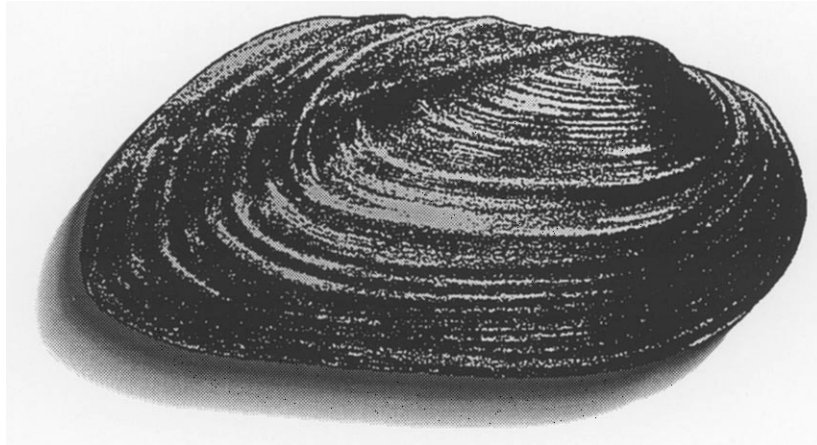


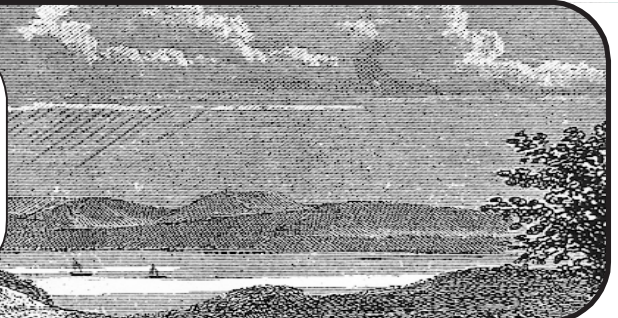
MANUAL OF THE FRESHWATER BIVALVES OF MARYLAND



CHESAPEAKE BAY AND WATERSHED PROGRAMS

MONITORING AND
NON-TIDAL ASSESSMENT

CBWP-MANTA- EA-96-03



MANUAL OF THE FRESHWATER BIVALVES OF MARYLAND

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INTRODUCTION

The freshwater bivalves of the state of Maryland are represented by one introduced unionid species and historically by 17 native unionid species in the Chesapeake Bay Basin and by at least 22 species prehistorically in the Monongahela River Basin. Two additional introduced bivalves complete the current freshwater bivalve community. The only comprehensive monograph of the freshwater bivalves of the region of including Maryland and Pennsylvania was prepared by Arnold E. Ortmann (1913, 1919), while working at The Carnegie Museum of Natural History, Pittsburgh. This workbook is designed to provide an introduction to the freshwater bivalves of Maryland. This is accomplished by providing a list of all of the freshwater unionids, their common names and distribution by river basin. A key based on shell characters for all of the species is provided. Each unionid species has a detailed shell description and is supplemented by a color figure of a representative specimen of the species. A glossary is included to obviate any obscure descriptive terms used in the notebook. An introductory bibliography is included to facilitate entry into the literature on freshwater mussels occurring in the state. The former bibliography has been removed as it was woefully out of date and in large part has been subsumed with an annual update in *Ellipsaria*.

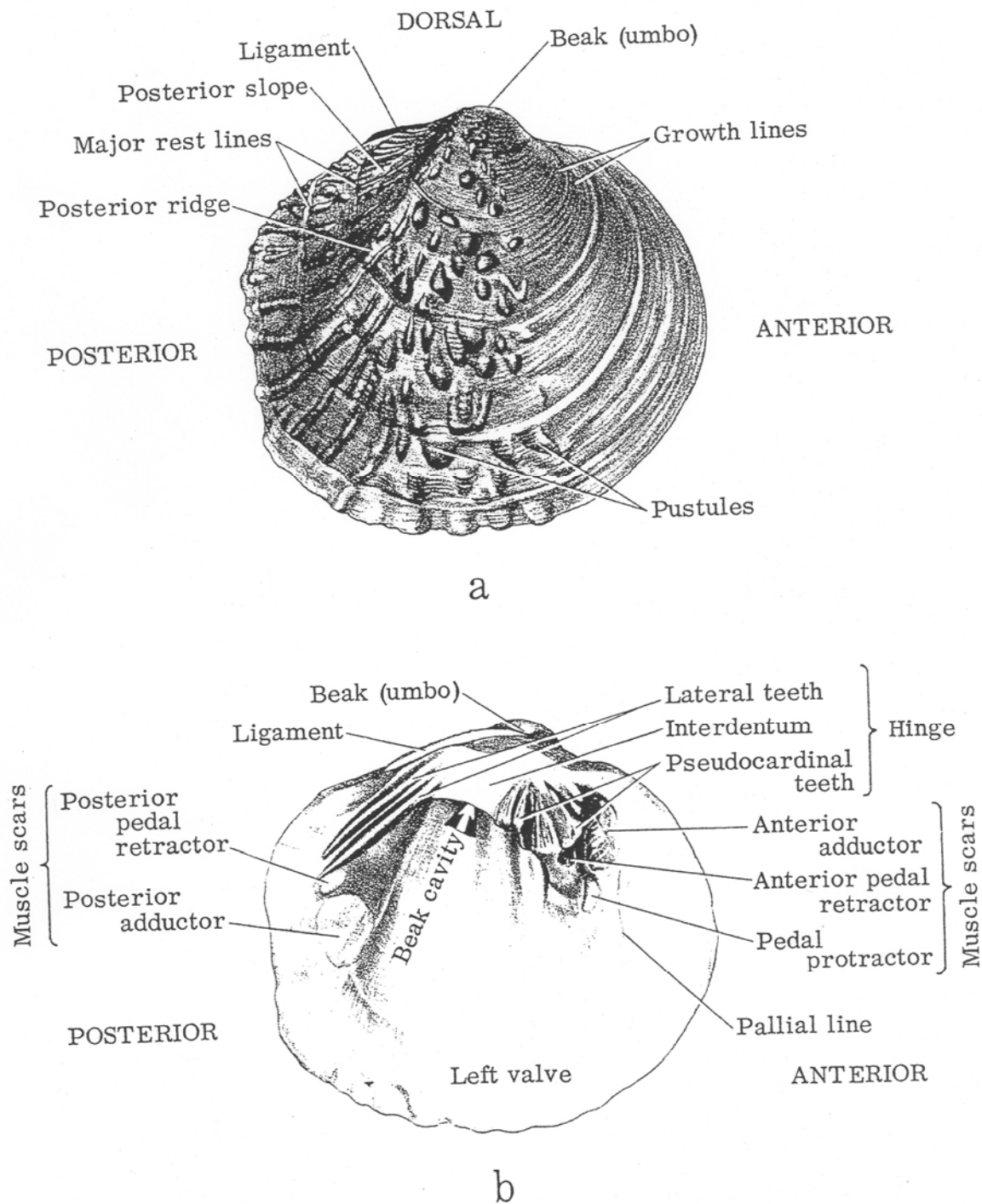
The purpose of the document is to train regulatory agency personnel and other interested parties in recognition and identification of freshwater bivalves that either are known or suspected to occur in Maryland. It is hoped that such training will lead to increased knowledge of species distribution in the state.

The format for each of the species accounts includes: a map of the distribution of the species, which includes historic (bullseye) and recent (solid dot) records. Map style was modified from Gerberich (1984); common names follow Turgeon et al. (1998); synonymy includes junior synonyms and previous generic combinations; shell description is a detailed list of the characteristics of the shell of the species described; distribution is the list of states in which the species occurred historically based on Williams et al. (1993) with conservative refinement from Natural Heritage Program sourced databases (e.g., NatureServe); ecology is the published notes on the ecology of the species; breeding season is that period of the year when female specimens have been observed with glochidia in the marsupium; fish hosts are noted where known as compiled from the literature by Cummings and Watters (2014); status is the perceived status of the species throughout its range as presented by Williams et al. (1993) and within the state as presented by Maryland DNR (2010).

ACKNOWLEDGMENTS

John Christmas was instrumental in developing the 1997 workshop and revising the key to the freshwater bivalves of Maryland. Dr. John Rawlins, Curator of Invertebrates, Carnegie Museum of Natural History, provided access to the collection for the photography of several species of unionids and provided specimens for the workshop. The Delaware Museum of Natural History and Dr. Paula M. Mikkelson, Curator of Malacology graciously provided study specimens used during the workshop. Contemporary distribution records are primarily the result of thousands of hours of survey effort made by biologists with Maryland Department of Natural Resources' Natural Heritage Program, including James McCann, Dan Feller, and Dave Brinker, and Monitoring and Non-Tidal Assessment division. Dr. Arthur Bogan, Curator of Aquatic Invertebrates, North Carolina Museum of Science, provided insight and review of editorial updates and distribution maps. Jennifer Morton provided considerable assistance in document formatting and applying revisions from numerous field notes.

Figure 1. Morphology of a freshwater mussels shell illustrating structures and terminology. a. exterior of right valve, b. interior of left valve (from Burch 1975:5, fig.2; Bogan and Parmalee 1983:9).



GLOSSARY OF BIVALVE TERMS

- Alate - with an extension or wing on the dorsal edge of the shell.
- Angular (subangulate) - having either the anterior or posterior margins forming a relatively acute (sharp) angle.
- Anterior - front or forward.
- Arcuate - bent in a bow or arched.
- Beak - the raised portion of the dorsal margin of a shell; formed by the embryonic shell around which the rest of the shell develops distally in a concentric manner.
- Beak cavity - the cavity on the inside of each valve leading into the beak, under the interdentum.
- Beak sculpture - raised ridges or undulations on the umbo.
- Biangulate - having two angles.
- Bradytictic - mussels which are long term breeders; females retain glochidia in their gills typically over the winter.
- Byssus, byssal threads - a bundle of tough threads secreted by the byssal gland in the foot of a bivalve, used to anchor the bivalve to some hard substrate.
- Cardinal teeth - teeth located between the lateral teeth in Corbiculidae and Sphaeriidae.
- Chevron - shaped like a wide-angled V.
- Clinal variation - the graded variation in morphology exhibited by a species in mollusks from headwater areas to the mouth of the highest order stream.
- Compressed (subcompressed) - flattened out or pressed together.
- Concentric - having a common center, such as ridges or loops radiating from the beak of a mussel valve.
- Conspicuous - pertaining to individuals or populations of the same species.
- Corrugated - marked by wrinkles or ridges and grooves.
- Crescentic - shaped like the figure of the crescent moon with a convex and a concave edge.
- Decorticate - to remove the outer covering, in mollusks the epidermis.
- Disc - the middle or central portion of the exterior of a valve; distinct from the posterior slope or other areas immediately adjacent to the margin of the valve.
- Discoidal - round and flat like a disc.
- Dorsal - the top or back; in mussels, the hinge area.
- Edentulous - lacking both pseudocardinal and lateral teeth.
- Effuse - spread out broadly.
- Elliptical (subelliptical) - elongated, having the form of an ellipse.
- Elongate - long or extended.
- Emarginate - having a shallow notching at the margin.
- Endangered - this status at the state level includes peripheral forms which may be common in another part of its range, but whose continued existence within the political boundaries of the state is in danger of extirpation. At the national level, this status means the organism is in danger of extinction, and included on or being considered for the U.S. List of Endangered Fauna and Endangered and Threatened Plant Species of the United States, under the Endangered Species Act of 1973 (Cooper et al. 1973:x).
- Epidermis - exterior or outside (corneous) layer of the shell.
- Extinct - a species which has no living representatives; all individuals are no longer extant.
- Extirpated - the extinction of a species within a portion of its range.
- Form - an animal with questionable taxonomic status; that is, one exhibiting variation but the extent or degree is not well enough known to determine whether it is a species, subspecies or simply individual or population variation.
- Fusiform - tapering toward each end.
- Gills - a thin plate-like paired structure within the mantle cavity which serves as a respiratory organ in aquatic mollusks and in female unionids all of the gills or certain portions of the gills serve as the marsupium.
- Globose - globe-like, spherical.
- Glochidium (plural - glochidia) - the bivalve larvae of unionids which are generally parasitic on the gills of fish.
- Gravid female - a female which has embryos in the marsupium.
- Growth lines - compact lines of temporarily arrested growth or rest periods appearing on the epidermis of the shell as a raised or darker concentric line.
- Hinge ligament - an elastic, elongate, corneous structure that unites the two valves dorsally along the hinge plate.
- Holotype - single specimen designated as the "type" by the author in the publication of a new species level taxon.
- Inequilateral - in a bivalve, having the two ends unequal, i.e., one end is wider or thicker than the other.
- Inflated (subinflated) - moderately to greatly inflated.
- Interdentum - a flattened area of the hinge plate between the pseudocardinal and lateral teeth.
- Iridescent - showing colors like those of a rainbow.
- Lachrymose - term describing teardrop-shaped pustules.
- Lateral teeth - the elongated, raised and interlocking structures along the hinge line of the valve.
- Lectotype - one of a series of syntypes which, subsequent to the publication of an original description of a species level taxon, is selected (by publication) to serve as the type specimen for that taxon.
- Lunule - depressed area immediately anterior to the umbo.

- Marsupial swelling - a section of the posterior ventral margin of the female unionid shell, which is enlarged or inflated to provide space for expansion of the marsupium with the development of the glochidia.
- Marsupium (marsupial pouch) - in unionids, a brood pouch for eggs and developing glochidia, formed by a restricted portion of the outer gill, the complete outer gill or all four gills.
- Muscle scar - the area of attachment of a muscle to the inside of the shell; e.g., the anterior adductor muscle scar is the location of attachment for the anterior adductor muscle.
- Nacre - the interior iridescent, thin layer of a mussel shell.
- Naiad - formerly a tribe of mollusca nearly equivalent taxonomically to the family Unionidae, often used as a synonym of unionid.
- Nodule (subnodulous) - a small rounded mass of irregular shape.
- Oblique - slanting; angled, but not horizontal or vertical.
- Obovate (subobovate) - ovate.
- Orbicular (suborbicular) - having the form of an orb; circular or nearly circular in outline.
- Oval, Ovate (subovate) - egg-shaped, broadly elliptical.
- Pallial line - an indented groove or line approximately parallel with the ventral margin of a bivalve shell which marks the line of muscles attaching the mantle to the shell.
- Paratype - each specimen of a type series other than the holotype designated in the original publication of the taxon.
- Periphery - the external boundary on a surface, edge.
- Periostracum - see epidermis.
- Plications - parallel ridges on the surface of the shell.
- Posterior - hind or rear.
- Posterior ridge - a ridge on the exterior of a mussel shell, extending from the umbo to the posterior margin.
- Posterior slope - the area across the dorsal portion of the valve extending from the umbo to the posterior margin, often above the posterior ridge.
- Pseudocardinal teeth - triangular-shaped hinge teeth near the anterior-dorsal margin of the shell.
- Pustule - small, raised structure on the external or outside surface of the shell (see also tubercle).
- Quadrangle (subquadrangle) - square, or nearly square in outline.
- Radial furrow - a groove or depression; in naiads a groove running from the umbo area toward the shell margin.
- Radiating - proceeding outward from a central point.
- Rare - seldom appearing, occurring widely separated in space; extremely few in numbers.
- Rectangular - a shape with four sides possessing four right-angles.
- Rest mark - see growth lines.
- Rhomboid (subrhomboid) - having generally four distinct sides, two sides being longer than the others.
- Semicircular - a partial or incomplete circle.
- Serrated - notched or grooved.
- Sexual dimorphism - a condition in which males and females of the same species are morphologically different, usually indicated by an expanded posterior marsupial area in the female in contrast to a more pointed or bluntly rounded area in the male.
- Sinus - a character of some unionids which have a depression above or below the posterior ridge.
- Solid (subsolid) - shells which are thick and heavy.
- Special Concern - This status covers cases where the organism exists in small populations over a broad range, may be over exploited which may pose a threat, the organism are especially vulnerable to specific pressures, or any other reasons identified by experienced researchers (Cooper et al. 1973:x).
- Species - group of interbreeding natural populations that are reproductively isolated from all other such groups.
- Striae - impressed or raised lines on a shell.
- Striate - having striae.
- Subspecies - a geographically defined aggregate of local populations within a species which differ morphologically and/or physiologically from other aggregations of local populations within that species.
- Sulcus (plural - sulci) - a longitudinal furrow or depression.
- Sympatric - pertaining to populations of two or more closely related species which occupy identical or broadly overlapping geographical areas.
- Syntype - one of a series of specimens of the same taxon which formed the material studied by the original author to describe a new species level taxon, from which no type specimen (holotype) was designated.
- Tachytictic - mussels which are short-term breeders; i.e., glochidia are found in the gills of the female only during the summer.
- Taxon - any formal taxonomic unit or category of an organism; e.g., a species or genus.
- Threatened - This status at the state level includes forms which are likely to become Endangered in the foreseeable future if certain conditions are not met. This includes forms which exhibit a considerable decrease in numbers beyond normal population fluctuations or a documented range contraction, but are not yet considered Endangered. At the national level this applies to the Endangered Species Act of 1973 (Cooper et al. 1973:x).
- Trapezoid (subtrapezoid) - a shape having four distinct sides with two sides parallel.
- Triangular (subtriangular) - a shape having three sides and three angles, like a triangle.

Truncate (subtruncate) - having the end squared off.

Tubercle (tuberculate) - small, raised, rounded knob on the outside of the shell.

Tuberculate - having tubercles on the outside of the shell.

Type - a designated specimen or specimens of an organism that serves as the basis for the original name and description of any species level taxon.

Umbo/umbone - the dorsally raised, inflated area of the bivalve shell.

Unionids - refers to any member of the freshwater bivalve mollusks which belong to the superfamily Unionoidea.

Undulation - pattern with waves; raised ridges or bars.

Valve - the right or left half of a mussel (or unionid) shell.

Ventral - the underside or bottom.

The following volumes, in addition to *Webster's Unabridged Dictionary*, were used to compile the definitions used in the glossary.

Burch, John B. 1962. *How to know the eastern land snails*, Pictured Key Nature Series, Wm. C. Brown Company Publishers, Dubuque, Iowa, 214 pp. 519 fig.

Burch, John B. 1975. *Freshwater Unionacean Clams (Mollusca: Pelecypoda) of North America*. Malacological Publications, Hamburg, Michigan, 204 pp. 252 fig.

Leonard, A. Byron. 1954. Handbook of Gastropods in Kansas. *University of Kansas Museum of Natural History Miscellaneous Publication* No. 20, pp. 1-224, 22 pl.

Murray, Harold D. and A. Byron Leonard. 1962. Handbook of Unionid Mussels in Kansas, *University of Kansas Museum of Natural History Miscellaneous Publication* No. 28, pp. 1-184, 45 pl. 42 fig.

Parmalee, Paul W. 1967. The Freshwater Mussels of Illinois. *Illinois State Museum, Popular Science Series*, Vol. 8, pp 108, 35 pl. 4 fig.

Pennak, Robert W. 1964. *Collegiate dictionary of zoology*, The Ronald Press Company, New York. 583 pp.

This glossary was taken from Bogan (1993).

Map 1. Major Drainage basins of Maryland. Fall line is represented by dashed line.



