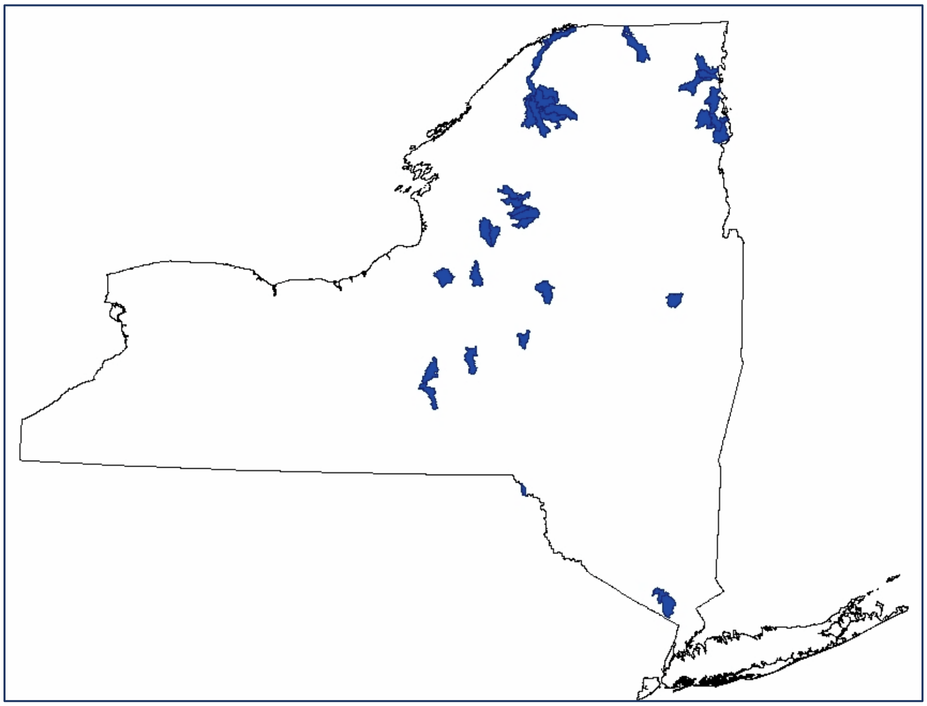

Figure 3. Records of eastern pearlshell in New York (NYSDEC 2022)

Years	# of Records	# of Distinct Waterbodies	% of State
Total		40	2.0%

Table 1. Records of eastern pearlshell in New York.

Details of historic and current occurrence:

2024: This species has been found in 40 waterbodies and 36 of 1802 HUC 12 watersheds (2.0%)

M. margaritifera was historically found in the St. Lawrence River's Grass River basin, and in the Lake Champlain basin in the Saranac River and the Boquet River. It may also have occurred in the Hudson basin in the southern Adirondacks. In the 1950s, it was known to live in the upper Hackensack River basin. A single shell taken from Silver Lake (Sullivan County) in 1949 establishes its presence in the Delaware basin in New York (Strayer & Jirka, 1997).

Since 1970, M. margaritifera has been documented in 24 New York State waterbodies (Figure 2). M. margaritifera is probably widespread along the margins of the Adirondacks and throughout eastern New York in nutrient-poor, soft water trout streams (Strayer & Jirka, 1997). In the mid 1990s this species was confirmed in the Grass River and its tributaries including Grannis Brook, Leonard Brook, Little River, Black Brook, Plumb Brook, the North Branch of the Grass River, and Elm Creek (NY Natural Heritage Program, 2013). Since the 1970s, this species has been found in the Black River and its tributaries including Butler Creek, Black Creek, Otter Creek, Fish Creek, and an unnamed tributary (NY Natural Heritage Program, 2013; White et al., 2011); and in Fish Creek and Scriba Creek, tributaries to Oneida (Strayer & Jirka, 1997; NY Natural Heritage Program, 2013; Mahar & Landry, 2013). In the Lake Champlain Valley, it is still found in Dry Mill Brook, the Boquet River, the North Branch of the Boquet River, and Salmon River and its tributary Riley Brook (NY Natural Heritage Program, 2013). By 1994, the upper Hackensack River site in the lower Hudson basin had low density and no evidence of reproduction (Strayer, 1995), probably a casualty of intensive residential development of the watershed (Strayer & Jirka, 1997). A single specimen was found in the Susquehanna basin in headwaters of the East Fork of the Otselic River in 2008 (Harman & Lord, 2010).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Core	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. **Size/Waterbody Type:** Headwater/Creek to Medium River

b. **Geology:** Low Buffered, Acidic to Moderately Buffered, Neutral

c. **Temperature:** Cold to Transitional Cool

d. **Gradient:** Low to Moderate-High Gradient

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Yes	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

M. margaritifera lives in cold, nutrient-poor, softwater, mountain streams and small rivers that support populations of trout and salmon. It never occurs in lakes, ponds, or warm-water streams; although relict populations may exist in warm and degraded portions of streams whose thermal regime and upland landscape have been altered by human activities. Best habitats are fairly small streams that are heavily shaded by a riparian canopy, possess clean cold water with high dissolved oxygen, and have stable channels with clean, stable substrates of coarse sand, gravel, and cobble (Nedeau, 2008; NatureServe, 2013). Factors believed to limit this species are eutrophication, pH (acidity), sedimentation, and water temperature (Nedeau, 2008). These habitats often are overlooked in surveys of other mussel species (Strayer & Jirka, 1997).

M. margaritifera is rarely associated with more than a very few other mussel species (Watters et al., 2009). Bauer et al. (as cited in Watters et al., 2009) hypothesized that this species has a lower metabolism than other mussels and can utilize food-poor streams not available to other species.

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, this species must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable habitat, they will burrow into the substrate, where they may remain for several years (Watters et al., 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations (COSEWIC as cited in NatureServe, 2013).

This species has an equilibrium life history strategy, characterized primarily by long life span, mostly short term brooding, low to moderate growth rate, and late maturity, with low reproductive effort and fecundity that increases slowly after maturation. This life history strategy is considered to be favored in stable, productive habitats (Haag, 2012).

M. margaritifera has the highest fecundity reported for any freshwater mussel, with upward of 17 million glochidia produced annually (Bauer 1994, 1987) and is thought to be the longest-lived invertebrate animal (NatureServe, 2013). North American specimens can live for more than 50 years, while European specimens have been known to reach a maximum age in excess of 130 years (Watters et al., Bauer, Nedeau, Ziuganov et al. as cited in NatureServe, 2013). M. margaritifera reaches sexual maturity at 12 to 20 years of age (Watters et al., 2009; Young & Williams, 1984; Bauer, 1987). Once mature, females reproduce for the rest of their lives, never reaching senescence (Bauer as cited in Watters et al., 2009; Young & Williams, 1984; Hastie & Young as cited in NatureServe, 2013).

Females of this species have the ability to become hermaphroditic (Bauer as cited in Nedeau, 2008, Bauer as cited in Watters et al., 2009). Hermaphroditism affords benefits when population densities are low; under such conditions, females may switch to self-fertilization to ensure that recruitment continues.

Typically, salmonids are the host fish for this species (Watters et al., 2009). For fish of northeast North America, glochidia have been found to transform on Chinook salmon (Oncorhynchus tshawytscha), rainbow trout (Oncorhynchus mykiss), Coho salmon (Oncorynchus kisutch), brook trout (Salvelinus fontinalis), brown trout, (Salvelinus fontinalis), and Atlantic salmon (Salmo salar)

(Watters et al., 2009). Young and Williams (1984), however, claim rainbow trout is an unsuitable host. Females are gravid from late summer to late October (Hastie & Young as cited in Nedeau, 2008), with glochidia released from July to October. Glochidia may overwinter on the host until the following May or longer (Watters et al., 2009).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Other Ecosystem Modifications (impassable culverts)
3. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)
4. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, other regulated discharges)
5. Pollution	Household Sewage & Urban Waste Water (sewer and septic overflows)
6. Climate Change & Severe Weather	Droughts
7. Natural System Modifications	Dams & Water Management/Use (lowering of water table from agriculture, etc…, causing drying of habitat)
8. Climate Change & Severe Weather	Storms & Flooding (extreme storms)
9. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (Whirling disease affecting salmonids)
10. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (lampricide)
11. Climate Change & Severe Weather	Habitat Shifting & Alteration (presence of salmonids)
12. Pollution	Air-Borne Pollutants (atmospheric pollutants from point and nonpoint sources including acid deposition)

Factors believed to limit *M. margaritifera* are pH (acidity), eutrophication, sedimentation, and water temperature. New York State's populations and their habitats are exposed to these threats.

Agricultural Runoff

Although the watersheds of most of New York's *M. margaritifera* streams are mostly forested, in some areas of known populations, there are exceptions. Almost the entire main stem of Fish

Creek, and both the Boquet River and the North Branch of the Boquet River run through large stretches of cultivated cropland. Grannis Brook and Leonard Brook run through extensive blocks of recently harvested forest. Many other upstream tributaries to the Grass River, including Little River, Black Brook, Elm Creek, upper reaches of Grass River, and Plum Brook, also run adjacent to multiple patches of recently harvested forest land (New York State Landcover, 2010). Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis, 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. For example, in Germany, deposition of sand and mud, and compaction of the streambed, reduced surface-subsurface exchange and had strongly negative effect on habitat quality and juvenile recruitment (Geist & Auerswald as cited in Nedeau, 2008). During recent mussel surveys in Western and Central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar & Landry, 2013), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag, 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag, 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al., 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag, 2012).

Fertilizer runoff is also a concern. Bauer (as cited in Strayer & Jirka, 1997) has shown that enrichment of streams by nutrients, especially nitrate, has caused declines in *M. margaritifera* populations in Europe. Bauer (1988) demonstrated that the adult mortality rate increased as stream nitrate concentrations increased, and that juvenile recruitment declined as phosphate, calcium, and biological oxygen demand increased. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag, 2012). In addition, ammonia adsorbs to sediment particles, resulting in higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom, 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al, 2012).

Treated Wastewater

M. margaritifera populations in the Fish Creek at Taberg, at Grass River at Canton, and in the Boquet River at both Willsboro and Wadhams are directly exposed to treated effluent from wastewater treatment facilities (SPDES, 2007). Recent studies show that mussel richness and abundance decrease with increased proximity to sewage effluent (Wildenberg, 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al., 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al., 1978). Endocrine disrupters from pharmaceuticals are also present in municipal sewage effluents and are increasingly common in rivers and lakes (Haag, 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag, 2012). It should be noted that in the Susquehanna Basin, Harman and Lord (2010) found no evidence that wastewater treatment plants were responsible for reductions in mussel species of greatest conservation need.

Runoff from Developed Land

Although this species is found in areas of the state that have not been heavily urbanized, local and regional roads criss-cross the North Country landscape, providing a source of non-point source pollution to adjacent waterways. In addition, a stretch of the Grass River that is known to have *M. margaritifera* runs through the municipality of Canton (New York State Landcover, 2010). These developed lands are likely sources of stormwater runoff containing metals and road salts. Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller & Zam, 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner & Pynnonen, 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al., 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller & Zam 1991, Liquori & Insler 1985; Pandolfo et al., 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al., 2012).

Habitat Modifications

Ecosystem modifications, such as in-stream work associated with canal dredging, bridge replacements, gravel mining, and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge, 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting "dredge" had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy, 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge, 2000).

Acidification

Acid deposition is of particular concern to New York State because of important and sensitive ecosystems which lie immediately downwind of the largest mid-western utilities burning fossil fuels and emitting sulfur dioxide and oxides of nitrogen in North America. The Adirondacks are particularly sensitive to acidic deposition because it lacks adequate soil and bedrock buffering capacity to counter the deposited acids. In this region, acidic deposition has affected hundreds of lakes and thousands of miles of headwater streams. The diversity of life in these acidic waters has been greatly reduced ("Environmental Impacts of Acid," 2012).

M. margaritifera is very sensitive to extended durations exposed to water with a pH ≤ 5.0-5.5 Dolmen & Kleiven (as cited in Nedeau, 2008), suggest that acidification and eutrophication were responsible for the extinction of 94 percent of *M. margaritifera* in Norway). For this reason, it is possible that this species has also been lost from portions of its historic New York range. Future efforts to control urban smog during the summer season will result in some reductions, however additional nitrate reductions are needed. A recent U.S. EPA report which used computer models to predict future lake acidity reported that without additional reductions in emissions, the number of acidic Adirondack lakes will actually continue to increase ("Environmental Impacts of Acid," 2012).

Water Temperature Changes

In a recent assessment of the vulnerability of at-risk species to climate change in New York, Schesinger et al. (2011) ranked this species as "extremely vulnerable." This indicates that abundance and/or range extent within New York is extremely likely to substantially decrease or disappear by 2050. Warmer stream temperatures due to the combined effects of land use, such as removal of shaded buffers, and climate change may contribute to the loss of coldwater fisheries and *M. margaritifera* populations in some watersheds (Nedeau, 2008). Temperature induced changes in fish communities could have a profound influence on the availability of hosts for freshwater mussels. Mussels, like *M. margaritifera*, that inhabit small streams and rivers and rely on fish adapted for cooler water, such as trout species, might be most affected by climate change (Nedeau, 2008).

Sea lamprey control treatments
M. margartifera populations are found in several stream that are regularly scheduled for sea lamprey control treatment. These streams include Scriba Creek, Fish Creek, and Black River in the Lake Ontario drainage and Boquet River and Salmon River in the Lake Champlain drainage. Fish Creek, a known *M. margaritifera* stream, was treated with lampricide in 2013. The impact of this treatment on the *M. margaritifera* population has not been evaluated.
In New York, tributaries harboring larval sea lamprey (*Petromyzon marinus*), are treated periodically with lampricides (TFM or TFM/Niclosamide mixtures) by Fisheries and Oceans Canada and the U.S. Fish and Wildlife Service to reduce larval populations (Sullivan and Adair 2014). Niclosamide was originally developed as a molluscicide. While unionid mortality is thought to be minimal at TFM concentrations typically applied to streams to control sea lamprey larvae (1.0 –1.5 × sea lamprey MLC), increases in unionid mortality were observed when exposed to the niclosamide mixture, indicating that mussels may be at risk when the mixture is used in control operations. Treatment managers should use caution when using the combination of TFM and niclosamide in streams with known mussel populations and every effort should be made to maintain lampricide concentrations at or near the MLC for sea lamprey to minimize the risk to this important faunal group (Boogaard, 2006).

Impoundments – Range wide
Across its range, impoundments likely contributed to the reduced distribution of mussels that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery & King 1983; ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓__ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law

(ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any “protected stream”, its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York’s mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c)of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al, 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to unionids at multiple life stages, and therefore needs to be addressed (Gillis, 2012).

- In areas subject to tree harvest, promote best forestry practices to reduce/eliminate sedimentation and to ensure that substantial woody vegetation in areas directly adjacent to streams continue to provide temperature-moderating shade to the stream.

- Establish a protocol whereas DEC staff work closely with state and local highway departments to reduce impacts to native mussels during maintenance and construction projects.

- Replace culverts that disrupt aquatic habitat connectivity to allow for passage of small fish species.

- Within the Great Lakes and Champlain watersheds, lamprey control efforts should consider specific, potentially adverse, impacts to native freshwater mussels when determining methods, including selection of lampricide formulations and concentrations.

  Lampricide treatment managers should use caution when using the combination of TFM and niclosamide in streams with known mussel populations and every effort should be made to maintain lampricide concentrations at or near the MLC for sea lamprey to minimize the risk to this important faunal group (Boogaard, 2006).

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g. point & nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	

Table 2. (need recommended conservation actions for eastern pearlshell).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

- Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
First revision	
Latest revision	January 16, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Eastern pondmussel **Date Updated:** 1/16/2024

Scientific Name: *Sagittunio nasutus* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Eastern pondmussel's scientific name was recently changed from Ligumia nasuta to Sagittunio nasutus (Watters 2018). S. nasutus is a freshwater mussel of the family Unionidae and subfamily Lampsilinae. belongs to the subfamily Ambleminae and the tribe Lampsilini, which includes 17 extant and 6 likely extirpated New York species of the genera Actinonaias, Epioblasma, Lampsilis, Leptodea, Ligumia, Obovaria, Potamilus, Ptychobranchus, Toxolasma, Truncilla, and Villosa (Haag 2012; Graf and Cummings 2011). S. nasutus is the only species of Sagittunio found in New York (Strayer and Jirka 1997).

In New York, S. nasutus is most often found in quiet waters in estuaries, lakes, in slackwater areas of rivers, canals, or slow streams, but it has also been found regularly in the Niagara River (Strayer & Jirka 1997, Nedeau 2008). S. nasutus inhabits in a wide range of substrates (Nedeau 2008), although it is thought to prefer fine sand and mud (Metcalfe-Smith et al. 2005, Watters et al. 2009).

Since 1970, S. nasutus has been found in 21 New York waterbodies. It is a widespread species that once was locally abundant from the Great Lakes to much of the Atlantic Slope, but has experienced decline in most areas (NatureServe 2013). Although not widespread in New York, S. nasutus can still be encountered regularly (Strayer & Jirka 1997). This species has been heavily impacted by zebra mussels in the St. Lawrence River basin, Hudson River estuary, lower Great Lakes, and elsewhere throughout the state (Strayer & Jirka 1997).

In New York, S. nasutus is ranked as imperiled, although it is apparently secure throughout its range (NatureServe 2024). In North America, approximately ⅔ to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993; Stein et al., 2000). While population trends in New York are unknown, it is assumed that they too are declining, due to a myriad of environmental stressors.

I. Status

a. Current legal protected Status

i. **Federal:** None **Candidate:** No

ii. **New York:** None, Special Concern listing proposed (2019)

b. Natural Heritage Program

i. **Global:** G4 – Apparently Secure

ii. **New York:** S2 - Imperiled **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Vulnerable (2015)

-Northeast Regional SGCN: Yes

-Committee on the Status of Endangered Wildlife in Canada (COSEWIC): Endangered

-American Fisheries Society Status: Threatened (1993)

Status Discussion:

This is a widespread species that was once locally abundant from the Great Lakes to the Atlantic Slope, but has experience decline in most areas (significantly so in the Canadian Great Lakes to New York and New England) although still maintains hundreds, if not thousands, of populations across its range (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Declining	Unknown			(blank)
Northeastern US	Yes	Declining	Choose an item.			Yes
New York	Yes	Unknown	Unknown			Yes
Connecticut	Yes	Choose an item.	Choose an item.		Special Concern, S2	Yes
Massachusetts	Yes	Choose an item.	Choose an item.		Special Concern, S2S3	Yes
New Jersey	Yes	Unknown	Unknown	1970-2013	Threatened, S2	Yes
Pennsylvania	Yes	Choose an item.	Choose an item.		S2S3	Yes
Vermont	No	N/A	N/A			No
Ontario	Yes	Declining	Declining	2003-2013	Special Concern, S1	(blank)
Quebec	No	N/A	N/A			(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

As part of a State Wildlife Grant, NYSDEC Region 8 Fish and Wildlife staff conducted a native freshwater mussel baseline inventory of tributaries in central and western New York, 2009 to 2020

Trends Discussion *(insert map of North American/regional distribution and status):*

Trends for New York populations are difficult to determine as most historic data comes from opportunistic naturalist collections, as opposed to more comprehensive baseline surveys. For example, mussels were documented for the first time in 50 of the 106 streams surveyed to date by the Southern Lake Ontario mussel inventory project (Mahar & Landry, 2013). This is because many of these streams had never before been surveyed for mussels, not because mussel distribution has dramatically increased. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993; Stein et al. 2000). Based on New York's Natural Heritage S-rank, sparse historical data, and the plight of North America's freshwater mussels, it is assumed that trends are declining due to a myriad of environmental stressors.

New York Natural Heritage Program (2013) Online Conservation Guide for S. nasutus reports that this species was once a major component of the lower Great lakes drainage basin, but is now virtually absent owing to the zebra mussel invasion. S. nasutus comprised about 5% of the pre-1960 Unionid records in the lower Great Lakes in Ontario, but dropped to 2.5% of the records post-1960. Between 1930 to 1982, this species was the second most common Unionid in western Lake Erie (Nalepa et al. 1991), but by 1991 it had disappeared (Schloesser and Nalepa 1994).

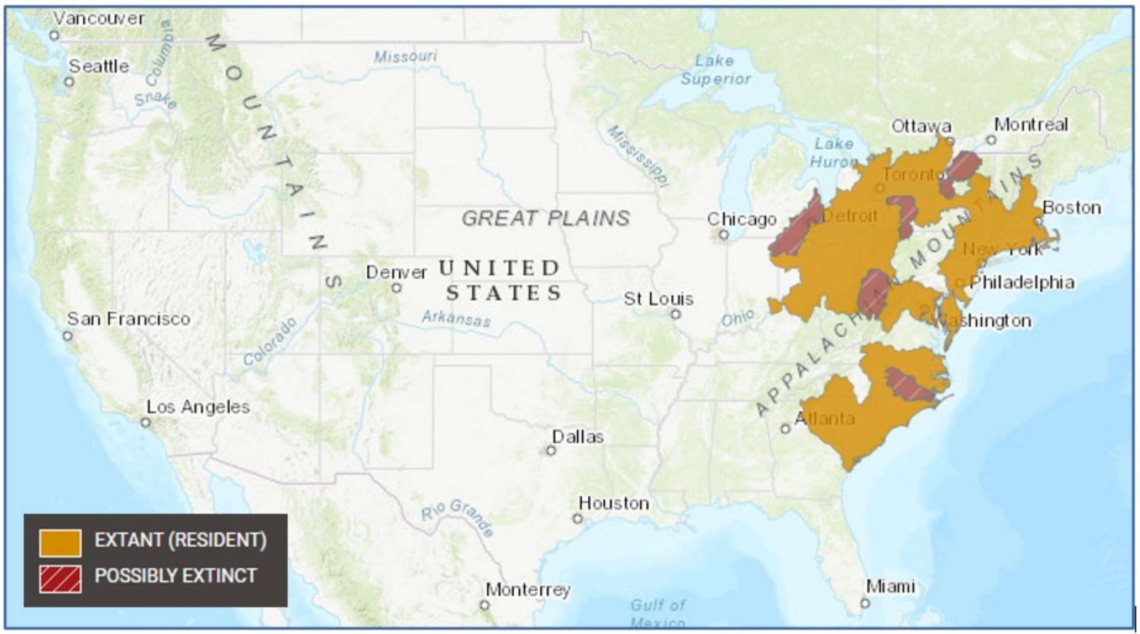

Figure 1. Eastern pondmussel distribution (IUCN Redlist 2024)

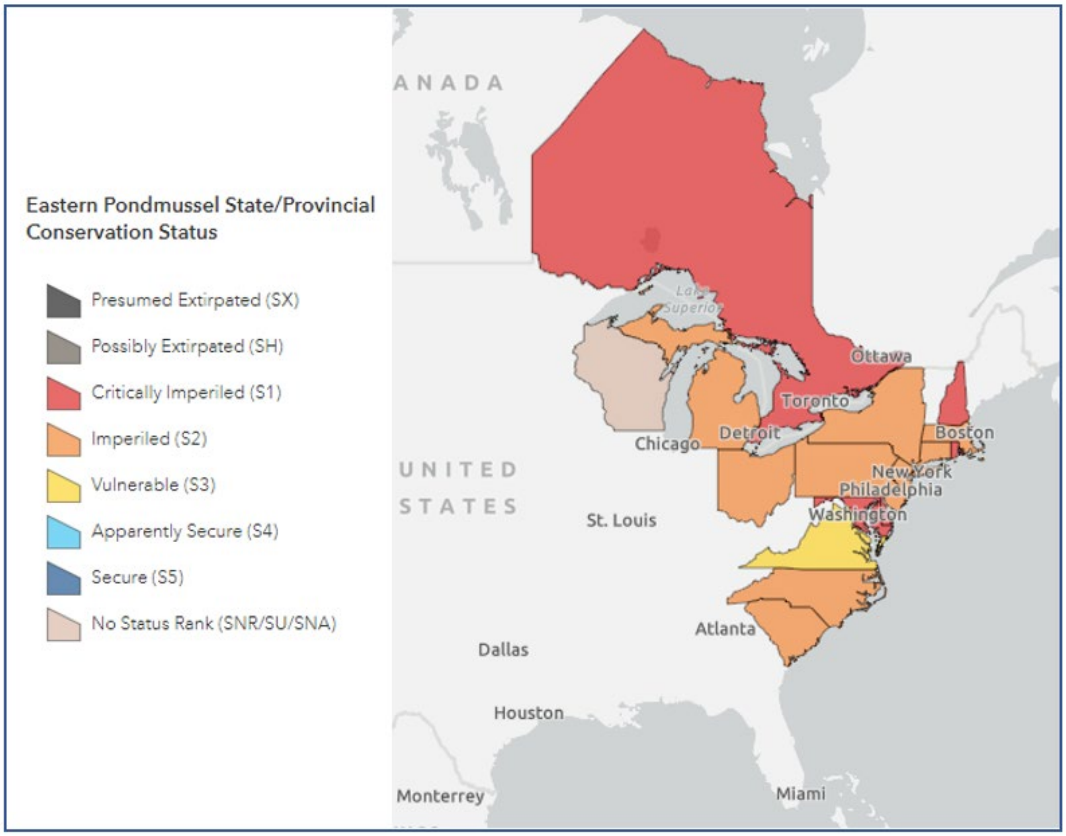

Figure 2. Eastern pondmussel status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

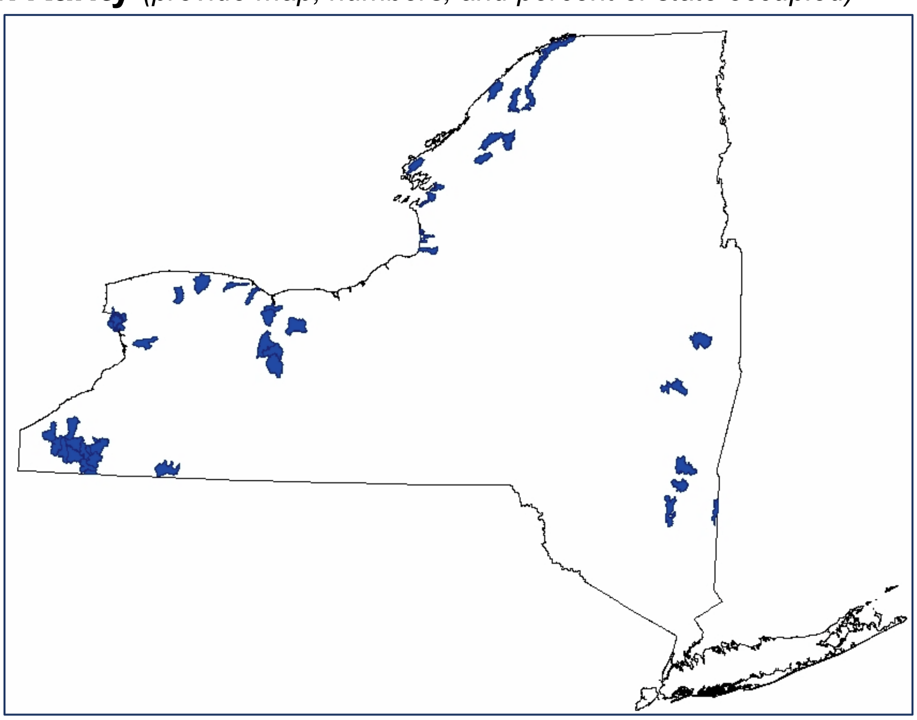

Figure 3. Records of eastern pondmussel in New York (NYSDEC 2022)

Years	# of Records	# of Distinct Waterbodies	% of State
	_______	_______	_______
	_______	_______	_______
	_______	_______	_______
Total	_______	29	2.4%

Table 1. Records of eastern pondmussel in New York.

Details of historic and current occurrence:

2024: This species is found in 44 of 1802 HUC 12 watersheds (2.4%) and 29 waterbodies.

Although S. nasutus originated on the Atlantic Slope, it has dispersed into much of New York and is most common in the western part of the state. It seems to be missing all together from the Susquehanna basin (Ortmann 1919). It is scattered in the Erie-Niagara drainage, central New York, and the St. Lawrence River and its tributaries, Oswegatchie River at Gouverneur and Indian River. There is an old record from a private fen in Genesee County (Strayer and Jirka 1997). It has been reported from one tributary to Lake Ontario in Niagara County (likely Twelvemile Creek or East Branch of Twelvemile Creek) and two tributaries to Lake Ontario in eastern Wayne County in the vicinity of Sodus Bay and Port Bay. In the Upper Hudson it had been found in North Chuctanunda Creek, as well as various locations along the Hudson River (Strayer and Jirka 1997).

Since 1970, S. nasutus has been found in 21 New York State waterbodies.

In the Lower Genesee basin 20 live S. nasutus were found in Honeoye and Bebee Creeks. In the West Lake Ontario basin shells were found in Oak Orchard, West, and Larkin Creeks. Shells were also found in the Mid Lake Ontario basin in Irondequoit Creek and the Erie Canal (Mahar & Landry 2013). In recent surveys of the Allegheny basin, 42 live individuals were found in Conewago and Cassadaga Creeks of the Conewago sub-basin, and populations were considered viable at five sites. Catches peaked at 8.6 individuals per hour in lower Cassadaga Creek. It has also been recorded live from the Allegheny River basin near Weston Mills (NY Natural Heritage Program 2013), Chautauqua Lake, and the Chadokoin River (Strayer & Jirka 1997). It was probably introduced into the Chautauqua area, perhaps with stocked fish (Strayer & Jirka 1997). S. nasutus have been found live in the Niagara River at Beaver Island and as shells at Buckhorn Island (NY Natural Heritage Program 2013), in Spicer Creek (2) and at Strawberry Island (1) in 2011 (Burlakova, Karatayev, unpublished data). From 54 sites at 33 locations in Lake Ontario surveyed in 2012 (Burlakova, Karatayev et al. in preparation) we found 12 S. nasutus in Lake Ontario tributaries and nearby wetlands (3 in North Pond, 3 in Salmon River mouth (both in Oswego Co, near Pulaski), and 6 in Black River Bay (Jefferson Co, near Sackets Harbor)).

In the Hudson basin there are records of live individuals in Lake Taghkanic and Webatuck Creek (28 live), and a single dead animal was found in Indian Kill at Norrie Point (NY Natural Heritage Program 2013; Strayer & Jirka 1997). One live mussel was found in Mohawk River (42.90464N, 73.68376W, Mechanicville, Saratoga Co.) in 2010 (Karatayev, Burlakova, unpublished data). In the Delaware basin, this species has been reported from Tennahnah Lake in Sullivan County (Strayer & Jirka 1997). In the St. Lawrence basin, it has been found in the Grass River and its tributary Harrison Creek (White et. al. 2011).

Waterbodies with greatest S. nasutus abundance include lower Cassadaga Creek, Webatuck Creek, and Honeoye Creek between Honeoye Falls and Honeoye Lake, and its tributary Bebee Creek, and Black River Bay of Lake Ontario.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Core	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. **Size/Waterbody Type:** Headwater/Creek to Small River

b. **Geology:** Moderately Buffered, Neutral

c. **Temperature:** Transitional Cool to Warm

d. **Gradient:** Low to Low-Moderate Gradient

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Yes	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

S. nasutus is most often found in quiet waters in estuaries, lakes, in slackwater areas of rivers, canals, or slow streams, but it has also been found regularly in the Niagara River (Strayer & Jirka 1997, Nedeau 2008). However, it is more commonly found in deeper areas of low-gradient and non-tidal rivers than in small shallow streams. It is also known to occur in ponds (Nedeau 2008). S. nasutus inhabits in a wide range of substrates, including gravel and cobble (Nedeau 2008), although it is thought to prefer fine sand and mud (Metcalfe-Smith et al. 2005, Watters et al. 2009).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, S. nasutus must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable habitat, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely to be a slow process for mussels which use resident fishes with limited home ranges as their hosts (COSEWIC as cited in NatureServe 2013).

S. nasutus is bradytictic with fertilization occurring in late summer and glochidia released the following spring (Watters et al. 2009). This species uses a visual display to attract host fish. The display behavior occurs primarily during daylight and pauses at night and when turbidity is increased. Fish hosts have not yet been determined. Closely related species have been reported to parasitize centrarchids as well as banded killifish (Nedeau 2008, Strayer & Jirka 1997). This species may live for ten years or more (Watters et al. 2009).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Other Ecosystem Modifications (levees and flood walls, channelization, dredging, culverts)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (zebra mussels)
4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)
5. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, other regulated discharges)
6. Pollution	Household Sewage & Urban Waste Water (waste water treatment effluent, sewer and septic overflows)

7. Climate Change & Severe Weather	Droughts
8. Natural System Modifications	Dams & Water Management/Use (lowering of water table from agriculture, Erie Canal, etc…, causing drying of habitat)
9. Climate Change & Severe Weather	Storms & Flooding (extreme storms)
10. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (die offs from unknown disease)

Agricultural Runoff

Several waterbodies in which S. nasutus has been found, including Honeoye Creek, Oak Orchard Creek, Webatuck Creek, and the Erie Canal, flow through heavily agricultural areas (New York State Landcover 2010) and are likely impacted by associated siltation, pesticide and nutrient loading. Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in Western and Central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar & Landry 2013), indicating that runoff is a major threat to resident mussel populations.

Increases in turbidity associated with agricultural runoff may be especially detrimental to S. nasutus, as this species uses visual cues to attract host fish, as its display frequency stops under conditions of high turbidity (Corey et al. in NatureServe 2013).

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer runoff is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag 2012). In addition, ammonia adsorbs to sediment particles, resulting in higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Runoff from Developed Land

All 14 of New York waterbodies that host S. nasutus populations are intermittently bordered by interstate highways, state routes, and/or local roads and lawns, and receive runoff containing metals and road salts from these sources (Gillis 2012). In particular, populations in the Niagara River receive urban runoff from Buffalo, Oak Orchard Creek receives runoff from Medina, Honeoye Creek receives runoff from Honeoye and Honeoye Falls, and populations in the lower reaches of the Cassadaga and Conewango receive runoff from Jamestown. In addition, Erie Canal populations between Pittsford and Macedon receive urban storm water runoff through various municipalities (New York State Landcover 2010). Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller & Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner & Pynnonen 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller & Zam 1991; Liquori & Insler 1985; Pandolfo et al. 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Treated and Untreated Wastewater

Several habitats of S. nasutus populations receive treated effluent from sewage treatment plants (SPDES 2007). The Niagara River, Oak Orchard Creek from Medina, Honeoye Creek at Honeoye and Honeoye Falls, and Cassadaga Creek receives treated effluent from the city of Jamestown sewage treatment plant (SPDES 2007). Furthermore, raw sewage enters known S. nasutus habitat from Combined Sewer Overflows to the Niagara River from Buffalo and Oak Orchard Creek from Medina (Combined Sewer Overflow 2013). In addition, illegal dumping of sewage by recreational boats may be a concern for S. nasutus populations in the Erie Canal. Recent studies show that mussel richness and abundance decrease with increased proximity to sewage effluent (Wildenberg 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al. 1978). Endocrine disrupters from pharmaceuticals are also present in municipal sewage effluents and are increasing common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012). It should be noted that in the Susquehanna basin, Harman and Lord (2010) found no evidence that wastewater treatment plants were responsible for reductions in mussel species of greatest conservation need.

Habitat Modifications

Ecosystem modifications, such as in-stream work associated with, canal dredging bridge replacements, gravel mining, and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting "dredge" had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000).

