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# Status and Distribution of Freshwater Mussels (Unionacea) Inhabiting the Saline River / Holly Creek Bottoms Area, Saline County, Arkansas

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# GENERAL NOTES

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Abundance and diversity of freshwater mussels (Bivalvia: Unionacea) have been declining for the past 40 years throughout North America (Williams et al., 1993). The Nature Conservancy (TNC) has recognized 55% of North American freshwater mussels as extinct or imperiled (Master, 1990). Harris et al. (1997) recommended 22 of the 75 (29%) freshwater mussel species considered native to Arkansas for conservation status listing. Eight species are listed as federally endangered, and one is listed as federally threatened.

The Saline River begins on the east end of the Ouachita Mountains as four distinctive branches (South, North, Middle, and Alum forks). These waters converge north of Benton, Arkansas, just before the Saline River enters the Gulf Coastal Plain. The Saline River flows southward before reaching its confluence with the Ouachita River near the Arkansas-Louisiana state line. The river basin is gently rolling, and some lands adjacent to larger streams are swampy. Substrates range from cobble to gravel, sand and clayey silt in a riffle-pool environment. The total drainage basin at the Saline River/Holly Creek Bottoms Area is 223 $km^2$ (USGS, 1979).

The upper Saline River is one of the last major undammed rivers in the Ouachita River drainage. Arkansas Department of Environmental Quality (ADEQ) has designated the headwaters of the Saline River as an Ecologically Sensitive Waterbody. This designation provides additional protection to waterbodies known to provide habitat for endangered, threatened, or endemic species. The remainder of the Saline River is designated as an Extraordinary Resource Waterbody due to a combination of chemical, physical and biological characteristics that is characterized by scenic beauty, aesthetics, scientific values, recreation potential, and intangible social values. TNC also recognizes this segment of the Saline River as an ecoregional priority for conservation.

Davidson and Clem (2002) reported 42 species as a component of the Saline River unionid fauna, with an additional four species as a possible component. Headwater reaches of the Saline River to near Benton, Arkansas have been adequately surveyed (Harris and Gordon, 1988; Brown and Brown, 1989; U.S. Fish and Wildlife Service, 1990; U.S. Fish and Wildlife Service, 1992; Burns and McDonnell, 1992a, 1992b). Davidson and Clem (2002) surveyed 158.8 km of the Saline River from Tull, Arkansas to Arkansas Highway 15 near Warren, Arkansas. Davidson (1997) surveyed the lower 18 km of the Saline River that lies within the boundary of Felsenthal National Wildlife Refuge. A few unionid records exist for highway crossings (John Harris, pers. comm.) on the Saline River. Unsurveyed portions of the Saline River in Arkansas include a short stretch from Benton to Tull and Arkansas Highway 15 near Warren to Felsenthal National Wildlife Refuge.

The study area lies within the Saline River/Holly Creek Bottoms Area. The Holly Creek watershed comprises upland and bottomland forests along the Saline River and Holly Creek. Mature bottomland hardwoods are the dominant trees of the forest bordering the Saline River. There are two pasture locations on both sides of the river near the confluence of Holly Creek. Land bordering the Saline River is privately owned and consists of bottomland hardwoods and pastures.

The objective of this survey was to document species composition, size distribution, approximate abundance of mussel concentrations, population and community estimates in mussel beds, and location of mussel beds and concentrations. Results will provide baseline information on the status of the mussel fauna inhabiting the Holly Creek Loop in the Saline River. Data derived may be added to an Arkansas Game & Fish Commission (AGFC) mussel database. These data will allow the development of management strategies for the protection of this mussel community.