List of families/superfamilies of freshwater bivalves occurring Maryland including the higher molluscan classification.

Phylum Mollusca

Class Bivalvia

Subclass Paleoheterodonta

Order Unionoida

Superfamily Unionoidea

Family Unionidae [3 Tribes, 10 genera, 18 species] (see page 11 for species list)

<i>Alasmidonta</i>	[4]
<i>Anodonta</i>	[1]
<i>Elliptio</i>	[4]
<i>Lampsilis</i>	[3]
<i>Lasmigona</i>	[1]
<i>Leptodea</i>	[1]
<i>Ligumia</i>	[1]
<i>Pyganodon</i>	[1]
<i>Strophitus</i>	[1]
<i>Utterbackia</i>	[1]

Subclass Heterodonta

Order Veneroida

Superfamily Dreissenoidea

Family Dreissenidae

Dreissena polymorpha (Pallas, 1771) [Zebra mussel]

Superfamily Corbiculoidea

Family Corbiculidae

Corbicula fluminea (Muller, 1776) [Asian clam]

List of unionid bivalves of Maryland with common and scientific names and status

<u>Species</u>	<u>Common Name</u> ¹	<u>Status</u>			
		<u>*</u>	<u>X</u>	<u>E</u>	<u>I</u>
<i>Alasmidonta heterodon</i> (Lea, 1829)	dwarf wedgemussel	*		E	
<i>Alasmidonta marginata susquehannae</i> (Ortmann, 1919)	Susquehanna elktoe				
<i>Alasmidonta undulata</i> (Say, 1817)	triangle floater			E	
<i>Alasmidonta varicosa</i> (Lamarck, 1819)	brook floater			E	
<i>Anodonta implicata</i> (Say, 1829)	Alewife floater				
<i>Elliptio complanata</i> (Lightfoot, 1786)	eastern elliptio				
<i>Elliptio fisheriana</i> (Lea, 1838)	northern lance				
<i>Elliptio lanceolata</i> (Lea, 1828)	yellow lance				
<i>Elliptio producta</i> (Lea, 1831)	Atlantic spike				
<i>Lampsilis cardium</i> Rafinesque, 1820	plain pocketbook				
<i>Lampsilis cariosa</i> (Say, 1817)	yellow lampmussel			E	
<i>Lampsilis radiata radiata</i> (Gmelin, 1791)	eastern lampmussel				
<i>Lasmigona subviridis</i> (Conrad, 1835)	green floater			E	
<i>Leptodea ochracea</i> (Say, 1817)	tidewater mucket				
<i>Ligumia nasuta</i> (Say, 1817)	eastern pondmussel				
<i>Pyganodon cataracta</i> (Say, 1817)	eastern floater				
<i>Strophitus undulatus</i> (Say, 1817)	creeper				I
<i>Utterbackia imbecillis</i> (Say, 1829)	paper pondshell				

* federally endangered

X presumed Extinct in Maryland

E suggested as Endangered in Maryland

I suggested as In Need of Conservation in Maryland

¹ Common names follow Turgeon et al. (1998)

KEY TO THE SHELLS OF THE FRESHWATER BIVALVES OF MARYLAND (2014 update)

- 1 a. Shell with very sharp posterior ridge, shaped like a marine mussel, *Mytilus*, generally less than 30 mm, and attached to a hard substrate with byssal threads (fig. 2) ***Dreissena polymorpha***
Note: (non-indigenous aquatic nuisance species, recently found in Maryland)
- b. Animal without byssal threads attaching adult animal to substrate, with or without teeth, but not with above shape..... 2
- 2 (1b) a. Valves with cardinal teeth and two sets of lateral teeth..... 3
- b. Valves with one set of lateral teeth and pseudocardinal teeth or without teeth (Unionidae)..... 4
- 3 (2a) a. Valves with serrated lateral teeth (fig. 3), non-indigenous species ***Corbicula fluminea***
- b. Valves with smooth lateral teeth..... ***Sphaeriidae***
- 4 (2b) a. Specimens from the Ohio basin **Appendix A**
- b. Specimens from the Chesapeake or coastal basins 5
- 5 (4b) a. Hinge teeth absent 6
- b. Hinge teeth present 9
- 6 (5a) a. Beaks not projecting above the hinge line (fig. 21) ***Utterbackia imbecillis***
- b. Beaks projecting above the hinge line..... 7
 1 (footnote)
- 7 (6b) a. Beak sculpture double looped¹..... 8
- b. Vestige of pseudocardinal teeth usually represented by a thickening near the beaks (fig. 20); nacre usually orange in the beak cavity, beak sculpture concentric ***Strophitus undulatus***
- 8 (7b) a. Shell prominently thickened along the anterior third of the ventral margin of the shell below the pallial line, nacre salmon or copper colored (fig. 8) ***Anodonta implicata***
- b. Ventral margin of shell uniformly thin, nacre bluish or white, greenish epidermis (fig. 19)
 ***Pyganodon cataracta***
- 9 (5b) a. Lateral teeth well developed, functional and interlocking 12
- b. Lateral teeth absent or reduced, neither functional nor interlocking 10
- 10 (9b) a. Fine transverse ridges present on the posterior slope, pseudocardinal teeth reduced and elongate, with smooth surfaces..... 11
- b. Transverse ridges on posterior slope absent, pseudocardinal teeth strong and triangular, with rough surfaces, shell small to medium size, triangular to ovate (fig. 6) ***Alasmidonta undulata***
- 11(10a) a. Posterior ridge angular and prominent, shell truncated, color of posterior margin lighter than rest of shell (fig. 5)..... ***Alasmidonta marginata susquehannae***

- b. Posterior ridge rounded, shell rounded and usually less than 70 mm long (fig. 7) ***Alasmidonta varicosa***
- 12 (9a) a. Right valve with two lateral teeth, rare (fig. 4)..... ***Alasmidonta heterodon***
- b. Right valve with one lateral tooth 13
- 13 (12b) a. Height/length ratio less than or equal to 0.5 shell elongate 14
- b. Height/length ratio greater than 0.5..... 15
- 14 (13a) a. Posterior ridge prominent, posterior end of shell subangular; pseudocardinal teeth thin, bladelike, some shells with prominent rays, shell usually less than 110 mm in length (fig. 18) ***Ligumia nasuta***
- b. Dark brown periostracum posterior ridge rounded, posterior end typically rounded to a point below the shells midline, ventral margin broadly rounded lacks rays (fig. 10), most commonly distributed lanceolate species on Maryland's Eastern Shore ***Elliptio fisheriana***²
- c. Posterior ridge rounded, posterior end bluntly rounded at or above the shells midline, ventral margin broadly rounded lacks rays (fig. 12), most common lanceolate species in Potomac drainage and Central part of state..... ***Elliptio producta***²
- d. Posterior ridge rounded, posterior end bluntly rounded, ventral margin broadly rounded lacks rays (fig. 11), periostracum waxy, ranging from green to yellow..... ***Elliptio lanceolata***
- 15 (13b) a. Nacre purple, may grade to a salmon color, shell subrhomboid with well-defined posterior ridge and slope, very common (fig. 9) periostracum yellowish green to black ***Elliptio complanata***
- b. Nacre white or colored but not purple..... 16
- 16(15b) a. Left valve with small interdental tooth, giving the appearance of three pseudocardinal teeth, shell more or less compressed and subrhomboid in outline, periostracum dark green with numerous green rays or brown, adult shell less than 65 mm long, posterior ridge rounded, beak sculpture is prominent raised bars (fig. 16) ***Lasmigona subviridis***
- b. Left valve without interdental tooth, valve appears to have only two pseudocardinal teeth 17
- 17(16b) a. Adult shell usually less than 80 mm in length, and thin, hardly thicker anteriorly than posteriorly, periostracum dull yellow without rays or with fine rays all over the shell, in or near tidewaters, nacre often a salmon color (fig. 17)..... ***Leptodea ochracea***
- b. Adult shell often greater than 80 mm in length, much thicker anteriorly than posteriorly, may have obvious broad color rays 18
- 18 (17b) a. Over 1.5 times as long as high. Height/length less than 0.60 in males and in most females, shell with rays all over the shell (may be obscured in old adults), posterior ridge low and broadly rounded, beaks not prominent (fig. 15)..... ***Lampsilis radiata***
- b. Height/length greater than 0.60 beaks prominent, periostracum yellow to light brown now bluish white 19
- 19 (18b) a. Periostracum glossy yellow reddish brown in adults. Green rays if present are very thin and restricted to the posterior slope. Posterior ridge is smooth and rounded. Pseudocardinal teeth are both serrated, angle between anterior pseudocardinal tooth in left valve is obtuse (>150°) with hinge line, posterior teeth on left valve is parallel to hinge line. (fig. 14)... ***Lampsilis cariosa***

- b. Periostracum dull yellow becoming yellowish-brown to dark brown in adults. Green rays are often distinct, which can be present throughout the shell and thicker than those in *L. cariosa* (indistinct in old shells). Shell globose, almost as high as long, beaks very inflated (fig. 13) nacre silver white and pink under beak. Posterior ridge is rounded to slightly concave and typically darker than the periostracum. In the left valve, angle between the anterior pseudocardinal tooth on left valve is obtuse to hinge line. Angle between posterior tooth in left valve and lateral teeth is slightly obtuse (<150°) approaching perpendicular. Non-indigenous species that was introduced into the Potomac River ***Lampsilis cardium***³

¹Beak sculpture is often difficult to evaluate, as a result of shelf erosion, in all but very small specimens.

²There are taxonomic problems with the group of lanceolate species in the genus *Elliptio*. Several names have been used for this group in Maryland including *E. lanceolata*, (Lea 1828), *E. fisheriana* (Lea 1838), *E. producta* (Conrad, 1836) and *E. angustata* (Lea, 1831). The last two species were described from the Savannah River in South Carolina and Georgia and the Cooper and Congaree rivers in South Carolina, respectively. *E. fisheriana* (Lea, 1838) was described from the head of Chester River, [Kent Co.] Maryland." There is confusion as to what constitutes a species within this complex, where one ends and the next begins. *Elliptio producta* has also been described in Maryland. Based on shell forms, *E. fisheriana* and *E. producta* have been used most recently in Maryland to describe dark-shelled lanceolate *Elliptio* species. Recent, unpublished phylogenetic analyses have reported that all dark lanceolate *Elliptio* in the Chesapeake Bay represent *E. fisheriana*. An overall lack of verifiable shell material for *E. lanceolata* and its synonymy with other lanceolate *Elliptio* species by Johnson (1970) has led to confusion regarding its status in Maryland. Many specimens reported as *E. lanceolata* are dark and rayed, such as those from tributary streams of the Middle Potomac River Basin and the mainstem of the river upstream of Great Falls. They appear to have been assigned to *Unio lanceolatus* at the time of their collection and remained under this synonym. One specimen (n.d) from "Washington D.C." is yellow, waxy, and rayless. Recent and newly discovered historic collections of valid specimens from the Patuxent River Basin and further phylogenetic analysis of *E. lanceolata* necessitate a re-examination of this taxa in Maryland.

³The inclusion of *Lampsilis ovata* (Say, 1817) on prior lists of species for Maryland is in error. It stems from the placement of the subspecies Ortmann described, *ventricosa cohongoronta* Ortmann, 1912, from the Potomac River. The confusion is a result of some people using *ventricosa* (Barnes, 1823) as either a subspecies or junior synonym of *L. ovata*, it is not. *Lampsilis cardium* Rafinesque, 1820 is an earlier name and senior synonym for *ventricosa* (Barnes, 1823).

List of Institutions with major unionid collections, address and contact person.

Dr. Diarmaid Ó. Foighil
Museum of Zoology
University of Michigan
Ann Arbor, Michigan 48109

Dr. Robert Hershler
Division of Mollusks
United State National Museum
Smithsonian Institution
Washington, DC 20560

Dr. James J. McCarthy
Division of Mollusks
Museum of Comparative Zoology
Harvard University
26 Oxford Street
Cambridge, MA 02138

Dr. Paula M. Mikkleson
Mollusks
Delaware Museum of Natural History
P.O. Box 4937
Wilmington, DE 19807-0937

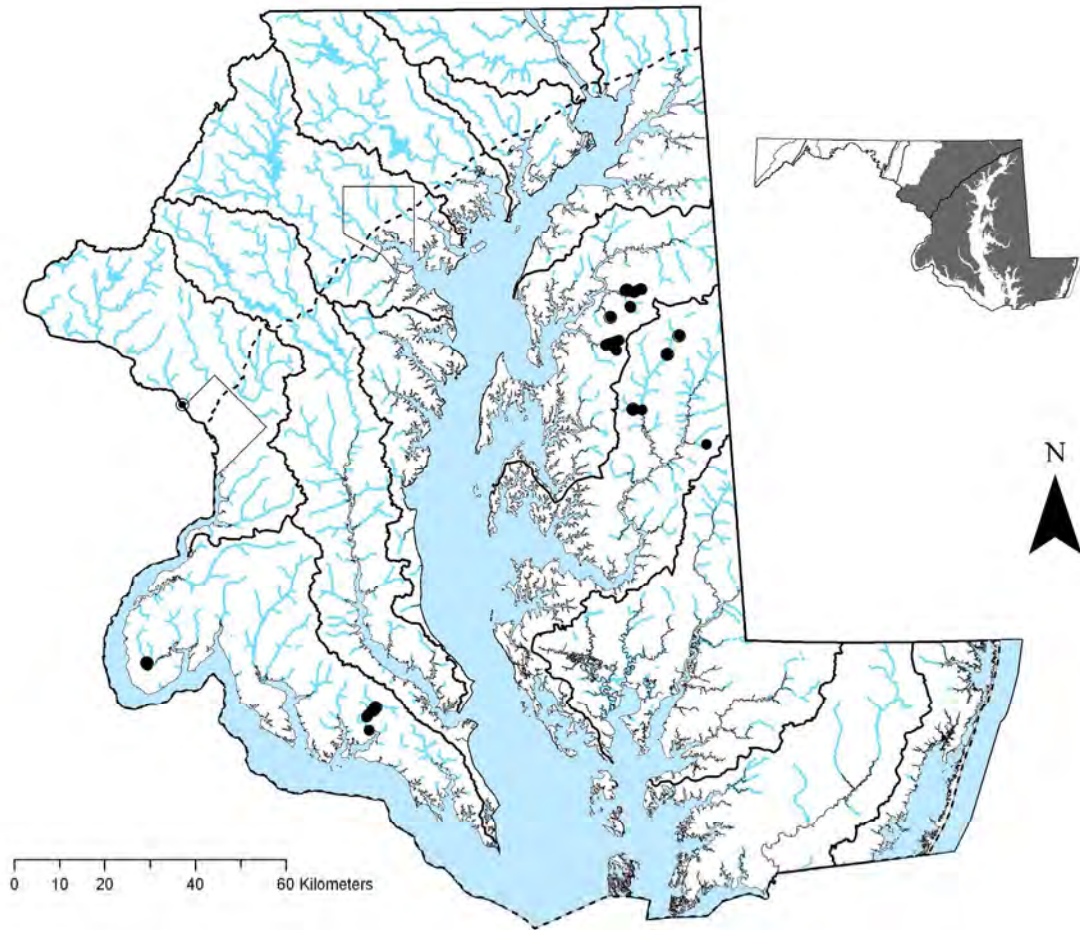
Dr. Arthur Bogan
Aquatic Invertebrates
North Carolina Museum of Science
11 West Jones Street
Raleigh, NC 27601

Dr. Tim Pearce
Division of Invertebrates
Carnegie Museum of Natural History
4400 Forbes Ave.
Pittsburgh, PA 15213

Dr. Gary Rosenberg
Department of Malacology
Academy of Natural Sciences
1900 Benajamin Franklin Parkway
Philadelphia, PA 19103

Dr. G. Thomas Watters
Museum of Biological Diversity
The Ohio State University
1315 Kinnear Road
Columbus, OH 43212

Dr. Fred Thompson
Mollusks
Florida Museum of Natural History
University of Florida
Gainesville, FL 32611



Map 2. Distribution of *Alasmidonta heterodon* (Lea, 1829) in Maryland.

Alasmidonta heterodon (Lea, 1829) dwarf wedgemussel Fig. 4

SYNONYMY

Unio heterodon Lea, 1829*Alasmidonta heterodon* (Lea, 1829)*Alasmidonta* (*Pressodonta*) *heterodon* (Lea, 1829)

SHELL DESCRIPTION. Shell small, subtrapezoid or “hump backed” shell thick anteriorly and thinning posteriorly, ventral margin mostly straight, posterior margin pointed near the base, dorsal margin slightly curved, beaks low and rounded, projecting only slightly above the hinge line, posterior ridge rounded, somewhat inflated and prominent, periostracum yellowish, olive brown to blackish with variable width reddish brown rays, hinge teeth unusual with an interdental projection, beak cavity narrow and rather shallow, nacre bluish white.

DISTRIBUTION. Connecticut, Delaware, Massachusetts, Maryland, north Carolina, New Hampshire, New Jersey, New York, Pennsylvania, Virginia, Vermont, Canada: New Brunswick (Williams et al. 1993).

ECOLOGY. Ortmann (1919:176) observed “I found this species in very small streams (“runs”), in strongly flowing water, and in rather coarse gravel, ...in a small branch of the river in sand and moderate current...in the canal at Manayunk at time when the water had been drained off ... Here the bottom consisted of larger and smaller stones, the interstices filled with sandy mud. This however, cannot be regarded as normal, and the ecological conditions of this species remain to be studied”.

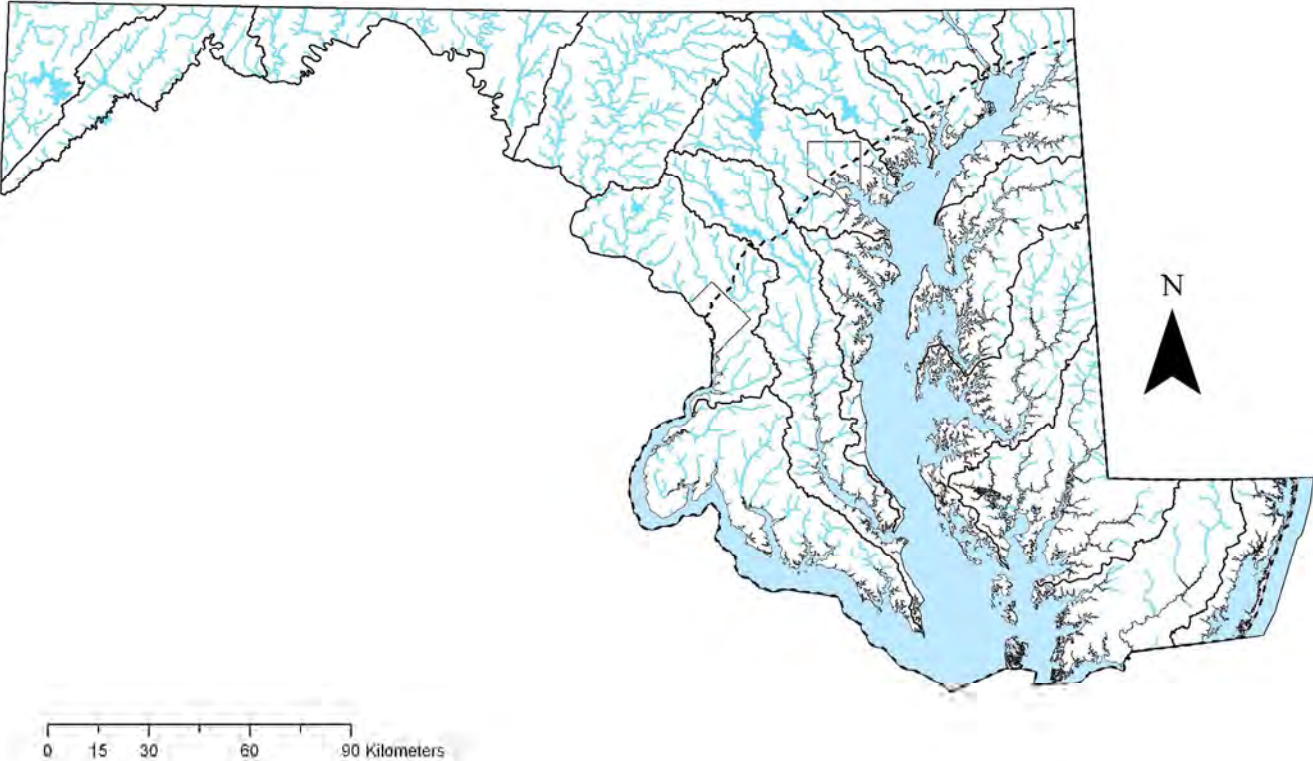
In Maryland, this species inhabits moderate to small Coastal Plain streams, although historically known from the Potomac River Gorge and Choptank River. Typically found in shallow runs with sand-gravel substrates, often in the outside bends of stream channel as it transitions into a pool.

