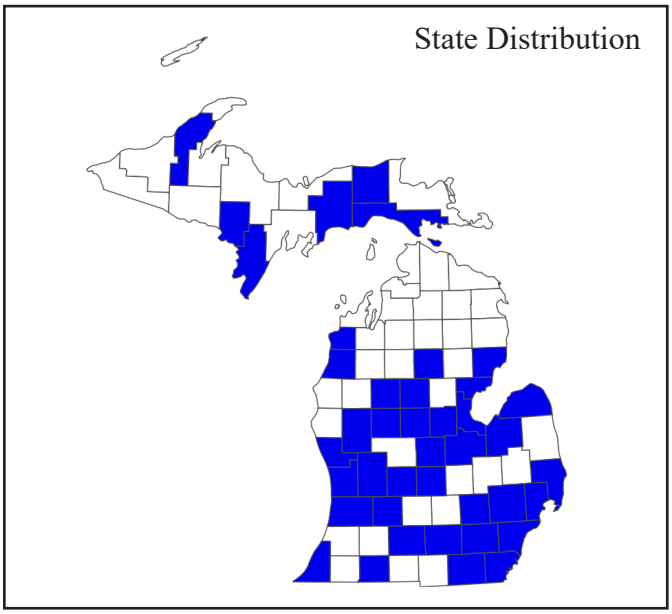
Ligumia recta Lamarck — Black sandshell



Best Survey Period

Status: State endangered

Global and State Rank: G4G5 (Globally Apparently Secure to Secure) / S1? (Possibly State Critically Imperiled [Inexact Numeric Rank])

Family: Unionidae (Freshwater mussels)

Synonyms: *Lampsilis (Eurynia) recta* (Lamarck), *Lampsilis (Eurynia) recta sageri* (Conrad), *Lampsilis (Eurynia) rectus* (Lamarck), *Lampsilis (Ligumia) recta* (Lamarck), *Lampsilis (Ligumia) recta latissima* (Rafinesque), *Lampsilis recta* (Lamarck), *Lampsilis recta recta* (Lamarck), *Ligumia latissima* (Rafinesque), *Ligumia recta latissima* (Rafinesque), *Margarita (Unio) rectus* (Lamarck), *Margaron (Unio) rectus* (Lamarck), *Ptychobranchus fasciolare arquatum* (Conrad), *Unio (Eurynia) latissima* (Rafinesque), *Unio angustatus cuniculus* (De Gregorio), *Unio arquatus* (Conrad), *Unio leprosus* (Miles), *Unio praelongus* (Barnes), *Unio recta* (Lamarck), *Unio rectoides* (Whitfield), *Unio rectus* (Lamarck), *Unio sageri* (Conrad) (MolluscaBase 2025)

Total Range: The black sandshell is widespread in eastern and central U.S. and Canada, occurring east to Vermont, south to Louisiana, west to Oklahoma, and north into Canada where it's found from Saskatchewan to Quebec (NatureServe 2024, Watters et al. 2009). While widespread, the black sandshell is uncommon throughout much of its range. The species is Presumed Extirpated (SX) in Georgia; Possibly Extirpated (SH) in Nebraska; Critically Imperiled (S1) in Iowa, Kansas, Louisiana, Mississippi, Oklahoma, Vermont, and likely Michigan (S1?); Imperiled (S2) in Alabama, Arkansas, Indiana, Missouri, New York, South Dakota, and Virginia; and Vulnerable (S3) in five states and Canada. Its status is Apparently Secure (S4) in Kentucky, North Dakota, and Pennsylvania, and Secure (S5) in Tennessee (NatureServe 2024). It is considered an introduced species in Montana (Stagliano 2010).

State Distribution: Black sandshell occurrences are broadly distributed in Michigan, with 143 element occurrences documented in 41 counties throughout both the Lower and Upper Peninsula (MNFI 2024). The species has been documented throughout the eastern and western Lower Peninsula, with occurrences extending north to the Betsie-Platte, Manistee, and Au Sable watersheds. In the Upper Peninsula, occurrences are restricted to the Sturgeon, Menominee, Manistique, and Tahquamenon watersheds. Many of the occurrences are limited to observations of shells only, with evidence of live or fresh dead individuals documented in the following waterbodies: Au Sable River, Belle River, Black River, Chippewa River, Detroit River, Flat River, Grand River, Huron River, Indian River, Kalamazoo River, Manistee River, Maple River, Menominee River, Pine River, Platte River, St. Joseph River, Sturgeon River,

Michigan Natural Features Inventory
Phone: (517) 284-6200 Email: mnfi@msu.edu
Website: mnfi.anr.msu.edu

Tahquamenon River, Tittabawasee River, White River, and Lake St. Clair (Asti Environmental 2022, Cardno 2017, GEI Consultants 2023, MNFI 2024, Stantec Consulting 2023, Zanatta et al. 2002). Of these, the Grand and Menominee River appear to support the largest populations, while only a single live individual has been documented in each of the Belle, Detroit, Kalamazoo, Tahquamenon, and White Rivers (MNFI 2024). Populations in the Detroit River may be extirpated, as a survey of 56 sites completed in 2019 failed to find any live individuals (Keretz et al. 2021).