A field survey for preliminary site assessment was conducted 29 September 2001. The study area begins in the Saline River at the upstream portion of a braided channel (Sec. 26; R15W; T2S); for the purposes of this report the study area is termed the "Holly Creek Loop Area" and extends approximately 4 km downstream to the "Haskell Bridge" (Sec. 36; R15W; T2S). The entire study area was

Table 1. Mussels collected during qualitative searches of mussel beds and concentrations, approximate concentration area ($m^2$) and approximate density of concentrations in the Holly Creek Loop, Saline River, Arkansas.

| Scientific name | B1 | B2 | C1 | C2 | C3 | Total |
|---|---|---|---|---|---|---|
| *Actinonaias ligamentina* | 12 | 25 | 21 | 28 | 31 | 120 |
| *Amblema plicata* | 11 | 3 | 7 | 0 | 1 | 22 |
| *Cyprogenia aberti* | 2 | 0 | 0 | 0 | 0 | 2 |
| *Elliptio dilatata* | 5 | 4 | 0 | 0 | 1 | 10 |
| *Fusconaia ebena* | 2 | 1 | 2 | 2 | 1 | 8 |
| *Fusconaia flava* | 1 | 2 | 5 | 0 | 0 | 8 |
| *Lampsilis cardium* | 3 | 3 | 6 | 3 | 1 | 16 |
| *Lampsilis hydiana* | 0 | 0 | 2 | 1 | 0 | 3 |
| *Lampsilis ornata* | 0 | 1 | 0 | 0 | 0 | 1 |
| *Lampsilis powelli* | 0 | 1 | 2 | 0 | 0 | 3 |
| *Lampsilis teres* | 0 | 0 | 1 | 0 | 0 | 1 |
| *Lasmigona costata* | 1 | 2 | 0 | 1 | 4 | 8 |
| *Ligumia recta* | 1 | 3 | 2 | 0 | 0 | 6 |
| *Obliquaria reflexa* | 0 | 0 | 1 | 0 | 0 | 1 |
| *Pleurobema rubrum* | R* | 0 | 0 | 0 | 0 | 0 |
| *Potamilus purpuratus* | 1 | 0 | 2 | 0 | 0 | 3 |
| *Ptychobranchus occidentalis* | 4 | 3 | 9 | 6 | 1 | 23 |
| *Quadrula metanevra* | 1 | 0 | 0 | 0 | 3 | 4 |
| *Quadrula pustulosa* | 3 | 3 | 7 | 0 | 2 | 15 |
| *Strophitus undulatus* | 0 | 2 | 1 | 1 | 0 | 4 |
| *Truncilla truncata* | 0 | 0 | 1 | 0 | 0 | 1 |
| *Truncilla donaciformis* | 1 | 0 | 0 | 0 | 0 | 1 |
| *Tritogonia verrucosa* | 1 | 0 | 2 | 0 | 0 | 3 |
| *Villosa lienosa* | 0 | 0 | 1 | 0 | 0 | 1 |
| Total Individuals | 49 | 56 | 72 | 42 | 45 | 264 |
| Number of Species | 16 | 13 | 17 | 7 | 9 | 24 |
| Approximate Area ($m^2$) | ** | ** | 120 | 30 | 80 | 230 |
| Approximate Density (#/$m^2$) | ** | ** | 6 | 8 | 6 | |

* R = Relict; ** Defined during quantitative analysis (see Tables 2 and 3)

surveyed for the presence of mussel resources. Due to the presence of shallow shoals, snorkeling and wading techniques were utilized to survey this segment of the Saline River. Quantitative sampling of two mussel beds identified during the preliminary site assessment was conducted on 6 June 2002.

The entire survey area was traversed in an upstream to downstream fashion to locate mussel concentrations and beds. Once mussel resources were located, bed dimensions were determined and a timed search was conducted to establish species composition and approximate abundance. Concentrations and beds were searched for 2/3 to 1 man-hour (m-h). Mussels were hand picked, bagged, identified and enumerated, and then returned to the substrate. Federally endangered and threatened species were photographed to verify identification.

Summary statistics including mean, minimum, maximum, standard deviation (SD), variance and sum were calculated for each stratum and for the entire data set. Quantitative estimates were made using the Sampford method (Huebner et al., 1990) and are outlined in Harris et al. (1993).

Mussel concentrations and beds were generally located in two physical settings: 1) riffle/run areas or 2) along descending banks immediately upstream of riffle/run areas. Mussels were located in water depths, at low flow conditions, ranging from approximately 15 cm to 1 m. Mussels were most often associated with gravel/sand. In some areas, dense mats of algae covered the gravel. Mussels in these areas appeared to be migrating upward from the gravel/sand substrate into the algal mats, which acted as sediment traps. Pools were generally devoid of mussels.

