Conservation Assessment
for
The Purple Lilliput (Toxolasma lividus) Rafinesque, 1831

USDA Forest Service, Eastern Region

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EXECUTIVE SUMMARY

The Purple Lilliput, *Toxolasma lividus* Rafinesque, 1831 is a small, dark mussel that is found in small to medium sized rivers. *Toxolasma lividus* can be distinguished from other mussels its size by its robust hinge teeth and from other members of *Toxolasma* by its purple nacre. The historical range of *T. lividus* includes the Ohio River system, including the Tennessee and Cumberland Rivers as well as the White and Arkansas rivers. Specimens reported from outside the Tennessee River System in Alabama may be range extensions.

Toxolasma lividus is currently not listed by the U. S. Fish and Wildlife Service as threatened or endangered, although it is listed by several states. *Toxolasma lividus* is a dioecious species, it brooding habit is bradytictic: spawning occurs in the summer, and the larvae are released the following spring. Two species of *Lepomis* have been determined to be suitable hosts for this species.

Factors considered detrimental to the persistence of many species of freshwater mussels include pollution, siltation and habitat perturbation such as gravel mining or the construction of impoundments. Additional information regarding the affects of these and other potential threats to *T. lividus* is needed. Studies to determine the suitability of other fishes as hosts should be undertaken prior to initiation of captive breeding and re-introduction or translocation projects.

Toxolasma lividus Rafinesque, 1831 Purple Lilliput

SYNONOMY

Toxolasma lividus Rafinseque, 1831; Rafinesque, 1831:2
Toxolasma livida Rafinseque, 1831; Morrison, 1969:24
Toxolasma lividum Rafinseque, 1831; Ortmann,, 1918:573
Toxolasma lividum lividum Rafinseque, 1831; Stansbery, 1972:46
Toxolasma lividus lividus Rafinseque, 1831; Stansbery, 1976a:48
Unio glans Lea, 1831; Lea, 1831:82, pl. 18, fig. 12
Margarita (*Unio*) *glans* (Lea, 1831); Lea, 1836:28
Margaron (*Unio*) *glans* (Lea, 1831); Lea, 1852c:31
Lampsilis (*Carunculina*) *glans* (Lea, 1831); Simpson, 1900a:565
Eurynia (*Carunculina*) *glans* (Lea, 1831); Ortmann, 1912a:339
Carunculina glans (Lea, 1831); Ortmann, 1910:119
Carunculina glans glans (Lea, 1831); Stansbery, 1970:18
Toxolasma glans (Lea, 1831); Valentine and Stansbery, 1971:29
Toxolasma glans glans (Lea, 1831); Stansbery, 1971:14
Toxolasma lividus glans (Lea, 1831); Stansbery, 1976a:48
Unio moestus Lea, 1841; Lea, 1841b:82, Lea, 1842b:244, pl. 26, fig. 60
Margaron (*Unio*) *moestus* (Lea, 1841); Lea, 1852c:31
Lampsilis moestus (Lea, 1841); Simpson, 1900a:565
Lampsilis moesta (Lea, 1841); Simpson, 1914:156
Carunculina moesta (Lea, 1841); Ortmann, 1921:89
Carunculina glans moesta (Lea, 1841); Stansbery, 1970:18

Type locality: Rockcastle River [Kentucky]

DISTRIBUTION

Ohio River Drainage including the Tennessee and Cumberland Rivers. The White River Drainage in Missouri and Arkansas and tributaries of the Arkansas River in Arkansas and Oklahoma. There are some museum records that indicate that the range of *T. lividus* extends further south in Alabama in to the Mobile River Basin. This may be the result of unintentional introduction of glochidia infested fishes or the result of dispersal via the Tennessee-Tombigbee Waterway.

DESCRIPTION

A small but very solid shell. The valves are inflated and elliptical with a rounded anterior and a sharply pointed posterior. The ventral margin is rounded in females to somewhat straight in males. The posterior ridge is low and rounded. Beaks are only slightly elevated above the hinge line. The periostracum ranges from dark brown to black in color, and is smooth except for growth lines. The nacre is a dark purple that lightens towards the margins. Members of this genus tend to have well-developed hinge teeth for shells this size. The glochidia are described by Ortmann (1921) as subovate in shape.

LIFE HISTORY AND ECOLOGY

This species is reported from the headwaters of small to medium sized rivers. They have been collected from various substrates including sand, mud, and gravel. Like other members of this genus *Toxolasma lividus* seems to adapt to lentic environments as many have been found in the Wheeler Reservoir in the Tennessee River Drainage (Tennessee Valley Authority, 1986). Laboratory infestations have indicated that *Lepomis cyanellus* and *Lepomis megalotis* are suitable hosts for this species. Females of *T. lividus* display a "caruncle" or fleshy, fingerlike growth immediately below the branchial opening during breeding season. It is thought this mantle modification may serve to attract a suitable host fish. This species is a long-term brooder (bradytictic) (Heard and Guckert, 1970). Gravid females have been collected in September (Neves, 1991).