Recognition: The black sandshell is one of the larger unionid mussels with a maximum length of 25 cm (10 in) (Mulcrone and Rathbun 2020). The shell is elongate and solid with a rounded anterior end and a sexually dimorphic posterior end. The posterior end is pointed in males and is broader, more rounded, and machete-shaped in females. Differences in female shells become apparent in the third year (Watters et al. 2009). The outer shell is smooth and shiny and ranges in color from dark green to brown to black, with green rays occasionally visible. Younger individuals tend to be more green, and adults become progressively daker with age. Beak sculpture consists of indistinct double-loops or ridges. The inside of the shell (nacre) ranges in color from white to pink to purple, and the beak (umbo) is low and broad (Cummings and Mayer 1992, Mulcrone and Rathbun 2020, Watters et al. 2009).

Similar species found in Michigan include the spike (*Eurynia dilatata*), which is smaller relative to age (as indicated by the number of external annular rings) and has a beak sculpture of 2-4 coarse ridges. The shell surface of spike has a less glossy/more matte texture similar to a vinyl record compared to black sandshell, which is glossy. The eastern pondmussel (*Sagittunio nasutus*) is smaller, has a thinner shell, and is more sharply pointed at the posterior end.

Best Survey Time: The best time of year to survey for black sandshell and other freshwater mussels in Michigan is typically the first week of June through the last week of September. Within this time frame, periods of high flow and high turbidity should be avoided to improve detection rates. Surveys occurring outside of this time frame or during periods when water temperatures are below 10º C (50º F) should be avoided, as mussels are more likely to burrow into the substrate as temperatures decrease, making detection difficult (Hanshue et al. 2021).

Habitat: Black sandshell typically occur in medium to large rivers and lakes (Cummings and Mayer 1992, Watters et al. 2009). Preferred habitats are generally areas containing strong currents and firm sand and gravel substrates (Cumings and Mayer 1992, Fichtel and Smith 1995, Watters et al. 2009). In Michigan rivers, black sandshell are commonly found in areas containing a combination of sand and gravel or sand, gravel, and cobble substrates (ASTI Environmental 2022, Badra and Goforth 2002, Cardno 2017, GEI Consultants 2023, Martinski and Woolnough 2023, MNFI 2024, Stantec 2023), and individuals have been documented in areas with currents of 0.3-0.4 m/sec (Badra and Goforth 2002).

Biology: Reproduction begins with males releasing sperm into the water column, which is taken up by females for internal fertilization (Cummings and Mayer 1992). Eggs are fertilized within the female in August and develop into microscopic larvae, called glochidia, by September (Ortman 1919). Black sandshell are bradytictic, which means the glochidia (parasitic larvae) are brooded overwinter within the gravid female until they are ready to be released the following July (Watters et al. 2009). Like all unionids, black sandshell have a lifecycle that includes an obligatory parasitic stage. Once these glochidia are released by the female, they must attach to the gills or fins of a suitable host fish to survive and successfully transform into juveniles.

Once glochidia are ready to be released, female black sandshell attempt to lure potential hosts by displaying a line of tentacles and an eyespot along the margin of their shell (Corey 2006, Watters et al. 2009). Unlike some mussel species that are restricted to a small number of suitable hosts, many potential hosts have been reported for black sandshell. In laboratory settings, glochidia have successfully transformed on 20 different species of fish (Freshwater Mussel Host Database 2017, Watters et al. 2009). No successful transformations have been documented in natural settings, but natural infestations have been observed on sauger (*Sander canadensis*), white crappie (*Promoxis annularis*), bluegill (*Lepomis macrochirus*), and American eel (*Anguilla rostrata*) (Freshwater Mussel Host Database 2017). Tests to determine host suitability indicate that sauger may be a preferred host, with over ten times more juveniles metamorphosing on them relative to other species tested (Khym and Layzer 2000).

