# *Conservation Assessment for The Lilliput (Toxolasma parvus)*

## *USDA Forest Service, Eastern Region*

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**Table of Contents**

## EXECUTIVE SUMMARY:

The Lilliput, *Toxolasma parvus* (Barnes, 1823) is a small elliptical mussel that is found throughout the Mississippi River system. *Toxolasma parvus* can usually be found in shallow water in lentic environments. It can be distinguished from other mussels by its dark brownish-green periostracum that has a cloth-like texture and it's white nacre. The historical range of this species appears to have included the entire Mississippi River system. This species is considered to widely distributed and globally stable, although some states on the edge of its range list it as locally imperiled. Although *T. parvus* is normally considered to be a dioecious species, hermaphroditic populations have been identified. Two species of *Lepomis* have been identified as potential hosts for *T. parvus*. Although populations of *T. parvus* are generally considered to be globally stable several factors are considered detrimental to the long-term persistence of this species. Among these factors is the introduction of invasive species such as Zebra mussels. Additional information regarding the affects of other potential threats to *T. parvus* is needed. Studies to determine the suitability of other fishes as hosts and the extent of hermaphroditism should be undertaken prior to initiation of captive breeding and re-introduction or translocation projects.

*Toxolasma parvus* (Barnes, 1823) Lilliput

## SYNONOMY:

*Unio parvus* Barnes, 1823; Barnes, 1823:pl. 13, fig. 18
*Mya parva* (Barnes, 1823); Eaton, 1826:222
*Margarita* (*Unio*) *parvus* (Barnes, 1823); Lea, 1836:28
*Margaron* (*Unio*) *parvus* (Barnes, 1823); Lea, 1852c:31
*Lampsilis* (*Corunculina*) *parvus* (Barnes, 1823); Baker, 1898:109, pl. 13, fig. 3
*Lampsilis* (*Carunculina*) *parvus* (Barnes, 1823); Simpson, 1900a:564
*Eurynia* (*Carunculina*) *parva* (Barnes, 1823); Ortmann, 1912a:338
*Carunculina parva* (Barnes, 1823); Wheeler 1914:75; Utterback, 1916a:396
*Toxolasma parvum* (Barnes, 1823); Ortmann, 1919:260
*Toxolasma parva* (Barnes, 1823); Valentine and Stansberry, 1971:29
*Carunculina parva cahni* F.C. Baker, 1928; Baker, 1928a:253-254; pl. 105, figs. 14-18

**Type locality**: Fox River, Wisconsin

## DISTRIBUTION:

Throughout the Mississippi River Drainage from Western New York to Minnesota, and from southern Canada to southern Texas (Parmalee and Bogan, 1998).

## DESCRIPTION:

The shell is subelliptical in outline and tends to be inflated. The beaks are slightly elevated above the hinge line. The anterior and posterior edges are evenly rounded. Members of this genus tend to have well-developed hinge teeth for shells this size. The sexes are dimorphic, female shells are more swollen than male, and the posterior margin

is more broadly rounded. The mantle margins of females possess a circular, "spongy looking mass" just posterior to the branchial opening. This "caruncle" is reddish in color and thought to be involved in attracting host fishes. The periostracum ranges from dark brown to dark green and is generally rayless. The glochidia are described by Lea (1874) as pouch shaped and without hooks.

## LIFE HISTORY AND ECOLOGY:

This species is most commonly found in shallow water in lentic environments in mud, sand or fine gravel (Parmalee and Bogan, 1998). This species is probably a long-term brooder (bradytictic). Gravid females have been have been observed May-July (Ortmann, 1919; Baker, 1928). Potential host fishes include *Lepomis cyanellus* (Hove, 1995), and *L. gulosus* (Wilson, 1916). Other centrarchids have been also implicated as hosts. Hermaphroditic populations of *T. parvus* have been identified in portions of Missouri (Utterback, 1916). One of the more recent examinations of this phenomenon (Tepe, 1943) revealed the unusual condition of sperm and eggs present in the same follicles. Typically in hermaphroditic unionoids sperm and eggs are found in separate follicles (e.g. van der Shalie and Locke, 1941).

