Species Status Assessment

Class: Amphibia
Family: Cryptobranchidae
Scientific Name: *Cryptobranchus alleganiensis alleganiensis*
Common Name: Eastern hellbender

Species synopsis:

There are two subspecies of hellbender in North America: the eastern hellbender, *Cryptobranchus a. 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 rangewide 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 and Legal Protected Status

i. Federal ___Not Listed_____ **Candidate?** __No__

ii. New York ___Special Concern; SGCN_____

b. Natural Heritage Program Rank

i. Global ____G3G4_____

ii. New York _____S2_____ **Tracked by NYNHP?** __Yes____

Other Rank:
USFWS – Status Assessment is being conducted.
Severe Concern (NEPARC 2010)

Species of Northeast Regional Conservation Concern (Therres 1999)

IUCN: Near Threatened
Partners in Amphibian and Reptile Conservation: Species of Northeast Responsibility

Status Discussion:
The U.S. Fish & Wildlife Service is conducting a status assessment to determine whether Eastern hellbender should be considered for federal listing.

Listed as Near Threatened by IUCN because this species is probably in significant decline (but probably at a rate of less than 30% over three generations (assuming a generation length to be approximately ten years) because of widespread habitat loss through much of its range, thus making the species close to qualifying for Vulnerable. Northeast Partners in Amphibian and Reptile Conservation (NEPARC) considered the eastern hellbender a Species of High Concern because more than 75% of states list the species as an SGCN.

In New York, hellbenders occur in two watersheds and are known to be declining in both; it has been listed as Special Concern since 1983.

II. Abundance and Distribution Trends

a. North America

i. Abundance

__X__ declining ____increasing _____stable ____unknown

ii. Distribution:

__X__ declining ____increasing _____stable ____unknown

Time frame considered: ___Last 20 years_____

b. Regional

i. Abundance

__X__ declining ____increasing ____stable _____unknown

ii. Distribution:

__X__ declining ____increasing ____stable _____unknown

Regional Unit Considered:_____Northeast_____
Time Frame Considered: ___Allegheny & Susquehanna river watersheds_____

c. Adjacent States and Provinces

CONNECTICUT	**Not Present __X___**	**No data _____**
MASSACHUSETTS	**Not Present __X___**	**No data _____**
NEW JERSEY	**Not Present __X___**	**No data _____**
ONTARIO	**Not Present __X___**	**No data _____**
QUEBEC	**Not Present __X____**	**No data _____**
VERMONT	**Not Present __X____**	**No data _____**
PENNSYLVANIA	**Not Present _____**	**No data _____**

i. Abundance

__X__ declining ____increasing ____stable ____unknown

ii. Distribution:

__X__ declining ____increasing ____stable ____unknown

Time frame considered: ___Last 20 years_____
Listing Status: ___Not Listed, but SGCN "Immediate Concern"__ SGCN? _Yes___

d. NEW YORK **No data _____**

i. Abundance

__X__ declining ____increasing ____stable _____unknown

ii. Distribution:

__X__ declining ____increasing ____stable _____unknown

Time frame considered: ___Last 20 years_____

Monitoring in New York.

The NY Amphibian and Reptile Atlas (Herp Atlas) was conducted in 1990-99. The Herp Atlas database also includes historic records from prior to 1990; these records are primarily a compilation of museum records and researchers' field notes.

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 1980s at 7 of these monitoring sites, and by 2012 a second interval of monitoring had been completed at nine of these sites. In the Susquehanna, two sub-watersheds will be surveyed to determine presence/absence of hellbenders, and habitat suitability will be assessed.

NYSDEC has released 146 head-started, pit-tagged animals into Allegheny tributaries. Hellbender health monitoring has been ongoing through studies at three sites in the Allegheny. Blood samples are taken from captured individuals to examine overall health, and skin swabs and tissue samples are taken for disease testing.

Trends Discussion:

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 rangewide in 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).

Recent surveys in New York recorded fewer individuals per site and a noticeable 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 did document 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 the 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 ability to maintain healthy genetic variation within a population (Mayasich et al. 2003, Wheeler et al. 2003, Foster 2006). Work is needed to determine the genetic diversity of NY populations.

Population size and distribution are difficult to determine due to inefficient survey methods and low population numbers. Approximately 37 hellbender sites are known throughout the Allegheny and Susquehanna watersheds. There are 14 locations in the Allegheny Watershed that currently or historically have had hellbender populations. The exact number of extant locations in the Susquehanna Watershed is currently unknown, but 23 sites were recently or historically occupied. 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.

