USGS

# WATER RESOURCES RESEARCH GRANT PROPOSAL

Title**:** Effects of zebra mussel, Dreissena polymorpha, infestation on Lake Dardanelle water quality.

Duration (month/year to month/year): September 1, 1996 through August 31, 1997

Federal funds: $15,151

Non-federal funds: $33,699

Principal investigators' names and university: Charles J. Gagen and Joseph N. Stoeckel, Arkansas Tech University

Congressional district of university where the research is to be conducted: 3rd Congressional District

Statement of critical regional or state water problem:

Zebra mussels, Dreissena polymorpha, were first discovered in Lake Dardanelle in September 1992 and their population has been increasing dramatically since that time. This bivalve mollusk was inadvertently transported to the Great Lakes from Europe in ballast water in the 1980's. Their rapid dispersal has been attributed to barge traffic and the fact that these bivalve attach to hard surfaces (including barges) rather than burrow in sediment like native freshwater bivalves. In the Great Lakes system zebra mussels have already reached extremely high densities and have fundamentally altered the ecology of those systems. Lake Dardanelle is a 13,800 hectare impoundment on the Arkansas River and is a large, shallow, sediment-ladden reservoir more typical of Great Plains systems than the deeper, relatively silt-free systems studied in the northern and eastern United States. We are concerned that high densities of zebra mussels. and associated high filtration rates, could have marked impact on the water quality and ecology of this reservoir and similar reservoirs along the Arkansas. Red. and Missouri Rivers.

Densities of the larval stage (veligers) in our plankton samples increased one-hundred-fold from 1993 to 1994. Veliger density was not as high in the summer of 1995 which provides some hope that zebra mussels will not proliferate in the reservoir: however, it could also be an artifact due to the unusually high Arkansas River flow. The population of adult zebra mussels has been steadily increasing and based on results from other parts of the county the trend is expected to continue for several more years. In northeastern Lake Erie, Dermortt et al. (1993) reported a total mean adult density of 54,3 17/$m^2$ and a mean density of 2,335/$m^2$ zebra mussels larger than 8mm within two years of colonization. At sites in western Lake Erie adult zebra mussels increased 325% between 1988 and 1990, and the population of juvenile mussels increased greater than 900%

(Leach 1993). Adults larger than 10mm in length reached a mean density of 18,457/m2on reefs.

Individual zebra mussel filtration rates range from 0.4 to 516 ml/h depending on shell length (Kryger and Riisgard 1988). Assuming an average filtration rate of 100 ml/h for the larger (10mm) zebra mussels, a population density of 18,457/$m^2$ would filter 1.8 $m^3$ of lake water per hour. This rate would result in the filtration of the entire volume of a shallow reservoir like Lake Dardanelle over 20 times per day. Thus, high densities of zebra mussels could have dramatic effects on the water quality, and consequently, the ecology of infested waters. The effects of the zebra mussel on water quality and ecology of Lake Dardanelle are difficult to predict, because it is a different system (i.e., has different sediment load, water chemistry, thermal regime, aquatic community structure, etc.) from those that have been previously studied. People potentially affected by the changes brought about by the zebra mussel are boaters, swimmers and skiers, anglers, commercial fisherman, lakeshore owners, public water suppliers, agricultural water users, and other groups that use reservoir water.

Statement of results or benefits:

Continuing this study will help us to understand the potential effects of zebra mussel infestation on Lake Dardanelle, and subsequently on other southern reservoirs. It will provide information that can help resource managers cope with the changes in the ecology of Lake Dardanelle. If zebra mussels tie-up a substantial portion of nutrients in Lake Dardanelle, then it is likely that there will be an increase in water clarity and macrophyte production in the reservoir. Phytoplankton and zooplankton populations will probably decrease, which in turn, will impact organisms higher on the food chain (e.g., fish populations). Suitability of the reservoir for recreational uses such as boating and fishing could be strongly impacted.

We are already involved in projects to monitor populations of the zebra mussel and fish in Lake Dardanelle. It is likely that other critical components of the aquatic system will be impacted. We expect the zebra mussel to directly reduce zooplankton and phytoplankton (chlorophylI) concentrations, and indirectly cause an increase in macrophytes as water transparency increases. Current macrophyte densities are low in Lake Dardanelle, but we have less than two complete years of data to support this observation. In addition, changes in a number of important water quality variables including turbidity, suspended solids, conductivity, phosphorous, nitrogen, calcium, pH, oxygen, and temperature are likely to occur. The adult zebra mussel population is not currently at a density likely to impact the above parameters, but the population is increasing and could reach a critical level (Gagen and Stoeckel, 1995). Thus, it is essential that we continue to collect rigorous limnological data before zebra mussels reach high densities. Because key parameters that may be impacted by zebra mussel infestation fluctuate annually, it is imperative that we collect several years of data. Data from tiffs study will be used to establish baseline information on the current status of the reservoir, and will be compared with data collected on Lake Dardanelle from 1972 through the present.