

found buried in a sand/gravel/mud mixture from 1/2 to 2/3 of its length in a position perpendicular to the substrate.

The continued survival of *A. atropurpurea* is uncertain as the streams in this portion of the Cumberland Plateau are continuously being decimated by coal mining operations. The Marsh Creek population of *A. atropurpurea* is being threatened by extensive strip mining operations which are taking place in the headwaters. Mining operations are also occurring throughout a large portion of the Big South Fork of the Cumberland River drainage in Tennessee.

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THE DISTRIBUTION AND HABITAT OF THE CURTIS' PEARLY MUSSEL, *EPIOBLASMA FLORENTINA CURTISI* (UTTERBACK 1915) IN SOUTHEASTERN MISSOURI.

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ABSTRACT

The distribution of *Epioblasma florentina curtisi* has never been well known. During the past fifteen years it has been reported only from Missouri at one site in Castor River, two sites on upper Black River, one site on upper Cane Creek, a tributary to Black River, and three sites on upper Little Black River. This species was also reported from two sites on upper White River during the early 1900's, but those sites are now impounded. *Epioblasma florentina curtisi* occurs in portions of Ozark streams which serve as transition areas between headwater and lowland stream reaches. This species has been found in slow current in or near riffles, in 4 to 22 inches of water, in a predominantly gravel substrate. Studies of the distribution, abundance, habitat requirements, and status of *Epioblasma florentina curtisi* in Missouri are continuing.

A REVIEW OF THE CURRENT STATUS OF THE UNIONID MOLLUSKS OF THE MISSISSIPPI AND ST. LAWRENCE RIVER SYSTEMS (BIVALVIA: UNIONACEA).

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ABSTRACT

The study of selected stream sites and a review of unionid records of the Ohio State University Museum of Zoology and those of some other institutions reveal an apparent decline in both numbers and species of unionids. These data indicate that many species are endangered in some degree and that some are apparently extinct or nearly so.

ENDANGERED OR THREATENED AQUATIC MOLLUSKS OF THE TENNESSEE RIVER SYSTEM

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It is not customary to begin a brief scientific paper with an

acknowledgement; however, this is not a typical single author paper. A number of Tennessee Valley Authority (TVA) biologists who study mollusks have pooled their recent data and observations to form this composite list of proposed endangered or threatened species. We have chosen this format to shorten presentation space and time for this symposium and to facilitate ongoing Agency evaluation studies. Contributors to this paper are: Steven A. Ahlstedt, Charles Gooch, Billy G. Isom, John J. Jenkinson, Leroy M. Koch, W. Jeffrey Pardue, Lynn B. Starnes and Donald C. Wade. The opinions expressed here are those of the contributors and do not necessarily represent the views or policies of our employer. Any errors in the presentation of this material are the fault of the compiler.

While TVA has funded mollusk studies throughout its 50 year history, during the last ten years (1971-1981) Agency biologists and our contractors have conducted extensive mollusk investigations all across the Tennessee River system. Early in this decade the focus of our work was primarily on the commercially important freshwater mussel species of the larger rivers. After the Endangered Species Act became a Federal law and some resident freshwater mussels and pleurocerid snails were proposed or listed as threatened or endangered, our focus shifted in large part to these species, many of which occur in smaller streams. The recent addition of the Cumberlandian Mollusk Conservation program to our activities (Jenkinson, 1981) has added considerable support to these small-stream studies.

Since 1971 we or our consultants have examined freshwater mussel or snail populations in approximately 1000 miles of Tennessee Valley rivers and streams. Over 800 miles of this survey effort involved scuba or snorkel diving and over 650 miles of our study was conducted in the 1979 and 1980 field seasons. While these numbers may be impressive, the 1000 miles examined constitutes only 2.4 percent of the total length of all streams in the Tennessee River system (42,000 miles). Included in this figure are major surveys of the Tennessee, Powell, Clinch, lower Nolichucky, Paint Rock, Elk, upper Duck and upper Buffalo rivers.

In addition to information on the presence and abundance of species, these surveys have given us the opportunity to observe the current status of a long list of present and former mollusk habitats. We have observed impounded reaches and altered tailwaters below impoundments where few or no mollusks exist; we have sampled reproducing populations from current swept gravel bars that are covered by 15-30 feet of impounded water; and we have sampled classic habitats that retain much of their original diversity.

