Yellow Lance
(*Elliptio lanceolata*)

5-Year Status Review:
Summary and Evaluation

Photo credit: North Carolina Wildlife Resources Commission

U.S. Fish and Wildlife Service
Southeast Region
Raleigh Ecological Services Field Office
Raleigh, North Carolina

August 2023

5-YEAR STATUS REVIEW
Yellow Lance (*Elliptio lanceolata*)

GENERAL INFORMATION

Current Classification: Threatened

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Date of original listing: May 3, 2018 (83 FR 14189; April 3, 2018)

Designation of Critical Habitat: May 10, 2021 (86 FR 18189; April 8, 2021).

Methodology used to complete the review:

In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a status review is to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants (50 CFR 424.11). The U.S. Fish and Wildlife Service (Service) evaluated the biology, habitat, and threats of the yellow lance to inform this status review.

We announced initiation of this review in the Federal Register on May 13, 2022 (87 FR 29364; Service 2022a) with a 60-day comment period and received two comments. A comment from Fort Pickett, Virginia, included a report on freshwater mussel surveys targeting the yellow lance and other species, and the results were incorporated into this review. The other comment provided information regarding the use and effectiveness of forestry best management practices and their importance in protecting aquatic species and stream habitats in the United States. The Service recognizes that best management practices from forestry, agriculture, development, transportation, and other industries can reduce threats to the yellow lance when they are widely used and properly implemented, and we have incorporated all information provided into the administrative record. Information solicited from conservation partners also informed this review. The primary sources of information used in this analysis were the 2018 final listing rule (83 FR 14189), the 2021

final rule designating critical habitat (86 FR 18189), the 2022 draft recovery plan (Service 2022b), agency reports, unpublished survey data and reports, and personal communication with recognized experts. This review was completed by the U.S. Fish and Wildlife Service, Raleigh Ecological Services Field Office, Raleigh, North Carolina. All literature and documents used for this review are on file at the Raleigh Field Office. All recommendations are the result of thoroughly reviewing the best available information on the yellow lance.

FR Notice citation announcing the species is under active review:
May 13, 2022 (87 FR 29364)

Species' Recovery Priority Number at start of 5-year review (48 FR 43098):
The yellow lance has a recovery priority number of 11C, indicating that it faces a moderate degree of threat and low recovery potential, including the potential for conflict with economic activity. The degree of threat is considered moderate because the species is not facing immediate extinction. However, threats to the yellow lance and its habitat are numerous and ongoing, and they are contributing to ongoing population decline. Recovery potential is considered low without intervention, such as captive propagation, population augmentation, and habitat conservation because threats to the species and its habitat are pervasive and difficult to alleviate (e.g., watershed-scale stressors that degrade aquatic habitats).

Review History:
This is the first 5-year status review for this species.

REVIEW ANALYSIS

Listed Entity

Taxonomy and nomenclature
We are not aware of any changes to the taxonomy of this entity, and it is still considered valid by the Service (Graf and Cummings 2021). Although phylogenetic studies indicate this species may warrant reclassification to a monotypic genus (Davis 1984; Bogan et al. 2009; Inoue et al. 2018; Lohmeyer 2020), no such proposal has been made by taxonomic or phylogenetic experts at this time.

Distinct Population Segment (DPS) (61 FR 4722)
The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing of a DPS to only vertebrate species. Because the species under review is a not a vertebrate, the DPS policy does not apply.

Recovery Criteria

Recovery Plan or Outline
At the time of this review, recovery criteria for this species have not been finalized. A draft recovery plan is currently available (Service 2022b).

Biology and Habitat Summary

The yellow lance is a freshwater mussel species (Family: Unionidae) native to the Atlantic Slope drainages of Maryland, Virginia, and North Carolina (Graf and Cummings 2021). It is dependent on riverine (i.e., flowing water) habitats with moderate water velocity and good water quality, and is a sand-associated species, often found burrowed in clean, stable, coarse- to medium-grained sand or gravel (Alderman 2003; North Carolina Wildlife Resources Commission [NCWRC] 2018). It does not occur in impounded waters and is intolerant of standing water (i.e., lentic) habitats. The yellow lance requires appropriate host fish species to complete its life cycle. The white shiner (*Luxilus albeolus*) and pinewoods shiner (*Lythrurus matutinus*) have been identified in laboratory trials as effective hosts for its parasitic larval life stage (Eads and Levine 2009); however, other fish species likely serve as effective hosts because both shiners have a narrower geographic range than the yellow lance (Page and Burr 2011).

