FRESHWATER MUSSELS AND ENVIRONMENTAL FLOWS IN SOUTHEASTERN OKLAHOMA

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The Little and Kiamichi River watersheds in southeastern Oklahoma are home to 80% of Oklahoma’s freshwater mussel fauna, including three federally listed species and one species proposed for listing. Freshwater mussels are large, long-lived bivalve mollusks that provide habitat, food and other services for river organisms such as insects and fish. Mussels also provide important ecosystem services to humans including water biofiltration and nutrient cycling and storage. Mussels are very sensitive to changes in flow regimes, and particularly to high water temperatures resulting from low summer flows. Adult mussels are highly sedentary; they move very slowly and only short distances if they move at all. Thus, unlike fish, mussels cannot move to new habitat, such as the bottom of a pool, when flows are inadequate. Thus, in-stream flow models developed for fish and other mobile organisms typically do not work well for mussel populations. Establishing environmental flows that safeguard mussel populations will protect mussel populations, help prevent litigation related to endangered species, and sustain ecosystem services provided by mussels.

Extreme hydro-meteorological events such as droughts and heat waves are becoming more frequent, intense and persistent in our region. Southeastern Oklahoma has experienced several severe droughts over the past couple of decades. In long-term studies (1990 – 2012) we found that mussel populations are declining in the Kiamichi River and that these declines are directly linked to low river flows combined with high water temperatures during the summer in drought years. Low river flows were partially a result of decreasing water releases from Sardis Lake. In contrast, during the same time period mussel populations in the Little River, where minimum flows from Pine Creek Lake were maintained, did not decrease.

We deployed automatic data loggers that measured water depth and water temperature at eight sites across the Kiamichi River watershed, and collected discharge data from USGS gages and air temperature data from Mesonet stations. We used these data to develop multivariate regression models that predicted water temperature from air temperature and water depth. We then used these models to create discharge-temperature rating curves that can be used to determine the required discharge from Sardis Lake to maintain targeted stream temperatures and mussel survival. We recommend that during droughts, enough water should be released from Sardis Lake to maintain sufficient flow at both the Clayton and Antlers gages to keep maximum water temperatures below 35°C, the temperature at which many mussels die. The reach between these two gages is critical mussel habitat with three federally listed endangered species.

Environmental flow recommendations for southeastern Oklahoma rivers should incorporate the needs of its rich aquatic life, including freshwater mussels. Mussel flow requirements include habitat permanence of existing beds, overlap with host fish during appropriate seasons, and good water quality. Threats posed by extreme hydro-meteorological events can be mitigated by focusing on water quality during the warmest and lowest flow months of the year.