After successful infestation of a suitable host fish, glochidia metamorphose and eventually fall off the

host as newly transformed juveniles. These juveniles then develop into adults, remaining relatively sessile on the river or lake bottom. Adults are filter feeders that consume algae, bacteria, detritus, microscopic animals, and dissolved organic material from the water column or sediment (Christian et al. 2004, Nichols and Garling 2000, Silverman et al. 1997, Strayer et al. 2004). Black sandshells complete most of their growth within the first six or seven years and may live to be over 30 years old (Watters et al. 2009).

Conservation/Management: The most prominent threats to black sandshell populations include contamination and degradation of water quality, habitat modification, altered hydrologic regimes, invasive species, habitat fragmentation, and changes in the availability of suitable host fish. These threats are not mutually exclusive and often work together to threaten populations.

Water contamination from point and non-point sources such as agricultural and urban run-off and industrial waste have both direct and indirect effects on freshwater mussels. Mussels are among the most sensitive of all freshwater organisms to heavy metals (Keller and Zam 1991, Naimo 1995, Wang et al. 2007, Wang et al. 2017), pesticides (Bringolf et al. 2007), ammonia (Wang et al. 2007, Wang et al. 2017), and pharmaceuticals (Hazelton et al. 2013). Excess sediment in aquatic systems, resulting largely from surrounding land use changes and resource extraction, is an additional source of contamination (Brim Box and Mossa 1999). High levels of sediment interfere with feeding and respiration and may limit recruitment by reducing fish abundance, diversity, and the effectiveness of structures that serve to visually attract hosts (Brim Box and Mossa 1999). As a species that uses visual lures to attract potential host fish, this may be a particularly relevant threat for black sandshell. Excess sediments and increased organic matter can also reduce dissolved oxygen content, which may limit juvenile survival (Sparks and Strayer 1998). The maintenance and restoration of vegetated riparian buffers along occupied rivers can help alleviate erosion and excessive sedimentation (Anbumozhi et al. 2005).

Changes to the hydrological regime result from several factors including the construction of dams, climate change, and an increase in impervious surfaces (USFWS 2022). Dams have a profound impact on mussel habitat (Watters et al. 2009), altering current speed and water temperature and converting river habitat into lentic habitat (USFWS 2022). Changes in precipitation patterns due to climate change have led to more frequent and severe droughts and increased stream flashiness, the latter of which is exacerbated by higher amounts of impervious surfaces due to development (USFWS 2022). Maintenance of vegetated riparian buffers along occupied rivers will help to mitigate adverse impacts of increased flashiness. In-stream activities that directly alter habitat, such as dredging and channelization, affect mussels in multiple ways. Such activities can alter substrates, increase downstream sediment levels, and cause direct mortality (Watters et al. 2009). When performing in-stream activities that may negatively impact freshwater mussel populations, proper mussel survey and relocation procedures should be followed to reduce impact (Hanshue et al. 2021).

The spread of invasive zebra (*Dreissena polymorpha*) and quagga mussels (*Dreissena bugensis*) are an imminent threat to black sandshell. Biofouling by these species interferes with feeding, reproduction, and movement of native mussels through direct attachment (Conn & Conn 1993; Schloesser et al., 1996). Direct attachment can dislodge mussels from the substrate and prevent the proper opening of valves (Watters et al. 2009). Dreissenid invasions have been implicated in the decline and possible extirpation of black sandshell from the Detroit River (Keretz et al. 2021) and likely continue to threaten other Michigan populations.

Artificial barriers such as dams and improperly sized or poorly installed culverts fragment habitat and serve as barriers to fish movement (Watters 1996, Watters et al. 2009). Such barriers have been implicated in extinctions (Vaughn and Taylor 1999) and artificially restricted distributions of mussel species (Watters 1996). Barriers to host fish movement effectively isolate populations, restricting gene flow and preventing colonization of new habitats. Removing obsolete barriers and improving fish passage within occupied habitats will help to improve population connectivity and overall species viability. All the threats mentioned above have the potential to impact associated fish communities, which may result in the loss or decline of suitable host fish within occupied habitats. Given the variety of potential host fish reported for black sandshell (Freshwater Mussel Host Database 2017, Watters et al. 2009), efforts should be taken to maintain or enhance overall fish diversity and abundance in occupied habitats. Sauger, a potentially preferred host for this species, is state endangered and critically imperiled in Michigan (NatureServe 2024). Efforts should be taken to conserve sauger within habitats where they co-occur. Such actions may be particularly needed for black sandshell, as no evidence of recruit-

ment was documented during recent surveys of several occupied rivers (Martinski and Woolnough 2023).