The yellow lance's documented historical range spans eight Atlantic Slope river basins, including the Patuxent, Potomac, Rappahannock, York, James, Chowan, Tar-Pamlico, and Neuse drainages; however, the species is presumed extirpated in the Potomac River basin (Service 2019; Figure 1). An analysis of the species' status conducted in 2016 estimated that six extant populations had low resiliency, meaning they are likely not self-sustaining populations, lack evidence of recruitment, and have very limited or fragmented distribution (i.e., Patuxent, Rappahannock, York, James, Chowan, and Neuse populations; Table 1). Only the Tar River population had an overall moderate resiliency with self-sustaining subpopulations, exhibiting evidence of multiple age classes, and with recruitment rates exceeding mortality rates (Service 2019).

Recent surveys (August – October 2018; June – September 2020) in the Patuxent River basin in Maryland indicate that the yellow lance occupies more habitat in the Hawlings River than previous detections indicated (total of 6.15 km now documented), and there was some evidence of reproduction (i.e., gravid mussel observed). However, the abundance of yellow lance appears to be declining in the Hawlings River (Ashton et al. 2019, 2020; McCann 2021, 2022). Confirmation of historical mussel specimens as yellow lance also increased the number of historically occupied watersheds in the Patuxent basin; confirmed historical locations now include Cattail Creek (new HUC12 within known HUC10) and the Little Patuxent River (new HUC10, 0206000602; Ashton et al. 2019). These reports also noted difficulties accessing and surveying Cattail Creek and the Little Patuxent River near historical records (e.g., private land; unexploded ordnance), and they suggested incorporating eDNA sampling techniques. The Service's Northeast Fisheries Center is currently working on eDNA marker development for the yellow lance to support surveys at the Patuxent National Wildlife Research Refuge, in partnership with the Refuge, the Chesapeake Bay Field Office, the Maryland Fish and Wildlife Conservation Office, and the state Department of Natural Resources (Cullen 2023).

In Virginia, no yellow lance were found in surveys on Fort Pickett, including portions of the Nottoway River and its tributaries (Carey and Emrick 2020). In a survey of Johns Creek, a fresh

Figure 1. Current range and designated critical habitat for yellow lance in the Patuxent, Potomac, Rappahannock, York, Chowan, Tar-Pamlico, and Neuse watersheds.

shell of yellow lance was found at one site (Orcutt 2021). In the Rappahannock and Rapidan River basins, Carey and Ostby (2022) reported apparent declines based on a survey of 65 sites. Their survey sites included 15 historical locations and were distributed among the two rivers and their major tributaries (n = 37 sites for Rappahannock and n = 28 sites for Rapidan). They also documented yellow lance at eight sites with no previous historical records and reported evidence of recruitment in one tributary (Beautiful Run; Carey and Ostby 2022). Other notable findings included low detection rates, a temporal trend in capture probabilities – higher in late June through early August, and declining through late September in their study area, and observations

of deeper burrowing (i.e., 30 – 60 cm) by yellow lance mussels than previous data have indicated (Ostby and Beaty 2021; Carey and Ostby 2022).

Surveys in North Carolina have focused on augmentation sites. The North Carolina Wildlife Resources Commission (NCWRC) stocked 9,373 yellow lance between May 2019 and November 2022 at augmentation sites in the Tar River and Fishing, Shocco, and Sandy Creeks, all in the Tar River basin. Stocked mussels were propagated in the 2016, 2017, 2019, and 2020 cohorts at North Carolina State University and the NCWRC Marion Conservation Aquaculture Center. A subset of augmentation sites have been monitored since 2020, resulting in 437 recaptured yellow lance that averaged about 4 mm growth (range 0 – 9 mm growth) since being released. Evidence of gravid females has been observed at the Tar River augmentation site (NCWRC 2020, 2021, 2022; Fisk 2023).

A recent genetic study expanded on earlier evidence that this species has been assigned incorrect taxonomy and should form a monotypic genus separate from *Elliptio* (Davis 1984; Bogan et al. 2009; Inoue et al. 2018; Lohmeyer 2020). Another recent study investigated the species' genetic diversity, but a small sample size (n = 10) collected from three river basins resulted in difficulty making inferences about the species' genetic diversity (Meyer 2021); thus, more comprehensive, rangewide genetic sampling is needed. Resolving the species' taxonomic status and gaining insights on population genetics and viability would contribute to assessing the species' adaptive capacity, limitations, and potential for recovery.

