Moxostoma collapsum - (Cope, 1870)
Notchlip Redhorse

Related ITIS Name(s): *Moxostoma collapsum* (Cope, 1870) (TSN 201946)
Unique Identifier: ELEMENT_GLOBAL.2.103565
Element Code: AFCJC10230
Informal Taxonomy: Animals, Vertebrates - Fishes - Bony Fishes - Suckers

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Actinopterygii	Cypriniformes	Catostomidae	Moxostoma

Genus Size: C - Small genus (6-20 species)

Check this box to expand all report sections: ☐

Concept Reference

Concept Reference: Warren, M. L., Jr., B. M. Burr, S. J. Walsh, H. L. Bart, Jr., R. C. Cashner, D. A. Etnier, B. J. Freeman, B. R. Kuhajda, R. L. Mayden, H. W. Robison, S. T. Ross, and W. C. Starnes. 2000. Diversity, distribution, and conservation status of the native freshwater fishes of the southern United States. Fisheries 25(10):7-31.
Concept Reference Code: A00WAR01NAUS
Name Used in Concept Reference: *Moxostoma collapsum*
Taxonomic Comments: Formerly included in M. ANISURUM. Warren et al. (1999) noted a forthcoming taxonomic rearrangement and recognized this fish as a species distinct from M. ANISURUM.

Harris and Mayden (2001) used molecular data to examine phylogenetic relationships of major clades of Catostomidae. In all trees, SCARTOMYZON was paraphyletic and embedded in MOXOSTOMA, and CATOSTOMUS was never recovered as monophyletic (XYRAUCHEN was embedded within CATOSTOMUS). They concluded that the phylogenetic relationships and taxonomic composition of taxa presently included in MOXOSTOMA and SCARTOMYZON are in need of further study, as are the relationships and composition of the genera CATOSTOMUS, CHASMISTES, DELTISTES, and XYRAUCHEN, and the phylogenetic affinites of ERIMYZON and MINYTREMA.

Conservation Status

NatureServe Status

Global Status: G5
Global Status Last Reviewed: 04Feb2000
Global Status Last Changed: 04Feb2000
Rounded Global Status: G5 - Secure
Nation: United States
National Status: N5

U.S. & Canada State/Province Status	
United States	Georgia (S4), North Carolina (S5), South Carolina (SNR), Virginia (S4)

Other Statuses

NatureServe Conservation Status Factors

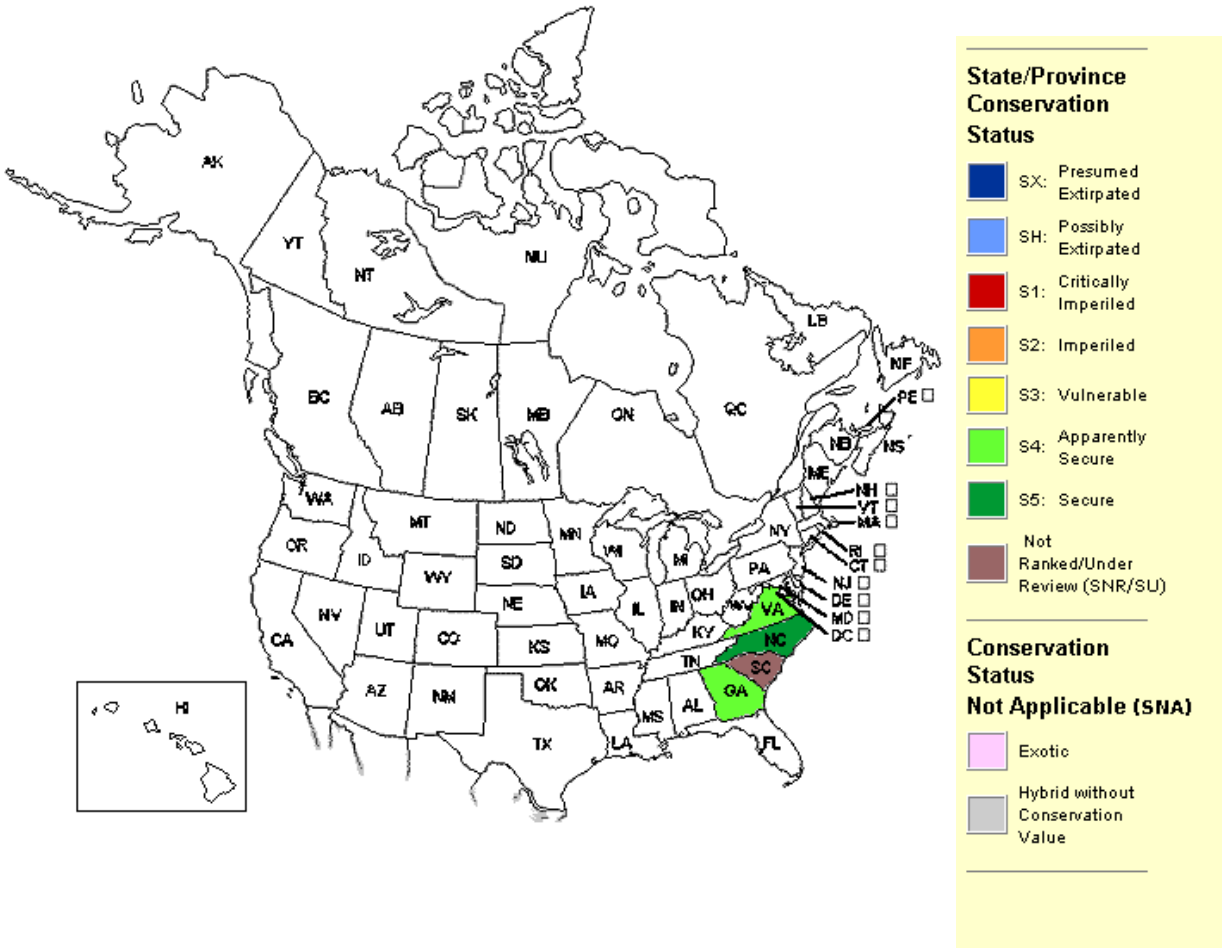
Global Short Term Trend: Stable (unchanged or within +/- 10% fluctuation in population, range, area occupied, and/or number or condition of occurrences)

Global Short Term Trend Comments: Currently stable.

Threats: Altered water-flow patterns that typically occur when water is released during hydropower generation can have negative effects on the growth and survival of larvae (Weyers et al. 2003).

Distribution

U.S. States and Canadian Provinces



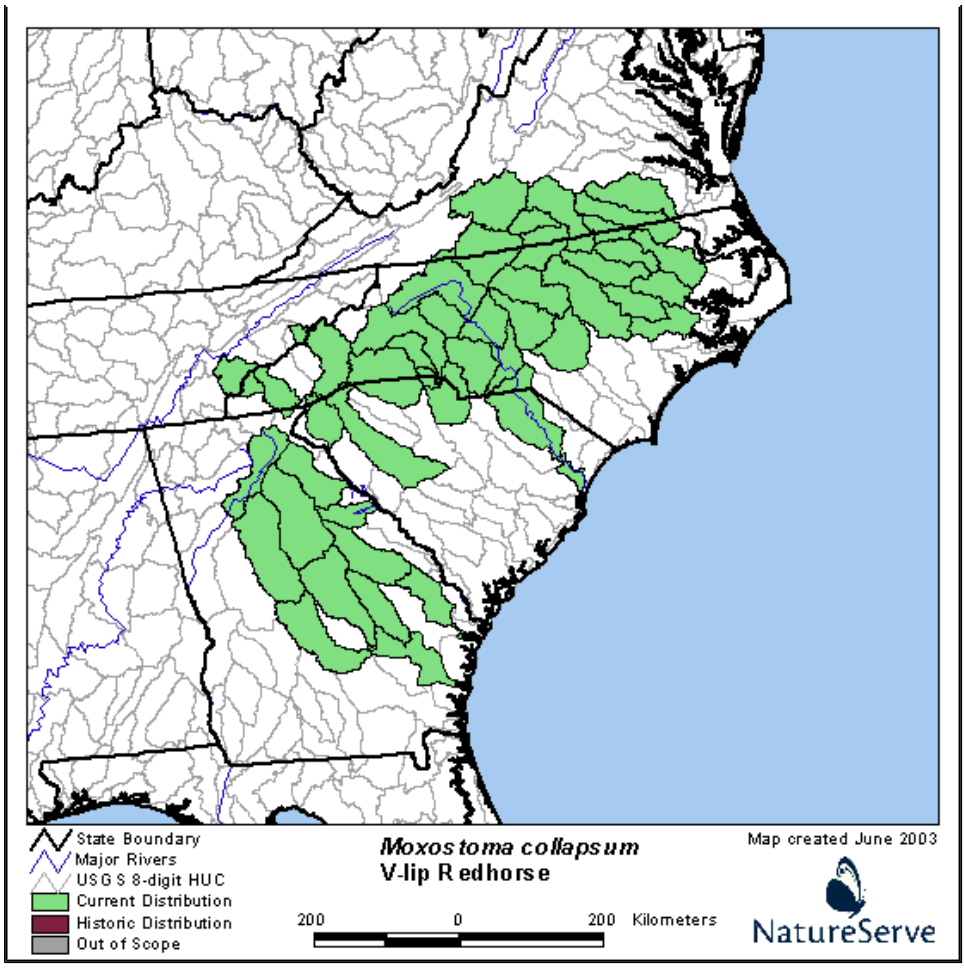
Endemism: endemic to a single nation

U.S. & Canada State/Province Distribution	
United States	GA, NC, SC, VA

Range Map
No map available.

Global Range Comments: Atlantic Slope from Altamaha River drainage, Georgia, to Roanoke-Chowan drainage, Virginia.

U.S. Distribution by Watershed (based on multiple information sources)



Ecology & Life History

Habitat Type: Freshwater
Non-Migrant: N
Locally Migrant: N
Long Distance Migrant: N
Riverine Habitat(s): BIG RIVER, CREEK, MEDIUM RIVER, Moderate gradient, Pool
Special Habitat Factors: Benthic
Habitat Comments: A riverine species.

Economic Attributes

Not yet assessed

Management Summary

Not yet assessed

Population/Occurrence Delineation

Group Name: MEDIUM SUCKERS

Use Class: Not applicable
Minimum Criteria for an Occurrence: Occurrences are based on evidence of historical presence, or current and likely recurring presence, at a given location. Such evidence minimally includes collection or reliable observation and documentation of one or more individuals (including eggs and larvae) in appropriate habitat.
Mapping Guidance: Occupied locations that are separated by a gap of 15 km or more of any aquatic habitat that is not known to be occupied represent different occurrences. However, it is important to evaluate migrations and seasonal changes in habitat to ensure that spawning areas and nonspawning areas for a single population are not artificially segregated as different occurrences simply because there have been no collections/observations in an intervening area that may exceed the separation distance.
Separation Barriers: Dam lacking a suitable fishway; high waterfall; upland habitat.
Separation Distance for Unsuitable Habitat: 15 km
Separation Distance for Suitable Habitat: 15 km
Separation Justification: Data on dispersal and other movements generally are not available. In some species, individuals may migrate variable distances between spawning areas and nonspawning habitats.

Separation distances (in aquatic kilometers) for catostomids are arbitrary but reflect the presumption that movements and appropriate separation distances generally should increase with fish size. Hence small, medium, and large catostomids, respectively, have

increasingly large separation distances. Separation distance reflects the likely low probability that two occupied locations separated by less than several kilometers of aquatic habitat would represent truly independent populations over the long term.

Because of the difficulty in defining suitable versus unsuitable habitat, especially with respect to dispersal, and to simplify the delineation of occurrences, a single separation distance is used regardless of habitat quality.

Occupied locations that are separated by a gap of 15 km or more of any aquatic habitat that is not known to be occupied represent different occurrences. However, it is important to evaluate seasonal changes in habitat to ensure that an occupied habitat occurrence for a particular population does not artificially separate spawning areas and nonspawning areas as different occurrences simply because there have been no collections/observations in an intervening area that may exceed the separation distance.
Date: 21Sep2004
Author: Hammerson, G.
Notes: This Specs Group includes catostomids that typically are 20-40 cm in adult standard length.

Population/Occurrence Viability

Justification: **Use the Generic Element Occurrence Rank Specifications (2008).**
Key for Ranking Species Element Occurrences Using the Generic Approach (2008).

U.S. Invasive Species Impact Rank (I-Rank)

Not yet assessed

Authors/Contributors

Element Ecology & Life History Edition Date: 03May2001

Zoological data developed by NatureServe and its network of natural heritage programs (see **Local Programs**) and other contributors and cooperators (see **Sources**).

References

- Harris, P. M., and R. L. Mayden. 2001. Phylogenetic relationships of major clades of Catostomidae (Teleostei: Cypriniformes) as inferred from mitchondrial SSU and LSU rDNA sequences. Molecular Phylogenetics and Evolution 20:225-237.
- Jenkins, R. E., and N. M. Burkhead. 1994. Freshwater fishes of Virginia. American Fisheries Society, Bethesda, Maryland. xxiii + 1079 pp.
- Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, Maryland. 386 pp.
- Warren, M. L., Jr., B. M. Burr, S. J. Walsh, H. L. Bart, Jr., R. C. Cashner, D. A. Etnier, B. J. Freeman, B. R. Kuhajda, R. L. Mayden, H. W. Robison, S. T. Ross, and W. C. Starnes. 2000. Diversity, distribution, and conservation status of the native freshwater fishes of the southern United States. Fisheries 25(10):7-31.
- Weyers, R. S., C. A. Jennings, and M. C. Freeman. 2003. Effects of pulsed, high-velocity water flow on larval robust redhorse and V-lip redhorse. Transactions of the American Fisheries Society 132:84-91.

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Note: All species and ecological community data presented in NatureServe Explorer at http://www.natureserve.org/explorer were updated to be current with NatureServe's central databases as of **July 17, 2009**.
Note: This report was printed on **November 10, 2009**

Citation for data on website including State Distribution, Watershed, and Reptile Range maps:
NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: November 10, 2009).

Citation for Bird Range Maps of North America:
Ridgely, R.S., T.F. Allnutt, T. Brooks, D.K. McNicol, D.W. Mehlman, B.E. Young, and J.R. Zook. 2003.

Digital Distribution Maps of the Birds of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

Acknowledgement Statement for Bird Range Maps of North America:
"Data provided by NatureServe in collaboration with Robert Ridgely, James Zook, The Nature Conservancy - Migratory Bird Program, Conservation International - CABS, World Wildlife Fund - US, and Environment Canada - WILDSPACE."

Citation for Mammal Range Maps of North America:
Patterson, B.D., G. Ceballos, W. Sechrest, M.F. Tognelli, T. Brooks, L. Luna, P. Ortega, I. Salazar, and B.E. Young. 2003. Digital Distribution Maps of the Mammals of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

Acknowledgement Statement for Mammal Range Maps of North America:
"Data provided by NatureServe in collaboration with Bruce Patterson, Wes Sechrest, Marcelo Tognelli, Gerardo Ceballos, The Nature Conservancy-Migratory Bird Program, Conservation International-CABS, World Wildlife Fund-US, and Environment Canada-WILDSPACE."

Citation for Amphibian Range Maps of the Western Hemisphere:
IUCN, Conservation International, and NatureServe. 2004. Global Amphibian Assessment. IUCN, Conservation International, and NatureServe, Washington, DC and Arlington, Virginia, USA.

Acknowledgement Statement for Amphibian Range Maps of the Western Hemisphere:
"Data developed as part of the Global Amphibian Assessment and provided by IUCN-World Conservation Union, Conservation International and NatureServe."

NOTE: Full metadata for the Bird Range Maps of North America is available at:
http://www.natureserve.org/library/birdDistributionmapsmetadatav1.pdf.

Full metadata for the Mammal Range Maps of North America is available at:
http://www.natureserve.org/library/mammalsDistributionmetadatav1.pdf.

Feedback Request: NatureServe encourages users to let us know of any errors or significant omissions that you find in the data through (see **Contact Us**). Your comments will be very valuable in improving the overall quality of our databases for the benefit of all users.

Version 7.1 (2 February 2009)

NatureServe

Data last updated: July 17, 2009

Cambarus spicatus - Hobbs, 1956
Broad River Spiney Crayfish

Related ITIS Name(s): *Cambarus spicatus* Hobbs, 1956 (TSN 97407)
Unique Identifier: ELEMENT_GLOBAL.2.107416
Element Code: ICMAL07770
Informal Taxonomy: Animals, Invertebrates - Crustaceans - Crayfishes

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Crustacea	Malacostraca	Decapoda	Cambaridae	Cambarus

Genus Size: D - Medium to large genus (21+ species)

Check this box to expand all report sections: ☐

Concept Reference

Concept Reference: Hobbs, Horton. H. Jr. 1989. An Illustrated Checklist of the American crayfishes (Decapoda: Astacidae, Cambaridae & Parastacidae). Smithsonian Contributions to Zoology 480. Smithsonian Institute Press, Washington, D. C. 236 pp.
Concept Reference Code: B89HOB01GAUS
Name Used in Concept Reference: *Cambarus spicatus*

Conservation Status

NatureServe Status

Global Status: G3
Global Status Last Reviewed: 01Jul2009
Global Status Last Changed: 19Feb1996
Rounded Global Status: G3 - Vulnerable
Reasons: This species has a somewhat restricted range in a few drainages in neighboring North and South Carolina (extent <5000 sq. km) in disjunct drainages; with potential threats to habitat possibly in the near future that have not yet been fully realized. It is usually uncommon when found but more survey effort is needed to see if its disjunct distribution is truly disjunct or just a relict of insufficient survey effort. More surveys should better resolve its conservation status.
Nation: United States
National Status: N3

U.S. & Canada State/Province Status	
United States	North Carolina (S2), South Carolina (S3)

Other Statuses

IUCN Red List Category: VU - Vulnerable
American Fisheries Society Status: Threatened (01Jan1996)

NatureServe Conservation Status Factors

Global Abundance: 2500 - 10,000 individuals
Global Abundance Comments: It is not very abundant at any of the sites at which it has been found in South Carolina (SC NHP, pers. comm., 2009). In North Carolina it is rare and represents the northern limit of its range.

Estimated Number of Element Occurrences: 21 - 80
Estimated Number of Element Occurrences Comments: Not uncommon within its limited range. LeGrand et al. (2006) cite streams in the Broad River drainage in Cleveland and Polk Cos., North Carolina. In South Carolina, it occurs in Fairfield and Richland Cos. in the Little River drainage (Eversole and Jones, 2004).

Global Short Term Trend: Unknown
Global Short Term Trend Comments: While trends are not clear, this narrowly distributed crayfish may be declining. Many streams within its range in North Carolina carry heavy sediment loads that can degrade habitat for this species (Simmons and Fraley, 2008).