Research Needs: Targeted surveys are needed throughout the current and historic range of black sandshell in Michigan. Historical occurrences need to be revisited to determine their current status, and watersheds containing few documented live individuals, such as the Belle, Kalamazoo, Tahquamenon, and White Rivers, should be revisited to determine if populations persist. Additionally, information regarding which species of fish serve as suitable hosts in natural settings is needed. Identifying populations where successful recruitment is occurring may help to prioritize conservation efforts, and the determination of relevant parameters (e.g., population size estimates, composition of associated fish community) at these sites would help to inform conservation strategies for this species.

Selected References

Anbumozhi, V., J. Radhakrishnan, and E. Yamaji. 2005. Impact of riparian buffer zones on water quality and associated management considerations. Ecological Engineering 24:517-523.

Asti Environmental. 2022. Native Mussel Survey and Relocation: Huron River at US-23 Bridge Green Oak Township, Livingston County, Michigan.

Badra, P.J. and R.R. Goforth. 2002. Surveys of Native Freshwater Mussels in the Lower Reaches of Great Lakes Tributary Rivers in Michigan. Michigan Natural Features Inventory, Report Number 2002-03, Lansing, MI.

Brim Box, J. and J. Mossa. 1999. Sediment, land use, and freshwater mussels: prospects and problems. Journal of North American Benthological Society 18:99-117.

Cardno. 2017. Mussel Relocation Report: Grand River at I-196 Bridge Downtown Grand Rapids, Michigan.

Christian, A.D., B.N. Smith, D.J. Berg, J.C. Smoot, and R.H. Findley. 2004. Trophic position and potential food sources of 2 species of unionid bivalves (Mollusca: Unionidae) in 2 small Ohio Streams. Journal of the North American Benthological Society 23:101-113.

Conn, D.B. and D.A. Conn. 1993. Parasitism, predation and other biotic associations between dreissenid mussels and native animals in the St. Lawrence River. In Tsou J. L. (Ed.), Proceedings: Third international zebra mussel conference (pp. 223–234). Electric Power Research Inst.

Corey, C.A., R. Dowling, and D.L. Strayer. 2006. Display behavior of *Ligumia* (Bivalvia: Unionidae). Northeastern Naturalist 13:319-332.

Cummings, K.S. and C.A. Mayer. 1992. Field guide to freshwater mussels of the Midwest. Illinois Natural History Survey Manual 5. pp. 1-194.

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.

Freshwater Mussel Host Database. 2017. The freshwater mussel host database, Illinois Natural History Survey & Ohio State University Museum of Biological Diversity, 2017. https://fms19.naturalhistorysurvey.org/fmi/webd/Freshwater%20Mussel%20Host%20Database (Accessed: November 2024).

GEI Consultants of Michigan, P.C. 2023. Draft Grand River (I-196) Mussel Relocation Report: I-196 crossing near Market Ave., Kent County, MI.

Hanshue, S., J. Rathbun, P. Badra, J. Bettaso, B. Hosler, J. Pruden, and J. Grabarkiewicz. 2021. Michigan Freshwater Mussel Survey Protocols and Relocation Procedures for Rivers and Streams. Version 3. 20 pp. + appendices.

Hazelton, P.D., W.G. Cope, S. Mosher, T.J. Pandolfo, J.B. Belden, M.C. Barnhart, and R.B. Bringolf. 2013. Fluoxetine alters adult freshwater mussel behavior and larval metamorphosis. Science of the Total Environment. 445-446:94-100.

Keller, A.E. and S.G. Zam. 1991. The acute toxicity of selected metals to the freshwater mussel, *Anodonta imbecilis*. Environmental Toxicology and Chemistry 10:539-546.

Keretz, S.S., D.A. Woolnough, T.J. Morris, E.F. Roseman, A.K. Elgin, and D.T. Zanatta. 2021. Limited co-existence of native unionids and invasive dre-

issenid mussels more than 30 Y post dreissenid invasion in a large river system. American Midland Naturalist 186:157-175.

Khym, J.R. and J.B. Layzer. 2000. Host fish suitability for glochidia of *Ligumia recta*. American Midland Naturalist 143:178-184.

Martinski, M.E. and D.A. Woolnough. 2023. Movement and surrounding community of the understudied and endangered *Ligumia recta* (Mollusca, Unionidae). Hydrobiologia 850:1091-1108.

Michigan Natural Features Inventory (MNFI). 2024. Michigan Natural Heritage Database, Lansing, MI.

