

Species Status Assessment

Common Name: Paper pondshell

Date Updated: 3/12/2025

Scientific Name: *Utterbackia imbecillis*

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):

Utterbackia imbecillis 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 one likely extirpated New York species of the genera Alasmidonta, Anodonta, Anodontoides, Lasmigona, Pyganodon, Simpsonaias, Strophitus, and Utterbackia (Haag, 2012; Graf and Cummings, 2011). *U. imbecillis* is the only member of the Utterbackia genus. The species name imbecillis comes from the Latin word meaning feeble or weak; most likely describing the thin, fragile shell of *U. imbecillis* (Watters et al., 2009).

U. imbecillis generally prefers muddy/silty habitats with relatively slow moving water (NatureServe 2013; Watters et al., 2009). This species is currently found in 28 waterbodies, scattered across most major basins in New York, showing a dramatic increase from the five streams recorded in the 2015 SSA and a single stream in 1997 (Mahar & Landry, 2016). *U. imbecillis* is found in the Allegheny, Erie-Niagara, West Lake Ontario-Genesee, East Lake Ontario, St. Lawrence, Susquehanna, and the Hudson basins. Historically, *U. imbecillis* was also found in the Mohawk and upper Hudson basins (Strayer & Jirka, 1997). The New York state rank for *U. imbecillis* has recently been updated from historic to imperiled/vulnerable reflecting its rarity and continued presence in the state.

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 _____

b. Natural Heritage Program

i. **Global:** G5 - Secure _____

ii. **New York:** S2S3 – Imperiled / _____ **Tracked by NYNHP?:** Yes _____
Vulnerable

Other Ranks:

-New York 2025 SGCN status: Species of Greatest Conservation Need

-IUCN Red List: Least Concern (2012)

-Northeast Regional SGCN: No (2023)

Status Discussion:

This species is very widespread with many populations across much of U.S. (edge of range states less common) and also into Mexico. It is stable or increasing, and is tolerant of a wide range of habitat conditions (NatureServe, 2013). Previously considered historic in New York, it was found during surveys in 2011 and 2012.

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Stable	Stable			(blank)
Northeastern US	Yes	N/A	N/A			No
New York	Yes	Unknown	Unknown		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	(blank)	(blank)		S4	No
Vermont	No	N/A	N/A			No
Ontario	Yes	N/A	N/A		S2	(blank)
Quebec	Yes	N/A	N/A		S1S2	(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. Baseline surveys out of Regions 8 and 9 will continue in unsurveyed portions of Allegheny and Lake Erie basin in 2025 to 2028. Regulatory surveys are conducted in known or likely habitat as part of the project review process.

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

Across its range, *U. imbecillis* has relatively stable long and short-term trends, with $\leq 10\%$ change and no evidence of range contraction or decline in number of occurrences (NatureServe 2025).

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, 2016). This is because many of these streams had never before been surveyed for mussels, not because mussel distribution has dramatically increased. For this reason, it is likely that the dramatic increase in the number of *U. imbecillis* found in New York over the past 10 years is a result of increased survey

efforts and not likely an increase in population. 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). 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.