Global Protection: Unknown whether any occurrences are appropriately protected and managed

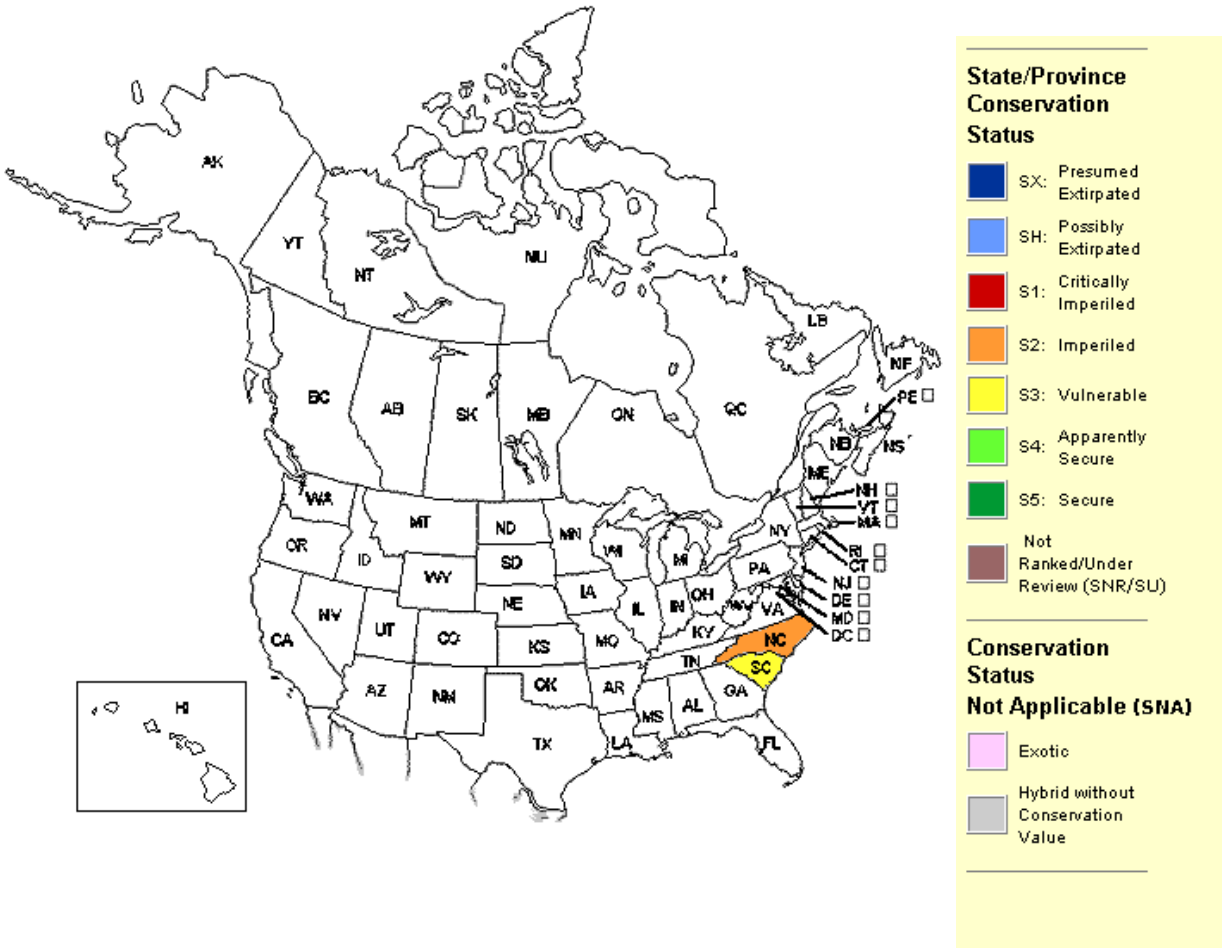
Global Protection Needs: Protection from situation, stream impoundment

Degree of Threat: Substantial, imminent threat
Threat Scope: High
Threat Severity: Moderate
Threat Immediacy: Moderate
Threats: While trends are not clear, this narrowly distributed crayfish may be declining. Many streams within its range in North Carolina carry heavy sediment loads that can degrade habitat for this species (Simmons and Fraley, 2008). Orconectes rusticus has been collected within the range of this species so may pose a future threat (Simmons and Fraley, 2008). Cambarus spicatus is likely to be impacted upon by a nonindigenous crayfish Orconectes rusticus, the Rusty Crayfish, which was unknown to occur in North Carolina until 2001. It is also likely to be impacted by Procambarus clarkii, the Red Swamp Crayfish, which has also been found in the Broad River basin (Fullerton and Watson 2001). There is population expansion occurring in the river basin inhabited by this species and therefore the urban development is likely to be impacting this species by reducing the area of available habitat and causing pollution .

Fragility Comments: Probably, however, can not survive impoundments on its habitat streams

Distribution

U.S. States and Canadian Provinces



Endemism: endemic to a single nation

U.S. & Canada State/Province Distribution	
United States	NC, SC

Range Map
No map available.

Global Range: 1000-5000 square km (about 400-2000 square miles)
Global Range Comments: Restricted to the Little and Broad River drainages in Fairfield, Richland, and Spartanburg counties, South Carolina (Eversole, 1995). Cooper and Braswell (1995) report a new record from Cleveland County, North Carolina. LeGrand et al. (2006) cite streams in the Broad River drainage in Cleveland and Polk Cos., North Carolina.

Natural heritage records exist for the following U.S. counties	
State	County Name (FIPS Code)
NC	Cleveland (37045), Polk (37149)

* Extirpated/possibly extirpated

U.S. Distribution by Watershed (based on available natural heritage records)	
Watershed Region	Watershed Name (Watershed Code)
03	Upper Broad (03050105)

+ Natural heritage record(s) exist for this watershed
* Extirpated/possibly extirpated

Ecology & Life History

Basic Description: A cray fish; Cambaridae
Non-Migrant: N
Locally Migrant: N
Long Distance Migrant: N
Riverine Habitat(s): CREEK, MEDIUM RIVER, Moderate gradient
Special Habitat Factors: Benthic
Habitat Comments: Found in streams of small to medium size with trapped leaf litter.

Economic Attributes

Not yet assessed

Management Summary

Biological Research Needs: Specific environmental requirements

Population/Occurrence Delineation

Group Name: CRAYFISHES

Use Class: Not applicable
Minimum Criteria for an Occurrence: Occurrences are based on some evidence of historical or current presence of single or multiple specimens, including live specimens or recently dead shells (i.e., soft tissue still attached without signs of external weathering or staining), at a given location with potentially recurring existence. Evidence is derived from reliable published observation or collection data; unpublished, though documented (i.e. government or agency reports, web sites, etc.) observation or collection data; or museum specimen information.
Separation Barriers: Separation barriers are based on hydrological discontinuity. Additional physical barriers, particularly for secondary and tertiary burrowers, include presence of upland habitat between water connections of a distance greater than 30 m. Migration of primary burrowers is generally not hindered by presence of upland habitat unless conditions are very xeric (dry and desert-like) (Smith, 2001).
Separation Distance for Unsuitable Habitat: 2 km
Separation Distance for Suitable Habitat: 2 km
Alternate Separation Procedure: Freshwater cave (troglobitic) species may occur from near entrances to very deep in cave systems. For cave species, each cave where an observation or collection was recorded (see Minimum EO Criteria, above) constitutes an element occurrence regardless of separation distance unless caves are part of a single hydrological system (see below). Occurrences are additionally separated by underground physical barriers to movement. Multiple caves within a single hydrological cave system are considered to be a single element occurrence when they are less than one km apart. Multiple caves within a single hydrological cave system are considered separate element occurrences when hydrological connections have not been determined or when separated by a distance of at least one km.
Separation Justification: Habitat for these creatures is primarily separated according to each species' burrowing ability. All crayfish are able to burrow to some extent and this ability will help determine the range of habitats in which a species can be found. Burrowing in the Astacidae is limited to streambed and bank excavation (Hobbs, 1988). The Cambaridae, as a whole are much more adept at burrowing than the Astacidae. As a result, they possess a greater habitat range than the Astacidae including dry water bodies (Hogger, 1988).

The burrowers can be classified into three categories: primary burrowers, secondary burrowers, and tertiary burrowers. Primary burrowers tend to remain in their burrows continuously and live in areas without permanent water except during breeding when they

must migrate to a nearby water source (Hogger, 1988). The prairies of eastern and central Mississippi and western Alabama are an example of primary burrower habitat (Hogger, 1988). Secondary burrowers remain in burrows during dry periods but emerge when habitats are inundated seasonally. Such habitat includes lentic systems flooded periodically but dry in summer (Huner and Romaire, 1979) and permanent and temporary ponds and swamps in the southern United States. Tertiary burrowers do not burrow except during infrequent drought conditions and/or during breeding season. Both flowing and standing water can be tertiary burrower habitat.

Because primary burrowers, and to a lesser extent secondary burrowers, can occupy xeric habitats, separation barriers for such species do not include presence of upland habitat except in extremely dry conditions. Survival during dry periods, particularly for secondary burrowers, is dependent upon construction of a burrow regardless of season. Several different types have been described (Smith, 2001) depending on species, soil, and depth of water table.

Published information about movement in relation to migration distance is lacking but Cooper (1998, personal communication) and Fitzpatrick (1998, personal communication) both recommend a separation distance of one km between element occurrences. Dispersal patterns are best known for invasive species which likely have the greatest dispersal capability, therefore, separation distances have been determined for all crayfish based on these studies. Guan and Wiles (1997) provided evidence from the River Great Ouse in the United Kingdom that the range of movement for the majority of the invasive *Pacifastacus leniusculus* was within 190 m. Bubb et al. (2004) also studied P. leniusculus in England using radio-tagging and found median maximal upstream and downstream movement distances were 13.5 m (range 0-283 m) and 15 m (range 0-417 m), respectively. Barbaresi et al. (2004) found that ranging speed in the invasive crayfish *Procambarus clarkii* (Girard) to be slow (0.3 to 76.5 m/day) with the widest ranging individual traveling 304 m. Lewis and Horton (1996) found that 21% of tagged *Pacifastacus leniusculus* in an Oregon harvest pond moved >1000 m in one year while the majority moved <500 m. As such minimum separation distance (unsuitable and suitable) has been set at the NatureServe standard minimum of two km.

Exposed pools and streams in caves represent "karst windows" into more extensive underground streams. No information on the distance cave crayfish can disperse in underground streams is yet available.
Date: 18Oct2004
Author: Cordeiro, J.
Notes: Primary burrowers include the following taxa: Cambarus (Cambarus) carolinus, C. (C.) diogenes diogenes, C. (Depressicambarus) catagius, C. (D.) cymatilis, C. (D.) deweesae, C. (D.) harti, C. (D.) reflexus, C. (D.) pyronotus, C. (D.) striatus, C. (D.) strigosus, C. (D.) truncatus, C. (Glareocola), C. (Jugicambarus) batchi, C. (J.) carolinus, C. (J.) causeyi, C. (J.) dubius, C. (J.) gentryi, C. (J.) monongalensis, C. (J.) nodosus, C. (Lacunicambarus), C. (Tubericambarus), Distocambarus, Fallicambarus, Procambarus (Acucauda), P. (Distocambarus), P. (Girardiella) barbiger, P. (G.) cometes, P. (G.) connus, P. (G.) curdi, P. (G.) gracilis, P. (G.) hagenianus hagenianus, P. (G.) hagenianus vesticeps, P. (G.) liberorum, P. (G.) pogum, P. (Hagenides) [except P. pygmaeus]
Secondary burrowers include the following taxa: Cambarus (Cambarus) ortmanni, C. (Depressicambarus) latimanus, C. (D.) reduncus, Hobbseus, Procambarus (Cambarus) clarkii, P. (Girardiella) kensleyi, P. (G.) reimeri, P. (G.) simulans, P. (G.) steigmani, P. (G.) tulanei, P. (Hagenides) pygmaeus, P. (Leconticambarus) [excepting P. alleni and P. milleri], P. (Ortmannicus) [excepting the cave dwelling species], P. (Tenuicambarus)
Tertiary burrowers include the following taxa: Barbicambarus, Bouchardina, Cambarus (Cambarus) angularis, C. (C.) bartonii carinirostris, C. (C.) bartonii cavatus, C. (C.) howardi, C. (C.) sciotensis, C. (Depressicambarus) englishi, C. (D.) graysoni, C. (D.) halli, C. (D.) obstipus, C. (D.) sphenoides, C. (Erebicambarus) ornatus, C. (E.) rusticiformis, C. (Exilicambarus) cracens, C. (Hiaticambarus), C. (Jugicambarus) asperimanus, C. (J.) bouchardi, C. (J.) crinipes, C. (J.) distans, C. (J.) friaufi, C. (J.) obeyensis, C. (J.) parvoculus, C. (J.) unestami, C. (Puncticambarus) [excepting the cave dwelling species], C. (Veticambarus), Cambarellus, Faxonella, Orconectes [excepting the cave dwelling species], Pacifastacus, Procambarus (Capillicambarus), P. (Girardiella) ceruleus, P.

Population/Occurrence Viability

Justification: **Use the Generic Element Occurrence Rank Specifications (2008).**
Key for Ranking Species Element Occurrences Using the Generic Approach (2008).

U.S. Invasive Species Impact Rank (I-Rank)

Not yet assessed

Authors/Contributors

NatureServe Conservation Status Factors Edition Date: 01Jul2009
NatureServe Conservation Status Factors Author: Cordeiro, J. (2008); Fitzpatrick, J.F., Jr.; C. Taylor (1996)
Element Ecology & Life History Edition Date: 23Jan1991
Element Ecology & Life History Author(s): FITZPATRICK, J. F.

Zoological data developed by NatureServe and its network of natural heritage programs (see **Local Programs**) and other contributors and cooperators (see **Sources**).

References

- Cooper, J. E., A. L. Braswell, and C. McGrath. 1998. Noteworthy distributional records for crayfishes (Decapoda: Cambaridae) in North Carolina. The Journal of the Elisha Mitchell Scientific Society 114(1):1-10.
- Cooper, J. E., and A. L. Braswell. 1995. Observations of North Carolina crayfishes (Decapoda: Cambaridae). Brimleyana 22:87-132.
- Eversole, A.G. 1990. Distribution of three rare crayfish species in South Carolina. Program and Abstracts of the 8th International Symposium of Astacology, Baton Rouge, LA, April 22-26:31.
- Eversole, A.G. 1995. Distribution of three rare crayfish species in South Carolina, USA. Freshwater Crayfish, 8: 113-120.
- Eversole, A.G. and D.R. Jones. 2004. Key to the crayfish of South Carolina. Unpublished report. Clemson University, Clemson, South Carolina. 43 pp.

- Fullerton, A.H. and B.T. Watson. 2001. New distributional records for two nonindigenous and one native crayfish in North Carolina. The Journal of the Elisa Mitchell 117(1):66-70.
- Hobbs, H. H., Jr. 1989. A illustrated checklist of the American crayfishes (Decapoda: Astacidae, Cambaridae, and Parastacidae). Smithsonian Contributions to Zoology, No. 480. 236 pp.
- Hobbs, Horton. H. Jr. 1989. An Illustrated Checklist of the American crayfishes (Decapoda: Astacidae, Cambaridae & Parastacidae). Smithsonian Contributions to Zoology 480. Smithsonian Institute Press, Washington, D. C. 236 pp.
- LeGrand, H.E., Jr., S.P. Hall, S.E. McRae, and J.T. Finnegan. 2006. Natural Heritage Program List of the Rare Animal Species of North Carolina. North Carolina Natural Heritage Program, Raleigh, North Carolina. 104 pp.
- McLaughlin, P.A., D.K. Camp, M.V. Angel, E.L. Bousfield, P. Brunel, R.C. Brusca, D. Cadien, A.C. Cohen, K. Conlan, L.G. Eldredge, D.L. Felder, J.W. Goy, T. Haney, B. Hann, R.W. Heard, E.A. Hendrycks, H.H. Hobbs III, J.R. Holsinger, B. Kensley, D.R. Laubitz, S.E. LeCroy, R. Lemaitre, R.F. Maddocks, J.W. Martin, P. Mikkelsen, E. Nelson, W.A. Newman, R.M. Overstreet, W.J. Poly, W.W. Price, J.W. Reid, A. Robertson, D.C. Rogers, A. Ross, M. Schotte, F. Schram, C. Shih, L. Watling, G.D.F. Wilson, and D.D. Turgeon. 2005. Common and scientific names of aquatic invertebrates from the United States and Canada: Crustaceans. American Fisheries Society Special Publication 31: 545 pp.
- Simmons, J.W. and S.J. Fraley. 2008. Distribution, status, and life history observations of crayfishes in western North Carolina. North Carolina Wildlife Resource Commission, Raleith, North Carolina. 114 pp.

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Note: This report was printed on **November 10, 2009**

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Citation for Bird Range Maps of North America:
Ridgely, R.S., T.F. Allnutt, T. Brooks, D.K. McNicol, D.W. Mehlman, B.E. Young, and J.R. Zook. 2003. Digital Distribution Maps of the Birds of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

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Citation for Amphibian Range Maps of the Western Hemisphere:
IUCN, Conservation International, and NatureServe. 2004. Global Amphibian Assessment. IUCN, Conservation International, and NatureServe, Washington, DC and Arlington, Virginia, USA.

Acknowledgement Statement for Amphibian Range Maps of the Western Hemisphere:
"Data developed as part of the Global Amphibian Assessment and provided by IUCN-World Conservation Union, Conservation International and NatureServe."

NOTE: Full metadata for the Bird Range Maps of North America is available at:
http://www.natureserve.org/library/birdDistributionmapsmetadatav1.pdf.

Full metadata for the Mammal Range Maps of North America is available at:
http://www.natureserve.org/library/mammalsDistributionmetadatav1.pdf.

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NatureServe

Version 7.1 (2 February 2009)
Data last updated: July 17, 2009

Distocambarus youngineri - Hobbs and Carlson, 1985
Newberry Burrowing Crayfish

Related ITIS Name(s): *Distocambarus youngineri* Hobbs and Carlson, 1985 (TSN 650409)
Unique Identifier: ELEMENT_GLOBAL.2.106760
Element Code: ICMAL50040
Informal Taxonomy: Animals, Invertebrates - Crustaceans - Crayfishes

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Crustacea	Malacostraca	Decapoda	Cambaridae	Distocambarus

Genus Size: B - Very small genus (2-5 species)

Check this box to expand all report sections: ☐

Concept Reference

Concept Reference: Williams, A.B., L.G. Abele, D.L. Felder, H.H. Hobbs, Jr., R.B. Manning, P.A. McLaughlin, and I.P. Farlante. 1989. A List of Common and scientific names of decapod crustaceans from America north of Mexico. American Fisheries Society Special Publication 17: 77 pp.
Concept Reference Code: B89WIL01EHUS
Name Used in Concept Reference: *Distocambarus youngineri*
Taxonomic Comments: Incorrectly spelled *yongineri* in Wilson (1989).

Conservation Status

NatureServe Status

Global Status: G1
Global Status Last Reviewed: 01Jul2009
Global Status Last Changed: 03Nov1999
Rounded Global Status: G1 - Critically Imperiled
Reasons: This species has a very limited range; and very small populations in South Carolina. The type locality of this species has been changed and now the species no longer exists there.
Nation: United States
National Status: N1

U.S. & Canada State/Province Status	
United States	South Carolina (S1)

Other Statuses

IUCN Red List Category: VU - Vulnerable
American Fisheries Society Status: Endangered (01Jan1996)

NatureServe Conservation Status Factors

Global Abundance: 1 - 1000 individuals
Global Abundance Comments: Distocambarus youngineri has been reported to have a very small total population in South Carolina . There are believed to be 1-1,000 individuals in South Carolina with a past decline of 10-30% (in an unknown time frame) and a current declining population. This species is no longer present at its type-locality which was clear cut in 1989.

Estimated Number of Element Occurrences: 6 - 20
Estimated Number of Element Occurrences Comments: Recent status survey by an experienced collector found ten locations. Eversole (1995) found this species at two historical sites and four new sites within the Saluda River basin in Newberry Co., South Carolina.

Global Short Term Trend: Declining (decline of 10-30%)
Global Short Term Trend Comments: The species is no longer present at its type-locality. The area around the type-locality was clearcut in 1989 and repeated attempts have been made to recollect there.

