Species Status Assessment

Common Name: Eastern hellbender **Date Updated:** January 8, 2025

Scientific Name: *Cryptobranchus alleganiensis alleganiensis*

Updated By: K. Crandall, J. Walters, T. Bell, R. Bakerian

Class: Amphibia

Family: Cryptobranchidae

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

There are two subspecies of hellbender in North America: the eastern hellbender, *Cryptobranchus alleganiensis alleganiensis* occurs in the eastern United States from southern New York southward to Alabama and Mississippi and westward to Missouri and Arkansas; and the Ozark hellbender, *Cryptobranchus a. bishopi*, occurs in the Ozark Mountains of northern Arkansas and southern Missouri (Petranka 1998). The Ozark hellbender is federally endangered.

The eastern hellbender reaches its northern limit in New York, where it occurs solely in the Allegheny and Susquehanna River basins. Strictly aquatic, adults are found in streams and rivers with shallow, swift moving currents and large, flat rocks (Smith 1907, Bishop 1941, Hillis and Bellis 1971, Nickerson and Mays 1973). Populations both range-wide and in New York are known to be declining, likely due to habitat degradation and loss, but possibly due to a suite of other human induced stressors such as non-native fish and introduced disease. Without intervention, it is likely that hellbenders will continue to decline in New York.

I. Status

a. Current legal protected Status

i. **Federal:** Not listed, except for Missouri DPS **Candidate:** Yes

ii. New York: Special Concern, HPSGCN

b. Natural Heritage Program

i. **Global:** G3T2

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

Other Ranks:
-IUCN Red List: Vulnerable
-COSEWIC: N/A
-Northeast Regional SGCN List (2023): High Conservation Concern
-NEPARC Regional List (2010): Species of Severe Concern
-USFWS: Missouri Distinct Population Segment (DPS) listed as endangered (USFWS 2021).

Status Discussion:

The U.S. Fish & Wildlife Service (USFWS) conducted a status assessment to determine whether the eastern hellbender should be considered for federal listing. Hellbender populations were split into four Adaptive Capacity Units (ACU) for the assessment based on four genetically distinct

lineages: Missouri (MACU), Ohio and Susquehanna River Drainages (OACU), Tennessee River Drainage (TACU), and Kanawha River Drainage (KACU). New York's populations fall within the OACU. Best-case scenarios predicted a slight increase in healthy populations range-wide, while worst-case scenarios predicted a slight decrease. However, under all scenarios, the number of healthy populations in the OACU was predicted to decline. The USFWS concluded that the eastern hellbender was not a candidate for federal listing due to the number of extant and healthy populations. However, the MACU population was concluded to be an exception to this ruling and was subsequently listed as endangered (USFWS 2021). Following this decision, a lawsuit was filed against the USFWS alleging that the agency did not rely on the best available scientific and commercial data. In response, the USFWS conducted an updated assessment and, in December 2024, announced a proposal to list the eastern hellbender as an endangered species throughout its range under the Endangered Species Act (USFWS 2024).

The eastern hellbender is listed as Vulnerable by the IUCN (2022) because the species is believed to be in significant decline, estimated at 30-50% over the past three generations (assuming a generation length to be approximately ten years), primarily driven by disease and widespread habitat loss and degradation through much of its range. Northeast Partners in Amphibian and Reptile Conservation (NEPARC) considers the eastern hellbender a Species of Severe Concern because more than 75% of states list the species as a Species of Greatest Conservation Need (SGCN).

In New York, hellbenders occur in two watersheds and are known to be declining in both (Foster 2006, Foster et al. 2009, Quinn 2009). This species has been listed as Special Concern in the state since 1983.

II. Abundance and Distribution Trends

Region	Present?	Abundance	Distribution	Time Frame	Listing status	SGCN?
North America	Yes	Declining	Declining	Last 30 years	Proposed Endangered	
Northeastern US	Yes	Declining	Declining			Yes
New York	Yes	Declining	Declining	Last 30 years	HPSGCN, Special Concern	Yes
Connecticut	No	N/A	N/A			
Massachusetts	No	N/A	N/A			
New Jersey	No	N/A	N/A			
Pennsylvania	Yes	Declining	Declining	Last 30 years	SGCN	Yes
Vermont	No	N/A	N/A			
Ontario	No	N/A	N/A			
Quebec	No	N/A	N/A			

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 Amphibian and Reptile Atlas Project (Herp Atlas), conducted from 1990-1999, documented the geographic distribution of all amphibians and reptiles in the state. The Herp Atlas database also includes pre-1990 records from various sources, such as museum records, researchers' field notes, agency reports, and published literature.