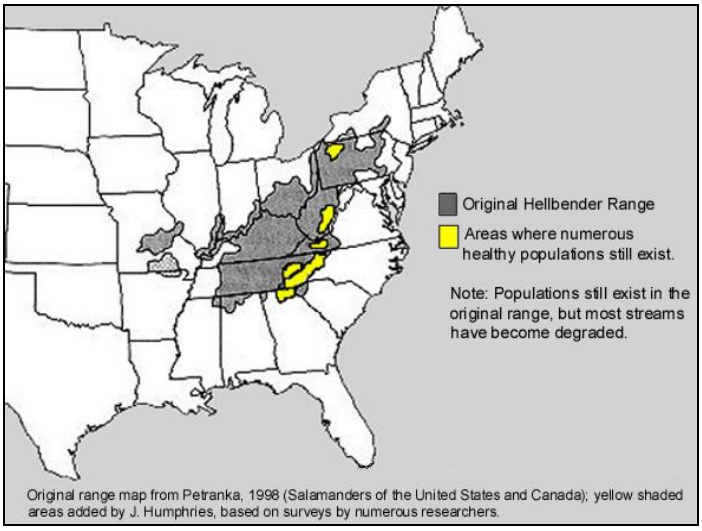


Figure 1: Distribution of eastern hellbender in the United States. Original range map from Petranka (1998), yellow shaded areas by J. Humphries. Used by permission.

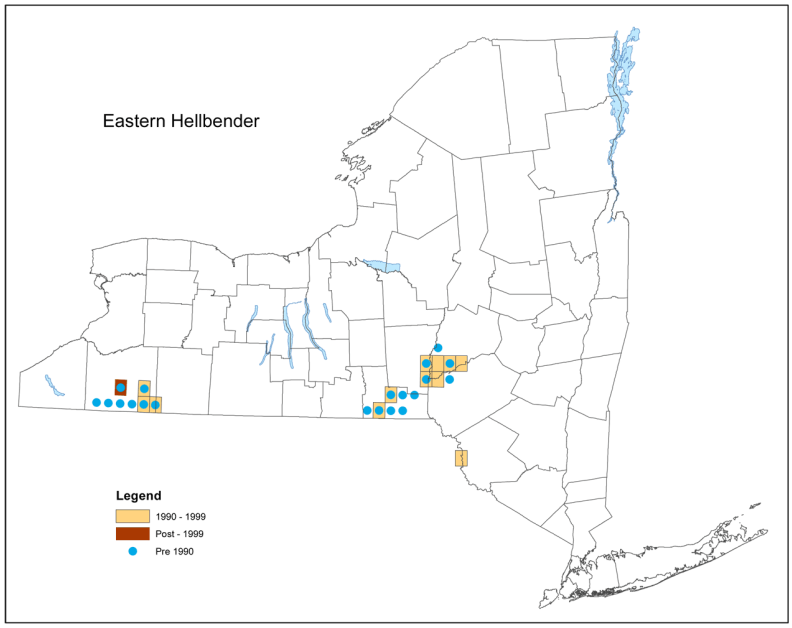


Figure 2: Distribution of eastern hellbender in New York (NY Herpetology database, NYSDEC)