BREEDING SEASON. Ortmann (1919:174) reported gravid females from February to April.

Michaelson and Neves (1995) found gravid Females beginning in September through November in North Carolina. Glochidia were probably released in April. In Massachusetts, glochidia release and host infection was observed during early May to late June (McClain and Ross 2005).

HOST FISH. *Etheostoma nigrum*; Tessellated darter, *Etheostoma olmstedi*; Mottled sculpin, *Cottus bairdi*; Atlantic salmon, *Salmo salar*; Brown trout, *Salmo trutta*; Banded killifish, *Fundulus diaphanus*; Striped bass, *Morone saxatilis*; Shield darter, *Percina peltata*.

STATUS. Endangered



Map 3. Distribution of *Alasmidonta marginata susquehannae* Ortmann, 1919 in Maryland.

Alasmidonta marginata susquehannae Ortmann, 1919 **Susquehanna elktoe** Fig. 5

SYNONYMY

Alasmidonta marginata Say, 1818
Alasmidonta marginata Say, 1818
Mya rugulosa Wood, 1828
Alasmidonta (Decurambis) scriptum Rafinesque, 1831
Unio swanaonensis Hanley, 1842
Alasmidonta corrugate DeKay, 1843
Marginata marginata "var. *truncata*" B.H. Wright, 1898
Alasmidonta (Decurambis) marginata susquehannae
 Ortmann, 1919
Alasmidonta marginata variabilis F.C. Baker, 19.28
Alasmidonta (Decurambis) marginata Say, 1818

SHELL DESCRIPTION. Shell elongated, dorsal margin generally rounded, ventral margin nearly straight, anterior end rounded, shell inflated, relatively thin, posterior ridge sharp and prominent, posterior slope broad, flat and often covered with fine flutings beak sculpture heavy double-looped ridges, periostracum yellowish brown often a rusty color, numerous green rays with dark green spots, pseudocardinal teeth elongate, lateral teeth reduced to a swelling, beak cavity open and moderately deep, nacre color bluish white often with a tinge of salmon.

DISTRIBUTION. New York, Pennsylvania.

ECOLOGY. Ortmann (1919:186) reported the ecology of *Alasmidonta marginata* from the Interior Basin as "most decidedly a species of the riffles, being found there in finer or coarse, but firmly packed gravel in swift currents. Call (1900) remarked on the strongly developed foot of this species.... When fully extended, the foot is firmly attached to the gravel in the river bed, and it requires quite an effort to dislodge the specimens." He noted that the subspecies in the Susquehanna River basin "frequents riffles, and this renders it the more conspicuous, since there are few species on the Atlantic Slope which prefer this habitat."

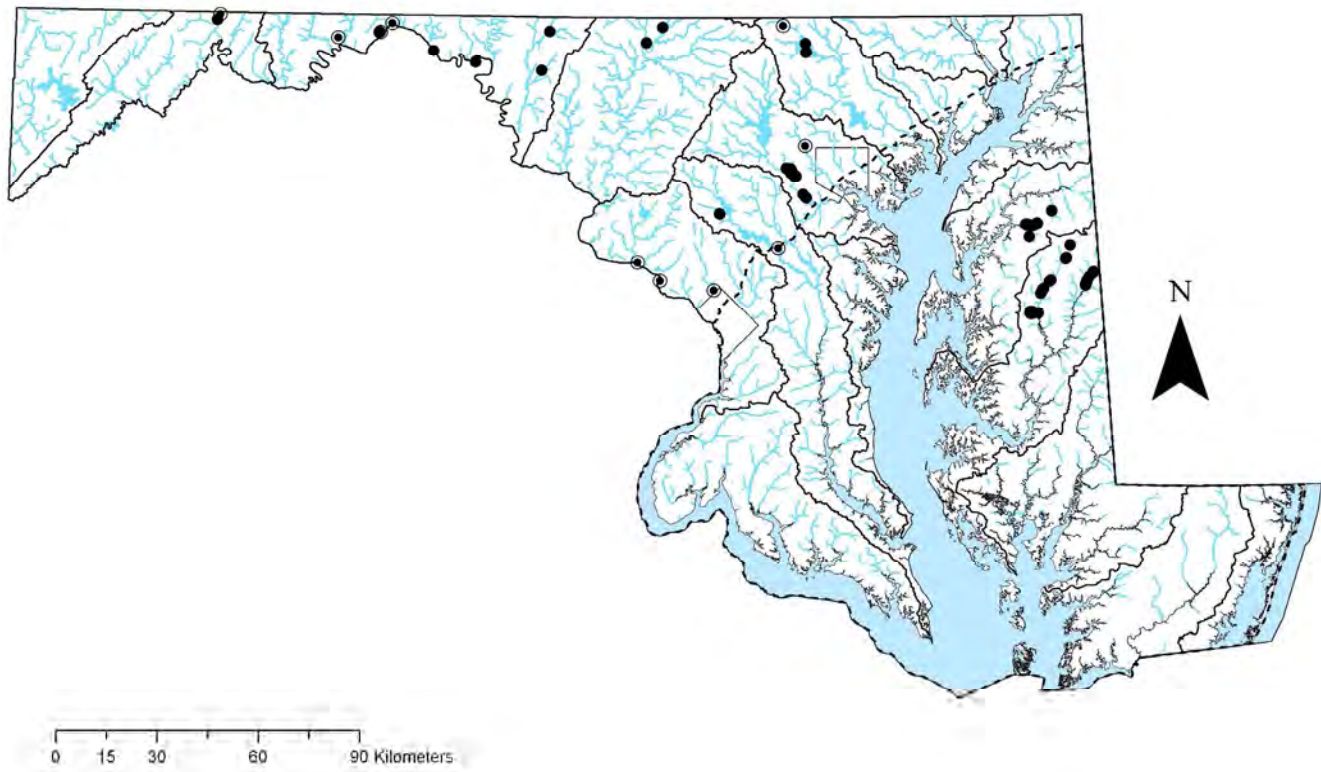
BREEDING SEASON. Ortmann (1919:188) reported eggs and glochidia in August and noted the species is probably bradyctictic. Bloodsworth et al. (2013) collected gravid Elktoe in September and October in Minnesota and Wisconsin.



HOST FISH. Banded killifish, *Fundulus diaphanus*; Banded sculpin, *Cottus carolinae*; Blackstripe topminnow, *Fundulus olivaceus*; Bleeding shiner, *Luxilus zonatus* Brook stickleback, *Culea inconstans*; Creek chub, *Semolitis atromaculatus*; Creek chubsucker, *Erimyzon oblongus*; Golden redhorse, *Moxostoma erythrurum*; Golden shiner, *Notimegonus crysoleucas*; Longnose dace, *Rhinichthys cataractae*; Mosquitofish, *Gambusia affinis*; Mottled sculpin, *Cottus bairdii*; Northern hogsucker, *Hypentelium nigricans*; Northern Studfish, *Fundulus catenatus*; River carpsucker, *Cyprinus carpio*; Rock bass, *Ambloplites rupestris*, Shorthead redhorse, *Moxostoma macrolepidotum*; Silver redhorse, *Moxostoma anisurum*; Slimy sculpin, *Cottus cognatus*; Smallmouth buffalo, *Ictiobus bubalus*; Striped shiner, *Luxilus chrysocephalus*; Warmouth, *Lepomis gulosus*. White sucker, *Catostomus commersoni*, No mention is made of the host fish for the Atlantic Slope subspecies

STATUS. Special Concern, n/a (state)

COMMENTS: Gerebrich (1984) noted that this taxon has not been reported from Maryland, but it probably occurred historically in the main channel of the Susquehanna River in Maryland. M. Walsh (pers. comm.) reported it from the lower river in Pennsylvania, near York Haven Dam, which is approximately 10 river miles from border with Maryland.

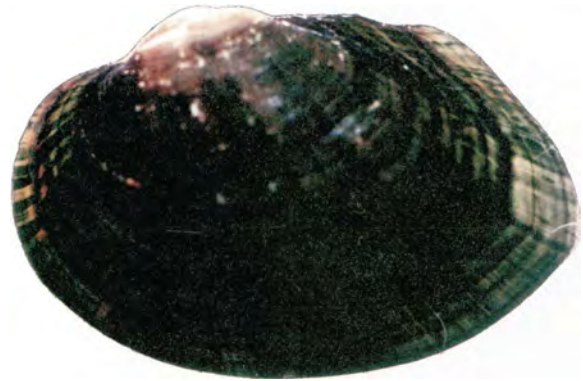


Map 4. Distribution of *Alasmidonta undulata* (Say, 1817) in Maryland.

Alasmidonta undulata (Say, 1817) **triangle floater** Fig. 6

SYNONYMY

Unio undulata Say, 1817
 "*Unio glabratus?* Lamarck" Sowerby, 1823
Unio hians Valenciennes, 1827
Alasmidonta sculptilis Say, 1829
Uniopsis radiata Swainson, 1840
Uniopsis mytiloides Swainson, 1840
Margaritana triangulate Lea, 1858
Unio swainsoni Sowerby, 1868
Alasmidonta (Alasmidonta) undulate (Say, 1817)



SHELL DESCRIPTION. Shell ovate to triangular, shell thickened and strong anteriorly becoming thin posteriorly, ventral margin evenly rounded, posterior margin rounded and pointed ventrally, beak somewhat inflated and located in the anterior third of the shell, posterior ridge well marked and rounded, posterior slope of adults with a few low coarse ridges, periostracum smooth and shiny, yellowish with green rays becoming brownish to black in adult specimens, pseudocardinal teeth stumpy, interdental projection well developed in left valve, nacre white and some with salmon or pink.

DISTRIBUTION. Alabama, Connecticut, Delaware, Florida, Georgia, Massachusetts, Maryland, Maine, north Carolina, New Hampshire, New Jersey, New York, Pennsylvania, Rhode island, south Carolina, Virginia, Vermont, west Virginia, Canada: New Brunswick, Nova Scotia, Ontario, Quebec.

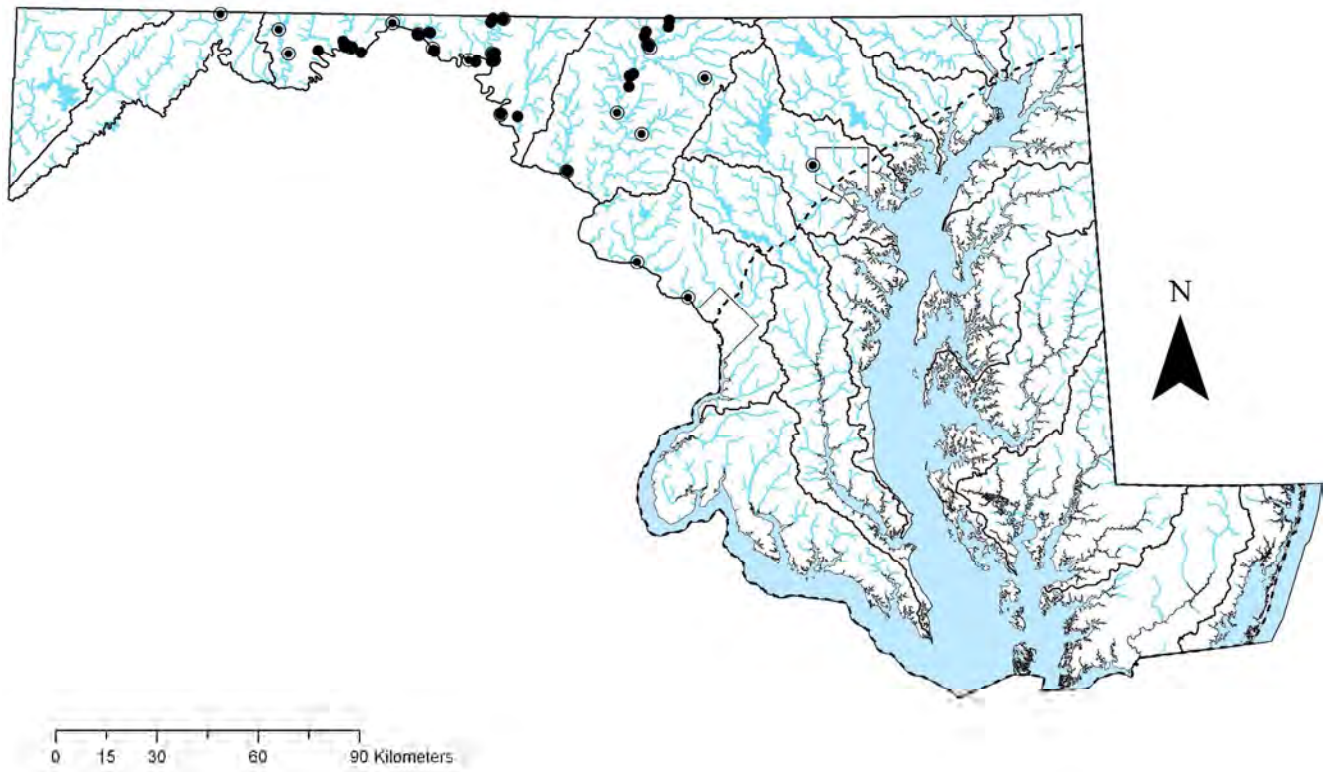
ECOLOGY. Ortmann (1919:180) noted this species "is quite evident that it avoids the larger rivers, and prefers the smaller streams, where it becomes locally abundant, going far up towards the headwaters...It does not seem to favor riffles and very rough water, but is found chiefly in more quiet parts, but with some current, for instance, above riffles, where a steady flow of water prevails. It does not like slack water, but occasionally it is found in ponds and canals. It also likes mill races, if the current is not too rapid. It lives mostly in a mixture of coarse or finer gravel with sand and mud; but I have taken it also in eddies with slow current embedded in the mud deposited between larger stones."

In Maryland, it can be found in larger streams, like the Potomac River, but is typically in low abundance. Also inhabits moderate to smaller sized streams of central and eastern Maryland, including the Delmarva Peninsula where it is often in mud or silted pools.

BREEDING SEASON. Ortmann (1919:178) reported gravid females July to September and April to June, a bradyctictic species.

HOST FISH. Blackside darter, *Percina maculata*; Central stoneroller, *Campostoma anomalum*; Common shiner, *Luxilus cornutus*; Fallfish, *Semotilus corporalis*; Fantail darter, *Etheostoma flabellare*; Largemouth bass, *Micropterus salmoides*; Longnose dace, *Rhinichthys cataracte*; Northern hogsucker, *Hypentelium nigricans*; Pumpkinseed, *Lepomis gibbosus*; Rosyface shiner, *Notropis rubellus*; Slimy sculpin, *Cottus cognatus*; White perch, *Morone americana*.

STATUS. Special Concern, Endangered.



Map 5 Distribution of *Alasmidonta varicosa* (Lamarck, 1819) in Maryland

Alasmidonta varicosa (Lamarck, 1819) **brook floater** Fig. 7

SYNONYMY

Unio varicosa Lamarck, 1819
Alasmidonta corrugata DeKay, 1843
Alasmidonta (Decurambis) varicosa (Lamarck, 1819)
Mya rugulosa Wood, 1856

SHELL DESCRIPTION. Kidney shaped, thin shelled, slightly thicker anteriorly, ventral margin straight and slightly concave centrally, beaks narrow and bluntly pointed, posterior ridge broad, flat and inflated, posterior slope flattened to slightly concave, often with poorly developed corrugations or culations, periostracum yellowish and partly to completely covered with green rays, hinge teeth poorly developed to rudimentary, interdental projection well defined or a small swelling, beak cavity open and shallow, nacre bluish to bluish white, tan to olive or pinkish in the beak cavity. Foot color is orange-cream.

DISTRIBUTION. Connecticut, Delaware, Georgia, Massachusetts, Maryland, Maine, north Carolina, new Hampshire, new jersey, new York, Pennsylvania, Rhode island, south Carolina, Virginia, Vermont, west Virginia, Canada: new Brunswick, nova Scotia,.

ECOLOGY. Ortmann (1919:193) noted 'in the smaller streams this species is more abundant, and locally common.... it is distinctly a shell which prefers strong currents and gravelly bottoms, thus being most frequently found in and near riffles... it goes far up into the headwaters.'