In the Allegheny River basin, 11 hellbender sites have been established for monitoring population trends through mark and recapture surveys at 5-10-year intervals. Mark and recapture surveys were initiated in the 1980's at seven of these monitoring sites, and by 2014 a second interval of monitoring had been completed at nine of these sites.

From 2011-2017 NYSDEC released 429 head-started and PIT-tagged hellbenders into the Allegheny River and several tributaries. Follow up studies on head-started hellbenders to evaluate survival, fidelity to release locations, and health monitoring has been ongoing at three of the release sites. Health monitoring includes biological measurements and skin swabs for ranavirus and chytrid (*Batrachochytrium dendrobatidis*) disease testing.

Hellbender population surveys in the New York portion of the Susquehanna watershed date back to 1923. More localized surveys occurred periodically in areas of the watershed between 1982 and 2017. Quinn (2009) completed a more comprehensive survey of the eastern portion of the watershed between 2008 and 2009, and Foster (2015), conducted a more systematic assessment of hellbender presence and habitat availability in the larger watershed between 2012 and 2015.

Population augmentation was also conducted within a section of the Upper Susquehanna watershed, starting in 2015, when eggs were collected from a single nest for head-starting. Two juvenile cohorts, totaling 223 individuals, were released in an effort to restore the hellbender population at this historic location in 2018 and 2021. Monitoring of juvenile cohorts started in 2018, and biweekly surveys occur annually and similarly consist of evaluating survival, site fidelity, and health of released hellbenders.

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

As early as 1957, it was noted that the hellbender's range was rapidly shrinking as a result of human modification of stream habitats (Smith and Minton 1957). Eastern hellbender populations have shown significant declines range-wide over the last 20 years (Wheeler et al. 2003, Humphries and Pauley 2005). Declines have also been documented in New York hellbender populations, where they occur in the Susquehanna and Allegheny River basins (Wheeler et al. 2003, Foster 2006, Quinn 2009).

Surveys conducted across time in New York recorded fewer individuals per site and a notable lack of reproductive activity (Gibbs et al. 2007). Many sites only produced single-digit totals or no individuals where populations were once healthy and thriving (Foster 2006, Foster et al. 2008). Foster (2006) documented a 44% decline at sites first surveyed by Gottlieb (1991); however, Foster's study also documented larval/juvenile individuals in the Allegheny drainage, indicating that some reproduction is still taking place. In the Allegheny River system, Foster (2006) documented that one hellbender population that had existed in the mid-1980s had become extirpated, and several other populations seemed to be less abundant than they were in the 1980s. Population declines seem to be even greater in the Susquehanna River system. In 2002 and 2003, researchers found no hellbenders at a site in the Susquehanna River system that previously supported the largest known hellbender population in the system in New York (Breisch and Bothner 2003).

Researchers speculate the lack of recruitment observed could be due to high mortality rates of larval/juvenile hellbenders, conspecific predation, and/or the inability to maintain healthy genetic variation within a population (Mayasich et al. 2003, Wheeler et al. 2003, Foster 2006). Research is needed to determine the genetic diversity of New York populations.

Population size and distribution are difficult to determine due to inefficient survey methods and low population numbers. Due to the cryptic nature of the species, the number of individuals found in the state is not considered as important as the number of established locations.