We now know that a great variety of habitats suitable for mollusk populations persists in this watershed. Long reaches of near-original stream conditions remain, although they are as rare in the Tennessee Valley as they are elsewhere in eastern North America. Many river reaches have been impounded providing extensive habitats for a few species. Downstream from the dams are a variety of habitat types, some of which already support surprisingly diverse faunas. Other reaches may become suitable habitats as proposed pollution abatement and habitat improvement programs are implemented.

In preparing the following list of mollusk species that we feel should be considered threatened or endangered, we have attempted to adhere to three criteria:

- 1) We have restricted our attention to those mollusk species that have been reported from the Tennessee River or its tributaries. Although several of us have

knowledge and opinions about species that do not occur in this watershed, we felt our expertise is strongest in dealing with the local fauna.

- 2) We have chosen to restrict our list to species that fit the definitions of "endangered species" and "threatened species" in the Federal Endangered Species Act. In both cases these definitions are tied to threats to a species throughout "all or a significant portion of its range." We also have chosen not to suggest whether a particular species ought to be considered threatened or endangered. That task is the responsibility of the U.S. Fish and Wildlife Service and both categories enjoy considerable protection under the law.
- 3) The last criterion we applied was that the listing of each species must be supported by our majority opinion. Like any other group of malacologists, we occasionally disagree on individual issues.

The chief result of our deliberations is the following annotated list of twelve species we feel are endangered or threatened in the Tennessee River system. All of these species are endemic to this watershed and, therefore, we have some confidence in recommending them for one or the other of these categories.

Bivalves

- Conradilla caetata* (Conrad, 1834) [= *Lemiox rimosus* Rafinesque, 1831]: only abundant in the Duck River.
- Epioblasma* [= "*Dysnomia*" = "*Plagiola*"] *turgida* (Lea, 1858): last found in the upper Duck River at sites now inundated by Normandy Dam; may be extinct.
- Fusconaia cuneolus* (Lea, 1840): widely distributed in tributary streams; most abundant in the Clinch River; often confused with similar species.
- Fusconaia edgariana* (Lea, 1840) [= *F. cor* (Conrad, 1834)]?: widely distributed in tributary streams; most abundant in the upper North Fork Holston River.
- Lampsilis virescens* (Lea, 1858): now apparently restricted to the Paint Rock River system.
- Lasmigona holstonia* (Lea, 1838)?: a headwaters species that is rare in our collections. We may not be collecting in streams small enough to locate it.
- Lexingtonia dolabelloides* (Lea, 1840): most abundant in the Duck River.
- Quadrula intermedia* (Conrad, 1836): most abundant in the Powell River.
- Quadrula sparsa* (Lea, 1841) (a subspecies or form of *Q. metanevra*?): present only in the Powell River.
- Toxolasma cylindrella* (Lea, 1868): apparently now restricted to the Paint Rock River system.
- Villosa perpurpurea* (Lea, 1861) [= *V. trabalis* (Conrad, 1834)]: only abundant in Copper Creek (Clinch River drainage).

Gastropod

- Io fluviatilis* (Lea, 1831): reduced to populations in the Powell, Clinch and Nolichucky rivers.

During our discussions we also identified the following 25 species which although not restricted to this watershed, appear to be declining in our streams. Each of these species should be added to the Federal list only if it is being impacted throughout "all of a significant portion of its range."