Erie Canal Specific Habitat Modifications

Based on the number of fresh shells found, it is thought that the Erie Canal system hosts a significant S. nasutus population. Threats present in the Erie Canal include maintenance dredging by the NY Canal Corporation and seasonal water draw downs. Seasonal draw downs of water bodies have been shown to impact unionid age distributions (Richardson et al. 2002) and it is likely that the Erie Canal water draw downs have negative impacts on S. nasutus populations. During spring mussel surveys of the Erie Canal, it is not uncommon to find hundreds of fresh shells of multiple species, including S. nasutus*,* and multiple age classes, many containing desiccating flesh along the exposed canal banks and bed (Mahar & Landry 2013). This antidotal evidence suggests seasonal draw downs have a large impact on these populations.

Invasive Species
Invasive zebra mussels (*Dreissena polymorpha*) are present in S. nasutus habitat in the lower reaches of Cassadaga and Conewango Creeks (The Nature Conservancy 2009). They have also been detected in the Oak Orchard Creek, downsteam of the Medina dam, where S. nasutus shells have been found (NY Natural Heritage Program 2013, Mahar & Landry 2013). In the Erie Canal, zebra and quagga mussels (*Dreissena bugenis*) and Asian clams (*Corbicula*) have been found in large numbers.

Invasive zebra and quagga mussels have been repeatedly cited as a threat to native mussel populations (Strayer & Jirka 1997, Watters et al. 2009). Rangewide, over 90% of historical records for S. nasutus are in waters that are now infested with zebra mussels and therefore uninhabitable. The species has declined dramatically and now occurs as two small, widely separated populations, one in the delta area of Lake St. Clair and one in a tributary of the upper St. Lawrence River. There is evidence that declines may be continuing (NatureServe 2013). En masse, Dreissenids out compete native mussels by efficiently filtering food and oxygen from the water. They reduce reproductive success by filtering native mussel male gametes from the water column and they can foul the shells of the native mussels to the point that their valves can no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury (USFWS 1994). In addition, Ammonia from Asian clam die offs has been shown to be capable of exceeding acute effect levels of some mussel species (Cherry et al. 2005).

Sea lamprey control treatments – in tributaries to Lake Ontario.

Climate Change
In a recent assessment of the vulnerability of at-risk species to climate change in New York, Schesinger et al. (2011) ranked this species as “moderately vulnerable.” This indicates that abundance and/or range extent within New York is likely to decrease by 2050.

Impoundments – Range wide
Across its range, impoundments likely contributed to the reduced distribution of mussels that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery & King 1983; ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓__ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any "protected stream", its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York's mussel resources occur within Class C and D waters (see species specific streams in threats/management discussion). An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Priority conservation efforts for this species should focus on, but not be limited to, lower Cassadaga Creek, Webatuck Creek, and Honeoye Creek between Honeoye Falls and Honeoye Lake, and its tributary Bebee Creek.

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis 2012).

- Establish a protocol whereas DEC staff work closely with state and local highway departments to reduce impacts to native mussels during maintenance and construction projects.

- Replace culverts that disrupt aquatic habitat connectivity to allow for passage of small fish species.

- Within the Great Lakes and Champlain watersheds, lamprey control efforts should consider specific, potentially adverse, impacts to native freshwater mussels when determining methods, including selection of lampricide formulations and concentrations.

Lampricide treatment managers should use caution when using the combination of TFM and niclosamide in streams with known mussel populations and every effort should be made to maintain lampricide concentrations at or near the MLC for sea lamprey to minimize the risk to this important faunal group (Boogaard 2006).

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g. point & nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	

Table 2. (need recommended conservation actions for eastern pondmussel).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
First revision	February 25, 2014 (Samantha Hoff)
Latest revision	January 16, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Elktoe **Date Updated:** 1/16/2024

Scientific Name: *Alasmidonta marginata* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Alasmidonta marginata belongs to the subfamily Unioninae and the tribe Anodontini, which includes 16 extant and 1 likely extirpated New York species of the genera Alasmidonta, Anodonta, Anodontoides, Lasmigona, Pyganodon, Simpsonaias, Strophitus, and Utterbackia (Haag 2012, Graf and Cummings 2011). A. marginata is one of five species of the genus Alasmidonta that have been found in New York (Strayer and Jirka 1997). Alasmidonta, means "without a lateral tooth," a distinct characteristic in all species of this genus. The species marginata refers to the chalky whiteness of the nacre in the inside of the shell (Watters 2009). A. marginata is closely related to and is often confused with Alasmidonta varicosa (Simpson 1914). Systematics of the genus have not been reviewed genetically.

This species is found in the Mississippi River system, from Minnesota south to Arkansas including the Tennessee and Cumberland Rivers, the Laurentian system except for Lake Superior, and the Atlantic Slope in the Susquehanna River drainage (Watters et al. 2009). In New York, A. marginata is widespread in the Allegheny basin, the Susquehanna basin, and is found at scattered sites along the course of the Erie Canal from the Niagara River to Albany. It also lives in the St. Lawrence River and its tributaries in northern New York. This species is rarely abundant at any particular site, often occurring as single individuals. A. marginata is usually found in running waters of various sizes, characteristically in riffles (Strayer and Jirka 1997).

A. marginata is ranked as vulnerable in New York and apparently secure throughout its range (NatureServe 2023). In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993, Stein et al. 2000). While population trends in New York are unknown, it is assumed that they too are declining, due to a myriad of environmental stressors. As this species is abundant in the Allegheny Basin in NY, The Nature Conservancy mussel survey report suggests that this would be a candidate for removal from the SGCN list (2009).

I. Status

a. Current legal protected Status

i. **Federal:** None **Candidate:** No

ii. **New York:** None, Special Concern listing proposed (2019)

b. Natural Heritage Program

i. **Global:** G4 – Apparently secure

ii. **New York:** S3 - Vulnerable **Tracked by NYNHP?:** No

Other Ranks:

-IUCN Red List: Least Concern (2015)

-Northeast Regional SGCN: No

-Midwest Regional SGCN: Yes

-American Fisheries Society Status: Special Concern (1993)

Status Discussion:

This species is widely distributed but is never abundant at any particular site, often occurring as single individuals. It has been extirpated from certain parts of the outer edges of its range and although still fairly common, recently it has experienced some decline (around 10-20% overall) in several areas but primarily is considered secure throughout the main portion of its range (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Declining	Unknown			(blank)
Northeastern US	Yes	Unknown	Unknown			No
New York	Yes	Unknown	Unknown		Proposed Special Concern, S3	Yes
Connecticut	No	N/A	N/A			No
Massachusetts	No	N/A	N/A			No
New Jersey	No	N/A	N/A			No
Pennsylvania	Yes	Stable	Stable		S3S4	Yes
Vermont	Yes	Unknown	Unknown		S1	Yes
Ontario	Yes	Stable	Stable		S3	(blank)
Quebec	Yes	Choose an item.	Choose an item.		S1	(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

As part of a State Wildlife Grant, NYSDEC Region 8 Fish and Wildlife staff conducted a native freshwater mussel baseline inventory of tributaries in central and western New York, 2009 to 2020.

Trends Discussion *(insert map of North American/regional distribution and status):*

Trends for New York populations are difficult to determine as most historic data comes from opportunistic naturalist collections, as opposed to more comprehensive baseline surveys. For example, mussels were documented for the first time in 50 of the 106 streams surveyed to date by the Southern Lake Ontario mussel inventory project (Mahar and Landry 2013). This is because many of these streams had never before been surveyed for mussels, not because mussel distribution has dramatically increased. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993, Stein et al.2000). Based on New York's Natural Heritage S-rank, sparse historical data, and the plight of North America's freshwater mussels, it is assumed that trends are declining due to a myriad of environmental stressors.

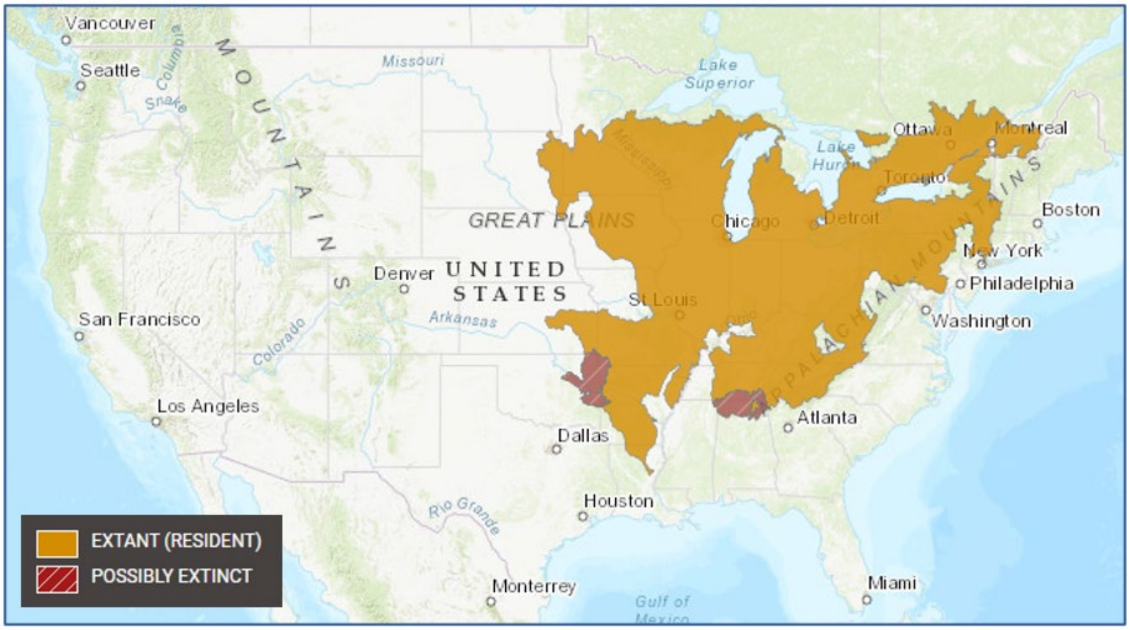

Figure 1. Elktoe distribution (IUCN Redlist 2024)

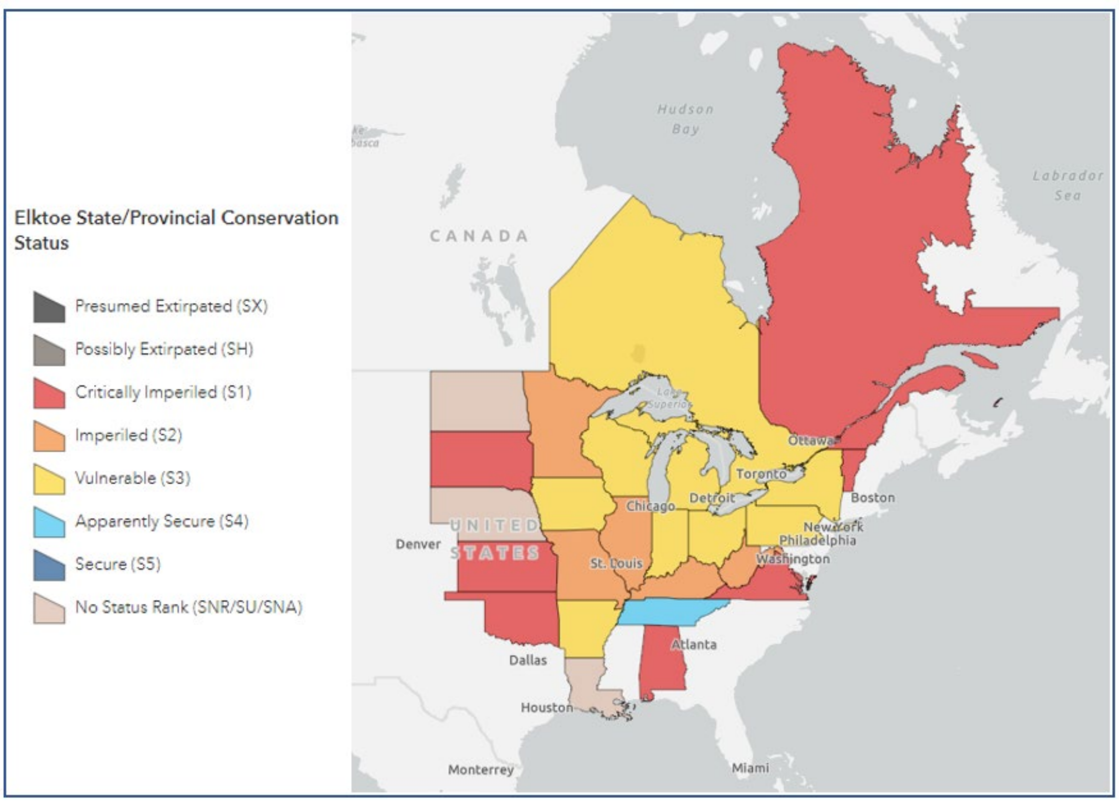

Figure 2. Elktoe status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

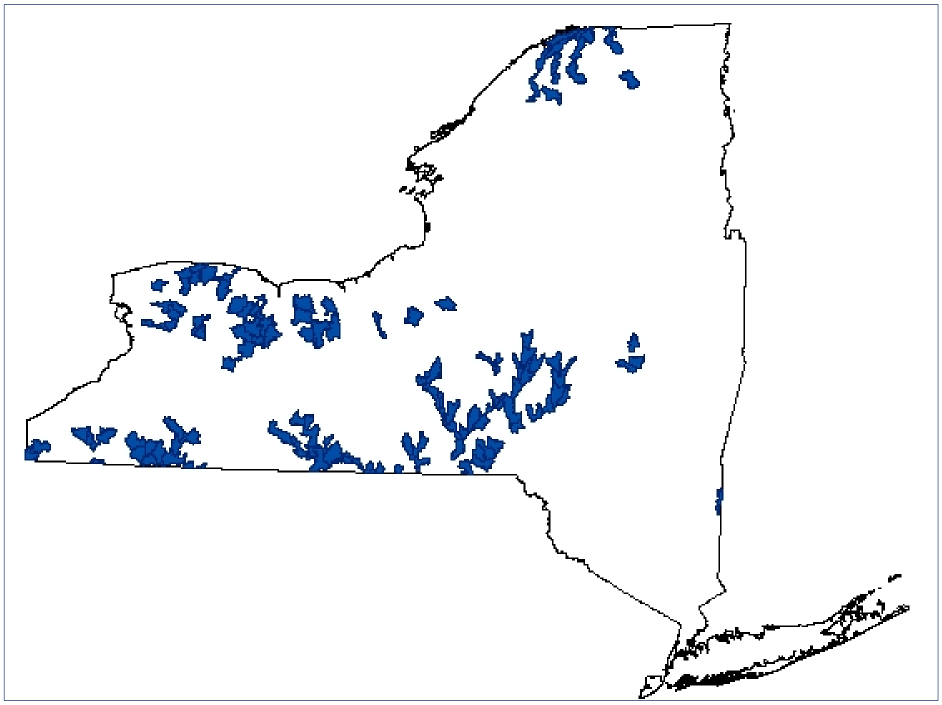

Figure 3. Records of elktoe in New York (NYSDEC 2022)

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	_______	_______	_______
1995-2004	_______	_______	_______
2005-2014	_______	_______	_______
2015- 2023	_______	40	6.4%

Table 1. Records of elktoe in New York.

Details of historic and current occurrence:

2024: A. marginata is found in 116 of 1802 HUC 12 watersheds (6.4%) and 40 waterbodies.

In New York, A. marginata is widespread in the Allegheny basin and is found at scattered sites along the course of the Erie Canal from the Niagara River to Albany. It also lives in the St. Lawrence River and its tributaries in northern New York. A. marginata is one of only two or three Interior Basin species to have reached the Susquehanna basin, where it is widely distributed. There is a lack of any records of A. marginata from the upper Genesee basin (Strayer and Jirka 1997).

Historic occurrences include French Creek, Niagara River, and St. Lawrence River.

Since 1970, A. marginata has been found in 33 New York State waterbodies.

In the recent Allegheny basin mussel survey (TNC 2009), a total of 1938 live A. marginata were found at 75 of 105 survey sites throughout both the Upper Allegheny (Allegheny River, Oswayo

Creek, Olean Creek, Ischua Creek) and Conewango sub-basins (Conewango Creek, Cassadaga Creek). The greatest total catches (up to 43 per hour) were in the Allegheny River between Olean and Killbuck, NY and in Upper Olean and Lower Ischua Creek. This species was considered viable at 73% of the sites where found (55 of 75 sites).

In surveys of the Southern Lake Ontario basin115 A. marginata were found live. In the lower Genesee basin, A. marginata was found live in Black Creek (2 sites: 5 live), Conesus Creek (3 sites: 7 live), Honeoye Creek (7 sites: 12 live), and the Genesee River (6 sites: 39 live). In the Oswego basin it was found live in Red Creek (1 site: 8 live), Ganargua Creek (2 sites: 3 live), and Canandaigua Outlet (6 sites: 20 live). In the West Lake Ontario basin A. marginata was found live in Johnson Creek (1 site: 7 live), Sandy Creek (1 site: 1 live), and Oak Orchard (3 sites: 9 live). In addition, shells were found in the Erie Canal and Tonawanda Creek. This species was not detected in the tributaries of the Mid Lake Ontario basin (Mahar and Landry 2013).

In the Susquehanna basin, A. marginata was found in the Susquehanna River main stem (4 sites: 32 live), Chenango River (2 sites: 12 live), Chemung River (3 sites: 19 live), East Branch Tioughnioga River (2 sites: 8 live), Tioughnioga River (1 site: 3 live), and Unadilla River (5 sites: 44 live) (Harman and Lord 2010).

This species was also found in Schaharie Creek and 2 unnamed tributaries, Grass River and its tributary Grannis Brook, an unnamed tributary to Trout Brook, a tributary of the St. Regis River, Raquette River, Tioga River, and Cole Creek, a tributary to Canisteo River (White et al. 2011).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	350 miles

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. **Size/Waterbody Type:** Small to Medium River

b. **Geology:** Moderately Buffered

c. **Temperature:** Transitional Cool to Warm

d. **Gradient:** Low Gradient to Moderate-High Gradient

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

A. marginata usually lives in running waters of various sizes, from small creeks to medium-sized rivers (Strayer and Jirka 1997, Watters et al. 2009, Metcalfe-Smith et al. 2005, Cummings and Mayer 1992), although it is reported to be more typical of smaller streams (Buchanan 1980, Goodrich and Van Der Schalie 1944, Oesch 1984, Parmalee 1967, Wilson and Clark 1914), where it reaches its greatest abundance (Parmalee and Bogan 1998). It is usually found in mixed sand and gravel substrates (Parmalee and Bogan 1998, Cummings and Mayer 1992, McMurry et al. 2012, Metcalfe-Smith et al. 2005, Ortman 1919), but may be found in cobble (Buchanan 1980, Watters et al. 2009). A. marginata lives in moderately fast current (Parmalee and Bogan 1998, Parmalee 1967) and is said to be characteristic of riffles (Strayer and Jirka 1997, Ortman 1919, Watters et al. 2009). It may be found at water depths of several inches to two feet (Parmalee 1967) and may be difficult to detect, as it is usually deeply buried in the substrate (Metcalfe-Smith et al. 2005). This species requires high water quality (Watters et al. 2009).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, A. marginata must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable habitat, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely to be a slow process for mussels which use resident fishes with limited home ranges as their hosts (COSEWIC 2003).

All potential hosts are based on a single study that identified natural infestations without metamorphosis. These hosts are questionable at best. These potential hosts include rockbass (Ambloplites rupestris), white sucker (Catastomus commersoni), northern hog sucker (Hypentelium nigricans), warmouth (Lepomis gulosus), and shorthead redhorse (Moxostoma nacrolepidotum),

Individuals of this species typically live for approximately 12 years. A. marginata is bradytictic, with spawning occurring in June, glochidia present in September, and glochidial release the following June. However, in Ohio, glochidial release may take place as early as May (Watters et al. 2009).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Other Ecosystem Modifications (levees and flood walls, channelization, dredging, culverts)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (rusty crayfish, zebra mussel)
4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)
5. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, other regulated discharges)
6. Pollution	Household Sewage & Urban Waste Water (waste water treatment effluent, sewer and septic overflows)
7. Climate Change & Severe Weather	Droughts
8. Natural System Modifications	Dams & Water Management/Use (lowering of water table from agriculture, NYC water use, etc…, causing drying of habitat)
9. Climate Change & Severe Weather	Storms & Flooding (extreme storms)
10. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (die offs from unknown disease)
11. Energy Production & Mining	Oil & Gas (hydraulic fracturing)

Agricultural Runoff

Agricultural practices in the basins with *A. marginata* populations may be sources of siltation and pollution. Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in Western and Central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar and Landry 2013), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer runoff is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag 2012). In addition, ammonia adsorbs to sediment particles, resulting in higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Runoff From Developed Land

Developed areas are likely sources of stormwater runoff containing metals and road salts (Gillis 2012). Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller and Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner and Pynnonen 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller and Zam 1991, Liqouri and Insler 1985, Pandolfo et al., 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Treated and Untreated Wastewater

Recent studies show that mussel richness and abundance decrease with increased proximity to sewage effluent (Wildenberg 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al. 1978). Endocrine disrupters from pharmaceuticals are also present in municipal sewage effluents and are increasing common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012). It should be noted that in the Susquehanna Basin, Harman and Lord (2010) found no evidence that wastewater treatment plants were responsible for reductions in mussel species of greatest conservation need.

Flood Control Projects

In the Allegheny and Susquehanna basins, large stretches of *A. marginata* habitat has been found within or adjacent to stream reaches shaped by levee and/or floodwall flood control projects. Additionally, many smaller streams have been channelized and bermed by landowners and highway departments to protect farm fields and other structures. These structures confine larger rivers, preventing the river from inundating its natural floodplains and wetlands to minimize flood damage. Channelization and dredging associated with flood control projects are catastrophic to mussels and have been implicated in the decline of some populations (Watters et al., 2009). The result of these projects is altered seasonality of flow and temperature regimes, increased stream velocities, unstable substrates, changed patterns of sediment scour and deposition, including streambank erosion, altered transport of particulate organic matter (the food base for mussels), and a general degradation of stream habitat (Benke 1999, Yeager 1993, Nedeau 2008).

Other Habitat Modifications

In addition to channelization and regular channel dredging for maintenance of flood control structures, other ecosystem modifications such as instream work associated with bridge replacement and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting “dredge” had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000).

Invasive Species

Invasive zebra and quagga mussels (*Dreissena polymorpha* and *Dreissena bugensis*) have been repeatedly cited as a threat to native mussel populations (Strayer and Jirka 1997; Watters et al. 2009). In mass, Dreissenids outcompete native mussels by removing food and oxygen from the water. They can also reduce reproductive success by filtering native mussel male gametes from the water column. They can foul the shells of the native mussels to the point at their valves can no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury.

Habitat Alteration

Channelization and dredging associated with flood control projects are catastrophic to mussels and have been implicated in the decline of some populations (Watters et al. 2009). The result of these projects is altered seasonality of flow and temperature regimes, increased stream velocities, unstable substrates, changed patterns of sediment scour and deposition, including streambank erosion, altered transport of particulate organic matter (the food base for mussels), and a general degradation of stream habitat (Benke 1999, Yeager 1993, Nedeau 2008).

Lamprey Control

A.marginata populations are found in several stream that are regularly scheduled for sea lamprey control treatment. These streams include Sandy Creek, Oak Orchard Creek, and Johnson Creek in the Lake Ontario drainage.

In New York, tributaries harboring larval sea lamprey (*Petromyzon marinus*), are treated periodically with lampricides (TFM, or TFM/Niclosamide mixtures) by Fisheries and Oceans Canada and the U.S. Fish and Wildlife Service to reduce larval populations (Sullivan and Adair 2014). Niclosamide was originally developed as a molluscicide. While unionid mortality is thought to be minimal at TFM concentrations typically applied to streams to control sea lamprey larvae (1.0 –1.5 × sea lamprey MLC), increases in unionid mortality were observed when exposed to the niclosamide mixture, indicating that mussels may be at risk when the mixture is used in control operations. Treatment managers should use caution when using the combination of TFM and niclosamide in streams with known mussel populations and every effort should be made to maintain lampricide concentrations at or near the MLC for sea lamprey to minimize the risk to this important faunal group (Boogaard 2006).

Climate Change

Temperature induced changes in fish communities could have a profound influence on the availability of hosts for freshwater mussels. The NatureServe Climate Change Vulnerability Index has been used in several states to help identify species that are particularly vulnerable to the effects of climate change. While *A. marginata* vulnerability was not evaluated for New York, the populations within West Virginia are ranked as “extremely vulnerable” to climate change (2013) and populations in Michigan were considered “highly vulnerable” to climate change (Hoving et al. 2013).

Impoundments – Range wide
Range wide, impoundments likely contributed to the reduced distribution of mussels that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery and King 1983, ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Species like *A. marginata*, whose range extends into Appalachia are impacted by coal-mines from strip-mining, silt, and coal washings (Ahlstedt and Brown 1980). Acidity from acid mine drainage effects the shells of the mussels.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓__ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any “protected stream”, its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts) (trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York's mussel resources occur within Class C and D waters (see species specific streams in threats/management discussion) An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.

- Through landowner incentive programs or regulation, riparian buffers should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012). Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

- Establish a protocol whereas DEC staff work closely with state and local highway departments to reduce impacts to native mussels during maintenance and construction projects.

- Replace culverts that disrupt aquatic habitat connectivity to allow for passage of small fish species.

- Within the Great Lakes and Champlain watersheds, lamprey control efforts should consider specific, potentially adverse, impacts to native freshwater mussels when determining methods, including selection of lampricide formulations and concentrations.

  Lampricide treatment managers should use caution when using the combination of TFM and niclosamide in streams with known mussel populations and every effort should be made to maintain lampricide concentrations at or near the MLC for sea lamprey to minimize the risk to this important faunal group (Boogaard 2006).

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g. point and nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated

subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	

Table 2. (need recommended conservation actions for elktoe).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).

- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

- Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	November 15, 2013
First revision	February 25, 2014 (Samantha Hoff)
Latest revision	January 16, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Fat pocketbook **Date Updated:** 1/17/2024

Scientific Name: *Potamilus capax* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Potamilus capax is thought to have been extirpated in New York State for over a century (Strayer and Jirka 1997) and has not been found at historical sites during recent surveys (Mahar & Landry 2013). This species was removed from the New York Species of Greatest Conservation list in 2015.

P. capax is a member of the widely distributed genus Potamilus. P. capax belongs to the subfamily Ambleminae and the tribe Lampsilini, which includes 17 extant and 6 likely extirpated New York species of the genera Actinonaias, Epioblasma, Lampsilis, Leptodea, Ligumia, Obovaria, Potamilus, Ptychobranchus, Toxolasma, Truncilla, and Villosa (Haag 2012; Graf and Cummings 2011).

This species is listed as state and federally endangered and is ranked by The Natural Heritage Program as historic in New York and as imperiled throughout its range. It is distributed in the Lower Ohio River system and Mississippi River drainages in Arkansas and Nebraska (Watters et al. 2009), where P. capax abundance is stable, with multiple reproductively viable sites. A current threat to the species is that populations are sporadic and disjunct, with the entire species only inhabiting approximately 20 sites (NatureServe 2013).

I. Status

a. Current legal protected Status

i. **Federal:** Endangered **Candidate:** ______

ii. **New York:** Endangered

b. Natural Heritage Program

i. **Global:** G2 - Imperiled

ii. **New York:** SH - Historic **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Vulnerable (2012)

-Northeast Regional SGCN: No (2023)

-Midwest Regional SGCN: Yes

- American Fisheries Society Status: Endangered (1993)

Status Discussion:

The peripheral range (where P. capax was never common) has greatly diminished with large scale historic extirpations (loss of >70% of range) and reintroduction efforts have thus far been unsuccessful, but the core population in the St. Francis River system in Arkansas and lower Wabash in Indiana are healthy and widely tolerant of habitat conditions, including sedimentation. A large population was recently discovered in the south Mississippi River in Jefferson County, Mississippi. Much of the decline of this species occurred historically with current populations more stable (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	No	Declining	Declining			(blank)
Northeastern US	No	Extirpated	Extirpated			No
New York	No	Extirpated	Extirpated		Endangered, SH	No
Connecticut	No	N/A	N/A			No
Massachusetts	No	N/A	N/A			No
New Jersey	No	N/A	N/A			No
Pennsylvania	No	N/A	N/A			No
Vermont	No	N/A	N/A			No
Ontario	No	N/A	N/A			(blank)
Quebec	No	N/A	N/A			(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

As part of a 2009 to 2020 State Wildlife Grant funded project, NYSDEC Region 8 Fish and Wildlife staff conducted a native freshwater mussel baseline inventory of tributaries in central and western New York where this species might be found. No regular surveys are being conducted for this species at this time. Regulatory surveys may be conducted in known or likely habitat as part of the project review process.

Trends Discussion *(insert map of North American/regional distribution and status):*

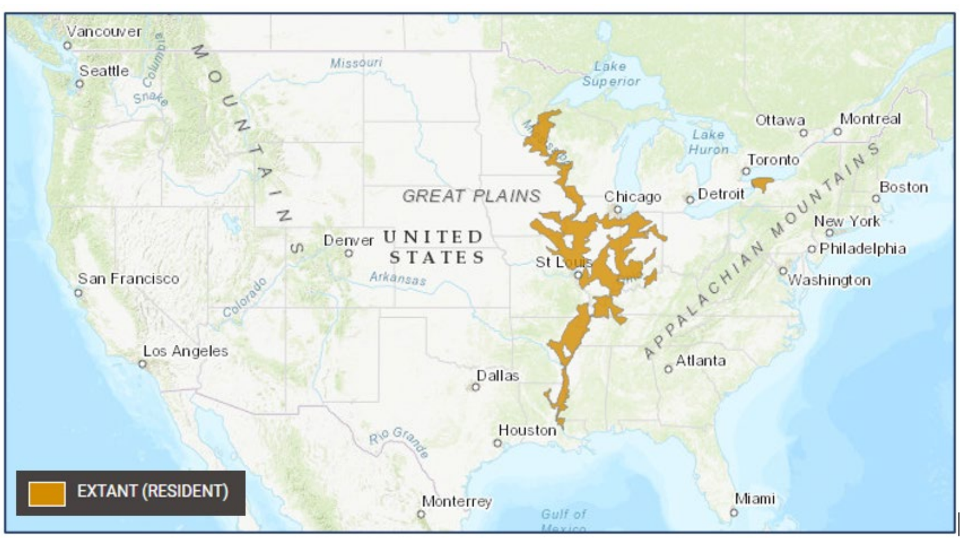

Figure 1. Fat pocketbook distribution (IUCN Redlist 2024)

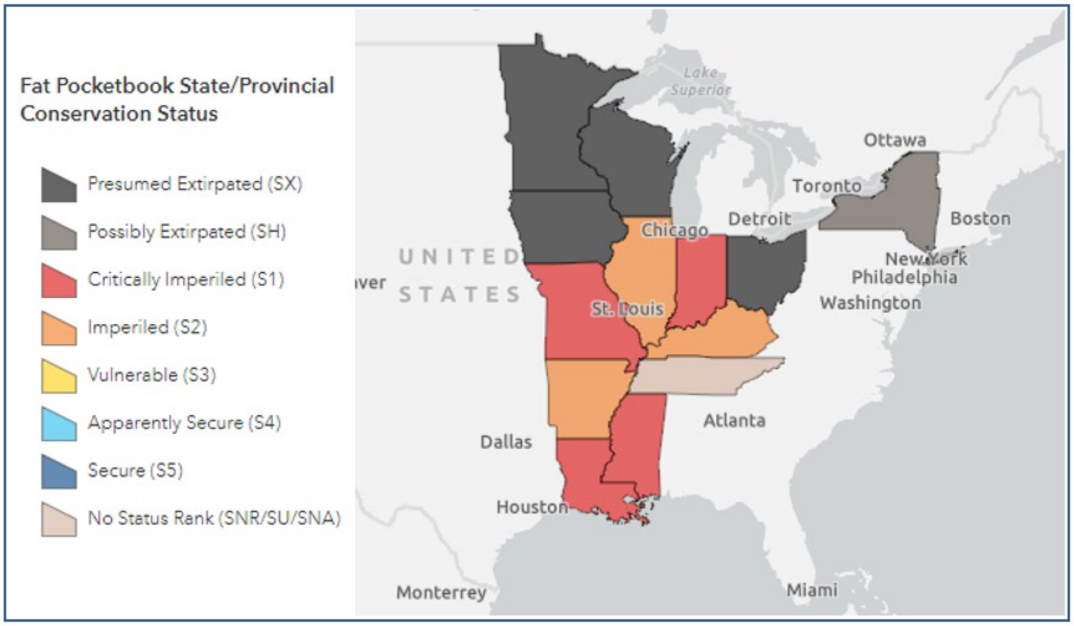

Figure 2. Fat pocketbook status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	2	2	2 of 56 HUC 8 watersheds
1995-2004	0	0	0
2005-2014	0	0	0
2015- 2023	0	0	0

Table 1. Records of fat pocketbook in New York.

Details of historic and current occurrence:

Strayer & Jirka (1997) report two occurrences of P. capax in New York. One pair of weathered valves was found in the Niagara River in 1906, and the second pair of weathered valves was found in Twelvemile Creek, also around the turn of the 20th century.

This species has not been found in New York in over a century (Strayer & Jirka 1997) and has not been found at historical sites during recent surveys (Mahar and Landry 2013, New York Natural Heritage Program 2013, The Nature Conservancy 2009, Harman and Lord 2010, White et al. 2011, NatureServe 2013).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
0%	Disjunct	580 miles

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Size/Waterbody Type:

b. Geology:

c. Temperature:

d. Gradient:

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

P. capax is found in large, slow moving rivers, often near the bank or in back waters, in mud, sandy silt, or sand (Strayer and Jirka 1997, McMurray et al. 2012, Watters et al. 2009, Cummings and Mayer 1992). It has been found to be tolerant of depositional areas that are usually unfavorable to other mussel species and is in fact, not a lotic species as indicated in the Recovery Plan (USFWS 1989). In fact, ditches and existing bayous, sloughs, and streams in the St. Francis watershed provide suitable habitat as this species is fairly tolerant to sedimentation (Miller & Payne 2005). Recent studies have shown that this species is not a habitat specialist (Miller & Payne 2005).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
No	No	No	No	No	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all

North American mussels, this species must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable substrate, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely to be a slow process for mussels which use resident fishes with limited home ranges as their hosts (COSEWIC as cited in NatureServe 2013).

This species is bradytictic, with gravid females appearing between June and December. Glochidial transformation has been confirmed only for freshwater drum (Aplodinotus grunniens) (Watters et al. 2009). Despite its large size this species is short lived with even the largest individuals only reaching 4 to 5 years old (Watters et al. 2009).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats within New York are irrelevant considering live *P.capax* hasn't been observed in over a century. However, threats do exist that would restrict the re-colonizing of New York habitats.

General threats to mussels that are likely relevant range wide:

Impoundments – Range wide
Range wide, impoundments likely contributed to the reduced distribution of mussels that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery & King 1983; ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Agricultural Runoff
Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in Western and Central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along

known mussel streams (Mahar & Landry 2013), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer runoff is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag 2012). In addition, ammonia adsorbs to sediment particles, resulting higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Treated and Untreated Wastewater
Recent studies show that mussel richness and abundance decreases with increased proximity to sewage effluent (Wildenberg 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al. 1978). Endocrine disrupters from pharmaceuticals also originate from municipal sewage effluents and are increasing common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012).