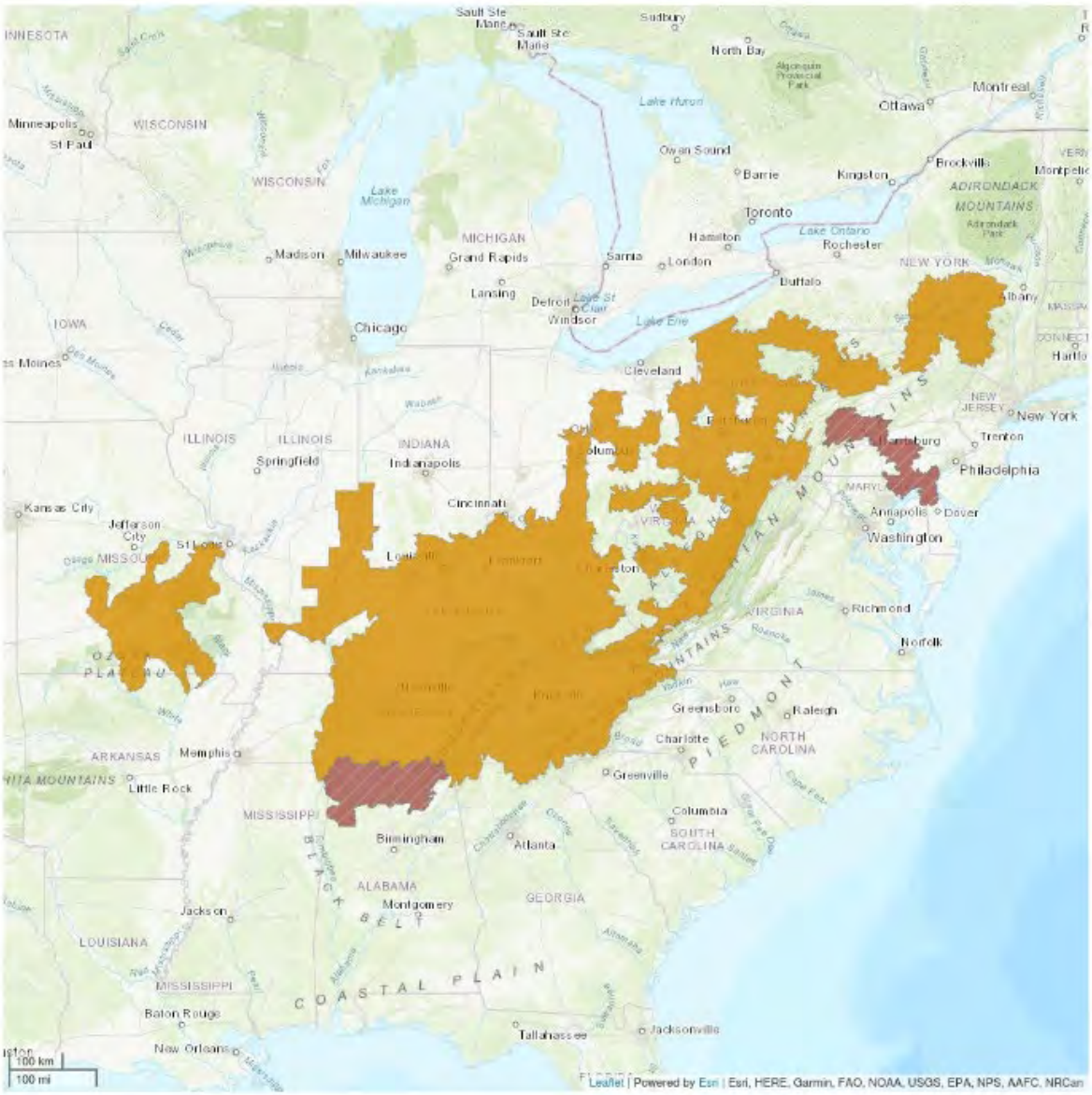

Figure 1: Distribution of the eastern hellbender (IUCN 2022)