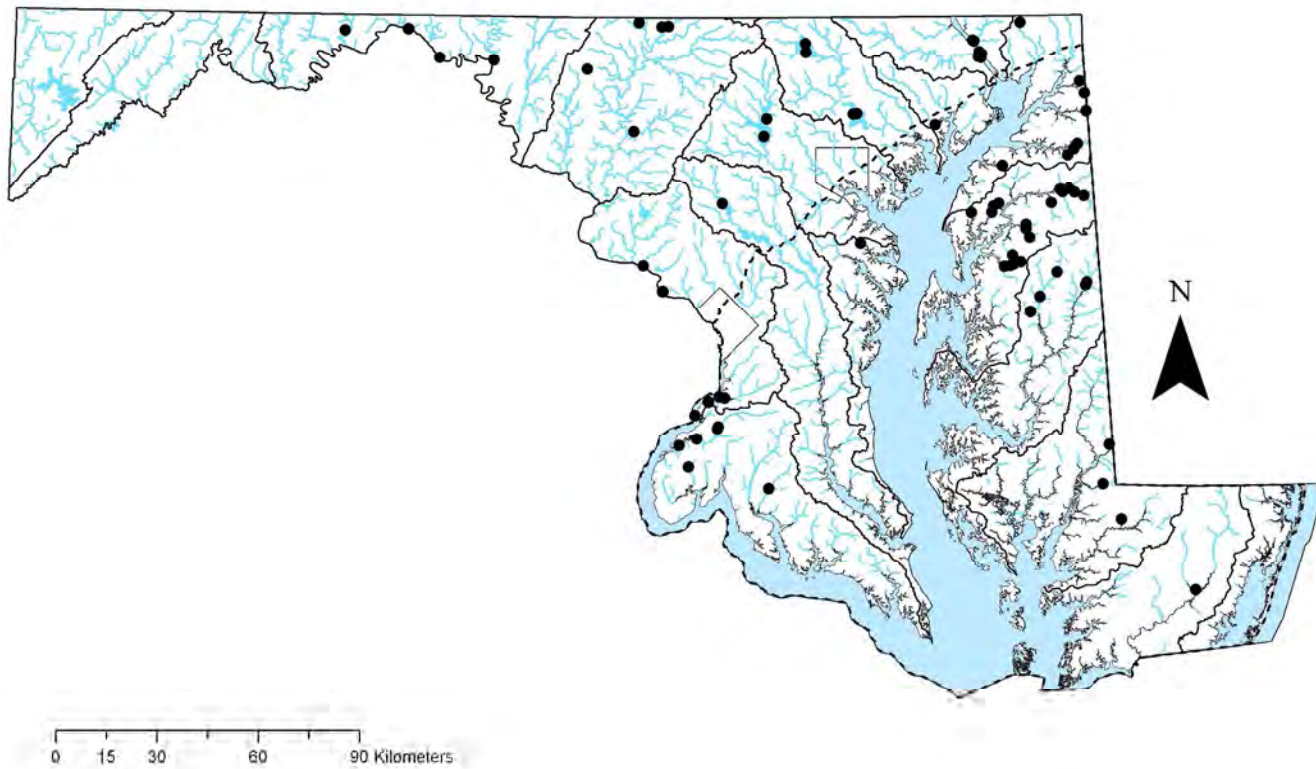
In Maryland the species can be found in larger streams and rivers with moderate flow, such as Licking Creek. Recently found in low numbers in the Potomac River, specifically in vicinity of islands with smaller channels and depositional substrate.

BREEDING SEASON. Ortmann (1919:191-192) observed eggs in the marsupium in August, glochidia in September and discharge of glochidia in May. The species is bradytic.



HOST FISH. Golden shiner, *Notemigonus chrysoleucas*; Mottled sculpin, *Cottus bairdi*; Slimy sculpin, *Cottus cognatus*; Fantail darter, *Etheostoma flabellare*; Johnny darter, *Etheostoma nigrum*; Redbreast sunfish, *Lepomis auritus*; Pumpkinseed, *Lepomis gibbosus*; Bluegill, *Lepomis macrochirus*; White shiner, *Luxilus albeolus*; Margined madtom, *Noturus insignis*; Yellow perch, *Perca flavescens*; Piedmont darter, *Percina crassa*; Longnose dace, *Rhinichthys cataracte*; Blacknose dace, *Rhinichthys atratulus*.

STATUS. Threatened, Endangered.



Map 6. Distribution of *Anodonta implicata* Say, 1829 in Maryland.

Anodonta implicata (Say, 1829) **Alewife floater** Fig. 8

SYNONYMY

Anodonta implicata Say, 1829
Anodonta newtonensis Lea, 1836
Anodonta housatonica Linsley, 1845
Anodonta (*Pyganodon*) *implicata* Say, 1829

SHELL DESCRIPTION. Shell elongate-elliptical to elongate-ovate, valves quite inflated, subcylindrical. Valves thick for *Anodonta*, ventral and dorsal margins straight, posterior ridge rounded and biangulate, umbos somewhat swollen and located in the anterior third of the shell, beak sculpture is 5 to 7 double looped bars, periostracum smooth, yellowish brown, greenish brown, reddish brown to black with age. Immature specimens have fine rays. No teeth, beak cavity shallow, shell distinctly thickens along the anterior ventral margin below the pallial line, nacre color pale copper, pinkish, or white.

DISTRIBUTION. Connecticut, Delaware, Massachusetts, Maryland, Maine, North Carolina, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, South Carolina, Virginia, Vermont, Canada: New Brunswick, Nova Scotia, Quebec.

ECOLOGY. Ortmann (1919:162) reported the ecology of this species as: "Generally it is reported as living in ponds, but sometimes also in rivers."

In Maryland, it is found almost exclusively in tidally influenced freshwater water or in close proximity, where blockages do not impede host fish migrations. Also found in mainland impoundments where stocking of host fish likely introduced mussels.

BREEDING SEASON. Ortmann (1919:160) reported the breeding season as September to May, a bradytictic species.



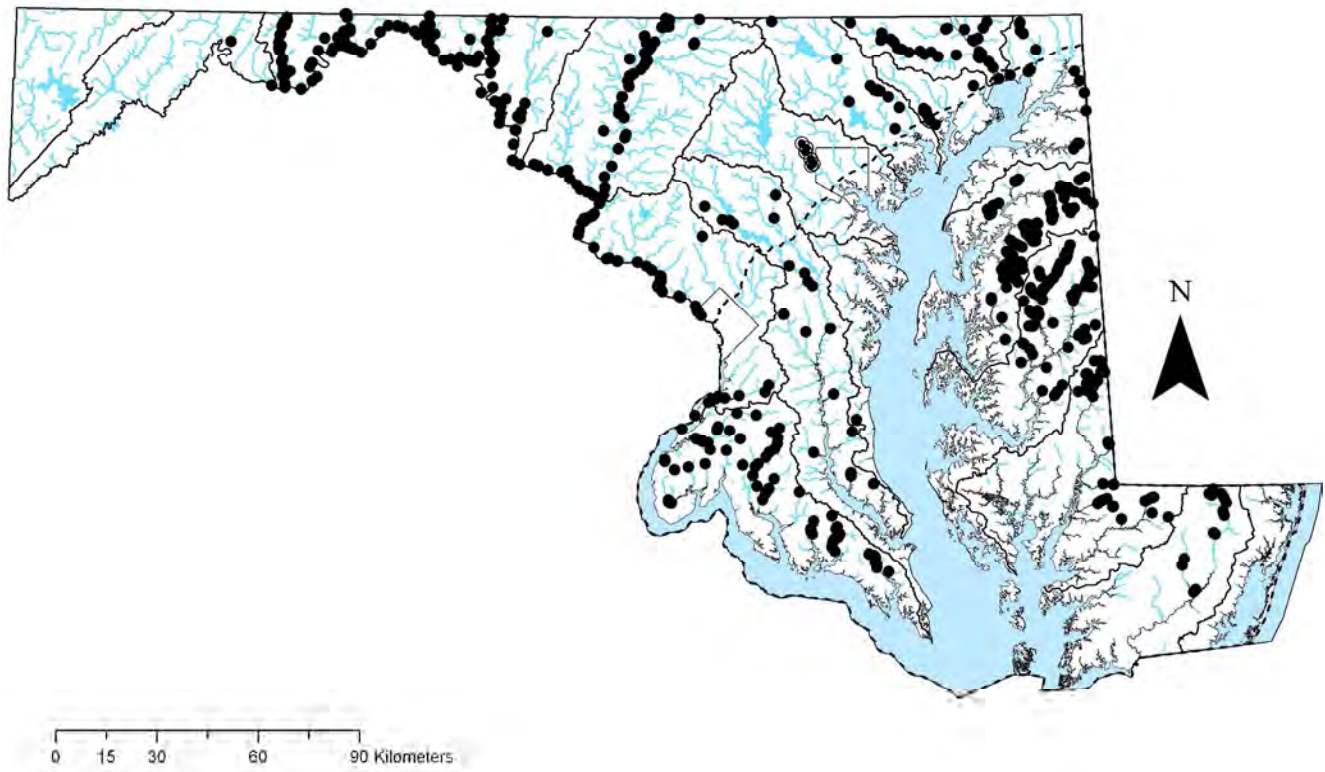
HOST FISH. Alewife, *Alosa pseudoharengus*; Pumpkinseed, *Lepomis gibbosus*; White perch, *Morone americana*; White sucker, *Catostomus commersoni*, Three-spined stickleback, *Gasterosteus aculeatus*, and Blueback herring, *Alosa aestivalis*.

STATUS. Currently stable, Watch list.

***Elliptio complanata* (Lightfoot, 1786) eastern elliptio**

SYNONYMY

- Mya complanata* Lightfoot, 1786
Unio violaceus Spengler, 1793
Unio purpureus Say, 1817
Unio rarisulcata Lamarck, 1819
Unio coarctata Lamarck, 1819
Unio purpurascens Lamarck, 1819
Unio rhombula Lamarck, 1819
Unio carinifera Lamarck, 1819
Unio georgina Lamarck, 1819
Unio glabrata Lamarck, 1819
Unio sulcidens Lamarck, 1819
Unio virginiana Lamarck, 1819
Unio aurata Rafinesque, 1820
Unio fluviatilis Green, 1827
Mya rigida Wood, 1828
Unio griffithianus Lea, 1834
Unio complanatus subinflatus Conrad, 1835
Unio jejunus Lea, 1838
Unio fuliginosus Lea, 1845
Unio cuvierianus Lea, 1852
Unio errans Lea, 1856 good species????
Unio vicinus Lea, 1856
Unio geminus Lea, 1856
Unio abbevilensis Lea, 1857
Unio percoarctatus Lea, 1857
Unio wheatleyi Lea, 1857
Unio catawbensis Lea, 1861
Unio insulsus Lea, 1857
Unio spadiceus Lea, 1857
Unio macer Lea, 1857
Unio contractus Lea, 1857
Unio virens Lea, 1857
Unio savannahensis Lea, 1857
Unio subflavuslea, 1857
Unio fumatus Lea, 1857
Unio subniger Lea, 1857
Unio neusensis Lea, 1857
Unio purus Lea, 1858
Unio exactus Lea, 1858
Unio pastellii Lea, 1858
Unio roswellensis Lea, 1859
Unio burkensis Lea, 1859
Unio hallenbeckii Lea, 1859
Unio baldwinensis Lea, 1859
Unio salebrosus Lea, 1859
Unio raeensis Lea, 1859
Unio latus Lea, 1859
Unio quadratus Lea, 1859
Unio squameus Lea, 1861
Unio rostrum Lea, 1861
Unio northamptonensis Lea, 1861
Unio decumbens Lea, 1861
Unio raleighensis Lea, 1863
Unio aberrans Lea, 1863
Unio weldonensis Lea, 1863
Unio mecklenbergensis Lea, 1863
Unio chathamensis Lea, 1863
Unio gastonensis Lea, 1863
Unio quadrilaterus Lea, 1863
Unio indefinilus Lea, 1863
Unio indefinitus Lea, 1866
Unio mediocris Lea, 1863
Unio perlucens Lea, 1863
Unio curatus Lea, 1863
Unio protensus Lea, 1865
Unio lazarus Sowerby, 1868 in Reeve.
Unio beaverensis Lea, 1868
Unio nubilus Lea, 1868
Unio datus Lea, 1868
Unio humerosus Lea, 1868
Unio uharensis Lea, 1868
Unio tortuosus Sowerby, 1868
Unio santeensis Lea, 1871
Unio yadkinensis Lea, 1872
Unio amplus Lea, 1872
Unio ligatus Lea, 1872
Unio differtus Lea, 1872
Unio subparallelus Lea, 1872
Unio oblongus Lea, 1872
Unio curvatus Lea, 1872
Unio irwinensis Lea, 1872
Unio subsquamosus Lea, 1872
Unio infuscus Lea, 1872
Unio ratus Lea, 1872
Unio basalis Lea, 1872
Unio dissimilis Lea, 1872
Unio cirratus Lea, 1874
Unio subolivaceus Lea, 1874
Unio infulgens Lea, 1874
Unio corneus Lea, 1874
Unio dooleyensis Lea, 1874
Unio gesnerii Lea, 1874
Unio invenustus Lea, 1874
Unio (Arconaia) provancheriana Pilsbry, 1890
Unio palliatus 'Ravenel' Simpson, 1900
Unio pullatus majusculus De Gregorio, 1914
Unio complanatus mainensis Rich, 1915
Elliptio (Elliptio) complanata (Lightfoot, 1786)



Map 7. Distribution of *Elliptio complanata* (Lightfoot, 1786) in Maryland.

Elliptio complanata (Lightfoot, 1786) **eastern elliptio** Fig. 9

SHELL DESCRIPTION. Shell outline long, trapezoidal, to rhomboid or subelliptical, shell compressed to inflated and thin to solid. Displays considerable clinal variation. Dorsal and ventral margins roughly parallel and often straight, posterior side broad, double and rounded to angular, beaks low and uninflated, periostracum brownish or yellowish green becoming almost black with age often with green rays over the entire shell. Lateral teeth straight, beak cavity very shallow, nacre usually purple but white to light orange or salmon occur.

DISTRIBUTION. Alabama, Connecticut, Delaware, Florida, Georgia, Massachusetts, Maryland, Maine, Michigan, Minnesota, North Carolina, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Virginia, Vermont, Wisconsin, West Virginia, Canada: New Brunswick, Nova Scotia, Ontario, Quebec.

ECOLOGY. Ortmann (1919:109) record the ecology as: "it apparently has no ecological preferences, being found practically in any permanent body of water as well as in large rivers with strong current and have gravel and rocks. In the small creeks it goes very far into the headwaters."

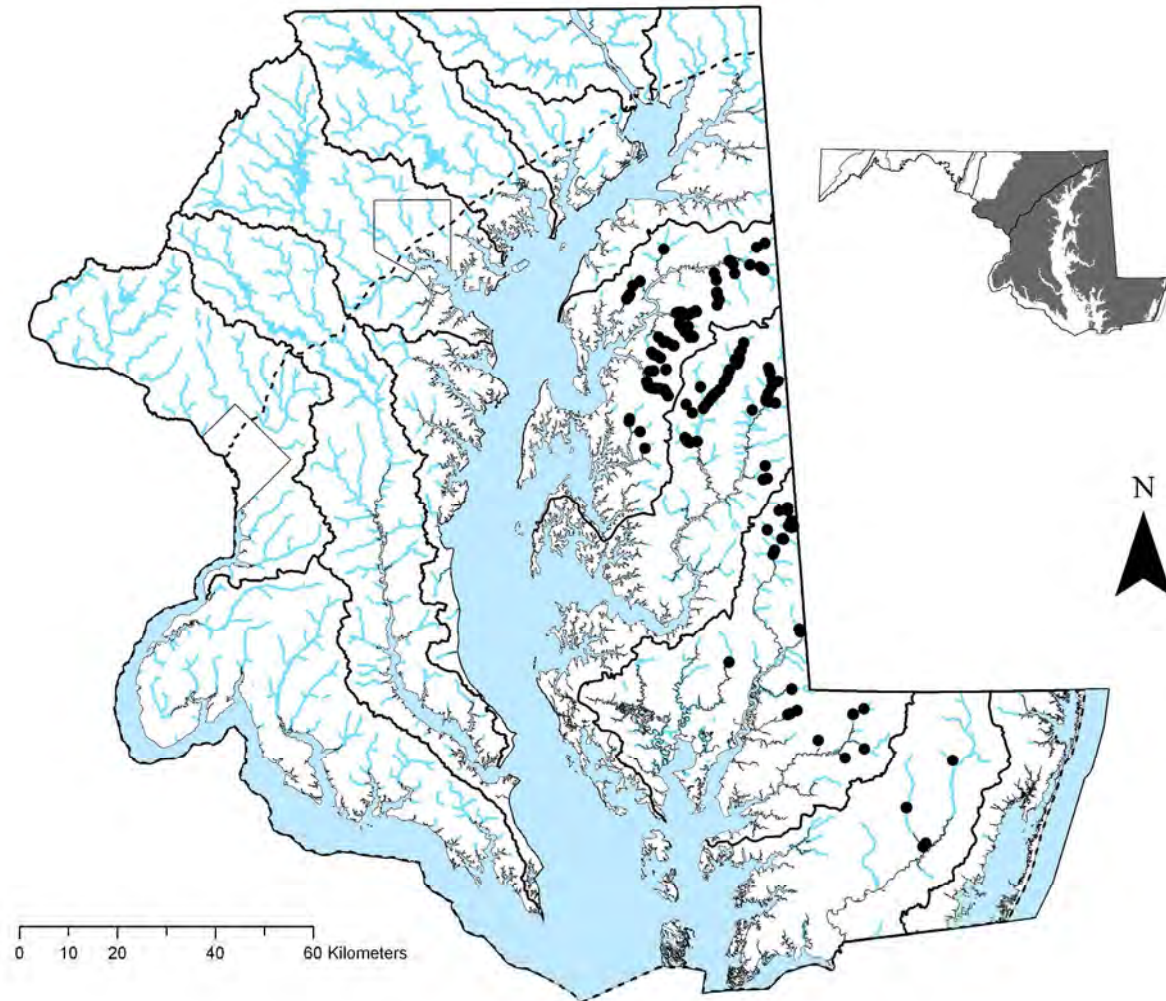
In Maryland, Ortmann's description holds true. It can be found in tidal rivers, coastal headwater streams, mill ponds, and rivers and streams of varying size throughout much of the state. They are generally absent from urban areas of the Baltimore-Washington D.C. corridor, acidic streams of the lower Delmarva, and watersheds of far western Maryland due to zoogeographic and anthropogenic constraints.

ECOLOGY. Ortmann (1919:104) reported gravid females from April to mid-July with glochidia present in early June and as late as August, a tachytictic species.



HOST FISH. Alewife, *Alosa pseudoharengus*; American eel, *Anguilla rostrata*; Banded killifish, *Fundulus diaphanous*; Green sunfish, *Lepomis cyanellus*; Largemouth bass, *Micropterus salmoides*; Pumpkinseed, *Lepomis gibbosus*; Orangespotted sunfish, *Lepomis humilis*; Redbreast sunfish, *Lepomis auritus*; Smallmouth bass, *Micropterus dolomieu*; White crappie, *Pomoxis annularis*; White perch, *Morone americana*; Yellow perch, *Perca flavascens*.

STATUS. Stable, Secure.



Map 8. Distribution map of *Elliptio fisheriana* (Lea, 1838) in Maryland.

Elliptio fisheriana (Lea, 1838) **northern lance** Fig. 10

SYNONYMY

Unio fisherianus Lea, 1838
Margarita (Unio) fisherianus (Lea, 1838)
Margarita (Unio) fisherianus (Lea, 1838)
Elliptio fisherianus (Lea, 1838)



SHELL DESCRIPTION. Elongate (rarely exceeding 100 mm), compressed, thin, beaks low, posterior ridge subangular to angular, posterior end bluntly rounded, ventral margin broadly curved, anterior end rounded, periostracum olive, green to brown and black with age, often with faint rays, beak cavity very shallow, nacre white to purplish, posteriorly iridescent.

DISTRIBUTION. Delaware, Maryland, North Carolina, Pennsylvania, South Carolina West Virginia, Virginia.

ECOLOGY. Johnson (1970:335) lists the ecology of *Elliptio lanceolata* sensu lato as "Lives on sandy bottoms, often found crawling about with much of the shell out of the sand, also found among rocks and in mud where the current is not too swift."