Runoff from Developed Land
Developed lands are likely sources runoff containing metals and road salts.
Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller & Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner & Pynnonen 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller & Zam 1991; Liquori & Insler 1985; Pandolfo et al. 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Invasive Species
Invasive zebra and quagga mussels (*Dreissena polymorpha* and *Dreissena bugenis*) have been repeatedly cited as a threat to native mussel populations (Strayer & Jirka 1997; Watters et al. 2009). En masse, Dreissenids outcompete native mussels by removing food and oxygen from the water. They can also reduce reproductive success by filtering native mussel male gametes from the water column. They can foul the shells of the native mussels to the point that their valves can

no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury (USFWS 1994). In addition, ammonia from Asian clam die offs has been shown to be capable of exceeding acute effect levels of some mussel species (Cherry et al. 2005). Didymo (*Didymosphenia geminata*), a filamentous diatom, can form extensive mats that can smother stream bottom and occlude habitat for mussels (Spaulding & Elwell, 2007)

Climate Change
Global climate change is expected (among other disruptions) to cause an increase in surface water temperatures. Although many species are tolerant of warm water, higher water temperatures may be an added stress for some. Increased water temperatures may also increase algal growth, which could result in reductions in dissolved oxygen levels at night (Morris & Burridge 2006). Galbraith et al. (2010) recently showed how regional climate patterns coupled with changing local water regimes and management strategies have shifted mussel populations from thermally sensitive species to thermally tolerant species.

In addition, warmer stream temperatures due to the combined effects of land use, such as removal of shaded buffers, and climate change may contribute to the loss of coldwater fisheries and *mussel* populations in some watersheds (Nedeau 2008). Temperature induced changes in fish communities could have a profound influence on the availability of hosts for freshwater mussels. Mussels that inhabit small streams and rivers and rely on fish adapted for cooler water might be most affected by climate change (Nedeau 2008).

Habitat Modifications
Ecosystem modifications, such as in-stream work associated with canal, navigational channel, or flood control dredging, bridge replacements, gravel mining, and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting "dredge" had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000). Seasonal draw downs of water bodies have been shown to impact unionid age distributions (Richardson et al. 2002).

Levees and flood walls confine larger rivers, preventing the river from inundating its natural floodplains and wetlands to minimize flood damage. Additionally, many smaller streams have been channelized and bermed by landowners and highway departments to protect farm fields and other structures. Channelization and dredging associated with flood control projects are catastrophic to mussels and have been implicated in the decline of some populations (Watters et al. 2009). The result of these projects is altered seasonality of flow and temperature regimes, increased stream velocities, unstable substrates, changed patterns of sediment scour and deposition, including streambank erosion, altered transport of particulate organic matter (the food base for mussels), and a general degradation of stream habitat (Benke 1999; Yeager 1993; Nedeau 2008).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓_ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

New York State Environmental Conservation Law, § 11-0535. 6 NYCRR Part 182: Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern; Incidental Take Permits

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any "protected stream", its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York's mussel resources occur within Class C and D waters (see species specific streams in threats/management discussion) An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Assess the need and opportunity for relocation/reintroduction efforts. Conduct relocation or reintroduction where adequate sources can be identified and appropriate stream conditions exist (water quality, habitat, host species etc.).

- Evidence of historic occurrence of multiple New York State extirpated mussel species exists for the Niagara River. These species include: *Epioblasma triquetra, Lampsilis teres, Lampsilis abrupta, Obovaria olivaria, Potamilus capax*, *Quadrula pustulosa*, *Quadrula quadrula, Simpsonaias ambigua, and possibly Truncilla donaciformis*. To assess the potential for future reintroduction efforts, a pilot program relocating common species to suitable sections of the Niagara River should be initiated and its results assessed to gage the possible success of reintroduction efforts for extirpated species in this waterbody.

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley & Tank 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Following any reintroduction efforts, develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

- Update wastewater treatment facilities in Buffalo to eliminate combined sewer outflows.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis 2012).

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

- Within the Great Lakes watersheds, lamprey control efforts should consider specific, potentially adverse, impacts to native freshwater mussels when determining methods, including selection of lampricide formulations and concentrations. Lampricide treatment managers should use caution when using the combination of TFM and niclosamide in streams with known mussel populations and every effort should be made to maintain lampricide concentrations at or near the MLC for sea lamprey to minimize the risk to this important faunal group (Boogaard 2006).

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g., point & nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	

Table 2. (no recommended conservation actions for fat pocketbook).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

- Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

VII. References

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
First revision	
Latest revision	January 17, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Fawnsfoot

Date Updated: 1/17/2024

Scientific Name: *Truncilla donaciformis*

Updated By: Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Truncilla donaciformis is thought to be extirpated in New York State. In New York, only a single historic (pre-1970) record from Buffalo exists (Strayer & Jirka, 1997). This species was removed from the New York Species of Greatest Conservation list in 2015.

T. donaciformis belongs to the subfamily Ambleminae and the tribe Lampsilini, which includes 17 extant and 6 likely extirpated New York species of the genera Actinonaias, Epioblasma, Lampsilis, Leptodea, Ligumia, Obovaria, Potamilus, Ptychobranchus, Toxolasma, Truncilla, and Villosa (Haag 2012; Graf and Cummings 2011). Its range is widespread in the Mississippi and lower Great Lakes basin. It is common in western Lake Erie, but it is much less common in the eastern parts of the lake (Strayer and Jirka 1997). This species is ranked by The Natural Heritage Program as historic in New York and secure throughout its range.

I. Status

a. Current legal protected Status

i. **Federal:** None **Candidate:** No

ii. **New York:** None

b. Natural Heritage Program

i. **Global:** G5 - Secure

ii. **New York:** SH - Historic **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Least Concern (2012)

-Northeast Regional SGCN: No (2023)

- Committee on the Status of Endangered Wildlife in Canada (COSEWIC): Endangered (2008)

-American Fisheries Society Status: Currently Stable (1993)

Status Discussion:

This species is wide ranging but has experienced some declines in the Great Lakes and Canada, northern Mississippi drainage, and range edges in the west and northeast; it is most stable in the Gulf Coastal region and southern Mississippi drainage (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Declining	Declining			(blank)
Northeastern US	Yes	Choose an item.	Choose an item.			No
New York	No	Extirpated	Extirpated		SH	No
Connecticut	No	N/A	N/A			No
Massachusetts	No	N/A	N/A			No
New Jersey	No	N/A	N/A			No
Pennsylvania	Yes	Choose an item.	Choose an item.		S1	Choose an item.
Vermont	No	N/A	N/A			No
Ontario	Yes	Unknown	Stable	2003-2013	Endangered, S1	(blank)
Quebec	No	N/A	N/A			(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

As part of a 2009 to 2020 State Wildlife Grant funded project, NYSDEC Region 8 Fish and Wildlife staff conducted a native freshwater mussel baseline inventory of tributaries in central and western New York where this species might be found. No regular surveys are being conducted for this species at this time. Regulatory surveys may be conducted in known or likely habitat as part of the project review process.

Trends Discussion *(insert map of North American/regional distribution and status):*

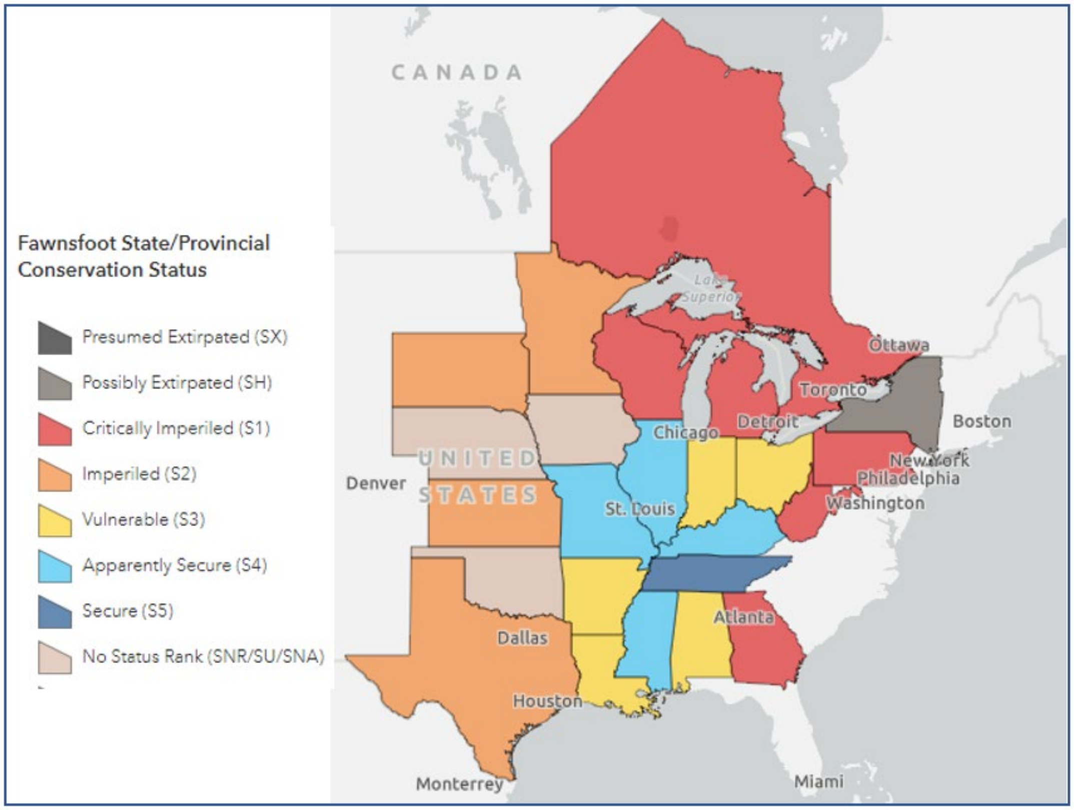

Figure 1. Fawnsfoot distribution and status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995		1	1 of 56 HUC 8 watersheds
1995-2004	0	0	0
2005-2014	0	0	0
2015- 2023	0	0	0

Table 1. Records of fawnsfoot in New York.

Details of historic and current occurrence:

A single pre-1970 specimen was taken from Buffalo (Strayer & Jirka 1997).

This species has not recently been found in New York (Strayer & Jirka 1997, Mahar and Landry 2013, NY Natural Heritage Program 2013, The Nature Conservancy 2009, Harman and Lord 2010, White et al. 2011, NatureServe 2013).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
0%	Disjunct	1,200 miles

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Size/Waterbody Type:

b. Geology:

c. Temperature:

d. Gradient:

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

T. donaciformis is a species of both large rivers and lakes (Strayer and Jirka 1997). In rivers it has been found at depths varying from less than three feet up to 15 or 18 feet. Although it is typically found in moderate current, it can adapt to a lake or embayment environment lacking current (Parmalee & Bogan 1998). Suitable substrates include gravel, sand or mud (Metcalfe-Smith 2005, Cummings and Mayer 1992). T. donaciformis spend much of their lives well-buried in the substrate (Parmalee and Bogan 1998).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
No	No	No	No	No	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, this species must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable substrate, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely to be a slow process for mussels which use resident fishes with limited home ranges as their hosts (COSEWIC as cited in NatureServe 2013).

Glochidial infestation, but not transformation has been reported for sauger (Sander canadensis) (Watters et al. 2009). Sietman et al., (2009) confirmed freshwater drum (Aplodinotus grunniens) as a host species.

T. donaciformis is bradytictic, with gravid females appearing between July and August (Watters et al. 2009). Individuals of this species are short lived and rarely exceed 7 years of age (Watters et al. 2009).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats within New York are irrelevant considering live *T. donaciformis* hasn't been observed in more than 40 years. However, threats do exist that would restrict the re-colonization of New York habitats.

General threats to mussels that are likely relevant range wide:

Impoundments – Range wide
Range wide, impoundments likely contributed to the reduced distribution of mussels that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery & King 1983; ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Agricultural Runoff
Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in Western and Central New York, it has been

documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar & Landry 2013), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer runoff is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag 2012). In addition, ammonia adsorbs to sediment particles, resulting higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Treated and Untreated Wastewater

Recent studies show that mussel richness and abundance decreases with increased proximity to sewage effluent (Wildenberg 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al. 1978). Endocrine disrupters from pharmaceuticals also originate from municipal sewage effluents and are increasing common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012).

Runoff from Developed Land

Developed lands are likely sources runoff containing metals and road salts.
Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller & Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner & Pynnonen 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller & Zam 1991; Liquori & Insler 1985; Pandolfo et al. 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Invasive Species

Invasive zebra and quagga mussels (*Dreissena polymorpha* and *Dreissena bugenis*) have been repeatedly cited as a threat to native mussel populations (Strayer & Jirka 1997; Watters et al. 2009). En masse, Dreissenids outcompete native mussels by removing food and oxygen from the water. They can also reduce reproductive success by filtering native mussel male gametes from the water column. They can foul the shells of the native mussels to the point that their valves can no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury (USFWS 1994). In addition, ammonia from Asian clam die offs has been shown to be capable of exceeding acute effect levels of some mussel species (Cherry et al. 2005). Didymo (*Didymosphenia geminata*), a filamentous diatom, can form extensive mats that can smother stream bottom and occlude habitat for mussels (Spaulding & Elwell, 2007)

Climate Change
Global climate change is expected (among other disruptions) to cause an increase in surface water temperatures. Although many species are tolerant of warm water, higher water temperatures may be an added stress for some. Increased water temperatures may also increase algal growth, which could result in reductions in dissolved oxygen levels at night (Morris & Burridge 2006). Galbraith et al. (2010) recently showed how regional climate patterns coupled with changing local water regimes and management strategies have shifted mussel populations from thermally sensitive species to thermally tolerant species.

In addition, warmer stream temperatures due to the combined effects of land use, such as removal of shaded buffers, and climate change may contribute to the loss of coldwater fisheries and mussel populations in some watersheds (Nedeau, 2008). Temperature induced changes in fish communities could have a profound influence on the availability of hosts for freshwater mussels. Mussels that inhabit small streams and rivers and rely on fish adapted for cooler water might be most affected by climate change (Nedeau, 2008).

Habitat Modifications
Ecosystem modifications, such as in-stream work associated with canal, navigational channel, or flood control dredging, bridge replacements, gravel mining, and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting “dredge” had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000). Seasonal draw downs of water bodies have been shown to impact unionid age distributions (Richardson et al. 2002).

Levees and flood walls confine larger rivers, preventing the river from inundating its natural floodplains and wetlands to minimize flood damage. Additionally, many smaller streams have been channelized and bermed by landowners and highway departments to protect farm fields and other structures. Channelization and dredging associated with flood control projects are catastrophic to mussels and have been implicated in the decline of some populations (Watters et al. 2009). The result of these projects is altered seasonality of flow and temperature regimes, increased stream velocities, unstable substrates, changed patterns of sediment scour and deposition, including streambank erosion, altered transport of particulate organic matter (the food base for mussels), and a general degradation of stream habitat (Benke 1999; Yeager 1993; Nedeau 2008).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓___ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any "protected stream", its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York's mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Assess the need and opportunity for relocation/reintroduction efforts. Conduct relocation or reintroduction where adequate sources can be identified and appropriate stream conditions exist (water quality, habitat, host species etc.).

- Evidence of historic occurrence of multiple New York State extirpated mussel species exists for the Niagara River. These species include: *Epioblasma triquetra, Lampsilis teres, Lampsilis abrupta, Obovaria olivaria, Potamilus capax*, Pustulosa *pustulosa*, *Quadrula quadrula, Simpsonaias ambigua, and possibly Truncilla donaciformis.* To assess the potential for future reintroduction efforts, a pilot program relocating common species to suitable sections of the Niagara River should be initiated and its results assessed to gage the possible success of reintroduction efforts for extirpated species in this waterbody.

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley & Tank 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Following any reintroduction efforts, develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

- Update wastewater treatment facilities in Buffalo to eliminate combined sewer outflows.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis 2012).

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

- Within the Great Lakes watersheds, lamprey control efforts should consider specific, potentially adverse, impacts to native freshwater mussels when determining methods, including selection of lampricide formulations and concentrations. Lampricide treatment managers should use caution when using the combination of TFM and niclosamide in streams with known mussel populations and every effort should be made to maintain lampricide concentrations at or near the MLC for sea lamprey to minimize the risk to this important faunal group (Boogaard 2006).

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g., point & nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	

Table 2. (need recommended conservation actions for fawnsfoot).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
First revision	
Latest revision	January 17, 2024 (Amy Mahar)

Species Status Assessment

Common Name: File rams-horn **Date Updated:**

Scientific Name: *Planorbella pilsbryi* **Updated By:**

Class: Gastropoda

Family: Planorbidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Freshwater gastropods (snails) are an important and diverse component of aquatic ecosystems worldwide. They have diversified into every available aquatic habitat, including springs, small streams, large rivers, ponds, lakes, and ephemeral to permanent wetlands. Most graze on algae, aquatic plants and biofilms, though some are suspension or deposit feeders, and they can play a vital role in the processing of detritus and decaying organic matter. Freshwater snails are not predatory, unlike some of their terrestrial or marine counterparts and they often dominate benthic stream communities, regularly exceeding 50% of the invertebrate biomass (Johnson et al 2013).
Gastropods are important dietary components of many North American fishes, and also are consumed by a variety of aquatic associated birds and mammals such as the snail kite and the muskrat (Johnson et al. 2013).

The file rams-horn is known from six states (MA, MN, MT, PA, WI, NY) and five provinces (MB, NB, ON, QC, SK). It is thought to be extirpated in New York (NatureServe 2012). This species is also taxonomically questionable and may not be recognized in surveys; most consider this species to be *P. trivolvis* (a common species) (expert meeting).

I. Status

a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Not listed; SGCN

b. Natural Heritage Program

i. **Global:** G4G5

ii. **New York:** SH **Tracked by NYNHP?:** Yes

Other Ranks:
-IUCN Red List:

-Northeast Regional SGCN:

American Fisheries Society: CS – Currently Stable

Status Discussion:

The file rams-horn is ranked “secure” globally and is possibly extirpated in New York. Little is known about its status within the state or throughout its whole range (NatureServe 2012).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable			Choose an item.
Northeastern US	Yes	Unknown	Unknown			Choose an item.
New York	No data	Unknown	Unknown		Not listed	Choose an item.
Connecticut	No	Choose an item.	Choose an item.			Choose an item.
Massachusetts	No	Choose an item.	Choose an item.			Choose an item.
New Jersey	No	Choose an item.	Choose an item.			Choose an item.
Pennsylvania	No	Choose an item.	Choose an item.			Choose an item.
Vermont	No	Choose an item.	Choose an item.			Choose an item.
Ontario	Yes	Unknown	Unknown		Not listed	Choose an item.
Quebec	No	Choose an item.	Choose an item.			Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

None.

Trends Discussion *(insert map of North American/regional distribution and status):*

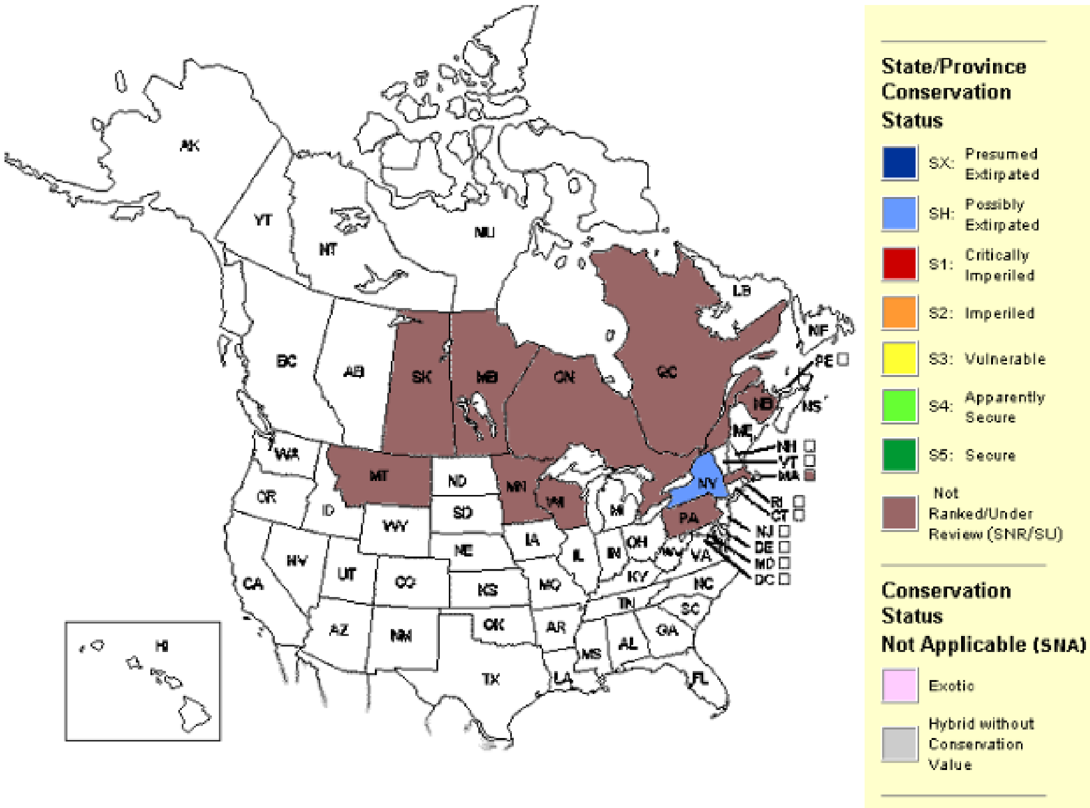

Figure 1. Conservation status of the file rams-horn in North America (NatureServe 2012).

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995			
1995-2004			
2005-2014			
2015- 2023			

Table 1. Records of file rams-horn in New York.

Details of historic and current occurrence:

There are no historic occurrence records available for this species in New York. There are no current occurrence records available for this species in New York. Rarity in New York State is unknown due to lack of records.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
26-50%	Peripheral	~800 miles

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Freshwater

b. Lentic

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Choose an item.	Yes	Choose an item.	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

Planorbids tend to occur in bodies of water with a firm mud bottom and high levels of decaying organic matter. Most species seem to prefer lentic habitats (lakes, wetland or ponds). With the exception of *Helisoma anceps*, which occurs more often in river pools, they prefer minimal current. Planorbid snails are scrapers of benthic surfaces and have been shown to eat bacterial films and algae (Montana Natural Heritage Program 2013).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	Choose an item.	Choose an item.	Yes	Yes	Choose an item.

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Very little is known regarding the life history of this species.

Most Gastropods belong to the clade Caenogastropoda, in which individuals mature slowly (requiring at least a year), are long-lived dioecious species with internal fertilization, and females generally attach eggs to firm substrates in late spring and early summer. Many species are narrow endemics associated with lotic habitats, often isolated in a single spring, river reach, or geographically restricted river basin (Johnson et al. 2013). In contrast, members of the clade Heterobranchia are hermaphroditic, mature quickly, and generally have shorter generation times (Johnson et al. 2013).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Residential & Commercial Development	Housing & Urban Areas (habitat loss/degradation)
2. Natural System Modifications	Dams & Water Management/Use (channelization)
3. Pollution	Industrial & Military Effluents (metals)
4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers)
5. Climate Change & Severe Weather	Habitat Shifting & Alteration

Insufficient information to assess threats.
High imperilment rates among freshwater gastropods have been linked to alteration, fragmentation and destruction of habitat and introduction of non-indigenous species. Causes of habitat degradation and gastropod species loss include dams, impounded reaches, development of riparian areas, channelization, erosion, excess sedimentation, groundwater withdrawal and associated impacts on surface streams (flows, temperature, dissolved oxygen), multiple forms of pollution (salt, metals such as Cu, Hg, Zn, untreated sewage, agricultural runoff, pesticides/fertilizers), changes in aquatic vegetation, and invasion of exotic species (Johnson et al. 2013). Most gastropod species live in the shallows (depths less than 3 m), where food abundance is greatest. As a result, drastic water fluctuations, such as draw-downs, may cause declines in snail populations (Hunt and Jones 1972).

Strayer (1987) concluded that human activities had destroyed much of the original mollusk fauna in some parts of the Hudson basin, but not in others. Channelization of farmed mucklands and industrial pollution from Beacon were noted as causes for the notably reduced biodiversity of mollusks in the Wallkill River of Orange County and the Fishkill Creek of Dutchess County, respectively.

The New Zealand mud snail (*Potamopyrgus antipodarum*) is a highly invasive species that was introduced in Idaho in the 1980s. It can have devastating consequences to aquatic ecosystems, reducing or eliminating native snail species (Benson et al. 2013). This snail was found established in Lake Ontario in 1991 (Zaranko et al. 1997) and in Lake Erie in 2005 (Levri et al. 2007).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Environmental Conservation Law; however this may not be sufficient enough to protect this species.

The Freshwater Wetlands Act provides protection for regulated wetlands greater than 12.4 acres in size under Article 24 of the NYS Conservation Law. The Adirondack Park Agency has the authority to regulate smaller wetlands within the Adirondack Park. The Army Corps of Engineers has the authority to regulate smaller wetlands in New York State, and the DEC has the authority to regulate smaller wetlands that are of unusual local importance.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Basic biological information is lacking for most taxa of freshwater gastropods and there is a strong need for surveys and biological studies given the strong evidence of decline and extinction.

Although not specific to the coldwater pond snail, the NYS Comprehensive Wildlife Conservation Strategy (CWCS) recommends the following actions for the freshwater gastropods (NYSDEC 2005):

- Develop fact sheets for paper distribution and the DEC website
- Determine habitat requirements for all life stages
- Determine threats specific to species
- Determine habitat management techniques
- Determine life history and population dynamics
- Determine distribution

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2. Recommended conservation actions for file rams-horn.

VII. References

American Fisheries Society (AFS). 2013. Conservation assessment of freshwater gastropods (snails) from Canada and the United States by the Gastropod Subcommittee (Endangered Species Committee). Fisheries 38: 247-282.

Baker, F. C. 1930. The molluscan fauna of the southern part of lake Michigan and its relationship to old glacial lake Chicago. Transactions Illinois State Academy of Sciences 22. Pages 193-193 *in* Collected Papers. F. C. Baker.

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Levri, E. P., A. A. Kelly, and E. Love. 2007. The invasive New Zealand mud snail (*Potamopyrgus antipodarum*) in Lake Erie. Journal of Great Lakes Research 33: 1–6.

Montana Natural Heritage Program. 2013. File Rams-horn — Planorbella pilsbryi. Montana Field Guide. <http://FieldGuide.mt.gov/detail_IMGASN0130.aspx>. Accessed 18 June 2013.

NatureServe. 2012. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. <http://www.natureserve.org/explorer>. Accessed 17 June 2013.

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Strayer, D. 1987. Ecology and zoogeography of the freshwater mollusks of the Hudson River basin. Malacological Review 20:1-68.

Zaranko, D.T., D.G. Farara, and F.G. Thompson. 1997. Another exotic mollusk in the Laurentian Great Lakes: the New Zealand native Potamopyrgus antipodarum (Gray 1843) (Gastropoda, Hydrobiidae).

Originally prepared by	Jenny Murtaugh
Date first prepared	June 18, 2013
First revision	February 20, 2014 (S. Hoff)
Latest revision	Transcribed March 2024

Species Status Assessment

Common Name: Fringed valvata **Date Updated:**

Scientific Name: *Valvata lewisi* **Updated By:**

Class: Gastropoda

Family: Valvatidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Freshwater gastropods (snails) are an important and diverse component of aquatic ecosystems worldwide. They have diversified into every available aquatic habitat, including springs, small streams, large rivers, ponds, lakes, and ephemeral to permanent wetlands. Most graze on algae, aquatic plants and biofilms, though some are suspension or deposit feeders, and they can play a vital role in the processing of detritus and decaying organic matter. Freshwater snails are not predatory, unlike some of their terrestrial or marine counterparts and they often dominate benthic stream communities, regularly exceeding 50% of the invertebrate biomass (Johnson et al 2013).

Gastropods are important dietary components of many North American fishes, and also are consumed by a variety of aquatic associated birds and mammals such as the snail kite and the muskrat (Johnson et al. 2013). The fringed valvata occurs in southern Canada from Quebec to British Columbia and in the United States from New York west to Minnesota (Goodrich 1932, Burch 1982).

I. Status

a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Special Concern; SGCN

b. Natural Heritage Program

i. **Global:** G5

ii. **New York:** S1 **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List:

-Northeast Regional SGCN:

-American Fisheries Society: CS – Currently Stable

Status Discussion:

The fringed valvata is ranked secure globally and critically imperiled in New York. Little is known about its status within the state or throughout its range.

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable			Choose an item.
Northeastern US	Yes	Unknown	Unknown			Choose an item.
New York	Yes	Unknown	Unknown			Yes
Connecticut	No	Choose an item.	Choose an item.			Choose an item.
Massachusetts	No data	Unknown	Unknown		Not listed	No
New Jersey	No	Choose an item.	Choose an item.			Choose an item.
Pennsylvania	Yes	Unknown	Unknown		Not listed	No
Vermont	No	Choose an item.	Choose an item.			Choose an item.
Ontario	Yes	Unknown	Unknown		Not listed	Choose an item.
Quebec	Yes	Unknown	Unknown		Not listed	Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

None.

Trends Discussion *(insert map of North American/regional distribution and status):*

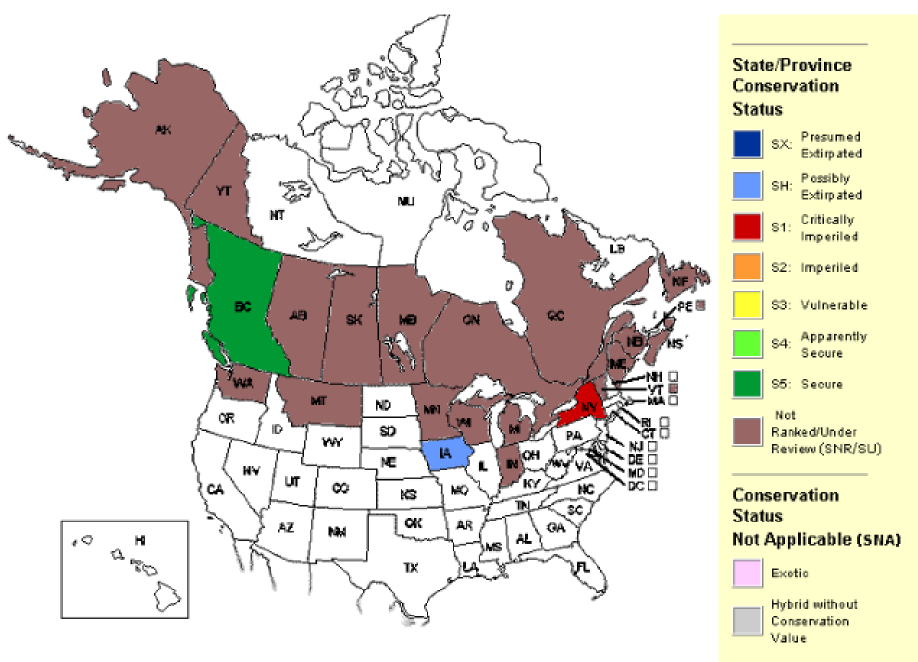

Figure 1. Conservation status of the fringed valvata in North America (NatureServe 2012).

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	______	______	______
1995-2004	______	______	______
2005-2014	______	______	______
2015- 2023	______	______	______

Table 1. Records of fringed valvata in New York.

Details of historic and current occurrence:

Harman and Berg (1971) documented a population in Oneida Lake, where it was relatively scarce, living on sand down to the depths of 7 m (Harman and Berg 1971). Other substrata include mud and aquatic vegetation (Baker 1928a).

One population was located during a survey of the freshwater snails of New York, in a ditch at Oneida Shores Country Park, Onondaga County, within the St. Lawrence River watershed (Jokinen 1992). In June of 2012 Alexander Karatayev, Vadim Karatayev, and Lyubov Burlakova found 4 individuals in 3 locations in Oneida Lake (A. Karatayev, personal communication). It is also known to occur in Lake Erie and in the Hudson River. Rarity in New York State is unknown due to lack of records.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Winter-stratisfied Monomictic Lake

b. Ditch/Intermittent Stream

c. Summer-stratisfied Monomictic Lake

d. Large/Great River

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Yes	Yes	Stable	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

The fringed valvata is most commonly found in lakes, often at considerable depths, as well as on mud among submerged vegetation (Clarke 1981). Sites where it has been found spanned a relatively narrow range of pH (7.7 to 8.6) and conductivity (0.31 to 0.57 mS) (Prescott and Curteanu 2004).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	Choose an item.	Choose an item.	Yes	Yes	Choose an item.

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Very little is known regarding the life history of this species.
Most Gastropods belong to the clade Caenogastropoda, in which individuals mature slowly (requiring at least a year), are long-lived dioecious species with internal fertilization, and females generally attach eggs to firm substrates in late spring and early summer. Many species are narrow endemics associated with lotic habitats, often isolated in a single spring, river reach, or geographically restricted river basin (Johnson et al. 2013). In contrast, members of the clade Heterobranchia are hermaphroditic, mature quickly, and generally have shorter generation times (Johnson et al. 2013).

VI. Threats *(from NY 2015 SWAP or newly described):*

Insufficient information to assess threats. High imperilment rates among freshwater gastropods have been linked to alteration, fragmentation and destruction of habitat and introduction of non-indigenous species. Causes of habitat degradation and gastropod species loss include dams, impounded reaches, development of riparian areas, channelization, erosion, excess sedimentation, groundwater withdrawal and associated impacts on surface streams (flows, temperature, dissolved oxygen), multiple forms of pollution (salt, metals such as Cu, Hg, Zn, untreated sewage, agricultural runoff, pesticides/fertilizers), changes in aquatic vegetation, and invasion of exotic species (Johnson et al. 2013). Most gastropod species live in the shallows (depths less than 3 m), where food abundance is greatest. As a result, drastic water fluctuations, such as draw-downs, may cause declines in snail populations (Hunt and Jones 1972).

Strayer (1987) concluded that human activities had destroyed much of the original mollusk fauna in some parts of the Hudson basin, but not in others. Channelization of farmed mucklands and industrial pollution from Beacon were noted as causes for the notably reduced biodiversity of mollusks in the Wallkill River of Orange County and the Fishkill Creek of Dutchess County, respectively.

The New Zealand mud snail (*Potamopyrgus antipodarum*) is a highly invasive species that was introduced in Idaho in the 1980s. It can have devastating consequences to aquatic ecosystems, reducing or eliminating native snail species (Benson et al. 2013). This snail was found established in Lake Ontario in 1991 (Zaranko et al. 1997) and in Lake Erie in 2005 (Levri et al. 2007).

Threats to NY Populations	
Threat Category	**Threat**
1. Residential & Commercial Development	Housing & Urban Areas (habitat loss/degradation)
2. Natural System Modifications	Dams & Water Management/Use (dams, channelization)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (New Zealand mud snail)
4. Pollution	Industrial & Military Effluents (metals)
5. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers)
6. Pollution	Household Sewage & Urban Wastewater (untreated sewage)
7. Climate Change & Severe Weather	Habitat Shifting & Alteration

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ **No:**_____ **Unknown:**_____

If yes, describe mechanism and whether adequate to protect species/habitat:

The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Environmental Conservation Law, however this may not be sufficient enough to protect this species.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Basic biological information is lacking for most taxa of freshwater gastropods and there is a strong need for surveys and biological studies given the strong evidence of decline and extinction.

Although not specific to the coldwater pond snail, the NYS Comprehensive Wildlife Conservation Strategy (CWCS) recommends the following actions for the freshwater gastropods (NYSDEC 2005):

- Develop fact sheets for paper distribution and the DEC website
- Determine habitat requirements for all life stages
- Determine threats specific to species
- Determine habitat management techniques
- Determine life history and population dynamics
- Determine distribution

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated

subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2. Recommended conservation actions for fringed valvata.