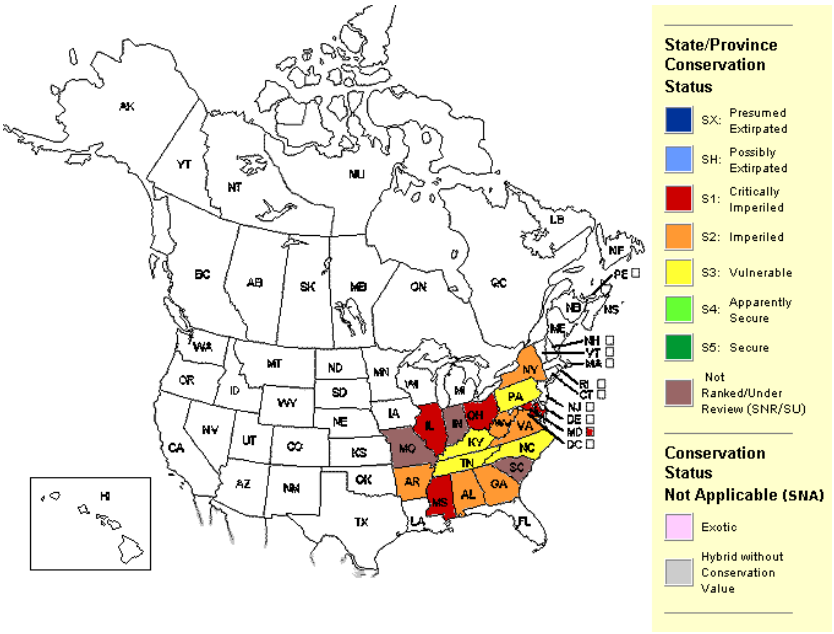
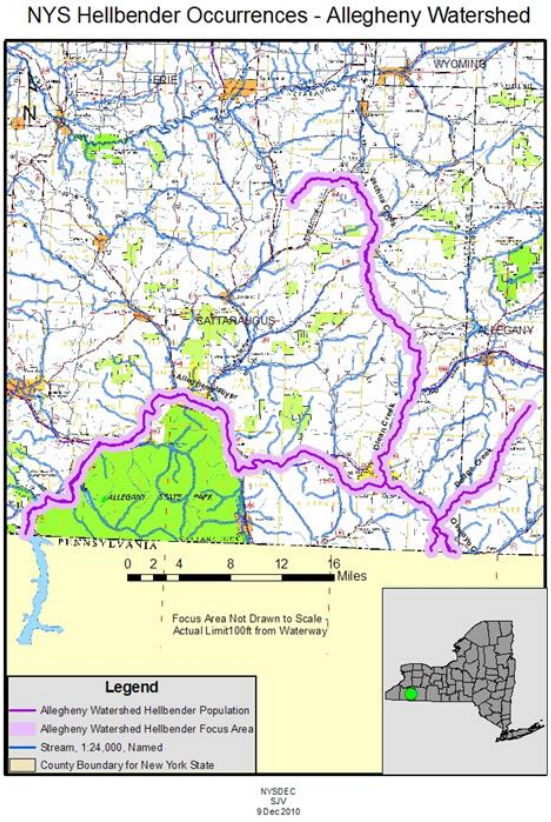
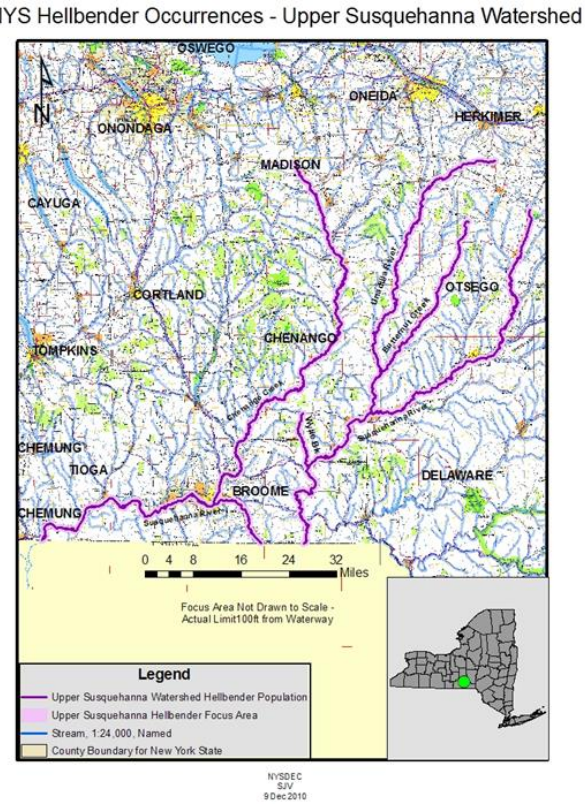


Figure 3: Conservation status of eastern hellbender in the United States (NatureServe 2012).





Figures 4 and 5: Hellbender streams in New York

III. New York Rarity, if known:

Historic	# of Animals	# of Locations	% of State
prior to 1970	_____	_____	_____
prior to 1980	_____	_____	_____
prior to 1990	_____	19-33	_____

Details of historic 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.

Current	# of Animals	# of Locations	% of State
	_____	11-17	_____

Details of current occurrence:

The eastern hellbender is known within two watersheds in New York: the Allegheny River watershed and the Susquehanna River watershed. There was a 1990 capture in the Delaware River in Sullivan County; this was believed to be a released animal (Gibbs et al. 2007).

Since 1990, the New York Heritage Program reports hellbenders have only been confirmed from 6 sites within the Susquehanna drainage down from a total of 10 historic locations, with only 3 locations known to have hellbenders present since 2005. The New York Herp Atlas database recorded 12 locations in the Susquehanna drainage with hellbenders present since 1990, a decline from 21 historic locations. For the Allegheny drainage, a total of 5 locations have been recorded as occupied by the New York Natural Heritage Program since 1990, including 4 of the 9 historical sites known to be occupied prior to 1990. Within the Allegheny drainage, the New York Herp Atlas database has only 5 occupied locations confirmed since 1990, down from 12 historic locations. See Table 1. The information in these databases is presumed incomplete since the historic sites have not all been revisited. Furthermore each of the 11 established monitoring sites have extant populations and at least five other extant sites are known to contain hellbenders.