STATUS

Toxolasma lividus is listed as a species of special concern by Williams et al. (1993). This species is listed as endangered in Illinois, Kentucky, Michigan and Ohio (Cummings and Mayer, 1992) and Virginia. The state of Indiana considers *T. lividus* a species of special concern and assigned it a rank of G1 (critically imperiled) and S2 (imperiled in the state), whereas the state of Missouri assigned it G2 (imperiled globally) S2. Based on museum records the rankings given this species by various state agencies appear accurate. Although the species range of *Toxolasma lividus* covers a fairly broad area, it is found sporadically throughout that range. Reasons for the decline of freshwater mussels in North America are still not well understood, and the interaction of a variety of factors appears to have confounded attempts to precisely identify causal relationships. Probable causes for the decline were listed by van der Schalie (1938), Fuller (1974), Bogan (1993) and Williams et

al. (1993), and include habitat modification and degradation, the introduction of exotic bivalves. *Toxolasma lividus* is not a commercially valuable species and so, is not threatened by over-harvesting. Although the *T. lividus* has been found in lotic environments it is more typically found in clean, swiftly flowing water. In order to maintain it's current distribution efforts should be directed at preventing further degradation by reducing siltation and impoundments of existing habitat. The completion of the life cycle of *T. lividus*, like all unionoids is dependent on the presence of a suitable fish host. Host suitability studies conducted to date indicate that two widespread centrarchids are suitable hosts.

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 lividus* tends to be found in small to medium sized rivers which might reduce 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. This species tends to be found in rocky and gravel substrates, although it does seem to do well in impounded rivers, which tend to have silty substrates. It is unclear if *T. lividus* is more susceptible to siltation than other mussels.

Pollution

Chemical pollution from domestic, agricultural, and domestic sources were responsible for the localized extinctions of native mussels in North America throughout the 20th 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. lividus*.

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. lividus* prefers riffle and headwater environments, it has also appears to have adapted well to at least some impoundments Drainage (Tennessee Valley Authority, 1986).

POPULATION BIOLOGY AND VIABILITY

The combination of river impoundments and the ecological requirements of *T. lividus* predict a series of isolated populations in the headwater streams throughout the species range. Museum records imply that populations west of the Mississippi River are isolated from the Ohio River populations. 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. lividus*.

SPECIAL SIGNIFICANCE OF THE SPECIES

There is no special significance of this species.

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. lividus* would also prove important to assess prior to initiating a translocation project. Differences in the timing of various aspects of reproduction such as the release of gametes by males and the movement of eggs into the demibranchs of females are critical for successful reproduction as is the presence of a suitable host fish. Further investigation aimed at more definitively identifying host fishes across the ranges of many 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.

Cummings, K.S. and C.A. Mayer. 1992. Field guide to the freshwater mussels of the midwest. Illinois Natural History Survey, manual 5.

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.

Goodrich, C. and van der Schalie, H. 1944. A revision of the Mollusca of Indiana. American Midland Naturalist 32: 257-326.

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.

Heard, W.H. and R.H. Guckert. 1970. A re-evaluation of the recent Unionacea (Pelycepoda) of North America. Malacologia 10:333-355.

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.

Hill, D.M. 1986. Cumberlandian Mollusks Conservation Program, activity 3: Identification of fish hosts. Office of Natural Resources and Economic Development, Tennessee Valley Authority, Knoxville. 57 pp.

Hoggarth. M.A. 1999. Descriptions of some of the glochidia of the Unionidae (Mollusca: Bivalvia). Malacologia 41: 1-118.

Jenkinson, J.J. 1982. Cumberlandian Mollusk Conservation Program. pp. 95-103 in A.C. Miller (compiler) Report of freshwater mollusks workshop (19-20 May 1981). U.S. Army Engineer Waterways Experimental Station, Vicksburg, Mississippi. 184 pp.

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.

Lydeard, C. and K.J. Roe. 1998. Phylogenetic systematics: the missing ingredient in the conservation of freshwater unionid bivalves. 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. 1991. Mollusks. Pp. 251-320. In: K. Terwilliger (ed.) Virginia's Endangered Species. Proceeding of a Symposium. Department of Game and Inland Fisheries, Commonwealth of Virginia. 672 pp.

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. 1921. The anatomy of certain mussels from the upper Tennessee. Nautilus 34:81-91.

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. Journal of 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.

Tennessee Valley Authority. 1986. Cumberlandian mollusk conservation program. Activity 1: Mussel distribution surveys. Knoxville, Tennessee: Office of Natural Resources and Economic Development, Tennessee Valley Authority.

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.

USGS. 2000. *Certus NRDA Injury Assessment Report*: Qualitative and quantitative assessment of the freshwater mussel fauna of the upper Clinch River at Cedar Bluff, Virginia, following a chemical truck spill. Prepared for the U.S. Fish and Wildlife Service, Virginia Field Office. Prepared by Steve Ahlstedt, Knoxville, TN, August, April-June, 2000.

Van der Schalie, H. 1938. Contributing factors in the depletion of naiades in eastern United States. Basteria 3(4): 51-57.

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.

APPENDIX

Figure 1. *Distribution of Toxolasma lividus by county based on museum records.*