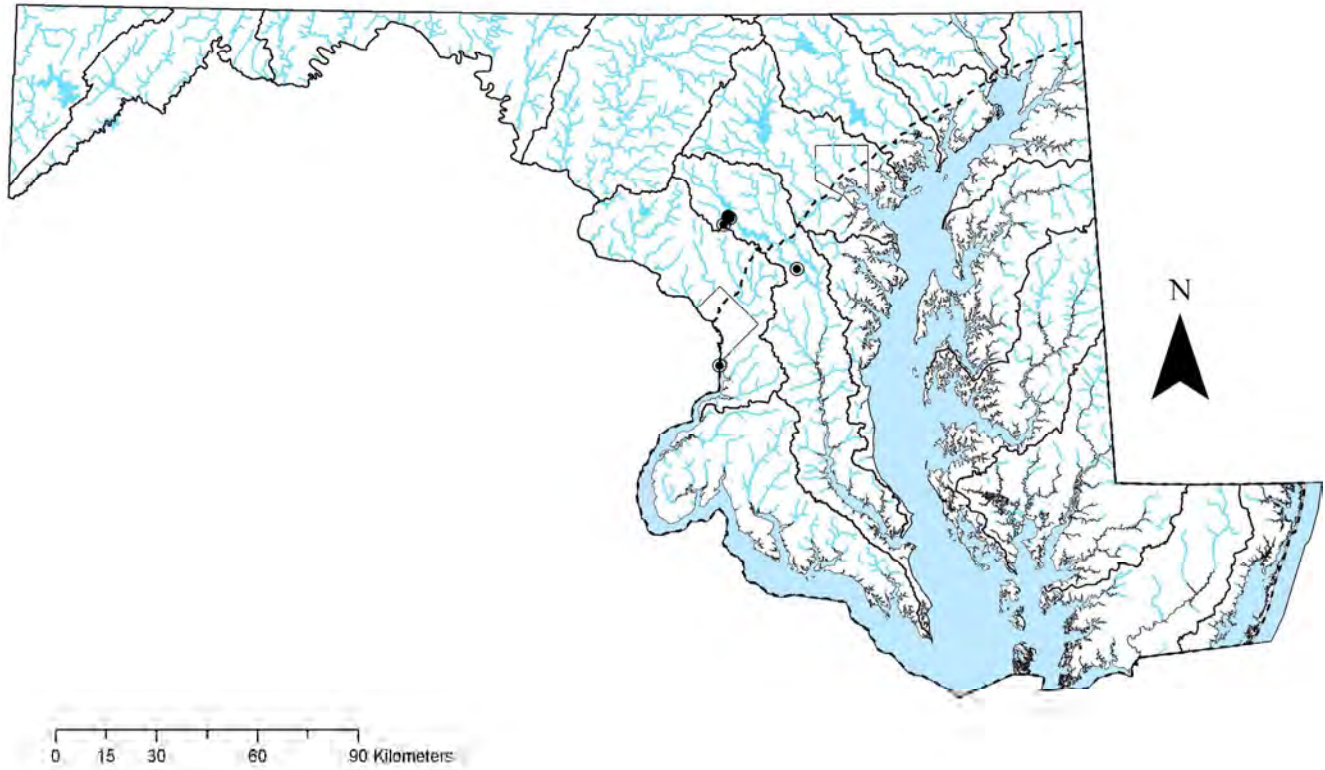
In Maryland, often found in mud or clay of runs and pools near the stream bank, occasionally found buried in the slope of the bank. Typically, they are the second most abundant mussel of coastal streams.

BREEDING SEASON. a tachytictic species O'DEE and WATTERS.

HOST FISH. Bluegill, *Lepomis macrochirus*; Green sunfish, *Lepomis cyanellus*; Johnny darter, *Etheostoma nigrum*; Largemouth bass, *Micropterus salmoides*; and White shiner, *Luxilus albeolus*.

STATUS. Special concern, Watch list

COMMENTS. The type locality of this species is "head of the Chester River [Kent Co.] Maryland (Johnson 1970:333)", presumably in reference to the head of tide. Taxonomic relationships among dark lanceolate *Elliptio* spp. are not well understood and names have been used seemingly interchangeably.



Map 9. Distribution map of *Elliptio lanceolata* (Lea, 1828) in Maryland

Elliptio lanceolata (Lea, 1828) **yellow lance** Fig. 11

SYNONYMY

Unio lanceolatus Lea, 1828
Unio duttonianus Lea, 1841
Unio sagittiformis Lea, 1852
Unio rostraeformis Lea, 1856
Unio rostriformis Lea, 1856
Unio emmonsii Lea, 1857
Unio naviculoides Lea, 1857
Unio hazlehurstianus Lea, 1858
Unio viridulus Lea, 1863
Unio haslehurstianus Sowerby, 1866
Margaron (Unio) hazlehurstianus Lea, 1859
Margaron (Unio) sagittaeformis Lea, 1870
Unio rostreformis de Gregorio, 1914
Unio arctior var. *fisheropsis* de Gregorio, 1914
Elliptio lanceolata (Lea, 1828)

SHELL DESCRIPTION. Elongate (rarely exceeding 100 mm), compressed, thin, beaks low, posterior ridge subangular to angular, posterior end bluntly rounded, ventral margin broadly curved, anterior end rounded, periostracum waxy, yellow, often with distinct growth lines, rayless, beak cavity very shallow, nacre white to purplish, posteriorly iridescent.

DISTRIBUTION. Maryland, North Carolina, South Carolina, Virginia.

ECOLOGY. Johnson (1970:335) lists the ecology of *Elliptio lanceolata* sensu lato as "Lives on sandy bottoms, often found crawling about with much of the shell out of the sand, also found among rocks and in mud where the current is not too swift."

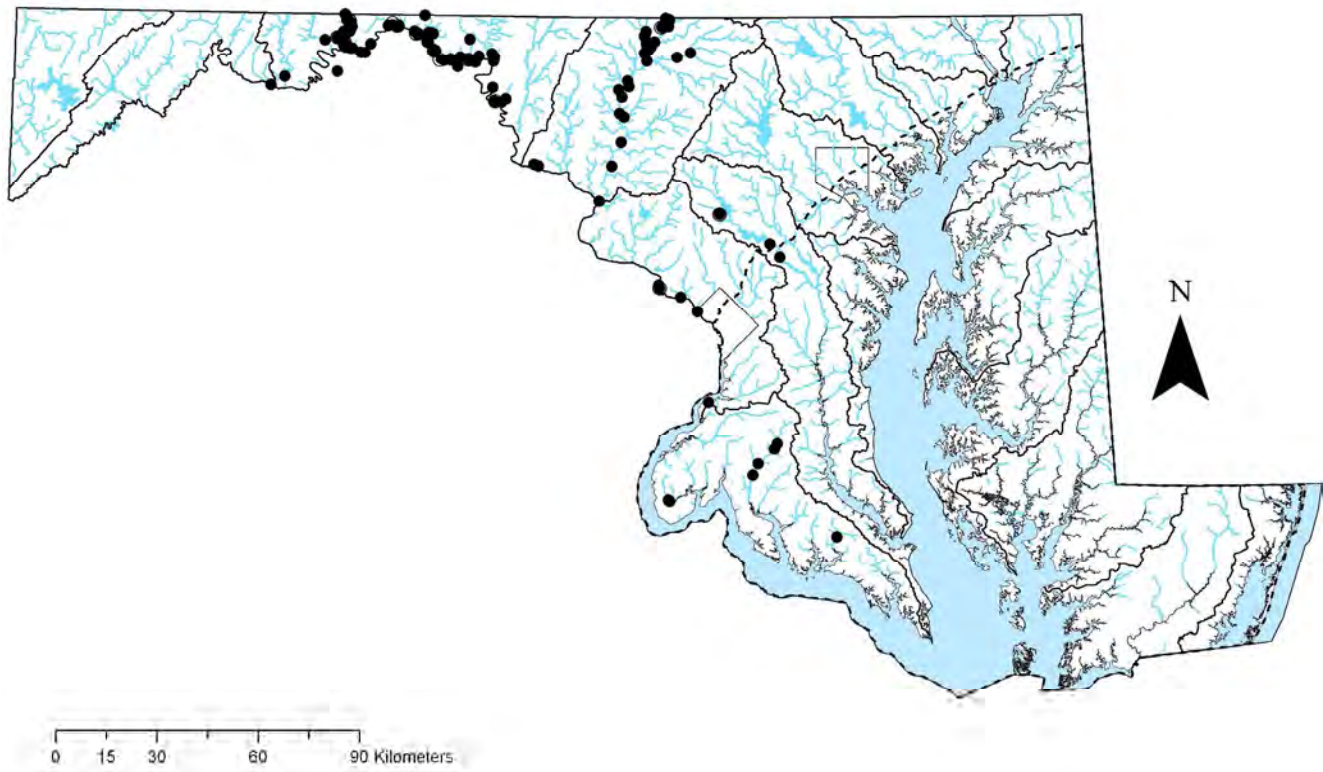
BREEDING SEASON. Ortmann (1919: 111) reported gravid females (presumably a dark lanceolate *Elliptio*) on May 6, June 3-8, 1912, in the Potomac and James River. Presumably a tachytictic species.

HOST FISH. unknown

STATUS. Endangered, Unknown



COMMENTS. It is uncertain where this species occurred in Maryland due to a lack of verified voucher specimens. Taxonomic uncertainty and multiple synonyms have further clouded the issue. Recent examination of voucher shells at USNM and NCSM has confirmed the existence of a historic and extant Paxulent population. It is likely that a population historically existed in the upper reaches of the tidal-freshwater Potomac River, although shells exhibit characteristics of *E. fisheriana* and *E. lanceolata*.



Map 10. Distribution map of *Elliptio producta* (Conrad, 1836) in Maryland

Elliptio producta (Conrad, 1836) **Atlantic spike** Fig. 12

SYNONYMY.

Unio productus Conrad 1836
Unio nasutus Conrad 1838
Unio barrotti Küester 1861
Unio nasutidus Lea 1863
Unio nasutululus Lea 1863
Unio nasutilus Simpson 1900
Elliptio producta Conrad 1836



SHELL DESCRIPTION. Elongate (rarely exceeding 100 mm), compressed, thin, beaks low, posterior ridge subangular to angular, posterior end bluntly rounded at or above midline of the shell, ventral margin broadly curved, anterior end rounded, periostracum olive, green to brown and black with age, often with faint rays, fine uneven growth lines often with stippling towards the ventral margin, beak cavity very shallow, nacre purplish and posteriorly iridescent.

DISTRIBUTION. Georgia, Maryland, North Carolina, Pennsylvania, South Carolina, Virginia.

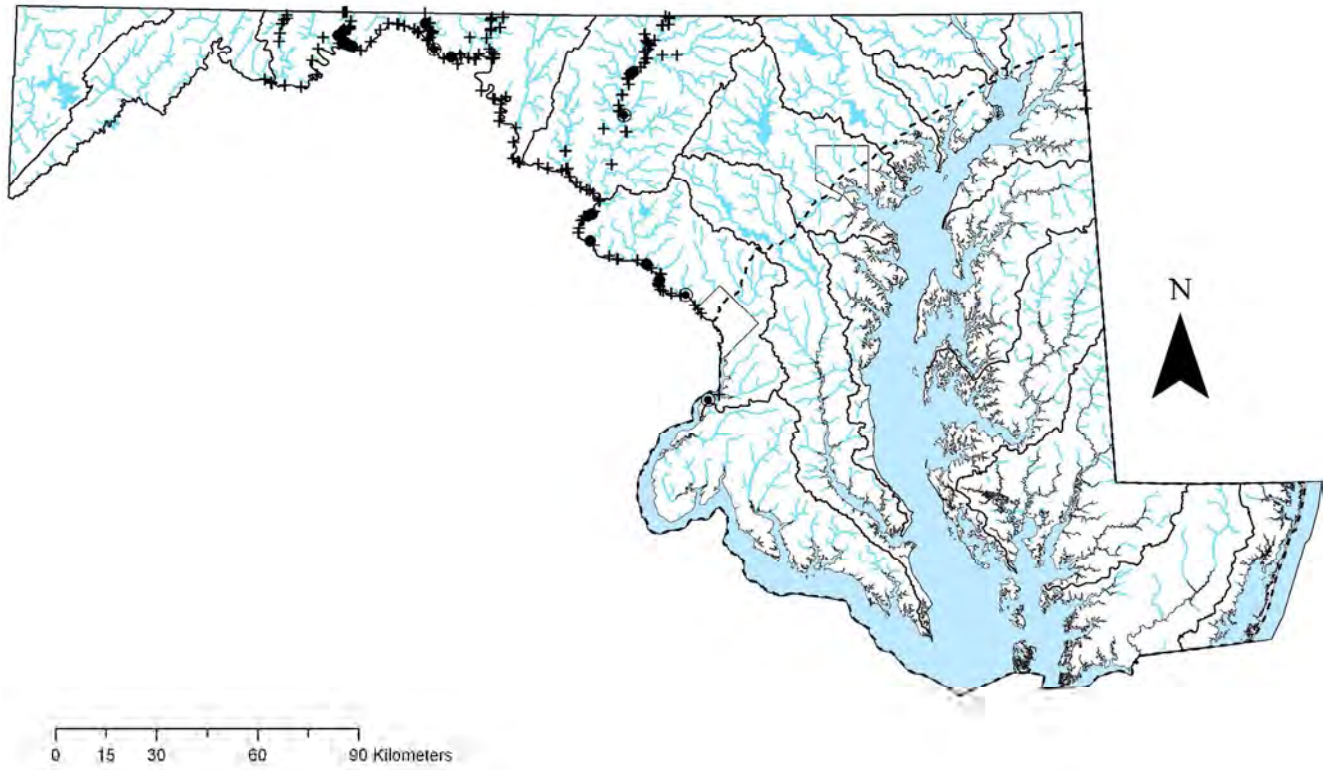
ECOLOGY. Likely similar to *E. fisheriana*.

BREEDING SEASON. Ortmann (1919: 111) reported gravid females (presumably a dark lanceolate *Elliptio*) on May 6, June 3-8, 1912, in the Potomac and James River. Presumably a tachytictic species.

HOST FISH. unknown

STATUS. Special concern, In need of conservation

COMMENTS. Taxonomic relationships among dark lanceolate *Elliptio* spp. are not well understood. Type locality has been reported to be the Potomac River, Washington D.C.



Map 11. Distribution of *Lampsilis cardium* Rafinesque, 1820 in Maryland. *Lampsilis* sp. records displayed as plus (+) symbols.

Lampsilis cardium (Rafinesque, 1820) **plain pocketbook** Fig. 13

SYNONYMY

Lampsilis cardium Rafinesque, 1820
Unio ventricosus Barnes, 1823
Unio occidens Call, 1887
Lampsilis ventricosus (Barnes, 1823)
Lampsilis ovata ventricosa (Barnes, 1823)
Unio occidens Lea, 1829
Unio subovatus Lea, 1831
Unio lenis Conrad, 1838
Unio canadensis Lea, 1857
Unio latissimus Sowerby, 1868
Lampsilis ventricosa var. *lurida* Simpson, 1914
Lampsilis ventricosa cohongoronta Ortmann, 1912
Lampsilis ventricosa winnebagoensis Baker, 1928
Lampsilis ventricosa pergloboas Baker, 1928
Lampsilis ovata ventricosa (Barnes, 1823)



SHELL DESCRIPTION. Shell globose, elliptical, ventral margin evenly rounded, shell relatively thin but stout, moderately inflated, posterior ridge not prominent and rounded, sexually dimorphic. Female shells more rectangular and inflated posteriorly. Periostracum yellowish to tan becoming darker with age. Broad to narrow rays usually cover the shell, although some shells may not have rays. Pseudo cardinal teeth compressed, lateral teeth short, interdentum narrow, beak cavity wide and deep, nacre white.

DISTRIBUTION. Alabama, Arkansas, Iowa, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Missouri, Mississippi, Ohio, Oklahoma, Tennessee, Texas, West Virginia, Wisconsin.

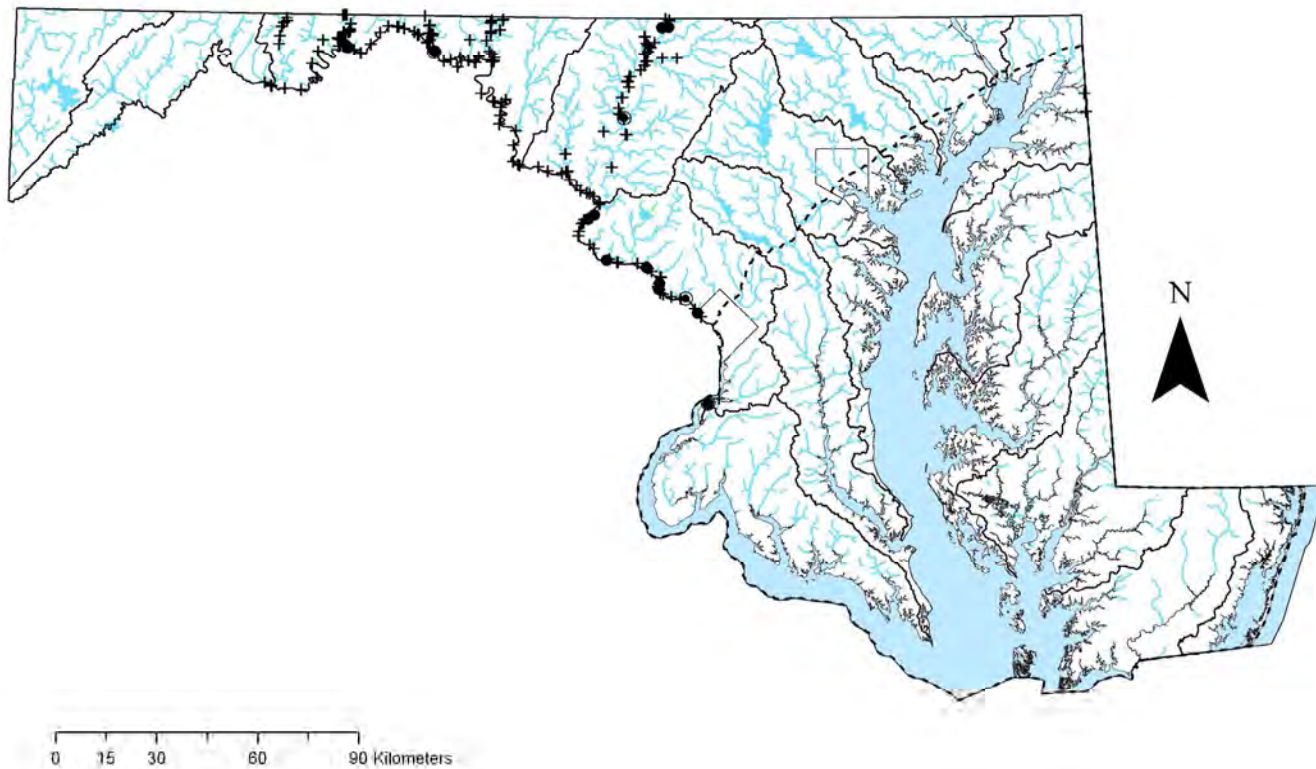
ECOLOGY. Ortmann (1919:306) listed the ecology of this species as favoring "rather quiet pools and eddies above and below riffles. Open pools in riffles, in Dianthera-patches, with moderate current, and a bottom of fine gravel covered with a thin layer of mud...occasional this form is found in pure sand and rather deep.