Global Inventory Needs: Precise range

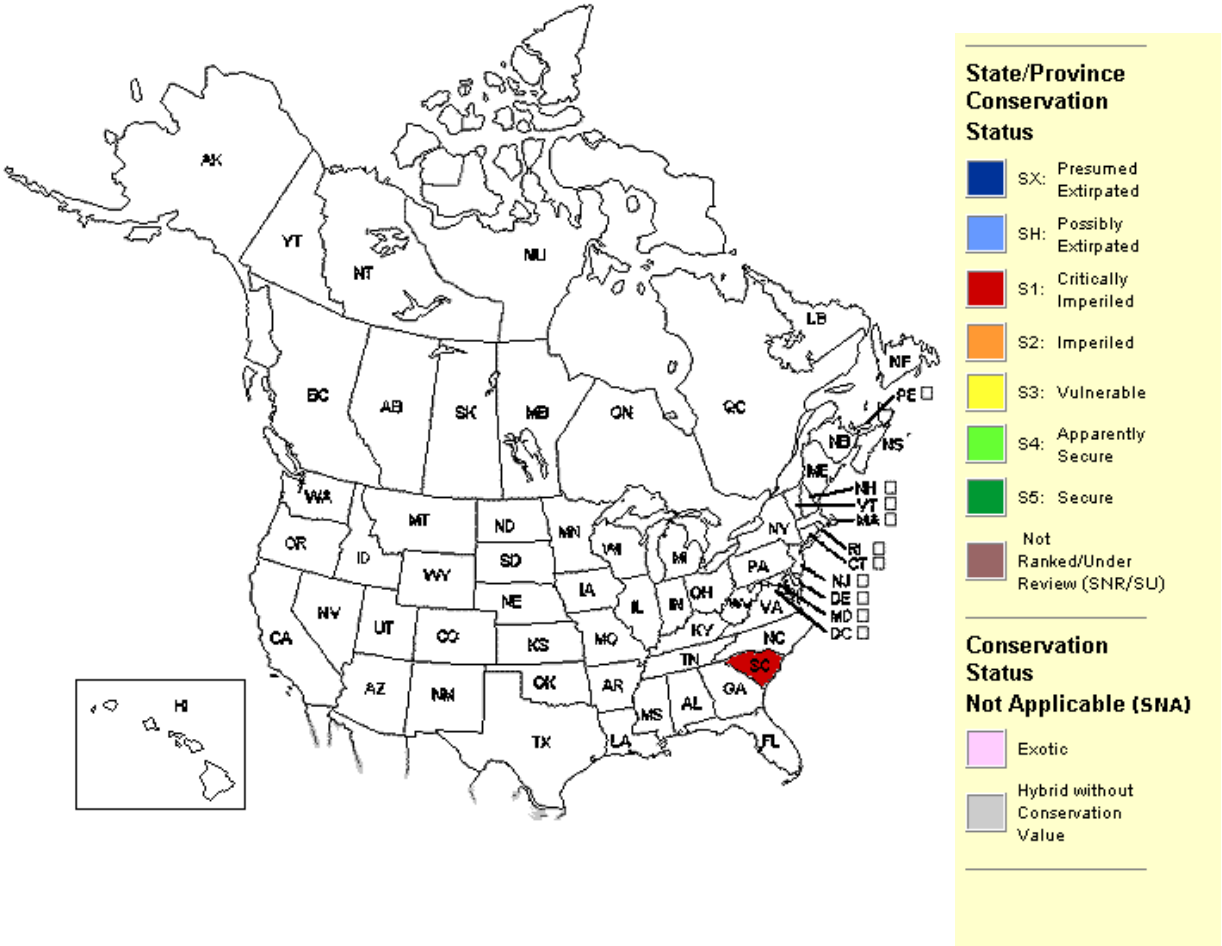
Global Protection: Unknown whether any occurrences are appropriately protected and managed

Degree of Threat: Substantial, imminent threat
Threat Scope: High
Threat Severity: High
Threat Immediacy: Moderate
Threats: In 1989 the entire forested area which is this species type location was clear felled. This species is no longer found at this location. This species appears to be sensitive to clear cutting and so any future felling could cause a decline in the population abundance. This species is also impacted by ground water abstraction.

Fragility Comments: Appears to be sensitive to clearcutting.

Distribution

U.S. States and Canadian Provinces



Endemism: endemic to a single state or province

U.S. & Canada State/Province Distribution	
United States	SC

Range Map
No map available.

Global Range: <100 square km (less than about 40 square miles)
Global Range Comments: Known from the Saluda River drainage in Newberry County, South Carolina (Eversole and Jones, 2004). Searches in adjacent drainages failed to find the species (Hobbs, 1989).

Natural heritage records exist for the following U.S. counties	
State	**County Name (FIPS Code)**
SC	Newberry (45071)

* Extirpated/possibly extirpated

U.S. Distribution by Watershed (based on available natural heritage records)	
Watershed Region	**Watershed Name (Watershed Code)**
03	Enoree (03050108)+, Saluda (03050109)+

+ Natural heritage record(s) exist for this watershed
* Extirpated/possibly extirpated

Ecology & Life History

Basic Description: A crayfish
General Description: Pigmented, eyes small but pigmented and faceted; rostrum spatulate, lacking marginal spines or tubercles, acumen poorly defined,acarinate; cervical and hepatic spines absent; areola quite narrow with 0-1 punctations in narrowest part; chela strongly depressed, most of palm studded with squamous to subsquamous tubercles, mesial margin with 2 rows of 4-6 tubercles each, mesial margin of palm shorter than width of palm; male with hook only on ischium of 3rd pereiopod, coxa of 4th lacking caudomesial boss; male 1st pleopod inclined caudodistally in distal half and with strong shoulder at cephalic base of terminal elements, terminating in 2 or 3 elements, central projection conspicuous subquadrangular platelike and somewhat mesially directed, mesial process broad basally and tapering into long caudodistally pointed element, cephalic process very poorly defined vestigial at best, subterminal setae absent; annulus ventralis of female hinged cephalically and movable in arc of about 35-45 degrees (Hobbs and Carlson, 1985). [LENGTH: to 32 TCL, to 50 TL] [WIDTH: to 16]
Diagnostic Characteristics: Pigmented, eyes small; rostrum spatulate; cepahlic and hepatic spines absent; areola quite narrow; mesial margin of palm with double row of tubercles and shorter than width of palm, dorsal surface studded with tubercles; male 1st pleopod inclined caudodistdallly in distal half and with strong shoulder at base of terminal elements, terminating in 2 or 3 elements, cephalic process vestigal at best, central projection subquadrangular and platelike, mesial process broad at base and tapering to long pointed element; annulus ventralis of female movable in arc of 35-45 degrees.
Reproduction Comments: Reproductively active males sharing burrow with females in February and March (probably time of amplexus); no data on brooding.
Ecology Comments: Complex burrows; primary burrower.
Habitat Type: Freshwater
Non-Migrant: Y
Locally Migrant: N
Long Distance Migrant: N
Mobility and Migration Comments: No data; home range probably does not exceed 20 m.
Palustrine Habitat(s): FORESTED WETLAND
Special Habitat Factors: Burrowing in or using soil
Habitat Comments: This species is a primary burrower whos' burrows extend below the water table, sometimes more than a metre down (Fitzpatrick and Eversole 1997). It is found in complex burrows in sandy clay soil with dense growth of *Pinus*, *Quercus*, and *Nyssa* surrounding small woodland pools.
Food Comments: No data.
Phenology Comments: No data; probably most active after sundown.
Length: 5 centimeters

Economic Attributes

Economic Comments: No known economic value.

Management Summary

Biological Research Needs: Range, population size, fecundity

Population/Occurrence Delineation

Group Name: CRAYFISHES

Use Class: Not applicable
Minimum Criteria for an Occurrence: Occurrences are based on some evidence of historical or current presence of single or multiple specimens, including live specimens or recently dead shells (i.e., soft tissue still attached without signs of external weathering or staining), at a given location with potentially recurring existence. Evidence is derived from reliable published observation or collection data; unpublished, though documented (i.e. government or agency reports, web sites, etc.) observation or collection data; or museum specimen information.
Separation Barriers: Separation barriers are based on hydrological discontinuity. Additional physical barriers, particularly for secondary and tertiary burrowers, include presence of upland habitat between water connections of a distance greater than 30 m. Migration of primary burrowers is generally not hindered by presence of upland habitat unless conditions are very xeric (dry and desert-like) (Smith,

2001).

Separation Distance for Unsuitable Habitat: 2 km

Separation Distance for Suitable Habitat: 2 km

Alternate Separation Procedure: Freshwater cave (troglobitic) species may occur from near entrances to very deep in cave systems. For cave species, each cave where an observation or collection was recorded (see Minimum EO Criteria, above) constitutes an element occurrence regardless of separation distance unless caves are part of a single hydrological system (see below). Occurrences are additionally separated by underground physical barriers to movement. Multiple caves within a single hydrological cave system are considered to be a single element occurrence when they are less than one km apart. Multiple caves within a single hydrological cave system are considered separate element occurrences when hydrological connections have not been determined or when separated by a distance of at least one km.

Separation Justification: Habitat for these creatures is primarily separated according to each species' burrowing ability. All crayfish are able to burrow to some extent and this ability will help determine the range of habitats in which a species can be found. Burrowing in the Astacidae is limited to streambed and bank excavation (Hobbs, 1988). The Cambaridae, as a whole are much more adept at burrowing than the Astacidae. As a result, they possess a greater habitat range than the Astacidae including dry water bodies (Hogger, 1988).

The burrowers can be classified into three categories: primary burrowers, secondary burrowers, and tertiary burrowers. Primary burrowers tend to remain in their burrows continuously and live in areas without permanent water except during breeding when they must migrate to a nearby water source (Hogger, 1988). The prairies of eastern and central Mississippi and western Alabama are an example of primary burrower habitat (Hogger, 1988). Secondary burrowers remain in burrows during dry periods but emerge when habitats are inundated seasonally. Such habitat includes lentic systems flooded periodically but dry in summer (Huner and Romaire, 1979) and permanent and temporary ponds and swamps in the southern United States. Tertiary burrowers do not burrow except during infrequent drought conditions and/or during breeding season. Both flowing and standing water can be tertiary burrower habitat.

Because primary burrowers, and to a lesser extent secondary burrowers, can occupy xeric habitats, separation barriers for such species do not include presence of upland habitat except in extremely dry conditions. Survival during dry periods, particularly for secondary burrowers, is dependent upon construction of a burrow regardless of season. Several different types have been described (Smith, 2001) depending on species, soil, and depth of water table.

Published information about movement in relation to migration distance is lacking but Cooper (1998, personal communication) and Fitzpatrick (1998, personal communication) both recommend a separation distance of one km between element occurrences. Dispersal patterns are best known for invasive species which likely have the greatest dispersal capability, therefore, separation distances have been determined for all crayfish based on these studies. Guan and Wiles (1997) provided evidence from the River Great Ouse in the United Kingdom that the range of movement for the majority of the invasive *Pacifastacus leniusculus* was within 190 m. Bubb et al. (2004) also studied P. leniusculus in England using radio-tagging and found median maximal upstream and downstream movement distances were 13.5 m (range 0-283 m) and 15 m (range 0-417 m), respectively. Barbaresi et al. (2004) found that ranging speed in the invasive crayfish *Procambarus clarkii* (Girard) to be slow (0.3 to 76.5 m/day) with the widest ranging individual traveling 304 m. Lewis and Horton (1996) found that 21% of tagged *Pacifastacus leniusculus* in an Oregon harvest pond moved >1000 m in one year while the majority moved <500 m. As such minimum separation distance (unsuitable and suitable) has been set at the NatureServe standard minimum of two km.

Exposed pools and streams in caves represent "karst windows" into more extensive underground streams. No information on the distance cave crayfish can disperse in underground streams is yet available.

Date: 18Oct2004

Author: Cordeiro, J.

Notes: Primary burrowers include the following taxa: Cambarus (Cambarus) carolinus, C. (C.) diogenes diogenes, C. (Depressicambarus) catagius, C. (D.) cymatilis, C. (D.) deweesae, C. (D.) harti, C. (D.) reflexus, C. (D.) pyronotus, C. (D.) striatus, C. (D.) strigosus, C. (D.) truncatus, C. (Glareocola), C. (Jugicambarus) batchi, C. (J.) carolinus, C. (J.) causeyi, C. (J.) dubius, C. (J.) gentryi, C. (J.) monongalensis, C. (J.) nodosus, C. (Lacunicambarus), C. (Tubericambarus), Distocambarus, Fallicambarus, Procambarus (Acucauda), P. (Distocambarus), P. (Girardiella) barbiger, P. (G.) cometes, P. (G.) connus, P. (G.) curdi, P. (G.) gracilis, P. (G.) hagenianus hagenianus, P. (G.) hagenianus vesticeps, P. (G.) liberorum, P. (G.) pogum, P. (Hagenides) [except P. pygmaeus]
Secondary burrowers include the following taxa: Cambarus (Cambarus) ortmanni, C. (Depressicambarus) latimanus, C. (D.) reduncus, Hobbseus, Procambarus (Cambarus) clarkii, P. (Girardiella) kensleyi, P. (G.) reimeri, P. (G.) simulans, P. (G.) steigmani, P. (G.) tulanei, P. (Hagenides) pygmaeus, P. (Leconticambarus) [excepting P. alleni and P. milleri], P. (Ortmannicus) [excepting the cave dwelling species], P. (Tenuicambarus)
Tertiary burrowers include the following taxa: Barbicambarus, Bouchardina, Cambarus (Cambarus) angularis, C. (C.) bartonii carinirostris, C. (C.) bartonii cavatus, C. (C.) howardi, C. (C.) sciotensis, C. (Depressicambarus) englishi, C. (D.) graysoni, C. (D.) halli, C. (D.) obstipus, C. (D.) sphenoides, C. (Erebicambarus) ornatus, C. (E.) rusticiformis, C. (Exilicambarus) cracens, C. (Hiaticambarus), C. (Jugicambarus) asperimanus, C. (J.) bouchardi, C. (J.) crinipes, C. (J.) distans, C. (J.) friaufi, C. (J.) obeyensis, C. (J.) parvoculus, C. (J.) unestami, C. (Puncticambarus) [excepting the cave dwelling species], C. (Veticambarus), Cambarellus, Faxonella, Orconectes [excepting the cave dwelling species], Pacifastacus, Procambarus (Capillicambarus), P. (Girardiella) ceruleus, P.

Population/Occurrence Viability

Justification: Use the Generic Element Occurrence Rank Specifications (2008).
Key for Ranking Species Element Occurrences Using the Generic Approach (2008).

U.S. Invasive Species Impact Rank (I-Rank)

Not yet assessed

Authors/Contributors

NatureServe Conservation Status Factors Edition Date: 01Jul2009
NatureServe Conservation Status Factors Author: Cordeiro, J. (2009); Fitzpatrick, J.F., Jr.; 1999 review by C. Taylor (1996)
Element Ecology & Life History Edition Date: 24Jun2009
Element Ecology & Life History Author(s): Cordeiro, J. (2009); Fitzpatrick, J.F. (1992)

Zoological data developed by NatureServe and its network of natural heritage programs (see **Local Programs**) and other contributors and cooperators (see **Sources**).

References

- Eversole, A. G. 1995. DISTOCAMBARUS (Fitzcambarus) YOUNGINERI status in South Carolina. Final Report. Submitted to U.S. Fish and Wildlife Service, Ashville, North Carolina. 27 pp.
- Eversole, A.G. 1995. Distribution of three rare crayfish species in South Carolina, USA. Freshwater Crayfish, 8: 113-120.
- Eversole, A.G. and D.R. Jones. 2004. Key to the crayfish of South Carolina. Unpublished report. Clemson University, Clemson, South Carolina. 43 pp.
- Hobbs, H. H., Jr. 1989. A illustrated checklist of the American crayfishes (Decapoda: Astacidae, Cambaridae, and Parastacidae). Smithsonian Contributions to Zoology, No. 480. 236 pp.
- Hobbs, Horton, H., Jr., and P.H. Carlson. 1985. A new member of the genus DISTOCAMBARUS (Decapoda: Cambaridae) from the Saluda Basin, South Carolina. Proc. of the Biol. Soc. of Washington, 98(1):81-89.
- Hobbs, Horton. H. Jr. 1989. An Illustrated Checklist of the American crayfishes (Decapoda: Astacidae, Cambaridae & Parastacidae). Smithsonian Contributions to Zoology 480. Smithsonian Institute Press, Washington, D. C. 236 pp.
- McLaughlin, P.A., D.K. Camp, M.V. Angel, E.L. Bousfield, P. Brunel, R.C. Brusca, D. Cadien, A.C. Cohen, K. Conlan, L.G. Eldredge, D.L. Felder, J.W. Goy, T. Haney, B. Hann, R.W. Heard, E.A. Hendrycks, H.H. Hobbs III, J.R. Holsinger, B. Kensley, D.R. Laubitz, S.E. LeCroy, R. Lemaitre, R.F. Maddocks, J.W. Martin, P. Mikkelsen, E. Nelson, W.A. Newman, R.M. Overstreet, W.J. Poly, W.W. Price, J.W. Reid, A. Robertson, D.C. Rogers, A. Ross, M. Schotte, F. Schram, C. Shih, L. Watling, G.D.F. Wilson, and D.D. Turgeon. 2005. Common and scientific names of aquatic invertebrates from the United States and Canada: Crustaceans. American Fisheries Society Special Publication 31: 545 pp.
- Williams, A.B., L.G. Abele, D.L. Felder, H.H. Hobbs, Jr., R.B. Manning, P.A. McLaughlin, and I.P. Farlante. 1989. A List of Common and scientific names of decapod crustaceans from America north of Mexico. American Fisheries Society Special Publication 17: 77 pp.

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Note: All species and ecological community data presented in NatureServe Explorer at http://www.natureserve.org/explorer were updated to be current with NatureServe's central databases as of **July 17, 2009**.
Note: This report was printed on **November 10, 2009**

Citation for data on website including State Distribution, Watershed, and Reptile Range maps:
NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: November 10, 2009).

Citation for Bird Range Maps of North America:
Ridgely, R.S., T.F. Allnutt, T. Brooks, D.K. McNicol, D.W. Mehlman, B.E. Young, and J.R. Zook. 2003. Digital Distribution Maps of the Birds of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

Acknowledgement Statement for Bird Range Maps of North America:
"Data provided by NatureServe in collaboration with Robert Ridgely, James Zook, The Nature Conservancy - Migratory Bird Program, Conservation International - CABS, World Wildlife Fund - US, and Environment Canada - WILDSPACE."

Citation for Mammal Range Maps of North America:
Patterson, B.D., G. Ceballos, W. Sechrest, M.F. Tognelli, T. Brooks, L. Luna, P. Ortega, I. Salazar, and B.E. Young. 2003. Digital Distribution Maps of the Mammals of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

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NatureServe

Version 7.1 (2 February 2009)
Data last updated: July 17, 2009

Etheostoma collis - (Hubbs and Cannon, 1935)
Carolina Darter

Other Related Name(s): *Etheostoma saludae* (Hubbs and Cannon, 1935)
Related ITIS Name(s): *Etheostoma collis* (Hubbs and Cannon, 1935) (TSN 168383) ;*Etheostoma saludae* (Hubbs and Cannon, 1935) (TSN 168384)
Unique Identifier: ELEMENT_GLOBAL.2.106371
Element Code: AFCQC02150
Informal Taxonomy: Animals, Vertebrates - Fishes - Bony Fishes - Perches and Darters

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Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Actinopterygii	Perciformes	Percidae	Etheostoma

Genus Size: D - Medium to large genus (21+ species)

Check this box to expand all report sections: ☐

Concept Reference

Concept Reference: Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. American Fisheries Society, Special Publishing 20. 183 pp.
Concept Reference Code: B91ROB01NAUS
Name Used in Concept Reference: *Etheostoma collis*
Taxonomic Comments: This species includes *E. saludae*, which was synonymized with *E. collis* by Jenkins and Burkhead (1994). The nominal subspecies *collis* and *lepidinion* were not recognized as valid by Burkhead and Jenkins (1991).