## STATUS:

*Toxolasma parvus* is listed as currently stable by Williams et al. (1993). Cummings and Mayer (1992) listed this species as widespread and locally abundant. Pennsylvania lists this species as globally widespread but imperiled in the state (G5/S1-S2). Indiana placed this species on its watch list and considers it globally widespread but imperiled in the state (G4/S2).

## LIMITING FACTORS:

Approximately 67% of freshwater mussel species are vulnerable to extinction or are already extinct (National Native Mussel Conservation Committee, 1998). Factors implicated in the decline of freshwater bivalves include the destruction of habitat by the creation of impoundments, siltation, gravel mining, and channel modification; pollution and the introduction of non-native species such as the Asiatic clam and the Zebra Mussel.

### Zebra Mussels:

The introduction of consequent spread of *Dreissena polymorpha* in the mid to late 1980's has severely impacted native mussel populations in the Lower Great Lakes region (Schlosser et al. 1996). Adverse effects on unionid mussels stem primarily from the attachment of *D. polymorpha* the valves native mussels. In sufficient numbers, *D. polymorpha* can interfere with feeding, respiration, excretion, and locomotion (Haag et al. 1993, Baker and Hornbach 1997). It has been estimated that the introduction of *D. polymorpha* into the Mississippi River basin has increased the extinction rates of native freshwater mussels from 1.2% of species per decade to 12% per decade.

Native mussels have shown differential sensitivity to *D. polymorpha* infestations. Mackie et al. (2000) stated that smaller species with specific substrate requirements and

few hosts and were long-term brooders were more susceptible than larger species with many hosts, that were short-term brooders. *Toxolasma parvu*s fits several of these criteria. In addition, it tends to be found in lentic environments, which may increase its risk of colonization by *D. polymorpha*.

**Siltation:**

Accumulation of sediments has long been implicated in the decline of native mussels. Fine sediments can adversely affect mussels in several ways they can interfere with respiration, feeding efficiency by clogging gills and overloading cilia that sort food. It can reduce the supply of food by interfering with photosynthesis. Heavy sediment loads can also smother juvenile mussels. In addition, sedimentation can indirectly affect mussels by affecting their host fishes (Brim-Box and Mossa, 1999). Strayer and Fetterman (1999) have suggested that fine sediments may be more harmful to mussels in lower gradient streams where sediments can accumulate. *Toxolasma parvus* seems to do quite well in muddy or silty substrates; it will often completely bury itself near the bank or in and around macrophyte beds (Gordon and Layzer, 1989).

**Pollution:**

Chemical pollution from domestic, agricultural, and domestic sources were responsible for the localized extinctions of native mussels in North America throughout the 20$^{th}$ century (Baker, 1928, Bogan, 1993). According to Neves et al. (1997) the eutrophication of rivers was a major source of unionid decline in the 1980's, while Havlik and Marking (1987) showed that many types of industrial and domestic substances: heavy metals, pesticides, ammonia, and crude oil were toxic to mussels. It is unclear what the effect of pollution is on *T. parvus*.

**Dams/Impoundments:**

Impoundments whether for navigational purposes or for the generation of power can dramatically affect the habitat of freshwater mussels. Impoundments alter flow, temperature, dissolved oxygen, substrate composition (Bogan, 1993). In addition, they can isolate freshwater mussels from their host fishes thereby disrupting the reproductive cycle. Changes in water temperature can suppress or alter the reproductive cycle and delay maturation of glochidia and juvenile mussels (Fuller, 1974, Layzer et al. 1993). Although as noted by Gordon and Layzer (1989) *T. parvus* does occur in small creeks and small rivers it also appears to do well in ponds and lakes and impoundments.

## POPULATION BIOLOGY AND VIABILITY:

The widespread distribution of *T. parvus* and its ability to exist in both lentic and lotic environments would tend to predict a large panmictic population. To date no genetic survey has been conducted on this species, such information would be a valuable resource for constructing a species wide management plan that would preserve existing genetic variability of existing populations of *T. parvus*. Host fishes identified to date include two species of *Lepomis* which are generally widely distributed. *Toxolasma*

*parvus* can be somewhat of a weedy species and have been found in significant numbers in park ponds (pers. obs).

