

ANNUAL PERFORMANCE REPORT

Physiological determination of mussel sensitivity to water management practices in the Kiamichi River and review and summarization of literature pertaining to mussels of the Kiamichi and Little watersheds, Oklahoma.

Submitted to:

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By

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STATE: Oklahoma

PROJECT NO: T-10-P-1

PROJECT TITLE: Physiological determination of mussel sensitivity to water management practices in the Kiamichi River and review and summarization of literature pertaining to mussels of the Kiamichi and Little watersheds, Oklahoma.

SEGMENT DATES: August 11, 2003 – June 30, 2004.

A. NEED

(1) Mussel sensitivity to water management practices.

In recent years, southeastern Oklahoman streams have been exposed to drought conditions resulting in lower flow and increased water temperature. This phenomenon has been exacerbated by the practice of holding water in upstream reservoirs, which further reduces downstream water volume and flow and increases temperatures. The summer of 2000 was particularly harsh on freshwater mussel populations. At one site in the Kiamichi River where we have multi-year monitoring data, drought conditions resulted in significant mortality of mussels. Mortality was related to decreased water depth and subsequent increased water temperature. While all mussel species were impacted, more mobile species that could move to deeper water had higher survival rates. Given the projected demands for water use in the region (i.e. water transfers to Texas, reservoirs etc...) it is imperative that we develop a protocol for determining the sensitivity of mussels to reduced water flows (and subsequent increased temperature). If we can predict, from flow and temperature data, when mussel populations are stressed, we may be able to manage water resources to protect mussels from mortality events. This study examines the relationship between stream-flow and thermal refugia for freshwater mussel populations.

(2) Literature review.

The Little River (including its major tributaries the Glover River and the Mountain Fork River) and the Kiamichi River, are threatened by a water development plan to sell water to the North Texas Water Alliance. The plan calls for water to be diverted from the Kiamichi River below Lake Hugo and the Little River near Idabel and below the Mountain Fork River. Changes in the natural flow regime in these rivers may negatively impact freshwater mussel populations, including populations of the endangered Ouachita Rock Pocketbook Mussel, *Arkansia wheeleri*. To determine how changes in the natural flow regime may impact mussel populations, we must first summarize the existing data on mussel populations in these rivers and their ecological requirements.

B. OBJECTIVES

- (1) Collect data on stream flow, water temperature, mussel critical thermal maxima and mussel tissue glycogen content and use these data to create a model that predicts the risk to freshwater mussels from specific flow regimes and temperatures
- (2) Summarize the available body of knowledge on mussel assemblages of the Kiamichi and Little River systems.

C. SUMMARY OF PROGRESS

(1) Mussel sensitivity to water management practices.

We are using a combined laboratory and field approach to develop a predictive model linking stream flow and temperature to freshwater mussel condition. Models have been developed that link physiological condition of marine mussels and zebra mussels to thermal stress. We are modifying these models for freshwater mussels. We will use tissue glycogen content as a measure of physiological stress or body condition. Protocols for measuring glycogen in freshwater mussels are established and have been used as a physiological measure of stress in studies of zebra mussel fouling, handling for propagation and culture, and contaminant loading. This technique should be easily transferable to measures of thermal stress.

In August 2003 we installed hobo continuous temperature loggers at four sites on the Kiamichi River. Two sites, sites 2 and 3 are above the inflow from Sardis Reservoir, and the remaining two sites, sites 4 and 7, are below the inflow from Sardis Reservoir (Figure 1). These sites are long-term monitoring sites for which we have over ten years of mussel assemblage composition and size data, including data on the federally endangered Ouachita Rock Pocketbook (*Arkansia wheeleri*). The hobo loggers record the water temperature every four hours. Loggers were placed at the sites in August, 2003, and left through June, 2004.

In August, 2003 (summer), December, 2003 (fall), February, 2004 (winter) and May, 2004 (spring) we collected tissue samples from mussels at each of the four sites. Our goal was to collect tissue samples from 10 individuals of *Actinonaias ligamentina*, *Amblema plicata*, *Fusconaia flava* and *Obliquaria reflexa* for each season. These species vary in adult size, shell morphology, activity and phylogeny, and thus should encompass the range of physiological responses to be expected in the mussel community. As it was not always possible to find enough of these four mussel species, we also sampled additional mussel species (Table 1). Tissue samples were collected with a non-invasive biopsy procedure and samples consisted of an approximately one square centimeter (approx. 25 ug) of mantle tissue; all mussels were returned to their original location in the river alive. Tissue samples were stored in liquid nitrogen in the field and are now in a -80°C freezer at the Biological Survey. Samples will be analyzed for glycogen concentration in winter 2005. On the same days that tissue samples were collected, we also collected depth and stream flow information from each site.

(2) Literature review.

We are in the process of reviewing all potential information sources on mussel assemblages of the Kiamichi and Little River systems, prioritizing the information according to its relevance for determining ecological flow needs, and identifying representative mussel species. All priority information sources will be reviewed and summarized.

D. FUTURE PLANS

We are currently in year 2 of this study. We are performing laboratory experiments measuring mussel glycogen and activity levels under different thermal regimes, using the suite of species described above. The results of these experiments will predict species-specific critical thermal maxima and will be presented in the final report.

Glycogen samples from the field collections are being stored in a -80°C freezer and will be analyzed this winter and the results presented in the final report.

When we have completed our laboratory experiments and analyzed the field-collected tissue for glycogen content, we will combine these data to create a species-specific and population-specific model that predicts the risk to freshwater mussels from specific flow regimes and temperatures.

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