Species Status Assessment

Common Name: Threeridge **Date Updated:** 2/4/2025

Scientific Name: *Amblema plicata* **Updated By:** A. Mahar & K. Crandall

Class: Bivalvia

Family: Unionidae

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

Amblema plicata belongs to the subfamily *Ambleminae* and the tribe *Amblemini*, which includes a single New York species of the genus *Amblema* (Haag, 2012). Until the advent of molecular phylogenetic analyses using mitochondrial DNA, the *Amblemini* and *Quadrulini* were united into a single taxon. Members of both tribes brood their larvae in all four demibranchs, and they tend to have shells sculptured with ridges, pustules or both (Graf and Cummings, 2011). *A. plicata* belongs to the genus *Amblema*, which is characterized by blunt margins on all four sides of its shell. *A. plicata* is characterized by folds on the lateral surface of the shell (Watters et al., 2009).

This species lives in lakes, creeks, and rivers, where it is common in muddy, low-gradient streams and rivers (Strayer & Jirka, 1997). Since 1970, this species has been found in twelve New York waterbodies. It is prevalent in Cassadaga and Conewango Creeks in the Allegheny basin and shell specimens have been recently located in the Erie Canal at Macedon (Mahar & Landry, 2013). It has been extirpated from the Buffalo River drainage, yet remains abundant in Tonawanda Creek (Erie Basin). Watters et al. (2009) stated that this once widespread and abundant species has been locally extirpated in many parts of its former range, for unknown reasons.

In New York, *A. plicata* is ranked as “imperiled,” although it is secure throughout its range (NatureServe 2014). 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. NatureServe also indicates that this species is in need of a global status review.

I. Status

a. Current legal protected Status

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

ii. **New York:** None

b. Natural Heritage Program

i. **Global:** G5 – Secure (2014)

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

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:

A. plicata is considered common and widespread throughout much of the U.S. and Canada and is considered stable, or in some cases expanding, throughout its range (NatureServe, 2013). This species ranges from the coastal plain portion of Gulf drainages from the Escambia River in Florida west to Texas and northward into the Mississippi River drainage (Mulvey et al., 1997). Butler (1989) lists the distribution as throughout the Interior Basin and from the San Antonio River, Texas, east to the Choctawhatchee River, but not from the Yellow River. In Canada, it is restricted to southern Ontario, southern Manitoba, and southeastern Saskatchewan, but is widely distributed and often abundant. In Canada, this species is restricted to the Lake Erie drainage in Ontario (Metcalfe-Smith and Cadmore-Vokey, 2004). It extends into the Niagara River drainage in western New York (Strayer & Jirka, 1997 in 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	N/A	N/A			No
New York	Yes	Unknown	Unknown		S1S2	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		S2S3	Yes
Vermont	No	N/A	N/A			No
Ontario	Yes	Stable	Stable	2003-2013	S4	(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.