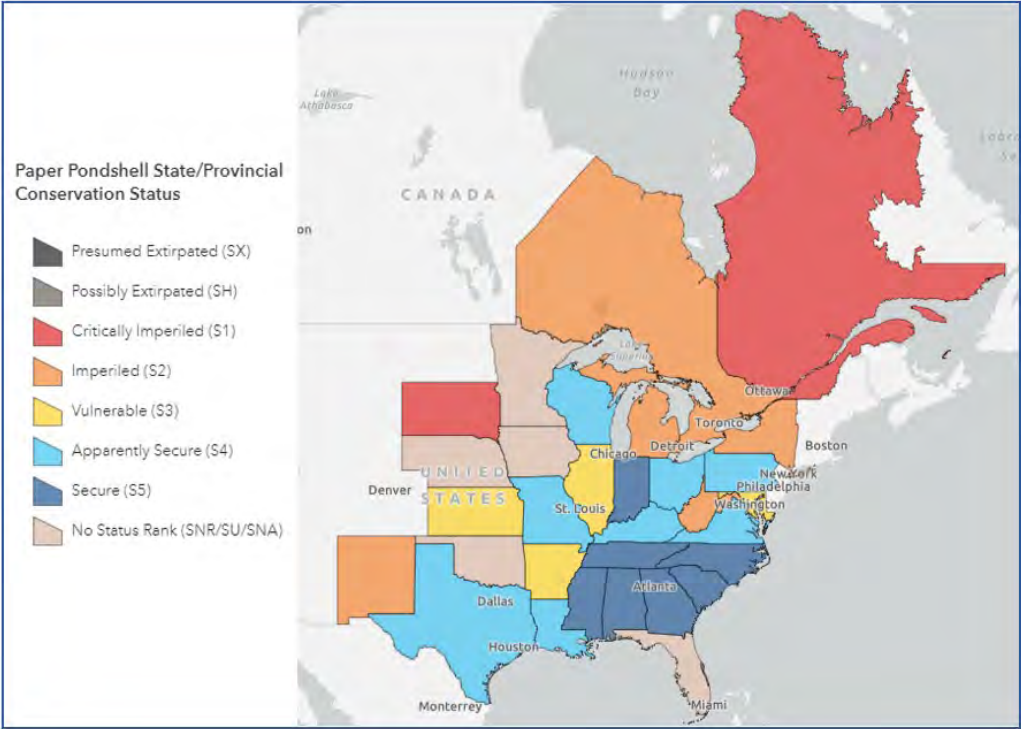


Figure 1. Paper pondshell status (NatureServe 2024)