Conservation Status

NatureServe Status

Global Status: G3
Global Status Last Reviewed: 06May2009
Global Status Last Changed: 23Sep1996
Rounded Global Status: G3 - Vulnerable
Reasons: Known from a few dozen occurrences in Virginia, North Carolina, and South Carolina, but has not been taken from several of these in recent surveys; uncommon; probably more widespread than now apparent, due to inadequate survey effort; threats may include chemical runoff from agricultural land and possibly turbidity caused by excessive silt in the water, such as may result from urbanization; habitat destruction through inundation by dams is a potential threat.
Nation: United States
National Status: N3

U.S. & Canada State/Province Status	
United States	North Carolina (S3), South Carolina (SNR), Virginia (S2)

Other Statuses

NatureServe Conservation Status Factors

Global Abundance: Unknown
Global Abundance Comments: Total adult population size is unknown. This species is generally rare or uncommon, but common or abundant in Mines Creek, Virginia (Jenkins and Burkhead 1994).

Estimated Number of Element Occurrences: 21 - 80
Estimated Number of Element Occurrences Comments: Menhinick (1991) mapped about 53 collection sites in North Carolina; these represent probably at least a few dozen distinct occurrences. Jenkins and Burkhead (1994) mapped 13 collection sites in Virginia, representing perhaps a half dozen or more distinct occurrences. Probably there are significantly more occurrences than available records indicate; the habitat tends not to attract ichthyologists and has not been well surveyed.

Global Short Term Trend: Unknown
Global Short Term Trend Comments: Population trend is unknown.

Global Long Term Trend: Moderate decline to relatively stable (25% change to 50% decline)
Global Long Term Trend Comments: Some populations have declined (Jenkins and Burkhead 1994), but the degree of decline is unknown.

Global Inventory Needs: Better information is needed on current distribution, abundance, and trends.

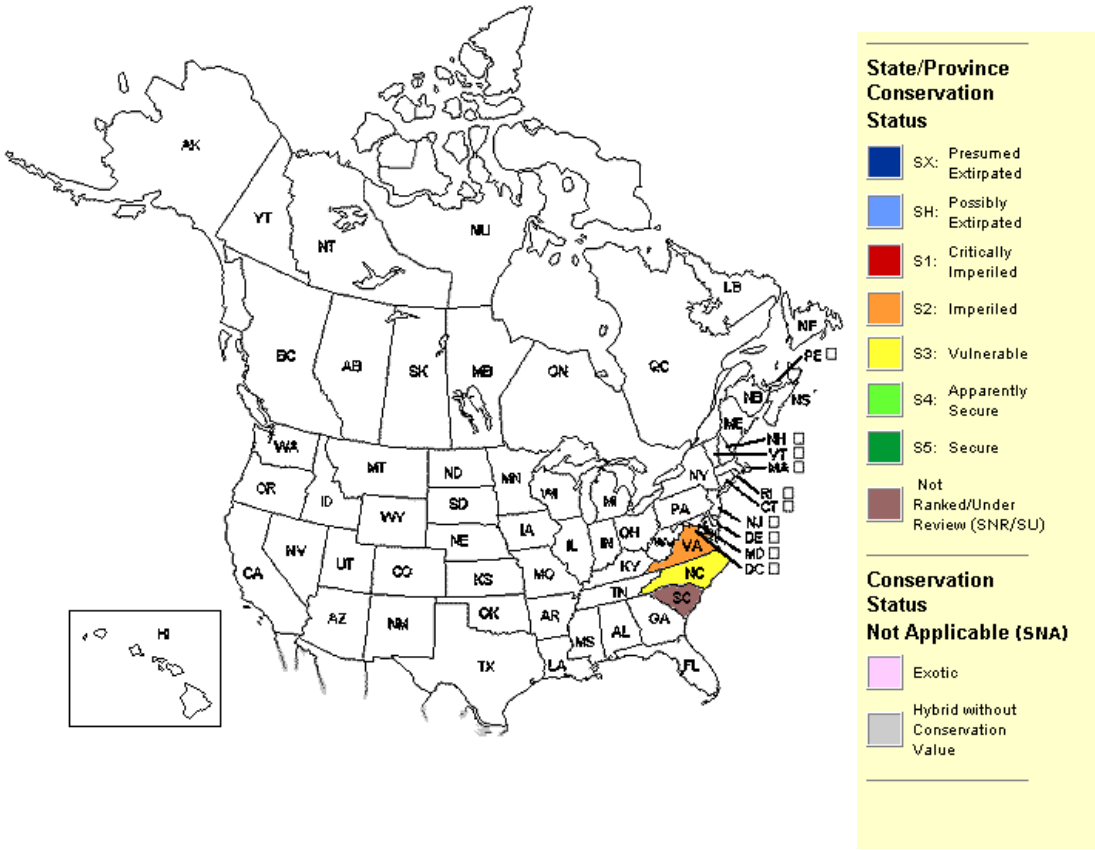
Global Protection: Unknown whether any occurrences are appropriately protected and managed

Degree of Threat: Localized substantial threat
Threat Scope: Unknown
Threat Severity: Moderate
Threat Immediacy: High
Threats: Threats may include chemical runoff from agricultural land and possibly turbidity caused by excessive silt in the water (Burkhead and Jenkins 1991), such as may result from urbanization. Habitat destruction through inundation by dams is a potential threat.

Jelks et al. (2008) categorized this species as Vulnerable (a taxon that is in imminent danger of becoming threatened throughout all or a significant portion of its range), based on present or threatened destruction, modification, or reduction of habitat or range.

Distribution

U.S. States and Canadian Provinces



Endemism: endemic to a single nation

U.S. & Canada State/Province Distribution	
United States	NC, SC, VA

Range Map
No map available.

Global Range: 5000-200,000 square km (about 2000-80,000 square miles)
Global Range Comments: Localized populations occur in lower and middle Piedmont streams from the Roanoke River system in Virginia to the Santee

River system in South Carolina (Jenkins and Burkhead 1994). some of the apparently localized distribution may be an artifact of insufficient survey effort (Jenkins and Burkhead 1994).

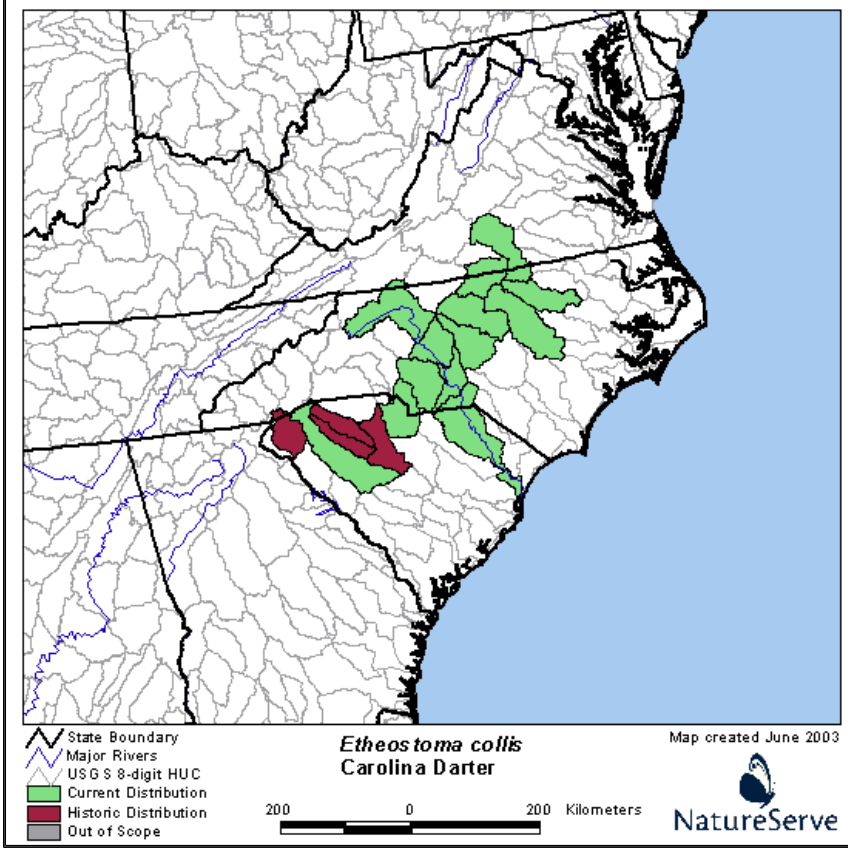
Natural heritage records exist for the following U.S. counties	
State	**County Name (FIPS Code)**
NC	Anson (37007), Cabarrus (37025), Chatham (37037), Davidson (37057), Durham (37063), Granville (37077), Guilford (37081), Mecklenburg (37119), Montgomery (37123), Moore (37125), Orange (37135), Randolph (37151), Richmond (37153), Stanly (37167), Union (37179)
SC	Anderson (45007)*, Fairfield (45039), Richland (45079)*, York (45091)*
VA	Charlotte (51037), Halifax (51083), Mecklenburg (51117)

* Extirpated/possibly extirpated

U.S. Distribution by Watershed (based on available natural heritage records)	
Watershed Region	**Watershed Name (Watershed Code)**
03	Middle Roanoke (03010102)+, Lower Dan (03010104)+, Lower Catawba (03050103)+, Wateree (03050104)+, Lower Broad (03050106)+, Seneca (03060101)+

+ Natural heritage record(s) exist for this watershed
* Extirpated/possibly extirpated

U.S. Distribution by Watershed (based on multiple information sources)



Ecology & Life History

Basic Description: A fish (darter) that reaches a maximum length of 6 cm.
Reproduction Comments: Spawning may peak near the end of March (Page 1983, Kuehne and Barbour 1983). Individuals captured in mid-March at a water temperature of 13.3 C began spawning the next day when placed in an aquarium at room temperature (Burkhead and Jenkins 1991). In North carolina, spawning occurs usually in late March and early April (Collette 1962).
Habitat Type: Freshwater
Non-Migrant: N
Locally Migrant: N
Long Distance Migrant: N
Riverine Habitat(s): CREEK, Low gradient, Moderate gradient, Pool
Special Habitat Factors: Benthic
Habitat Comments: This darter typically occurs in small upland creeks and rivulets in wooded and deforested (pasture) areas, in areas of low current velocity (pools and very slow runs), usually on sand, gravel, and detritus in open and stick-littered areas, sometimes among brush and fallen tree limbs, and likely also among vegetation (Lee et al. 1980, Burkhead and Jenkins 1991, Jenkins and Burkhead 1994). It has been collected also in faster water (Jenkins and Burkhead 1994), on substrates of sand, gravel, and bedrock (Collette 1962) or sand, mud, or rubble covered by silt or detritus (Lee et al. 1980), and in murky water over clay and silt (Kuehne and Barbour 1983).
Adult Food Habits: Invertivore

Immature Food Habits: Invertivore
Food Comments: Eats microcrustaceans and mayfly and dipteran larvae (Knicely, in Burkhead and Jenkins 1991; Jenkins and Burkhead 1994).
Length: 4 centimeters

Economic Attributes

Not yet assessed

Management Summary

Biological Research Needs: Research on basic life history is needed.

Population/Occurrence Delineation

Group Name: DARTERS

Use Class: Not applicable
Minimum Criteria for an Occurrence: Occurrences are based on evidence of historical presence, or current and likely recurring presence, at a given location. Such evidence minimally includes collection or reliable observation and documentation of one or more individuals (including eggs and larvae) in appropriate habitat.
Separation Barriers: Dam lacking a suitable fishway; high waterfall; upland habitat.
Separation Distance for Unsuitable Habitat: 10 km
Separation Distance for Suitable Habitat: 10 km
Separation Justification: Data on dispersal and other movements generally are not available. Though larvae of some species may drift with the current, Turner (2001) found no significant relationship between a larval transport index and gene flow among several different darter species.

Separation distances are arbitrary but reflect the likely low probability that two occupied locations separated by less than several kilometers of aquatic habitat would represent truly independent populations.

Because of the difficulty in defining suitable versus unsuitable habitat, especially with respect to dispersal, and to simplify the delineation of occurrences, a single separation distance is used regardless of habitat quality.

Occupied locations that are separated by a gap of 10 km or more of any aquatic habitat that is not known to be occupied generally represent different occurrences. However, it is important to evaluate seasonal changes in habitat to ensure that an occupied habitat occurrence for a particular population does not artificially separate spawning areas and nonspawning areas as different occurrences simply because there have been no collections/observations in an intervening area that may exceed the separation distance.
Date: 21Sep2004
Author: Hammerson, G.

Population/Occurrence Viability

Justification: **Use the Generic Element Occurrence Rank Specifications (2008).**
Key for Ranking Species Element Occurrences Using the Generic Approach (2008).

U.S. Invasive Species Impact Rank (I-Rank)

Not yet assessed

Authors/Contributors

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NatureServe Conservation Status Factors Author: Hammerson, G., J. M. Clayton, and F. Dirrigl, Jr.
Element Ecology & Life History Edition Date: 06May2009
Element Ecology & Life History Author(s): Hammerson, G.

Zoological data developed by NatureServe and its network of natural heritage programs (see **Local Programs**) and other contributors and cooperators (see **Sources**).

References

- Burkhead, N. M., and R. E. Jenkins. 1991. Fishes. Pages 321-409 in K. Terwilliger (coordinator). Virginia's Endangered Species: Proceedings of a Symposium. McDonald and Woodward Publishing Company, Blacksburg, Virginia.
- Collette, B. B. 1962. The swamp darters of the subgenus *Hololepis* (Pisces, Percidae). Tulane Studies in Zoology 9:115-211.
- Jelks, H. L., S. J. Walsh, N. M. Burkhead, S. Contreras-Balderas, E. Díaz-Pardo, D. A. Hendrickson, J. Lyons, N. E. Mandrak, F. McCormick, J. S. Nelson, S. P. Platania, B. A. Porter, C. B. Renaud, J. Jacobo Schmitter-Soto, E. B. Taylor, and M.L. Warren, Jr. 2008. Conservation status of imperiled North American freshwater and diadromous fishes. Fisheries 33(8):372-407.
- Jenkins, R. E., and N. M. Burkhead. 1994. Freshwater fishes of Virginia. American Fisheries Society, Bethesda, Maryland. xxiii + 1079 pp.
- Kuehne, R. A., and R. W. Barbour. 1983. The American Darters. University Press of Kentucky, Lexington, Kentucky. 177 pp.
- Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. 1980 et seq. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History, Raleigh, North Carolina. i-x + 854 pp.
- Menhinick, E. F. 1991. The freshwater fishes of North Carolina. North Carolina Wildlife Resources Commission. 227 pp.
- Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, Maryland. 386 pp.
- Page, L. M. 1983. Handbook of Darters. T. F. H. Pub., Inc., Neptune City, New Jersey. 271 pp.
- Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Company, Boston, Massachusetts. 432 pp.
- Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. American Fisheries Society, Special Publishing 20. 183 pp.
- Rohde, F. C., et al. 1994. Freshwater Fishes of the Carolinas, Virginia, Maryland, and Delaware. University of North Carolina Press, Chapel Hill, North Carolina. 222 pp.

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Use Guidelines and Citation

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Note: All species and ecological community data presented in NatureServe Explorer at http://www.natureserve.org/explorer were updated to be current with NatureServe's central databases as of **July 17, 2009**.
Note: This report was printed on **November 10, 2009**

Citation for data on website including State Distribution, Watershed, and Reptile Range maps:
NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: November 10, 2009).

Citation for Bird Range Maps of North America:
Ridgely, R.S., T.F. Allnutt, T. Brooks, D.K. McNicol, D.W. Mehlman, B.E. Young, and J.R. Zook. 2003. Digital Distribution Maps of the Birds of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

Acknowledgement Statement for Bird Range Maps of North America:
"Data provided by NatureServe in collaboration with Robert Ridgely, James Zook, The Nature Conservancy - Migratory Bird Program, Conservation International - CABS, World Wildlife Fund - US, and Environment Canada - WILDSPACE."

Citation for Mammal Range Maps of North America:
Patterson, B.D., G. Ceballos, W. Sechrest, M.F. Tognelli, T. Brooks, L. Luna, P. Ortega, I. Salazar, and B.E. Young. 2003. Digital Distribution Maps of the Mammals of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

Acknowledgement Statement for Mammal Range Maps of North America:
"Data provided by NatureServe in collaboration with Bruce Patterson, Wes Sechrest, Marcelo Tognelli, Gerardo Ceballos, The Nature Conservancy-Migratory Bird Program, Conservation International-CABS, World Wildlife Fund-US, and Environment Canada-WILDSPACE."

Citation for Amphibian Range Maps of the Western Hemisphere:
IUCN, Conservation International, and NatureServe. 2004. Global Amphibian Assessment. IUCN, Conservation International, and NatureServe, Washington, DC and Arlington, Virginia, USA.

Acknowledgement Statement for Amphibian Range Maps of the Western Hemisphere:
"Data developed as part of the Global Amphibian Assessment and provided by IUCN-World Conservation Union, Conservation International and NatureServe."

NOTE: Full metadata for the Bird Range Maps of North America is available at:
http://www.natureserve.org/library/birdDistributionmapsmetadatav1.pdf.

Full metadata for the Mammal Range Maps of North America is available at:
http://www.natureserve.org/library/mammalsDistributionmetadatav1.pdf.

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NatureServe

Version 7.1 (2 February 2009)
Data last updated: July 17, 2009

Pyganodon cataracta - (Say, 1817)
Eastern Floater

Related ITIS Name(s): *Anodonta cataracta* Say, 1817 (TSN 79932) ;*Pyganodon cataracta* (Say, 1817) (TSN 568176)
Unique Identifier: ELEMENT_GLOBAL.2.109938
Element Code: IMBIV54010
Informal Taxonomy: Animals, Invertebrates - Mollusks - Freshwater Mussels

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Mollusca	Bivalvia	Unionoida	Unionidae	Pyganodon

Check this box to expand all report sections: ☐

Concept Reference

Concept Reference: Turgeon, D.D., J.F. Quinn, Jr., A.E. Bogan, E.V. Coan, F.G. Hochberg, W.G. Lyons, P.M. Mikkelsen, R.J. Neves, C.F.E. Roper, G. Rosenberg, B. Roth, A. Scheltema, F.G. Thompson, M. Vecchione, and J.D. Williams. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: Mollusks. 2nd Edition. American Fisheries Society Special Publication 26, Bethesda, Maryland: 526 pp.
Concept Reference Code: B98TUR01EHUS
Name Used in Concept Reference: *Pyganodon cataracta*
Taxonomic Comments: This species was placed in the newly elevated genus *Pyganodon* by Hoeh (1990). Recently, Zanatta et al. (2007) supported the monophyly of both *Pyganodon* and *Utterbackia* using mutation coding of allozyme data, but also resolved the Eurasian *Anodonta cygnea* to *Pyganodon*, *Utterbackia*, and North American *Anodonta*; indicating futher phylogenetic analysis of the Anodontinae is required including both North American and Eurasian species.

Conservation Status

NatureServe Status

Global Status: G5
Global Status Last Reviewed: 14Apr2007
Global Status Last Changed: 25Nov1996
Rounded Global Status: G5 - Secure
Reasons: This species is common and wide ranging in the Atlantic dranages from the Lower St. Lawrence River basin south to the Altamaha River basin, Georgia, and in the Alabama-Coosa River drainage, and the Apalachicola and Choctawhatchee River basins, Georgia.
Nation: United States
National Status: N5
Nation: Canada
National Status: N5 (17Jul2006)

U.S. & Canada State/Province Status	
United States	Alabama (S3), Connecticut (SU), Delaware (S4), District of Columbia (SNR), Florida (SNR), Georgia (S5), Maine (SNR), Maryland (S5), Massachusetts (S5), New Hampshire (S4?), New Jersey (S5), New York (S4), North Carolina (S5), Pennsylvania (S3S4), Rhode Island (SNR), South Carolina (SNR), Vermont (S4), Virginia (S5), West Virginia (SH), Wisconsin (SU)
Canada	New Brunswick (S5), Nova Scotia (S5), Ontario (S2), Prince Edward Island (SNR), Quebec (S4)

Other Statuses

American Fisheries Society Status: Currently Stable (01Jan1993)

NatureServe Conservation Status Factors

Global Abundance: >1,000,000 individuals
Global Abundance Comments: In the ACF basin, it was recently collected from 4 of 324 sites in Alabama, Florida, and Georgia the lower main channel of the Chipola River in Florida (new state record) and three tributaries of the Flint River (the first records from this system) (Brim-Box and Williams, 2000). This is the southern range limit where it is considered rare.