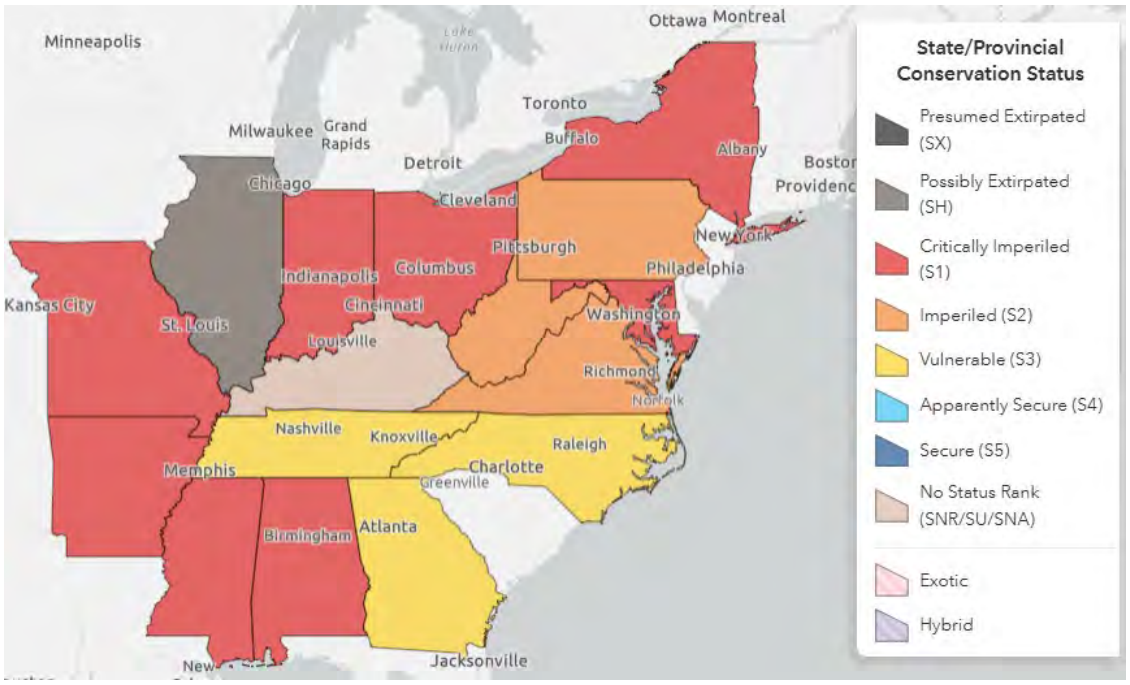

Figure 2: Conservation status of eastern hellbender in the United States (NatureServe 2024).

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

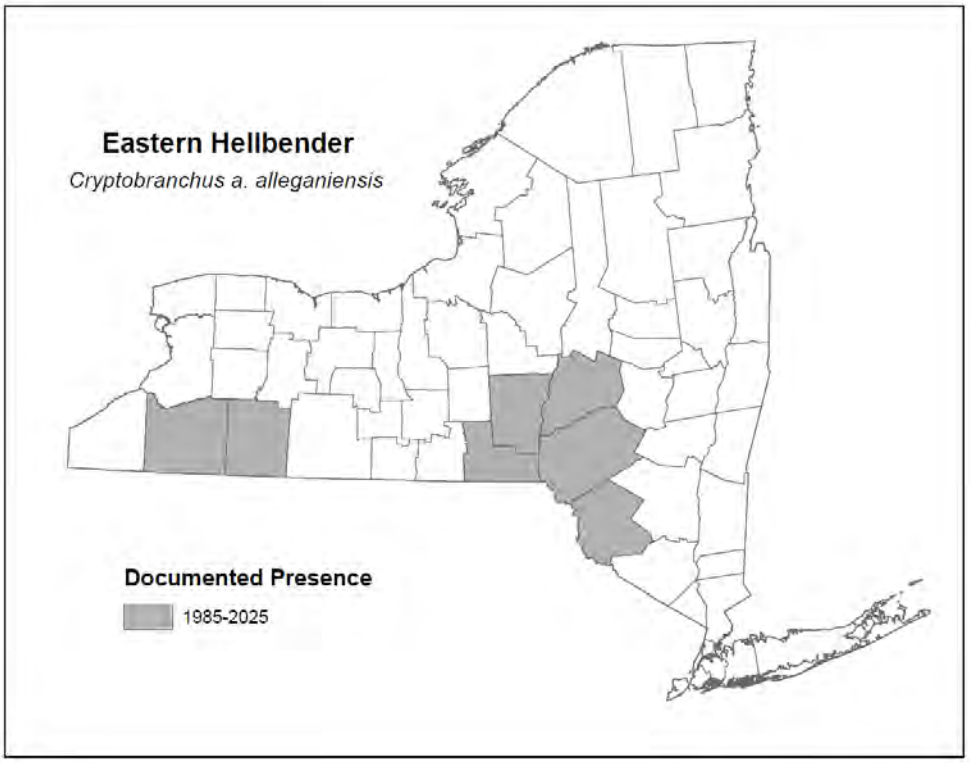

Figure 3: Distribution of eastern hellbender in New York, 1985-2025 (NY Herpetology database, NYSDEC)