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

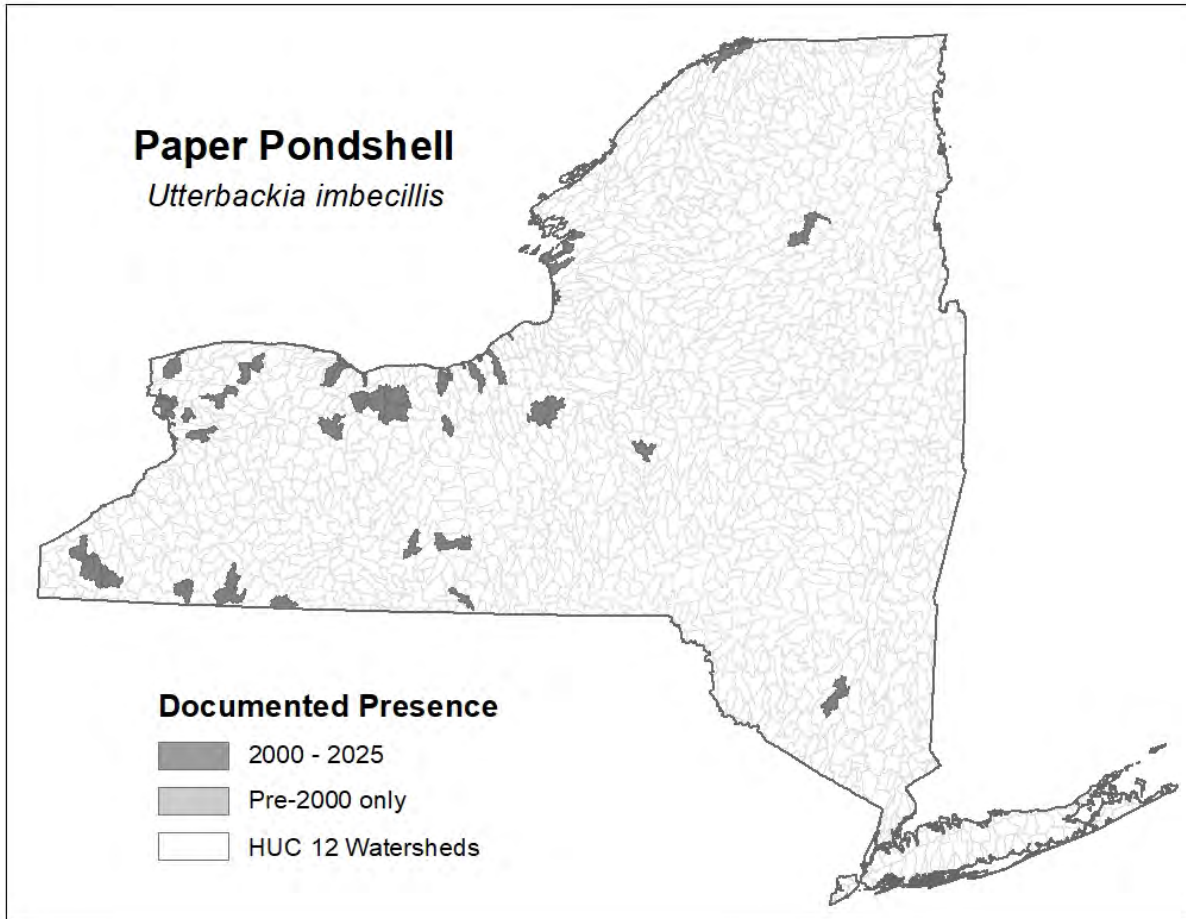


Figure 2. Records of paper pondshell in New York (NYSDEC 2022)

Years	# of Records (survey sites with <i>U. imbecillis</i>)	# of Distinct Waterbodies	% of State
Total	71	<u>28</u>	2.1%
2000-2025	70	<u>28</u>	<u>2.1%</u>

Table 1. Records of paper pondshell in New York.

Details of historic and current occurrence:

In New York, historic records for *U. imbecillis* are few and scattered. They include: Chautauqua Lake (1895) and its outlet; Erie Canal from Pittsford to Macedon (1959); Irondequoit Creek (1891); Seneca Lake near Geneva; Clyde River near Marengo, and Seneca River at the north end of Cayuga Lake (1970); Onondaga County (1887); Oswego River (1895); Mohawk River (1868); Brown's Tract Pond; and Raquette Lake (Strayer & Jirka, 1997). This distribution is remarkable for its wide extent and erratic character, which unlike distributions of other unionoids, does not closely follow drainage patterns other than the central part of the Erie Canal (Strayer & Jirka, 1997). Strayer and Jirka (1997) show no records for this species after 1970.

Since 1997, *U. imbecillis* has been found in 2.1% of New York’s HUC 12 watersheds and 28 waterbodies. It has been found in the Allegheny, Erie-Niagara, West Lake Ontario-Genesee, East Lake Ontario, St. Lawrence, Susquehanna, and the Hudson basins.

In the Allegheny basin *U. imbecillis* is found Chautauqua Lake (Johnson 2019), Allegheny River (Jirka 2014), Red House Brook (Mahar and Landry 2019), and Olean Creek (Jirka 2002, personal communication).

In the Erie-Niagara basin, this species was found in Lake Erie, Niagara River (Harper 2015), Spicer Creek (Jirka 2019, personal communication), Slate Bottom Creek, Tonawanda Creek, and a tributary to Mud Creek, and Ellicott Creek (Mahar and Landry 2019).

Records from the West Lake Ontario Basin include Long Pond (Snavely 2020a) and Twelvemile Creek (Bossenbroek et al. 2012). This species has also been found in the Genesee River. *U. imbecillis* was found in the Genesee River (Mahar & Landry, 2016).

In the East Lake Ontario basin, this species has been found in Red Creek (Palmyra) and Pond Brook, Catharine Creek Canal, Red Creek (Wolcott), First Creek, and Sterling Valley Creek (Mahar and Landry 2016; Jirka, personal communication), Geddes Brook (Jirka 2015, personal communication), Onondaga Lake (Mayer 2023, personal communication), and Black River Bay (Bossenbroek et al. 2018). A total of 57 fresh shells were found at 13 Erie Canal locations between Ridgeway, Orleans Co. and Macedon, Wayne County, with the majority of the shells (32) found at a single site in Macedon (Mahar & Landry, 2016).