VII. References

American Fisheries Society (AFS). 2013. Conservation assessment of freshwater gastropods (snails) from Canada and the United States by the Gastropod Subcommittee (Endangered Species Committee). Fisheries 38: 247-282.

Baker, F. C. 1928. The fresh water Mollusca of Wisconsin, Part 1: Gastropoda. Wisconsin Geographical and Natural History Survey Bulletin 70: 1-494.

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Jokinen, E. H. 1992. The freshwater snails (Mollusca: Gastropoda) of New York State. New York State Museum Bulletin 482.

Levri, E. P., A. A. Kelly, and E. Love. 2007. The invasive New Zealand mud snail (*Potamopyrgus antipodarum*) in Lake Erie. Journal of Great Lakes Research 33: 1–6.

Prescott, D. R. C. and M. M. Curteanu. 2004. Survey of Aquatic Gastropods in the Central Parkland Subregion of Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 92, Edmonton, AB. 50 pp.

NatureServe. 2012. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. <http://www.natureserve.org/explorer>. Accessed 17 June 2013.

New York Department of Environmental Conservation (NYSDEC). 2005. New York State Comprehensive Wildlife Conservation Strategy. http://www.dec.ny.gov/index.html. Accessed 17 June 2013.

Zaranko, D.T., D.G. Farara, and F.G. Thompson. 1997. Another exotic mollusk in the Laurentian Great Lakes: the New Zealand native Potamopyrgus antipodarum (Gray 1843) (Gastropoda, Hydrobiidae).

Originally prepared by	Jenny Murtaugh
Date first prepared	June 18, 2013
First revision	February 20, 2014 (S. Hoff)
Latest revision	Transcribed March 2024

Species Status Assessment

Common Name: Globe siltsnail **Date Updated:**

Scientific Name: *Birgella subglobosus* **Updated By:**

Class: Gastropoda

Family: Hydrobiidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Freshwater gastropods (snails) are an important and diverse component of aquatic ecosystems worldwide. They have diversified into every available aquatic habitat, including springs, small streams, large rivers, ponds, lakes, and ephemeral to permanent wetlands. Most graze on algae, aquatic plants and biofilms, though some are suspension or deposit feeders, and they can play a vital role in the processing of detritus and decaying organic matter. Freshwater snails are not predatory, unlike some of their terrestrial or marine counterparts and they often dominate benthic stream communities, regularly exceeding 50% of the invertebrate biomass (Johnson et al. 2013).

Gastropods are important dietary components of many North American fishes, and also are consumed by a variety of aquatic associated birds and mammals such as the snail kite and the muskrat (Johnson et al. 2013).

Although more commonly accepted as *Birgella*, some authors have placed the globe siltsnail in the genus *Somatogyrus*. The distribution of the species in New York extends from Lake Champlain and its outlet, the Richelieu River, in New York, Vermont, and Quebec, west to Minnesota and southward to Arkansas, Alabama, and Georgia (Baker 1928, Berry 1942, Clark 1981, Thompson 1984, Branson et al. 1987).

I. Status

a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Not listed

b. Natural Heritage Program

i. **Global:** G4

ii. **New York:** S3 **Tracked by NYNHP?:** Watch List

Other Ranks:

-IUCN Red List:

-Northeast Regional SGCN:

American Fisheries Society: CS – Currently Stable

Status Discussion:

The globe siltsnail is ranked secure globally and vulnerable in New York. Little is known about its status within the state or throughout its whole range, but this species has a wide distribution, presumed large population, and is not in decline or is unlikely to be declining fast enough to qualify for listing in a more threatened category (NatureServe 2012).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable			Choose an item.
Northeastern US	Yes	Unknown	Unknown			Choose an item.
New York	No data	Unknown	Unknown		Not listed	Choose an item.
Connecticut	No	Choose an item.	Choose an item.			Choose an item.
Massachusetts	No	Choose an item.	Choose an item.			Choose an item.
New Jersey	No	Choose an item.	Choose an item.			Choose an item.
Pennsylvania	No data	Unknown	Unknown		Not listed (SNR)	No
Vermont	No	Choose an item.	Choose an item.			Choose an item.
Ontario	No data	Unknown	Unknown		Not listed (S2)	Choose an item.
Quebec	No data	Unknown	Unknown		Not listed	Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

None.

Trends Discussion *(insert map of North American/regional distribution and status):*

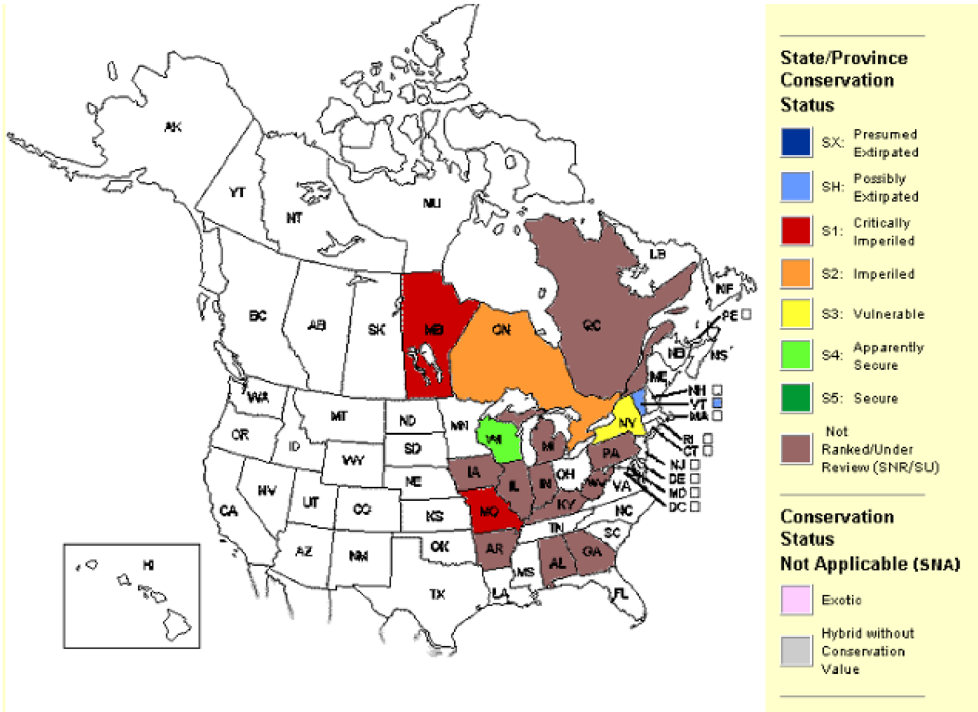

Figure 1. Conservation status of the globe siltsnail in North America (NatureServe 2012).

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	_______	_______	_______
1995-2004	_______	_______	_______
2005-2014	_______	_______	_______
2015- 2023	_______	_______	_______

Table 1. Records of globe siltnail in New York.

Details of historic and current occurrence:

Lewis (1868, 1872) and Marshall (1894) reported the presence of the globe siltsnail in the Hudson River basin, Mohawk, Herkimer County, and in the Erie Canal at Mohawk, into which it was believed introduced after 1860 to become "…numerically more abundant than any other mollusk in the canal" (Lewis 1872). It was also found in Onondaga County (Beauchamp 1886) and as a beach wash from Lake Ontario, Monroe County (Baker 1900b), the Niagara River, Niagara County (Letson 1909); Oneida Lake, Oswego County (Baker 1916a, b, 1918a, b); and the Hudson River from Hudson, Columbia County, to Hyde Park, Dutchess County (Townes 1936). Specimens deposited in Harvard's Museum of Comparative Zoology, the University of Michigan's Museum of Zoology, the Academy of Natural Sciences in Philadelphia, and the Florida State University Museum were collected from the Buffalo River; St. Albans Bay, Lake Champlain, Vermont; Hudson River, Coxsackie, Green County; and Palmyra, Wayne County. Thompson (1984b) cites museum records from the Erie Canal and Mohawk River, Herkimer County, and from Schenectady County.

The only population found during the Jokinen (1992) survey of the freshwater snails of New York was in Lake Champlain in the St. Lawrence River watershed. Strayer (1987) did not find this species during a survey of the Hudson River drainage system. Buckley (1977) located one colony in the Black River, Jefferson County. In June of 2012 Alexander Karatayev, Vadim Karatayev, and Lyubov Burlakova found one dead individual in Oneida Lake and 15 in Lake Erie but not NYS waters (A. Karatayev, personal communication). Rarity in New York State is unknown due to lack of records.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Great Lakes Deepwater Community

b. Summer-stratified Monomictic Lake

c. Large/Great River

d. Winter-stratified Monomictic Lake

e. Canal

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Stable	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

In some areas, this species is a deep water inhabitant of large lakes and rivers (Berry 1943, Clark 1981). However, in Lake Champlain, it was found on a submerged tree trunk in shallow water. In the Hudson River, the globe siltsnail was found in mud and among aquatic plants in shallow water (Townes 1936) and on a soft silt substratum (Thompson 1984b).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	Choose an item.	Choose an item.	Yes	Yes	Choose an item.

Column options

First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Very little is known regarding the life history of this species.
Most Gastropods belong to the clade Caenogastropoda, in which individuals mature slowly (requiring at least a year), are long-lived dioecious species with internal fertilization, and females generally attach eggs to firm substrates in late spring and early summer. Many species are narrow endemics associated with lotic habitats, often isolated in a single spring, river reach, or geographically restricted river basin (Johnson et al. 2013). In contrast, members of the clade Heterobranchia are hermaphroditic, mature quickly, and generally have shorter generation times (Johnson et al. 2013).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Residential & Commercial Development	Housing & Urban Areas (habitat loss/degradation)
2. Natural System Modifications	Dams & Water Management/Use (dams, channelization)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (New Zealand mud snail)
4. Pollution	Industrial & Military Effluents (metals)
5. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers)
6. Pollution	Household Sewage & Urban Wastewater (untreated sewage)
7. Climate Change & Severe Weather	Habitat Shifting & Alteration

Insufficient information to assess threats.

High imperilment rates among freshwater gastropods have been linked to alteration, fragmentation and destruction of habitat and introduction of non-indigenous species. Causes of habitat degradation and gastropod species loss include dams, impounded reaches, development of riparian areas, channelization, erosion, excess sedimentation, groundwater withdrawal and associated impacts on surface streams (flows, temperature, dissolved oxygen), multiple forms of pollution (salt, metals such as Cu, Hg, Zn, untreated sewage, agricultural runoff, pesticides/fertilizers), changes in aquatic vegetation, and invasion of exotic species (Johnson et al. 2013). Most gastropod species live in the shallows (depths less than 3 m), where food abundance is greatest. As a result, drastic water fluctuations, such as draw-downs, may cause declines in snail populations (Hunt and Jones 1972).

Strayer (1987) concluded that human activities had destroyed much of the original mollusk fauna in some parts of the Hudson basin, but not in others. Channelization of farmed mucklands and industrial pollution from Beacon were noted as causes for the notably reduced biodiversity of mollusks in the Wallkill River of Orange County and the Fishkill Creek of Dutchess County, respectively.

The New Zealand mud snail (*Potamopyrgus antipodarum*) is a highly invasive species that was introduced in Idaho in the 1980s. It can have devastating consequences to aquatic ecosystems, reducing or eliminating native snail species (Benson et al. 2013). This snail was found established in Lake Ontario in 1991 (Zaranko et al. 1997) and in Lake Erie in 2005 (Levri et al. 2007).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ **No:**_____ **Unknown:**_____

If yes, describe mechanism and whether adequate to protect species/habitat:

The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Environmental Conservation Law, however this may not be sufficient enough to protect this species.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Basic biological information is lacking for most taxa of freshwater gastropods and there is a strong need for surveys and biological studies given the strong evidence of decline and extinction.

Although not specific to the coldwater pond snail, the NYS Comprehensive Wildlife Conservation Strategy (CWCS) recommends the following actions for the freshwater gastropods (NYSDEC 2005):

- Develop fact sheets for paper distribution and the DEC website
- Determine habitat requirements for all life stages
- Determine threats specific to species
- Determine habitat management techniques
- Determine life history and population dynamics
- Determine distribution

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2. Recommended conservation actions for globe siltsnail.

VII. References

American Fisheries Society (AFS). 2013. Conservation assessment of freshwater gastropods (snails) from Canada and the United States by the Gastropod Subcommittee (Endangered Species Committee). Fisheries 38: 247-282.

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Originally prepared by	Jenny Murtaugh
Date first prepared	June 18, 2013
First revision	February 20, 2014 (S. Hoff)
Latest revision	Transcribed March 2024

Species Status Assessment

Common Name: Gravel pyrg **Date Updated:**

Scientific Name: *Marstonia letsoni* **Updated By:**

Class: Gastropoda

Family: Hydrobiidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Freshwater gastropods (snails) are an important and diverse component of aquatic ecosystems worldwide. They have diversified into every available aquatic habitat, including springs, small streams, large rivers, ponds, lakes, and ephemeral to permanent wetlands. Most graze on algae, aquatic plants and biofilms, though some are suspension or deposit feeders, and they can play a vital role in the processing of detritus and decaying organic matter. Freshwater snails are not predatory, unlike some of their terrestrial or marine counterparts and they often dominate benthic stream communities, regularly exceeding 50% of the invertebrate biomass (Johnson et al 2013).
Gastropods are important dietary components of many North American fishes, and also are consumed by a variety of aquatic associated birds and mammals such as the snail kite and the muskrat (Johnson et al. 2013).

The gravel pyrg is known from Michigan, Ohio, Ontario and the Great Lakes region (Hershler 1994). Most records are from fossil specimen and one live record from the 1920s in New York.

I. Status

a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Not listed

b. Natural Heritage Program

i. **Global:** G5

ii. **New York:** SH **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List:

-Northeast Regional SGCN:

American Fisheries Society: CS – Currently Stable

Status Discussion:

The gravel pyrg is ranked secure globally and possibly extirpated in New York. Little is known about its status within the state or throughout its whole range.

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Unknown	Unknown			Choose an item.
Northeastern US	Yes	Unknown	Unknown			Choose an item.
New York	No data	Unknown	Unknown			Choose an item.
Connecticut	No	Choose an item.	Choose an item.			Choose an item.
Massachusetts	No	Choose an item.	Choose an item.			Choose an item.
New Jersey	No	Choose an item.	Choose an item.			Choose an item.
Pennsylvania	No	Choose an item.	Choose an item.			Choose an item.
Vermont	No	Choose an item.	Choose an item.			Choose an item.
Ontario	No data	Unknown	Unknown		Not listed (SNR)	Choose an item.
Quebec	No	Choose an item.	Choose an item.			Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

None.

Trends Discussion *(insert map of North American/regional distribution and status):*

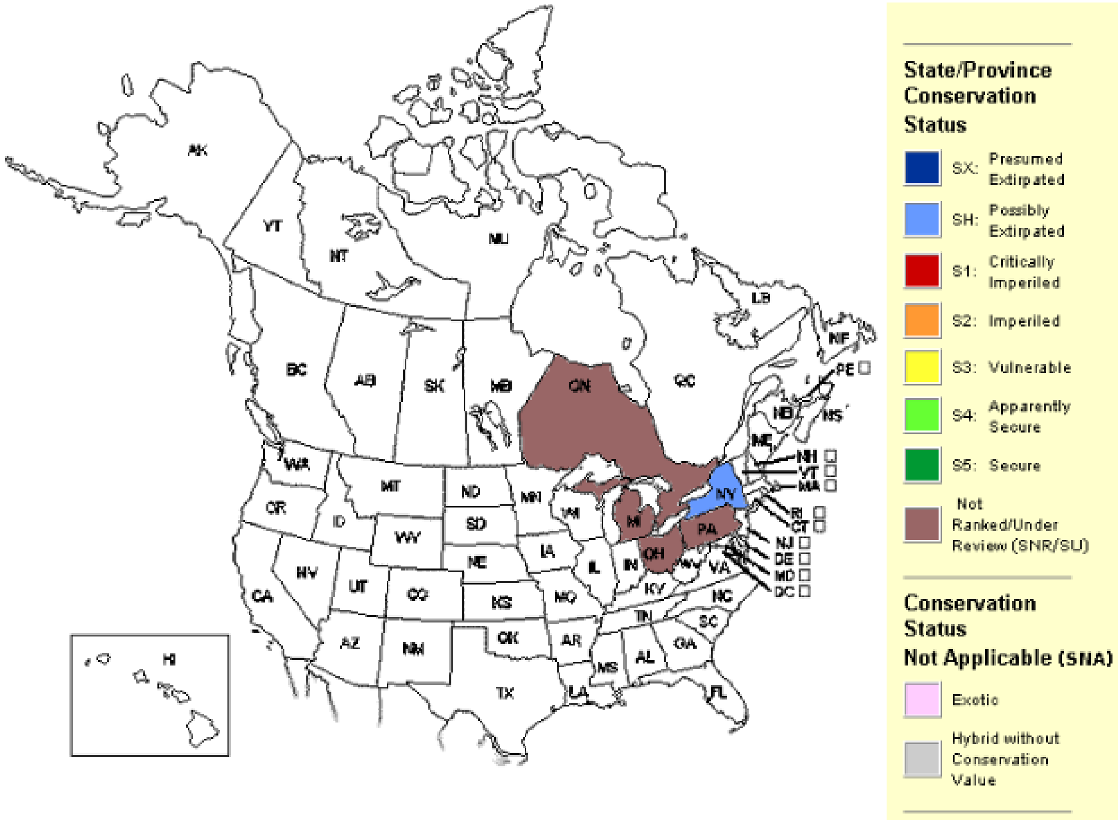

Figure 1. Conservation status of the gravel pyrg in North America (NatureServe 2012).

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	_______	_______	_______
1995-2004	_______	_______	_______
2005-2014	_______	_______	_______
2015- 2023	_______	_______	_______

Table 1. Records of gravel pyrg in New York.

Details of historic and current occurrence:

Most records are from fossil specimen and one live record from the 1920s (expert meeting).
There are no current occurrence records available for this species in New York.
Rarity in New York State is unknown due to lack of records.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Freshwater

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Choose an item.	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	Choose an item.	Choose an item.	Yes	Yes	Choose an item.

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Very little is known regarding the life history of this species.

Most Gastropods belong to the clade Caenogastropoda, in which individuals mature slowly (requiring at least a year), are long-lived dioecious species with internal fertilization, and females generally attach eggs to firm substrates in late spring and early summer. Many species are narrow endemics associated with lotic habitats, often isolated in a single spring, river reach, or geographically restricted river basin (Johnson et al. 2013). In contrast, members of the clade Heterobranchia are hermaphroditic, mature quickly, and generally have shorter generation times (Johnson et al. 2013).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Residential & Commercial Development	Housing & Urban Areas (habitat loss/degradation)
2. Natural System Modifications	Dams & Water Management/Use (dams, channelization)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (New Zealand mud snail)
4. Pollution	Industrial & Military Effluents (metals)
5. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers)
6. Pollution	Household Sewage & Urban Wastewater (untreated sewage)
7. Climate Change & Severe Weather	Habitat Shifting & Alteration

Insufficient information to assess threats.

High imperilment rates among freshwater gastropods have been linked to alteration, fragmentation and destruction of habitat and introduction of non-indigenous species. Causes of habitat degradation and gastropod species loss include dams, impounded reaches, development of riparian areas, channelization, erosion, excess sedimentation, groundwater withdrawal and associated impacts on surface streams (flows, temperature, dissolved oxygen), multiple forms of pollution (salt, metals such as Cu, Hg, Zn, untreated sewage, agricultural runoff, pesticides/fertilizers), changes in aquatic vegetation, and invasion of exotic species (Johnson et al. 2013). Most gastropod species live in the shallows (depths less than 3 m), where food abundance is greatest. As a result, drastic water fluctuations, such as draw-downs, may cause declines in snail populations (Hunt and Jones 1972).

Strayer (1987) concluded that human activities had destroyed much of the original mollusk fauna in some parts of the Hudson basin, but not in others. Channelization of farmed mucklands and industrial pollution from Beacon were noted as causes for the notably reduced biodiversity of mollusks in the Wallkill River of Orange County and the Fishkill Creek of Dutchess County, respectively.

The New Zealand mud snail (*Potamopyrgus antipodarum*) is a highly invasive species that was introduced in Idaho in the 1980s. It can have devastating consequences to aquatic ecosystems, reducing or eliminating native snail species (Benson et al. 2013). This snail was found established in Lake Ontario in 1991 (Zaranko et al. 1997) and in Lake Erie in 2005 (Levri et al. 2007).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ No: _____ Unknown: _____

If yes, describe mechanism and whether adequate to protect species/habitat:

The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Environmental Conservation Law, however this may not be sufficient enough to protect this species.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Basic biological information is lacking for most taxa of freshwater gastropods and there is a strong need for surveys and biological studies given the strong evidence of decline and extinction. This species is small and easy to overlook so experts recommend determining presence in NY through targeted surveys.

Although not specific to the coldwater pond snail, the NYS Comprehensive Wildlife Conservation Strategy (CWCS) recommends the following actions for the freshwater gastropods (NYSDEC 2005):

- Develop fact sheets for paper distribution and the DEC website
- Determine habitat requirements for all life stages
- Determine threats specific to species
- Determine habitat management techniques
- Determine life history and population dynamics
- Determine distribution

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2. Recommended conservation actions for gravel pyrg.

VII. References

American Fisheries Society (AFS). 2013. Conservation assessment of freshwater gastropods (snails) from Canada and the United States by the Gastropod Subcommittee (Endangered Species Committee). Fisheries 38: 247-282.

Benson, A.J., R.M. Kipp, J. Larson, and A. Fusaro. 2013. *Potamopyrgus antipodarum*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=1008 Revision Date: 6/11/2012

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Levri, E. P., A. A. Kelly, and E. Love. 2007. The invasive New Zealand mud snail (*Potamopyrgus antipodarum*) in Lake Erie. Journal of Great Lakes Research 33: 1–6.

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New York Department of Environmental Conservation (NYSDEC). 2005. New York State Comprehensive Wildlife Conservation Strategy. <http://www.dec.ny.gov/index.html. Accessed 17 June 2013>. Accessed 17 June 2013.

Strayer, D. 1987. Ecology and zoogeography of the freshwater mollusks of the Hudson River basin. Malacological Review 20:1-68.

Zaranko, D.T., D.G. Farara, and F.G. Thompson. 1997. Another exotic mollusk in the Laurentian Great Lakes: the New Zealand native Potamopyrgus antipodarum (Gray 1843) (Gastropoda, Hydrobiidae).

Originally prepared by	Jenny Murtaugh
Date first prepared	June 18, 2013
First revision	February 20, 2014 (S. Hoff)
Latest revision	Transcribed March 2024

Species Status Assessment

Common Name: Green floater **Date Updated:** 1/16/2024

Scientific Name: *Lasmigona subviridis* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Lasmigona subviridis belongs to the subfamily Unioninae, and the tribe Anodontini, which includes 16 extant and 1 likely extirpated New York species of the genera Alasmidonta, Anodonta, Anodontoides, Lasmigona, Pyganodon, Simpsonaias, Strophitus, and Utterbackia (Haag 2012, Graf and Cummings 2011). L. subviridis is a member of the Lasmigona genus, from the Greek words elasma, referring to the "plate-like" lateral tooth. The species name subviridis refers to its light green color (Watters et al. 2009).

This species is found in the Atlantic Slope from North Carolina to New York, as well as the Kanawha River basin in North Carolina, Virginia, and West. Virginia. Since 1970, this species has been found live in thirteen New York waterbodies. Most records are from the Susquehanna River drainage, but records from the Mohawk, Hudson, Genesee, and Oswego River basins, and the Erie Canal also exist. The species has declined throughout most of its range, and relatively few populations remain in New York (Strayer & Jirka 1997).

L. subviridis is ranked as "imperiled" in New York and throughout its range. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993, Stein et al. 2000). While population trends in New York are unknown, based on sparse historical information, it is assumed that they too are declining due to a myriad of environmental stressors.

I. Status

a. Current legal protected Status

i. **Federal:** Proposed Threatened (2023) **Candidate:** Yes

ii. New York: Threatened

b. Natural Heritage Program

i. Global: S2S3 – Imperiled / Vulnerable

ii. New York: S2 – Imperiled **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Least Concern (2012)

-Northeast Regional SGCN: Yes (2023)

-American Fisheries Society Status: Threatened (1993)

Status Discussion:

L. subviridis has recently been found more infrequently and generally in lower numbers than in the past, with many documented extirpated occurrences. However, this species is easier to overlook than others and might be under-sampled. It still maintains a wide range, although there is considerable confusion as to the taxonomy of this species in the northern part of its range. Although occurrences are still widespread, decline is evident at many localities and historical extirpations have occurred in Georgia and Kentucky (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Declining	Choose an item.		Proposed Threatened	(blank)
Northeastern US	Yes	Declining	Choose an item.			Yes
New York	Yes	Choose an item.	Choose an item.		Threatened, S2	Yes
Connecticut	No	N/A	N/A			No
Massachusetts	No	N/A	N/A			No
New Jersey	Yes	Declining	Declining	1970 - 2014	Endangered, S1	Yes
Pennsylvania	Yes	Choose an item.	Choose an item.			Yes
Vermont	No	N/A	N/A			No
Ontario	No	N/A	N/A			(blank)
Quebec	No	N/A	N/A			(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

As part of a State Wildlife Grant, NYSDEC Region 8 Fish and Wildlife staff conducted a native freshwater mussel baseline inventory of tributaries in central and western New York, 2009 to 2020.

Trends Discussion *(insert map of North American/regional distribution and status):*

Trends for New York populations are difficult to determine as most historic data comes from opportunistic naturalist collections, as opposed to more comprehensive baseline surveys. For example, mussels were documented for the first time in 50 of the 106 streams surveyed to date by the Southern Lake Ontario mussel inventory project (Mahar & Landry 2015). This is because many of these streams had never before been surveyed for mussels, not because mussel distribution has dramatically increased. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993, Stein et al. 2000). Based on New York's Natural Heritage S-rank, sparse historical data, and the plight of North America's freshwater mussels, it is assumed that trends are declining due to a myriad of environmental stressors.

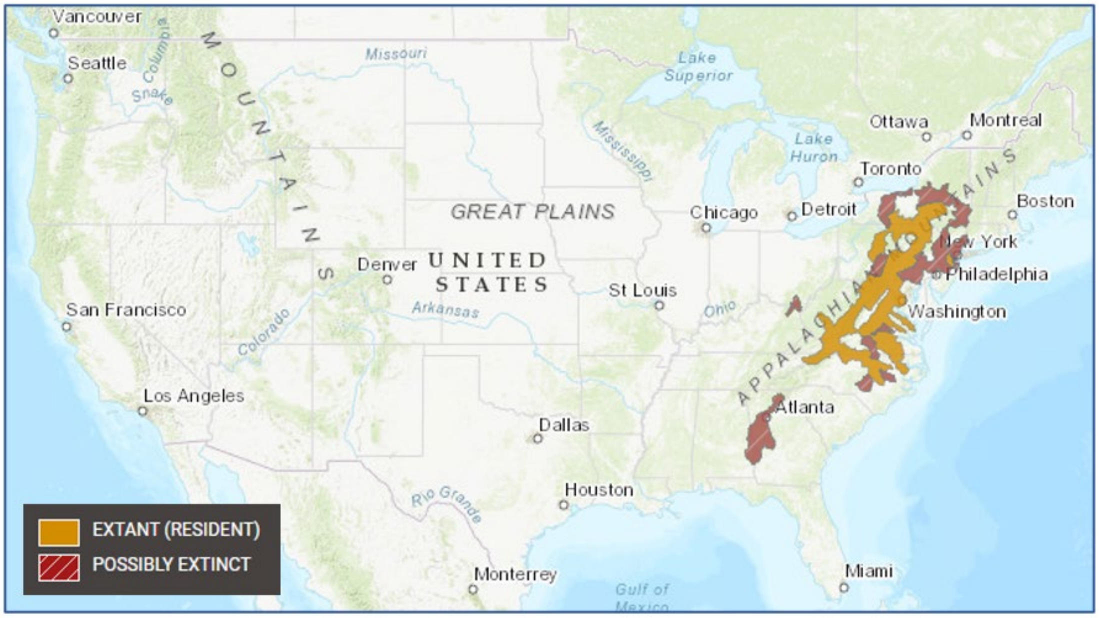

Figure 1. Green floater distribution (IUCN Redlist 2024)

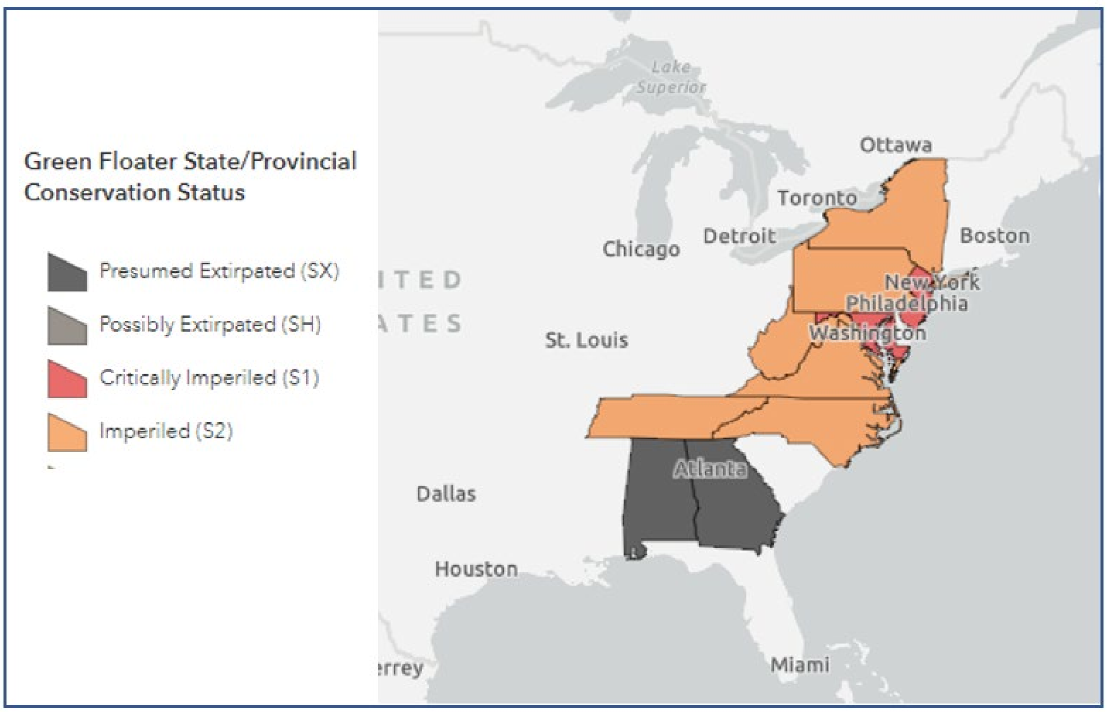

Figure 2. Green floater status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

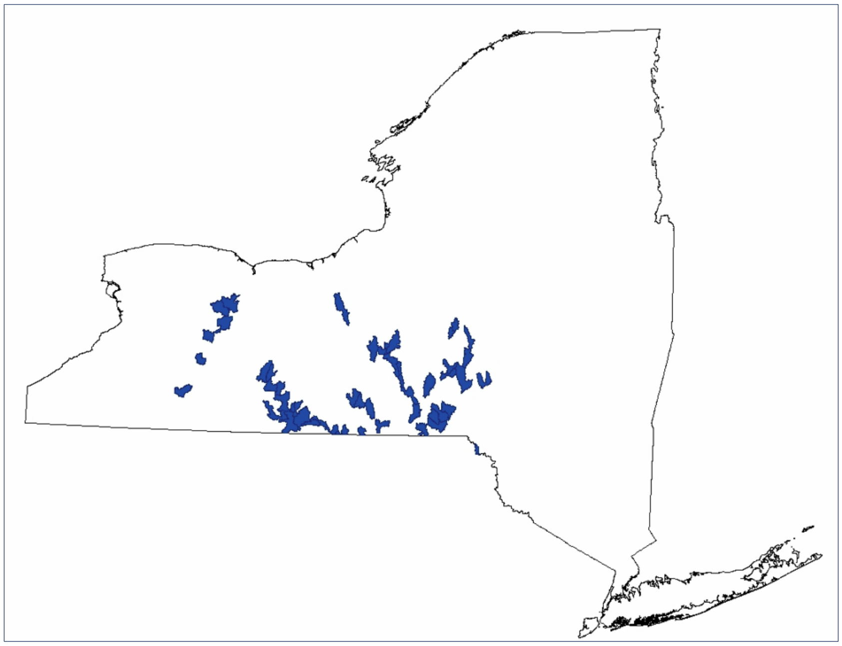

Figure 3. Records of green floater in New York (NYSDEC 2022)

Years	# of Records	# of Distinct Waterbodies	% of State
Total		21	2.6.%

Table 1. Records of green floater in New York.

Details of historic and current occurrence:

2024: L. subviridis has been found in 47 of 1802 HUC 12 watersheds (2.6%) and 21 waterbodies.

Most of the records from New York are from the Susquehanna River drainage (approximately nine waterbodies), where L. subviridis was widespread. NY Natural Heritage Program (2013) reported occurrences in the Susquehanna from both Willseyville Creek and Cayuta Creek in 1959. L. subviridis was not found at either of these sites upon revisit in the late 1990's. It has been reliably recorded from a few sites in the Mohawk and Hudson Rivers, although not in the last century. L. subviridis was also recorded prior to 1970 in the Oswego River basin near Syracuse; Chittenango Creek (1956); the Erie Canal near Baldwinsville; and the Genesee River drainage (Strayer & Jirka, 1997).

Since 1970, L.subviridis has been found in thirteen New York State waterbodies (Figure 2).

A recent State Wildlife Grants funded survey of portions of the Susquehanna basin detected live L. subviridis at 7 sites in the Unadilla River (79 live), 7 sites in the Chenango River (20 live), 6 sites in the Susquehanna River (155 live), 5 sites in the Tioughnioga River (45 live), 5 sites in the Chemung River (51 live) (8 live – Mahar & Landry 2014), and 2 sites in the Sangerfield River (10 live) (Harman &, Lord 2010). There are also reports of live mussels from 3 sites in Catatonk Creek (3 live) (Harman &, Lord 2010; NY Natural Heritage Program, 2013). In the Cohocton subbasin, L. subviridis was found live in Fivemile Creek (40 live) and in the Cohocton River near Bath (102 live) (Mahar & Landry 2014).

In the Genesee River basin, three live specimens were found in the Genesee River at Mt. Morris and at least one live specimen was found at Geneseo (Livingston Co). Additional live individuals were found in Black Creek (Allegany Co), a tributary to the upper Genesee River. Fresh shells were also found in the Genesee River, including a juvenile specimen just downstream of Honeoye Creek confluence (Rush, Monroe Co.) and an adult specimen just upstream of Oatka Creek confluence (Henrietta, Monroe Co.) (Mahar & Landry 2015).

In the Seneca basin, L. subviridis was found live in Crane Brook (3 live) and Fall Creek (1 live) (Mahar & Landry 2015).