MolluscaBase eds., 2025. MolluscaBase. *Ligumia recta* (Lamarck, 1819). Accessed at: https://www.molluscabase.org/aphia.php?p=taxdetails&id=857339 on 2025-04-21.

Mulcrone, R.S. and J.E. Rathbun. 2020. Pocket field guide to the freshwater mussels of Michigan (2nd ed.). Michigan Department of Natural Resources. 78 p.

Naimo, T.J. 1995. A review of the effects of heavy metals on freshwater mussels. Ecotoxicology 4:341-362.

NatureServe. 2024. NatureServe Network Biodiversity Location Data accessed through NatureServe Explorer [web application]. NatureServe, Arlington, Virginia. https://explorer.natureserve.org/. (Accessed: November 24, 2024).

Nichols, S.J. and D. Garling 2000. Food-web dynamics and trophic-level interactions in a multispecies community of freshwater unionids. Canadian Journal of Zoology 78:871-882.

Ortman, A.E. 1919. A monograph of the Naiades of Pennsylvania. Part III: Systematic account of the genera and species. Memoirs of the Carnegie Museum. Vol. VIII, No.1, Pittsburgh, Pennsylvania. 385 pp.

Schloesser, D., T. Nalepa, and G. Mackie. 1996. Zebra mussel infestation of unionid bivalves (Unionidae) in North America. American Zoologist, 36, 300–310.

Silverman, H., S.J. Nichols, J.S. Cherry, E. Achberger, J.W. Lynn, and T.H. Dietz. 1997. Clearance of laboratory-cultured bacteria by freshwater bivalves: differences between lentic and lotic unionids. Canadian Journal of Zoology 75:1857-1866.

Sparks, B.L. and D.L. Strayer. 1998. Effects of low dissolved oxygen on juvenile *Elliptio complanate* (Bivalvia: Unionidae). Journal of the North American Benthological Society 17:129-134.

Stagliano, D. 2010. Freshwater mussels in Montana: Comprehensive results from 3 years of SWG funded surveys. Report prepared for the Montana Department of Fish, Wildlife and Parks. Helena, Montana.

Stantec Consulting Services Inc. 2023. Freshwater Mussel Survey of the Huron River at McCabe Road, Livingston County, Michigan.

Strayer, D.L., J.A. Downing, W.R. Haag, T.L. King, J.B. Layzer, T.J. Newton, and S.J. Nichols. 2004. Changing perspectives on pearly mussels. North America's most imperiled animals. BioScience 54:429-439.

U.S. Fish and Wildlife Service (USFWS). 2022. Species status assessment report for the snuffbox. May 2022 (Version 1.0). Ohio Ecological Services Field Office, Columbus, Ohio.

Vaughn, C.C. and C.M. Taylor. 1999. Impoundments and the Decline of Freshwater Mussels: a Case Study of an Extinction Gradient. Conservation Biology 13:912-920.

Wang, N., C.G. Ingersoll, I.E. Greer, D.K. Hardesty, C.D. Ivey, J.L. Kunz, W.G. Brumbaugh, F.J. Dwyer, A.D. Roberts, T. Augspurger, C.M. Kane, R.J. Neves, and M.C. Barnhart. 2007. Environmental Toxicology and Chemistry 26:2048-2056.

Wang, N., C.D. Ivey, C.G. Ingersoll, W.G. Brumbaugh, D. Alvarez, E.J Hammer, C.R. Bauer, T. Augspurger, S. Raimondo, and M.C. Barnhart. 2017. Acute sensitivity of a broad range of freshwater mussels to chemicals with different modes of toxic action. Environmental Toxicology and Chemistry 36:786-796.

Watters, G.T. 1996. Small dams as barriers to freshwater mussels (Bivalvia, Unionoida) and their hosts. Biological Conservation 75:79-85.

Watters, G.T., M.A. Hoggarth, and D.H. Stansbery. 2009. The Freshwater Mussels of Ohio. The Ohio State University Press, Columbus, OH, US.

Zanatta, D.T., G.L. Mackie, J.L. Metcalfe-Smith, and D.A. Woolnough. 2002. A refuge for native freshwater mussels (Bivalvia: Unionidae) from the impacts of the exotic zebra mussel (*Dreissena polymorpha*) in Lake St. Clair. Journal of Great Lakes Research 28:479-489.

Abstract Citation: Branch, E.C. 2025. Special animal abstract for *Ligumia recta* (black sandshell). Michigan Natural Features Inventory. Lansing, MI.

Funding for abstract provided by Michigan Department of Transportation.