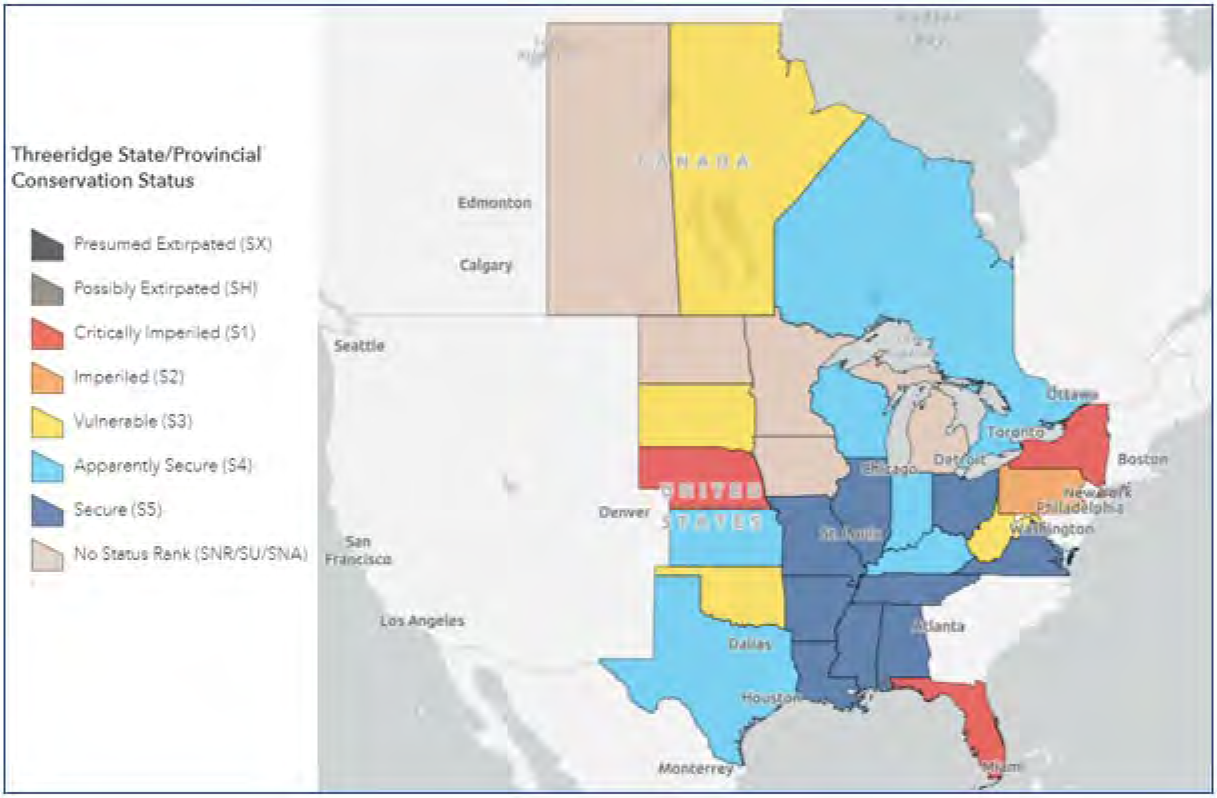

Figure 1. Threeridge distribution and status (NatureServe 2024)