In the St. Lawrence basin, *U. imbecillis* has been found in Long Lake (Gangloff 2017), in the Hudson basin at Wallkill River (Nedeau 2018), and in the Susquehanna basin in Birdseye Hollow Brook, Chemung River (Mahar and Landry 2019), and Payne Brook (Nedeau 2022).

While *U. imbecillis* is usually found in small numbers, it was most abundant in Geddes Brook (75 live) and Chautauqua Lake (41 live). Given the number of shells (57) found in the Erie Canal during seasonal draw downs, it is likely that a large population is present in this waterbody.

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: Headwater/Creek to Small 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:

U. imbecillis is most typically found in soft substrates in quiet waters of ponds, lakes, and sluggish mud-bottomed pools and backwaters of creeks and rivers (Strayer & Jirka, 1997; Cummings & Mayers, 1992; Metcalfe-Smith et al., 2005; McMurray et al., 2012; Watters et al., 2009). It is commonly found in artificial waters (e.g., canals, impoundments, boat basins, retention ponds, old phosphate pits) (NatureServe 2013; Watters et al., 2009). This species seems to be tolerant of moderately poor water and habitat quality (muddy substrates). Such substrates have become more prevalent with increased eutrophication (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):

U. imbecillis is thought to be hermaphroditic with both gametes maturing simultaneously in the same individual. Hermaphroditism affords benefits when population densities are low; under such conditions, females may switch to self-fertilization to ensure that recruitment continues (Watters et al., 2009).

This species is also one only of 2-3 unionid species capable of direct development, meaning there is no need for a host fish, at least under certain conditions (NatureServe, 2013). Metamorphosis in the absence of host parasitism has been confirmed, although in the laboratory, fish-reared juveniles were found to be in more robust physiological condition than their counterparts that metamorphosed without a host fish (Dickinson and Sietman, 2008 and Fisher and Dicmock, 2006as cited in NatureServe, 2013).

Although this species may be able to develop without a fish host, it also can complete its life cycle in the usual way (Strayer & Jirka, 1997). *U. imbecillis* is a host generalist (Watters et al., 2009) and has more identified hosts, including three amphibians, than any other unionid (Watters et al., 2009). Known fish hosts, not including exotic aquaria fish, include: rock bass (*Ambloplites rupestris*), spotfin shiner (*Cyprinella spiloptera*), greenthroat darter (*Etheostoma lepidum*), banded killifish (*Fundulus diaphanus*), channel catfish (*Ictalurus punctatus*), green sunfish (*Lepomis cyanellus*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), longear sunfish (*Lepomis megalotis*), largemouth bass (*Micropterus salmoides*), golden shiner (*Notemigonus crysoleucas*), yellow perch (*Perca flavescens*), black crappie (*Pomoxis nigromaculatus*), and creek chub (*Semotilus atromaculatus*) (Watters et al., 2009). Amphibian hosts include tiger

salamander (*Ambystoma tigrinum*), bullfrog tadpole (*Rana catesbeiana*), and northern leopard frog tadpole (*Rana pipens*) (Watters et al., 2009). Other potential hosts include: mosquitofish (*Gambusia affinus*) and warmouth (*Lepomis gulosus*) (Watters et al., 2009).

These characteristics may make *U. imbecillis* an unusually good colonizer among unionoids and may free it to some extent from the constraint of dispersing within drainage basins (Strayer & Jirka, 1997).

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. imbecillis is a short lived species and rarely lives for more than five years. The species is bradyctictic, with gravid females present from April through September in Ohio (Watters et al., 2009).

In the adult form, freshwater mussels are basically sessile; movement is limited to a few meters of 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).

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

Agricultural Runoff

Several streams that host *U. imbecillis* populations, including Red Creek in Wolcott, Pond Brook, and the Erie Canal, flow through heavily agricultural areas and are likely impacted by associated siltation, nutrient and pesticide loading. In addition, just upstream of the site where live specimens were found, First Creek flows through a golf course and likely receives pesticide and fertilizer runoff from this source (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, 2016), 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-offs are 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 New York waterbodies that are known to currently host *U. imbecillis* populations are intermittently bordered by an interstate highways, state routes, and/or local roads and lawns (New York State Landcover, 2010), and likely receive runoff containing metals and road salts from these sources. 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., 2007).