Table 2. Physical parameters, species composition and population and community estimates for Mussel Bed 1 (Unionacea) in the Saline River/Holly Creek Bottoms Area, Arkansas, 2002.

Location: Mussel Bed 1, Head of riffle, NE 1/4 SW 1/4 S25, T2S, R15W, Saline Co.
Latitude: 34.517841, Longitude: -92.567141
Stratum Size: 7 m x 12 m = 84 $m^2$
Substrate: Gravel
Total Samples: 5
Minimum - Maximum density (#/$m^2$): 4.0 - 22.0
Mean density #/$m^2$ (Standard deviation): 11.8 (6.8)

| Species | Number Collected | Percent of Total | Population Estimate |
|---|---|---|---|
| *Actinonaias ligamentina* | 24 | 41.4 | 403±446 |
| *Amblema plicata* | 2 | 3.4 | 34±55 |
| *Cyprogenia aberti* | 1 | 1.7 | 17±45 |
| *Elliptio dilatata* | 7 | 12.1 | 118±152 |
| *Fusconaia ebena* | 2 | 3.4 | 34±90 |
| *Fusconaia flava* | 2 | 3.4 | 34±90 |
| *Lampsilis cardium* | 2 | 3.4 | 34±90 |
| *Lasmigona costata* | 1 | 1.7 | 17±45 |
| *Ptychobranchus occidentalis* | 4 | 6.9 | 67±84 |
| *Quadrula pustulosa* | 7 | 12.1 | 118±90 |
| *Strophitus undulatus* | 5 | 8.6 | 84±123 |
| *Villosa arkansasensis** | 1 | 1.7 | 17±45 |
| Totals | 59 | 99.8 | 991±683 |

*Represents species not found during preliminary searches within study area

Twenty-seven species of unionids were found within the study area (Tables 1 - 3). *Actinonaias ligamentina* was dominant, accounting for 46% of the live mussels examined during preliminary searches. Numerous gravid individuals of *A. ligamentina* and *Lampsilis cardium* were observed within the study area. *Amblema plicata, L. cardium, Ptychobranchus occidentalis*, and *Quadrula pustulosa* collectively comprised 29% of the live mussels.

Mussel concentrations were defined as areas with > 0 and <10 mussels/square meter ($m^2$). Three mussel concentrations were identified within the survey reach (C1: Latitude 34.509686, Longitude -92.566872; C2: Latitude 34.507894, Longitude -92.567352; C3: Latitude 34.504136, Longitude -92.569044). Approximate area of mussel concentrations ranged from 30 to 120 $m^2$. A total of 159 specimens from three mussel concentrations found in the Holly Creek Area included 20 species (Table 1). Approximate mean abundance ranged from 5 to 8 mussels/$m^2$. *Actinonaias ligamentina* was dominant in each mussel concentration. Two *Lampsilis powelli*, a federally threatened species, were found in Mussel Concentration 1.

Mussel beds were defined as areas with ≥10 mussels/$m^2$ and > 50 $m^2$. Collections from two mussel beds made during preliminary searches consisted of 105 live individuals and included 19 species (Table 1), of which *Actinonaias ligamentina* (40%) numerically dominated live individuals. *Pleurobema rubrum* was found only as a relict. One individual of *Lampsilis powelli* was found in Mussel Bed 2. Two individuals of *Cyprogenia aberti*, a state special concern species, were found in Mussel Bed 1.

Sixteen 1-$m^2$ samples yielded 242 individuals. Mean density was 11.8 and 16.6 mussels/$m^2$ for Mussel Beds 1 and 2, respectively. Total bed area was 84 $m^2$ and 203 $m^2$ for Mussel Beds 1 and 2, respectively. *Actinonaias ligamentina* was the dominant species in both mussel beds. The second-most dominant species in each mussel bed was *Elliptio dilatata*. Estimated community numerical standing crop was 991±683 and 3,357±1,163 mussels per bed for Mussel Beds 1 and 2, respectively (Tables 2 and 3).

Shell dimensions were calculated for each species encountered during quantitative analysis of mussel beds (Table 4). No specimens were of legally harvestable size

Table 3. Physical parameters, species composition and population and community estimates for Mussel Bed 2 (Unionacea) in the Saline River/Holly Creek Bottoms Area, Arkansas, 2002.