Details of historic and current occurrence:

Early accounts of hellbender populations in New York often described them as abundant (Bishop 1941). Bishop (1941) reported hellbenders in the Susquehanna River watershed in 1923 from Rockdale (Unadilla River), Chenango County. Harlan (1835) first identified the species in the Allegheny River in 1835. The eastern hellbender is known within two watersheds in New York: the Allegheny River watershed and the Susquehanna River watershed. There was also a 1990 capture in the Delaware River in Sullivan County; however, this was believed to be a released animal (Gibbs et al. 2007).

The following information is based on a review of the New York Natural Heritage Program database as of January 2025. The New York Natural Heritage Program reports ten distinct locations for eastern hellbender in the Upper Susquehanna Watershed prior to 1985. Eight of these locations are now considered historic records with no hellbenders observed during subsequent surveys of these locations after 1985. Hellbenders were still documented during surveys at two of the ten original sites after 1985. Since 1985, five new locations were documented for eastern hellbender in the Upper Susquehanna watershed. Currently, seven locations out of fifteen total documented locations for hellbenders in the Upper Susquehanna watershed are considered to be extant. Current site occupancy remains unknown or questionable at some locations, though, without more recent survey data, and number of individuals at these locations are unknown with the exception of one site. Not all extant sites have been resurveyed since 2015. Eight locations of the fifteen total locations in the Upper Susquehanna Watershed are likely extirpated.

In the Allegheny Drainage, the New York Natural Heritage Program reports 25 locations for eastern hellbender prior to 1985, eleven of which are now considered historic records. Fourteen of the 25 sites documented prior to 1985 have been resurveyed and are considered extant. In addition to these 14 locations that have persisted after 1985, 14 new locations have also been documented since 1985. Currently, 28 out of the 39 total sites are reported to have hellbenders documented since 1985. The number of individuals at these locations is unknown. The information in these databases is presumed incomplete, as not all historic sites have been revisited, and not all extant sites have been resurveyed since 2015.

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 mi

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, Cold

b. Small River, Cold

c. Medium River, Cold

d. Large/Great River, Cold

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:

Strictly aquatic, adult habitat requirements are well documented in the literature. Hellbenders respire primarily (approximately 90%) through the skin (Guimond and Hutchinson 1973) and are therefore dependent on cool, well-oxygenated, flowing water. Hellbenders usually avoid water that is warmer than 20 degrees Celsius, and are not well adapted to low-oxygen conditions. Most researchers cite streams and rivers with shallow, swift moving currents and with large (> 30 cm), flat rocks as the preferred habitat (Smith 1907, Bishop 1941, Hillis and Bellis 1971, Nickerson and Mays 1973). Individuals rest and nest beneath large flat rocks with a downstream-facing opening. They may use an existing cavity or may excavate one to accommodate its body size (Gibbs et al. 2007).

Research in New York suggests the riparian zone along a stream's margins is important as a buffer (Trimble 1999, Madden et al. 2007). Forested areas lining the margins of a stream have numerous effects on the water quality flowing through the system. Forested riparian areas filter runoff that contains silt and other organic and inorganic molecules that can negatively impact water quality and hellbender nesting sites. Trees can also provide shade for streams, suppressing water temperatures and increasing dissolved oxygen levels (Sweeney 1992, Madden et al. 2007).

Foster (2006) found that methodically searching 3-4 meters from stream margins in areas that contained moderate to fast flowing water with gravel beds and piles of smaller rocks returned the best results for larval/juvenile hellbenders.