**Special Significance Of The Species:**

Hermaphroditic individuals of *Toxolasma parvus* have been identified (Tepe, 1943). This variation in "normal" unionid life history has been observed most frequently in this genus. Further research on this reproductive strategy is warranted.

## MANAGEMENT RECOMMENDATIONS:

Plans for the conservation of North American freshwater mussels have generally taken one of two approaches: 1.) the preservation of existing populations and allow the mussels to re-invade historical ranges naturally and 2.) to actively expand the existing ranges by re-introducing mussels through translocation from "healthy" populations or from captive rearing programs (NNMCC, 1998). The second strategy is the more pro-active, and may ultimately prove to be effective, however several important factors should not be over-looked. Before translocations or re-introductions occur it should be established that conditions at the re-introduction site are suitable for the survival of mussels. Mussel translocation projects have had mixed success (Sheehan et al. 1989, Cope and Waller, 1995). Re-introducing mussels into still contaminated or otherwise un-inhabitable habitat is a waste of resources and can confound attempts to obtain unbiased estimates of the survival of species after re-introduction. Additionally, the genetic variation across and within populations should be assessed prior to the initiation of a reintroduction/ translocation scheme (Lydeard and Roe, 1998). Evaluation of the genetic variation is crucial to establishing a captive breeding program that maintains the maximal amount of variation possible and avoid excessive inbreeding (Templeton and Read, 1984) or outbreeding depression (Avise and Hamrick, 1996).

Additional information about the life-history variation across populations of *T. parvus* would be useful. This species potentially could be used as a surrogate for developing conservation plans for *T. lividus* which is considered to be imperiled in several states. Further investigation aimed at more definitively identifying host fishes across the range of this species is advised.

## REFERENCES:

Avise, J.C. and J.L. Hamrick. 1996. Conservation genetics: case histories from nature. Chapman and Hall, New York.

Baker, F.C. 1928. The fresh water mollusca of Wisconsin. Part II: Pelycepoda. Bulletin 70, Wisconsin Geological and Natural History Survey: 495 pp.

Baker, S. M. and D. J. Hornbach. 1997. Acute physiological effects of zebra mussel (*Dreisenna polymorpha*) infestation on two unionid mussels, *Actinonaias ligamentina* and *Amblema plicata*. *Can. J. Fish. Aquat. Sci*. 54: 512-519.

Bogan, A. E. 1993. Freshwater bivalve extinctions (Mollusca: Unionoida): A search for causes. *Am. Zool.* 33: 599-609.

Brim-Box, J.M. and J. Mossa. 1999. Sediment, land use, and freshwater mussels: prospects and problems. *J. N. Am. Benthol. Soc*. 18: 99-117.

Cope, W.G. and D.L. Waller. 1995. Evaluation of freshwater mussel relocation as a conservation and management strategy. *Regulated Rivers: Research and Management*. 11: 147-155.

Fuller, S.L.H. 1974. Clams and mussels (Mollusca: Bivalvia) In: Pollution Ecology of Freshwater Invertebrates. (Eds. C.W. Hart Jr. and S.L.H Fuller). Academic Press, New York.

Gordon, M.E. and J.B. Layzer. 1989. Mussels (Bivalvia: Unioniodea) of the Cumberland River. Review of life histories and ecological relationships. Biological Report 89(15) U. S. Fish and Wildlife Service.

Haag, W.R., D.J. Berg, D.W. Garton, and J.L. Ferris. 1993. Reduced survival and fitness in native bivalves in response to fouling by the introduced zebra mussel (*Dreisenna polymorpha*) in western Lake Erie. *Can. J. Fish. Aquat. Sci.* 50: 13-19.

Havlik, M.E. and L.L. Marking. 1987. Effects of contaminants on naiad molluscs (Unionidae): a review. U.S. Fish and Wildlife Service, Resource Publication 164: 20p.

