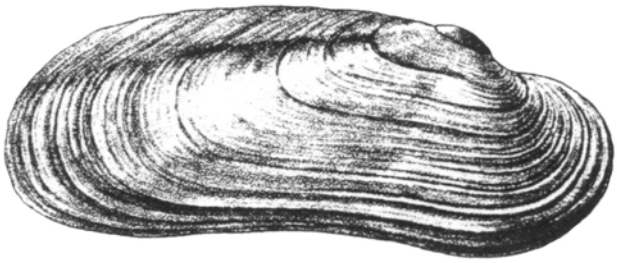
Conservation Assessment

# The Spectaclecase, *Cumberlandia monodonta* (Say, 1829)



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Executive Summary:

The spectaclecase, *Cumberlandia monodonta* (Say, 1829) is a medium to large, elongate, arcuate, thin-shelled mussel that is found in medium to large sized rivers often near rocks or logs. It should be easily distinguishable from other mussels by the above characters and its poorly developed hinge teeth. The historical range of *C. monodonta* includes the Ohio River Basin and the Mississippi River Basin from Arkansas north to Minnesota. *Cumberlandia monodonta* is not listed by the U. S. Fish and Wildlife Service as threatened or endangered, whereas several states list this species as endangered, threatened, or of special concern. *Cumberlandia monodonta* is considered to be tachytictic: spawning occurs in the summer, and the larvae are released in the spring. Information on which fishes serve as hosts remains to be determined. Factors considered detrimental to the persistence of this species are pollution and siltation, and invasive species. Additional information regarding the distribution, life history and genetic variation in *C. monodonta* should be obtained prior to initiation of any captive breeding and re-introduction or translocation projects.

*Cumberlandia monodonta* (Say, 1829) Spectaclecase

Synonomy:

*Unio monodonta* Say, 1829; Say, 1829:293; Say, 1830:pl.5
*Unio soleniformes* Lea, 1831; Lea 1831:87, pl. 10, fig. 17
*Margaritana soleniformes* (Lea, 1831); Paetel, 1890: 173
*Unio monodontus* Say, 1829; Say, 1834: no pagination
*Alasmidonta monodonta* (Say, 1829); Férrussac, 1835:26
*Baphia hildrethiana* (Lea, 1834); H. and A. Adams, 1857:499
*Margarita* (*Unio*) *monodontus* (Say, 1829); Lea, 1836:40
*Margaron* (*Unio*) *monodontus* (Say, 1829); Lea, 1852:39
*Margaritana monodonta* (Say, 1829); Conrad, 1853:262
*Margaritania monodonta* (Say, 1829); Ortmann, 1912a:233
*Cumberlandia monodonta* (Say, 1829); Ortmann,1912b:13
*Margaritifera* (*Cumberlandia*) *monodonta* (Say, 1829); Haas, 1969:14

Type Locality: Ohio and Wabash Rivers.

Distribution:

The Ohio River Basin, including the Tennessee and Cumberland Rivers. The Mississippi River Basin from Minnesota south to Arkansas.

Description:

The shell of the spectaclecase is elongate and arcuate and can reach a length of 23 cm. This species is described as sub-inflated and the valves tend to be quite thin, particularly the posterior half. The beak is anterior to the middle of the shell and is barely raised above the hinge line. The posterior ridge is broadly rounded as are the anterior and posterior margin of the shell. The periostracum ranges from brown to black and growth lines are pronounced. The nacre is white. Lateral and pseudocardinal teeth that are simple and unpronounced in young specimens, become even more indistinct with age. The glochidia of this species are very small, sub-circular in shape and the average length and height are both 60µm (Howard, 1915; Baird, 2000). No hooks or micropoints are

apparent along the valves edges. Whereas most unionids have complete gill septa that can be readily observed as dorso-ventral interlamerllar connections that create distinct "tubes" in the gills; *Cumberlandia* has septa that are arranged in diagonal rows.

Life History and Ecology:

It has been proposed that *C. monodonta* produces two broods per year (Howard, 1951; Gordon and Smith, 1990) although Baird (2000) found no evidence of biannual reproduction. Females appear to gravid with mature glochidia in the early spring (April-May) in Missouri (Baird, 2000). *Cumberlandia monodonta* has been observed to produce small, white, branched conglutinates which contain glochidia embryos and unfertilized eggs (Knudson and Hove, 1997). The host of the spectaclecase is currently not known (Baird, 2000) although individuals of two species (*Hybopsis amblops* and *Moxostoma macrolepidotum*) carried glochidia with no evidence of transformation. Salmonids and cyprinids are often hosts for other margaritiferids (Baird, 2000), although no native salmonids co-occur with the spectaclecase. Van der Schalie (1966) found that occasionally individuals of *C. monodonta* are hermaphrodites, although Baird (2000) reported no evidence of this.

*Cumberlandia monodonta* has been collected in medium to large size rivers in gravel, sand, or mud substrates (Buchanan, 1980) in water up to 10 meters deep (Baird, 2000). They may be collected in or adjacent to rapid current embedded in the substrate and near or under large rocks (Call, 1900; Oesch, 1984; Baird, 2000). Up to 200 individuals were reported under a single large rock slab (Hinkley, 1906).