Blais (1996) conducted a radio telemetry study of wintering hellbenders in the Susquehanna watershed. He identified three major areas used for overwintering: pools greater than two meters deep, fast-moving riffles that remained fluid throughout the winter, and deeper pockets within riffles less than two meters deep. Overwintering hellbenders typically utilize the same large, flat rocks that are used throughout the year. They appear to select overwintering sites that have less chance of freezing (Blais 1996). The physical act of hibernation has not been recorded and Blais (1996) found little to no movement during winter months.

V. Species Demographic, and Life History:

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

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):*

Hellbenders are a long-lived species, with captive specimens surviving in laboratory conditions for 29 years (Nigrelli 1954) and growth rate data suggesting they can live more than 30 years in the wild (Taber et al. 1975, Petranka 1998). Hellbenders are primarily nocturnal, with daytime movements being observed close to breeding season (Mayasich et al. 2003). Movements by tagged adults of up to 1km have been reported (Wiggs 1977, Foster 2006), and Blais (1996) concurs, reporting little to no seasonal migratory behavior. Adults feed primarily on crayfish. Nickerson and Mays (1973) and Gall (2008) identify northern pike, non-native trout species, muskellunge, turtles, water snakes, and humans as hellbender predators.

Hellbenders reproduce via external fertilization, and in New York, breeding occurs in late August and early September. Males select a suitable breeding site, typically an opening beneath a large rock that is natural or excavated by the male. Males guide a female into the nest and block her exit until the eggs are laid. A male may entice more than one female to lay eggs in his nest. Females typically produce approximately 200-450 eggs per breeding season (Bishop 1941, Pfingsten 1990, Petranka 1998, Gibbs et al. 2007). Once the female lays her clutch, she leaves the nest. The male fertilizes the eggs and remains with them until they hatch in 68-75 days. Larval hellbenders rely on their large embryonic yolk as their main food source for the first few months after hatching (Smith 1912 as cited by Petranka 1998). The external gills of larvae fall off in 1.5 to 2 years and sexual maturity is attained at 5 to 7 years of age (Smith 1907, Bishop 1941, Dundee and Dundee 1965, Nickerson and Mays 1973, Petranka 1998).

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

As a habitat specialist with little tolerance to environmental change (Williams et al. 1981), the primary threat to this species is degradation of habitat. One source of habitat degradation is dam construction, which causes changes in water flow, temperature, and oxygen levels (Mayasich et al. 2003, USFWS 2007). Construction of roads and bridges can lead to sedimentation, which causes loss of habitat by reducing water quality and filling in cavities beneath rocks. Channelization and gravel mining in streams causes habitat disturbance. Stream channel relocation has caused severe hellbender habitat loss in both New York river basins where hellbenders occur. In most cases, the eroding streambank responsible for generating cover rocks used by hellbenders are eliminated with stream relocation. Chemical pollutants and acid mine drainage are probably destructive, especially to eggs and larvae. Thermal pollution of water, with a consequent oxygen loss, would also be detrimental (Hammerson and Phillips 2004). There is some indication that hellbender populations suffer from low genetic variability and that recruitment is limited by endocrine disruption (Mayasich et al. 2003).

Collection for scientific research and the commercial pet trade, as well as incidental collection and persecution by anglers (Foster 2006, USFWS 2007), has historically affected populations. Some anglers erroneously believe that hellbenders are poisonous, or that they impact fish populations, and kill them when accidentally caught. Hellbenders generally are intolerant of heavy recreational use of habitat, such as canoeing. Cattle and other grazing animals can degrade river habitats.

The introduction of invasive and non-native species may also impact the hellbender. The rusty crayfish, *Orconectes rusticus*, is a large, aggressive crayfish that has been found in the Upper Susquehanna watershed (Kuhlmann and Hazelton 2007). Its effects on the native crayfish and its relationship with hellbenders are unknown, though experimental investigations indicated hellbenders use rusty crayfish as a prey source and were not displaced from under rocks by rusty

crayfish (Hartzell et al., 2022). Non-native predatory fish may also impact hellbenders through direct predation on eggs, larvae, and sub-adults and through competition for resources (Gall and Mathis 2010).