Hove, M.C. 1995. Suitable fish hosts of the lilliput, *Toxolasma parvus*. Triannual Unionid Report (8):9

Layzer, J.B., M.E. Gordon, and R.M. Anderson. 1993. Mussels: The forgotten fauna of regulated rivers. A case study of the Caney Fork River. *Regulated Rivers: research and Management* 8: 63-71.

Lea, I. 1874. Descriptions of fifty-two species of Unionidae. *J. Acad. Nat. Sci. Phil*. 8[New Series](1): 5-54, pls. 1-18.

Lydeard, C. and K.J. Roe. 1998. Phylogenetic systematics: the missing ingredient in the conservation of freshwater unionid bivalves. *Fisheries* 23: 16-17.

Mackie, G.L., D. Zanatta, J.L. Metcalf-Smith, J. Di Maio, and S.K. Staton. 2000. Toward developing strategies for re-habilitating/re-establishing Unionidae populations in southwestern Ontario. Final Report to the Endangered Species Recovery Fund.

National Native Mussel Conservation Committee. 1998. National Strategy for the conservation of native freshwater mussels. *J. Shellfish Res.* 17:1419-1428.

Neves, R.J., A.E. Bogan, J.D. Williams, S. A. Ahlstedt and P.W. Hartfield. 1997. Status of aquatic mollusks in the southeastern United States: A downward spiral of diversity. Pp. 43-85. In: G.W. Benz and D.E. Collins, eds. *Aquatic fauna in peril: the southeastern*

*perspective*. Special publication 1, Southeast Aquatic Research Institute, Lenz Design and Communication, Decatur, Georgia.

Ortmann, A.E. 1919. A monograph of the naiades of Pennsylvania. Part III: Systematic account of the genera and species. *Mem. Carnegie Mus*. 8: xvi-384, 21 pls.

Parmalee, P.W. and A.E. Bogan. 1998. The freshwater mussels of Tennessee. The University of Tennessee Press, Knoxville.

Schlosser, D. W., T. F. Nalepa, and G. L. Mackie. 1996. Zebra mussel infestation of unionid Bivalves (Unionidae) in North America. *Amer. Zool.* 36: 300-310.

Sheehan, R.J. R.J. Neves, and H.E. Kitchel. 1989. Fate of freshwater mussels transplanted to formerly polluted reaches of the Clinch and North Fork Holston Rivers, Virginia. *J. Freshwater Ecology*. 5: 139-149.

Strayer, D.L. and A.R. Fetterman. 1999. Changes in the distribution of freshwater mussels (Unionidae) in the Upper Susquehanna River basin, 1955-1965 to 1996-1997. *Am. Midl. Nat*. 142:328-339.

Templeton, A.R. and B. Read. 1984. Factors eliminating inbreeding depression in a captive heard of Speke's gazelle (*Gazella spekei*). *Zoo. Biol.* 3:177-199.

Tepe, W.C. 1943. Hermaphroditism in *Carunculina parva*, a fresh water mussel. *Am. Midl. Nat.* 29(3):621-623.

Utterback, W.I. 1916. The Naiades of Missouri. *Am. Midl. Nat*. 4:(1-10) reprint with pagination 1-200.

van der Shalie, H. and F. Locke. 1941. Hermaphroditism in Anodonta grandis, a freshwater mussel. *Occas. Papers Mus. Zool. Univ. Mich.* 432.

Williams, J. D., Warren, M. L. Jr., Cummings, K. S., Harris, J. L., and Neves, R. J. 1993. Conservation status of the freshwater mussels of the United States and Canada. *Fisheries* 18: 6-22.

Wilson, C.B. 1916. Copepod parasites of freshwater fishes and their economic relations to mussel glochidia. *Bull. Bureau Fisheries.* 34:333-374+ 15 plates.

# APPENDIX

**Figure 1.** *Distribution of Toxolasma parvus by county based on museum records. Records from Alabama, Florida, and Mississippi are likely misidentifications.*