In Maryland, the species occupies runs and pools with predominately gravel, sand substrates in most portions of the Potomac River and its major tributaries. Often found downstream of bedrock ridges in patches of depositional substrates.

HOST FISH. Bluegill, *Lepomis macrochirus*; Largemouth bass, *Micropterus salmoides*; Smallmouth bass, *Micropterus dolomieu*; White crappie, *Pomoxis annularis*; Sauger, *Stizostedion canadense*, Walleye, *Stizostedion vitreum*; Yellow perch, *Perca flavescens*.

STATUS. Special concern, Stable (non-native)

COMMENTS: The figured specimen is the lectotype of *Lampsilis ventricosa cohongoronta* Ortmann, 1912, CMNH 61.3994. The type locality of this subspecies is the Potomac River at Hancock, Washington County, Maryland. Introduced into the Potomac River basin.



Map 12. Distribution of *Lampsilis cariosa* (Say, 1817) in Maryland. *Lampsilis* sp. records displayed as plus (+) symbols.

Lampsilis cariosa (Say, 1817) **yellow lampmussel** Fig. 14

SYNONYMY

Unio cariosus Say, 1817
Margarita (Unio) cariosus (Say, 1817)
Margaron (Unio) cariosus (Say, 1817)
Lampsilis pallida Rafinesque, 1820
Unio ovata Valenciennes, 1827 PREOCCUPIED
Unio viridis Ferussac, 1835
Unio crocatus Lea, 1841
Unio oratus Conrad, 1849
Lampsilis cariosa (Say, 1817)
Lampsilis (Lampsilis) cariosa (Say, 1817)



SHELL DESCRIPTION: Shell medium size, dimorphic. Male shell elliptical and somewhat elongate, female shells subobovate to obovate, moderately inflated, thick, anterior margin rounded, ventral margin slightly curved, dorsal margin straight, posterior ridge rounded, umbos swollen, and raised just above the hinge line and located enterer of the midline of the shell. Periostracum shiny, waxy or straw yellow, becoming darker brownish yellow, green or black rays when present are usually restricted to the posterior slope. Pseudocardinal teeth compressed beak cavity moderately deep, nacre color white or tinged with salmon

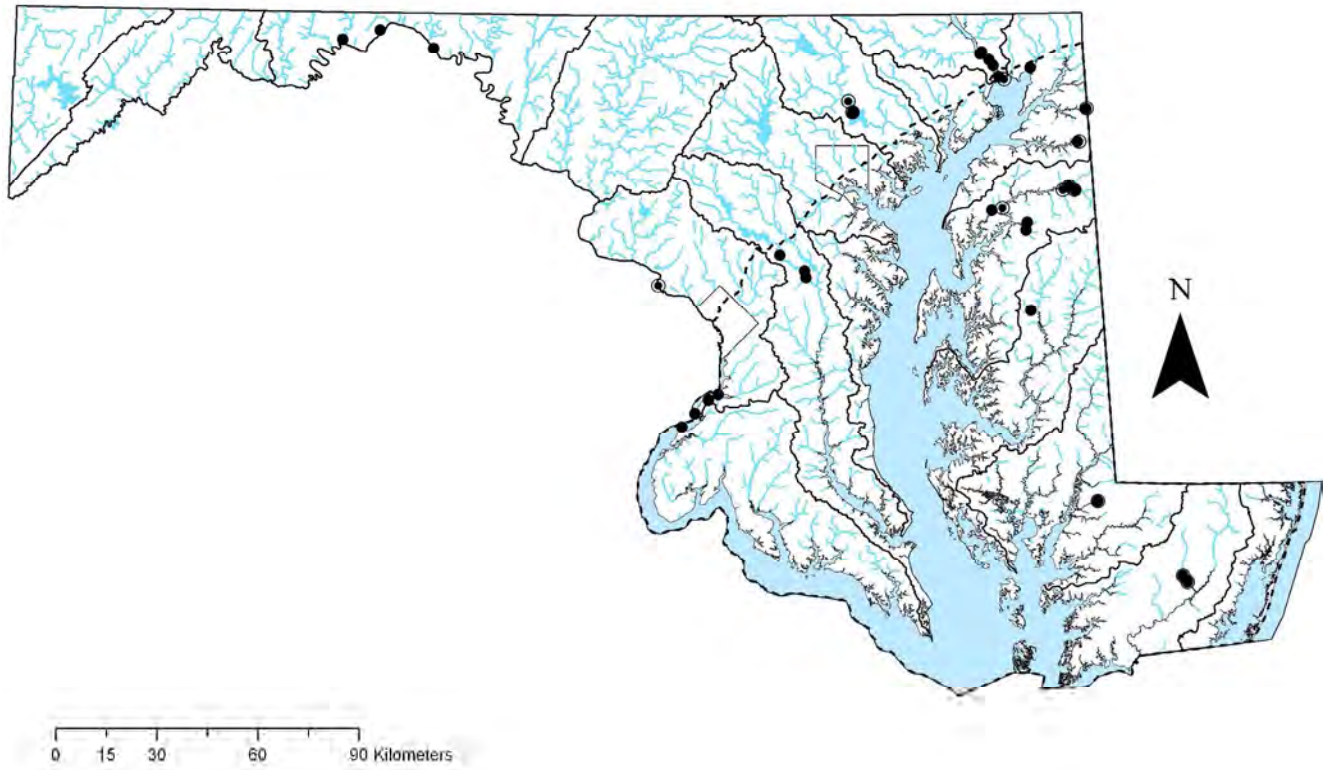
DISTRIBUTION: Connecticut, Delaware, Georgia, Massachusetts, Maine, Maryland, North Carolina, New Jersey, New York, Pennsylvania, South Carolina, Virginia, New Brunswick, Nova Scotia Canada.

ECOLOGY: Ortmann (1919:317) reported "Where found this species is generally abundant, even in smaller streams...It is always found in lively currents, on shoals and riffles, in finer or coarser gravel, and often in bars of pure sand."

HOST FISH. Banded killifish, *Fundulus diaphanous*; Chain pickerel, *Esox niger*; Largemouth bass, *Micropterus salmoides*; Smallmouth bass, *Micropterus dolomieu*; White bass, *Morone americana*; White sucker, *Catostomus commersoni*; Yellow perch, *Perca flavescens*.

STATUS: Threatened, Unknown.

COMMENTS: Previously listed as extirpated in Maryland, but current status is unknown due to taxonomic confusion obscuring the certainty of historic and recent collection records.



Map 13. Distribution of *Lampsilis radiata* (Gmelin, 1791) in Maryland.

Lampsilis radiata (Gmelin, 1791) eastern lampmussel Fig. 15

SYNONYMY

Mya radiata Gmelin, 1791
Unio luteola Lamarck, 1819
Unio lineata 'Valenciennes' Bory de St. Vincent, 1827
Unio tenebrosus Conrad, 1834
Unio melinus Conrad, 1838
Unio boydianus Lea, 1840
Unio rosaceus De Kay, 1843
Mya oblongata Wood, 1856
Unio elongata S.G. Goodrich, 1858
Unio obliquiradiatus Reeve, 1865
Unio conspicuus Lea, 1872
Unio virginiana Simpson, 1900
Lampsilis radiata (Gmelin, 1791)
Lampsilis radiata oneidensis Baker, 1916
Unio virginea Frierson, 1927
Lampsilis radiata radiata (Gmelin, 1791)
Lampsilis radiata var. *conspicua* (Lea, 1872)
Lampsilis (*Lampsilis*) *radiata radiata* (Gmelin, 1791)

SHELL DESCRIPTION. Shell medium to large, subelliptical or subovate in outline, moderately elongate, valves from not inflated to quite inflated, anterior end rounded, posterior end in females broadly expanded and rounded, dorsal margin straight and ventral margin straight to gently curved, posterior ridge mostly absent, posterior slope broad, beaks rather sharp but not very inflated. Periostracum yellowish or brownish green with dark green rays over the entire surface, no interdentum, beak cavity shallow, nacre white, may be tinged pink or salmon.

DISTRIBUTION. Connecticut, Delaware, Massachusetts, Maryland, Maine, Michigan, North Carolina, Vermont, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Virginia, West Virginia, New Brunswick, Nova Scotia, Ontario, Quebec Canada.

ECOLOGY. Ortmann (1919:317) recorded this species "Where found, this species is generally abundant, even in smaller streams...It is always found in lively current on shoals and riffle, in finer or coarser gravel and very often in bars of pure sand."

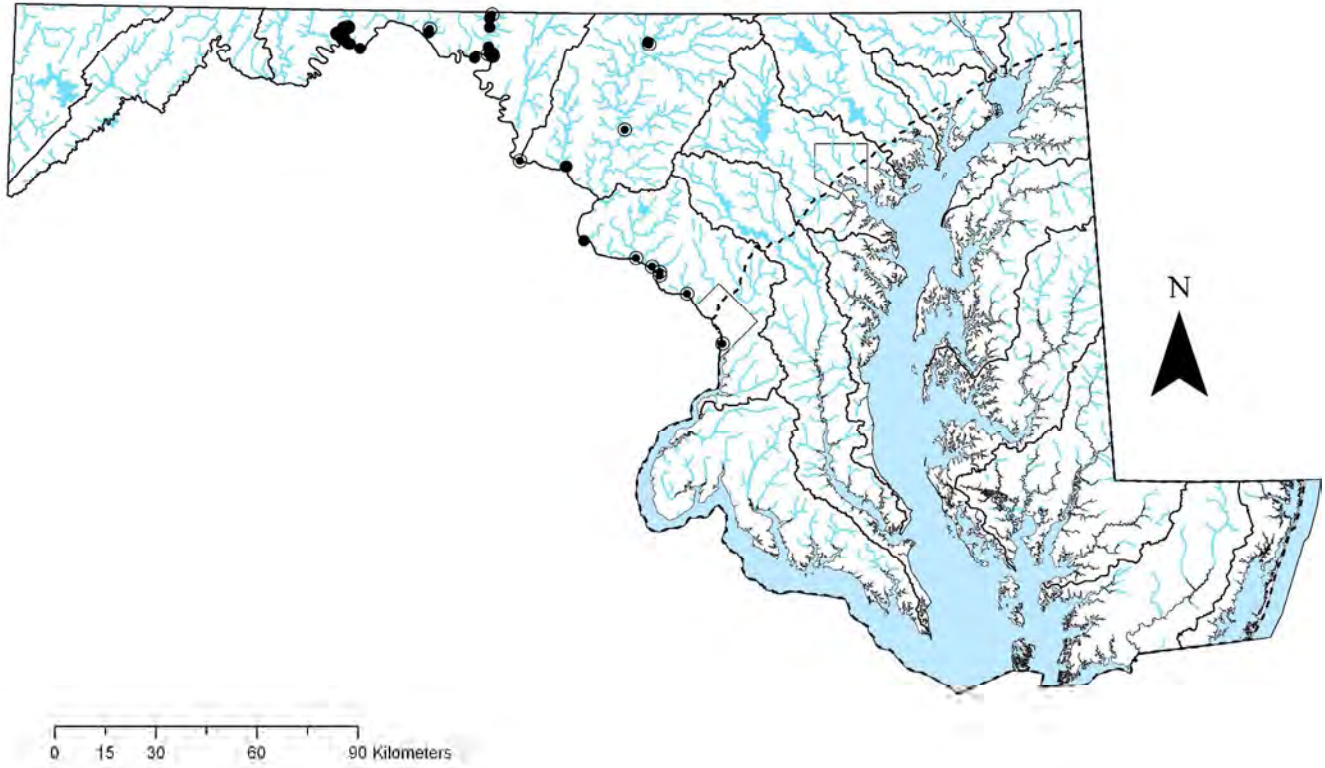


In Maryland, this species is almost entirely restricted to and in greatest abundance in tidal-freshwater where it can be found in sand and gravel often near shorelines where substrate is regularly cleaned from tidal fluctuation and waves. They can be also found in ponds and reservoirs, where stocking of host fish likely introduced mussels.

BREEDING SEASON. Ortmann (1919:293) reported gravid females in late August.

HOST FISH. Banded killifish, *Fundulus diaphanous*; Black crappie, *Pomoxis nigromaculatus*; Largemouth bass, *Micropterus salmoides*; Rock bass, *Ambloplites rupestris*; Pumpkinseed, *Lepomis gibbosus*; Smallmouth bass, *Micropterus dolomieu*; White perch, *Morone americana*; Yellow perch, *Perca flavescens*.

STATUS: Currently stable, Unknown.



Map 14. Distribution of *Lasmigona subviridis* (Conrad, 1835) in Maryland

Lasmigona subviridis (Conrad, 1835) **green floater** Fig. 16

SYNONYMY

Unio subviridis Conrad, 1835
Unio tappanianus Lea, 1838
Unio hyalinus Lea, 1845
Margaritana quadrata Lea, 1861
Unio pertenus Lea, 1863
Lasmigona (Platynaias) subviridis (Conrad, 1835)



SHELL DESCRIPTION. Shell ovate trapezoid, thin and rather fragile, beaks only projecting slightly above the hinge line, posterior ridge rounded, periostracum green, light yellow or brown with numerous green rays especially in juveniles. Pseudocardinal and lateral teeth small and delicate, interdental tooth present, beak cavity shallow, nacre whitish to blush and iridescent posteriorly.

DISTRIBUTION. Georgia, Kentucky, Maryland, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, Tennessee, Virginia, West Virginia.

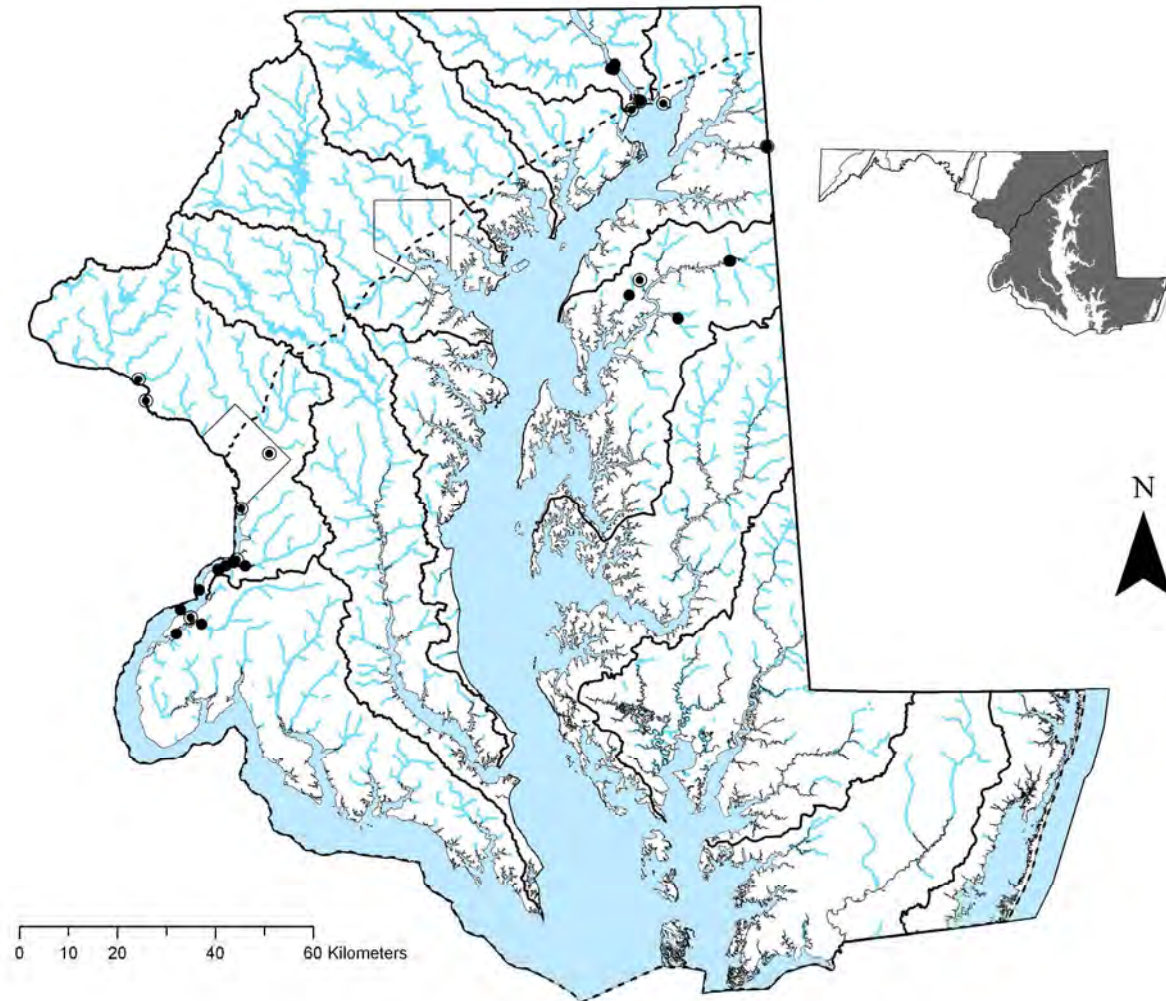
ECOLOGY. Ortmann (1919:124) listed the ecology of the species: "this species is very erratic in its distribution...The specimens found by myself in larger river generally were few, and often in small branches of the river. But even in small streams, it is not everywhere present...it is averse to very strong current, and prefers more quiet parts, pools or eddies, with gravelly and sandy bottoms, and it also goes into canals."

In Maryland, it is restricted to pools and slow runs of larger streams and rivers where they can be sporadically found in fine substrates.

BREEDING SEASON. Ortmann (1919:122) reported gravid females from August to September and April to June, a bradytictic species. They are unique among unionids in that they seemingly do not require a host fish. Fully transformed juveniles were found in females during April in Sideling Hill Creek (Barfield & Watters 1998, Lellis & King 1998).

HOST FISH: not required

STATUS: Threatened, Endangered



Map 15. Distribution of *Leptodea ochracea* (Say, 1817) in Maryland.

Leptodea ochracea (Say, 1817) **tidewater mucket** Fig. 17

SYNONYMY

Mytilus fluviatilis Gmelin 1791 (Nomen dubium)
Unio ochraceus Say, 1817
Lampsilis rosea Rafinesque, 1820
Unio rosaceus Conrad, 1849
Lampsilis ochracea (Say, 1817)
Lampsilis (Lampsilis) ochracea (Say, 1817)
Leptodea ochracea (Say, 1817)

SHELL DESCRIPTION. Shell relatively small, male shell elliptical and female more ovate, shell subinflated and thin, anterior end rounded, posterior margin evenly rounded, somewhat pointed in males and truncated in females, posterior ridge rounded, often with a few ridges or wrinkles (inter-annuli). Beaks moderately swollen and raised above the hinge line, located near the midline of the shell. Periostracum slightly shiny, brownish olive, greenish-yellow, yellow or reddish, often with fine blue or green rays over most of the shell. Pseudocardinal teeth compressed, thin, lateral teeth short and curved, beak cavities shallow, nacre white or pinkish.

DISTRIBUTION. Connecticut, Delaware, Georgia, Massachusetts, Maryland, Maine, North Carolina, New Jersey, New York, Pennsylvania, Rhode Island, South Carolina, Virginia, New Brunswick, Nova Scotia Canada.