The chytrid fungus, *Batrachochytrium dendrobatidis* (Bd), first described in 1998 (Longcore et al. 1999), is a fungal pathogen that has affected more than 200 amphibian species (Skerratt et al. 2007). Bd has been identified in hellbender museum specimens from as early as 1969 (Bodinof et al. 2011). Bd was first identified in Allegheny River basin hellbenders in 2009 during DEC surveys for this pathogen. During 2012 surveys, significant numbers of hellbenders tested positive for Bd (K. Roblee, pers. comm.). First identified in the 1960s (Granoff et al. 1965), ranaviruses have been shown to cause mortality in at least 14 families and more than 70 individual species of amphibians, including hellbenders (Miller et al. 2011).

Climate change may negatively affect hellbender populations by increasing water temperatures, thus reducing dissolved oxygen levels. The hellbender was classified as “highly vulnerable” to predicted climate change in an assessment of vulnerability conducted by the New York Natural Heritage Program (Schlesinger et al. 2011). A study on the impacts of rising water temperatures on eastern hellbenders initiated by the National Zoo indicated hellbenders can physiologically tolerate projected warming temperatures and temperature fluctuations driven by climate change, but warmer summers may cause hellbenders to enter the fall breeding season with a caloric deficit that may have population-level consequences (Terrell et al., 2021)

Threat Level 1	Threat Level 2	Threat Level 3	Spatial Extent*	Severity*	Immediacy*	Trend	Certainty
1. Residential and Commercial	1.1 Housing & Urban Areas	Choose an item. (habitat loss)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
2. Agriculture & Aquaculture	2.1 Annual & Perennial Non-Timber Crops	Choose an item. (siltation from farming)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
4. Transportation & Service Corridors	4.1 Roads & Railroads	Choose an item. (siltation during construction & maintenance)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
5. Biological Resource Use	5.1 Hunting & Collecting Terrestrial Animals	5.1.4 Poaching/persecution of terrestrial animals (by anglers) (pet trade)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
6. Human Intrusions & Disturbance	6.1 Recreational Activities	6.1.8 Wildlife observation/photography (herping and bait collection)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
6. Human Intrusions & Disturbance	6.3 Work & Other Activities	6.3.1 Research activities	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
7. Natural System Modifications	7.2 Dams & Water Management/Use	7.2.1 Water level management using dams (channelization)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
8. Invasive & Other Problematic Species	8.1 Invasive Non-Native Plants & Animals	8.1.3 Aquatic animals (rusty crayfish, non-native game fish, carp)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
8. Invasive & Other Problematic Species	8.4 Pathogens	8.4.2 Viral pathogens (ranavirus)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
8. Invasive & Other Problematic Species	8.4 Pathogens	8.4.3 Fungal pathogens (chytrid)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
9. Pollution	9.1 Domestic & Urban Wastewater	Choose an item. (leaking septic, wastewater treatment plants)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
9. Pollution	9.2 Industrial & Military Effluents	Choose an item. (contamination from mines)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
9. Pollution	9.3 Agricultural & Forestry Effluents	9.3.3 Herbicides & pesticides	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.

9. Pollution	9.3 Agricultural & Forestry Effluents	Choose an item. (manure & whey; O2 not nutrient loading issue)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
11. Climate Change	11.3 Changes in Temperature Regimes	Choose an item. (temperature extremes)	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
11. Climate Change	11.4 Changes in Precipitation & Hydrological Regimes	11.4.2 Droughts	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.
11. Climate Change	11.5 Storms & Severe Weather	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Choose an item.

Table 1. Threats to eastern hellbender.

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:

In 2006, the State of New York adopted legislation (ECL section 11-0107 sub 2) that gave all native frogs, turtles, snakes, lizards and salamanders legal protection as game species, and no salamander species are open to harvest. The legislation also outlaws the sale of any native species of herpetofauna regardless of its origin.

The hellbender's habitat is protected under Article 15 of the ECL, which provides regulations in Title 5 for the protection of streams (classified as C(T) or higher), stream beds, and navigable waters.

The U.S. Fish and Wildlife Service's (FWS) lists the hellbender, including its two subspecies, the eastern hellbender and Ozark hellbender in Appendix III of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES or Convention). Listing of hellbenders in Appendix III of CITES took effect on April 3, 2012.