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

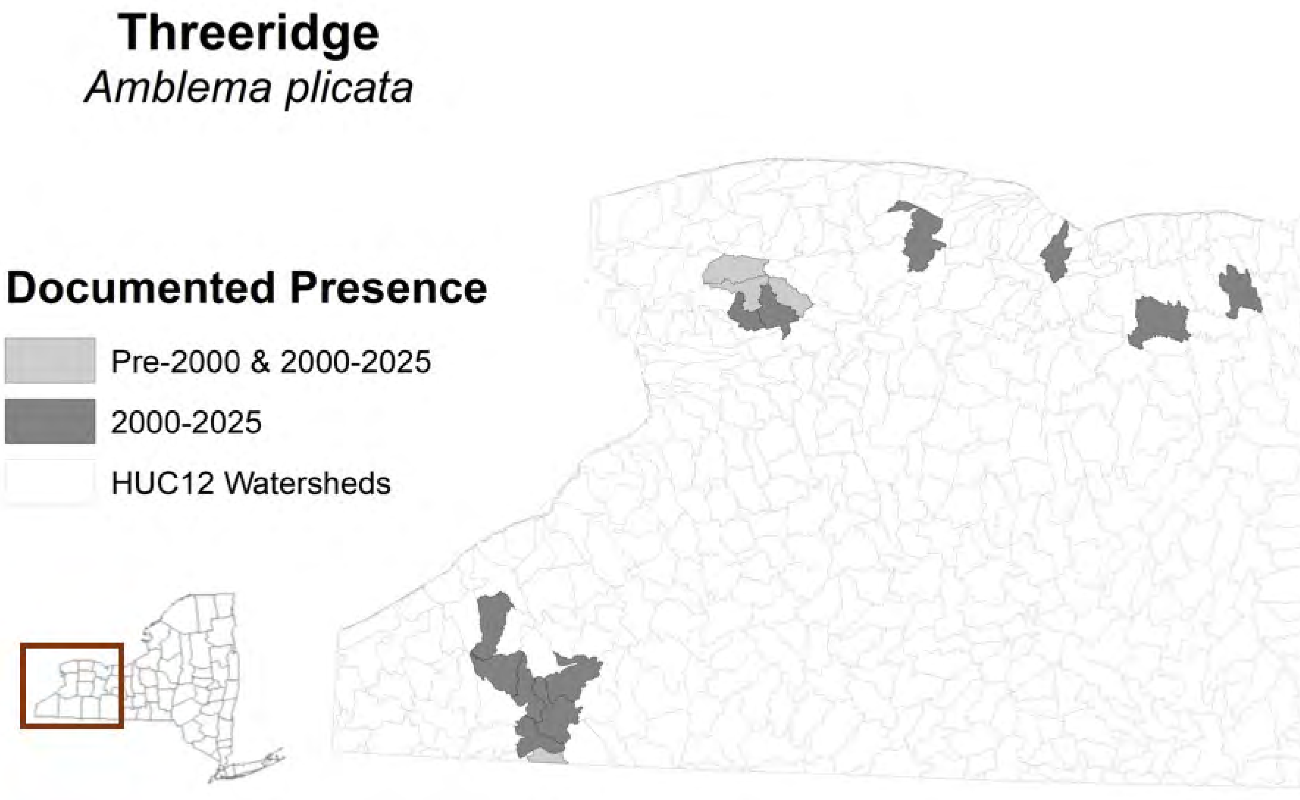

Figure 2. Records of Threeridge in New York (NYSDEC 2024)

	# of Distinct Waterbodies	% of State
Total	12	0.9%

Table 1. Records of Threeridge in New York.

Details of historic and current occurrence:

2024: *A. plicata* has been found in 12 waterbodies and 8 of New York's 349 HUC 10 waterbodies (2.3%).

This species has historically been recorded from low-gradient streams of the Allegheny basin, the Erie-Niagara basin, and several sites along the Erie Canal near Rochester. In addition, there are a few old, poorly documented, records of this species from central New York including: Oneida River, Skaneatales Lake, and old Erie Canal in Onondaga County, suggesting that it followed the Erie Canal well into central New York (Strayer & Jirka, 1997).

Since 1970, *A. plicata* has been found in twelve New York State waterbodies.

A. plicata has apparently been eliminated from the Buffalo River basin, but it remains abundant in Tonawanda Creek (Strayer & Jirka, 1997). In Tonawanda Creek a moderate to relatively large population exists in stable habitat (NY Natural Heritage Program, 2013; Mahar & Landry, 2013). In 1998, a site on Tonawanda Creek was found to have 4-5 animals per square meter of various sizes and age classes (NY Natural Heritage Program, 2013). During The Nature Conservancy's 2005-2007 survey of the Allegheny drainage, 1584 live *A. plicata* was found at 30 of 105 sites. The greatest catches (up to 148 per hour) were in the mid and upper reaches of Cassadaga Creek, with some found in the mid and lower reaches of Conewango Creek. A. plicata was considered viable at 77% of the sites where found. None were found in the Upper Allegheny subbasin (The Nature Conservancy, 2009).

In Central NY, fresh shells, including juveniles and adults, were found in the Erie Canal at Macedon (Wayne 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	80 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:** Small to Medium River

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

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

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:

A. plicata can be found in a variety of habitats, ranging from small streams to big rivers, and from locations such as lakes, reservoirs, rivers, and streams with little or no current to areas of very swift current. Individuals are found in a variety of substrates that are stable enough to support them, including mud, sand, and gravel (Metcalfe-Smith et al, 2005; Cummings & Mayer 1992; Watters et al., 2009). In New York, it is especially common in muddy, low-gradient creeks and rivers (Strayer & Jirka, 1997). It is most common in one to three feet of water, but has been found at depths of 30 feet (Parmalee & 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, *A. plicata* 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).