ECOLOGY. Ortmann (1919:320) noted this species was found in "most tide waters north of the Savannah River...It is a form of estuaries, ponds, canals, and ditches, probably with more or less muddy bottoms.

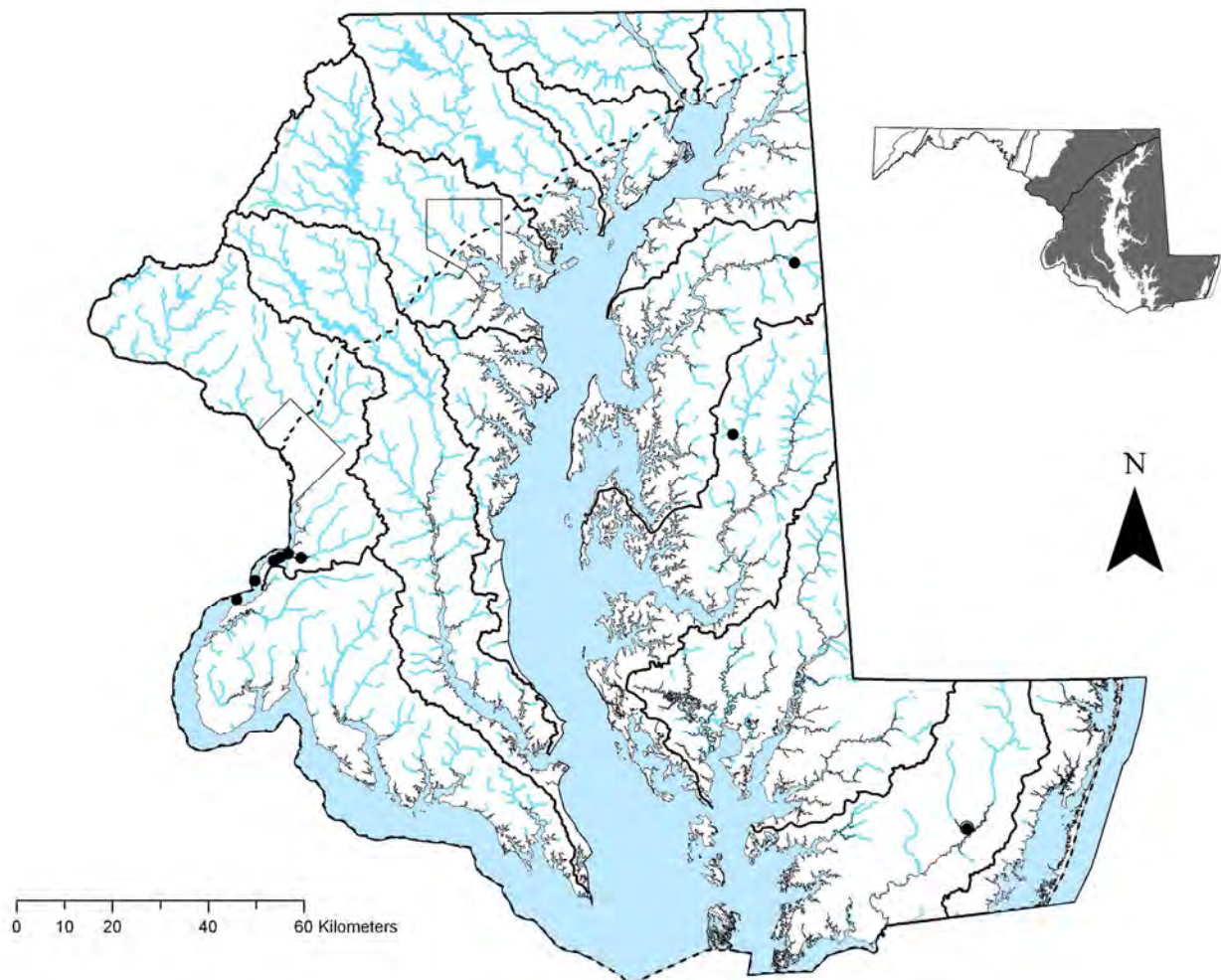
In Maryland, the species is restricted to tidal-freshwater or in close proximity. Substrates are sand, fine gravel, and mud. Shells often numerous yet live individuals rarely found.

BREEDING SEASON. Ortmann (1919:319) noted that Isaac Lea communicated this species was gravid October to November. There is a lack of information on the anatomy and biology of this species.



HOST FISH. Banded killifish, *Fundulus diaphanous*; White perch, *Morone americana*.

STATUS. Special concern, Rare.



Map 16 Distribution of *Ligumia nasuta* (Say, 1817) in Maryland.

Ligumia nasuta (Say, 1817) eastern pondmussel Fig. 18

SYNONYMY

Unio nasutus Say, 1817
Obliquaria attenuata Rafinesque, 1820
Unio rostrata Valenciennes, 1827
Unio vaughaniana Sowerby, 1868
Unio fisherianus Kuester, 1860 non Lea, 1838
Lampsilis nasuta (Say, 1817)
Eurynia nasuta (Say, 1817)
Ligumia nasuta (Say, 1817)



SHELL DESCRIPTION. Shell elongated, subelliptical, shell is over twice as long as high, rather thin, subinflated, posterior end bluntly pointed, dorsal margin straight, ventral margin curved, posterior ridge distinct, beaks low and located in anterior quarter of shell. Periostracum greenish-yellow to dark olive or brown sometimes with fine rays. Beak cavity shallow, lateral teeth long and straight, pseudocardinal teeth compressed, nacre white. Male shell tapers to a blunt point posteriorly, female shell is distinctly swollen posteriorly.

STATUS. Special concern, Rare.

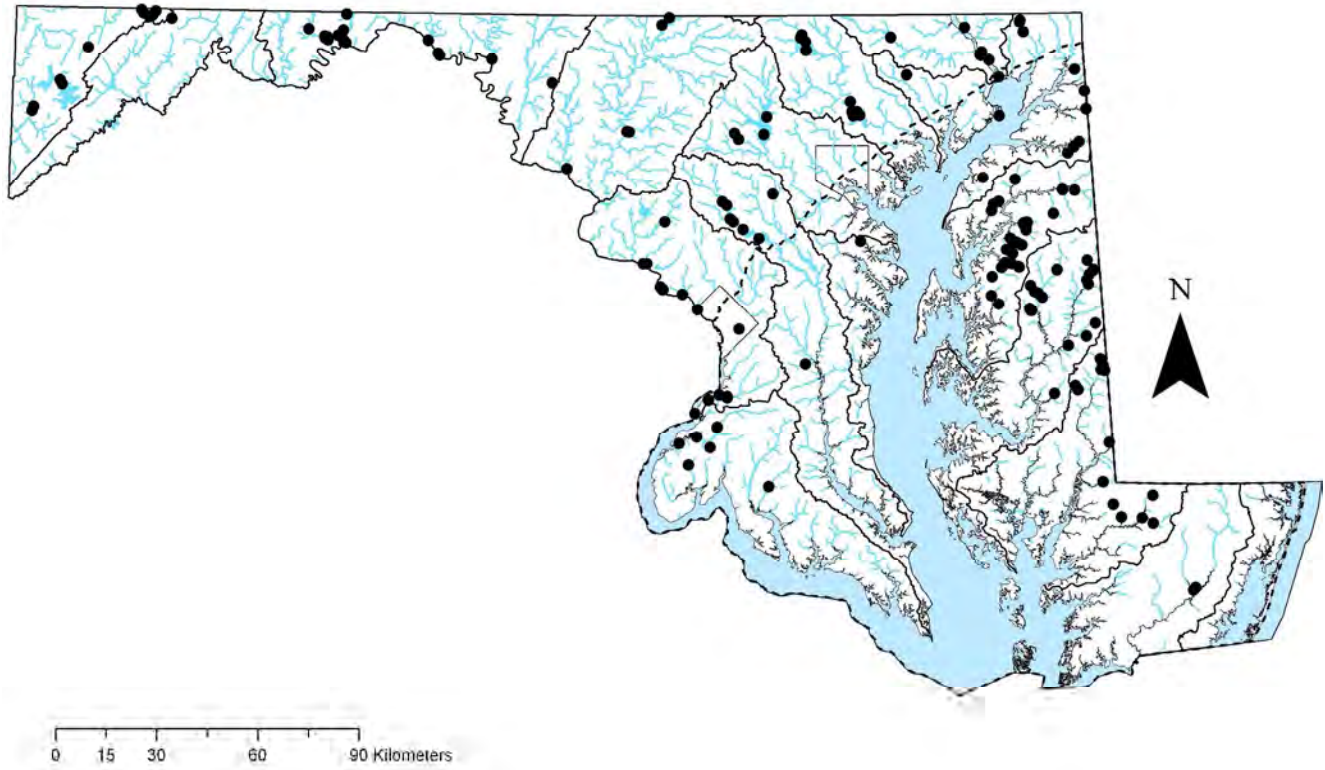
DISTRIBUTION. Connecticut, Delaware, Massachusetts, Maryland, Maine, Michigan, North Carolina, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Virginia, Ontario, Canada.

ECOLOGY. Ortmann (1919:275) recorded the ecology of this species as "Sandy bottom of great, quiet bodies of water (tidewaters, lakes and probably also canals) seem to furnish the conditions most favorable to this species."

In Maryland, restricted to tidal-freshwater.

BREEDING SEASON. Ortmann (1919) reported gravid females from eastern Pennsylvania from September and May. He noted gravid females from Lake Erie from August to early July, a bradytictic species.

HOST FISH. Yellow perch, *Perca flavescens*.



Map 17 Distribution of *Pyganodon cataracta* (Say, 1817) in Maryland.

Pyganodon cataracta (Say, 1817) eastern floater Fig. 19

SYNONYMY

Anodonta cataracta Say, 1817
Anodonta marginata Say, 1817
Anodonta teres Conrad, 1834
Anodon excurvata De Kay, 1843
Anodonta virgulata Lea, 1857
Anodonta lacustris Lea, 1857
Anodonta hallenbeckii Lea, 1858
Anodonta gesnerii Lea, 1858
Anodonta dariensis Lea, 1858
Anodonta williamsii Lea, 1862
Anodonta tryoni Lea, 1862
Anodonta dolearis Lea, 1863
Anodonta doliaris Lea, 1866
Anodonta (Pyganodon) cataracta cataracta Say, 1817

SHELL DESCRIPTION. Shell medium to large, outline subelliptical and elongate, shell inflation increases with age, shell thin, posterior margin pointed, ventral margin straight to slightly curved, posterior ridge indistinct, slope often with two faint ridges, beaks slightly swollen, located in the anterior third of shell. Periostracum usually smooth, shiny, straw yellow to light green to dark green, rays on posterior slope darker than rays on disk of shell. No teeth are present, muscle scars poorly defined, nacre bluish-white.

DISTRIBUTION. Alabama, Connecticut, Delaware, Georgia, Massachusetts, Maryland, Maine, Michigan, North Carolina, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, South Carolina, Virginia, Vermont, Wisconsin, West Virginia, New Brunswick, Nova Scotia, Ontario, Prince Edward Island, Quebec Canada.

ECOLOGY. Ortmann (1919:158) noted a creek and a pond form of this species and remarked: "I collected the pond-form in rather small (artificial) ponds, with very muddy bottoms, and also, but more rarely, in quiet pools of creeks...the creek-form...It seems to avoid the larger rivers...It favors small rivers and creeks. Here it lives on gravelly bottoms, in more or less strongly flowing water (even in riffles), or in more quiet pools in gravel, sand or mud. The short high form...seems to prefer large rivers with muddy bottoms.

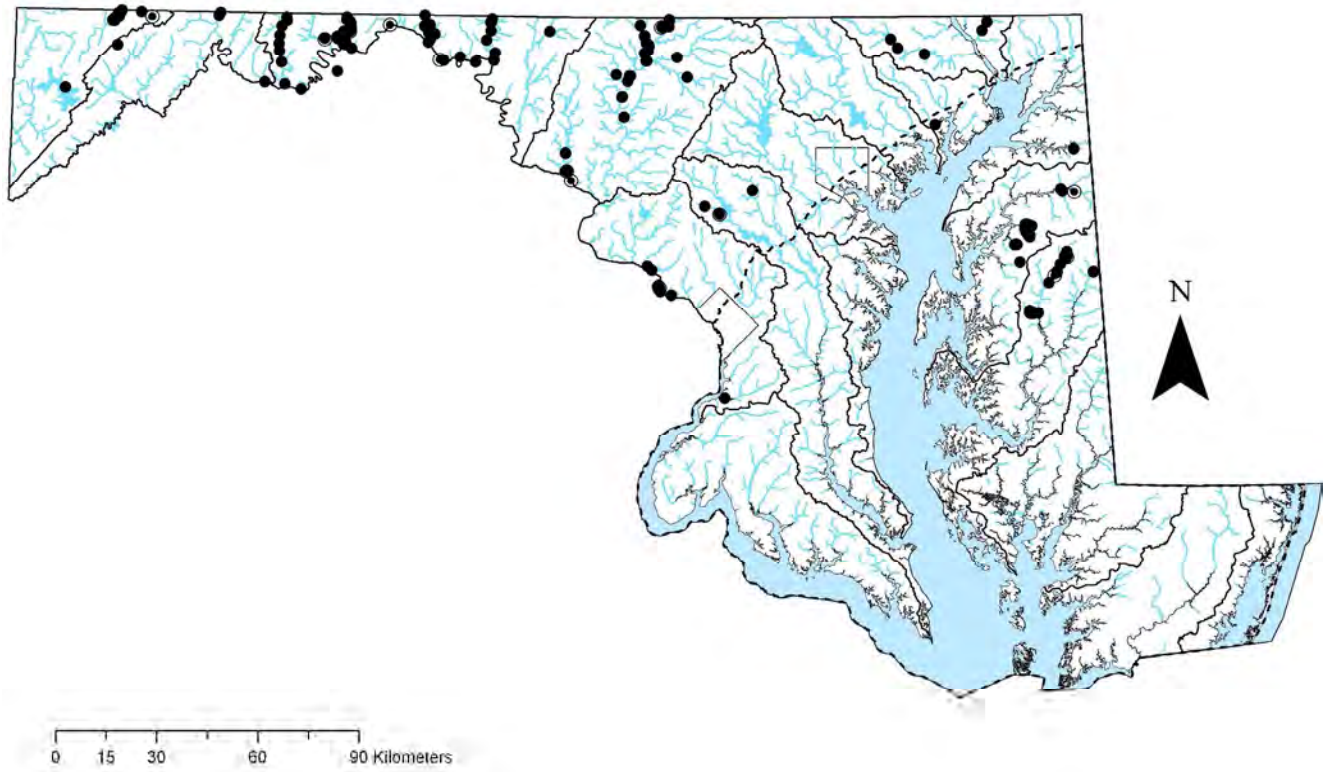


In Maryland, it can be found in most lentic waters, including ponds, canals, and reservoirs, along tidal-freshwater. They are occasionally found in streams, especially those with nearby connections to impoundments.

BREEDING SEASON. Ortmann (1919:153) reported gravid females from late July to late April. A bradytictic species.

HOST FISH. Common carp, *Cyprinus carpio*; Pumpkinseed, *Lepomis gibbosus*; Rock bass, *Ambloplites rupestris*; Threespine stickleback, *Gasterosteus aculeatus*; White sucker, *Catostomus commersoni*.

STATUS: Currently stable, Secure.



Map 18 Distribution of *Strophitus undulatus* (Say, 1817) in Maryland.

Strophitus undulatus (Say, 1817) **creeper** Fig. 20

SYNONYMY

Anodonta undulata Say, 1817
Alasmodonta edentula Say, 1820
Anodon rugosus Swainson, 1822
Anodonta arkansensis Call, 1885
Anodonta edentula (Say, 1817)
Strophitus edentulus (Say, 1817)
Strophitus rugosus (Swainson)
Anodonta pensylvanica [sic] Lamarck, 1819
Anodon areolatus Swainson, 1829
Alasmodonta edentula Say, 1829
Anodonta virgata Conrad, 1836
Anodonta pavonia Lea, 1836
Anodonta wardiana Lea, 1838
Anodon unadilla De Kay, 1843
Anodonta tetragona Lea, 1845
Anodonta arkansensis Lea, 1852
Anodonta shaefferiana Lea, 1852
Alasmodon rhombica Anthony, 1865
Anodon papyracea Anthony, 1865
Anodon annulatus Sowerby, 1867
Anodon quadriplicatus Sowerby, 1867
Anodonta salmonia Clessin, 1873
Strophitus undulatus ovatus Frierson, 1927
Strophitus rugosus pepinensis Baker, 1928
Strophitus rugosus winnebagoensis Baker, 1928
Strophitus rugosus lacustris Baker, 1928
Strophitus edentulus (Say, 1817)

SHELL DESCRIPTION. Shell oblong oval, dorsal and ventral margins rounded, shell thin and fragile when young but becoming thicker with age, length to 11 cm. Shell compressed to inflated, posterior ridge rounded, beaks narrow but only slightly raised above the hinge. Periostracum yellow-brown to greenish becoming darker with age, green rays may cover the shell. Pseudocardinal teeth are only swellings or thickening along the hinge, lateral teeth absent, beak cavity shallow, hinge line undulate, nacre white with cream or salmon color in beak cavity.

DISTRIBUTION. Alabama, Arkansas, Colorado, Connecticut, Delaware, Georgia, Iowa, Illinois, Indiana, Kansas, Kentucky, Louisiana, Massachusetts, Maryland, Maine, Michigan, Minnesota, Missouri, Mississippi, North Carolina, North Dakota, Nebraska, New Hampshire, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Virginia, Vermont, Wisconsin, West Virginia, Manitoba, New Brunswick, Nova Scotia, Ontario, Quebec, Saskatchewan Canada.