Table 1. The eight river basins and 12 management units where the yellow lance has current or historical records, states of occurrence, estimated resiliency, and year of the last observed record for each management unit. Summarized from the Service's 2019 Species Status Assessment, with updated information from recent observations.

Basin: Management Unit	**States**	**Current Resiliency**	**Last Observed**
Patuxent	Maryland	Very Low	2020
Potomac	Maryland, Virginia	Presumed Extirpated	Pre-1970
Rappahannock	Virginia	Low	2022
York	Virginia	Very Low	2007
James: Johns Creek	Virginia	Low	2021
Chowan: Nottoway	Virginia	Low	2011
Chowan: Meherrin	Virginia	Presumed Extirpated	1994
Tar: Upper/Middle Tar	North Carolina	High	2021*
Tar: Lower Tar	North Carolina	Presumed Extirpated	1987
Tar: Fishing Creek	North Carolina	Moderate	2022*
Tar: Sandy-Swift	North Carolina	High	2019*
Neuse: Middle Neuse	North Carolina	Low	2016

*These management units have been augmented with individuals propagated in captivity; the last-observed records are based on encounters of wild mussels.

Threats (Five-Factor Analysis) Summary

The status of a species is determined from an assessment of factors specified in section 4(a)(1) of the Act, including: Factor A, the present or threatened destruction, modification, or curtailment of its habitat or range; Factor B, overutilization for commercial, recreational, scientific, or educational purposes; Factor C, disease or predation; Factor D, the inadequacy of existing regulatory mechanisms; and Factor E, other natural or manmade factors affecting its continued existence. A summary of this assessment is detailed below.

The final listing rule described habitat degradation (Factor A) including declines in water quality, loss of stream flow, riparian and instream fragmentation, and degraded instream habitats posed the greatest threats to the yellow lance (83 FR 14189; Service 2018). These threats are exacerbated by continued urbanization (Factor A) and effects of climate change (Factor E) (e.g., drought, flooding). Recent information shows that these threats remain ongoing, severe, and occur throughout the species range, and we expect these threats to continue in the future. The primary threat to the future viability of the yellow lance continues to be habitat degradation resulting from the cumulative impacts of land use changes and associated watershed-level effects on water quality, water quantity, habitat connectivity, and instream habitat quality. Significant portions of the yellow lance's current and historical range are affected by these stressors.

We have no indication that overutilization for commercial, recreational, scientific, or educational purposes (Factor B) poses a significant threat for the species.

Disease and predation (Factor C) were not described as threats at the time of listing (83 FR 14189). However, the increased prevalence of unexplained die-offs in other mussel populations suggest that disease is a potential threat to yellow lance population health throughout its range. Disease has been implicated as a potential causative factor in some recent unexplained mussel declines in other parts of the U.S. (Haag 2019, Richard et al. 2020).

As discussed in the final listing rule, there is an inadequacy of existing regulatory mechanisms to sufficiently protect this species from existing threats (Factor D; 83 FR 14189; Service 2018). No new regulations have been enacted that would provide additional protection for the yellow lance, and use of existing regulations have not been improved for the benefit of the species. For example, states have not adopted the U.S. Environmental Protection Agency's updated water quality criteria (e.g., for ammonia and cadmium) that prescribe thresholds more protective of freshwater mussels. The Service is working toward leveraging existing regulations to improve protections for the yellow lance. However, at this time, regulatory mechanisms are not sufficient to protect the species from other alterations of water quality, water quantity, instream habitat, and habitat connectivity or impacts from disease, invasive species, and climate change.

Invasive species (Factor E) were identified as threats to the yellow lance at the time of listing (83 FR 14189; Service 2018), and we expect these effects to continue in the future. The invasive clam *Corbicula fluminea* has established populations throughout much of the U.S., including all of the river basins in the yellow lance's range (Foster et al. 2022). A recent study demonstrated that native mussel growth was negatively associated with abundance of *Corbicula*, indicating that invasive clams may be a pervasive stressor to native mussels by competition for food (Haag et al. 2021). Invasive catfishes (e.g., flathead catfish (*Pylodictis olivaris*)) are voracious predators that have become established within the yellow lance's range, and they may affect host fish

communities and mussel-host interactions essential for reproduction and dispersal (Fuller et al. 2022; Service 2022). Although effects of these species on the yellow lance have not been quantified, evidence suggests they are problematic for native mussels.