Estimated Number of Element Occurrences: > 300
Estimated Number of Element Occurrences Comments: In Maine, this is the second most common freshwater mussel species occurring in every major watershed in every county (Nedeau et al., 2000). It is found throughout much of Rhode Island (Raithel and Hartenstein, 2006). In Massachusetts, it is very common occurring in every drainage system in the state in every county (Smith, 2000) and is similarly common in Vermont (Fichtel and Smith, 1995) and Connecticut (Nedeau and Victoria, 2003). In the Delaware River basin, it has been recorded in the Middle Delaware- Mongaup- Broadhead drainage in New York to bordering Pennsylvania (Strayer and Ralley, 1991). In the Delmarva peninsula, this species was found in the Susquehanna, Bohemia, Sassafras, Chester, Choptank, Nanticoke, Wicomico, Appoquiniminik, Leipsic, St. Jones, Murderkill, Mispillion, Cedar Creek, and Indian River systems in Delaware and Maryland (Counts et al., 1991). In Maryland, it is known from the Upper Potomac, Washington Metro, Gunpowder, Susquehanna, Elk, Choptank, Chester, and Naticoke River drainages (Bogan and Proch, 1995), but may be extirpated from the upper Potomac in West Virginia (Taylor, 1987). It is found throughout much of eastern Virginia including the James (Burch, 2002), Potomac (Bogan and Proch, 1995), Chowan and Roanoke (Bogan, 2002). Johnson (1970) cites the Dan, James, Rapidan, and Roanoke drainages in Virginia. Recently, this species was found in 3 sites in Great Pee Dee River and Lynches River in South Carolina (Catena Group, 2006). In South Carolina, it is wide ranging from the Savannah, Cooper-Santee, Pee Dee, and Waccamaw River basins (Bogan and Alderman, 2004). In Alabama, it is restricted to the Chattahoochee and possibly Chipola River systems but has not been reported since the 1970s (Mirarchi, 2004). It has since been collected in the Uchee Creek, Russell Co. and Lake Martin (Tallapoosa River) specimens are this species (Williams et al., 2008). In North Carolina, it is wide-ranging from the Broad River basin north to the Pasquotank River basin (Bogan, 2002). It was recently documented in Georgia in the Lower Ogeechee/ Canoochee drainages (Sukkestad et al., 2006). In the ACF basin, it was recently collected from 4 of 324 sites in Alabama, Florida (a new state record), and Georgia the lower main channel of the Chipola River in Florida and three tributaries of the Flint River (the first records from this system) (Brim-Box and Williams, 2000). Johnson (1970) also lists it for the Altamaha, Ocmulgee, and Savannah River systems in Georgia and South Carolina. In Canada, this species is secure throughout most of its range; peripheral in Ontario (Ottawa River only), widespread and abundant in Nova Scotia (Athearn and Clarke, 1962; Clarke and Rick, 1964), Quebec, New Brunswick (Athearn, 1961) where it is stable in Petitcodiac (Hanson and Locke, 2001), Prince Edward Island (Metcalfe-Smith and Cudmore-Vokey, 2004; Davis, 1999).

Global Short Term Trend: Stable (unchanged or within +/- 10% fluctuation in population, range, area occupied, and/or number or condition of occurrences)

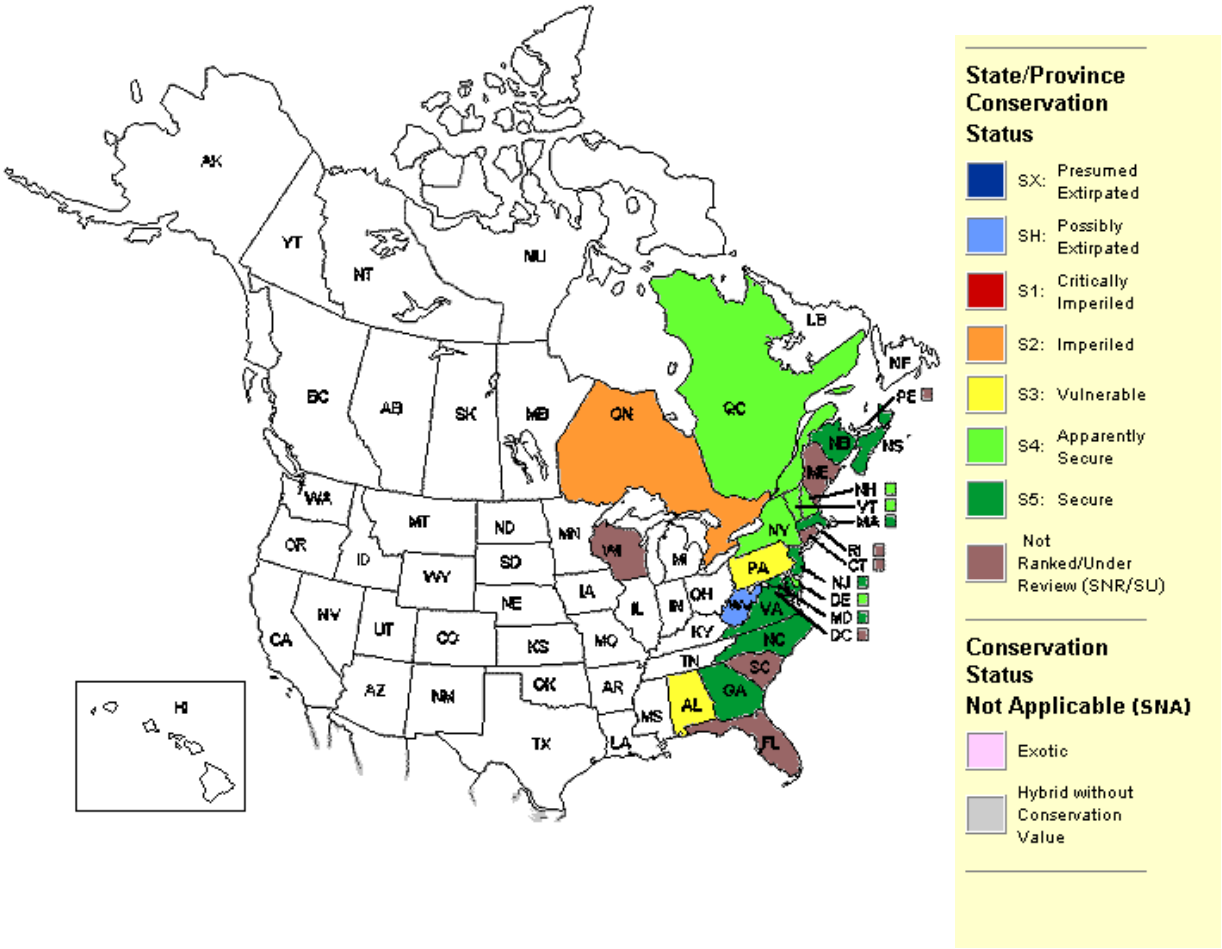
Global Long Term Trend: Relatively stable (+/- 25% change)

Global Protection: Unknown whether any occurrences are appropriately protected and managed

Fragility: Environmental Specificity: Broad. Generalist or community with all key requirements common.
Environmental Specificity Comments: This species has a broad environmental tolerance and low host specificity (Nedeau et al., 2000).

Distribution

U.S. States and Canadian Provinces



Endemism: occurs (regularly, as a native taxon) in multiple nations

U.S. & Canada State/Province Distribution	
United States	AL, CT, DC, DE, FL, GA, MA, MD, ME, NC, NH, NJ, NY, PA, RI, SC, VA, VT, WI, WV
Canada	NB, NS, ON, PE, QC

Range Map
No map available.

Global Range: >2,500,000 square km (greater than 1,000,000 square miles)
Global Range Comments: This species is common and wide ranging in the Atlantic dranages from the Lower St. Lawrence River basin south to the Altamaha River basin and west to the Great Lakes, Georgia, and in the Alabama-Coosa River drainage, and the Apalachicola and Choctawhatchee River basins, Georgia. In the Apalachicola Basin (ACF basin = formed by Apalachicola, Chattahoochee, and Flint Rivers) of Alabama, Florida, and Georgia, this species is historically known from 21 records from 12 sites from the ACF system including the main channel of the Apalachicola River and mainstem and tributaries of the Chipola and Chattahoochee Rivers (but not the Flint River) (Brim Box and Williams, 2000). In the ACF basin, it was recently collected from 4 of 324 sites in Alabama, Florida, and Georgia the lower main channel of the Chipola River in Florida (first state record) and three tributaries of the Flint River (the first records from this system) (Brim-Box and Williams, 2000).

Natural heritage records exist for the following U.S. counties	
State	**County Name (FIPS Code)**
PA	Bradford (42015), Bucks (42017), Cameron (42023), Centre (42027), Chester (42029), Clinton (42035), Columbia (42037), Cumberland (42041), Dauphin (42043), Luzerne (42079), Lycoming (42081)*, Northampton (42095), Northumberland (42097), Perry (42099), Snyder (42109)*, Susquehanna (42115)*, Tioga (42117), Wyoming (42131), York (42133)
SC	Allendale (45005), Anderson (45007), Barnwell (45011), Chesterfield (45025), Edgefield (45037), Fairfield (45039), Hampton (45049), Jasper (45053), Lancaster (45057), McCormick (45065), Orangeburg (45075), Saluda (45081)
WI	Oneida (55085)

* Extirpated/possibly extirpated

U.S. Distribution by Watershed (based on available natural heritage records)

Watershed Region	Watershed Name (Watershed Code)
02	Middle Delaware-Musconetcong (02040105)+, Crosswicks-Neshaminy (02040201)+, Schuylkill (02040203)+, Upper Susquehanna (02050101)+, Tioga (02050104)+, Chemung (02050105)+, Upper Susquehanna-Tunkhannock (02050106)+, Upper Susquehanna-Lackawanna (02050107)+, Upper West Branch Susquehanna (02050201)+, Sinnemahoning (02050202)+, Middle West Branch Susquehanna (02050203)+, Lower West Branch Susquehanna (02050206)+, Lower Susquehanna-Penns (02050301)+, Lower Juniata (02050304)+, Lower Susquehanna-Swatara (02050305)+, Lower Susquehanna (02050306)+
03	Lynches (03040202)+, Lower Broad (03050106)+, Saluda (03050109)+, Lake Marion (03050111)+, Salkehatchie (03050207)+, Broad-St. Helena (03050208)+, Upper Savannah (03060103)+, Middle Savannah (03060106)+, Stevens (03060107)+, Lower Savannah (03060109)+
07	Upper Wisconsin (07070001)+

+ Natural heritage record(s) exist for this watershed
* Extirpated/possibly extirpated

Ecology & Life History

Reproduction Comments: This species is a long-term brooder- eggs are fertilized in August and glochidia are released the following spring. Reported glochidial hosts include Amploplites rupestris (rock bass) (Gray et al., 1999), *Catostomus commersoni* (white sucker) (Gray et al., 1999; Wiles, 1975), *Cyprinus carpio* (common carp) (Lefevre and Curtis, 1911; 1912), *Gasterosteus aculeatus* (threespine stickleback) (Wiles, 1975; Threlfall, 1986), *Lepomis gibbosus* (pumpkinseed) (Connor, 1905; Gray et al., 1999), *Lepomis macrochirus* (bluegill) (see Watters, 1994), and *Perca flavescens* (yellow perch) (see Watters, 1994; Gray et al., 1999).
Habitat Type: Freshwater
Non-Migrant: N
Locally Migrant: N
Long Distance Migrant: N
Riverine Habitat(s): BIG RIVER, CREEK, Low gradient, MEDIUM RIVER, Pool
Lacustrine Habitat(s): Deep water, Shallow water
Special Habitat Factors: Benthic
Habitat Comments: This species is found in a wide variety of habitats, including small streams, rivers, ponds, and lakes. It is usually confined to slow-moving portions of riverine environments, in sandy or muddy substrates. It has a high tolerance for silt and can be found in deeper water of lakes and ponds (Nedeau et al., 2000).

Economic Attributes

Not yet assessed

Management Summary

Not yet assessed

Population/Occurrence Delineation

Group Name: FRESHWATER MUSSELS

Use Class: Not applicable
Minimum Criteria for an Occurrence: Occurrences are based on some evidence of historical or current presence of single or multiple specimens, including live specimens or recently dead shells (i.e., soft tissue still attached and/or nacre still glossy and iridescent without signs of external weathering or staining), at a given location with potentially recurring existence. Weathered shells constitute a historic occurrence. Evidence is derived from reliable published observation or collection data; unpublished, though documented (i.e. government or agency reports, web sites, etc.) observation or collection data; or museum specimen information.
Mapping Guidance: Based on the separation distances outlined herein, for freshwater mussels in STANDING WATER (or backwater areas of flowing water such as oxbows and sloughs), all standing water bodies with either (1) greater than 2 km linear distance of unsuitable habitat between (i.e. lotic connections), or (2) more than 10 km of apparently unoccupied though suitable habitat (including lentic shoreline, linear distance across water bodies, and lentic water bodies with proper lotic connections), are considered separate element occurrences. Only the largest standing water bodies (with 20 km linear shoreline or greater) may have greater than one element occurrence within each. Multiple collection or observation locations in one lake, for example, would only constitute multiple occurrences in the largest lakes, and only then if there was some likelihood that unsurveyed areas between collections did not contain the element.

For freshwater mussels in FLOWING WATER conditions, occurrences are separated by a distance of more than 2 stream km of unsuitable habitat, or a distance of more than 10 stream km of apparently unoccupied though suitable habitat. Standing water between occurrences is considered suitable habitat when calculating separation distance for flowing water mussel species unless dispersal barriers (see Separation Barriers) are in place.

Several mussel species in North America occur in both standing and flowing water (see Specs Notes). Calculation of separation distance and determination of separation barriers for these taxa should take into account the environment in which the element was collected. Juvenile mussels do not follow this pattern and juveniles are typically missed by most standard sampling methods (Hastie and Cosgrove, 2002; Neves and Widlak, 1987), therefore juvenile movement is not considered when calculating separation distance.
Separation Barriers: Separation barriers within standing water bodies are based solely on separation distance (see Separation Distance-suitable, below). Separation barriers between standing water bodies and within flowing water systems include lack of lotic connections, natural barriers such as upland habitat, absence of appropriate species specific fish hosts, water depth greater than 10 meters (Cvancara, 1972; Moyle and Bacon, 1969) or anthropogenic barriers to water flow such as dams or other impoundments and high waterfalls.
Separation Distance for Unsuitable Habitat: 2 km

Separation Distance for Suitable Habitat: 10 km

Alternate Separation Procedure: None

Separation Justification: Adult freshwater mussels are largely sedentary spending their entire lives very near to the place where they first successfully settled (Coker et al., 1921; Watters, 1992). Strayer (1999) demonstrated in field trials that mussels in streams occur chiefly in flow refuges, or relatively stable areas that displayed little movement of particles during flood events. Flow refuges conceivably allow relatively immobile mussels to remain in the same general location throughout their entire lives. Movement occurs with the impetus of some stimulus (nearby water disturbance, physical removal from the water such as during collection, exposure conditions during low water, seasonal temperature change or associated diurnal cycles) and during spawning. Movement is confined to either vertical movement burrowing deeper into sediments though rarely completely beneath the surface, or horizontal movement in a distinct path often away from the area of stimulus. Vertical movement is generally seasonal with rapid descent into the sediment in autumn and gradual reappearance at the surface during spring (Amyot and Downing, 1991; 1997). Horizontal movement is generally on the order of a few meters at most and is associated with day length and during times of spawning (Amyot and Downing, 1997). Such locomotion plays little, if any, part in the distribution of freshwater mussels as these limited movements are not dispersal mechanisms. Dispersal patterns are largely speculative but have been attributed to stream size and surface geology (Strayer, 1983; Strayer and Ralley, 1993; van der Schalie, 1938), utilization of flow refuges during flood stages (Strayer, 1999), and patterns of host fish distribution during spawning periods (Haag and Warren, 1998; Watters, 1992). Lee and DeAngelis (1997) modeled the dispersal of freshwater into unoccupied habitats as a traveling wave front with a velocity ranging from 0.87 to 2.47 km/year (depending on mussel life span) with increase in glochidial attachment rate to fish having no effect on wave velocity.

Nearly all mussels require a host or hosts during the parasitic larval portion of their life cycle. Hosts are usually fish, but a few exceptional species utilize amphibians as hosts (Van Snik Gray et al., 2002; Howard, 1915) or may metamorphose without a host (Allen, 1924; Barfield et al., 1998; Lefevre and Curtis, 1911; 1912). Haag and Warren (1998) found that densities of host generalist mussels (using a variety of hosts from many different families) and displaying host specialists (using a small number of hosts usually in the same family but mussel females have behavioral modifications to attract hosts to the gravid female) were independent of the densities of their hosts. Densities of non-displaying host specialist mussels (using a small number of hosts usually in the same family but without host-attracting behavior) were correlated positively with densities of their hosts. Upstream dispersal of host fish for non-displaying host specialist mussels could, theoretically, transport mussel larvae (glochidia) over long distances through unsuitable habitat, but it is unlikely that this occurs very often. D. Strayer (personal communication) suggested a distance of at least 10 km, but a greater distance between occurrences may be necessary to constitute genetic separation of populations. As such, separation distance is based on a set, though arbitrary, distance between two known points of occurrence.

Date: 18Oct2004
Author: Cordeiro, J.
Notes: Contact Jay Cordeiro (jay_cordeiro@natureserve.org) for a complete list of freshwater mussel taxa sorted by flow regime.

Population/Occurrence Viability

Justification: Use the Generic Element Occurrence Rank Specifications (2008).
Key for Ranking Species Element Occurrences Using the Generic Approach (2008).

U.S. Invasive Species Impact Rank (I-Rank)

Not yet assessed

Authors/Contributors

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Element Ecology & Life History Edition Date: 12Jul2006
Element Ecology & Life History Author(s): Cordeiro, J.

Zoological data developed by NatureServe and its network of natural heritage programs (see **Local Programs**) and other contributors and cooperators (see **Sources**).

References

- Athearn, H.D. 1961. Additions to the New Brunswick checklist. Sterkiana, 4: 33-34.
- Athearn, H.D. and A.H. Clarke, Jr. 1962. The freshwater mussels of Nova Scotia. National Museum of Canada Bulletin, 183: 11-41.
- Becker, A.J., R. Gauza, and J.A. Smith. 2006. A summary of Freshwater Mussel data collected by the Maryland Biological Stream Survey 1995-2006. MD DNR-MBSS, Annapolis. 28 pp.
- Bogan, A.E. 2002. Workbook and key to the freshwater bivalves of North Carolina. North Carolina Museum of Natural Sciences: Raleigh, North Carolina. 101 pp.
- Bogan, A.E. and J.M. Alderman. 2004. Workbook and key to the freshwater bivalves of South Carolina. North Carolina Museum of Natural Sciences: Raleigh, North Carolina. 64 pp.
- Bogan, A.E. and T. Proch. 1995. Manual of the freshwater bivalves of Maryland. Prepared for a workshop held at Versar, Inc., Columbia, Maryland, 9 March 1995. 68 pp.
- Brim Box, J. and J.D. Williams. 2000. Unionid mollusks of the Apalachicola Basin in Alabama, Florida, and Georgia. Alabama Museum of Natural History Bulletin, 21: 1-143.
- Burch, P.R. 2002. Mollusks. [Reprinted- a preliminary list of the land and freshwater mollusks of the James River Basin, Virginia]. Walkerana, 13(29/30): 113-122.
- Catena Group. 2006. Freshwater mussel surveys of the Pee Dee River basin in South Carolina. Unpublished report prepared for the Nature Conservancy- South Carolina Chapter, January 3, 2006. 47 pp.
- Clarke, A.H. 1981. The Freshwater Molluscs of Canada. National Museum of Natural Sciences: Ottawa, Ontario, Canada. 446 pp.