Two specimens of L. subviridis were reported from the Grass River drainage in northern New York's St. Lawrence basin (1996), but this record is well out of the known range of the species and must be verified (Strayer & Jirka 1997).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
26-50%	Core	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. **Size/Waterbody Type:** Medium River

b. **Geology:** Moderately Buffered

c. **Temperature:** Transitional Cool to Warm

d. **Gradient:** Low to Moderate-High Gradient

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Yes	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

L. subviridis is considered to be a species of creeks and small rivers (Watters et al. 2009, Strayer & Jirka 1997, Ortman 1919). Watters et al. (2009) noted that it is not typically a large river species. Despite this, in New York, this species has been most commonly found in large and medium sized rivers (Susquehanna River, Chemung River, Chenango River, Unadilla River, Tioghnioga River, Genesee River). L. subviridis is most commonly found in gravel or sandy substrate in water depths of one to four feet (NatureServe 2013, Ortmann 1919, Spoo 2008, Watters et al. 2009). It is thought to be intolerant of strong currents and occurs in pools and other calm water areas (Ortmann 1919, Watters et al. 2009, NatureServe 2013). It seems to occur more often in good condition (Watters et al., 2009), good water quality (NatureServe 2013), hydrologically stable streams than in those subject to severe floods and droughts (Strayer & Jirka 1997).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

L. subviridis is considered to be a species of creeks and small rivers (Watters et al. 2009, Strayer & Jirka 1997, Ortman 1919). Watters et al. (2009) noted that it is not typically a large river species. Despite this, in New York, this species has been most commonly found in large and medium sized rivers (Susquehanna River, Chemung River, Chenango River, Unadilla River, Tioghnioga River, Genesee River). L. subviridis is most commonly found in gravel or sandy substrate in water depths of one to four feet (NatureServe 2013, Ortmann 1919, Spoo 2008, Watters et al. 2009). It is thought to be intolerant of strong currents and occurs in pools and other calm water areas (Ortmann 1919, Watters et al. 2009, NatureServe 2013). It seems to occur more often in good condition (Watters et al., 2009), good water quality (NatureServe 2013), hydrologically stable streams than in those subject to severe floods and droughts (Strayer & Jirka 1997).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Other Ecosystem Modifications (levees and flood walls, channelization, dredging, impassable culverts)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (zebra mussels, rusty crayfish)
4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)

5. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, other regulated discharges)
6. Pollution	Household Sewage & Urban Waste Water (waste water treatment effluent, sewer and septic overflows)
7. Climate Change & Severe Weather	Droughts
8. Natural System Modifications	Dams & Water Management/Use (lowering of water table from agriculture, etc…, causing drying of habitat)
9. Climate Change & Severe Weather	Storms & Flooding (extreme storms)
10. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien (die offs from unknown disease)

Agricultural Runoff

Agricultural practices and wood harvest in the basins with *L. subviridis* populations may be sources of siltation and pollution. Although only 27 percent of the land in the New York portion of the Susquehanna basin is agriculture (Homer 2007) the large majority of this agriculture is located adjacent to streams, many of which are identified as *L. subviridis* habitat. Seventy percent of the land cover in the basin is in forest. In the lower Genesee basin, *L. subviridis* has also been found in highly agricultural areas ("New York State Landcover" 2010). Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in Western and Central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar & Landry 2015), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer runoff is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag, 2012). In addition, ammonia adsorbs to sediment particles, resulting in higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Treated and Untreated Wastewater

In the Susquehanna basin, known *L. subviridis* habitat is located downstream of the numerous combined sewer outflow (CSO) outfalls in the City of Elmira (10 outfalls) and the City of Binghamton (9 outfalls) ("Combined Sewer Overflow" 2012). In addition, *L. subviridis* habitat receives treated wastewater from the municipalities of Corning, Painted Post, Erwin, Elmira, Waverly, Owego, Binghamton and its suburbs, Whitney Point, Green, Sidney, and Bainbridge (SPDES 2007). Recent studies show that mussel richness and abundance decrease with increased proximity to sewage effluent (Wildenberg 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al. 1978). Endocrine disrupters from pharmaceuticals are also present in municipal sewage effluents and are increasingly common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012). It should be noted that in the Susquehanna Basin, Harman and Lord (2010) found no evidence that wastewater treatment plants were responsible for reductions in mussel species of greatest conservation need.

Runoff from Developed Land

All New York waterbodies that host *L. subviridis* populations are intermittently bordered by interstate highways, state routes, and/or local roads. Municipalities bordering *L. subviridis* habitat include Corning, Painted Post, Erwin, Elmira, Waverly, Owego, Binghamton and its suburbs, Whitney Point, Green, Sidney, and Bainbridge (New York State Landcover 2010). These developed lands are likely sources of stormwater runoff, containing metals and road salts (Gillis 2012). Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller & Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner & Pynnonen 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller & Zam 1991, Liqouri & Insler 1985, Pandolfo et al. 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Flood Control Projects

L. subviridis has been found within or adjacent to stream reaches shaped by levee and/or floodwall flood control projects in Elmira and Corning/Painted Post on the Chemung River, Nichols on the Susquehanna River, Binghamton on the Susquehanna River and Chenango River, and Whitney Point on the Tioughnioga River ("New York State Flood Protection" 2013). Additionally, many smaller streams have been channelized and bermed by landowners and highway departments to protect farm fields and other structures. These structures confine larger rivers, preventing the river from inundating its natural floodplains and wetlands to minimize flood damage. Channelization and dredging associated with flood control projects are catastrophic to mussels and have been implicated in the decline of some populations (Watters et al. 2009). The result of these projects is altered seasonality of flow and temperature regimes, increased stream velocities, unstable substrates, changed patterns of sediment scour and deposition, including streambank erosion, altered transport of particulate organic matter (the food base for mussels), and a general degradation of stream habitat (Benke 1999, Yeager 1993, Nedeau 2008).

Other Habitat Modifications

In addition to channelization and regular channel dredging for maintenance of flood control structures, other ecosystem modifications such as instream work associated with bridge replacement and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils, and has subsequently been recommended only as a monitored and highly managed effort (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting "dredge" had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000).

Invasive Species
Invasive zebra mussels (*Dreissena polymorpha*) pose a threat to *A. varicosa* populations in the Chenango River, particularly downstream of Eastonbrook Reservoir in Madison County, the West Branch of the Tioughnioga River near Cortland, and in the Susquehanna River at Binghamton and south of Copperstown (Harman & Lord 2010, iMapInvasives 2013). Harman and Lord (2010) note that zebra mussels are moving downstream from these headwater areas on the Susquehanna and are fouling and killing native pearly mussels. This invasive species has been repeatedly cited as a threat to native mussel populations (Strayer & Jirka 1997, Watters et al. 2009). En masse, Dreissenids out compete native mussels by efficiently filtering food and oxygen from the water. They reduce reproductive success by filtering native mussel male gametes from the water column and they can foul the shells of the native mussels to the point that their valves can no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury.

Water Temperature Change
Stream temperature can increases due to many factors such as global climate change as well as industrial activities. In a recent assessment of the vulnerability of at-risk species to climate change in New York, Schesinger et al. (2011) ranked this species as "extremely vulnerable." This indicates that abundance and/or range extent within New York is extremely likely to substantially decrease or disappear by 2050. Gailbreth et al. (2010) recently showed how regional climate patterns coupled with changing local water regimes and management strategies have shifted mussel populations from thermally sensitive species to thermally tolerant species. This threat could result in a decrease in the diversity of freshwater mussels in watersheds.

Impoundments – Range wide
Across its range, impoundments likely contributed to the reduced distribution that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery & King 1983; ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ **No:** ____ **Unknown:** ____

If yes, describe mechanism and whether adequate to protect species/habitat:

New York State Environmental Conservation Law, § 11-0535. 6 NYCRR Part 182: Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern; Incidental Take Permits

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any “protected stream”, its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York’s mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Priority conservation efforts for this species should focus on, but not be limited to, the Susquehanna River, especially in the area of high abundance between Windsor and the Pennsylvania border, the Unadilla River, and the Chemung River.

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al, 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis, 2012).

- Update wastewater treatment facilities in Elmira and Binghamton to eliminate combined sewer outflows.

- Establish a protocol whereas DEC staff work closely with flood control management to reduce or impacts to native mussels during maintenance flood control projects.

- Establish a protocol whereas DEC staff work closely with state and local highway departments to reduce impacts to native mussels during maintenance and construction projects.

- Replace culverts that disrupt aquatic habitat connectivity to allow for passage of small fish species.

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g. point & nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	

Table 2. (need recommended conservation actions for green floater).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:
- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:
- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.

- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:
- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:
- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:
- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:
- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:
- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:
- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:
- Conduct population estimates of species-at-risk listed mussel species in NY

- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:
- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:
- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:
Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
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Latest revision	January 16, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Hickorynut **Date Updated:** 1/17/2024

Scientific Name: *Obovaria olivaria* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Hickorynut

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Obovaria olivaria is thought to be extirpated in New York but experts believe it could still be found in deepwater locations. A weathered shell of this species was found in 2019 in the Niagara River (Jirka, personal communication). Historically, it has been found in the Niagara River and the St. Lawrence River (Strayer and Jirka 1997). This species was removed from the New York Species of Greatest Conservation list in 2015.

O. olivaria belongs to the subfamily Ambleminae and the tribe Lampsilini, which includes 17 extant and 6 likely extirpated New York species of the genera Actinonaias, Epioblasma, Lampsilis, Leptodea, Ligumia, Obovaria, Potamilus, Ptychobranchus, Toxolasma, Truncilla, and Villosa (Graf and Cummings 2011, Haag 2012).

O. olivaria is a deepwater, large river unionid that can be abundant in the Mississippi basin (Parmalee and Bogan 1998, Williams et al. 2008) and rare in the St. Lawrence River and Great Lakes watershed (NatureServe 2013). This species is generally considered to be stable, yet the sporadic distribution throughout its range is a cause for concern (NatureServe 2013). This species is ranked by The Natural Heritage Program as critically imperiled in New York and apparently secure throughout its range.

I. Status

a. Current legal protected Status

i. **Federal:** None **Candidate:** No

ii. **New York:** None

b. Natural Heritage Program

i. **Global:** G4 – Apparently Secure

ii. **New York:** S1 – Critically imperiled **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Least Concern (2012)

-Northeast Regional SGCN: No (2023)

- Committee on the Status of Endangered Wildlife in Canada (COSEWIC): Endangered (2011)

- American Fisheries Society Status: Currently Stable (1993)

Status Discussion:

This species is found throughout most of Mississippi River drainage from Pennsylvania and New York to Minnesota and Kansas, south to Missouri, Arkansas, and Louisiana; also in St. Lawrence River basin from Lake Ontario to Quebec. Although it has a very wide range and is considered stable throughout portions of its range, it is likely extirpated from Alabama, New York, Pennsylvania, Ohio, West Virginia, Nebraska, Kansas, the Tennessee River, and the Detroit River between Lake St. Clair and Lake Erie, Michigan/Ontario (the latter due to zebra mussel invasion). In Canada, it only occurs in a small number of rivers in eastern Ontario and southern Quebec (NatureServe 2013). Although it has not been recently found in New York, experts agree that it could still exist in deepwater locations.

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Declining	Declining			(blank)
Northeastern US	Yes	Declining	Declining	2003-2013		No
New York	Yes	Unknown	Unknown			No
Connecticut	No	N/A	N/A			No
Massachusetts	No	N/A	N/A			No
New Jersey	No	N/A	N/A			No
Pennsylvania	No	N/A	N/A		SH	Yes
Vermont	No	N/A	N/A			Yes
Ontario	Yes	Declining	Declining	2003-2013	Endangered, S1	(blank)
Quebec	Yes	Unknown	Unknown		Endangered, S2	(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

As part of a 2009 to 2020 State Wildlife Grant funded project, NYSDEC Region 8 Fish and Wildlife staff conducted a native freshwater mussel baseline inventory of tributaries in central and western New York where this species might be found. No regular surveys are being conducted for this species at this time. Regulatory surveys may be conducted in known or likely habitat as part of the project review process.

Trends Discussion *(insert map of North American/regional distribution and status):*

Figure 1. Hickorynut distribution (IUCN Redlist 2024)

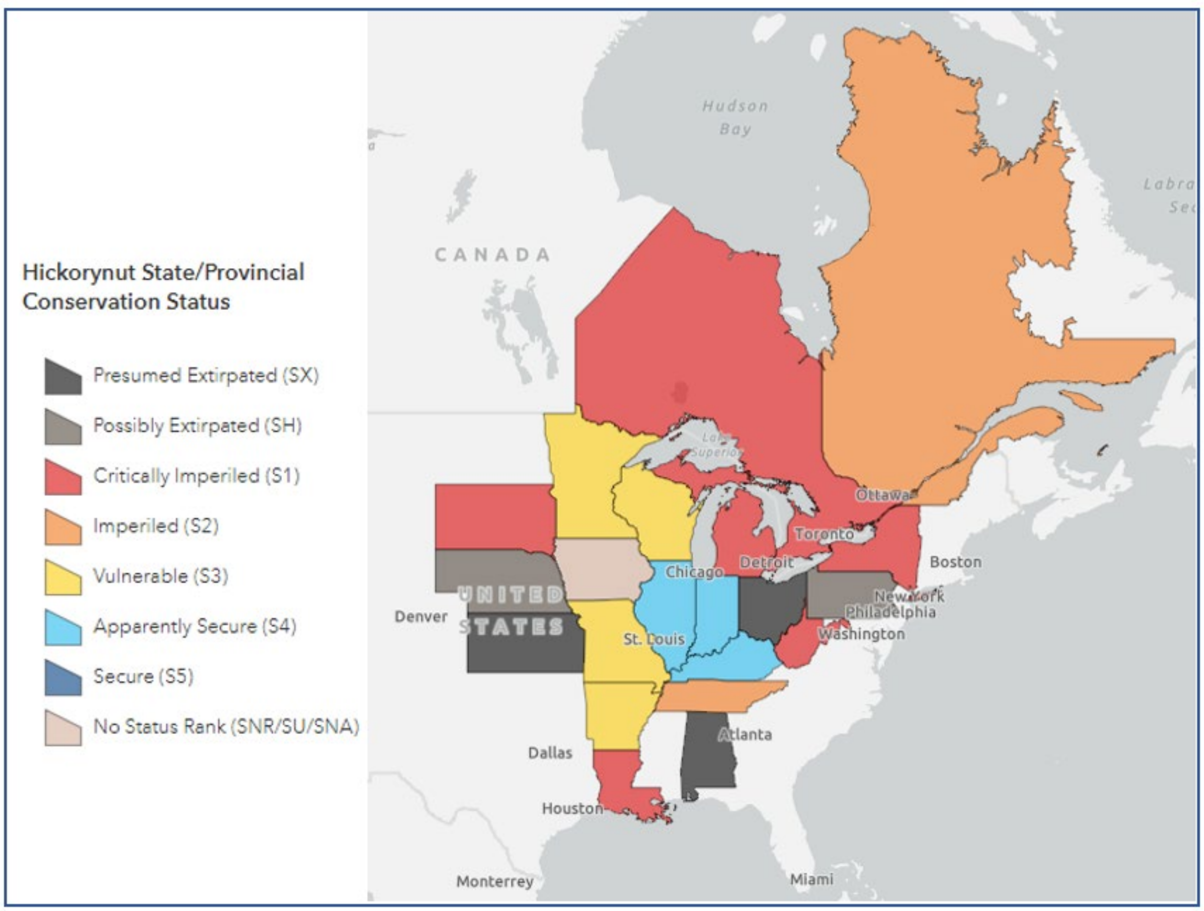

Figure 2. Hickorynut distribution and status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	____	____	2 of 56 HUC 8 watersheds
1995-2004	0	0	0
2005-2014	0	0	0
2015- 2023	1	____	____

Table 1. Records of hickorynut in New York.

Details of historic and current occurrence:

Historically, O. olivaria was found only in the Niagara River and the St. Lawrence River. Museums contain multiple specimens from the Niagara River, suggesting that this species was abundant there (Strayer & Jirka 1997).

A weathered shell of this species was found in 2019 in the Niagara River (Jirka, personal communication), but O. olivaria has not recently been found live in New York (Strayer & Jirka 1997, The Nature Conservancy 2009, Harman and Lord 2010, White et al. 2011, NatureServe 2013, Mahar and Landry 2013, NY Natural Heritage Program 2013).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Size/Waterbody Type:

b. Geology:

c. Temperature:

d. Gradient:

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

This species is typically found on muddy sand or gravel substrate in deep water, depths usually exceeding six to eight feet, with good current. In large rivers it is often found in large mussel beds, midriver, in gravel bars (Cummings and Mayer 1992, Parmalee and Bogan 1998, Metcalfe-Smith 2005, Watters et al. 2009, McMurray et al. 2012).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, this species must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable substrate, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely to be a slow process for mussels which use resident fishes with limited home ranges as their hosts (COSEWIC as cited in NatureServe, 2013).

O.olivaria is known to be bradytictic with eggs reported from June through August and glochidia present from September to the following June. Glochidial transformation has been confirmed on shovelnose sturgeon (Scaphirhynchus platorhynchus) and lake sturgeon (Acipenser fulvescens) (Watters et al. 2009). Individuals may live to more than 30 years old (Watters et al. 2009).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Other Ecosystem Modifications (dredging, impassable culverts)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (zebra and quagga mussels, Asian clams)
4. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, waste water treatment effluent, other regulated discharges, combined sewer overflows)
5. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)
6. Climate Change & Severe Weather	Habitat Shifting & Alteration (warmer water temperatures)

At SGCN meetings that DEC conducted in December 2013 to evaluate the status of mussels, experts agreed there is too little information known about this species to evaluate threats or viability and intrinsic vulnerability. The general threats discussed below are likely relevant to this species.

Impoundments – Range wide
Range wide, impoundments likely contributed to the reduced distribution of mussels that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery & King 1983; ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Agricultural Runoff
Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not

closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in Western and Central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar & Landry 2013), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer runoff is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag 2012). In addition, ammonia adsorbs to sediment particles, resulting higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Treated and Untreated Wastewater

Recent studies show that mussel richness and abundance decreases with increased proximity to sewage effluent (Wildenberg 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al. 1978). Endocrine disrupters from pharmaceuticals also originate from municipal sewage effluents and are increasing common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012).

Runoff from Developed Land

Developed lands are likely sources runoff containing metals and road salts.
Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller & Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner & Pynnonen 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller & Zam 1991; Liquori & Insler 1985; Pandolfo et al. 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Invasive Species

Invasive zebra and quagga mussels (*Dreissena polymorpha* and *Dreissena bugenis*) have been repeatedly cited as a threat to native mussel populations (Strayer & Jirka 1997; Watters et al.

2009). En masse, Dreissenids outcompete native mussels by removing food and oxygen from the water. They can also reduce reproductive success by filtering native mussel male gametes from the water column. They can foul the shells of the native mussels to the point that their valves can no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury (USFWS 1994). This has been shown to be the case in Michigan and Ontario, as invasive mussels out compete *O. olivaria* populations.

In addition, ammonia from Asian clam die offs has been shown to be capable of exceeding acute effect levels of some mussel species (Cherry et al. 2005). Didymo (*Didymosphenia geminata*), a filamentous diatom, can form extensive mats that can smother stream bottom and occlude habitat for mussels (Spaulding & Elwell 2007)

Climate Change
Global climate change is expected (among other disruptions) to cause an increase in surface water temperatures. Although many species are tolerant of warm water, higher water temperatures may be an added stress for some. Increased water temperatures may also increase algal growth, which could result in reductions in dissolved oxygen levels at night (Morris & Burridge 2006). Galbraith et al. (2010) recently showed how regional climate patterns coupled with changing local water regimes and management strategies have shifted mussel populations from thermally sensitive species to thermally tolerant species.

In addition, warmer stream temperatures due to the combined effects of land use, such as removal of shaded buffers, and climate change may contribute to the loss of coldwater fisheries and *mussel* populations in some watersheds (Nedeau 2008). Temperature induced changes in fish communities could have a profound influence on the availability of hosts for freshwater mussels. Mussels that inhabit small streams and rivers and rely on fish adapted for cooler water might be most affected by climate change (Nedeau 2008).

Habitat Modifications
Ecosystem modifications, such as in-stream work associated with canal, navigational channel, or flood control dredging, bridge replacements, gravel mining, and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting “dredge” had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000). Seasonal draw downs of water bodies have been shown to impact unionid age distributions (Richardson et al. 2002).

Levees and flood walls confine larger rivers, preventing the river from inundating its natural floodplains and wetlands to minimize flood damage. Additionally, many smaller streams have been channelized and bermed by landowners and highway departments to protect farm fields and other structures. Channelization and dredging associated with flood control projects are catastrophic to mussels and have been implicated in the decline of some populations (Watters et al. 2009). The result of these projects is altered seasonality of flow and temperature regimes, increased stream velocities, unstable substrates, changed patterns of sediment scour and deposition, including streambank erosion, altered transport of particulate organic matter (the food base for mussels), and a general degradation of stream habitat (Benke 1999; Yeager 1993; Nedeau 2008).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: ✓ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any "protected stream", its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York's mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Continued conservation efforts for its host fish, the lake sturgeon (*Acipenser fulvescens*), would help to possibly expand the range of *O. olivaria* back into New York. Current conservation efforts have brought breeding lake sturgeon populations back to Lake Ontario (Dittman, 2012, personal communication). Until sturgeon populations reach viable levels, the possibility of *O. olivaria* recolonizing New York is slim.

- Assess the need and opportunity for relocation/reintroduction efforts. Conduct relocation or reintroduction where adequate sources can be identified and appropriate stream conditions exist (water quality, habitat, host species etc.).

- Evidence of historic occurrence of multiple New York State extirpated mussel species exists for the Niagara River. These species include: *Epioblasma triquetra, Lampsilis teres, Lampsilis abrupta, Obovaria olivaria, Potamilus capax*, *Quadrula pustulosa*, *Quadrula quadrula, Simpsonaias ambigua, and possibly Truncilla donaciformis*. To assess the potential for future reintroduction efforts, a pilot program relocating common species to suitable sections of the Niagara River should be initiated and its results assessed to gage the possible success of reintroduction efforts for extirpated species in this waterbody.

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley & Tank 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Following any reintroduction efforts, develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

- Update wastewater treatment facilities in Buffalo to eliminate combined sewer outflows.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis 2012).

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

- Within the Great Lakes watersheds, lamprey control efforts should consider specific, potentially adverse, impacts to native freshwater mussels when determining methods, including selection of lampricide formulations and concentrations. Lampricide treatment managers should use caution when using the combination of TFM and niclosamide in streams with known mussel populations and every effort should be made to maintain lampricide concentrations at or near the MLC for sea lamprey to minimize the risk to this important faunal group (Boogaard 2006).

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g. point & nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	

Table 2. (no recommended conservation actions for hickorynut).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

- Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
First revision	February 25, 2014 (Samantha Hoff)
Latest revision	January 17, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Kidneyshell **Date Updated:** 1/16/2024

Scientific Name: *Ptychobranchus fasciolaris* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Ptychobranchus fasciolaris belongs to the subfamily Ambleminae and the tribe Lampsilini, which includes 17 extant and 6 likely extirpated New York species of the genera Actinonaias, Epioblasma, Lampsilis, Leptodea, Ligumia, Obovaria, Potamilus, Ptychobranchus, Toxolasma, Truncilla, and Villosa (Haag 2012, Graf and Cummings 2011). P. fasciolaris is grouped into the genus Ptychobranchus, named for its series of folds in the outer gills of a gravid female. The species name refers to banding pattern on the periostracum (Watters et al. 2009).

Since 1970, P. fasciolaris has been found in eight New York State waterbodies. It has recently been confirmed in multiple locations in the Allegheny basin, as well as in Lake Erie tributaries (The Nature Conservancy 2009, Mahar & Landry 2013). P. fasciolaris inhabits gravel riffles in large streams and small rivers.

Although rare and ranked as “imperiled” in New York, this edge of range species is considered apparently secure throughout its range. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993, Stein et al.2000). While population trends in New York are unknown, based on sparse historical information it is assumed that they too are declining due to a myriad of environmental stressors.

I. Status

a. Current legal protected Status

i. **Federal:** None **Candidate:** No

ii. **New York:** None, Proposed Special Concern (2019)

b. Natural Heritage Program

i. **Global:** G4G5 – Apparently Secure / Secure

ii. **New York:** S2 - Imperiled **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Near Threatened (2015)

-Northeast Regional SGCN: No (2023)

-Midwest Regional SGCN: Yes

-Canadian Species at Risk Act (SARA) Schedule 1/Annexe 1 Status: E (2005)

-Committee on the Status of Endangered Wildlife in Canada (COSEWIC): Endangered (2003)

-American Fisheries Society Status: Currently Stable (1993)

Status Discussion:

This species is found throughout the Mississippi River system, including the Ohio, Tennessee, and Cumberland Rivers. It has declined to some extent in certain places, although many sites still report large populations. In particular, significant declines have occurred in Canada, while U.S. occurrences have been more stable (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Declining	Declining			(blank)
Northeastern US	Yes	Choose an item.	Choose an item.			No
New York	Yes	Unknown	Unknown		S2	Yes
Connecticut	No	N/A	N/A			No
Massachusetts	No	N/A	N/A			No
New Jersey	No	N/A	N/A			No
Pennsylvania	Yes	Unknown	Unknown		S4	No
Vermont	No	N/A	N/A			No
Ontario	Yes	Stable	Stable	2003 - 2013	Endangered, S1	(blank)
Quebec	No	N/A	N/A			(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

As part of a State Wildlife Grant, NYSDEC Region 8 Fish and Wildlife staff conducted a native freshwater mussel baseline inventory of tributaries in central and western New York, 2009 to 2020.

Trends Discussion *(insert map of North American/regional distribution and status):*

Trends for New York populations are difficult to determine as most historic data comes from opportunistic naturalist collections, as opposed to more comprehensive baseline surveys. For example, mussels were documented for the first time in 50 of the 106 streams surveyed to date by the Southern Lake Ontario mussel inventory project (Mahar & Landry 2013). This is because many of these streams had never before been surveyed for mussels, not because mussel distribution has dramatically increased. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993; Stein et al.2000). Based on New York's Natural Heritage S-rank, sparse historical data, and the plight of North America's freshwater mussels, it is assumed that trends are declining due to a myriad of environmental stressors.

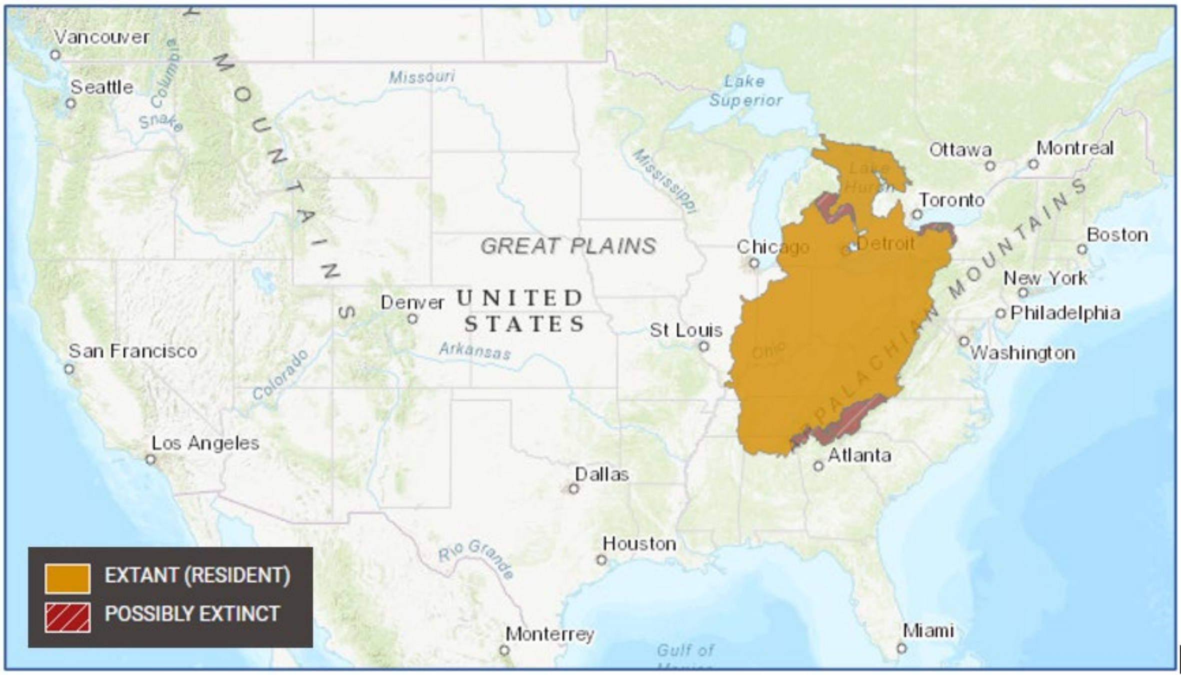

Figure 1. Kidneyshell distribution (IUCN Redlist 2024)

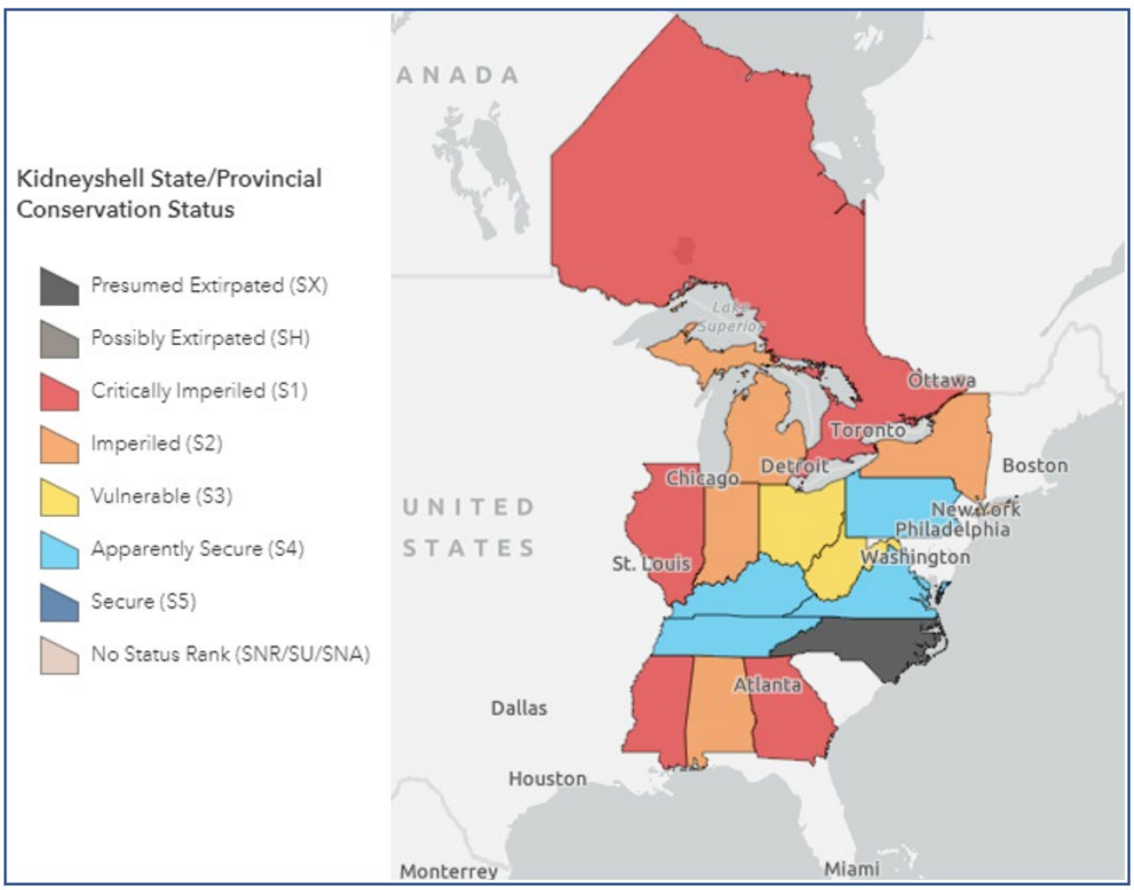

Figure 2. Kidneyshell status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

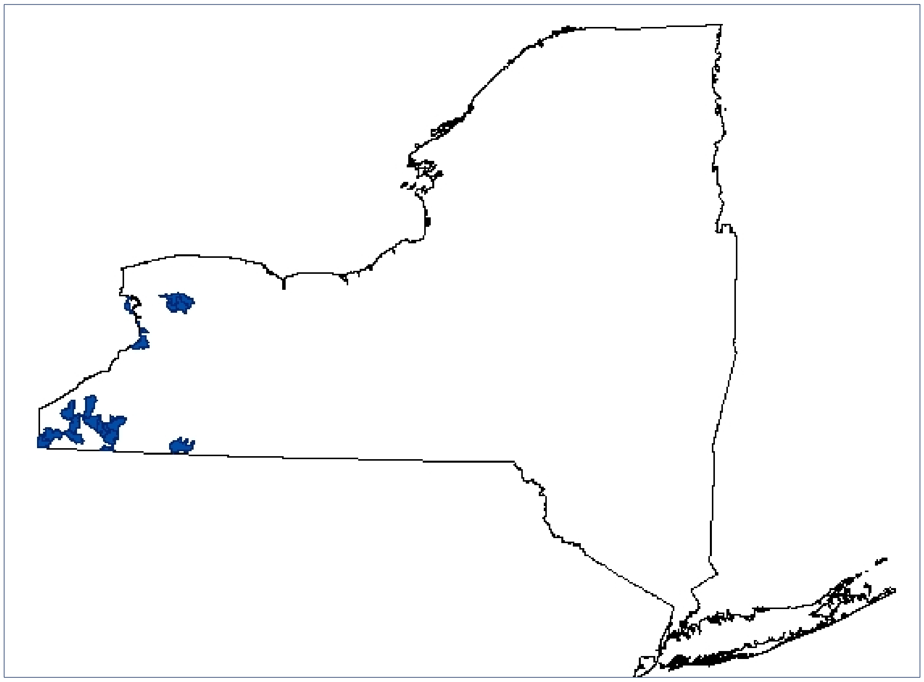

Figure 3. Records of kidneyshell in New York (NYSDEC 2022)

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	______	______	______
1995-2004	______	______	______
2005-2014	______	______	______
2015- 2023	______	12	1.0%

Table 1. Records of kidneyshell in New York.

Details of historic and current occurrence:

2024: P. fasciolaris has been found in 12 waterbodies and in 18 of 1802 HUC 12 watersheds (1.0%).

Although P. fasciolaris does not have a wide range in New York, it is often abundant where it does occur. This species reached New York via both the Allegheny River and Lake Erie. It is common and widespread in the western parts of the Allegheny basin in New York, but it seems to be missing from the eastern parts of the basin. It also occurs in Lake Erie, the Niagara River, and their tributaries. It was historically reported from Johnson Creek, Orleans County, in the Lake Ontario drainage (Strayer & Jirka 1997).

Since 1970, P.fasciolaris has been found in eight New York State waterbodies (Figure 2).

In the Allegheny watershed, 347 live P. fasciolaris were found in Conewango Creek and Cassadaga Creek, with most of the individuals found in the Cassadaga. This species was found at 16 of 105 Allegheny basin survey sites, with a mean catch of 1.65 per hour; its population was considered viable at 69% of these sites. A single unverified P. fasciolaris was reported from

Oswayo Creek (The Nature Conservancy 2009). P. fasciolaris has also been found in French Creek (Mahar & Landry 2013; New York National Heritage Program 2013) and in abundance in Chautauqua Lake at Midway Park (2008, one live), Bemus Point (1987-1990, shells), and hundreds of live, some with mature glochidia, at Long Point (1989) (New York National Heritage Program 2013).

