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# Needs for Research in Biological Conservation of Freshwater Mussels in the Southeastern United States: An Annotated Outline

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## SHORT PAPERS AND NOTES

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**NEEDS FOR RESEARCH IN BIOLOGICAL CONSERVATION OF FRESHWATER MUSSELS IN THE SOUTHEASTERN UNITED STATES: AN ANNOTATED OUTLINE.**—With freshwater mussels being one of the most imperiled groups of organisms in North America, they have received much attention with regard to conservation. To address the conservation needs of the group in a comprehensive manner, a National Strategy for the Conservation of Native Freshwater Mussels has been composed but is still in draft form (R. G. Biggins, R. J. Neves, and C. K. Dohner, unpubl.). The strategy is a product of several state and federal resource agencies, as well as the commercial mussel industry, and was initiated to address the magnitude and immediacy of threats to our native freshwater mussels. Most of the following discussion topics were taken from the National Strategy.

*Distributions.*—Recent surveys of most areas in the southeastern United States have given the current status of mussel distributions, as well as a good idea of which species are in need of conservation measures. However, a few areas remain in need of mussel surveys. A priority should be placed on assessing these areas to determine if imperiled species are present. Also, continued point- and nonpoint-source water pollution, sedimentation, instream sand and gravel mining, channel maintenance, competition with nonindigenous species, and occasional construction of new dams make continued vigilance necessary to keep track of changes in distributions and population demographics.

*Life history.*—For conservation efforts to be successful, fundamentals of an organism's life history must be known. The unique life history strategies of freshwater mussels make such studies especially critical. These studies can be broken down into the following aspects.

**Gametogenesis and spawning:** The gametogenic cycle of a species can be described by noting temporal changes in germ cells within the gonadal tissues. Detailed specific studies have demonstrated a great degree of variability among taxa, even among some closely related species. Further investigations should compare closely related species that occur in different habitats (e.g., comparison of congeners from small streams and large rivers). Knowledge of gametogenic cycles in general, and spawning

dates in particular, is critical for propagation efforts to be carried out. This information may also be useful in other conservation measures, such as timing mussel transplantation, channel maintenance, and other forms of disturbance.

Also important in this aspect of life history studies is the determination of the earliest age at which gametogenesis begins, at what age gametogenesis peaks, how long the peak lasts, and reproductive longevity of a species.

**Brooding strategies:** Life history strategies of freshwater mussels have been classified into two broad categories, bradytic (long-term brooders) and tachytic (short-term brooders) for about 100 years (Sterki, 1895; Ortmann, 1911). However, specific studies have indicated subtle differences among species within these two groups. As with gametogenic cycles and spawning periods, knowledge of brooding strategy is important in a variety of conservation measures, including propagation, relocation, and timing disturbance activities.

**Host fish interactions:** The life cycles of freshwater mussels are unique among bivalves in that they include an obligatory parasitic stage. Fertilization is internal and development of offspring occurs within specialized compartments of the gills, called marsupia. The parasitic larval stage, called a glochidium, is released from the female. Attachment to a host, usually a fish, is required soon after release or a glochidium will not survive. Many species of freshwater mussels are highly host specific. For propagation efforts to proceed, suitable hosts for a species must be known. Also, for reintroduced mussel populations to be self sustaining, suitable host fish must be present and available for infestation. Therefore, knowledge of host fish requirements is necessary to choose areas suitable for reintroductions.

Recent studies have examined fish immune responses to glochidial infestation (O'Connell and Neves, 1999). If these responses can be suppressed, without leaving the host susceptible to pathogens, propagation efforts will be aided by allowing fish to be infested multiple times. Another possibility may be repression of host specificity.

*Population dynamics.*—Definition of a healthy mussel population: All remaining mussel populations have been influenced by human activities, including physical alterations to habitat, changes in water chemistry, sedimentation, and addition of pollutants by runoff or atmo-

spheric deposition. Some mussel communities appear to have stabilized and adjusted to current environmental conditions. If these populations can be proven to be healthy, a series of quantitative parameters describing their fitness should be developed. This information would be useful in assessing the need for conservation measures in other populations.

**Minimum viable populations:** Some of the most imperiled mussel species are those that occur in headwater and tributary streams. Construction of dams on most large and many medium sized rivers has left the habitat of these species highly fragmented. Some of the isolated populations continue to decline, though no ongoing habitat deterioration is evident. One possibility for the gradual disappearance of these populations may be that they have been reduced in density or range below their minimum viable population threshold. Before widespread reintroductions are carried out, minimum viability thresholds should be determined.

A related matter is minimum level of recruitment required for survival and viability of a population. Once densities decline below a threshold of viability, it is only a matter of time before a population disappears by attrition. With mussels being long-lived organisms, these nonreproducing relic populations often remain for years. For augmentation of relic populations with captive-reared juveniles, knowledge of the minimum level of recruitment needed for viability would aid in determination of the level of effort (i.e., number of juveniles) required to save the population.

Minimum viable populations may be another area in which the complexities of mussel life cycles come into play. Habitat fragments large enough to support minimum viable populations of mussels may not be large enough for viability of their host fishes, preventing reproduction in the population. Therefore, similar studies of minimum viable population size should be carried out with known and/or probable host fish species.

**Temporal changes in demographics:** Annual variation in recruitment is well documented in mussel populations (Payne and Miller, 1989). However, causation of the yearly fluctuations remains uncertain. Possibilities include variable concentrations of sperm, which are dependent on river discharge, and inconsistent availability of host fish. Information on the causes of such variability would be beneficial for several conservation measures, such as choosing potential reintroduction sites.