- Clarke, A.H. and A.M. Rick. 1964. Supplementary records of Unionacea from Nova Scotia with a discussion of the identity of *Anodonta fragilis* Lamarck. National Museum of Canada Bulletin, Biological Science Series, 199(72): 15-27.
- Conner, C.H. 1905. Glochidia of *Unio* on fishes. The Nautilus, 18(12): 142-143.
- Counts, C.L., III, T.S. Handwerker, and R.V. Jesien. 1991. The naiades (Bivalvia: Unionidea) of the Delmarva Peninsula. American Malacological Bulletin, 9(1): 27-37.
- Fichtel, C. and D.G. Smith. 1995. The freshwater mussels of Vermont. Nongame and Natural Heritage Program, Vermont Fish and Wildlife Department. Technical Report 18. 54 pp.
- Gray, E. van S., Lellis, W.A., Cole, J.C. and C.S. Johnson. 1999. Hosts of *Pyganodon cataracta* (eastern floater) and *Strophitus undulatus* (squawfoot) from the Upper Susquehanna River basin, Pennsylvania. Triannual Unionid Report, 18: 6.
- Hanson, J.M. and A. Locke. 2001. Survey of freshwater mussels in the Petitcodiac River drainage, New Brunswick. The Canadian Field-Naturalist, 115: 329-340.
- Hoeh, W.R. 1990. Phylogenetic relationships among eastern North American *Anodonta* (Bivalvia: Unionidae). Malacological Review, 23: 63-82.
- Howard, A.D. 1915. Some exceptional cases of breeding among the Unionidae. The Nautilus, 29: 4-11.
- Johnson, R.I. 1970. The systematics and zoogeography of the Unionidae (Mollusca: Bivalvia) of the southern Atlantic slope region. Bulletin of the Museum of Comparative Zoology, Harvard University, 140(6): 263-449.
- LONG, G.A. 1983. THE UNIONIDS (BIVALVIA) OF LOCH RAVEN RESERVOIR, MARYLAND. THE NAUTILUS 97(3):114-116.
- Lefevre, G. and W.T. Curtis. 1911. Metamorphosis without parasitism in the Unionidae. Science, 33(857): 863-865.
- Lefevre, G. and W.T. Curtis. 1912. Studies on the reproduction and artificial propogation of fresh-water mussels. Bulletin of the Bureau of Fisheries, 30: 102-201.
- MACIVOR, L. ET AL. 1995. FRESHWATER MUSSEL SURVEYS OF THE C& O CANAL NATIONAL HISTORICAL PARK AND POTOMAC RIVER IN WASHINGTON, FREDERICK, AND MONTGOMERY COUNTIES IN MARYLAND. MARYLAND NATURAL HERITAGE PROGRAM.
- Martel, André L. et Jean-Marc Gagnon. 2005. Noms scientifiques et communs des moules d'eau douce (mulettes) du Canada Musée canadien de la nature, Aylmer. 6 pages
- Metcalfe-Smith, J.L. and B. Cudmore-Vokey. 2004. National general status assessment of freshwater mussels (Unionacea). National Water Research Institute / NWRI Contribution No. 04-027. Environment Canada, March 2004. Paginated separately.
- Mirarchi, R.E. 2004. Alabama Wildlife. Volume One: A Checklist of Vertebrates and Selected Invertebrates: Aquatic Mollusks, Fishes, Amphibians, Reptiles, Birds, and Mammals. University of Alabama Press: Tuscaloosa, Alabama. 209 pp.
- Moyle, P. and J. Bacon. 1969. Distribution and abundance of molluscs in a fresh water environment. Journal of the Minnesota Academy of Science, 35(2/3): 82-85.
- Nedeau, E.J. and J. Victoria. 2003. A Field Guide to the Freshwater Mussels of Connecticut. Connecticut Department of Environmental Protection, Hartford, Connecticut. 31 pp.
- Nedeau, E.J., M.A. McCollough, and B.I. Swartz. 2000. The freshwater mussels of Maine. Maine Department of Inland Fisheries and Wildlife, Augusta, Maine. 118 pp.
- Nickens, T. 1994. Printout of all computerized District of Columbia mollusk specimens at the U.S. National Museum. Printout of 22 December. 4 pp.
- Raithel, C.J. and R.H. Hartenstein. 2006. The status of freshwater mussels in Rhode Island. Northeastern Naturalist, 13(1): 103-116.
- Ricciardi, A., F.J. Whoriskey, and J.B. Rasmussen. 1996. Impact of *Dreissena* invasion on native unionid bivalves in the upper St. Lawrence River. Canadian Journal of Fisheries and Aquatic Science, 53: 1434-1444.
- Smith, D.G. 2000. Keys to the Freshwater Macroinvertebrates of Southern New England. Douglas G. Smith: Sunderland, Massachusetts. 243 pp.
- Strayer, D. 1983. The effects of surface geology and stream size on freshwater mussel (Bivalvia, Unionidae) distribution in southeastern Michigan, U.S.A. Freshwater Biology, 13: 253-264.
- Strayer, D.L. 1999. Use of flow refuges by unionid mussels in rivers. Journal of the North American Benthological Society, 18(4): 468-476.
- Strayer, D.L. and J. Ralley. 1991. The freshwater mussels (Bivalvia: Unionoidea) of the upper Delaware River drainage. American Malacological Bulletin, 9(1): 21-25.
- Strayer, D.L. and J. Ralley. 1993. Microhabitat use by an assemblage of stream-dwelling unionaceans (Bivalvia) including two rare species of *Alasmidonta*. Journal of the North American Benthological Society, 12(3): 247-258.
- Sukkestad, K.E., E.P. Keferl, and T.D. Bryce. 2006. Freshwater molluscs of Fort Stewart, Georgia, U.S.A. American Malacological Bulletin, 21(1/2): 31-38.
- Taylor, R.W. 1985. Comments on the distribution of freshwater mussels (Unionacea) of the Potomac River headwaters in West Virginia. The Nautilus, 99(2-3): 84-87.
- Threlfall, W. 1986. Seasonal occurrence of *Anodonta cataracta* Say, 1817, glochidia on three-spined sticklebacks, *Gasterosteus aculeatus* Linnaeus. The Veliger, 29(2): 231-234.
- Turgeon, D.D., J.F. Quinn, Jr., A.E. Bogan, E.V. Coan, F.G. Hochberg, W.G. Lyons, P.M. Mikkelsen, R.J. Neves, C.F.E. Roper, G. Rosenberg, B. Roth, A. Scheltema, F.G. Thompson, M. Vecchione, and J.D. Williams. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: Mollusks. 2nd Edition. American Fisheries Society Special Publication 26, Bethesda, Maryland: 526 pp.
- Van Snik Gray, E.S., W.A. Lellis, J.C. Cole, and C.S. Johnson. 1999. Hosts of *Pyganodon cataracta* (eastern floater) and *Strophitus undulatus* (squawfoot) from the Upper Susquehanna River basin, Pennsylvania. Triannual Unionid Report, 18: 6.
- Van der Schalie, H. 1938. The naiad fauna of the Huron River in southeastern Michigan. Miscellaneous Publication of the Museum of Zoology, University of Michigan, 40: 7-78.

- Watters, G.T. 1992. Unionids, fishes, and the species-area curve. Journal of Biogeography, 19: 481-490.
- Watters, G.T. 1994. An annotated bibliography of the reproduction and propagation of the Unionoidea (primarily of North America). Ohio Biological Survey Miscellaneous Contributions, 1: 1-158.
- Wiles, M. 1975. The glochidia of certain Unionidae (Mollusca) in Nova Scotia and their fish hosts. Canadian Journal of Zoology, 53: 33-41.
- Williams, J.D., A.E. Bogan, and J.T. Garner. 2008. Freshwater Mussels of Alabama & the Mobile Basin in Georgia, Mississippi & Tennessee. University of Alabama Press: Tuscaloosa, Alabama. 908 pp.
- Zanatta, D.T., A. Ngo, and J. Lindell. 2007. Reassessment of the phylogenetic relationships among *Anodonta*, *Pyganodon*, and *Utterbackia* (Bivalvia: Unionoida) using mutation coding of allozyme data. Proceedings of the Academy of Natural Sciences of Philadelphia, 156: 211-216.

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Note: All species and ecological community data presented in NatureServe Explorer at http://www.natureserve.org/explorer were updated to be current with NatureServe's central databases as of **July 17, 2009**.
Note: This report was printed on **November 10, 2009**

Citation for data on website including State Distribution, Watershed, and Reptile Range maps:
NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: November 10, 2009).

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Ridgely, R.S., T.F. Allnutt, T. Brooks, D.K. McNicol, D.W. Mehlman, B.E. Young, and J.R. Zook. 2003. Digital Distribution Maps of the Birds of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

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Citation for Mammal Range Maps of North America:
Patterson, B.D., G. Ceballos, W. Sechrest, M.F. Tognelli, T. Brooks, L. Luna, P. Ortega, I. Salazar, and B.E. Young. 2003. Digital Distribution Maps of the Mammals of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

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NOTE: Full metadata for the Bird Range Maps of North America is available at:
http://www.natureserve.org/library/birdDistributionmapsmetadatav1.pdf.

Full metadata for the Mammal Range Maps of North America is available at:
http://www.natureserve.org/library/mammalsDistributionmetadatav1.pdf.

NatureServe

Version 7.1 (2 February 2009)
Data last updated: July 17, 2009

Villosa delumbis - (Conrad, 1834)
Eastern Creekshell

Related ITIS Name(s): *Villosa delumbis* (Conrad, 1834) (TSN 80207)
Unique Identifier: ELEMENT_GLOBAL.2.115946
Element Code: IMBIV47190
Informal Taxonomy: Animals, Invertebrates - Mollusks - Freshwater Mussels

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Mollusca	Bivalvia	Unionoida	Unionidae	Villosa

Genus Size: C - Small genus (6-20 species)

Check this box to expand all report sections: ☐

Concept Reference

Concept Reference: Turgeon, D.D., J.F. Quinn, Jr., A.E. Bogan, E.V. Coan, F.G. Hochberg, W.G. Lyons, P.M. Mikkelsen, R.J. Neves, C.F.E. Roper, G. Rosenberg, B. Roth, A. Scheltema, F.G. Thompson, M. Vecchione, and J.D. Williams. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: Mollusks. 2nd Edition. American Fisheries Society Special Publication 26, Bethesda, Maryland: 526 pp.
Concept Reference Code: B98TUR01EHUS
Name Used in Concept Reference: *Villosa delumbis*

Conservation Status

NatureServe Status

Global Status: G4
Global Status Last Reviewed: 08Jun2007
Global Status Last Changed: 25Nov1996
Rounded Global Status: G4 - Apparently Secure
Reasons: This species ranges from the Ocmulgee River, Georgia, north to the Cape Fear River in North Carolina and is generally secure throughout its range.
Nation: United States
National Status: N4

U.S. & Canada State/Province Status	
United States	Georgia (S4), North Carolina (S3), South Carolina (SNR)

Other Statuses

American Fisheries Society Status: Currently Stable (01Jan1993)

NatureServe Conservation Status Factors

Global Abundance: 100,000 to >1,000,000 individuals
Global Abundance Comments: The eastern creekshell was found at 18 of the 61 sites in a recent study of the Pee Dee River drainage in South Carolina, predominately in shallow water habitats, with a variety of substrates. The maximum number of individuals found at any site was 14. The relatively low numbers of this species found is likely partially attributable to search efforts, as the majority of survey time with this study was focused on deeper habitats (Catena Group, 2006).

Estimated Number of Element Occurrences: 81 - 300
Estimated Number of Element Occurrences Comments: In South Carolina, it can be found in the Savannah, Salkehatchee-Cumbahee, Edisto, Cooper-Santee, Pee Dee, and Waccamaw River basins (Bogan and Alderman, 2004). Recently, this species was found in 18 (of 61) sites in Pee Dee River drainage in South Carolina (Catena Group, 2006) including the Waccamaw River, Black River, Pocotaligo River, Lynches River, and Great Pee Dee River. In North Carolina, its range includes most Atlantic drainages such as the Catawba, Pee Dee, Waccamaw, and Cape Fear River basins (Bogan, 2002) in 18 counties (LeGrand et al., 2006). Johnson (1972) claims *Villosa amygdala* is replaced in the Atlantic Slope from the Altamaha River system, Georgia, north to the Neuse River system, North Carolina, by *Villosa delumbis*.

Global Short Term Trend: Stable (unchanged or within +/- 10% fluctuation in population, range, area occupied, and/or number or condition of occurrences)

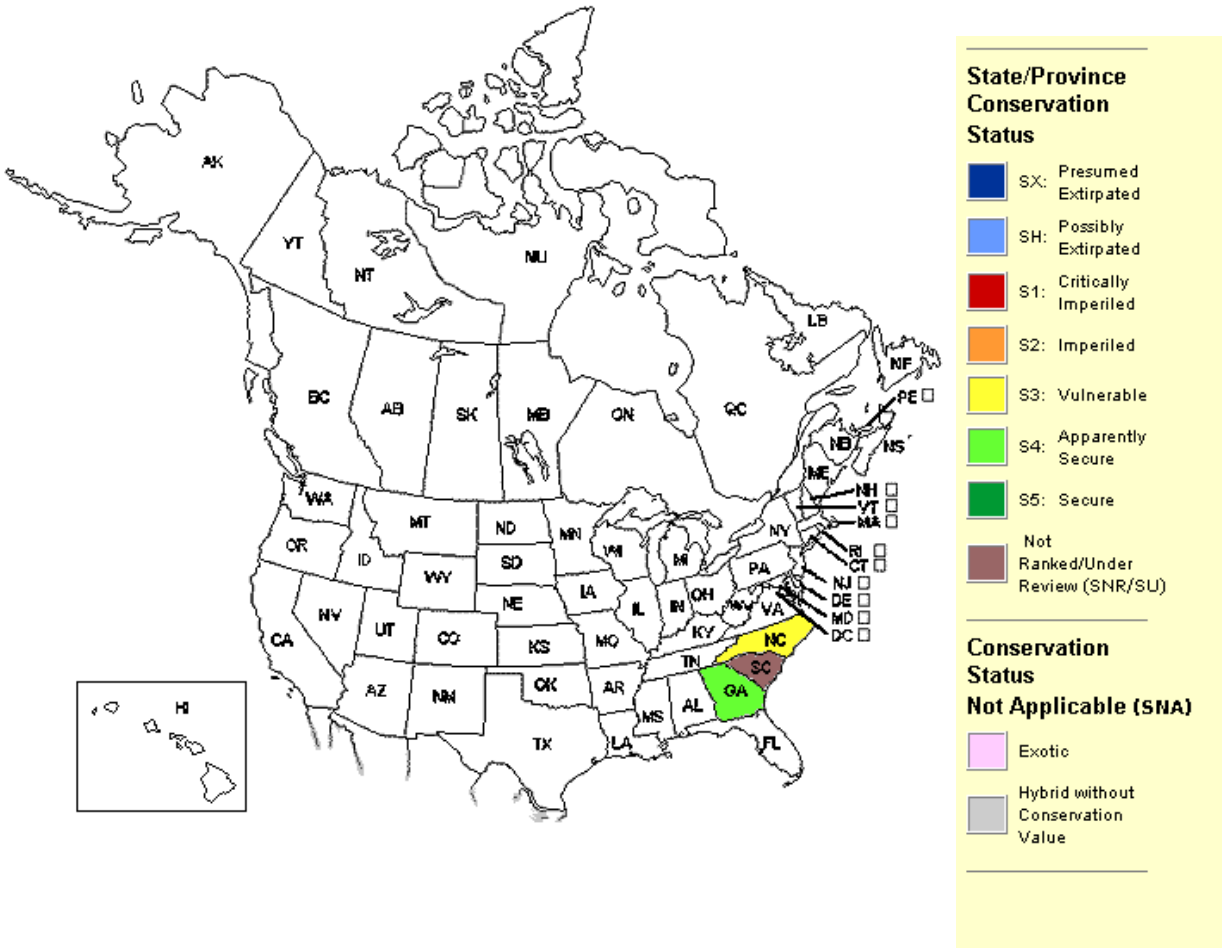
Global Long Term Trend: Relatively stable (+/- 25% change)

Global Protection: Unknown whether any occurrences are appropriately protected and managed

Fragility: Environmental Specificity: Moderate. Generalist or community with some key requirements scarce.
Environmental Specificity Comments: Johnson (1970) reported this species living in mud or soft sand, rich in vegetation, in small creeks and rivers.

Distribution

U.S. States and Canadian Provinces



Endemism: endemic to a single nation

U.S. & Canada State/Province Distribution	
United States	GA, NC, SC

Range Map
No map available.

Global Range: 5000-20,000 square km (about 2000-8000 square miles)
Global Range Comments: This species ranges from Ocmulgee River drainage of the Altamaha River basin, Georgia, north to the Cape Fear River basin in North Carolina (Bogan and Alderman, 2004).

Natural heritage records exist for the following U.S. counties	
State	**County Name (FIPS Code)**
GA	Tattnall (13267), Wayne (13305)
NC	Alamance (37001), Anson (37007), Bladen (37017), Brunswick (37019), Burke (37023), Cabarrus (37025), Caldwell (37027), Chatham (37037), Cumberland (37051), Duplin (37061), Granville (37077), Guilford (37081), Mecklenburg (37119), Montgomery (37123), Orange (37135), Person (37145), Randolph (37151), Rockingham (37157), Sampson (37163), Stanly (37167), Union (37179)
SC	Abbeville (45001), Allendale (45005), Barnwell (45011), Chester (45023), Chesterfield (45025), Colleton (45029), Edgefield (45037), Fairfield (45039), Greenwood (45047), Hampton (45049), Horry (45051), Jasper (45053), Lancaster (45057), McCormick (45065), Orangeburg (45075), Richland (45079), Saluda (45081)

* Extirpated/possibly extirpated

U.S. Distribution by Watershed (based on available natural heritage records)	
Watershed Region	**Watershed Name (Watershed Code)**
03	Upper Tar (03020101)+, Upper Neuse (03020201)+, Haw (03030002)+, Deep (03030003)+, Upper Cape Fear (03030004)+, Lower Cape Fear (03030005)+, Black (03030006)+, Northeast Cape Fear (03030007)+, Lower Yadkin (03040103)+, Upper Pee Dee (03040104)+, Rocky, North Carolina, (03040105)+, Lynches (03040202)+, Waccamaw (03040206)+, Upper Catawba (03050101)+, Lower Catawba (03050103)+, Wateree (03050104)+, Lower Broad (03050106)+, Saluda (03050109)+, Edisto (03050205)+, Salkehatchie (03050207)+, Upper Savannah (03060103)+, Middle Savannah (03060106)+, Stevens (03060107)+, Lower Savannah (03060109)+, Altamaha (03070106)+, Ohoopee (03070107)+

+ Natural heritage record(s) exist for this watershed
* Extirpated/possibly extirpated

Ecology & Life History

Reproduction Comments: The glochidial host is not known.
Habitat Type: Freshwater
Non-Migrant: N
Locally Migrant: N
Long Distance Migrant: N
Riverine Habitat(s): CREEK, Pool
Special Habitat Factors: Benthic
Habitat Comments: Johnson (1970) reported this species living in mud or soft sand, rich in vegetation, in small creeks and rivers.