Since 1987, P. fasciolaris has been found in the Lake Erie basin, including locations in Lake Erie (shells at Athol Springs), an unnamed tributary to Lake Erie at Mount Vernon, west of Hamburg, and the Niagara River (live at Beaver Island and shells at Buckhorn Island) (Strayer & Jirka 1997, New York National Heritage Program 2013, White et al. 2011). In addition, live P. fasciolaris has recently been confirmed in Tonawanda Creek (Mahar & Landry 2013).

Post 1970, P. fasciolaris has not been found in Johnson Creek, despite recent survey efforts (Mahar & Landry 2013).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
Choose an item.	Peripheral	340 miles

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Size/Waterbody Type: Small to Medium River

b. Geology: Moderately Buffered

c. Temperature: Transitional Cool to Warm

d. Gradient: Low to Low-Moderate Gradient

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

P. fasciolaris is a high-water-quality species (Watters et al. 2009). It is most common in large creeks and small rivers, although can be found in large rivers (Niagara River) and some lakes (Erie, Chautauqua), where it attains a much smaller size (Strayer & Jirka 1997). It may be found at depths of less than three feet up to those as great as 18 to 24 feet (Parmalee & Bogan 1998, Spoo, 2008). It is usually absent from headwater creeks less than 3 meters wide (COSEWIC 2003).

It is said to favor riffle areas with firmly-packed coarse gravel and sand substrate with moderate to swift flows, and to have an aversion to ponded or backwater conditions (COSEWIC 2003; Watters et al. 2009; Metcalfe-Smith et al. 2005; Strayer & Jirka 1997). However, there is some evidence that it occurs most frequently in low gradient streams (Strayer & Jirka 1997). Furthermore, this species is often found near beds of aquatic vegetation (Metcalfe-Smith et al. 2005).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, P. fasciolaris must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable habitat, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely to be a slow process for mussels which use resident fishes with limited home ranges as their hosts (COSEWIC, as cited in NatureServe 2013).

This species has an equilibrium life history strategy, characterized primarily by long life span, mostly short term brooding, low to moderate growth rate, and late maturity, with low reproductive effort and fecundity that increases slowly after maturation. This life history strategy is considered to be favored in stable, productive habitats (Haag 2012).

P. fasciolaris is bradytictic, with eggs appearing in August and glochidia developing by September and overwintering until the following June to August (Ortmann 1919), however in Ohio, glochidial release has been observed in April and May (Watters et al. 2009). Various darter species (Etheostoma spp.) serve as hosts for this species (Strayer & Jirka 1997). Glochidia transformations have been confirmed on brook stickleback (Culaea inconstans), rainbow darter (Etheostoma caeruleum), and fantail darter (Etheostoma flabellare). Other potential hosts may include greenside darter (Etheostoma blennioides), johnny darter (Etheostoma nigrum), and banded darter (Etheostoma zonale). Individuals of this species can commonly live for over 30 years (Watters et al. 2009).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Other Ecosystem Modifications (levees and flood walls, channelization, dredging, impassable culverts)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (zebra mussels)
4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)
5. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, other regulated discharges)
6. Pollution	Household Sewage & Urban Waste Water (waste water treatment effluent, sewer and septic overflows)
7. Climate Change & Severe Weather	Droughts
8, Natural System Modifications	Dams & Water Management/Use (lowering of water table from agriculture, etc…, causing drying of habitat)
9. Climate Change & Severe Weather	Storms & Flooding (extreme storms)
10. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (die offs from unknown disease)

Agricultural Runoff

Both French Creek watershed and Tonawanda Creek watershed are highly agricultural. And although the mid reaches of Cassadaga Creek are quite forested, both the up and downstream portions of Cassadaga Creek and Conewango Creek, in which *P. fasciolaris* have been found, are shaped by agriculture (NYS Landcover 2010). Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in western and central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar & Landry 2013), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Runoff from fertilizers is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag 2012). In addition, ammonia adsorbs to sediment particles, resulting in higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Runoff from Developed Land

All five of the streams in which this species occurs in New York are located adjacent to roads and residential structures (NYS Landcover 2010). These developed lands are likely sources of stormwater runoff containing metals and road salts. Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller & Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner & Pynnonen 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller & Zam 1991; Liquori & Insler 1985; Pandolfo et al. 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Treated and Untreated Wastewater

Populations of *F. flava* in the Niagara River, Chautauqua Lake, and Cassadaga Creek receive effluent from wastewater/sewage treatment plants either directly or through nearby tributaries (SPDES 2007). In addition, Niagara River populations are subject to input from numerous combined sewer outflows (CSOs) from the City of Buffalo ("Combined Sewer Overflow" 2012). Recent studies show that mussel richness and abundance decrease with increased proximity to sewage effluent (Wildenberg, 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al. 1978). Endocrine disrupters from pharmaceuticals are also present in municipal sewage effluents and are increasingly common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012). It should be noted that in the Susquehanna basin, Harman and Lord (2010) found no evidence that wastewater treatment plants were responsible for reductions in mussel species of greatest conservation need.

Habitat Modifications

Ecosystem modifications, such as in-stream work associated with canal dredging, bridge replacements, gravel mining, and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting "dredge" had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000).

Invasive Species

Invasive zebra and quagga mussels (*Dreissena polymorpha* and *Dreissena bugenis*) remain a threat to *P. fasciolaris* populations in Chautauqua Lake, Lake Erie, and Niagara River (iMapInvasives 2013). The invasion of zebra and quagga mussels has compromised the continued presence of many mussel populations. Native mussels have been effectively eliminated from the western basin of Lake Erie by these exotics. En masse, Dreissenids outcompete native mussels by efficiently filtering food and oxygen from the water. They reduce reproductive success by filtering native mussel male gametes from the water column and they can foul the shells of the native mussels to the point that their valves can no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury (USFWS 1994).

Impoundments – Range wide

Across its range, impoundments likely contributed to the reduced distribution that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery & King 1983, ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓_ **No:** ____ **Unknown:** ____

If yes, describe mechanism and whether adequate to protect species/habitat:

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any “protected stream”, its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York's mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Priority conservation efforts for this species should focus on, but not be limited to, Cassadaga Creek.

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley & Tank 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

- Update wastewater treatment facilities in Buffalo to eliminate combined sewer outflows.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis 2012).

- Establish a protocol whereas DEC staff work closely with state and local highway departments to reduce impacts to native mussels during maintenance and construction projects.

- Replace culverts that disrupt aquatic habitat connectivity to allow for passage of small fish species.

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g. point & nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - ***https://www.iucnredlist.org/resources/conservation-actions-classification-scheme***

Conservation Actions	
Action Category	**Action**
1.	

Table 2. (need recommended conservation actions for kidneyshell).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

- Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
First revision	February 25, 2014 (Samantha Hoff)
Latest revision	January 16, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Lance aplexa **Date Updated:**

Scientific Name: *Aplexa elongata* **Updated By:**

Class: Gastropoda

Family: Physidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

The lance aplexa occurs in a wide distribution from the District of Columbia northward to James Bay and arctic Alaska, and southward to Idaho (Jokinen 1992). This snail is found in temporary pools, ditches, ponds, and swampy meadows as well as in intermittent streams; it prefers hard water (Jokinen 1992).

Historic records exist for 16 counties across New York from 1856 to 1977, but this snail is now known from only two locations: the St. Lawrence drainage and the Hudson River drainage (Jokinen 1992). It was not detected in the Hudson Valley during surveys by Strayer (1987).

I. Status

a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Not listed

b. Natural Heritage Program

i. **Global:** G5

ii. **New York:** S2 **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List:

-Northeast Regional SGCN:

American Fisheries Society (AFS): Currently stable

Status Discussion:

Lance aplexa is thought to have been extirpated from nine watershed basins in New York (NYSDEC 2005). Jokinen (1992) noted that potential habitats were undersurveyed.

Lance aplexa is ranked as Imperiled in Connecticut, Pennsylvania, and New York. It is ranked as Secure in Ontario and Apparently Secure in Massachusetts. No rank (SNR) has been assigned across the balance of the extensive range.

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Unknown	Unknown			Choose an item.
Northeastern US	Yes	Unknown	Unknown			Choose an item.
New York	Yes	Unknown	Unknown		Not listed	Choose an item.
Connecticut	Yes	Declining	Declining		Not listed	No
Massachusetts	Yes	Stable	Stable		Not listed	No
New Jersey	Yes	Unknown	Unknown		Not listed	No
Pennsylvania	Yes	Declining	Declining		Not listed	No
Vermont	Yes	Unknown	Unknown		Not listed	No
Ontario	Yes	Stable	Stable		Not listed	Choose an item.
Quebec	Yes	Unknown	Unknown		Not listed	Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

None.

Trends Discussion *(insert map of North American/regional distribution and status):*

Jokinen (1992) notes that the lance aplexa's habitats were under-sampled during four survey periods ranging from 1978 to 1991, but it was detected in two sites. Strayer (1987) notes that numerous museum specimens indicate the presence of this snail in the lower Hudson River watershed.

Although there have been few repeated surveys of gastropods in New York that would allow a population trend analysis, Strayer (1987) was able to conclude that there has been little change in the composition of the molluscan fauna of the tidal Hudson River over the previous 100 years. Strayer (1987) also noted that even without good historical records from other parts of the Hudson basin, it was clear that human activities had devastated the mollusk fauna of some streams including the Wallkill River in Orange County and the Fishkill Creek in Dutchess County.

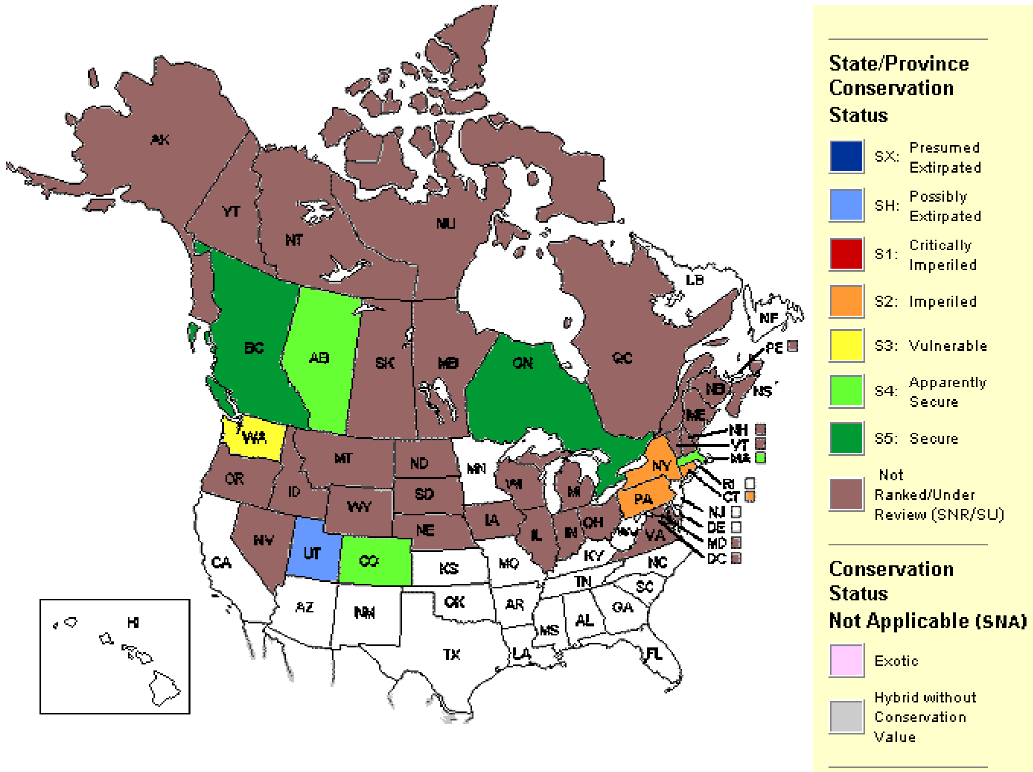

Figure 1. Conservation status of lance aplexa in North America (NatureServe 2013)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

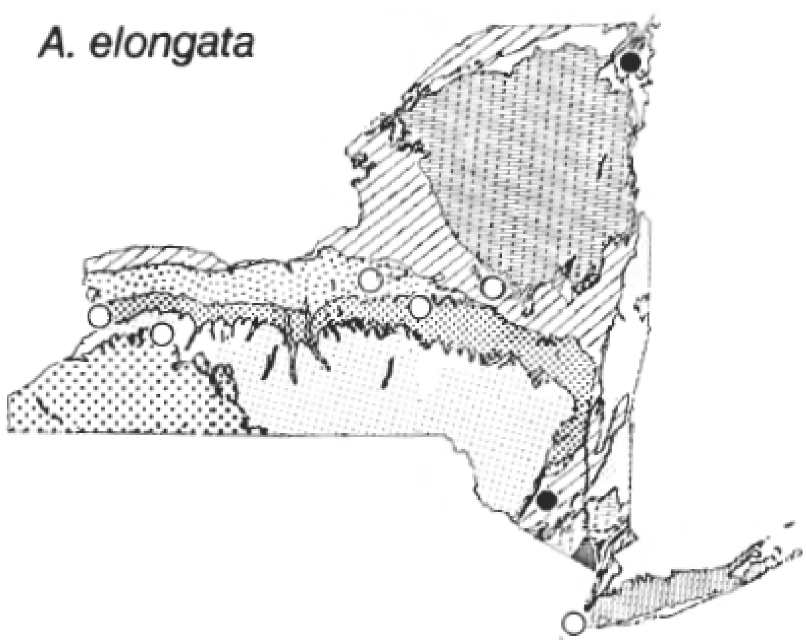

Figure 2. Records of *A. elongata* (lance aplexa) in New York. Closed circles indicate records from Jokinen (1992) surveys, open circles indicate records from museum specimens (Jokinen 1992).

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	______	______	______
1995-2004	______	______	______
2005-2014	______	______	______
2015- 2023	______	______	______

Table 1. Records of lance aplexa in New York.

Details of historic and current occurrence:

Jokinen (1992) summarized the historic occurrence (1856 to 1977) in the following counties: Albany, Cattaraugus, Cayuga, Erie, Herkimer, Jefferson, Madison, Monroe, Niagara, Onondaga, Otsego, Rensselaer, Richmond, Suffolk, Warren, and Wyoming. During four survey periods ranging from 1978 to 1991, Jokinen (1992) found lance aplexa in two locations: Dead Creek in the St. Lawrence drainage in Plattsburgh, and an unnamed stream and vernal pool in Wallkill, Hudson River drainage.

Lance aplexa is thought to have been extirpated from the following nine basins: Lake Champlain, Lake Erie, Lower Hudson – Long Island bays, NE Lake Ontario – St. Lawrence, SE Lake Ontario, Susquehanna, Upper Hudson River, and Allegheny (NYSDEC 2005). It is thought to still occur in the two locations where it was documented by Jokinen (1992) but no surveys have since been conducted.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Core	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Headwater/Creek

b. Vernal Pool

c. Ditch/Artificial Intermittent Stream

d. Intermittent Stream

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
Yes	Yes	Stable	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

Lance aplexa are most successful in shallow, temporary pools with no predators (Turner and Montgomery 2009). They are found under in dried ponds, under moist leaves, in ditches, swampy meadows, swales, intermittent streams, and less frequently, lakes and ponds. Sediments range from mud to sand but usually include decaying vegetation (see Jokinen 1992). The lance aplexa is a detritivore (Brown 1982). It typically occurs in hard water (Jokinen 1992). At 17 sites in central New York, pH values at sites occupied by lance aplexa measured 6.8 to 8.1 (Harman and Berg 1971).

Aquatic gastropods are frequently used as bioindicators because they are sensitive to water quality and habitat alteration (Callil and Junk 2001, Salanki et al. 2003).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	Choose an item.	Choose an item.	Yes	Yes	Choose an item.

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

As a species of ephemeral habitats, lance aplexa is tolerant of thermal stress and periodic drying (Burch and Jung 1992) though it cannot withstand desiccation during the summer months.

Most Gastropods belong to the clade Caenogastropoda, in which individuals mature slowly (requiring at least a year), are long-lived dioecious species with internal fertilization, and females generally attach eggs to firm substrates in late spring and early summer. Many species are narrow endemics associated with lotic habitats, often isolated in a single spring, river reach, or geographically restricted river basin (Johnson et al. 2013). In contrast, members of the clade Heterobranchia are hermaphroditic, mature quickly, and generally have shorter generation times (Johnson et al. 2013).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Residential & Commercial Development	Housing & Urban Areas (habitat loss/degradation)
2. Pollution	Industrial & Military Effluents (atomospheric deposition- mercury, acid)

3. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers)
4. Biological Resource Use	Logging & Wood Harvesting

*Any threat to vernal pools would affect this species.

Threats to lance aplexa are similar to those faced by many freshwater organisms in New York. These include loss of habitat due to water table drawdown, development, alteration of drainage and surface water flows, and change in aquatic vegetation. Threats also include use of pesticides and other chemicals either directly on habitat areas or from nonpoint source pollution. Competition from exotic species may also be a problem.

High imperilment rates among freshwater gastropods have been linked to alteration, fragmentation and destruction of habitat and introduction of non-indigenous species. Causes of habitat degradation and gastropod species loss include dams, impounded reaches, development of riparian areas, channelization, erosion, excess sedimentation, groundwater withdrawal and associated impacts on surface streams (flows, temperature, dissolved oxygen), multiple forms of pollution (salt, metals such as Cu, Hg, Zn, untreated sewage, agricultural runoff, pesticides/fertilizers), changes in aquatic vegetation, and invasion of exotic species (Johnson et al. 2013).

Strayer (1987) concluded that human activities had destroyed much of the original mollusk fauna in some parts of the Hudson basin, but not in others. Channelization of farmed mucklands and industrial pollution from Beacon were noted as causes for the notably reduced biodiversity of mollusks in the Wallkill River of Orange County and the Fishkill Creek of Dutchess County, respectively.

The New Zealand mud snail (*Potamopyrgus antipodarum*) is a highly invasive species that was introduced in Idaho in the 1980s. It can have devastating consequences to aquatic ecosystems, reducing or eliminating native snail species (Benson et al. 2013). This snail was found established in Lake Ontario in 1991 (Zaranko et al. 1997) and in Lake Erie in 2005 (Levri et al. 2007).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓_ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Environmental Conservation Law.

The Freshwater Wetlands Act provides protection for regulated wetlands greater than 12.4 acres in size under Article 24 of the NYS Conservation Law. The Adirondack Park Agency has the authority to regulate smaller wetlands within the Adirondack Park. The Army Corps of Engineers has the authority to regulate smaller wetlands in New York State, and the DEC has the authority to regulate smaller wetlands that are of unusual local importance. The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Conservation Law.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Basic biological information is lacking for most taxa of freshwater gastropods and there is a strong need for surveys and biological studies given the strong evidence of decline and extinction.

The following goals and recommended actions are provided in the NY Comprehensive Wildlife Conservation Strategy (NYSDEC 2005):

- Conduct surveys to determine distribution and population trends
- Identify habitat requirements for all life stages
- Develop specific plans for each listed species (or appropriate suite of species) that details status, threats, and actions necessary to reverse declines or maintain stable populations
- Develop fact sheets for each listed species for paper and online distribution

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2. Recommended conservation actions for lance aplexa.

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Originally prepared by	Kimberley Corwin
Date first prepared	June 20, 2013
First revision	February 20, 2014 (S. Hoff)
Latest revision	Transcribed March 2024

Species Status Assessment

Common Name: Lilliput **Date Updated:** 1/16/2024

Scientific Name: *Toxolasma parvum* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Toxolasma parvum species belongs to the subfamily Ambleminae and the tribe Lampsilini, which includes 17 extant and 6 likely extirpated New York species of the genera Actinonaias, Epioblasma, Lampsilis, Leptodea, Ligumia, Obovaria, Potamilus, Ptychobranchus, Toxolasma, Truncilla, and Villosa (Haag, 2012; Graf and Cummings, 2011).

T. parvum is known for being one of the smallest unionoid species. The name parvum refers to its small size; most individuals never grow beyond 50mm in length. T. parvum typically lives in quiet waters of low-gradient streams, rivers, and reservoirs, often in muddy bottoms (Strayer & Jirka, 1997). It has been shown to be a generalist even while being fairly rare (Pilger & Gido, 2012). Since 1970, evidence of this species has been found in six New York waterbodies. Live specimens have been recently found in the Erie Canal and the Genesee River, with shells having been recently found in the Lake Ontario and lower Genesee basins (Mahar & Landry, 2013). The New York state rank has been updated from historic to imperiled, reflecting its rarity and continued presence in the state.

In North America, approximately ⅔ to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993; Stein et al.2000). While T. parvum population trends in New York are unknown, it is assumed that they too are declining, due to a myriad of environmental stressors.

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I. Status

a. Current legal protected Status

i. **Federal:** None **Candidate:** No

ii. **New York:** None, Proposed Threatened (2019)

b. Natural Heritage Program

i. **Global:** G5 - Secure

ii. **New York:** S2 - Imperiled **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Least Concern (2012)

-Northeast Regional SGCN: No

-Committee on the Status of Endangered Wildlife in Canada (COSEWIC): Endangered (2013)
-American Fisheries Society Status: Currently Stable (1993)

Status Discussion:

This species is widespread throughout the Mississippi River basin to southern Canada. Although considered stable throughout much of its range, it is rare in Canada (only a few records from

Ontario remain). It has recently expanded its range in the south and southeastern United States (NatureServe, 2013). However, Watters et al. (2009) reported that this once widespread and abundant species is becoming rare and even extirpated in much of its range due to unknown factors.

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Unknown	Unknown			(blank)
Northeastern US	Yes	Choose an item.	Choose an item.			No
New York	Yes	Unknown	Unknown			Yes
Connecticut	No	N/A	N/A			No
Massachusetts	No	N/A	N/A			No
New Jersey	Unknown	Choose an item.	Choose an item.		Unranked	No
Pennsylvania	Yes	Choose an item.	Choose an item.		S1S2	Yes
Vermont	No	N/A	N/A			No
Ontario	Yes	Choose an item.	Choose an item.		S1	(blank)
Quebec	No	N/A	N/A			(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

As part of a State Wildlife Grant, NYSDEC Region 8 Fish and Wildlife staff conducted a native freshwater mussel baseline inventory of tributaries in central and western New York, 2009 to 2020.

Trends Discussion *(insert map of North American/regional distribution and status):*

Trends for New York populations are difficult to determine as most historic data comes from opportunistic naturalist collections, as opposed to more comprehensive baseline surveys. For example, mussels were documented for the first time in 50 of the 106 streams surveyed to date by the Southern Lake Ontario mussel inventory project (Mahar & Landry, 2013). This is because many of these streams had never before been surveyed for mussels, not because mussel distribution has dramatically increased. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993; Stein et al.2000). Based on New York's Natural Heritage S-rank, sparse historical data, and the plight of North America's freshwater mussels, it is assumed that trends are declining due to a myriad of environmental stressors.

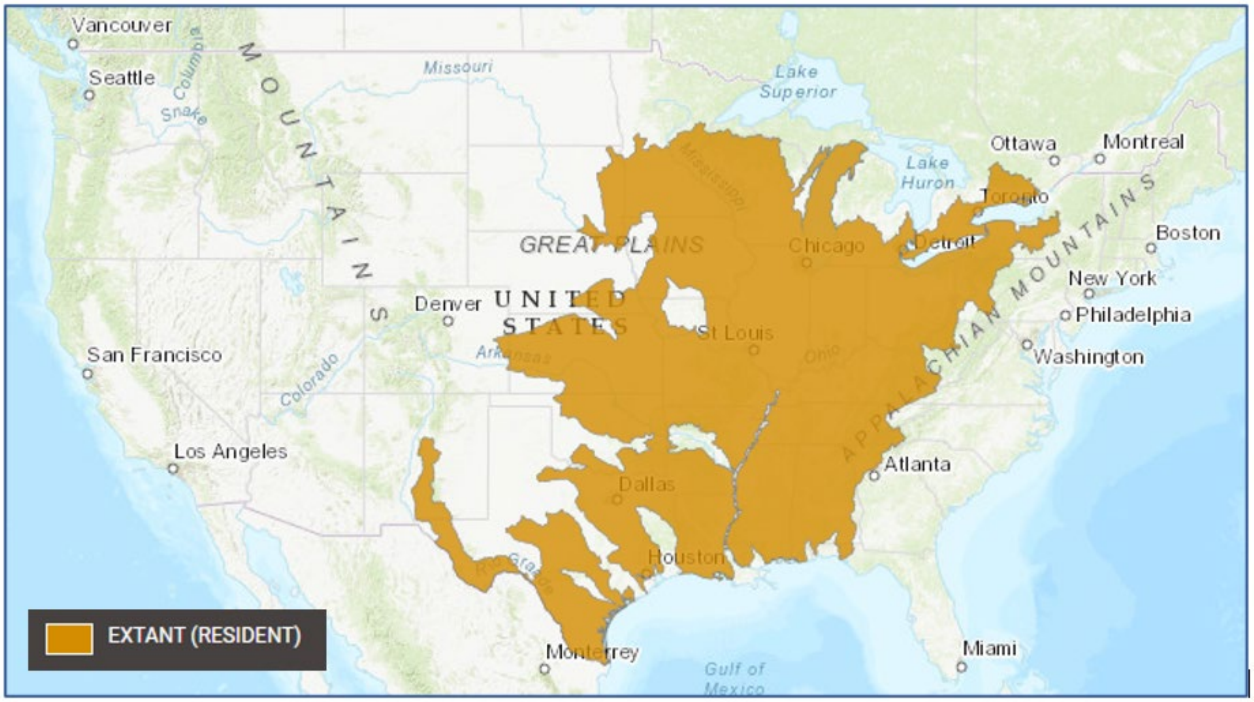

Figure 1. Lilliput distribution (IUCN Redlist 2024)

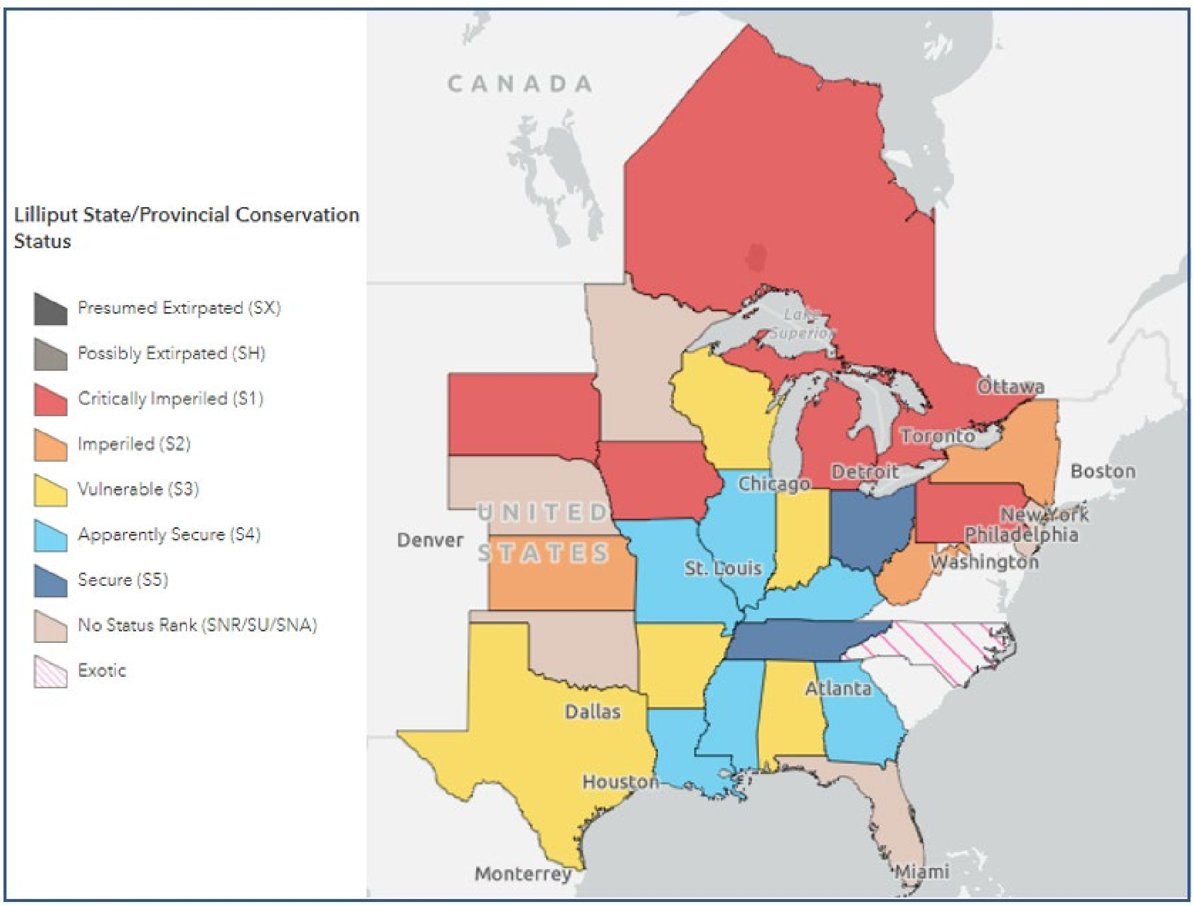

Figure 2. Lilliput status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

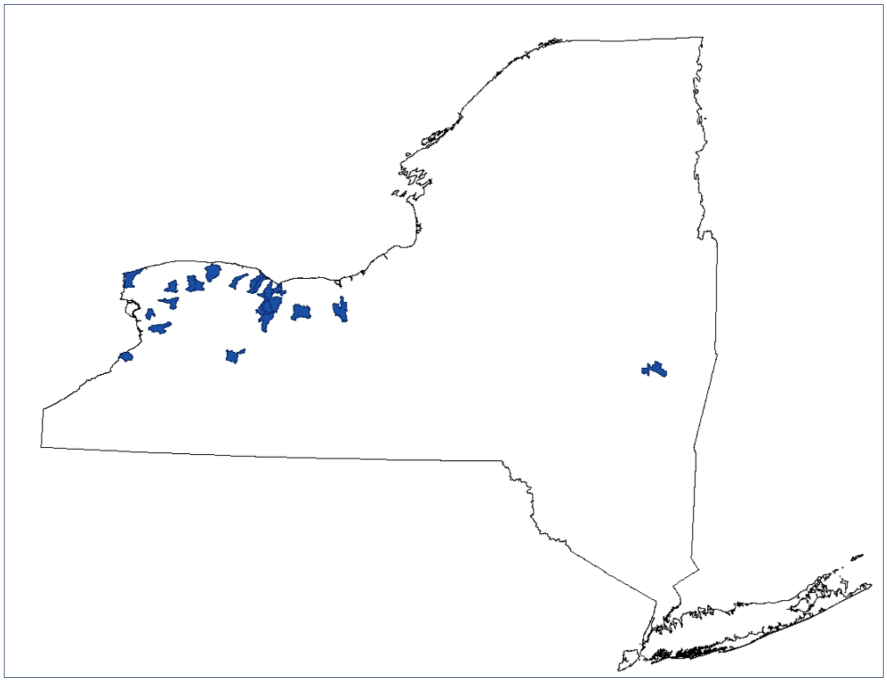

Figure 3. Records of Lilliput in New York (NYSDEC 2023)

Years	# of Records	# of Distinct Waterbodies	% of State
	______	______	______
	______	______	______
	______	______	______
Total	______	13	1.2%

Table 1. Records of Lilliput in New York.

Details of historic and current occurrence:

2024: T. parvum has been found in 13 waterbodies and 22 of 1802 HUC 12 watersheds (1.2%).

Historic records for T. parvum in New York include the Erie Canal (at Buffalo, Pittsford, and 2 km west to Macedon), Ives Ice Pond (in Tonawanda, Erie County), Genesee Canal (Monroe County), Seneca River, Syracuse, and Old Erie Canal (Onondaga County). Apparently this species followed the Erie Canal eastward into central New York (Strayer & Jirka, 1997).

T. parvum was found live in the Genesee River at Mt. Morris, and in the Erie Canal in Palmyra and at Lock 30 (Macedon, Wayne Co.). Fresh shells have been found in the West Lake Ontario basin (Fourmile Creek, Niagara County), the Mid Lake Ontario basin (Red Creek and Allen Creek, both in Monroe County), and the Lower Genesee basin (Honeoye Creek, a tributary to the Genesee River). In addition, 55 lilliput shells were found in the Erie Canal at eleven locations between the Royalton, Niagara County and Lyons, Wayne County, with 27 of those shells found in Brockport, Monroe County (Mahar & Landry, 2013).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	900 miles

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. **Size/Waterbody Type:** Headwater/Creek to Medium River

b. **Geology:** Moderately Buffered

c. **Temperature:** Transitional Cool to Warm

d. **Gradient:** Low to Moderate-High Gradient

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

T. parvum can be found in the shallows of lakes, ponds, and reservoirs, as well as in low gradient, quiet waters of creeks, and small to large rivers, where it lives in soft substrate of mud, sand, or fine gravel (Cummings & Mayer, 1992, Metcalfe-Smith et al., 2005; McMurray et al., 2012; Parmalee & Bogan, 1998; Strayer & Jirka, 1997). In large rivers and wetlands, it can be found in backwater areas with little current. In New York, T. parvum is most common in the muddy substrate of low gradient canals and creeks (Mahar & Landry, 2013). T. parvum is considered a generalist (Pilger & Gido, 2012, NatureServe, 2013).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, T. parvum must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable habitat, they will burrow into the substrate, where they may remain for several years (Watters et al., 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely to be a slow process for mussels which use resident fishes with limited home ranges as their hosts (COSEWIC as sited in NatureServe, 2013).

It has an opportunistic life history strategy. This strategy is often characterized by short life span, early maturity, high fecundity achieved soon after maturation, and, to a lesser extent, moderate to large body size. Species in this group have the fastest growth rates and highest reproductive effort. Nearly all opportunistic species are long-term brooders. This life history strategy is considered an adaptation for rapid colonization and persistence in disturbed and unstable but productive habitats (Haag, 2012).

While T. parvum is a short lived species, with most individuals less than five years old, exceptional specimens may reach up to 12 years in age. Some, but not all, populations of this species are thought to consist of hermaphrodites, although the sexuality of New York's specimens has not been investigated (Strayer & Jirka, 1997; Watters et al., 2009). Hermaphroditism affords benefits when population densities are low; under such conditions, females may switch to self-fertilization to ensure that recruitment continues. This species is bradytictic, with eggs present in June and August and glochidia persisting to the following July (Watters et al., 2009).

Various centrarchids serve as hosts (Strayer & Jirka, 1997). Glochidial transformation has been documented on johnny darter (Etheostoma nigrum) and green sunfish (Lepomis cyanellus). Additional possible hosts include warmouth (Lepomis gulosus), orangespotted sunfish (Lepomis humilis), bluegill (Lepomis macrochirus), and white crappie (Pomoxis annularis) (Watters et al., 2009).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Other Ecosystem Modifications (levees and flood walls, channelization, dredging, culverts)

3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (zebra mussels, rusty crayfish)
4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)
5. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, other regulated discharges)
6. Pollution	Household Sewage & Urban Waste Water (waste water treatment effluent, sewer and septic overflows)
7. Climate Change & Severe Weather	Droughts
8. Natural System Modifications	Dams & Water Management/Use (lowering of water table from agriculture, etc…, causing drying of habitat)
9. Climate Change & Severe Weather	Storms & Flooding (extreme storms)
10. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (die offs from unknown disease)

Watters et al. reports that this once widespread and abundant species is becoming rare and even extirpated in much of its range due to unknown factors (2009).