Although the long-term impact of climate change (Factor E) is unknown, it may affect the future viability of yellow lance (Fogelman et al. 2023). Temperatures have been increasing across the species' range since the 1900s, and heat waves, droughts, extreme precipitation, and flood events are expected to become more frequent and intense (Runkle et al. 2022a, 2022b and Frankson et al. 2022). Such conditions may result in reaching thermal maximum thresholds for mussels or their host species (Pandolfo et al. 2012; Fogelman et al. 2023), or transport excessive sediment and pollutants into waterways, causing direct harm to mussels and potentially impact reproductive success (Berry et al. 2003; Wang et al. 2017; Goldsmith et al. 2021). These threats also were recognized in the final listing rule for the yellow lance (83 FR 14189; Service 2018).

Synthesis

The yellow lance is a freshwater mussel species native to Atlantic Slope rivers in Maryland, Virginia, and North Carolina. Populations are currently known from seven of eight historically occupied river basins; six have low resiliency and one has moderate resiliency. Although some augmentation efforts have improved abundance in portions of the Tar River population and recent monitoring efforts showed some limited evidence of reproduction in the Patuxent, Rappahannock, and Tar populations, surveys indicate that detection and abundance of the yellow lance remain in decline. Threats from habitat degradation, invasive species (e.g., *Corbicula* and catfishes), and climate change continue throughout that species' range, and disease is a potential concern due to several recent unexplained die-offs observed in other mussel species. Because of ongoing threats and the current condition of the species, the yellow lance continues to meet the definition of a threatened species.

RECOMMENDED FUTURE ACTIVITIES

This species does not have a final recovery plan. While completing this status review, we have identified the following potential recovery activities as focal areas over the next five years; these also are documented in the draft recovery plan (Service 2022b).

Recovery Activities

- Continue and expand captive propagation efforts to support augmentation and reintroduction of populations within the species' current and historical range, as appropriate, and develop propagation/augmentation plans to strategically focus efforts.
- Develop a rangewide genetics program, prioritizing topics that inform monitoring, management, and population restoration efforts, and resolve the taxonomy of the species.
- Develop and implement a long-term population and habitat monitoring program, and consistently monitor the status of known populations and augmented/reintroduced populations.

- Maintain, enhance, and restore habitat by using voluntary conservation practices, removal of barriers, and land acquisition/conservation easements in watersheds that support yellow lance to protect extant populations and reduce threats. Early focus should be on riparian areas adjacent to locations with occurrence records or designated critical habitat.
- Coordinate with local, state, and federal entities to promote yellow lance recovery, including using existing agency programs to minimize, mitigate, or remove threats; developing methods to incentivize conservation; and increasing public awareness of the need to protect the species and is habitats.
- Identify and evaluate the magnitude of site-specific stressors affecting yellow lance populations (e.g., sedimentation, invasive species, industrial effluents, nonpoint source pollution, climate/land use factors), and manage for their abatement.
- Implement protective water quality standards, classifications, and protections in waters within the species' range to address ongoing threats from a variety of land use practices.
- Use and refine the recently-developed rangewide species distribution model to inform species restoration efforts, recovery actions, and conservation planning assistance work.

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RESULTS / SIGNATURES

U.S. Fish and Wildlife Service
Status Review of Yellow Lance

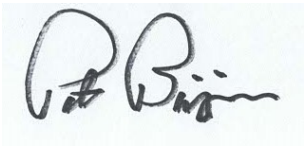
Status Recommendation:

On the basis of this review, we recommend the following status for this species. A 5-year review presents a recommendation of the species status. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the Act.

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist:
____ *The species is extinct*
____ *The species does not meet the definition of an endangered or threatened species*
____ *The listed entity does not meet the statutory definition of a species*
__X__ No change needed

FIELD OFFICE APPROVAL:

Field Supervisor, Raleigh Ecological Services Field Office, Fish and Wildlife Service



Approve _____

LEAD REGIONAL OFFICE APPROVAL:
***Acting for* Assistant Regional Director – Ecological Services, Fish and Wildlife Service**

Approve AARON VALENTA _____ Digitally signed by AARON VALENTA Date: 2023.08.28 09:35:35 -04'00'

COOPERATING REGIONAL OFFICE APPROVAL:
We emailed this 5-year review to the Northeast Regional Office for their concurrence prior to finalizing the document. We will retain any comments that we received, as well as verification of concurrence from other regions, in the administrative record for this 5-year review.