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

Mayasich and Phillips (2003) make the following recommendations of actions needed in 'The Conservation Assessment for Eastern Hellbenders':

- Monitoring and surveys
- Basic research (demographic, ecological, behavioral)
- Use of Best Management Practices
- Habitat restoration
- Captive breeding and reintroduction
- Public outreach

The St. Louis Zoo maintains a captive-breeding program for Ozark hellbenders. The Nashville Zoo is developing captive-breeding program for eastern hellbenders. The success of either program to enhance native populations has not been determined.

NYSDEC, in cooperation with the Buffalo Zoo, investigated the efficacy of head-starting hellbenders. Over 400 hellbenders from eggs collected from the Allegheny River have been released back into extant or restored sites in this river basin. Monitoring for up to 5 years post release has occurred to determine the success of this management technique. Survival and site fidelity of released head-started hellbenders was very low. At the end of 2017, an estimated 3% were still alive. This estimate may be lower than the true number of surviving head-started hellbenders as it is plausible that some head-started hellbenders emigrated from the release sites and survived.

New York's draft hellbender management plan provides a list of management actions for hellbenders. It states a goal of having hellbenders present in at least 40 locations in the Allegheny unit and at least 10 locations in the Susquehanna unit that are rated with a EO Ranking of "BC" or above by the New York Natural Heritage Program. The ranking of "BC" corresponds to good to fair viability.

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2005) includes recommendations for the following actions for hellbenders. Actions that have been accomplished, or where progress has been made, are indicated with a check. Conservation actions following IUCN taxonomy are categorized in the table that follows.

Educational signs:

✓ Educational outreach to fishermen in the Allegheny and Susquehanna drainages could encourage release of incidentally caught hellbenders, as well as enlisting fishermen to report captures to wildlife managers.

Habitat management:

____ Undertake management actions to control water pollutant inputs and sediment loading of streams in the Susquehanna and Allegany River watersheds. Manage land use practices in the upland vicinity of streams where such practices may be adversely impacting stream qualities which are critical to hellbender survival. Investigate whether removal of some dams blocking movement of the hellbender is feasible.

✓ Investigate the efficacy of supplementing available cover and nest rocks with placed flagstone and artificial nest boxes in order to increase availability of suitable cover in situ.

Habitat research:

✓ Develop standardized habitat survey protocols, and implement survey protocols at all known and potentially suitable sites, to document the character, quality and extent of occupied habitat.

Life history research:

____ Document life history parameters specific to New York populations of the species, including age and sex ratios, longevity, age at sexual maturity, survivorship of young, predator-prey relationships, and stream habitat requirements.

____ Undertake research to document life history and habitat use by juvenile hellbenders in New York.

Modify regulation:

✓ Adopt into New York's Environmental Conservation Law provisions which designate hellbender as a protected small game species.

Other action:

✓ Periodically evaluate status of the species to determine whether the appropriate E/T/SC status listing is in effect.

Population enhancement:

✓ Employ restoration techniques at selected sites as needed, including captive breeding, head starting, nest protection, and repatriation/relocation strategies.

Population monitoring:

✓ Conduct periodic re-survey of known sites of species occurrence, in order to detect population trends.

Statewide baseline survey:

✓ Develop population survey protocols and implement protocols at known and potentially suitable sites to determine the extent of occupied habitat in New York.

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

Action Category	Action	Description
A.1 Direct Habitat Management	A.1.0.0.0 Direct habitat management	Site/Area management
A.2 Direct Species Management	A.2.0.0.0 Direct species management	Invasive/Problematic Species Control
A.2 Direct Species Management	A.2.0.0.0 Direct species management	Species Recovery
B.3 Outreach	B.3.1.0.0 Outreach, communication, and distribution	Awareness & Communications
B.4 Law Enforcement and Prosecution	B.4.0.0.0 Law Enforcement and Prosecution	Compliance and Enforcement
C.6 Design and Plan Conservation	C.6.5.1.3 Develop a conservation, management, or restoration plan for protected private lands	Habitat and natural process restoration
C.7 Legislative and Regulatory Framework or Tools	C.7.1.2.0 Create, amend, or influence legislation	Legislation

Table 2. Recommended conservation actions for eastern hellbender.

VII. References

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