Economic Attributes

Not yet assessed

Management Summary

Not yet assessed

Population/Occurrence Delineation

Group Name: FRESHWATER MUSSELS

Use Class: Not applicable
Minimum Criteria for an Occurrence: Occurrences are based on some evidence of historical or current presence of single or multiple specimens, including live specimens or recently dead shells (i.e., soft tissue still attached and/or nacre still glossy and iridescent without signs of external weathering or staining), at a given location with potentially recurring existence. Weathered shells constitute a historic occurrence. Evidence is derived from reliable published observation or collection data; unpublished, though documented (i.e. government or agency reports, web sites, etc.) observation or collection data; or museum specimen information.
Mapping Guidance: Based on the separation distances outlined herein, for freshwater mussels in STANDING WATER (or backwater areas of flowing water such as oxbows and sloughs), all standing water bodies with either (1) greater than 2 km linear distance of unsuitable habitat between (i.e. lotic connections), or (2) more than 10 km of apparently unoccupied though suitable habitat (including lentic shoreline, linear distance across water bodies, and lentic water bodies with proper lotic connections), are considered separate element occurrences. Only the largest standing water bodies (with 20 km linear shoreline or greater) may have greater than one element occurrence within each. Multiple collection or observation locations in one lake, for example, would only constitute multiple occurrences in the largest lakes, and only then if there was some likelihood that unsurveyed areas between collections did not contain the element.

For freshwater mussels in FLOWING WATER conditions, occurrences are separated by a distance of more than 2 stream km of unsuitable habitat, or a distance of more than 10 stream km of apparently unoccupied though suitable habitat. Standing water between occurrences is considered suitable habitat when calculating separation distance for flowing water mussel species unless dispersal barriers (see Separation Barriers) are in place.

Several mussel species in North America occur in both standing and flowing water (see Specs Notes). Calculation of separation distance and determination of separation barriers for these taxa should take into account the environment in which the element was collected. Juvenile mussels do not follow this pattern and juveniles are typically missed by most standard sampling methods (Hastie and Cosgrove, 2002; Neves and Widlak, 1987), therefore juvenile movement is not considered when calculating separation distance.

Separation Barriers: Separation barriers within standing water bodies are based solely on separation distance (see Separation Distance-suitable, below). Separation barriers between standing water bodies and within flowing water systems include lack of lotic connections, natural barriers such as upland habitat, absence of appropriate species specific fish hosts, water depth greater than 10 meters (Cvancara, 1972; Moyle and Bacon, 1969) or anthropogenic barriers to water flow such as dams or other impoundments and high waterfalls.

Separation Distance for Unsuitable Habitat: 2 km

Separation Distance for Suitable Habitat: 10 km

Alternate Separation Procedure: None

Separation Justification: Adult freshwater mussels are largely sedentary spending their entire lives very near to the place where they first successfully settled (Coker et al., 1921; Watters, 1992). Strayer (1999) demonstrated in field trials that mussels in streams occur chiefly in flow refuges, or relatively stable areas that displayed little movement of particles during flood events. Flow refuges conceivably allow relatively immobile mussels to remain in the same general location throughout their entire lives. Movement occurs with the impetus of some stimulus (nearby water disturbance, physical removal from the water such as during collection, exposure conditions during low water, seasonal temperature change or associated diurnal cycles) and during spawning. Movement is confined to either vertical movement burrowing deeper into sediments though rarely completely beneath the surface, or horizontal movement in a distinct path often away from the area of stimulus. Vertical movement is generally seasonal with rapid descent into the sediment in autumn and gradual reappearance at the surface during spring (Amyot and Downing, 1991; 1997). Horizontal movement is generally on the order of a few meters at most and is associated with day length and during times of spawning (Amyot and Downing, 1997). Such locomotion plays little, if any, part in the distribution of freshwater mussels as these limited movements are not dispersal mechanisms. Dispersal patterns are largely speculative but have been attributed to stream size and surface geology (Strayer, 1983; Strayer and Ralley, 1993; van der Schalie, 1938), utilization of flow refuges during flood stages (Strayer, 1999), and patterns of host fish distribution during spawning periods (Haag and Warren, 1998; Watters, 1992). Lee and DeAngelis (1997) modeled the dispersal of freshwater into unoccupied habitats as a traveling wave front with a velocity ranging from 0.87 to 2.47 km/year (depending on mussel life span) with increase in glochidial attachment rate to fish having no effect on wave velocity.

Nearly all mussels require a host or hosts during the parasitic larval portion of their life cycle. Hosts are usually fish, but a few exceptional species utilize amphibians as hosts (Van Snik Gray et al., 2002; Howard, 1915) or may metamorphose without a host (Allen, 1924; Barfield et al., 1998; Lefevre and Curtis, 1911; 1912). Haag and Warren (1998) found that densities of host generalist mussels (using a variety of hosts from many different families) and displaying host specialists (using a small number of hosts usually in the same family but mussel females have behavioral modifications to attract hosts to the gravid female) were independent of the densities of their hosts. Densities of non-displaying host specialist mussels (using a small number of hosts usually in the same family but without host-attracting behavior) were correlated positively with densities of their hosts. Upstream dispersal of host fish for non-displaying host specialist mussels could, theoretically, transport mussel larvae (glochidia) over long distances through unsuitable habitat, but it is unlikely that this occurs very often. D. Strayer (personal communication) suggested a distance of at least 10 km, but a greater distance between occurrences may be necessary to constitute genetic separation of populations. As such, separation distance is based on a set, though arbitrary, distance between two known points of occurrence.

Date: 18Oct2004
Author: Cordeiro, J.
Notes: Contact Jay Cordeiro (jay_cordeiro@natureserve.org) for a complete list of freshwater mussel taxa sorted by flow regime.

Population/Occurrence Viability

Justification: Use the Generic Element Occurrence Rank Specifications (2008).
Key for Ranking Species Element Occurrences Using the Generic Approach (2008).

U.S. Invasive Species Impact Rank (I-Rank)

Not yet assessed

Authors/Contributors

NatureServe Conservation Status Factors Edition Date: 08Jun2007
NatureServe Conservation Status Factors Author: Cordeiro, J.
Element Ecology & Life History Edition Date: 08Jun2007
Element Ecology & Life History Author(s): Cordeiro, J.

Zoological data developed by NatureServe and its network of natural heritage programs (see **Local Programs**) and other contributors and cooperators (see **Sources**).

References

- Bogan, A.E. 2002. Workbook and key to the freshwater bivalves of North Carolina. North Carolina Museum of Natural Sciences: Raleigh, North Carolina. 101 pp.
- Bogan, A.E. and J.M. Alderman. 2004. Workbook and key to the freshwater bivalves of South Carolina. North Carolina Museum of Natural Sciences: Raleigh, North Carolina. 64 pp.
- Catena Group. 2006. Freshwater mussel surveys of the Pee Dee River basin in South Carolina. Unpublished report prepared for the Nature Conservancy- South Carolina Chapter, January 3, 2006. 47 pp.
- Howard, A.D. 1915. Some exceptional cases of breeding among the Unionidae. The Nautilus, 29: 4-11.
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- Johnson, R.I. 1972. The Unionidae (Mollusca: Bivalvia) of peninsular Florida. Bulletin of the Florida State Museum of Biological Science, 16(4): 181-249.

- Johnson, R.I. 1984. A new mussel, *Lampsilis* (*Lampsilis*) *fullerkati* (Bivalvia: Unionidae) from Lake Waccamaw, Columbus County, North Carolina, with a list of the other unionid species of the Waccamaw River system. Occasional Papers on Molluscs, 4 (63): 305-319.
- LeGrand, H.E., Jr., S.P. Hall, S.E. McRae, and J.T. Finnegan. 2006. Natural Heritage Program List of the Rare Animal Species of North Carolina. North Carolina Natural Heritage Program, Raleigh, North Carolina. 104 pp.
- Lefevre, G. and W.T. Curtis. 1912. Studies on the reproduction and artificial propogation of fresh-water mussels. Bulletin of the Bureau of Fisheries, 30: 102-201.
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Version 7.1 (2 February 2009)
Data last updated: July 17, 2009

Elliptio lanceolata - (I. Lea, 1828)
Yellow Lance

Related ITIS Name(s): *Elliptio lanceolata* (I. Lea, 1828) (TSN 79964)
Unique Identifier: ELEMENT_GLOBAL.2.110016
Element Code: IMBIV14180
Informal Taxonomy: Animals, Invertebrates - Mollusks - Freshwater Mussels

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Mollusca	Bivalvia	Unionoida	Unionidae	Elliptio

Genus Size: D - Medium to large genus (21+ species)

Check this box to expand all report sections: ☐

Concept Reference

Concept Reference: Turgeon, D.D., J.F. Quinn, Jr., A.E. Bogan, E.V. Coan, F.G. Hochberg, W.G. Lyons, P.M. Mikkelsen, R.J. Neves, C.F.E. Roper, G. Rosenberg, B. Roth, A. Scheltema, F.G. Thompson, M. Vecchione, and J.D. Williams. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: Mollusks. 2nd Edition. American Fisheries Society Special Publication 26, Bethesda, Maryland: 526 pp.
Concept Reference Code: B98TUR01EHUS
Name Used in Concept Reference: *Elliptio lanceolata*
Taxonomic Comments: The classification of the Atlantic Slope species of *Elliptio* is currently in a state of confusion. Johnson (1970) lumped many named taxa under a single name. Current research is finding many of these synonomized taxa to be valid species. This research is in progress and will result in the recognition of numerous additional taxa in this genus. Long recognized as a species-complex (e.g., Fuller, 1977), Johnson (1970) listed 25 nominal species in the synonymy of *Elliptio lanceolata*. At least one of these species (and probably others) deserves species-level recognition based on genetic data (Davis and Mulvey, 1993). Although Britton and Fuller (1979) noted that the range of *Elliptio lanceolata* extended from the Escambia and Apalachicola River systems in Alabama and Florida, this species is no longer recognized from those drainages. Historically the range extended from the Satilla River system, Georgia, to the Susquehanna River system, Pennsylvania (Britton and Fuller, 1979; Johnson, 1970). John Alderman (pers. comm.) considered this species to range from the Neuse-Tar River system in North Carolina to the Rappahannock River system in Virginia. Records for this species north of the Rappahannock are now considered to be in error (J. Alderman, pers. comm.). Some additional genetic work on the complex has been completed by Allen Stivens at the University of North Carolina (J. Alderman pers. comm.). Specimens from the Pee Dee River system in South Carolina more closely resemble what was described from the Cape Fear River Basin in North Carolina and have at times been called *Elliptio nasutilius* (Lea, 1863) (Catena Group, 2006). This species is very similar to, if not the same as the northern lance (*Elliptio fisherianus*), which was described from the Chester River in Maryland. Much more research is needed.

Conservation Status

NatureServe Status

Global Status: G2G3
Global Status Last Reviewed: 01Nov2007
Global Status Last Changed: 01Oct2000
Rounded Global Status: G2 - Imperiled
Reasons: This species appears to be in decline throughout its historical range in North Carolina and Virginia and is probably extirpated from several of the historical occurrences, however taxonomy is uncertain because specimens from the Pee Dee River system in South Carolina more closely resemble what was described from the Cape Fear River Basin in North Carolina and have at times been called *Elliptio nasutilius*. Despite questions about its taxonomy, whether it eventually is deemed to be a species or species complex, the taxon is clearly beginning to experience the effects of decline throughout much of its range.
Nation: United States
National Status: N2N3

U.S. & Canada State/Province Status	
United States	Maryland (SU), North Carolina (S1), South Carolina (SNR), Virginia (S2S3)

Other Statuses

IUCN Red List Category: NT - Near threatened
American Fisheries Society Status: Endangered (01Jan1993)

NatureServe Conservation Status Factors

Global Abundance: 2500 - 100,000 individuals
Global Abundance Comments: The abundance of *Elliptio lanceolata* appears to be declining throughout most of its historical range. For example, only one individual was found in a recent survey of parts of the South Anna River drainage (J. Alderman, pers. comm.).

Estimated Number of Element Occurrences: 6 - 80
Estimated Number of Element Occurrences Comments: The number of historical and extant occurrences is difficult to determine because of the taxonomic confusion regarding this species, and because status surveys have not been conducted throughout its historical range. However, within the range where it is currently recognized to occur, Johnson (1970) lists three historical occurrences from the Neuse River drainage, two from the Tar River, two from the Roanoke River system, one from the Chowan River system, seven from the James River drainage, two from the South Anna River drainage, and four from the Rappahannock River system. It may currently be extirpated from the Roanoke River system and from the main stem of the Rappahannock River (J. Alderman, pers. comm.). In Virginia, it is extirpated, or nearly so, from the Lower Chesapeake and James River basins with extant occurrences only in the Rapidan-Upper Rappahannock and Mattaponi, and the Upper James and Middle James-Willis (J. Alderman, pers. comm., 2000; VA NHP, pers. comm., 2006; see also Burch, 2002). Bogan (2002) cites the Pamlico (Tar) and Neuse River systems (possibly ranging into the far corner of the northeast Cape Fear basin) in North Carolina in Edgecombe, Franklin, Granville, Halifax, Johnson, Nash, Vance, Wake, Warren, and Wayne Cos. (LeGrand et al., 2006). Bogan and Alderman (2004) include *Elliptio angustata*, *Elliptio folliculata*, and *Elliptio producta* in the *Elliptio lanceolata* group citing all three taxa as occurring in all the Atlantic Slope drainages (Savannah, Salkehatchee, Edisto, Cooper-Santee, Pee-Dee/Waccamaw). Although specimens are known from South Carolina (Stevens, Lynches, Saluda, Tagaloo, Upper Savannah, Enoree- SC NHP, pers. comm., 2007), identification of this species in these areas is tentative. Bogan and Proch (1995) list this species for Maryland in the North Branch Potomac and the Middle Potomac-Cadoctin drainages but there is some question as to whether this species occurs this far north (J. Alderman, pers. comm.). If the species ever occurred in Maryland (tentative historical records from Middle Potomac- Annacostina- Occoquan, Chester- Sassafras, Patuxent, Monocacy, Middle Potomac- Catoctin basins; see Johnson, 1970; MCZ specimens), recent surveys have not found it and it is likely extirpated from that state (Jim McCann, MD NHP, pers. comm., 2007). Specimens from the Pee Dee River system in South Carolina more closely resemble what was described from the Cape Fear River Basin in North Carolina and have at times been called *Elliptio nasutilius* (Lea, 1863) (Catena Group, 2006). Should they prove to be synonymous with *Elliptio lanceolata*, South Carolina occurrences would include the Waccamaw, Black, Lynches, Little Pee Dee, and Great Pee Dee Rvier drainages (Catena Group, 2006).

Global Short Term Trend: Declining (decline of 10-30%)
Global Short Term Trend Comments: This species is currently being considered for possible Endangered and Threatened status by the U.S. Fish and Wildlife Service (J. Alderman, pers. comm.). It is extremely threatened with extirpation in the Neuse River system. Stable populations exist in the Tar River, but these are patchily distributed and therefore vulnerable to extirpation. It appears to be extirpated from historical occurrences in the Tar River below Rocky Mount, North Carolina (J. Alderman, pers. comm.). It also appears to have been recently extirpated from Ruin creek in Vance County and the Tar River in Edgecombe County, North Carolina. *Elliptio lanceolata* occurs in the Chowan River basin, but has a restricted range within that system. Is now very rare in the James, S. Anna, and Rappannock rivers, and no information is available regarding its current status in the Roanoke River (J. Alderman, pers. comm.).

Global Long Term Trend: Moderate decline to relatively stable (25% change to 50% decline)
Global Long Term Trend Comments: In Virginia, it is extirpated, or nearly so from the Lower Chesapeake and James River basins with extant occurrences only in the Rapidan-Upper Rappahannock and Mattaponi, and the Upper James and Middle James-Willis (J. Alderman, pers. comm., 2000; VA NHP, pers. comm., 2006).

Global Inventory Needs: Surveys are needed in parts of its histrorical range, particularly the Roanoke River system.

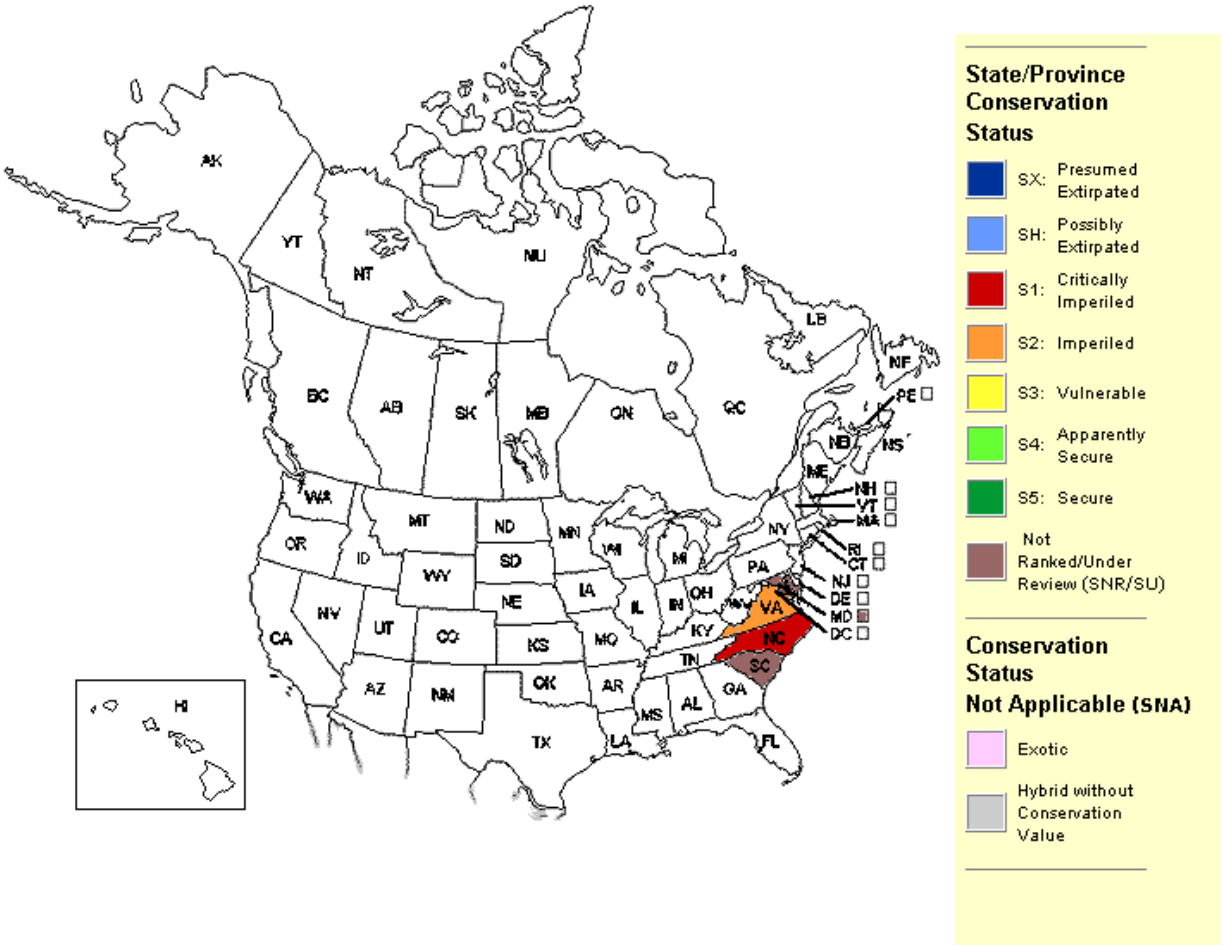
Global Protection: None. No occurrences appropriately protected and managed

Degree of Threat: Moderate and imminent threat
Threat Scope: Moderate
Threat Severity: Moderate
Threat Immediacy: Moderate
Threats: This species is most common in sandy areas but does not appear to tolerate fine sediments. Human population growth within its historical range, especially the Neuse River drainage, may be an impact. This species, unlike other species of *Elliptio*, appears to be particularly sensitive to chemical pollutants.

