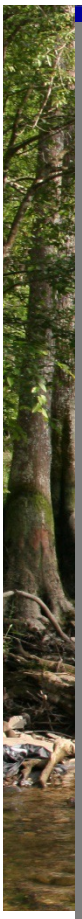
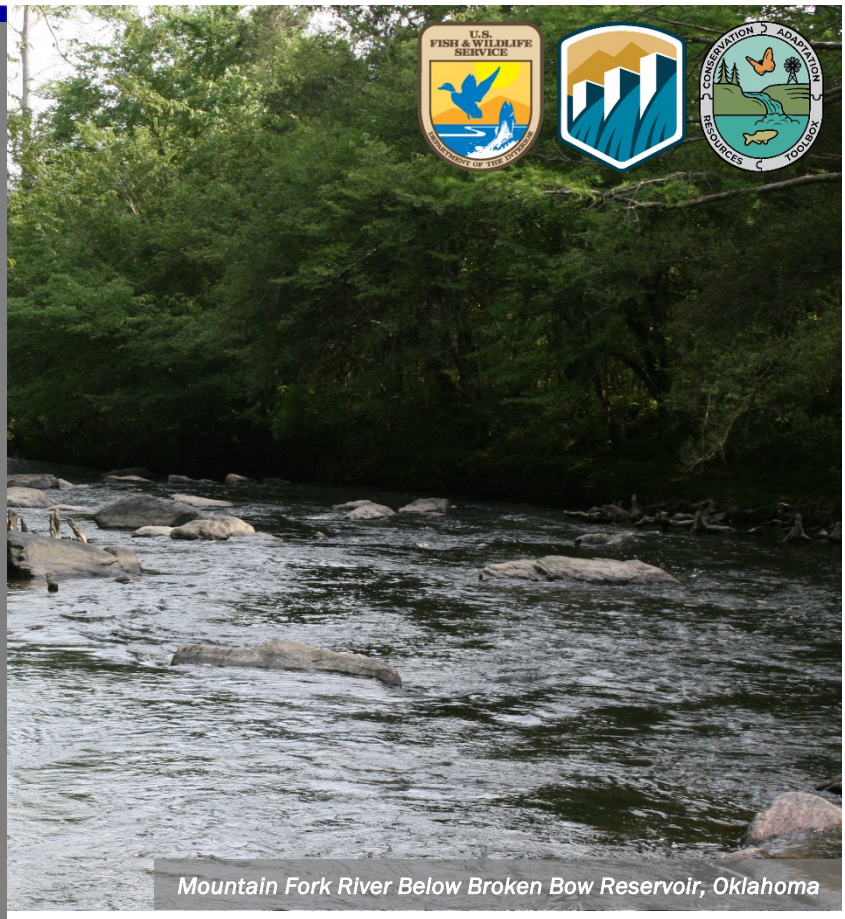


Water Resources

Evaluation of Sustainable Water Availability in Drought Prone Watersheds in Southeastern Oklahoma

AquaStrategies
Water Planning, Science & Engineering

SOUTH CENTRAL
CLIMATE ADAPTATION SCIENCE CENTER



Mountain Fork River Below Broken Bow Reservoir, Oklahoma

The Red River Basin (RRB) covers about 27% of Oklahoma. Communities and wildlife within the Chickasaw Nation (CN) and Choctaw Nation of Oklahoma (CNO) territories rely on its waters, making them vulnerable to hydrology changes for residential, municipal, and ecological needs. Regional models show increased flood risk in the east and prolonged droughts in the west. Recognizing a need to further assess future climate impacts on current water permits and availability, the CN and CNO initiated additional research to enhance drought planning and ecosystem preservation.

KEY ISSUES ADDRESSED

During the 2010 to 2015 drought, several communities in the CN and CNO's jurisdiction were on the brink of water scarcity. As the potential for severe drought increases with climate change, drought planning protects vulnerable communities and ecosystems from harmful effects. In 2016, researchers downscaled climate projections to build a RiverWare water availability model for the Southwest Oklahoma region, providing streamflow projections from precipitation and temperature inputs. However, drought planning requires more extensive information, such as anthropogenic impacts like diversions, return flows, and legal water permit limits. Including these features in the model gives community leaders and ecologists a more accurate estimate of water availability to assess potential drought impacts on municipal water sources and local water-dependent species.