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Bivalves

- Alasmidonta viridis* (Rafinesque, 1820) (per Clarke, 1981): a widespread species not present in our recent collections.
- Cyprogenia irrorata* (Lea, 1830) [= *C. stegaria* (Rafinesque, 1820)?]: an Ohioan species, declining in our streams.
- Dromus dromas* (Lea, 1834): a Cumberlandian species, now in the Powell, Clinch, Tennessee (one site), and Cumberland rivers.
- Epioblasma brevidens* (Lea, 1831) [= *E. interrupta* (Rafinesque, 1820)?]: a Cumberlandian species, declining in some of our streams.
- Epioblasma capsaeformis* (Lea, 1834): a Cumberlandian species, declining in our streams.
- Epioblasma florentina florentina* (Lea, 1857),
- Epioblasma haysiana* (Lea, 1834),
- Epioblasma lenior* (Lea, 1834),
- Epioblasma lewisi* (Walker, 1910),
- Epioblasma torulosa gubernaculum* (Reeve, 1865),
- Epioblasma walkeri* (Wilson and Clark, 1914): this and the preceding 5 species are all representatives of a larger group of Cumberlandian forms that may well be extinct; none of these forms is represented by living or fresh specimens in our recent collections.
- Epioblasma sulcata sulcata* (Lea, 1829): originally present in the lower Tennessee; now only known from the impounded Cumberland River where it does not appear to be reproducing.
- Epioblasma torulosa torulosa* (Rafinesque, 1820): a subspecies of the largest Ohio basin rivers not found by us in the Tennessee River; may be extinct.
- Hemistena lata* (Rafinesque, 1820): a widespread species that seems to be becoming increasingly rare in our streams.
- Leptodea leptodon* (Rafinesque, 1820): a widespread species that has not been found recently in the Tennessee River system.
- Obovaria retusa* (Lamarck, 1819): an Ohioan species that is becoming increasingly rare in the lower Tennessee River.
- Pegias fabula* (Lea, 1838): a widespread species not represented in any of our recent Tennessee River system collections.
- Plethobasus cicatricosus* (Say, 1829): an Ohioan species represented in our collections by a single specimen from the lower Tennessee River; nearly extinct.
- Plethobasus cooperianus* (Lea, 1834) [?= *P. striatus* (Rafinesque, 1820)]: an Ohioan species rare, but still present in the Tennessee and Cumberland rivers.
- Pleurobema clava* (Lamarck, 1819): an Ohioan species only rarely found in the lower Tennessee River.
- Pleurobema oviforme* (Conrad, 1834): a Cumberlandian species which may be declining in our streams.
- Pleurobema plenum* (Lea, 1840): a widespread species (or form?) rarely distinguished from other members of the *P. cordatum* complex.
- Simpsoniconcha* [= *Simpsonaias*?] *ambigia* (Say, 1825) and *Villosa fabalis* (Lea, 1831): both widespread species that have not been found in any of our recent collections.

Gastropod

- Lithasia armigera armigera* (Say, 1821): in the Tennessee River this subspecies (form?) has a more restricted habitat than the other species (forms?) present.
- One freshwater mussel species presently considered en-

dangered on the Federal list purposely has not been included here. Our surveys have located specimens of *Lampsilis orbiculata* in most of the tailwater reaches of the mainstem Tennessee River dams and in the 30 mile reach of the Cumberland River that we have examined. One of our contributors (Koch) has accumulated age and growth data on a population of *L. orbiculata* as sampled by commercial mussel fishermen and has documented continuing reproduction for the last 20 years. Our opinion (as yet not completely substantiated by field data) is that *L. orbiculata* remains the widely distributed, uncommon-to-rare species that it always has been. We see no threat to the continued existence of this species and, for that reason, have chosen not to suggest it for inclusion.

A final comment is required concerning the taxonomic coverage of this list. All of the species we have discussed are members of the bivalve superfamily Unionacea or the gastropod genera *Io* and *Lithasia* (= *Pleurocera* to some). Other groups of native aquatic mollusks have received little of our attention because they are not of commercial importance or because they have not been the subjects of Endangered Species Act issues. We are keenly aware that there may be endangered or threatened species in these other taxa; however, we have not had the occasion or the means to study them in any detail.

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ENDANGERED MOLLUSK STUDIES AT THE US ARMY
ENGINEER WATERWAYS EXPERIMENT STATION
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ABSTRACT

The U.S. Army Engineer Waterways Experiment Station is working on a two-year project, funded by the Office, Chief of Engineers, to collect information on sampling methodologies, biological and ecological requirements, and habitat creation, for the federally-listed endangered mollusks. Information developed from this study will assist Corps of Engineers district biologists working with impact analysis, permit actions and environmental assessments.

INTRODUCTION

The Endangered Mollusk Study is a two-year project funded by the Office, Chief of Engineers, as part of the Environment Impact Research Program (EIRP). This study was designed to provide assistance to federal biologists involved with impact assessments, permit action, endangered species coordination, and directing contractor studies involved with endangered mollusks. This study has three major objectives:

- a. To collect information on sampling techniques for