Agricultural Runoff
Several waterbodies in which *T. parvum* has been found, including the Genesee River, Honeoye Creek, Fourmile Creek, and the Erie Canal, flow through heavily agricultural areas and are likely impacted by associated siltation, pesticide and nutrient loading. Fourmile Creek flows through a golf course 1.5 miles downstream from the site where multiple lilliput shells were found (New York State Landcover, 2010). Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis, 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in Western and Central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar & Landry, 2013), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag, 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag, 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al., 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman, 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag, 2012).

Fertilizer runoff is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag, 2012). In addition, ammonia adsorbs to sediment particles, resulting in higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom, 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al., 2012).

Runoff from Developed Land

All six of New York water bodies that host *T. parvum* populations are intermittently bordered by interstate highways, state routes, and/or local roads and lawns, and receive runoff containing metals and road salts from these sources (Gillis, 2012). In addition, Allen Creek and Red Creek, located in Rochester's heavily urbanized area, and the Erie Canal and reaches of the Genesee River, which flow through various municipalities from Mt. Morris to Rochester, receive urban storm water runoff (New York State Landcover, 2010). Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller & Zam, 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner & Pynnonen, 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al., 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller & Zam 1991; Liqouri & Insler 1985; Pandolfo et al., 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al., 2012).

Treated Wastewater

The habitats of *T. parvum* on the Genesee River and Honeoye Creek receive treated effluent from sewage treatment plants (SPDES, 2007). Recent studies show that mussel richness and abundance decrease with increased proximity to sewage effluent (Wildenberg, 2012). The input of biomaterial from waste water treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al*.,* 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al*.,* 1978). Endocrine disrupters from pharmaceuticals are also present in municipal sewage effluents and are increasing common in rivers and lakes (Haag, 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag, 2012). It should be noted that in the Susquehanna basin, Harman and Lord (2010) found no evidence that wastewater treatment plants were responsible for reductions in mussel species of greatest conservation need.

Habitat Modifications

Ecosystem modifications, such as in-stream work associated with, canal dredging bridge replacements, gravel mining, and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge, 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting "dredge" had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy, 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge, 2000).

Erie Canal Specific
Based on the number of fresh shells found, it is thought that the majority of New York's *T. parvum* populations reside in the Erie Canal system. Threats present in the Erie Canal include maintenance dredging by the NY Canal Corporation and seasonal water draw downs. Seasonal draw downs of water bodies have been shown to impact unionid age distributions (Richardson et al. 2002) and it is likely that the Erie Canal water draw downs have negative impacts on *T.parvum* populations. During spring mussel surveys of the Erie Canal, it is not uncommon to find hundreds of fresh shells of multiple species, including *T. parvum,* and multiple age classes, many containing desiccating flesh along the exposed canal banks and bed (Mahar & Landry, 2013). This antidotal evidence suggests seasonal draw downs have a large impact on these populations.
In addition, invasive zebra and quagga mussels (*Dreissena polymorpha* and *Dreissena bugenis*) have been repeatedly cited as a threat to native mussel populations (Strayer & Jirka, 1997, Watters et al., 2009). En masse, Dreissenids out compete native mussels by efficiently filtering food and oxygen from the water. They reduce reproductive success by filtering native mussel male gametes from the water column and they can foul the shells of the native mussels to the point that their valves can no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury (USFWS, 1994).

Impoundments – Range wide
Across its range, impoundments likely contributed to the reduced distribution of mussels that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery & King 1983; ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓_ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any "protected stream", its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussels habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York's mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c)of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Priority conservation efforts for this species should focus on, but not be limited to, the Erie Canal, especially between Brockport and Palmyra, Fourmile Creek, and the Genesee River, downstream of Mt. Morris (Mahar & Landry, 2013).

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley & Tank, 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

- Enforce No Discharge Zone, and promote the proper discharge of sewage by recreational boaters on the Erie Canal.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to unionids at multiple life stages, and therefore needs to be addressed (Gillis, 2012).

- Establish a protocol whereas DEC staff work closely with state and local highway departments to reduce impacts to native mussels during maintenance and construction projects.

- Replace culverts that disrupt aquatic habitat connectivity to allow for passage of small fish species.

- Within the Great Lakes and Champlain watersheds, lamprey control efforts should consider specific, potentially adverse, impacts to native freshwater mussels when determining methods, including selection of lampricide formulations and concentrations.

Lampricide treatment managers should use caution when using the combination of TFM and niclosamide in streams with known mussel populations and every effort should be made to maintain lampricide concentrations at or near the MLC for sea lamprey to minimize the risk to this important faunal group (Boogaard, 2006).

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g. point & nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	

Table 2. (need recommended conservation actions for Lilliput).

The Comprehensive Wildlife Conservation Strategy (NYSDEC, 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

- Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
First revision	February 25, 2014 (Samantha Hoff)
Latest revision	January 16, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Mapleleaf **Date Updated:** 1/17/2024

Scientific Name: *Quadrula quadrula* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Quadrula quadrula has not been found in New York in almost 80 years (Strayer & Jirka 1997) and is thought to be extirpated in the state.

Q. quadrula species belongs to the subfamily Ambleminae and the tribe Quadrulini, which includes two likely extirpated New York species of genus Quadrula (Haag 2012, Graf and Cummings 2011). The species quadrula is named for its distinct square shape, unlike any other native species. (NatureServe 2013). Q. quadrula is found in the entire Mississippi River system and in the Great Lakes drainages (Watters et al. 2009). This species is ranked by The Natural Heritage Program as historic in New York and secure throughout its range.

I. Status

a. Current legal protected Status

i. Federal: None **Candidate:** No

ii. New York: None

b. Natural Heritage Program

i. Global: G5 - Secure

ii. New York: SH - Historic **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Least Concern (2015)

-Northeast Regional SGCN: None (2023)

- Committee on the Status of Endangered Wildlife in Canada (COSEWIC): The Saskatchewan - Nelson Rivers population is designated Threatened, the Great Lakes - Upper St. Lawrence population is designated Special Concern

- American Fisheries Society Status: Currently Stable (1993)

Status Discussion:

Distribution includes the entire Mississippi River drainage; various localities in the St. Lawrence basin; the Red River of the North; southwest into eastern Texas; and southeast to Louisiana and the species is secure throughout its range with some declines in the Canadian portions recently. (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable			(blank)
Northeastern US	Yes	Choose an item.	Choose an item.			No
New York	Unknown	Extirpated	Extirpated		SH	No
Connecticut	No	N/A	N/A			No
Massachusetts	No	N/A	N/A			No
New Jersey	No	N/A	N/A			No
Pennsylvania	Yes	Unknown	Unknown		SNR	No
Vermont	No	N/A	N/A			No
Ontario	Yes	Stable	Stable	2003-2013	Special Concern, S2	(blank)
Quebec	No	N/A	N/A			(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

As part of a 2009 to 2020 State Wildlife Grant funded project, NYSDEC Region 8 Fish and Wildlife staff conducted a native freshwater mussel baseline inventory of tributaries in central and western New York where this species might be found. No regular surveys are being conducted for this species at this time. Regulatory surveys may be conducted in known or likely habitat as part of the project review process.

Trends Discussion *(insert map of North American/regional distribution and status):*

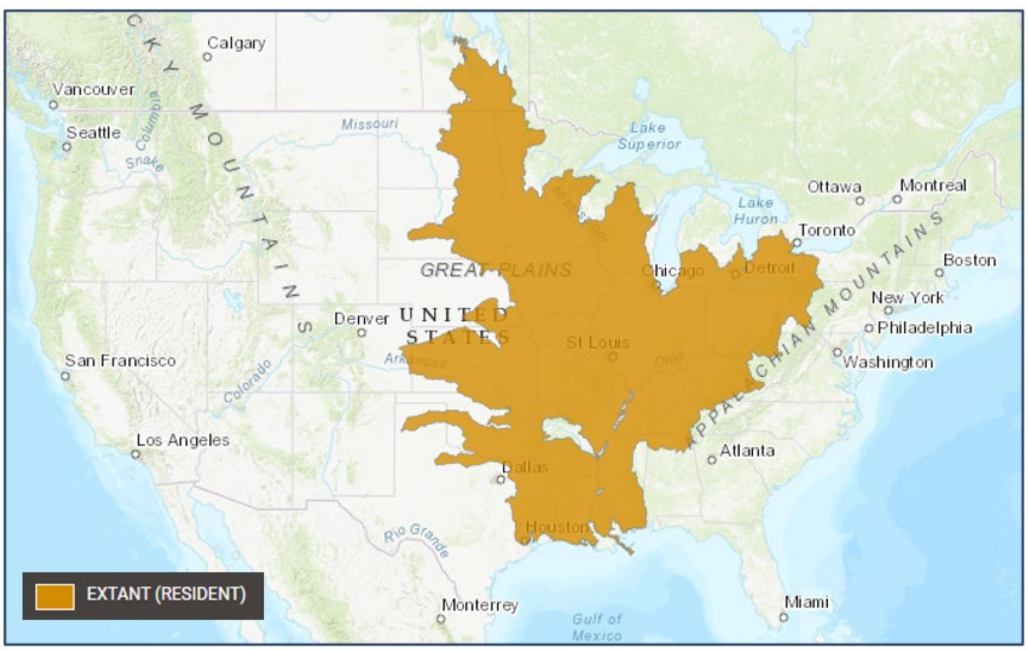

Figure 1. Mapleleaf distribution (IUCN Redlist 2024)

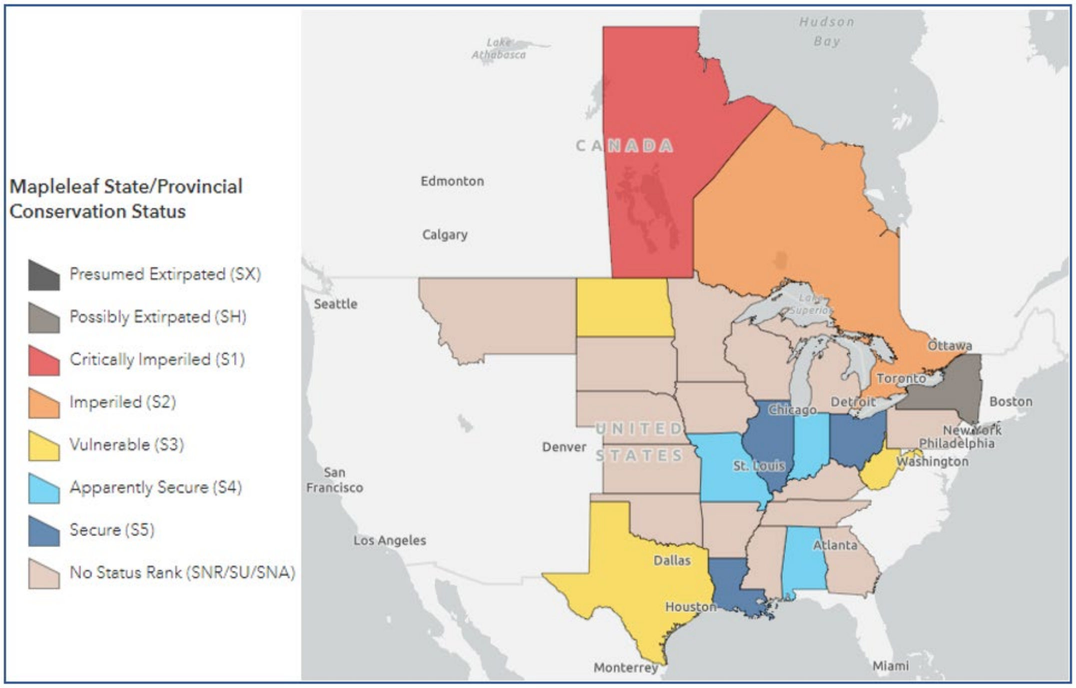

Figure 2. Mapleleaf distribution and status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	3	1	1 of 56 HUC 8 watersheds
1995-2004	0	0	0
2005-2014	0	0	0
2015- 2023	0	0	0

Table 1. Records of mapleleaf in New York.

Details of historic and current occurrence:

Between 1917 and 1934 three specimens of Q. quadrula were taken from the Niagara River (Strayer and Jirka 1997).

Although this species has not been found in New York in almost 80 years, Strayer and Jirka (1997) suggest that it may still occur in Lake Erie, the Niagara River, or their larger tributaries (Strayer & Jirka 1997, Mahar and Landry 2013, NY Natural Heritage Program 2013, The Nature Conservancy 2009, Harman and Lord 2010, White et al. 2011, NatureServe 2013).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
0%	Peripheral	1,000 miles

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Size/Waterbody Type:

b. Geology:

c. Temperature:

d. Gradient:

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Unknown	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

Q. quadrula is found medium-sized to large rivers and reservoirs (at 15-18 feet), and also lives in Lake Erie (Strayer and Jirka 1997, Metcalfe-Smith et al. 2005, McMurray et al. 2012, Cummings and Mayer 1992, Watters et al. 2009, Williams et al. 2008, Parmalee and Bogan 1998). It occurs in still or flowing water in a variety of substrates ranging from mud and sand to gravel and cobble (Williams et al. 2008, Watters et al. 2009, Cummings and Mayer 1992, Parmalee and Bogan 1998, McMurray et al. 2012, Metcalfe-Smith et al. 2005).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Unknown	No	No	Unknown	Unknown	(blank)

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, this species must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable substrate, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely to be a slow process for mussels which use resident fishes with limited home ranges as their hosts (COSEWIC as cited in NatureServe 2013).

This species is tachytictic, with glochidia developing from July and August and being released by late August. Glochidial metamorphosis has only been confirmed on channel catfish (Ictalurus punctatus), while infestation has been observed on flathead catfish (Pylodictus olivaris) (Watters et al. 2009). Specimens may reach ages up to 20 years old (Watters et al. 2009).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats within New York are irrelevant considering live *Q. quadrula h*as not been observed in almost 80 years. However, threats do exist that would restrict the re-colonizing of New York habitats.

General threats to mussels that are likely relevant range wide:

Impoundments – Range wide
Range wide, impoundments likely contributed to the reduced distribution of mussels that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range. Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery & King 1983; ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Agricultural Runoff
Aquatic habitats lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in Western and Central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along

known mussel streams (Mahar & Landry 2013), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer runoff is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag 2012). In addition, ammonia adsorbs to sediment particles, resulting higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Treated and Untreated Wastewater

Recent studies show that mussel richness and abundance decreases with increased proximity to sewage effluent (Wildenberg 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al. 1978). Endocrine disrupters from pharmaceuticals also originate from municipal sewage effluents and are increasing common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012).

Runoff from Developed Land

Developed lands are likely sources runoff containing metals and road salts.
Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller & Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner & Pynnonen 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller & Zam 1991; Liquori & Insler 1985; Pandolfo et al. 2012). Based on these studies, the U.S. EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Invasive Species

Invasive zebra and quagga mussels (*Dreissena polymorpha* and *Dreissena bugenis*) have been repeatedly cited as a threat to native mussel populations (Strayer & Jirka 1997; Watters et al. 2009). En masse, Dreissenids outcompete native mussels by removing food and oxygen from the water. They can also reduce reproductive success by filtering native mussel male gametes from the water column. They can foul the shells of the native mussels to the point that their valves can no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury (USFWS 1994). In addition, ammonia from Asian clam die offs has been shown to be capable of exceeding acute effect levels of some mussel species (Cherry et al. 2005). Didymo (*Didymosphenia geminata*), a filamentous diatom, can form extensive mats that can smother stream bottom and occlude habitat for mussels (Spaulding & Elwell 2007).

Climate Change
Global climate change is expected (among other disruptions) to cause an increase in surface water temperatures. Although many species are tolerant of warm water, higher water temperatures may be an added stress for some. Increased water temperatures may also increase algal growth, which could result in reductions in dissolved oxygen levels at night (Morris & Burridge 2006). Galbraith et al. (2010) recently showed how regional climate patterns coupled with changing local water regimes and management strategies have shifted mussel populations from thermally sensitive species to thermally tolerant species.

In addition, warmer stream temperatures due to the combined effects of land use, such as removal of shaded buffers, and climate change may contribute to the loss of coldwater fisheries and *mussel* populations in some watersheds (Nedeau 2008). Temperature induced changes in fish communities could have a profound influence on the availability of hosts for freshwater mussels. Mussels that inhabit small streams and rivers and rely on fish adapted for cooler water might be most affected by climate change (Nedeau 2008).

Habitat Modifications
Ecosystem modifications, such as in-stream work associated with canal, navigational channel, or flood control dredging, bridge replacements, gravel mining, and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting “dredge” had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000). Seasonal draw downs of water bodies have been shown to impact unionid age distributions (Richardson et al. 2002).

Levees and flood walls confine larger rivers, preventing the river from inundating its natural floodplains and wetlands to minimize flood damage. Additionally, many smaller streams have been channelized and bermed by landowners and highway departments to protect farm fields and other structures. Channelization and dredging associated with flood control projects are catastrophic to mussels and have been implicated in the decline of some populations (Watters et al. 2009). The result of these projects is altered seasonality of flow and temperature regimes, increased stream velocities, unstable substrates, changed patterns of sediment scour and deposition, including streambank erosion, altered transport of particulate organic matter (the food base for mussels), and a general degradation of stream habitat (Benke 1999; Yeager 1993; Nedeau 2008).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓_ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any “protected stream”, its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussel habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York’s mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c) of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Assess the need and opportunity for relocation/reintroduction efforts. Conduct relocation or reintroduction efforts in the Lake Ontario basin where adequate sources can be identified and appropriate stream conditions exist (water quality, habitat, host species etc).

- Evidence of historic occurrence of multiple New York State extirpated mussel species exists for the Niagara River. These species include: *Epioblasma triquetra, Lampsilis teres, Lampsilis abrupta, Obovaria olivaria, Potamilus capax*, *Quadrula pustulosa*, *Quadrula quadrula, Simpsonaias ambigua, and possibly Truncilla donaciformis*. To assess the potential for future reintroduction efforts, a pilot program relocating common species to suitable sections of the Niagara River should be initiated and its results assessed to gage the possible success of reintroduction efforts for extirpated species in this waterbody.

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley & Tank 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Following any reintroduction efforts, develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

- Update wastewater treatment facilities in Buffalo to eliminate combined sewer outflows.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis 2012).

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

- Within the Great Lakes watersheds, lamprey control efforts should consider specific, potentially adverse, impacts to native freshwater mussels when determining methods, including selection of lampricide formulations and concentrations. Lampricide treatment managers should use caution when using the combination of TFM and niclosamide in streams with known mussel populations and every effort should be made to maintain lampricide concentrations at or near the MLC for sea lamprey to minimize the risk to this important faunal group (Boogaard 2006).

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g. point & nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) -
https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	

Table 2. (no recommended conservation actions for mapleleaf).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

- Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

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Originally prepared by	Amy Mahar and Jenny Landry
Date first prepared	June 2013
First revision	
Latest revision	January 16, 2024 (Amy Mahar)

Species Status Assessment

Common Name: Mossy valvata **Date Updated:**

Scientific Name: *Valvata sincera* **Updated By:**

Class: Gastropoda

Family: Valvatidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

The mossy valvata, also known as the boreal turret snail, is a northern species. It is found from the Arctic Circle southward to Connecticut and westward to Minnesota (see Jokinen 1992); New York is at the southern extent of its range. The mossy valvata lives in cold water and is limited to lakes and large streams, in which it can live at considerable depths; it is associated with submerged aquatic vegetation (Clarke 1981). Mossy valvata occurs at four known locations in the St. Lawrence River watershed (Jokinen 1992); new locations were documented in 2012 and 2013 in Oneida Lake and Cayuga Lake.

I. Status

a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Special Concern; SGCN

b. Natural Heritage Program

i. **Global:** G5

ii. **New York:** S1 **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Least Concern

-Northeast Regional SGCN:

-American Fisheries Society (AFS): Currently stable

Status Discussion:

Cordeiro and Perez (2011) call the North American distribution of mossy valvata “widespread and abundant.” This snail’s current presence in southern New England and New York is likely a relict of a broader Holocene distribution (Smith 1987, Strayer 1987). Mossy valvata is common within its distribution in Oneida, Erie and Cayuga Lakes (Expert meeting). It is listed as a SGCN in Vermont. Kart et al. (2005) note that the freshwater snails group in the Vermont State Wildlife Action Plan, which includes mossy valvata, range from extirpated to declining to rare. There are three records in Vermont, all in the Lake Champlain Valley (Kart et al. 2005).

Mossy valvata is listed as endangered in Massachusetts where it is considered to be locally rare and possible extirpated. Recent surveys did not detect mossy valvata at historical sites (McLain 2003 *in* Massachusetts Division of Fisheries and Wildlife 2005).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable			Choose an item.
Northeastern US	Yes	Declining	Declining			Choose an item.
New York	Yes	Unknown	Unknown		SC	Yes
Connecticut	Yes	Declining	Declining		SC	Yes
Massachusetts	Yes	Declining	Declining	Since 1980	Endangered	Yes
New Jersey	No	Choose an item.	Choose an item.			Choose an item.
Pennsylvania	Yes	Unknown	Unknown		Not listed	No
Vermont	Yes	Declining	Declining		Not listed	Yes
Ontario	Yes	Stable	Stable		Not listed	Choose an item.
Quebec	Yes	Unknown	Unknown		Not listed	Choose an item.

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

None.

Trends Discussion *(insert map of North American/regional distribution and status):*

Strayer (1987) notes that although only a few records of mossy valvata exist for the Hudson basin, the presence of the species in postglacial deposits suggest that it may have been more widespread in the basin historically.

Two sites in the Hudson basin that were visited during three survey periods from the late 1800s through 1985, had mossy valvata during the more recent surveys (1973 to 1985) and not during the earlier surveys (Strayer 1987).

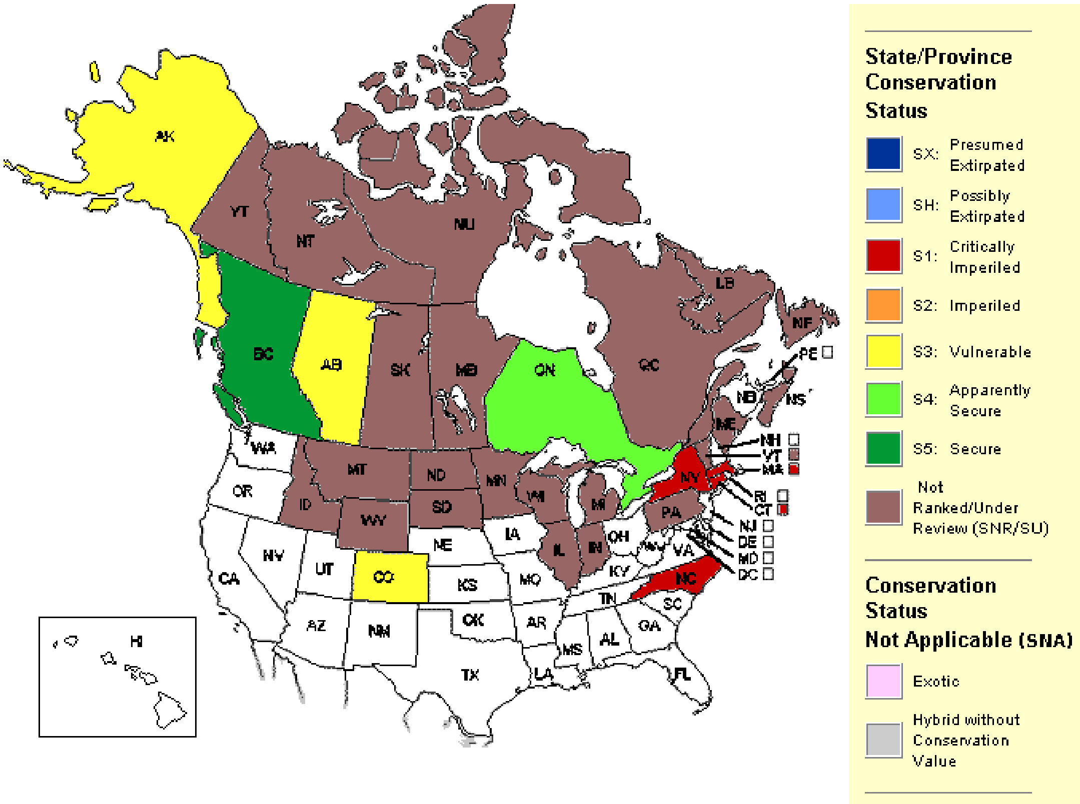

Figure 1. Conservation status of mossy valvata in North America (NatureServe 2013).

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

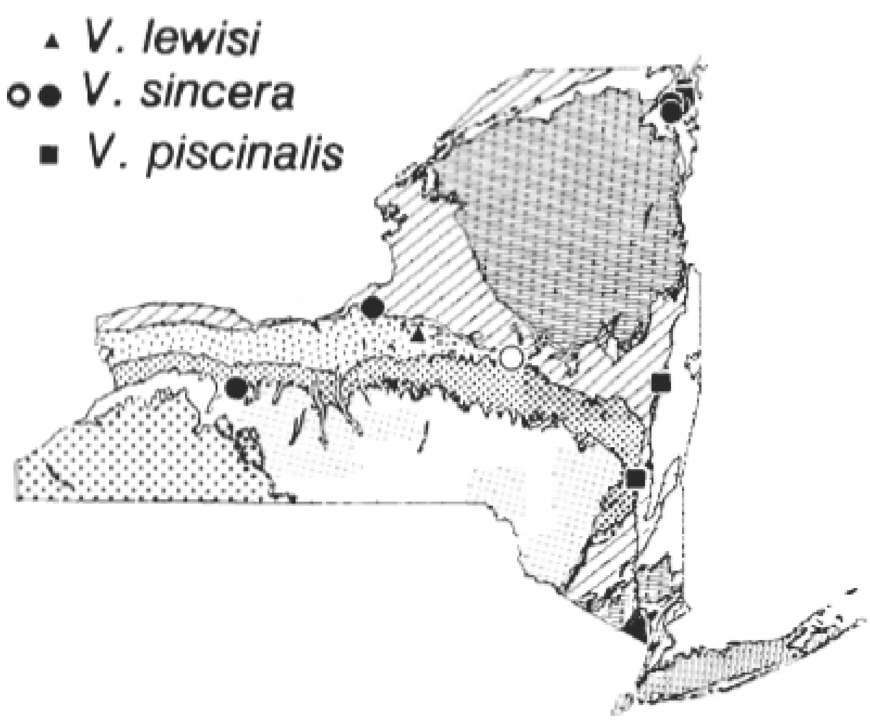

Figure 2. Records of *V. sincera* (mossy valvata) in New York. Closed circles indicate records from Jokinen (1992) surveys, open circles indicate records from museum specimens (Jokinen 1992).

Years	# of Records	# of Distinct Waterbodies	% of State
Pre-1995	_______	_______	_______
1995-2004	_______	_______	_______
2005-2014	_______	_______	_______
2015- 2023	_______	_______	_______

Table 1. Records of mossy valvata in New York.

Details of historic and current occurrence:

Jokinen (1992) provides details on historic records occurring in the following counties: Cayuga, Chautauqua, Clinton, Dutchess, Greene, Herkimer, Monroe, Onondaga, Otsego, Wayne.
During four survey periods ranging from 1978 to 1991, Jokinen (1992) recorded living mossy valvata at four locations, all within the St. Lawrence River watershed: two locations in Dead Creek, a tributary of Lake Champlain; Lake Champlain; and the Oswego River. Shells were found at one additional site—Conesus Lake in Livingston County—but no living individuals were located.

In June of 2012 Alexander Karatayev, Vadim Karatayev, and Lyubov Burlakova found 105 individuals in 11 locations in Oneida Lake. In September of 2013 Alexander Karatayev and Lyubov Burlakova found 2 individuals in 2 locations in Cayuga Lake (A. Karatayev, personal communication).

The mossy valvata is common within its distribution in Oneida, Erie and Cayuga Lakes.

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. Summer-stratified Monomictic Lake

b. Winter-stratified Monomictic Lake

c. Headwater/Creek

d. Large/Great River

Habitat or Community Type Trend in New York

Habitat Specialist?	Indicator Species?	Habitat/ Community Trend	Time frame of Decline/Increase
No	Yes	Stable	

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

This is a northern, cold water species that is typically associated with submerged aquatic vegetation (Clarke 1981). In southern New England and New York, mossy valvata is limited primarily to large lakes and rivers, though in Canada it is also found in muskeg pools (Clarke 1981). Of the five known sites in New York, one is a river, three are lakes, and the last is a marshy creek that feeds into Lake Champlain (Jokinen 1992). Habitats are typically high calcium, and pH ranges from 6.9 to 7.4 in the five sites sampled by Jokinen (1992). Habitats in Connecticut and New York are eutrophic (Jokinen 1992) but this snail is generally limited to oligotrophic and mesotrophic situations (Kart et al. 2005).

Aquatic gastropods are frequently used as bioindicators because they are sensitive to water quality and habitat alteration (Callil and Junk 2001, Salanki et al. 2003).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	Choose an item.	Choose an item.	Yes	Yes	Choose an item.

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Mossy valvata has an annual life cycle and individuals are hermaphroditic. Adults are present only in the summer. Egg capsules containing 2 to 6 eggs are attached to aquatic plants (Lang and Dronen 1970). Newly hatched individuals lay eggs during the following season and then die.

Both perch (*Perca flavescens*) and whitefish (*Coregonus clupeaformis*) feed on mossy valvata (Goodrich 1932, Clarke 1981).

Most Gastropods belong to the clade Caenogastropoda, in which individuals mature slowly (requiring at least a year), are long-lived dioecious species with internal fertilization, and females generally attach eggs to firm substrates in late spring and early summer. Many species are narrow endemics associated with lotic habitats, often isolated in a single spring, river reach, or geographically restricted river basin (Johnson et al. 2013). In contrast, members of the clade Heterobranchia are hermaphroditic, mature quickly, and generally have shorter generation times (Johnson et al. 2013).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Residential & Commercial Development	Housing & Urban Areas (habitat loss/degradation)
2. Natural System Modifications	Dams & Water Management/Use (channelization)
3. Pollution	Industrial & Military Effluents (metals)

4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers)
5. Climate Change & Severe Weather	Habitat Shifting & Alteration

Insufficient information to assess threats. Recognize any threats that cause water quality decline in large waterbodies could threaten this species in NY.

Jokinen (1992) notes that Conesus Lake (Livingston County), which was used as a reservoir for the Genesee Valley Canal, was subject to repeated drawdowns, and this could have destroyed the valvatids there. In Massachusetts, shoreline development, water level drawdowns, lake draining, increased nutrient input, and herbicides have been cited as threats to mossy valvata. The resulting loss in water clarity can prevent the growth of rooted aquatic vegetation in deeper waters, which may be essential for the survival of mossy valvata (Massachusetts Division of Fisheries and Wildlife 2005).

High imperilment rates among freshwater gastropods have been linked to alteration, fragmentation and destruction of habitat and introduction of non-indigenous species. Causes of habitat degradation and gastropod species loss include dams, impounded reaches, development of riparian areas, channelization, erosion, excess sedimentation, groundwater withdrawal and associated impacts on surface streams (flows, temperature, dissolved oxygen), multiple forms of pollution (salt, metals such as Cu, Hg, Zn, untreated sewage, agricultural runoff, pesticides/fertilizers), changes in aquatic vegetation, and invasion of exotic species (Johnson et al. 2013).

The New Zealand mud snail (*Potamopyrgus antipodarum*) is a highly invasive species that was introduced in Idaho in the 1980s. It can have devastating consequences to aquatic ecosystems, reducing or eliminating native snail species (Benson et al. 2013). This snail was found established in Lake Ontario in 1991 (Zaranko et al. 1997) and in Lake Erie in 2005 (Levri et al. 2007).

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓__ **No:**_____ **Unknown:**_____

If yes, describe mechanism and whether adequate to protect species/habitat:

The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Environmental Conservation Law.

The Freshwater Wetlands Act provides protection for regulated wetlands greater than 12.4 acres in size under Article 24 of the NYS Conservation Law. The Adirondack Park Agency has the authority to regulate smaller wetlands within the Adirondack Park. The Army Corps of Engineers has the authority to regulate smaller wetlands in New York State, and the DEC has the authority to regulate smaller wetlands that are of unusual local importance. The Protection of Waters Program provides protection for rivers, streams, lakes, and ponds under Article 15 of the NYS Environmental Conservation Law.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Basic biological information is lacking for most taxa of freshwater gastropods and there is a strong need for surveys and biological studies given the strong evidence of decline and extinction.

The following goals and recommended actions are provided in the NY Comprehensive Wildlife Conservation Strategy (NYSDEC 2005):

- Conduct surveys to determine distribution and population trends
- Identify habitat requirements for all life stages
- Develop specific plans for each listed species (or appropriate suite of species) that details status, threats, and actions necessary to reverse declines or maintain stable populations
- Develop fact sheets for each listed species for paper and online distribution

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) - https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	
2.	

Table 2. Recommended conservation actions for mossy valvata.

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Originally prepared by	Kimberley Corwin
Date first prepared	June 20, 2013
First revision	February 20, 2014 (S. Hoff)
Latest revision	Transcribed March 2024

Species Status Assessment

Common Name: Mucket **Date Updated:** 1/16/2024

Scientific Name: *Actinonaias ligamentina* **Updated By:** Amy Mahar

Class: Bivalvia

Family: Unionidae

Species Synopsis *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Actinonaias ligamentina belongs to the subfamily Ambleminae and the tribe Lampsilini, which includes 17 extant and 6 likely extirpated New York species of the genera Actinonaias, Epioblasma, Lampsilis, Leptodea, Ligumia, Obovaria, Potamilus, Ptychobranchus, Toxolasma, Truncilla, and Villosa (Haag 2012; Graf and Cummings 2011). A. ligamentina belongs to the genus Actinonaias, which is characterized by rays on the periostracum. Ligamentina is named for its large, strong ligament (Watters et al. 2009).

This species typically inhabits fast flowing sections of large streams and rivers in cobble and gravel, and is occasionally found in slow water (Strayer & Jirka 1997). Since 1970, it has been found in seven New York waterbodies. It is often the most abundant mussel in the Allegheny River system's medium gradient streams (The Nature Conservancy 2009). In addition to the upper Allegheny basin and Conewango Creek basin, A. ligamentina is also found in the French Creek and Lake Erie basins.

Although ranked as "imperiled" in New York, this edge of range species is considered secure throughout its range. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993; Stein et al.2000). While population trends in New York are unknown, based on sparse historical information, it is assumed that they too are declining due to a myriad of environmental stressors.

I. Status

a. Current legal protected Status

i. **Federal:** None **Candidate:** No

ii. **New York:** None, Proposed Special Concern (2019)

b. Natural Heritage Program

i. **Global:** G5 - Secure

ii. **New York:** S2 - Imperiled **Tracked by NYNHP?:** Yes

Other Ranks:

-IUCN Red List: Least Concern (2011)

-Northeast Regional SGCN: No (2023)

-American Fisheries Society Status: Currently Stable (1993)

Status Discussion:

This species is widely distributed and found throughout the Mississippi River system, with the exception of extreme southern and western reaches. It also occurs in the St. Lawrence River basin and tributaries of Lakes Erie, Michigan, and Ontario and is considered stable throughout much of its range and is globally secure (NatureServe 2013).