Baird (2000) examined the population structure of spectaclecase in Missouri and found that the greatest age was 56 years. Age at sexual maturity was determined to be 4-5 years for males and 5-7 years for females, and sex ratios in populations examined did not differ significantly from 50:50. Fecundity of females is high, Baird (2000) estimated that total fecundity (glochidia and ova) ranged between 1.93-9.57 million per female.

Status:

Williams et al. (1993) list *C. monodonta* as a threatened species. Historically widespread, the species was known from Alabama, Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Minnesota, Missouri, Nebraska, Ohio, Tennessee, Virginia, and Wisconsin. Parmalee and Bogan (1998) listed the distribution of this species from Minnesota south to the Gulf of Mexico. No records were found for this species south of Arkansas in the Mississippi River basin and Northern Alabama (Tennessee River). The spectaclecase was considered to be rare as early as the 1970 (Stansbery, 1970), and Cummings and Mayer (1992) list the species as widespread but absent from portions of its range. Baker, (1906) reported this species from the Kankakee, Illinois and Mississippi rivers, in 1967, Parmalee reported that the species was no longer found in the Illinois and Kankakee rivers. The spectaclecase is considered threatened in the states of Virginia and Minnesota; endangered in Illinois, Iowa, Kentucky, and Wisconsin; and it is considered extirpated in Arkansas, Indiana and Kansas. As late as the 1980's specimens were collected in Alabama, Arkansas, Illinois, Iowa, Kentucky, Minnesota, Missouri, Tennessee, Virginia, West Virginia, and Wisconsin. *Cumberlandia monodonta* is not a commercially valuable species and so is not threatened by the shell industry.

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/*Corbicula*:

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. Zebra mussels currently occupy much of the range of the spectacle case including the upper Mississippi, St. Croix, Ohio, and Tennessee rivers. Kelner and Davis (2002) reported that zebra mussels in the Mississippi river were very abundant and were having a significant impact on freshwater mussels.

Asian clams (*Corbicula fluminea*) have been implicated as competitor with native mussels (Neves and Widlak, 1987). Yeager et al. (2001) found that in high densities *C. fluminea* had a negative impact on the survival and growth of juvenile native mussels. Laboratory experiments found that *C. fluminea* will readily ingest glochidia, and that *C. fluminea* density and juvenile mussel mortality are positively correlated.

<u>Siltation</u>:

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. In situations where lack of current or seasonal flooding cannot clear away accumulated silt, it is conceivable that interstitial spaces and the undersides of flat rocks could become clogged with sediment that could potentially suffocate the mussels under it and preclude settlement of juvenile *C. monodonta*.

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. Glochidia and juvenile mussels appear to be particularly susceptible to contaminants (Robinson et al. 1996, Jacobson et al., 1997). Although continued chronic exposure to pesticides and other toxicants can have a negative impact on freshwater mussels (Naimo, 1995), acute exposure from chemical spills can have disastrous effects. In a recent spill on the Clinch River over 7,000 individual mussels were killed including three federally listed species (Jones et al. 2001). In 1999 a spill on the Ohio River resulted in the mortality of all mussels (~1 million individuals) along a 10-mile stretch of river (Butler, 2002).

Dams/Impoundments:

Impoundments whether for navigational purposes or for the generation of power can dramatically affect the habitat of freshwater mussels, particularly those species that inhabit riffles and shoals. 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). Large amounts of habitat throughout the range of *C. monodonta* have been impounded resulting in very small segments of suitable habitat generally in the tail waters below dams. The Tennessee and Cumberland rivers, which at one time contained large populations of the spectaclecase are now extremely fragmented due to impoundments with approximately 2,300 miles directly affected by impoundments (Tennessee Valley Authority, 1971). In addition to habitat fragmentation and temperature alteration the increase in siltation

above impoundments alters the substrate making it unsuitable for many riffle dwelling species.

Population Biology and Viability:

The habitat preferences of the spectaclecase and the availability of that habitat predicts a series of isolated populations across the species range. 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 *C. monodonta*. If the trend of habitat reduction and fragmentation continues the continued loss of genetic variation through genetic drift has the potential to reduce the genetic variation within populations to the point where they may no longer be able to adapt to changing conditions.

Special Significance Of The Species:

*Cumberlandia monodonta* is the sole species in the monotypic genus *Cumberlandia*, and is the only member of the Margaritiferidae to occupy the interior drainages of North America. Other margaritiferids are found on the Atlantic, Pacific, or Gulf Coasts.

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).

Substantial information about the life-history of *C. monodonta* is indicates that the species is long-lived and mature populations can persist in isolated areas. Information on distribution, abundance and genetic variation of the spectaclecase throughout its range and its host is also required to form a complete understanding of this species.

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Figure 1. Distribution of *Cumberlandia monodonta* by county, based on a survey of museum records.

NORTH AMERICA
No. 2
SCALE
0 200 400 600 800 1000 MILES
0 200 400 600 800 1000 1200 1400 KILOMETERS
LAMBERT AZIMUTHAL EQUAL-AREA PROJECTION
WEST LONGITUDE
GOODE BASE MAP SERIES
Prepared by Henry M. Leppard