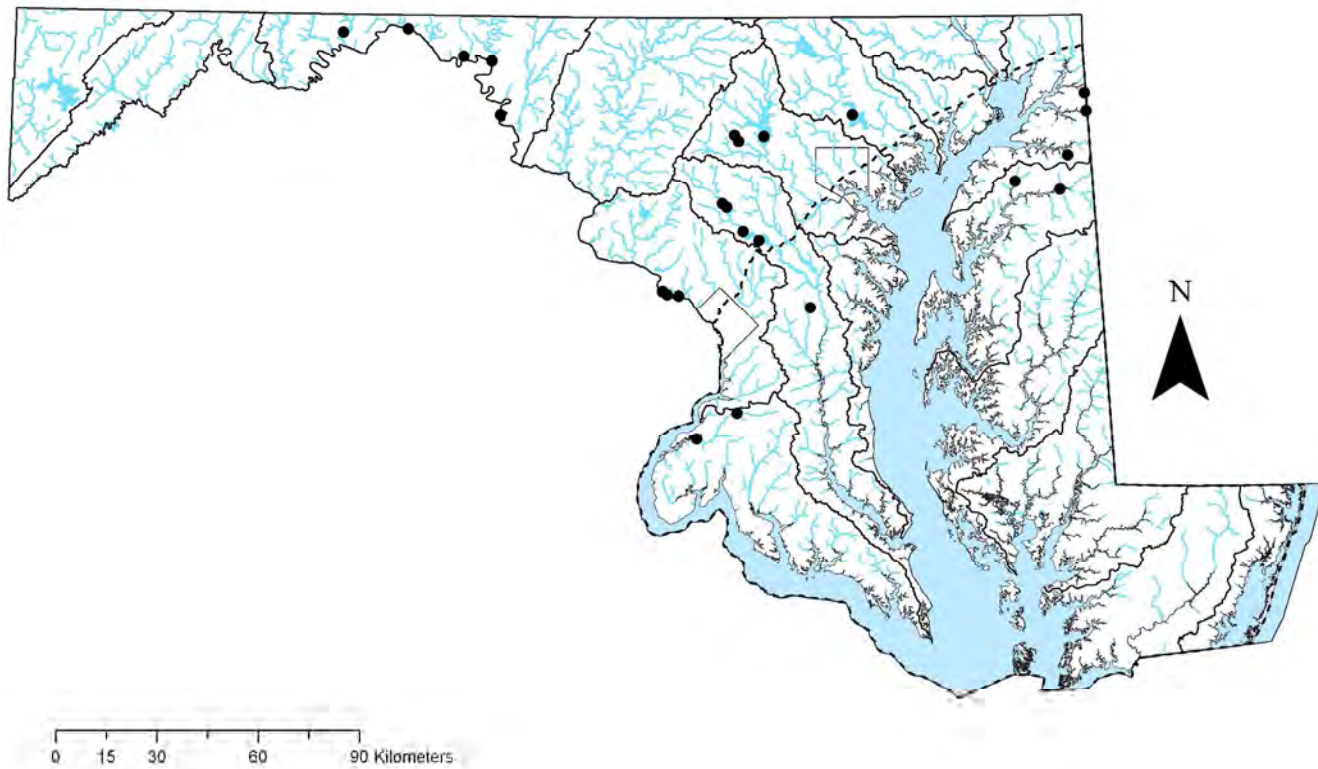
ECOLOGY. Ortmann (1919:204-205) reported "it is distinctly averse to large rivers...We may call *S. edentulous* a form characteristic of smaller streams...Baker says that it is found in the larger lakes and rivers on muddy bottoms...while Scammon reports it to prefer mud and quiet water, and to be the most abundant in small streams (in Kansas)...in small streams it avoids riffles, but delights in quiet and protected pools and eddies, where there is a moderate and rather uniform current, and a deposit of fine gravel or sand."

In Maryland, this species inhabits most rivers and large streams and the headwaters of some watersheds. In low abundance range wide.

BREEDING SEASON. Ortmann (1919:196) reported Atlantic slope individuals were "gravid in December and March, but not in April and May", a bradytictic species.

HOST FISH. Banded darter, *Etheostoma zonale*; Black bullhead, *Ameriurus melas*; Bluegill, *Lepomis macrochirus*; Bluntnose minnow, *Pimephales notatus*; Central stoneroller, *Campostoma anomalum*; Creek chub, *Semotilus atromaculatus*; Fantail darter, *Etheostoma flabellare*; Largemouth bass, *Micropterus salmoides*; Longear sunfish, *Lepomis megalotis*; Longnose dace, *Rhinichthys cataractae*; Rainbow darter, *Etheostoma caeruleum*; Rock bass, *Ambloplites rupestris*; Spotfin shiner, *Cyprinella spiloptera*; Walleye, *Stizostedion vitreum*; White crappie, *Pomoxis annularis*; Yellow bullhead, *Ameriurus natalis*;

STATUS. Currently Stable, In need of conservation.



Map 19 Distribution of *Utterbackia imbecillis* (Say, 1829) in Maryland.

Utterbackia imbecillis (Say, 1829) **paper pondshell** Fig. 21

SYNONYMY

Anodonta imbecillis Say, 1829
Anodonta imbecilis [sic] Say, 1829
Anodonta incert Lea, 1834
Anodon horda Gould, 1855
Anodonta henryana Lea, 1857
Utterbackia imbecillis fusca Baker, 1927
Anodonta ohioensis Rafinesque, 1820 [in part]
Anodonta (Utterbackia) imbecilis Say, 1829



SHELL DESCRIPTION. Shell elongate, oblong, dorsal hinge line rather short and straight, the ventral margin rounded, shell inflated and thin growing to about 10 cm in length, beaks flat, even with the hinge line, beaks on the anterior third of the shell. Periostracum shiny, light yellow on the umbo, rest of shell bright green with rays and posterior slope that is dark green to black. Both valves edentulous, nacre bluish-white, often with pink tinges.

DISTRIBUTION. Alabama, Arkansas, Florida, Georgia, Iowa, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Missouri, Mississippi, North Carolina, Nebraska, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, Wisconsin, West Virginia, Ontario Canada, Mexico.

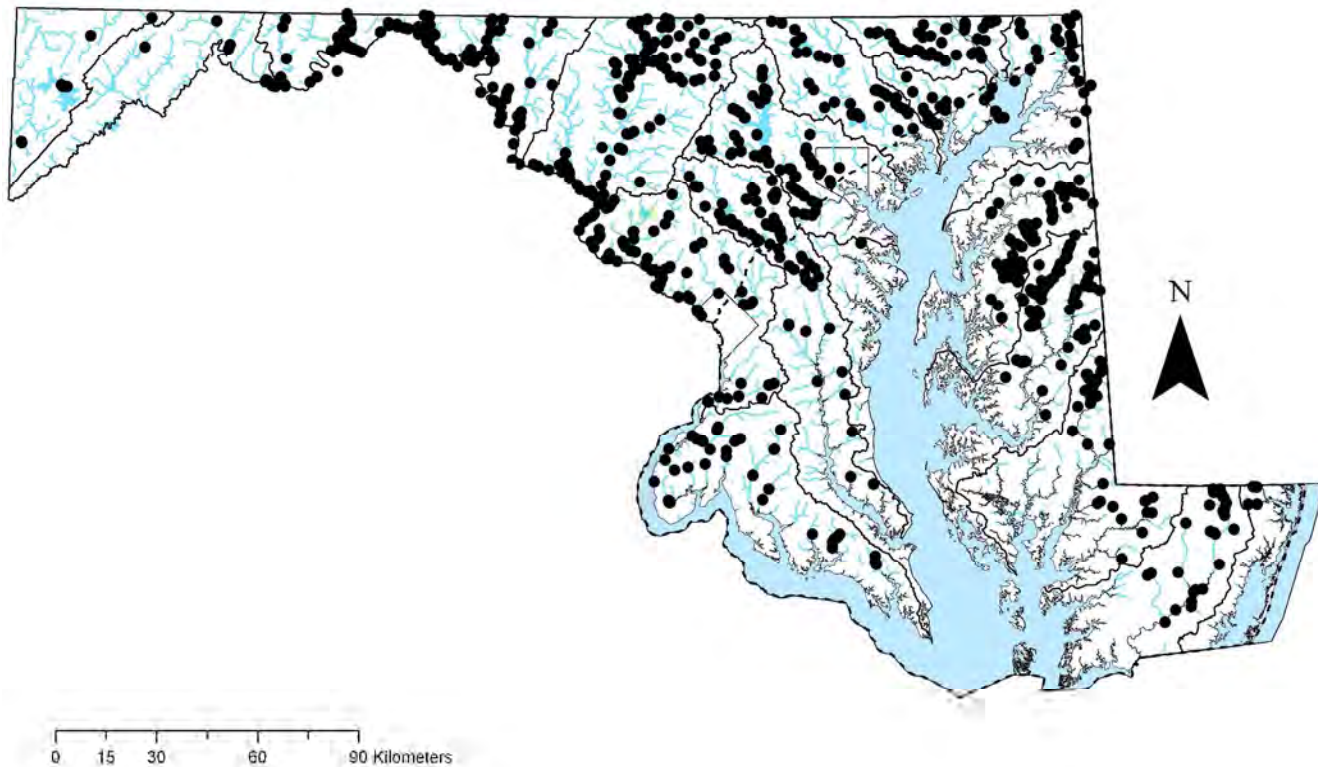
ECOLOGY. Johnson (1970:364) noted "lives in soft mud or sand in ponds, creeks, and near the banks of larger rivers."

In Maryland, found in ponds, lakes, canals, and reservoirs on sand and mud flats, often in very high numbers. Can be found in larger rivers like the Potomac where small dams have created run-of-river impoundments.

BREEDING SEASON. Ortmann (1919:163) noted this species as bradyctictic. Females beginning gravid in June and July and discharging glochidia in May noted "the succeeding breeding season overlap in June and July, but probably not in the same individual." The species is hermaphroditic (Hoeh 1991).

HOST FISH. Banded killifish, *Fundulus diaphanous*, Creek chub, *Semotilus atromaculatus*, Rock bass, *Ambloplites rupestris*; Bluegill, *Lepomis macrochirus*; Dollar sunfish, *Lepomis marginatus*; Green sunfish, *Lepomis cyanellus*; Longear sunfish, *Lepomis megalotis*; Pumpkinseed, *Lepomis gibbosus*; Warmouth, *Lepomis gulosus*; Largemouth bass, *Micropterus salmoides*; Western mosquitofish, *Gambusia affinis*; Yellow perch, *Perca falvescens*.

STATUS. Currently stable, Stable



Map 20 Distribution of *Corbicula fluminea* (Mueller 1776) in Maryland.

Corbicula fluminea (Mueller, 1776) **Asian clam** Fig. 3

SHELL DESCRIPTION. Shell small (< 50 mm), creamy yellow-green to olive to black periostracum marked with concentric rings, beaks high and positioned in the middle of shell., beaks on the anterior third of the shell. Nacre bluish-white, to white to purple-white.



DISTRIBUTION. Alabama, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Mississippi, North Carolina, Nebraska, New Hampshire, New Mexico, New Jersey, New York, Nevada, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, Wisconsin, West Virginia, Wyoming,

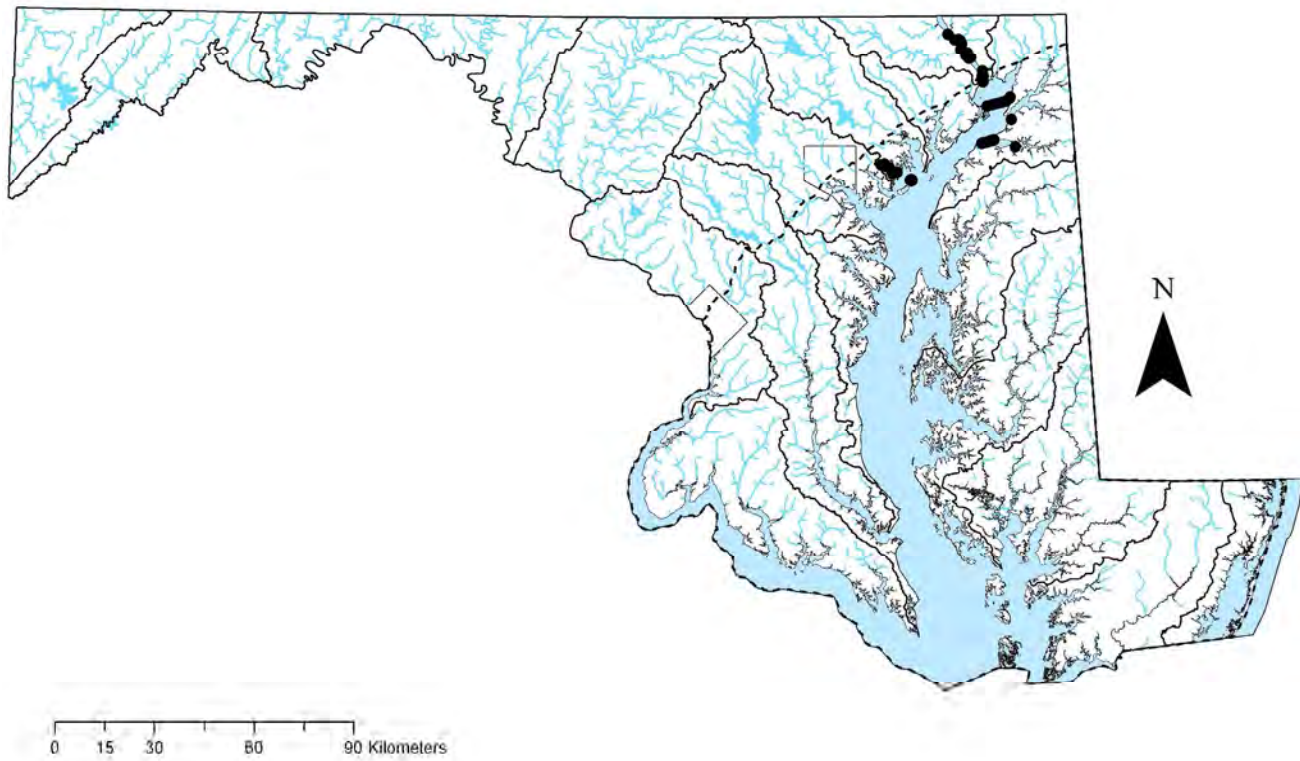
ECOLOGY. An invasive bivalve tolerant of a variety of conditions, but typically found in fine substrates. Often observed in high (>100 per square meter) densities. Sensitive to excessively high and low temperatures, which may produce large population swings.

In Maryland, *Corbicula* are found in ponds, lakes, canals, and reservoirs on sand and mud flats. They are also ubiquitous to nearly every watershed. For example, they can be found in drainages like the Potomac basin from headwaters into the tidal-freshwater estuary.

BREEDING SEASON. It is a simultaneous hermaphrodite and broods larvae in inner demibranchs.

HOST FISH. n/a

STATUS. Non-native



Map 21 Distribution of *Dreissena polymorpha* (Pallas 1771) in Maryland

Dreissena polymorpha (Pallas, 1771) **zebra mussel** Fig. 2

SHELL DESCRIPTION. Shell small (< 50 mm), triangular, ventrally flattened. Periostracum typically alternations between bands of cream and brown or black, thus lending the zebra striping appearance, but can be without stripes. Attaches to hard substrates with byssus.



DISTRIBUTION. Alabama, Arkansas, California, Colorado, Connecticut, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, South Dakota, Tennessee, Texas, Utah, Vermont, West Virginia, and Wisconsin

ECOLOGY. An invasive bivalve. Often observed in high (>100 per square meter) densities that foul other bivalves. Sensitive to excessively high and low temperatures, which may produce large population swings. Filter feeding zebra mussel aggregations have caused ecological shifts across multiple trophic levels in Great Lakes and Hudson River and caused the decline or extirpation of native mussels in Lake St. Clair, western Lake Erie, and the upper Mississippi River.

In Maryland, zebra mussels are chiefly found in the Susquehanna River, above and below Conowingo Dam. They have been found in tidal-freshwater estuaries on hard surfaces and aquatic vegetation from the Susquehanna Flats as far south as Hart-Miller Island.

BREEDING SEASON. Dioecus. Oogenesis occurs in autumn, with eggs developing until release and fertilization in spring, but can take place year round in thermally altered water bodies.

HOST FISH. n/a

STATUS. Non-native



Fig. 2 *Dreissena polymorpha* (Pallas, 1771)



Fig. 3 *Corbicula fluminea* (Mueller, 1776)



Fig. 4 *Alasmidonta heterodon* (Lea, 1829)



Fig. 5 *Alasmidonta marginata susquehannae*
Ortmann, 1919

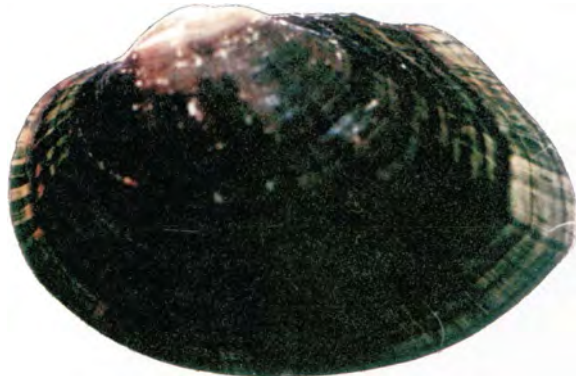


Fig. 6 *Alasmidonta undulata* (Say, 1817)



Fig. 7 *Alasmidonta varicosa* (Lamarck, 1819)



Fig. 8 *Anodonta implicata* Say, 1829



Fig. 9 *Elliptio complanata* (Lightfoot, 1786)

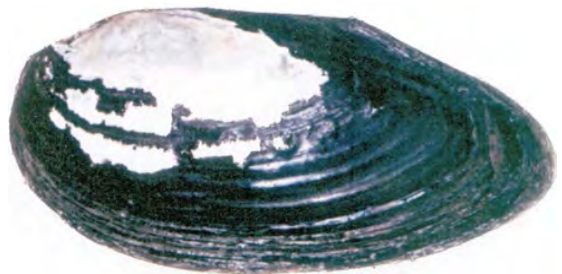


Fig. 10 *Elliptio fisheriana* (Lea, 1838)



Fig. 11 *Elliptio lanceolata* (Lea, 1828)



Fig. 12 *Elliptio producta* (Conrad, 1836)



Fig. 13 *Lampsilis cardium* Rafinesque, 1820



Fig. 14 *Lampsilis cariosa* (Say, 1817)



Fig. 15 *Lampsilis radiata* (Gmelin, 1791)



Fig. 17 *Leptodea ochracea* (Say, 1817)



Fig. 19 *Pyganodon cataracta* (Say, 1817)



Fig. 16 *Lasmigona subviridis* (Conrad, 1835)



Fig. 18 *Ligumia nasuta* (Say, 1817)



Fig. 20 *Strophitus undulatus* (Say, 1817)



Fig. 21 *Utterbackia imbecillis* (Say, 1829)

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APPENDIX 1

Freshwater bivalves reported from the Youghiogheny and Casselman rivers in Pennsylvania and potentially occurring in Maryland¹.

	Youghiogheny River	Casselman River
<i>Actinonaias ligamentina</i>	HA ²	
<i>Amblema plicata</i>	A	
<i>Cylconaias tuberculata</i>	A	
<i>Elliptio crassidens</i>	A	
<i>Elliptio dilatata</i>	A	A
<i>Epioblasma torulosa rangiana</i>	A	
<i>Fusconaia flava</i>	A	
<i>Fusconaia subrotunda</i>	A	
<i>Lampsilis abrupta</i>	A	
<i>Lampsilis fasciola</i>	A	
<i>Lampsilis ovata</i>	A	
<i>Lampsilis siliquoidea</i>	A	
<i>Lasmigona costata</i>	A	
<i>Ligumia recta</i>	A	
<i>Obovaria retusa</i>	A	
<i>Obovaria subrotunda</i>	A	
<i>Pleurobema clava</i>	A	
<i>Pleurobema cordatum</i>	A	
<i>Pleurobema sintoxia</i>	A	
<i>Ptychobranhus fasciolaris</i>	A	
<i>Strophitus undulatus</i>	HA	Present
<i>Villosa fabalis</i>	A	
TOTAL TAXA	22	2

¹ Historic data for the Youghiogheny and Casselman rivers is derived from Ortmann (1919). The archaeological data is from Winters (n.d.), an unpublished manuscript on file in the Div. of Anthropology, Carnegie Museum of Natural History, Pittsburgh, Pennsylvania.

² H - Historic record; A - Archaeological record.