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable	Pre-2011		(blank)
Northeastern US	Yes	Choose an item.	Choose an item.			No
New York	Yes	Choose an item.	Choose an item.		Proposed Special Concern, S2	Yes
Connecticut	No	N/A	N/A			No
Massachusetts	No	N/A	N/A			No
New Jersey	No	N/A	N/A			No
Pennsylvania	Yes	Choose an item.	Choose an item.		S4	No
Vermont	No	N/A	N/A			No
Ontario	Yes	Choose an item.	Choose an item.		S4	(blank)
Quebec	Unknown	N/A	N/A			(blank)

Column options
Present?: Yes; No; Unknown; No data; (blank) or Choose an Item
Abundance and Distribution: Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
SGCN?: Yes; No; Unknown; (blank) or Choose an item

Monitoring in New York *(specify any monitoring activities or regular surveys that are conducted in New York):*

As part of a State Wildlife Grant, NYSDEC Region 8 Fish and Wildlife staff conducted a native freshwater mussel baseline inventory of tributaries in central and western New York, 2009 to 2020.

Trends Discussion *(insert map of North American/regional distribution and status):*

Trends for New York populations are difficult to determine as most historic data comes from opportunistic naturalist collections, as opposed to more comprehensive baseline surveys. For example, mussels were documented for the first time in 50 of the 106 streams surveyed to date by the Southern Lake Ontario mussel inventory project (Mahar & Landry 2013). This is because many of these streams had never before been surveyed for mussels, not because mussel distribution has dramatically increased. In North America, approximately 2/3 to ¾ of native mussel species are extinct, listed as endangered or threatened, or are in need of conservation status (Williams et al. 1993; Stein et al.2000). Based on New York’s Natural Heritage S-rank, sparse historical data, and the plight of North America’s freshwater mussels, it is assumed that trends are declining due to a myriad of environmental stressors.

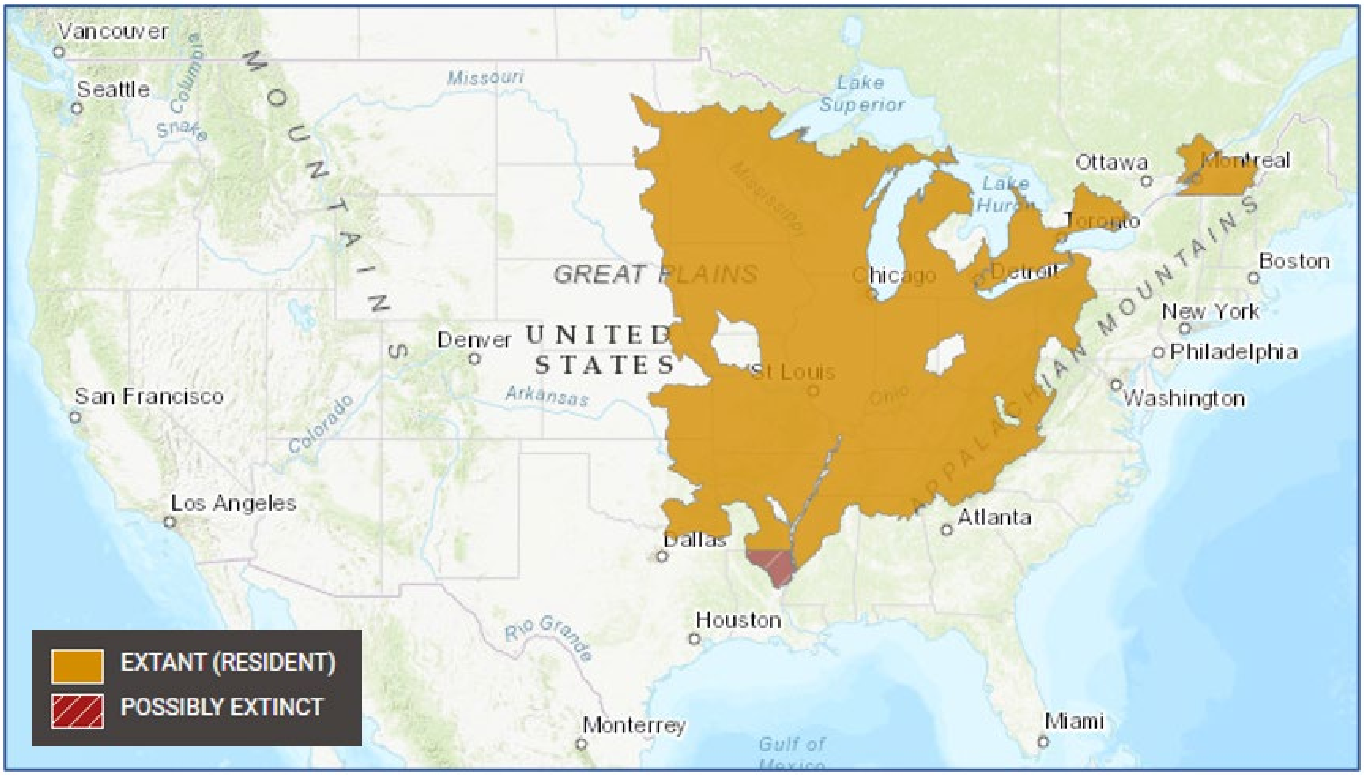

Figure 1. Mucket distribution (IUCN Redlist 2024)

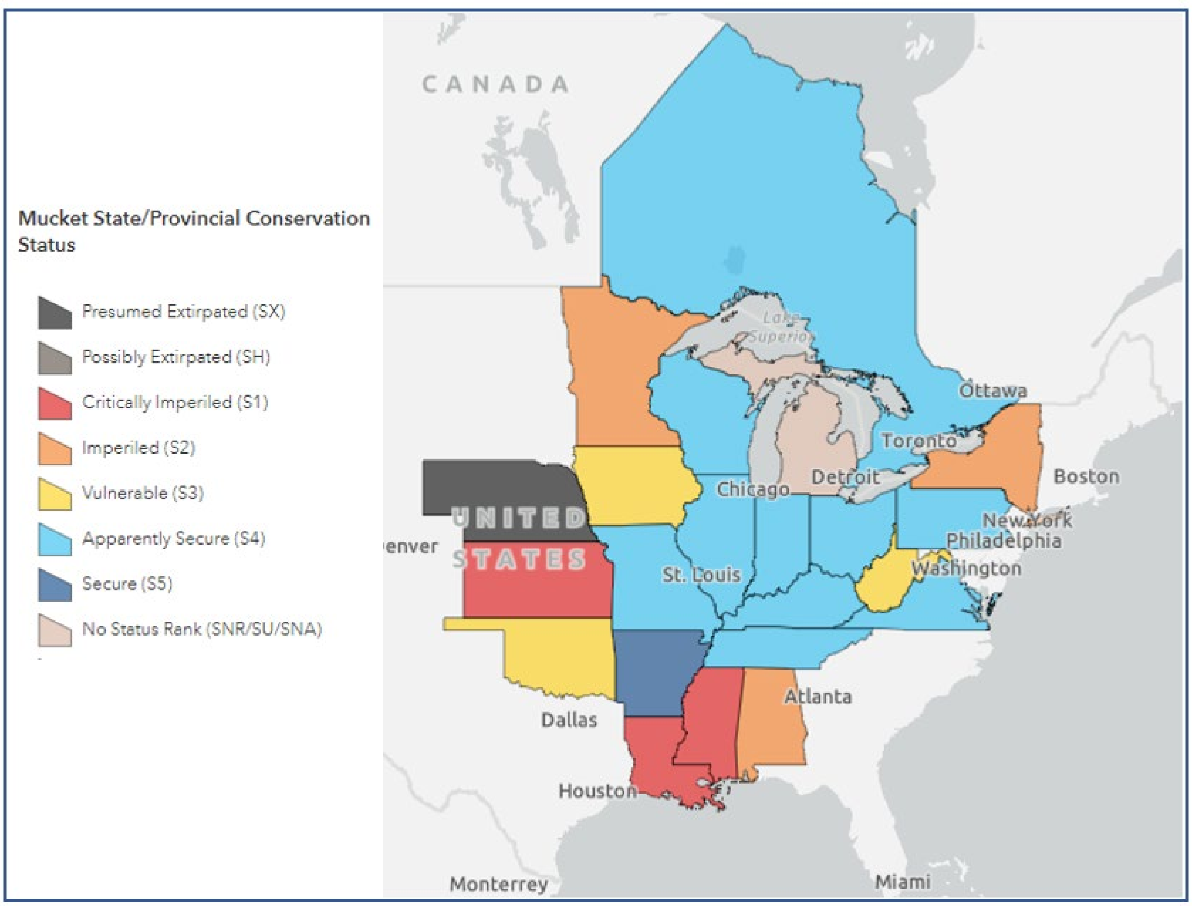

Figure 2. Mucket status (NatureServe 2024)

III. New York Rarity *(provide map, numbers, and percent of state occupied)*

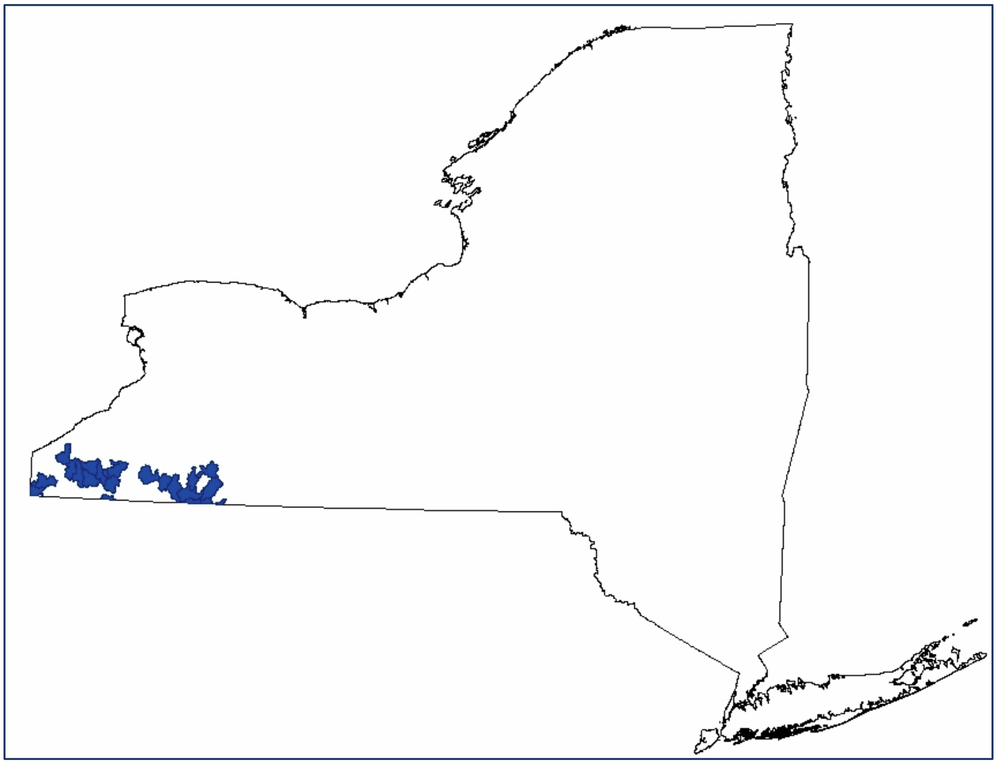

Figure 3. Records of mucket in New York (NYSDEC 2022)

Years	# of Records	# of Distinct Waterbodies	% of State
Total		10	1.2%

Table 1. Records of mucket in New York.

Details of historic and current occurrence:

2024: A. ligamentina has been found in 21 of 1802 HUC 12 watersheds (1.2%) and 10 waterbodies in New York.

Historically, this species was widespread and abundant in the Allegheny basin. There are also old records from the Niagara River, Oak Orchard Creek, and possibly Tonawanda Creek (Strayer & Jirka 1997).

Since 1970, A. ligamentina has been found in seven New York State waterbodies.

A. ligamentina is currently found in medium and large creeks and rivers of the greater Allegheny River system, in which it is arguably the most abundant species (Strayer & Jirka 1997; Smith &

Crabtree 2005; Smith & Meyer 2008; Smith and Crabtree 2009; The Nature Conservancy 2009), and often is the dominant species in medium-gradient habitats (such as the main stem of the Allegheny River) (The Nature Conservancy 2009). The Nature Conservancy found 4,163 live A. ligamentina at 61 of 105 survey sites with greatest total catches (up to 117 per hour) in the Allegheny River upstream of Olean. A. ligamentina populations were found throughout both the Upper Allegheny and Conewango sub-basins, including Oswayo Creek, Olean Creek, Conewango Creek, Cassadaga Creek, and the mainstem of the Allegheny River from downstream of Salamanca upstream to Portville. Populations were considered viable at 82% of the sites where they were found (The Nature Conservancy 2009).

Between 1988 and 1990, live A. ligamentina were found at several locations in the New York portion of French Creek. During this same time period, old shells were found in Tonawanda Creek in the Erie Basin (New York Natural Heritage Program 2013).

In 2013 over 50 live A. ligamentina were found in French Creek, southwest of French Creek town, Chautauqua Co (Burlakova, Karatayev, unpublished data).

New York's Contribution to Species North American Range:

Percent of North American Range in NY	Classification of NY Range	Distance to core population, if not in NY
1-25%	Peripheral	230 miles

Column options
Percent of North American Range in NY: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
Classification of NY Range: Core; Peripheral; Disjunct; (blank) or Choose an item

IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

a. **Size/Waterbody Type:** Small River to Medium River

b. **Geology:** Moderately Buffered

c. **Temperature:** Transitional Cool to Warm

d. **Gradient:** Low Gradient to Moderate-High Gradient

Habitat or Community Type Trend in New York

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	No	No	Yes	Yes	(blank)

Column options
Habitat Specialist and Indicator Species: Yes; No; Unknown; (blank) or Choose an item
Habitat/Community Trend: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

Habitat Discussion:

Mucket typically inhabits large creeks and rivers (Strayer & Jirka 1997; Cummings & Mayer 2002; NatureServe 2013). It is "best fitted for the rough parts, riffles with strong current and heavy gravel and rocks," but may also be found in sandy mud or gravel along stream margins (Ortmann, 1919). This early habitat assessment is consistent with Watters et al. (2009) and Strayer & Jirka (1997), who note that the species is most common in cobble and sand in moving water, although habitats in New York range from stony riffles to soft–bottomed pools. It may rarely occur in shallow water areas of large lakes (NatureServe 2013).

V. Species Demographic, and Life History:

Breeder in NY?	Non-breeder in NY?	Migratory Only?	Summer Resident?	Winter Resident?	Anadromous/ Catadromous?
Yes	Choose an item.	Choose an item.	Yes	Yes	Choose an item.

Column options
First 5 fields: Yes; No; Unknown; (blank) or Choose an item
Anadromous/Catadromous: Anadromous; Catadromous; (blank) or Choose an item

Species Demographics and Life History Discussion *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

Upstream males release sperm into the water. Females downstream take up the sperm with incoming water. Fertilization success may be related to population density, with a threshold density required for any reproductive success to occur. Eggs are fertilized within the female. Like nearly all North American mussels, A. ligamentina must parasitize an often specific vertebrate host to complete its life cycle. It is suspected that some mussel populations are not recruiting because their hosts no longer occur with them. Once released by the female, glochidia must acquire a suitable host or die, usually within 24-48 hours. After attaching to a suitable host, glochidia encyst, usually at the fish's gills or fins and receive food and dispersal. Once the glochidia metamorphose into juveniles, they drop from the host. If they land in suitable habitat, they will burrow into the substrate, where they may remain for several years (Watters et al. 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of the lake or river bottom. The only time that significant dispersal can take place is during the parasitic phase. Infected host fishes can transport the larval unionids into new habitats, and can replenish depleted populations with new individuals. Dispersal is particularly important for genetic exchange between populations. Dispersal is likely a slow process for mussels which use resident fishes with limited home ranges as their hosts (COSEWIC as cited in NatureServe 2013).

It has an equilibrium life history strategy, characterized primarily by long life span, mostly short term brooding, low to moderate growth rate, and late maturity, with low reproductive effort and fecundity that increases slowly after maturation. This life history strategy is considered to be favored in stable, productive habitats (Haag 2012).

A. ligamentina reaches sexual maturity at 4 to 6 years and can live up to 25 years. This species is bradytictic, with eggs developing in mid-summer and glochidia are present in the female from September to the following May to August (Watters et al. 2009). A ligamentina has been known to use many species of warm water fish as hosts and glochidia have been found to transform on rock bass (Ambloplites rupestris), central stoneroller (Campostoma anomalum), silverjaw minnow (Notropis buccatus), banded killifish (Fundulus diaphanus), green sunfish (Lepomis cyanellus), smallmouth bass (Micropterus dolomieu), largemouth bass (Micropterus salmoides), white bass (Morone chrysops), yellow perch (Perca flavescens), white crappie (Pomoxis annularis), and black crappie (Pomoxis nigromaculatus). It is able to infest American eel (Anguilla rostrata), common carp (Cyprinus carpio), bluegill (Lepomis macrochirus), tadpole madtom (Noturus gyrinus), and sauger (Sander canadensis) (Watters et al. 2009; Strayer & Jirka 1997).

VI. Threats *(from NY 2015 SWAP or newly described):*

Threats to NY Populations	
Threat Category	**Threat**
1. Human Intrusions & Disturbance	Work & Other Activities (bridge projects and other instream work)
2. Natural System Modifications	Other Ecosystem Modifications (levees and flood walls, channelization, dredging, impassable culverts)
3. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (zebra mussels)
4. Pollution	Agricultural & Forestry Effluents (pesticides, fertilizers, sediment)
5. Pollution	Household Sewage & Urban Waste Water (road runoff of salts and metals, other regulated discharges)
6. Pollution	Household Sewage & Urban Waste Water (waste water treatment effluent, sewer and septic overflows)
7. Climate Change & Severe Weather	Droughts
8. Natural System Modifications	Dams & Water Management/Use (lowering of water table from agriculture, etc…, causing drying of habitat)
9. Climate Change & Severe Weather	Storms & Flooding (extreme storms)
10. Invasive & Other Problematic Species & Genes	Invasive Non-Native/Alien Species (die offs from unknown disease)

Agricultural Runoff

New York's largest populations of *A. ligamentina* are found in the Allegheny River upstream of Olean, with additional viable populations between Olean and Salamanca (The Nature Conservancy 2009). Roughly half of these sections of stream are bordered by agriculture, primarily in the Olean/Allegheny area. Although the mid reaches of Cassadaga Creek are quite forested, both the upstream portions of Cassadaga Creek and the lower portions of Conewango Creek, in which *A. ligamentina* have been found, are influenced by limited agriculture. The French Creek watershed is also highly agricultural (New York State Landcover 2010). Aquatic habitat lacking vegetated buffers of adequate width are threatened by runoff from urban areas, roads, lawns, and agricultural land (Gillis 2012). If best management practices are not closely adhered to, mussel habitat adjacent to wood harvest or agricultural land is subjected to pesticide, fertilizer, and silt/sediment runoff. During recent mussel surveys in Western and Central New York, it has been documented that sufficient vegetated riparian buffers are often lacking along known mussel streams (Mahar & Landry 2013), indicating that runoff is a major threat to resident mussel populations.

The presence of pesticides and fertilizers in our rural watersheds is nearly ubiquitous (Haag 2012). And because pesticides and their associated surfactants adsorb onto sediment particles, sedimentation may act as a vector for their transport into the aquatic system (Haag 2012). Mussels are more sensitive to pesticides than many other animals (Watters et al. 2009). Although effects of pesticides are species-specific, sub-lethal levels of PCBs, DDT, malathion, and other compounds inhibit respiratory efficiency and accumulate in the tissues. Atrazine and permethrin at sublethal concentrations reduced juvenile growth (Bringolf et al. 2007a, 2007b) and environmental levels of atrazine altered mussel movement and aggregation behavior (Flynn and Spellman 2009). Pesticides can affect mussels in many ways, but the full range of long-term effects remains unknown (Haag 2012).

Fertilizer runoff is also a concern. High inputs of nitrogen from fertilizers can cause increases in ammonia in the water and the substrate, leading to direct toxicity for a wide range of mussel species. Mussels, especially in their early life stages, are more sensitive to un-ionized ammonia than other organisms, and high sensitivity is seen across a range of species and life histories (Haag 2012). In addition, ammonia adsorbs to sediment particles, resulting in higher nitrogen concentrations in the substrate than in the overlying water. The nitrogen present in the interstitial spaces in the substrate is thought to result in juvenile mortality and to prevent recruitment by some mussel species (Strayer and Malcom 2012). Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley et al. 2012).

Treated Wastewater

The habitat of *A. ligamentina* receives treated wastewater from the cities of Olean, Salamanca, and the village of Portville, either directly to the Allegheny River or through tributaries. Cassadaga Creek receives treated effluent from the city of Jamestown sewage treatment plant (SPDES 2007). Recent studies show that mussel richness and abundance decrease with increased proximity to sewage effluent (Wildenberg 2012). The input of biomaterial from wastewater treatment plants depletes dissolved oxygen levels, negatively impacting mussels. Ammonia from wastewater treatment plants has been found to be toxic to glochidia (Goudraeu et al. 1993) and at sub-lethal exposure, adult mussels exhibit decreased respiratory efficiency (Anderson et al. 1978). Endocrine disrupters from pharmaceuticals are also present in municipal sewage effluents and are increasing common in rivers and lakes (Haag 2012). In mussels, chronic exposure to estrogenic compounds in effluents caused feminization of male mussels, but these individuals did not produce eggs, suggesting major disruption of reproductive function (Gagne et al. 2011). The long-term effects of these compounds on mussels are unknown (Haag 2012). It should be noted that in the Susquehanna Basin, Harman and Lord (2010) found no evidence that wastewater treatment plants were responsible for reductions in mussel species of greatest conservation need.

Runoff from Developed Land

The habitat of *A. ligamentina* receives storm water runoff from the cities of Olean, Salamanca, and the village of Portville, either directly to the Allegheny River or through tributaries. Cassadaga Creek receives Jamestown's urban runoff via the Chadokoin River. All seven New York waterbodies that host *A. ligamentina* populations are intermittently bordered by interstate highways, state routes, and/or local roads (New York State Landcover, 2010). These developed lands are likely sources runoff containing metals and road salts. Mussels are particularly sensitive to heavy metals, more so than many other animals used in toxicological tests (Keller & Zam 1991). Low levels of metals may interfere with the ability of glochidia to attach to the host (Huebner & Pynnonen 1992), suggesting that U.S. EPA ambient water quality criteria may not adequately protect mussels from toxic metals (Wang et al. 2011). In addition, increases in salinity from the runoff of salt used for clearing roads in winter may be lethal to glochidia and juvenile mussels (Keller & Zam 1991; Liquori & Insler 1985; Pandolfo et al. 2012). Based on these studies, the U.S.

EPA's ambient water quality criterion for acute chloride exposures may not be protective of all freshwater mussels (Pandolfo et al. 2012).

Flood Control Projects

Large stretches of *A. ligamentina* habitat are within the leveed portions of the Allegheny River, Olean Creek, and Oswayo Creek ("New York State Flood Protection" 2013). These structures confine larger rivers, preventing the river from inundating its natural floodplains and wetlands to minimize flood damage. Additionally, many smaller streams have been channelized and bermed by landowners and highway departments to protect farm fields and other structures. Channelization and dredging associated with flood control projects are catastrophic to mussels and have been implicated in the decline of some populations (Watters et al. 2009). The result of these projects is altered seasonality of flow and temperature regimes, increased stream velocities, unstable substrates, changed patterns of sediment scour and deposition, including streambank erosion, altered transport of particulate organic matter (the food base for mussels), and a general degradation of stream habitat (Benke 1999; Yeager 1993; Nedeau 2008).

Other Habitat Modifications

Ecosystem modifications, such as isolated occurrences of flood control channel dredging, instream work associated with bridge replacement, or gravel mining, and vegetation removal kill mussels and destroy their habitat. For example, dredging for vegetation removal has been shown to remove up to 23% of mussels in spoils (Aldridge 2000). Further evidence for disruption was provided by mussel surveys adjacent to approximately 20 river miles of Conewango Creek that had been channelized and straightened in the first half of the 20th century. The resulting "dredge" had no riffle or run habitat and sites just below and above this channelized section contained few or no mussels (The Nature Conservancy 2009). Although limited in geographic scope these habitat modification activities have long term impacts on mussels and their distribution (Aldridge 2000).

Invasive Species

Invasive zebra mussels (*Dreissena polymorpha*) pose a potential threat to *A. ligamentina* populations in Cassadaga and Conewango Creeks, where they are present in the lower reaches. Chautauqua Lake's connection to Cassadaga Creek, Chadakoin Creek, is the main source of this exotic invasive (The Nature Conservancy 2009), that has been repeatedly cited as a threat to native mussel populations (Strayer & Jirka 1997; Watters et al. 2009). Studies have shown that *A. ligamentina* are significantly stressed by zebra mussels (Baker & Hornbach 1997). En masse, Dreissenids outcompete native mussels by efficiently filtering food and oxygen from the water. They reduce reproductive success by filtering native mussel male gametes from the water column and they can foul the shells of the native mussels to the point that their valves can no longer open. In heavily invested areas, they may transform a habitat by hardening the substrate, such that dislodged mussels are not able to rebury (USFWS 1994). Although zebra mussels will continue to cause problems for Chautauqua Lake, they currently appear to have minimal impact downstream. However, precautions should be taken to avoid invasions by zebra mussels to upstream locations, especially the headwater lakes in the Cassadaga system. Monitoring for zebra mussels in these lakes may provide early detection of this invader (The Nature Conservancy 2009).

Impoundments

Across its range, impoundments likely contributed to the reduced distribution of mussels that we see today. Vaughn and Taylor (1999) observed a mussel extinction gradient with a gradual, linear increase in mussel species richness and abundance with increasing distance downstream from impoundments. Species and their hosts that require shallow, oxygenated, fast-flowing water quickly are eliminated. Continuously cold water from both increased water depth upstream of the dam and dam discharges downstream of the dam may prevent reproduction. Impoundment increases silt load and eutrophication, resulting in changes in the fish fauna, and therefore the availability of hosts. Dams represent distributional barriers to fish hosts, and therefore to the mussels themselves. The zoogeographic patterns of several species suggest a dam-limited range.

Dams also act as sediment traps, often having many feet of silt and debris caught on their upstream side. These areas generally are without mussels. Below the dam, the tailwaters often have dense mussel beds, as these reaches are the only areas left that still have oxygenated, fast moving water. This is exemplified by the distribution of beds in the lower Muskingum River, Ohio (Stansbery & King 1983; ESI 1993c).

In addition, improperly sized and poorly installed or poorly maintained culverts have impacts similar to dams in that they fragment habitat, preventing the movement by host fish, and effectively isolating mussel populations. And because culverts are located at nearly every road-stream intersection, there is the potential for landscape level fragmentation of mussel habitat.

Are there regulatory mechanisms that protect the species or its habitat in New York?

Yes: _✓_ **No:** _____ **Unknown:** _____

If yes, describe mechanism and whether adequate to protect species/habitat:

Mussel habitats receive some generic protection under several New York State regulations (NYCRR) promulgated under the authority of the New York Environmental Conservation Law (ECL), specifically Part 608 of the NYCRR: Use and Protection of Waters, and Part 617 of the NYCRR: State Environmental Quality Review (SEQR). Part 608 provides protection of some mussel habitats by regulating and requiring environmental review of the modification or disturbance of any "protected stream", its bed or bank, and removal of sand, gravel or other material from its bed or banks (608.2 Disturbance of Protected Streams). This does not provide adequate protection of mussels and their habitats as it only protects streams or particular portions of a streams for which there has been adopted by NYSDEC or any of its predecessors any of the following classifications or standards: AA, AA(t), A, A(t), B, B(t) C(t), or Streams designated (t)(trout) also include those more specifically designated (ts)(trout spawning). Mussels habitats may also receive some additional protections as the construction, repair, breach or removals of dams, and the excavation and placement of fill in navigable waters are subject to regulation and environmental review under Part 608, 608.3 and 608.5 respectively. Under Part 608, projects requiring a permit can be conditioned by NYSDEC to include best management practices, such as sediment and erosion protections. Through the review process, these projects can also be modified to reduce impacts in order to meet permit issuance standards.

Under Part 608, protection of unlisted species of mussels is general and relatively limited. More importantly, Class C and D waters with mussels do not receive protection under these regulations. A significant portion of the New York's mussel resources occur within Class C and D waters. An additional but not insignificant gap in protection occurs because agricultural activities consisting of the crossing and re-crossing of a protected stream by livestock or wheeled farming equipment normally used for traditional agricultural purposes or of withdrawing irrigation water in a manner which does not otherwise alter the stream, are exempt from these regulations and environmental review.

Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c)of this Section) may provide protection for freshwater mussels and their habitats from some activities that would potentially have adverse impacts by regulating construction or operation of facilities that may result in any discharge into navigable waters. Water quality certifications set water quality-related effluent limitations, water quality standards, thermal discharge criteria, effluent prohibitions and pretreatment standards for projects on navigable waters.

The State Environmental Quality Review (SEQR, Part 617 NYCRR) may also protect mussels and their habitats by requiring the consideration of environmental factors into the existing planning, review and decision-making processes of state, regional and local government agencies for activities that require discretionary approval. SEQR requires the preparation of an Environmental Impact Statement, including an alternatives analysis, for those activities that may result in a substantial adverse change in ground or surface water quality; a substantial increase in potential for erosion, flooding, leaching or drainage problems; the removal or destruction of large quantities of vegetation or fauna; substantial interference with the movement of any resident or migratory fish or wildlife species; impacts on a significant habitat area; substantial adverse impacts on a threatened or endangered species of animal or plant, or the habitat of such a species; other significant adverse impacts to natural resources; or, a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses.

New York State has numerous laws and regulations that both directly or indirectly protect waters of the state (mussel habitats) including regulations governing direct discharges to surface and groundwater, storm water, agricultural activities, pesticides, flood control, and dams. Without these regulations, mussels would certainly be in worse shape; however, most of these generic protections are not adequate in scope or specific enough to mussel threats to protect the mussel resources of New York State.

Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

- Priority conservation efforts for this species should focus on, but not be limited to, the Allegheny River upstream of Olean.

- Modify marine mussel regulations or the definition of protected wildlife in NYCRR to clarify that freshwater mussels are protected under ECL. Current regulations could be interpreted that freshwater mussels may only be protected as shellfish without a season within the Marine District.

- Through landowner incentive programs or regulation, riparian buffers, particularly those that also provide shade, should be added/maintained/widened, along agricultural fields, subdivisions, and along major roads to decrease the levels of nitrogen, pesticides, sediment, heavy metals, and salts from entering these aquatic systems, as well as to moderate water temperature. Studies have suggested decreasing sediment loads entering aquatic systems as the best way to decrease the impact of numerous stressors for mussels in general (Roley & Tank 2012).

- Require all state agencies to maintain appropriate vegetative buffers along streams, rivers and lakes on state-owned or state managed properties.

- Develop and implement a comprehensive monitoring strategy that identifies protocols, including locations and specific intervals, for regular monitoring of known mussel populations to detect assess trends and detect dangerous declines.

- Mussel sensitivity to particular pollutants should be considered or addressed in the regulation of wastewater and stormwater discharges to groundwater and surface waters, State Pollutant Discharge Elimination Systems (SPDES). This should be reflected in effluent limitations for discharges, including discharges from P/C/I facilities (Private/Commercial/Industrial), CAFO facilities (Concentrated Animal Feeding Operations), High Volume Hydraulic Fracturing Discharges, and Wastewater treatment plants, etc. Discharges whose receiving waters have mussels, particularly those with known populations of mussels listed as Endangered, Threatened, Special concern or SGCN, should be carefully reviewed for potential impacts to mussels. For example, deleterious levels of ammonia (a component of many types of discharges) and molluscicides (a commonly used water treatment chemical in discharged water) should not be permitted.

- Establish a protocol whereas DEC staff work closely with Flood Control Management to reduce impacts to native mussels during maintenance flood control projects.

- Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge. This has been documented as a threat to Unionids at multiple life stages, and therefore needs to be addressed (Gillis 2012).

- Establish a protocol whereas DEC staff work closely with state and local highway departments to reduce impacts to native mussels during maintenance and construction projects.

- Replace culverts that disrupt aquatic habitat connectivity to allow for passage of small fish species.

- NYSDEC should consider sensitivity of freshwater mussels to specific pollutants in the establishment and setting of water quality standards and TMDLs for waters containing freshwater mussels. A Total Maximum Daily Load (TMDL) specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. TMDLs account for all contributing sources (e.g. point & nonpoint sources, and natural background levels), seasonal variations in the pollutant load, and incorporate a margin of safety that accounts for unknown or unexpected sources of the pollutant. In essence, a TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards. The Clean Water Act requires states to identify waterbodies that do not meet water quality standards after application of technology-based effluent limitations. For these "impaired waters," states must consider the development of alternative strategies, including TMDLs, for reducing the pollutants responsible for the failure to meet water quality standards.

Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection) -
https://www.iucnredlist.org/resources/conservation-actions-classification-scheme

Conservation Actions	
Action Category	**Action**
1.	

Table 2. (need recommended conservation actions for mucket).

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2006) includes recommendations for the following actions for freshwater mussels:

Habitat management:

- Manage areas of important mussel populations by controlling degradation factors (e.g.. Controlling livestock access, point source or non-point source pollution, flow alteration, etc.)
- Develop methods to improve and restore freshwater bivalve habitat.

Habitat research:

- Conduct research to determine habitat parameters necessary for good populations of each species of species-at-risk listed mussels.
- Research flow requirements of freshwater bivalves and model the effects of flow changes both in volume and timing.
- Research all parameters of mussel habitat requirements including temperature, substrate, fish, flow, food, etc.

Habitat restoration:

- Restore degraded habitat areas to allow for recolonization or reintroduction of listed mussels.

Invasive species control:

- Develop a monitoring/control plan that includes measures to detect invasive species problematic to freshwater bivalves in all New York watersheds and actions that will be taken to control them before they become threats.
- Conduct research on control of exotic bivalve species that compete with native mussels and exotic crustaceans or fish which may prey on them.

Life history research:

- Research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves: sperm/egg, glochidia, larva, adults.
- Research potential interbreeding between *Alasmidonta varicosa* and *Alasmidonta marginata* and, if occurring, evaluate the potential threat to *A. varicosa* population integrity.
- Determine fish hosts for species where this is not known for populations living in New York.
- Research population dynamics of listed mussel species including connectivity of populations or subpopulations and genetic distinctness of populations or subpopulations.
- Determine or confirm breeding phenology and habitat conditions necessary for successful breeding for listed mussels (e.g.. mussel density, pop. level of fish host, temp, flow).

Modify regulation:

- Modify marine mussel regulations to be clearer that freshwater mussels are protected under ECL.

New regulation:

- Ban the importation of fish that feed on freshwater mollusks (e.g.. black carp).
- Require inclusion of all stages of freshwater mussels in testing for approval of new pesticides in New York.

Other action:

- Develop an outreach program to private landowners through the Landowner Incentive Program to educate the public about freshwater mussel protection and initiate projects to prevent or repair impacts from land use on mussels.
- Increase regional permit control of development and highway projects that may impact native mussels.
- Develop standard monitoring/survey protocols for development projects in all watersheds in New York.
- Evaluate threats to mussels in each New York watershed and prioritize areas for actions to address the threats.
- Research the best survey methods both for detection of rare species and evaluation of population status and trends.
- Begin evaluation of members of the family Sphaeridae (fingernail clams) for inclusion into the species at risk list.

Population monitoring:

- Conduct population estimates of species-at-risk listed mussel species in NY
- Conduct surveys to determine distribution of species-at-risk listed mussel species in NY.

Regional management plan:

- Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.

Relocation/reintroduction:

- Where appropriate, reintroduce listed mussels into appropriate habitat within their historic range.

Statewide management plan:

- Incorporate freshwater mussel goals and objectives into statewide water quality and fish management plans and policies.

VII. References

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