A.plicata is thought to be tachytictic, with eggs developing in May and glochidia forming from June through August. In Ohio, glochidia were released in July when water temperatures reached a sustained 20°F (Watters et al. 2009). Individuals of this species can live 50 years (Watters et al., 2009).

Hosts for *A. plicata* include a wide variety of fishes, including many centrarchids. Glochidia transformation was confirmed on rock bass (*Ambloptites rupestris*), shortnose gar (*Lepisosteus platostomus*), green sunfish (*Lepomis cyanellus*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), yellow perch (*Perca flavescens*), white crappie (*Pomoxis annularis*), black crappie (*Pomoxis nigromaculatus*), and flathead catfish (*Pylodictis olivaris*). Infestation by glochidia, but not transformation was confirmed on mooneye (*Hiodon tergisus*), emerald shiner (*Notropis antherinoides*),spotfin shiner (*Cyprinella spilopter*), steelcolor shiner (*Cyprinella whipplei*), streamline chub (*Erimystax dissimilis*), black redhorse (*Moxostoma duquesnei*), golden redhorse (*Moxostoma erythrurum*), northern hogsucker (*Hyperntelium nigricans*), channel catfish (*Ictalurus punctatus*), logperch (*Percina caprodes*), freshwater drum (*Aplodinotus grunniens*) (Watters et al., 2009).

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	Serious	Immediate	Stable and ongoing	High
3. Energy Production & Mining	3.3 Renewable Energy	3.3.1 Hydroelectric dams	Large	Moderate	Near-term	Intensifying	High
4. Transportation & Service Corridors	4.1 Roads & Railroads	4.1.3 Bridges	Restricted	Serious	Long-term	Stable and ongoing	High
6. Human Intrusions & Disturbance	6.3 Work & Other Activities	6.3.1 Research activities	Restricted	Slight	Immediate	Stable and ongoing	Low
7. Natural System Modifications	7.2 Dams & Water Management/Use	7.2.1 Water level management using dams	Large	Moderate	Near-term	Intensifying	High
7. Natural System Modifications	7.2 Dams & Water Management/Use	7.2.6 Withdrawl of surface water	Restricted	Moderate	Long-term	Unknown	High
7. Natural System Modifications	7.2 Dams & Water Management/Use	7.2.3 Water management using culverts	Large	Slight	Long-term	Unknown	High
7. Natural System Modifications	7.3 Other Ecosystem Modifications	7.3.3 Natural erosion & sedimentation	Large	Moderate	Near-term	Intensifying	High
8. Invasive & Other Problematic Species	8.1 Invasive Non-Native Plants & Animals	8.1.3 Aquatic animals	Large	Extreme	Near-term	Stable and ongoing	High
8. Invasive & Other Problematic Species	8.2 Problematic Native Plants & Animals	8.2.5 Increased predation by mesopredators	Restricted	Slight	Long-term	Intensifying	Moderate
8. Invasive & Other Problematic Species	8.5 Intrinsic Biological Limitations	8.5.1 Loss of genetic diversity	Large	Moderate	Long-term	Intensifying	High