Treated Wastewater

Red Creek in Wolcott receives treated effluent from the village of Red Creek Regional Wastewater Treatment Plant (SPDES, 2011). It is also possible that raw sewage enters the Erie Canal from illegal dumping by recreational boats. 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 disruptors from pharmaceuticals also are present in municipal sewage effluents and are increasingly common 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, Harmon & 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).

Based on the number of fresh shells found, it is thought that the majority of New York's *U. imbecillis* populations reside in the Erie Canal system. Habitat modification 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 the *U. imbecillis* population. During spring mussel surveys of the Erie Canal, it is not uncommon to find hundreds of fresh shells of multiple species, including *U. imbecillis*, and multiple age classes, many containing desiccating flesh, along the exposed canal banks and bed (Mahar & Landry, 2016). This antidotal evidence suggests seasonal draw downs have a large impact on these populations.

Invasive Species

Invasive zebra and quagga mussels (*Dreissena polymorpha* and *Dreissena bugensis*) have been repeatedly cited as a threat to native mussel populations (Strayer & Jirka, 1997; Watters et al., 2009). This threat is of particular concern to the *U. imbecillis* populations in the Erie Canal. 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).

Lamprey Control

U. imbecillis populations are found in several stream that are regularly scheduled for sea lamprey control treatment. These streams include Red Creek and Catharine 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) or by NYSDEC. 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).

Threat Level 1	Threat Level 2	Threat Level 3	Spatial Extent	Severity	Immediacy	Trend	Certainty
1. Residential and Commercial	1.3 Tourism & Recreation Areas	1.3.5 Docks & marinas	Restricted	Moderate	Immediate	Stable and ongoing	Choose an item.
3. Energy Production & Mining	3.3 Renewable Energy	3.3.1 Hydroelectric dams	Small	Moderate	Immediate	Stable and ongoing	Choose an item.
4. Transportation & Service Corridors	4.1 Roads & Railroads	4.1.3 Bridges	Small	Serious	Near-term	Stable and ongoing	Choose an item.
6. Human Intrusions & Disturbance	6.3 Work & Other Activities	6.3.1 Research activities	Small	Slight	Near-term	Intensifying	Choose an item.
7. Natural System Modifications	7.2 Dams & Water Management/Use	7.2.1 Water level management using dams	Small	Moderate	Long-term	Stable and ongoing	Choose an item.
7. Natural System Modifications	7.2 Dams & Water Management/Use	7.2.3 Water management using culverts	Small	Moderate	Near-term	Stable and ongoing	Choose an item.
7. Natural System Modifications	7.2 Dams & Water Management/Use	7.2.6 Withdrawal of surface water	Small	Moderate	Near-term	Intensifying	Choose an item.
7. Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.1 Shoreline alteration	Small	Moderate	Near-term	Intensifying	Choose an item.
8. Invasive & Other Problematic Species	8.1 Invasive Non-Native Plants & Animals	8.1.3 Aquatic animals	Restricted	Extreme	Immediate	Stable and ongoing	Choose an item.
9. Pollution	9.1 Domestic & Urban Wastewater	9.1.1 Domestic wastewater	Restricted	Moderate	Immediate	Intensifying	Choose an item.
9. Pollution	9.1 Domestic & Urban Wastewater	9.1.2 Runoff	Large	Moderate	Immediate	Intensifying	Choose an item.
9. Pollution	9.3 Agricultural & Forestry Effluents	9.3.1 Nutrient loads	Pervasive	Moderate	Immediate	Stable and ongoing	Choose an item.