**Ecology.**—Habitat requirements: Generalities of habitat requirements are known for most species. However, detailed specific studies on optimum water chemistry, flow regime, temperature, and substratum size would be helpful in reintroduction efforts as well as in maintenance of captive populations. The possibility of different requirements between juveniles and adults should also be addressed.

**Food requirements:** Mussels occur in mixed communities, with over 60 species documented from a single site (Stansbery, 1964); therefore, some form of resource partitioning mechanism is probably in place. Food is one of the likely candidates for a partitioned resource. If this is the case, specific diets for cultured mussels may increase survivability. Another aspect of these studies should be determination of changes in a mussel's diet throughout its life cycle.

**Mortality factors:** Little is known about the impacts of parasites, disease, predation, and harvest on mussel populations. Mussels are known to serve as hosts for a variety of parasites, including trematodes and unionicolid mites. The effects of these organisms on the survivability and reproductive success of individual mussels should be assessed. Similar studies dealing with disease and predation should also be carried out.

Current management measures appear to be suitable for sustained commercial mussel harvest. However, the actual effects of harvest on population demographics are not known. Some anecdotal evidence suggests that removal of old individuals from a population allows increased recruitment of juveniles. Studies should compare exploited populations with those in nearby protected areas. This information would be useful in management of commercial species and, possibly, in conservation of imperiled species.

**Genetic considerations.**—With recent advances in mussel propagation technology, augmentation of imperiled populations will be an increasingly important conservation measure. Genetic considerations are vital for such endeavors. Genetic compatibility between existing and potentially introduced specimens should be foremost in determining which genetic stock to use for propagation. Therefore, research should

focus on gaining a better understanding of overall mussel genetics as well as examine the problems or benefits of mixing gene pools that have been isolated for less than a century. Another potential problem that should be investigated is flooding populations with specimens propagated from too few individuals.

Recovery plans for most federally protected mussels call for establishment of new populations throughout their historical ranges. This plan entail transplantation of specimens within river systems and possibly between river systems. Because these populations will be isolated, genetic considerations may not be as important as in augmentation of existing populations. However, a better understanding of mussel genetics would be valuable prior to moving mussels from place to place.

*Culture technology.*—Production of juvenile mussels with host fish has been performed for many years. However, recent advances in rearing technology have allowed maintenance of juveniles for much longer periods than were previously possible. Rearing juveniles to larger sizes enhances survival after release into the wild. Further research in the area of culture technology is needed to continue perfection of optimal diets and decrease juvenile mortality.

Artificial culture, circumventing the host fish by using an artificial medium, may simplify mussel propagation in the future. Benefits of using this method include eliminating the added effort and expense required to collect or rear fish and keep them alive for extended periods. Currently, mussels can be cultured with artificial media, but the mortality rate is higher among artificially cultured juveniles than among those transformed by traditional fish host methods. Several aspects of artificial culture are in need of research. One important aspect is evaluation of culture media for possible missing elements that may be necessary for survival past the early juvenile stage. Specificity of culture media among mussel taxa should also be investigated.

*Pollution tolerance.*—Much is known about toxicity of various compounds to mussels. However, gaps in our knowledge exist. Included in future studies should be a determination of suitability of current toxicity testing protocols to protect the various life history stages of freshwater mussels.

*Nuisance species.*—Several species of mollusks, including the Asiatic clam (*Corbicula fluminea*), zebra mussel (*Dreissena polymorpha*), and New Zealand mud snail (*Potamopyrgus antipodarum*), have

been introduced into the waters of North America. All of these species compete with native mussels for food and space. The Asiatic clam is well established in the southeastern United States. Though the Asiatic clam can reach densities of several hundred per square meter, native mussel populations appear to have adjusted to its presence. The effects of zebra mussels on native species are well documented in more northerly areas. However, populations of zebra mussels in the southeast have not yet reached densities high enough to cause problems. Efforts to develop strategies for control of zebra mussels, which have been underway for several years, should continue. Though the New Zealand mud snail is not currently found in the southeastern United States, future consideration should be afforded this snail, which could appear in the region in the near future.

In addition to developing strategies to deal with exotic nuisance species, one line of research has been aimed at developing a protocol and holding facilities for native freshwater mussels in jeopardy of extinction because of competition with exotic species. These efforts should continue as a last ditch effort against extinction of critically imperiled taxa.

#### LITERATURE CITED

- O'CONNELL, M. T., AND R. J. NEVES. 1999. Evidence of immunological responses by a host fish (*Ambloplites rupestris*) and two non-host fishes (*Cyprinus carpio* and *Carassius auratus*) to glochidia of a freshwater mussel (*Villosa iris*). *J. Freshwater Ecol.* 14:71–78.
- ORTMANN, A. E. 1911. A monograph of the naiades of Pennsylvania. *Mem. Carnegie Mus.* 4:79–347.
- PAYNE, B. S., AND A. C. MILLER. 1989. Effects of current velocity on the freshwater bivalve *Fusconaia ebena*. *Am. Malacol. Bull.* 5:177–179.
- STANSBERY, D. H. 1964. The Mussel (Muscle) Shoals of the Tennessee River revisited. *Ann. Rep.* 1964 *Am. Malacol. Union*, p. 25–28.
- STERKI, V. 1895. Some notes on the genital organs of Unionidae, etc. *Nautilus* 9:91–94.
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FRESHWATER MUSSELS IN THE GULF REGION: ALABAMA.—The southeastern United States has the greatest diversity of freshwater bi-