8. Invasive & Other Problematic Species	8.5 Intrinsic Biological Limitations	8.5.2 Depends on another species that has declined	Restricted	Moderate	Long-term	Unknown	High
9. Pollution	9.1 Domestic & Urban Wastewater	9.1.1 Domestic wastewater	Small	Moderate	Near-term	Unknown	High
9. Pollution	9.1 Domestic & Urban Wastewater	9.1.2 Runoff	Restricted	Moderate	Near-term	Unknown	Moderate
9. Pollution	9.3 Agricultural & Forestry Effluents	9.3.2 Soil erosion, sedimentation	Large	Extreme	Near-term	Unknown	High
9. Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Restricted	Moderate	Near-term	Unknown	Moderate
11. Climate Change	11.3 Changes in Temperature Regimes	11.3.3 Gradual temperature change	Large	Moderate	Long-term	Intensifying	Low
11. Climate Change	11.3 Changes in Temperature Regimes	11.3.4 Increase in temperature fluctuations	Large	Moderate	Long-term	Intensifying	Low
11. Climate Change	11.4 Changes in Precipitation & Hydrological Regimes	11.4.2 Droughts	Restricted	Moderate	Long-term	Intensifying	High
11. Climate Change	11.5 Storms & Severe Weather	11.5.1 Storms & severe weather	Restricted	Moderate	Long-term	Intensifying	Moderate

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

Table 2. Threats to Threeridge.

Watters et al. (2009) reports that this once widespread and abundant species is becoming rare and even extirpated in much of its range due to unknown factors.

Agricultural Runoff

Tonawanda Creek watershed is highly agricultural. And 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. plicata* have been found, are influenced by limited agriculture. In addition, wood harvest or agricultural practices may be sources of siltation and pollution (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 four New York water bodies that host *A. plicata* populations are intermittently bordered by interstate highways, state routes, and/or local roads and lawns. In addition, Cassadaga Creek also receives Jamestown's urban runoff via the Chadokoin River (New York State Landcover, 2012). These developed areas are likely sources of runoff (Gillis, 2012) 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

Cassadaga Creek receives treated effluent from the city of Jamestown sewage treatment plant (SPDES, 2007). Furthermore, raw sewage from illegal dumping by recreational boats may be a concern for *A. plicata* populations in the Macedon section of 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 as cited in Watters et al., 2009) 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 isolated occurrences of canal dredging, instream work associated with bridge replacement or gravel mining, and vegetation removal kill mussels and destroy their habitat. This is of particular concern for the Erie Canal *A. plicata* population, as maintenance dredging by the NY Canal Corporation is an accepted practice. 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).

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 *A. plictata* population. During spring mussel surveys of the Erie Canal, it is not uncommon to find hundreds of fresh shells of multiple species, including *A. plicata,* 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 and quagga mussels (*Dreissena polymorpha* and *Dreissena bugenis*) remain a threat to *A. plicata* populations in the Erie Canal, while zebra mussels pose a potential threat to 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. These invasive species 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 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. 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).
It is uncertain if sea lamprey control treatments pose a threat to *A. plicata* as most occurrences are well upstream in the Tonawanda, but the sensitivity of this species to lampricides is currently unknown.

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 "highly vulnerable." This indicates that abundance and/or range extent within New York is likely to decrease significantly 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). 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, Cassadaga Creek and Tonawanda Creek (Mahar & Landry, 2013).

- 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.

Action Category	Action	Description
A.1 Direct Habitat Management	A.1.2.4.1 Plant for erosion management	Implement riparian buffers to reduce sedimentation
A.1 Direct Habitat Management	A.1.3.0.0 Mitigate human environmental impact	Mitigation focus on Cassadaga Creek and Tonawanda Creek
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 Highway Departments to reduce impacts on mussels
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.7.1.3.0 Create, amend, or influence regulation	-Modify marine mussel regulations to clarify protection under ECL -Require state agencies to maintain vegetative buffers along water on state land
C.7 Legislative and Regulatory Framework or Tools	C.7.2.3.0 Create or amend standards	Implement TMDLs to meet water quality standards
C.8 Research and Monitoring	C.8.2.1.2 Monitoring and evaluating the results of project activities	Monitor lampricide treatment sites, especially those using a combination of TFM and niclosamide

Table 3. Recommended conservation actions for Threeridge.

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.
- Repair or create riparian buffer zones adjacent to mussel streams to mitigate the effects of runoff and increase stream bank stabilization.

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.
- 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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