Fragility: Environmental Specificity: Unknown

Distribution

U.S. States and Canadian Provinces



Endemism: endemic to a single nation

U.S. & Canada State/Province Distribution	
United States	MD, NC, SC, VA

Range Map
No map available.

Global Range: 5000-20,000 square km (about 2000-8000 square miles)
Global Range Comments: Although Britton and Fuller (1979) noted that the range of *Elliptio lanceolata* extended from the Escambia and Apalachicola River systems in Alabama and Florida, this species is no longer recognized from those drainages. Historically the range extended from the Satilla River system, Georgia, to the Susquehanna River system, Pennsylvania (Britton and Fuller, 1979; Johnson, 1970). John Alderman (pers. comm.) considered this species to range from the Neuse-Tar River system in North Carolina to the Rappahannock River system in Virginia. Records for this species north of the Rappahannock are now considered to be in error (J. Alderman, pers. comm.). There is also some speculation this species may be restricted to the Tar-Neuse River basin of North Carolina (Art Bogan, pers. comm., 1999). Specimens from the Pee Dee River system in South Carolina more closely resemble what was described from the Cape Fear River Basin in North Carolina and have at times been called *Elliptio nasutilius* (Lea, 1863) (Catena Group, 2006). This species is very similar to, if not the same as the northern lance (*Elliptio fisherianus*), which was described from the Chester River in Maryland. Much more research is needed.

Natural heritage records exist for the following U.S. counties	
State	**County Name (FIPS Code)**
MD	Frederick (24021)*, Montgomery (24031)*, Prince Georges (24033)*, Queen Annes (24035), Washington (24043)*
NC	Duplin (37061), Edgecombe (37065), Franklin (37069), Granville (37077), Halifax (37083), Johnston (37101), Nash (37127), Vance (37181), Wake (37183), Warren (37185), Wayne (37191)
SC	Abbeville (45001), Chesterfield (45025), Edgefield (45037), Greenwood (45047), Lancaster (45057), Laurens (45059), McCormick (45065), Newberry (45071), Oconee (45073), Saluda (45081)
VA	Alleghany (51005), Amherst (51009), Bath (51017), Bedford (51019), Botetourt (51023), Brunswick (51025),

	Buckingham (51029), Buena Vista (city) (51530), Chesterfield (51041), Craig (51045), Culpeper (51047), Cumberland (51049), Dinwiddie (51053), Emporia (city) (51595), Fairfax (51059)*, Fauquier (51061), Fluvanna (51065), Goochland (51075), Greensville (51081), Hanover (51085), Louisa (51109), Lunenburg (51111), Madison (51113), Nelson (51125), Nottoway (51135), Orange (51137), Powhatan (51145), Prince William (51153), Rappahannock (51157), Rockbridge (51163), Southampton (51175), Spotsylvania (51177), Stafford (51179)*, Sussex (51183)*

* Extirpated/possibly extirpated

U.S. Distribution by Watershed (based on available natural heritage records)	
Watershed Region	**Watershed Name (Watershed Code)**
02	Chester-Sassafras (02060002)+, Severn (02060004)+, Patuxent (02060006)+, Middle Potomac-Catoctin (02070008)+, Monocacy (02070009)+, Middle Potomac-Anacostia-Occoquan (02070010)+, Rapidan-Upper Rappahannock (02080103)+, Lower Rappahannock (02080104)+, Mattaponi (02080105)+, Pamunkey (02080106)+, Upper James (02080201)+, Maury (02080202)+, Middle James-Buffalo (02080203)+, Rivanna (02080204)+, Middle James-Willis (02080205)+, Appomattox (02080207)+
03	Nottoway (03010201)+, Blackwater (03010202)+, Meherin (03010204)+, Upper Tar (03020101)+, Fishing (03020102)+, Lower Tar (03020103)+, Upper Neuse (03020201)+, Northeast Cape Fear (03030007)+, Lynches (03040202)+, Enoree (03050108)+, Saluda (03050109)+, Tugaloo (03060102)+, Upper Savannah (03060103)+, Stevens (03060107)+

+ Natural heritage record(s) exist for this watershed
* Extirpated/possibly extirpated

Ecology & Life History

Basic Description: A freshwater mussel
General Description: This elongate, freshwater mussel has shells over twice as long as tall. The periostracum is usually bright yellow over the entire surface in younger individuals. Older individuals may have a brown discoloration at the posterior end of the shell. Uniformly brown individuals are also found, however, yellow and brown individuals are not found at the same location. The nacre may range from salmon to white to an iridescent blue color. The posterior ridge is distinctly rounded and curves dorsally toward the posterior end. Rays are usually never present; however, one individual has been onserved with three wide, prominent green rays on the posterior third of the shell in the Tar River drainagte basin. Brownish growth rests are clearly evident on the periostracum. The palolial line and adductor muscle scars are less impressed than the anterior adductor muscle scars. The lateral teeth are long- two on the left valve and one on the right valve. Two pseudocardinal teeth are on each valve. On teh left valve one is before the other with the posterior tooth tending to be vestigial. On the right valve, the two pseudocardinal teeth are parallel with the more anterior one rather vestigial (Adams et al., 1990).
Reproduction Comments: Ortmann (1919) found gravid females during the spring in the James River. Gravid females have been found in the Tar River drainage basin in June (Alderman in Adams et al., 1990). Glochidia are hookless. Hosts are unknown.
Habitat Type: Freshwater
Non-Migrant: Y
Locally Migrant: N
Long Distance Migrant: N
Mobility and Migration Comments: This species probably is rather sessile with only limited movement in the substrate. Passive downstream movement may occur when mussels are displaced from the substrate during floods. Major dispersal occurs while glochidia are encysted on their hosts.
Riverine Habitat(s): CREEK, MEDIUM RIVER
Special Habitat Factors: Benthic
Habitat Comments: This species is found in sandy substrates, rocks and in mud, in slack water areas (Johnson, 1970), but apparently is absent from lakes (Britton and Fuller, 1979). It is also found buried deep in sand and may migrate with shifting sands (J. Alderman, pers. comm.). Although it prefers clean, coarse to medium sized sands as substrate, on occasion, specimens are also found in gravel substrates. This species is found in the main channels of drainages down to streams as small as a meter across.

Length: 8.6 centimeters

Economic Attributes

Not yet assessed

Management Summary

Biological Research Needs: Toxicological studies are needed to assess the impacts of chemical pollutants on *Elliptio lanceolata*, including those most common in the run-off of urbanized areas. The entire *Elliptio lanceolata* species complex is in need of genetic and taxonomic study, and should include *Elliptio* spp. from the Satilla River drainage in Georgia to the Potamac River in Virginia that were historically included in the synonomy of this species.

Population/Occurrence Delineation

Group Name: FRESHWATER MUSSELS

Use Class: Not applicable
Minimum Criteria for an Occurrence: Occurrences are based on some evidence of historical or current presence of single or multiple specimens, including live specimens or recently dead shells (i.e., soft tissue still attached and/or nacre still glossy and iridescent without signs of external weathering or staining), at a given location with potentially recurring existence. Weathered shells constitute a historic occurrence. Evidence is derived from reliable published observation or collection data; unpublished, though documented (i.e. government or agency reports, web sites, etc.) observation or collection data; or museum specimen information.

Mapping Guidance: Based on the separation distances outlined herein, for freshwater mussels in STANDING WATER (or backwater areas of flowing water such as oxbows and sloughs), all standing water bodies with either (1) greater than 2 km linear distance of unsuitable habitat between (i.e. lotic connections), or (2) more than 10 km of apparently unoccupied though suitable habitat (including lentic shoreline, linear distance across water bodies, and lentic water bodies with proper lotic connections), are considered separate element occurrences. Only the largest standing water bodies (with 20 km linear shoreline or greater) may have greater than one element occurrence within each. Multiple collection or observation locations in one lake, for example, would only constitute multiple occurrences in the largest lakes, and only then if there was some likelihood that unsurveyed areas between collections did not contain the element.

For freshwater mussels in FLOWING WATER conditions, occurrences are separated by a distance of more than 2 stream km of unsuitable habitat, or a distance of more than 10 stream km of apparently unoccupied though suitable habitat. Standing water between occurrences is considered suitable habitat when calculating separation distance for flowing water mussel species unless dispersal barriers (see Separation Barriers) are in place.

Several mussel species in North America occur in both standing and flowing water (see Specs Notes). Calculation of separation distance and determination of separation barriers for these taxa should take into account the environment in which the element was collected. Juvenile mussels do not follow this pattern and juveniles are typically missed by most standard sampling methods (Hastie and Cosgrove, 2002; Neves and Widlak, 1987), therefore juvenile movement is not considered when calculating separation distance.
Separation Barriers: Separation barriers within standing water bodies are based solely on separation distance (see Separation Distance-suitable, below). Separation barriers between standing water bodies and within flowing water systems include lack of lotic connections, natural barriers such as upland habitat, absence of appropriate species specific fish hosts, water depth greater than 10 meters (Cvancara, 1972; Moyle and Bacon, 1969) or anthropogenic barriers to water flow such as dams or other impoundments and high waterfalls.

Separation Distance for Unsuitable Habitat: 2 km

Separation Distance for Suitable Habitat: 10 km

Alternate Separation Procedure: None
Separation Justification: Adult freshwater mussels are largely sedentary spending their entire lives very near to the place where they first successfully settled (Coker et al., 1921; Watters, 1992). Strayer (1999) demonstrated in field trials that mussels in streams occur chiefly in flow refuges, or relatively stable areas that displayed little movement of particles during flood events. Flow refuges conceivably allow relatively immobile mussels to remain in the same general location throughout their entire lives. Movement occurs with the impetus of some stimulus (nearby water disturbance, physical removal from the water such as during collection, exposure conditions during low water, seasonal temperature change or associated diurnal cycles) and during spawning. Movement is confined to either vertical movement burrowing deeper into sediments though rarely completely beneath the surface, or horizontal movement in a distinct path often away from the area of stimulus. Vertical movement is generally seasonal with rapid descent into the sediment in autumn and gradual reappearance at the surface during spring (Amyot and Downing, 1991; 1997). Horizontal movement is generally on the order of a few meters at most and is associated with day length and during times of spawning (Amyot and Downing, 1997). Such locomotion plays little, if any, part in the distribution of freshwater mussels as these limited movements are not dispersal mechanisms. Dispersal patterns are largely speculative but have been attributed to stream size and surface geology (Strayer, 1983; Strayer and Ralley, 1993; van der Schalie, 1938), utilization of flow refuges during flood stages (Strayer, 1999), and patterns of host fish distribution during spawning periods (Haag and Warren, 1998; Watters, 1992). Lee and DeAngelis (1997) modeled the dispersal of freshwater into unoccupied habitats as a traveling wave front with a velocity ranging from 0.87 to 2.47 km/year (depending on mussel life span) with increase in glochidial attachment rate to fish having no effect on wave velocity.

Nearly all mussels require a host or hosts during the parasitic larval portion of their life cycle. Hosts are usually fish, but a few exceptional species utilize amphibians as hosts (Van Snik Gray et al., 2002; Howard, 1915) or may metamorphose without a host (Allen, 1924; Barfield et al., 1998; Lefevre and Curtis, 1911; 1912). Haag and Warren (1998) found that densities of host generalist mussels (using a variety of hosts from many different families) and displaying host specialists (using a small number of hosts usually in the same family but mussel females have behavioral modifications to attract hosts to the gravid female) were independent of the densities of their hosts. Densities of non-displaying host specialist mussels (using a small number of hosts usually in the same family but without host-attracting behavior) were correlated positively with densities of their hosts. Upstream dispersal of host fish for non-displaying host specialist mussels could, theoretically, transport mussel larvae (glochidia) over long distances through unsuitable habitat, but it is unlikely that this occurs very often. D. Strayer (personal communication) suggested a distance of at least 10 km, but a greater distance between occurrences may be necessary to constitute genetic separation of populations. As such, separation distance is based on a set, though arbitrary, distance between two known points of occurrence.
Date: 18Oct2004
Author: Cordeiro, J.
Notes: Contact Jay Cordeiro (jay_cordeiro@natureserve.org) for a complete list of freshwater mussel taxa sorted by flow regime.

Population/Occurrence Viability

Justification: **Use the Generic Element Occurrence Rank Specifications (2008).**
Key for Ranking Species Element Occurrences Using the Generic Approach (2008).

U.S. Invasive Species Impact Rank (I-Rank) **Not yet assessed**

Authors/Contributors

NatureServe Conservation Status Factors Edition Date: 01Nov2007
NatureServe Conservation Status Factors Author: Cordeiro, J. (2007); J. Brim Box and C. O'Brien (2000)
Element Ecology & Life History Edition Date: 11Dec2007
Element Ecology & Life History Author(s): Cordeiro, J.

Zoological data developed by NatureServe and its network of natural heritage programs (see **Local Programs**) and other contributors and cooperators (see **Sources**).

References

- Adams, W.F., J.M. Alderman, R.G. Biggins, A.G. Gerberich, E.P. Keferl, H.J. Porter, and A.S. van Davender (eds.) 1990. A report on the conservation status of North Carolina's freshwater and terrestrial molluscan fauna. Report to NCWRC by Scientific Council on Freshwater and Terrestrial Mollusks. 246 pp.
- Bogan, A.E. 2002. Workbook and key to the freshwater bivalves of North Carolina. North Carolina Museum of Natural Sciences: Raleigh, North Carolina. 101 pp.
- Bogan, A.E. and T. Proch. 1995. Manual of the freshwater bivalves of Maryland. Prepared for a workshop held at Versar, Inc., Columbia, Maryland, 9 March 1995. 68 pp.
- Britton, J.C. and S.L.H. Fuller. 1979. The freshwater bivalve mollusca (Unionidae, Sphaeriidae, Corbiculidae) of the Savannah River Plant, South Carolina. Savannah River Plant Publications SRO-NEPR-3. Department of Energy. 37 pp.
- Burch, P.R. 2002. Mollusks. [Reprinted- a preliminary list of the land and freshwater mollusks of the James River Basin, Virginia]. Walkerana, 13(29/30): 113-122.
- Catena Group. 2006. Freshwater mussel surveys of the Pee Dee River basin in South Carolina. Unpublished report prepared for the Nature Conservancy- South Carolina Chapter, January 3, 2006. 47 pp.
- Clench, W.J. and K.J. Boss. 1967. Fresh water Mollusca from James River, VA, and a new name for *Mudalia* of authors. The Nautilus, 80(3): 99-102.
- Davis, G.M. and M. Mulvey. 1993. Species status of Mill Creek *Elliptio*. Savannah River Site National Environmental Research Park Program, 22: 4-58.
- Fuller, S.L.H. 1977. Freshwater and terrestrial mollusks. Pages 143-194 in J. E. Cooper, S. S. Robinson, and J. B. Funderburg (eds.). Endangered and Threatened Plants and Animals of North Carolina. North Carolina State Museaum of Natural History, Raleigh, North Carolina.
- Howard, A.D. 1915. Some exceptional cases of breeding among the Unionidae. The Nautilus, 29: 4-11.
- Johnson, R.I. 1970. The systematics and zoogeography of the Unionidae (Mollusca: Bivalvia) of the southern Atlantic slope region. Bulletin of the Museum of Comparative Zoology, Harvard University, 140(6): 263-449.
- LeGrand, H.E., Jr., S.P. Hall, S.E. McRae, and J.T. Finnegan. 2006. Natural Heritage Program List of the Rare Animal Species of North Carolina. North Carolina Natural Heritage Program, Raleigh, North Carolina. 104 pp.
- Lefevre, G. and W.T. Curtis. 1912. Studies on the reproduction and artificial propogation of fresh-water mussels. Bulletin of the Bureau of Fisheries, 30: 102-201.
- Moyle, P. and J. Bacon. 1969. Distribution and abundance of molluscs in a fresh water environment. Journal of the Minnesota Academy of Science, 35(2/3): 82-85.
- Ortmann, A.E. 1919. Monograph of the naiades of Pennsylvania. Part III. Systematic account of the genera and species. Memoirs of the Carnegie Museum, 8(1): 1-385.
- Strayer, D. 1983. The effects of surface geology and stream size on freshwater mussel (Bivalvia, Unionidae) distribution in southeastern Michigan, U.S.A. Freshwater Biology, 13: 253-264.
- Strayer, D.L. 1999. Use of flow refuges by unionid mussels in rivers. Journal of the North American Benthological Society, 18(4): 468-476.
- Strayer, D.L. and J. Ralley. 1993. Microhabitat use by an assemblage of stream-dwelling unionaceans (Bivalvia) including two rare species of *Alasmidonta*. Journal of the North American Benthological Society, 12(3): 247-258.
- Turgeon, D.D., J.F. Quinn, Jr., A.E. Bogan, E.V. Coan, F.G. Hochberg, W.G. Lyons, P.M. Mikkelsen, R.J. Neves, C.F.E. Roper, G. Rosenberg, B. Roth, A. Scheltema, F.G. Thompson, M. Vecchione, and J.D. Williams. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: Mollusks. 2nd Edition. American Fisheries Society Special Publication 26, Bethesda, Maryland: 526 pp.
- Van der Schalie, H. 1938. The naiad fauna of the Huron River in southeastern Michigan. Miscellaneous Publication of the Museum of Zoology, University of Michigan, 40: 7-78.
- Watters, G.T. 1992. Unionids, fishes, and the species-area curve. Journal of Biogeography, 19: 481-490.

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Use Guidelines and Citation

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Note: All species and ecological community data presented in NatureServe Explorer at http://www.natureserve.org/explorer were updated to be current with NatureServe's central databases as of **July 17, 2009**.
Note: This report was printed on **November 10, 2009**

Citation for data on website including State Distribution, Watershed, and Reptile Range maps:
NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: November 10, 2009).

Citation for Bird Range Maps of North America:
Ridgely, R.S., T.F. Allnutt, T. Brooks, D.K. McNicol, D.W. Mehlman, B.E. Young, and J.R. Zook. 2003. Digital Distribution Maps of the Birds of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

Acknowledgement Statement for Bird Range Maps of North America:
"Data provided by NatureServe in collaboration with Robert Ridgely, James Zook, The Nature Conservancy - Migratory Bird Program, Conservation International - CABS, World Wildlife Fund - US, and Environment Canada - WILDSPACE."

Citation for Mammal Range Maps of North America:
Patterson, B.D., G. Ceballos, W. Sechrest, M.F. Tognelli, T. Brooks, L. Luna, P. Ortega, I. Salazar, and B.E. Young. 2003. Digital Distribution Maps of the Mammals of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

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Citation for Amphibian Range Maps of the Western Hemisphere:
IUCN, Conservation International, and NatureServe. 2004. Global Amphibian Assessment. IUCN, Conservation International, and NatureServe, Washington, DC and Arlington, Virginia, USA.

Acknowledgement Statement for Amphibian Range Maps of the Western Hemisphere:
"Data developed as part of the Global Amphibian Assessment and provided by IUCN-World Conservation Union, Conservation International and NatureServe."

NOTE: Full metadata for the Bird Range Maps of North America is available at:
http://www.natureserve.org/library/birdDistributionmapsmetadatav1.pdf.

Full metadata for the Mammal Range Maps of North America is available at:
http://www.natureserve.org/library/mammalsDistributionmetadatav1.pdf.

contacted for a site-specific review of the project area (see **Visit Local Programs**).

Feedback Request: NatureServe encourages users to let us know of any errors or significant omissions that you find in the data through (see **Contact Us**). Your comments will be very valuable in improving the overall quality of our databases for the benefit of all users.

NatureServe

Version 7.1 (2 February 2009)
Data last updated: July 17, 2009