

**South Dakota Department of Transportation
Research Project Statement
Project SD2006-05**

Title: Impacts of Barriers on Topeka Shiner Metapopulations

Problem Description: The Topeka shiner was listed as endangered in 1999 due to an estimated 80% reduction of occurrence throughout its historical range. At the time current information on the distribution of this fish was lacking in South Dakota. Recent studies have found that the Topeka shiner is extant throughout its historical range in South Dakota but population trends are not known. Numerous barriers to fish movement in the Big Sioux River, Vermillion River, and James River watersheds may increase the vulnerability of Topeka shiner metapopulations to local extinction. The extent that metapopulation viability has been reduced is not known.

Although the Department of Transportation has been proactive in modifying culvert designs and changing construction practices to minimize future impacts to Topeka Shiner habitat, many existing drainage structures may act as permanent or intermittent barriers to movement. Research is needed to gather information on which drainage structures constitute barriers, examine population distributions and genetic diversity above and below selected drainage structures, characterize the effectiveness of current culvert design in minimizing interference with movement and assess potential mitigation strategies for existing culverts. This information will allow refinement of mitigation requirements to appropriate levels while insuring the best use of limited funding for both state and local governments.

Importance: This project is of moderate importance. The Department has already taken measures to address Topeka shiner impacts. This research will provide information and recommendations for further refinements based on improved understanding of the issues involved.

Urgency: This project is of moderate urgency. Results from this project could clarify existing procedures which could benefit construction requirements.

Literature Summary: Although literature is available on the Topeka shiner in a general sense, no information directly addresses the research subject area specific to South Dakota. Since South Dakota's historic range for the Topeka shiner is relatively intact, studies involving significant reductions in Topeka shiner populations are not really applicable.

Are Research results already available? Yes If so, how can SDDOT implement these results? Limited information involving Topeka shiner genetics as well as a culvert survey conducted in the affected watersheds can be used as a baseline for developing the research plan. There are no results directly addressing this research.

In summary, does research need exist? Yes Explain: Research is necessary to gather specific information on the potential for culverts to act as barriers and possible methods for mitigation.

Research Objectives:

- 1) Determine if various culvert types, designs, and in-place characteristics are acting as intermittent or permanent barriers to movement of the Topeka shiner.
 - 2) Clarify the effects of culvert types, designs and flow characteristics on Topeka shiner movement and distribution above and below culverts.
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- 3) Develop strategies for mitigating existing culverts and improving new culvert designs to allow fish passage.

Research Tasks:

- 1) Review current literature on Topeka Shiner population distribution, culvert designs and methodologies for determining Topeka shiner movements and characterizing the existence of metapopulations.
- 2) Recommend a study area within a single watershed with a variety of culvert types and conditions based on a prior study assessing potential culvert barriers in the critical watersheds as well as a preliminary survey to appraise suitability.
- 3) Conduct interviews with Department staff in Environmental, Bridge Design and Roadway Design to gather available information on prior Topeka shiner mitigation efforts, current culvert designs and issues associated with culvert capacity and performance.
- 4) Meet with the technical panel to review project scope and work plan including a site specific plan to determine the movement of Topeka shiner through culverts using appropriate methodologies.
- 5) Measure movement of Topeka shiner through culverts and assess community assemblages of fish above and below at least five designated culverts over a two year monitoring period a minimum of twice each year using methods approved as part of the work plan.
- 6) Characterize the hydraulic environment and install or access instrumentation capable of continuously monitoring water flows at each site and throughout the selected watershed during the study period and relate this data to individual culvert flows measured during each sampling period.
- 7) Document habitat in the study area including rainfall and climatology, and its effect on water level fluctuations, water quality, natural barriers, and hydraulics in the context of other potential impactors besides culverts.
- 8) Conduct microsatellite DNA analysis of sufficient representative Topeka Shiner biological samples (a minimum of 10 at each location, if obtainable) both above and below each designated culvert site to characterize and evaluate population genetic diversity and possible isolation.
- 9) Analyze field and laboratory data to develop a comprehensive model of Topeka shiner movement potential and impacts where said movement is impeded or impossible.
- 10) Evaluate effects of culvert type and design on the movement and distribution of fish (including Topeka shiner) within the context of maintaining suitable engineering drainage requirements.
- 11) Make recommendations to improve culvert designs, maintenance or rehabilitation of existing culverts to allow fish passage.
- 12) Prepare a final report and executive summary of the research methodology, findings, conclusions, and recommendations.
- 13) Make an executive presentation to the SDDOT Research Review Board at the conclusion of the project.

Potential Implementation: The results of this research could be used to refine designs for new culverts to optimize the potential for free movement of Topeka shiner populations as well as mitigate problems with existing culverts. In addition, the information collected during this project will clarify the Topeka shiner situation and could allow beneficial modifications to current construction procedures.

Budget Estimate: \$120,000 – 3 years

Funding: SPR

SDDOT Involvement: SDDOT will provide access to department staff for interviews, available information on Topeka shiner preservation efforts, and prior and current culvert designs and hydraulic design and flow considerations in the study watershed. In addition, the environmental staff of the Office of Project Development will make available additional assistance to the researchers with respect to test site selection and appropriate procedures for sample collection.

Recommendation: Contract **Explain:** The Department lacks the expertise and time necessary to perform this research.

Technical Panel:

Charles BerrySDSU
Curt CadyProject Development
Ted Eggebraaten Brookings County
Dan Johnston..... Research
Tom Lehmkuhl..... Operations
Dave MaddenBridge Design
Ginger Massie FHWA

Nathan MoreyProject Development
Daris Ormesher..... Research.
Craig Paukert KSU
Shane Sarver BHSU
Jeff Shearer GF&P
Wayne Stancill USFWS
Steve Wall James River Water Dev Dstrt