PROJECT GOALS

- Refine the RiverWare model to determine climate change impacts on hydrology and water permits
- Identify the communities with future water shortages and assess water needs
- Evaluate the impacts of wet and dry cycles on flow-ecology relationships

OKA HOLLISO

The Chickasaw Nation and Choctaw Nation of Oklahoma collaborated on a comprehensive guide to water stewardship within their boundaries. The book includes research on policies, agreements, ecology, and water monitoring.

Scientists Discuss Monitoring Equipment and Environmental Flow

PROJECT HIGHLIGHTS

Refining the RiverWare Model: The updated water availability model includes the region's legal water permits, small tributaries, and complex reservoir operations, giving water managers a more detailed view of the constraints and demands on different water sources. This analysis shows where more water supply and infrastructure development are needed.

Applying the RiverWare Model for Communities: Researchers found that half the region's municipalities depend on water permits with decreased projected reliability. This knowledge encourages growing cities to seek out additional water sources as they anticipate heavier water demands alongside decreased water availability.

Water Flow Affects Stream Fish Occurrence: Ecologists combined refined water flow metrics with fish survey records to understand how local stream fish presence changes with water availability. They found significant relationships between fish occurrence and water flow metrics for 77 species, two seasonal differences based on the dates of annual maximum and minimum water flows, and decreased occurrence probability for ten species during dry seasons.

Collaborators

- The Chickasaw Nation
- The Choctaw Nation of Oklahoma
- Aqua Strategies Inc.
- South Central Climate Adaptation Science Center

LESSONS LEARNED

The CN and CNO embrace a holistic approach to water sustainability, prioritizing the well-being of seven generations to come. The Tribes are devoting personnel and resources toward long-term projects that improve water availability, water quality, and ecosystem needs.

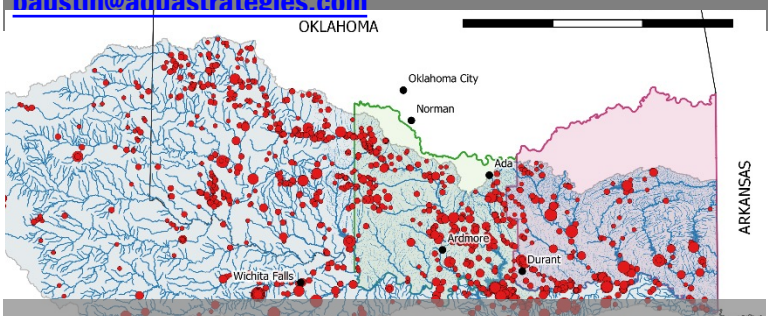
Climate projections must accept uncertainty at all stages since they account for variables such as ongoing climate change, unpredictable natural phenomena, and future levels of human greenhouse gas emissions. Researchers should model multiple scenarios rather than assuming one model is always accurate. This study incorporates two downscaling methods, three Global Climate Models (GCMs), and three Representative Concentration Pathways (RCPs), allowing for more comprehensive drought plans.

Effective climate change solutions require contributions from multiple disciplines, such as ecology, hydrology, biology, and engineering. Communication challenges may arise if the full scope of the project is not expressed to everyone involved. Researchers should develop a clear communication protocol from the beginning to avoid confusion based on varying information needs.

NEXT STEPS

- Support communities as they address water vulnerabilities identified in the report
- Share methods to enhance drought planning in other regions
- Increase awareness for water resource protection initiatives across the RRB

For more information on this project, contact Barney Austin: baustin@aquastrategies.com



Surface Water Rights and Permitted Amounts Red River Basin

CART Authors: Haylee Kraker and Jessica Zimmerman, University of Oklahoma, October 2024.
Photos courtesy of Barney Austin, Aqua Strategies Inc.
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