Location: Mussel Bed 2, Riffle/run at head of braided channel, NE1/4 SW1/4 S25, T2S, R15W, Saline Co., Latitude: 34.515836, Longitude: -92.569088
Stratum Size: 1.) 8 m x 1 m = 128 $m^2$
2.) 5 m x 15 m = 75 $m^2$
Substrate: Gravel
Total Samples: 12
Minimum - Maximum density (#/$m^2$): 0.0 - 26.0
Mean density #/$m^2$ (Standard deviation): 1.) 14.9 (10.0)
2.) 15.8 (7.9)

| Species | Number Collected | Percent of Total | Population Estimate |
|---|---|---|---|
| *Actinonaias ligamentina* | 75 | 41.0 | 1,386±720 |
| *Amblema plicata* | 10 | 5.5 | 185±136 |
| *Alasmidonta marginata* | 1 | 0.5 | 19±40 |
| *Cyprogenia aberti* | 4 | 2.2 | 74±87 |
| *Elliptio dilatata* | 17 | 9.3 | 314±147 |
| *Fusconaia ebena* | 6 | 3.3 | 110±93 |
| *Fusconaia flava* | 6 | 3.3 | 110±85 |
| *Fusconaia/Pleurobema* complex* | 9 | 4.9 | 166±110 |
| *Lampsilis cardium* | 6 | 3.3 | 110±103 |
| *Lampsilis hydiana* | 1 | 0.5 | 18±39 |
| *Lampsilis powelli* | 1 | 0.5 | 19±40 |
| *Lasmigona costata* | 6 | 3.3 | 111±123 |
| *Ligumia recta* | 3 | 1.6 | 56±57 |
| *Ptychobranchus occidentalis* | 12 | 6.6 | 222±107 |
| *Potamilus purpuratus* | 1 | 0.5 | 18±39 |
| *Quadrula metanevra* | 4 | 2.2 | 74±87 |
| *Quadrula pustulosa* | 14 | 7.7 | 258±164 |
| *Strophitus undulatus* | 2 | 1.1 | 37±50 |
| *Truncilla truncata* | 4 | 2.2 | 73±55 |
| *Tritogonia verrucosa* | 1 | 0.5 | 18±39 |
| Totals | 183 | 100.0 | 3,357±1,163 |

* Represents species not found during preliminary searches within study area

based on size restrictions set by the AGFC.

Shells of mussels surveyed in this study appeared to be characteristic of mature populations. The presence of gravid females of several species suggested reproduction might be occurring within these populations. However, the only apparent juvenile encountered was one *Ligumia recta*. There is a need for information on size at onset of sexual maturity for mussels in the Saline River basin. This information could contribute to multi-phase management schemes, such as monitoring population dynamics, suggested by Christian et al. (2000). Future studies should investigate life history characteristics including drainage-specific growth (Christian et al., 2000) and age at sexual maturity.

The introduced Asian Clam, *Corbicula fluminea,* was found throughout the present study area. This species has invaded nearly every major river system in the United States since its introduction sometime during or before the 1920's.

One federally listed threatened species, *Lampsilis powelli*, was encountered during this survey from two new locations. *Lampsilis powelli* is an Arkansas endemic species known to occur in the four forks of the Saline River,

Table 4. Mean ( $\bar{x}$ ) and standard deviation measurements for mussel species from Mussel Bed 1 and 2 in the Saline River/Holly Creek Bottoms Area, Arkansas, 2002.