9. Pollution	9.3 Agricultural & Forestry Effluents	9.3.2 Soil erosion, sedimentation	Restricted	Moderate	Near-term	Stable and ongoing	Choose an item.
9. Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Large	Moderate	Near-term	Unknown	Choose an item.
11. Climate Change	11.3 Changes in Temperature Regimes	11.3.3 Gradual temperature change	Large	Moderate	Long-term	Intensifying	Choose an item.
11. Climate Change	11.4 Changes in Precipitation & Hydrological Regimes	11.4.2 Droughts	Large	Moderate	Long-term	Intensifying	Choose an item.
11. Climate Change	11.4 Changes in Precipitation & Hydrological Regimes	11.4.4 Increase in fluctuations in precipitation regime	Restricted	Slight	Long-term	Intensifying	Choose an item.
11. Climate Change	11.5 Storms & Severe Weather	11.5.1 Storms & severe weather	Restricted	Extreme	Immediate	Intensifying	Choose an item.
4. Transportation & Service Corridors	4.3 Shipping Lanes	4.3.3 Locks & canals	Small	Serious	Long-term	Stable and ongoing	Choose an item.
5. Biological Resource Use	5.4 Fishing & Harvesting Aquatic Resources	5.4.4 Management/control of aquatic species	Large	Moderate	Unknown	Stable and ongoing	Choose an item.

Table 2. Threats to paper pondshell.

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 Pittsford and Macedon/Palmyra (Mahar & Landry, 2016).
- 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, 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 & 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.

Action Category	Action	Description
A.1 Direct Habitat Management	A.1.2.4.1 Plant for erosion management	Implement vegetated riparian buffers on state owned or managed properties to reduce water pollution, nutrient loading, and sedimentation
A.1 Direct Habitat Management	A.1.3.0.0 Mitigate human environmental impact	-Mitigation involving the cleanup of toxins in occupied substrate must include a remediation plan for mussels -Mitigation should address disturbance caused by routine dredging -Mitigate impacts to streams in occupied waters
A.1 Direct Habitat Management	A.1.3.3.0 Remove and improve anthropogenic infrastructure	Replace culverts that disrupt habitat connectivity
B.3 Outreach	B.3.1.3.0 Targeted Communication	-Coordinate with local wastewater treatment to improve ammonia removal in treated discharge -Work with NYS Canal Corp to reduce impacts of Erie Canal dredging -Work with NYSDEC Flood Control to decrease impacts of flood control projects and maintenance on mussels

		- Work with Highway Departments to reduce impacts on mussels by directing road and bridge runoff away from waterbodies and minimizing impacts to mussels during maintenance and construction activities
B.5 Economic and other Incentives	B.5.4 Economic incentives and disincentives	- Through landowner incentive programs, riparian buffers that provide shade, should be added/ maintained/ widened, along agricultural fields, subdivisions, and along major roads to moderate temperature, decrease nitrogen, pesticides, sediment, heavy metals, and salts from entering aquatic systems -Update wastewater treatment facilities in Medina, Watertown, Syracuse, Elmira, and Massena to eliminate combined sewer outflows. -Coordinate with local wastewater treatment facilities to improve ammonia removal of treated discharge.
C.6 Design and Plan Conservation	C.6.4.0.0 Conserve via zoning or informal designations	Protection through acquisition, easements, registry, and/or working with local, state, and federal government on issues relating to zoning and streamside development
C.6 Design and plan conservation	C.6.5.1.2 Develop a strategy, guideline, monitoring plan or follow-up in a protected area	Develop a plan to monitor mussel population trends
C.7 Legislative and regulatory framework or tools	C.7.2.3.0 Create or amend standards	- Consider mussel sensitivity to pollutants in the regulation of wastewater and stormwater discharges to surface waters, State Pollutant Discharge Elimination Systems (SPDES). -Implement TMDLs that are protective of mussels to meet water quality standards -Require state agencies to maintain vegetative buffers along water on state land
C.8 Research and Monitoring	C.8.1.1.1 Characterization, demographic study, population, or inventory	-Surveys to determine trends should take place throughout its range.
C.8 Research and Monitoring	C.8.2.1.2 Monitoring and evaluating the results of project activities	Monitor lampricide treatment site, especially those using a combination of TFM and niclosamide

Table 3. Recommended conservation actions for paper pondshell

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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