Table 1: Number of historic and current locations of hellbenders from the NY Natural Heritage Program and the NYS Herp Atlas.

	Data Source	Time Period		
		Historic (pre-1990)	**Since 1990**	**Since 2005**
Susquehanna	NYNHP	10	6	3
	Herp Atlas	21	12	---
Allegheny	NYNHP	9	5	---
	Herp Atlas	12	5	---
TOTAL		**19 to 33**	**11 to 17**	**At least 3**

New York's Contribution to Species North American Range:

% of NA Range in New York	**Classification of New York Range**
____ 100 (endemic)	**____ Core**
____ 76-99	**__X__ Peripheral**
____ 51-75	**____ Disjunct**
____ 26-50	**Distance to core population:**
__X__ 1-25	**_____**

Rarity Discussion:

Hellbenders are known from only two watersheds in the state. Numbers of individuals are unknown.

IV. Primary Habitat or Community Type:

1. Headwater/Creek, Cold
2. Small River, Cold
3. Medium River, Cold
4. Large/Great River, Cold

Habitat or Community Type Trend in New York:

____ Declining __X__ Stable ____ Increasing ____Unknown

Time frame of decline/increase: _____

Habitat Specialist? __X__ Yes _____ No

Indicator Species? __X__ Yes _____ No

Habitat Discussion:

Strictly aquatic, adult habitat requirements are well documented in the literature. Hellbenders breathe primarily (approximately 90%) through the skin (Guimond 1970) and are therefore dependent on cool, well-oxygenated, flowing water. Hellbenders usually avoid water that is warmer than 20 degrees C. Most researchers cite streams and rivers with shallow, swift moving currents and with large (> 30 cm), flat rocks as primary habitat choice (Smith 1907, Bishop 1941, Hillis and Bellis 1971, Nickerson and Mays 1973b). 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).

From NY Draft Management Plan: Research in New York suggests the riparian zone along a stream's margins is necessary 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 affect water quality and hellbender nesting sites. Trees 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. New York Species Demographics and Life History

__X__ Breeder in New York

__X__ Summer Resident

__X__ Winter Resident

_____ Anadromous

_____ Non-breeder in New York

_____ Summer Resident

_____ Winter Resident

_____ Catadromous

_____ Migratory only

_____Unknown

Species Demographics and Life History Discussion:

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 on cloudy days close to breeding season (Mayasich and Phillips 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. They exhibit little to no seasonal migratory behavior. Nickerson and Mays (1973) identify northern pikw, muskellunge, turtles, water snakes, and humans as hellbender predators.

In New York, breeding occurs in the last week in August or the first week in September. Males select a suitable breeding site, an opening beneath a 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 450 eggs per breeding season. 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 month 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 1973b, Petranka 1998).

VI. Threats:

As a habitat specialist with little tolerance to environmental change (Williams et al. 1981), the principal 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 siltation, 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 and Phillips 2003).

Collection for scientific research and the commercial pet trade, as well as incidental collection by anglers (Foster 2006, USFWS 2007) has historically affected populations. Many anglers believe that hellbenders are poisonous and kill them when they are 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 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 has been initiated at the National Zoo, but the results will not be available for several years (Barrat 2011).

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.

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

_____ No ____ Unknown

__X__ Yes

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:

New York's draft hellbender management plan provides a thorough 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 NYS Natural Heritage Program. The ranking of "BC" corresponds to good to fair viability.

Mayasich and Phillips (2003) makes the following recommendations in The Conservation Assessment for Eastern Hellbenders:

- Monitoring and surveys
- Basic research (demographic, ecological, behavioral, etc…)
- 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, is investigating the efficacy of headstarting hellbenders. Just over 600 hellbenders from eggs collected from the Allegheny River have been or

are destined for release back into extant or restored sites in this river basin. Monitoring for up to 4 years post release is proposed to determine the success of this management technique.

The Comprehensive Wildlife Conservation Strategy (NYSDEC 2005) includes recommendations for the following actions for hellbenders. Conservation actions following IUCN taxonomy are categorized in the table.

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.

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.

Conservation Actions	
Action Category	**Action**
Land/Water Management	Site/Area Management
Land/Water Management	Invasive/Problematic Species Control
Land/Water Management	Habitat & Natural Process Restoration
Species Recovery	Species Recovery
Education & Awareness	Awareness & Communications
Law/Policy	Legislation
Law/Policy	Compliance & Enforcement

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