| Species | (N) | ( $\bar{x}$ ) length (mm) | S | ( $\bar{x}$ ) depth (mm) | S | ( $\bar{x}$ ) width (mm) | S |
|---|---|---|---|---|---|---|---|
| *A. ligamentina* | 99 | 74.1 | 12.9 | 47.7 | 7.9 | 30.5 | 5.4 |
| *A. plicata* | 12 | 74.7 | 13.4 | 53.9 | 7.0 | 33.9 | 4.6 |
| *A. marginata* | 1 | 65.2 | na[1] | 33.3 | na | 31.7 | na |
| *C. aberti* | 5 | 48.2 | 19.5 | 38.8 | 2.4 | 24.8 | 1.0 |
| *E. dilatata* | 24 | 58.4 | 8.7 | 30.5 | 5.4 | 17.3 | 3.2 |
| *F. ebena* | 8 | 43.7 | 10.2 | 37.0 | 8.6 | 22.7 | 4.2 |
| *F. flava* | 8 | 41.0 | 14.6 | 32.3 | 10.0 | 23.0 | 7.6 |
| *F./P.* complex[2] | 9 | 49.9 | 5.0 | 38.8 | 4.7 | 27.0 | 3.6 |
| *L. cardium* | 8 | 80.4 | 13.1 | 52.5 | 5.9 | 39.0 | 5.5 |
| *L. hydiana* | 1 | 63.4 | na | 37.2 | na | 24.3 | na |
| *L. powelli* | 1 | 88.9 | na | 48.2 | na | 36.5 | na |
| *L. costata* | 7 | 97.2 | 16.2 | 49.2 | 7.0 | 26.6 | 4.2 |
| *L. recta* | 3 | 108.7 | 23.2 | 45.7 | 10.9 | 29.9 | 8.9 |
| *P. occidentalis* | 16 | 66.0 | 13.2 | 33.4 | 6.7 | 20.5 | 5.2 |
| *P. purpuratus* | 1 | 39.5 | na | 26.2 | na | 16.2 | na |
| *Q. metanevra* | 4 | 69.2 | 8.1 | 46.6 | 2.4 | 38.0 | 5.3 |
| *Q. pustulosa* | 21 | 49.3 | 8.4 | 40.7 | 8.2 | 27.7 | 4.0 |
| *S. undulatus* | 7 | 45.7 | 19.4 | 27.4 | 10.2 | 17.1 | 8.2 |
| *T. truncata* | 4 | 46.1 | 3.6 | 32.4 | 1.5 | 22.4 | 1.8 |
| *T. verrucosa* | 1 | 53.3 | na | 32.8 | na | 17.9 | na |
| *V. arkansasensis* | 1 | 29.8 | na | 18.8 | na | 12.9 | na |

[1]na = not applicable
[2]*F./P.* complex = *Fusconaia/Pleurobema* complex

mainstem Saline River upstream of Arkansas Highway 270, the Caddo River, the South Fork Ouachita River, and upper mainstem Ouachita River. *Cyprogenia aberti* and *Villosa arkansasensis*, considered imperiled globally by TNC and of Special Concern in Arkansas (Harris et al., 1997), were found within the surveyed area. Mussels exist in areas where the substrate and environmental conditions permit, but these areas are small and subject to natural or anthropogenic disturbances. Management strategies should concentrate on maintaining the quantity and/or quality of habitat throughout the study area in order to sustain viable populations.

As an ecoregional priority, TNC's prospective management activities for the Saline River (including Holly Creek Bottoms) will follow a site conservation plan and will include terrestrial community assessment and monitoring. Assessment, including the results of this study, will promote the identification of key areas such as mussel beds and concentrations and encourage recruitment of landowners or potential partners interested in compatible ecological management options. Conservation and protection of mussel resources on the Saline River may involve runoff reductions streambank stabilization, pollution control and compatible land use promotion.

In order to successfully develop long-term management for rare species populations, qualitative and quantitative monitoring of freshwater mussel populations must be conducted and tailored for target mussel species. Size and distribution data of mussel populations from the Holly Creek Loop could provide the basis for formulation of management strategies to protect reproductive mussels within the Saline River. The information obtained from monitoring activities will establish baseline data that will be used to modify future stewardship activities.

Protection or improvements in the status of mussels in the Holly Creek Loop of the Saline River require proper management of the watershed and cooperative efforts of stakeholders. Private landowners, and personnel from Aluminum Company of America (Alcoa), TNC, AGFC and ADEQ should consider efforts to stabilize existing habitats (i.e. stream bank stabilization projects) and sustain exceptional water quality. Execution of these management

strategies should improve and/or sustain the quality and quantity of vegetative cover in riparian zones, decrease siltation and subsequently improve habitat quality for mussels.

Alcoa provided access to the survey area via a gated road (Sec. 25; R15W; T2S).

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