Understanding temporal and spatial habitat relationships is important to the recovery of the federally threatened Niangua darter Etheostoma nianguae, and other imperiled freshwater fishes. We evaluated resource selection of Niangua darters at four spatial scales within the Osage River Basin in Missouri. Resource selection of Niangua darters was determined at the macrohabitat-, reach-, and watershed-scale in third to sixth order streams within the Osage Ecological Drainage Unit (EDU) in Missouri during summer in 2010 and 2011. Seventy-four reaches containing 651 macrohabitats were sampled using snorkeling from mid-June through August. We examined support for logistic regression models containing variables we believe to influence the presence of Niangua darters at each scale. At the macrohabitat- and reach-scale, depth and velocity had the greatest influence on Niangua darter presence. Niangua darters occupied macrohabitats with depths of 41.4 cm and velocities of 0.20 m s⁻¹ and reaches with depths of 38.5 cm and water velocities of 0.26 m s⁻¹. Depth and velocity selection for lotic species is likely a tradeoff among numerous factors, and for Niangua darters may largely be determined by energetics and biotic interaction. At the watershed-scale, soil and geology characteristics had the greatest influence on the presence of Niangua darters. Streams originating from watersheds dominated by: limestone and dolomite bedrock geology, soils with relatively greater infiltration rates and lower transmission rates, and greater relief have the greatest likelihood of containing Niangua darters. We believe that this model is indicative of watershed characteristic which create stable, coarse, silt-free instream habitats that are favorable for Niangua darters. Our findings suggest that currently anthropogenic land use does not play a dominant role in the presence of Niangua darters however water temperature does. Predicted increases in water temperature in the Ozarks of Missouri of 2-4 °C is likely to have negative effects on populations of Niangua darters, unless thermal refugia is available. We also evaluated microhabitat-scale selection of adult Niangua darters among seasons in two Missouri Ozark streams. Niangua darters were located every other month from July 2011 to May 2012 to determine selection related to six instream habitat variables believed to be important to Niangua darter. We collected 196 locations which we fit to univariate discrete choice models. Overall Niangua darters selected relatively shallower depths during summer compared to spring and fall. Substrate embeddedness and habitat type also fell within the 90% confidence set of candidate models along with depth in spring and fall, respectively, however results differed between streams. Adult Niangua darters in Little Niangua River selected locations with less embedded substrate during spring but in Starks Creek showed no selection for substrate embeddedness. During fall in Starks Creek, adult Niangua darters selected deep runs and pools, the latter having stronger selection, but used all habitats in proportion to their availability in the Little Niangua River. We were unable to detect Niangua darters during winter as they may be using subsurface refugia or migrating outside of sample reaches, the latter being less likely due to their sedentary nature. We collected few juvenile Niangua darters, but the ones collected used habitats with shallower depths and slower velocities consisting of fine or gravel substrates that were greater than 50% embedded.

Across spatial and temporal scales, our results suggest that populations of Niangua darters may benefit from watershed- and reach-scale management that increase habitat diversity (depth and velocity) and buffer against increases in water temperature are likely to benefit population of Niangua darters. For example, reducing soil erosion and increasing/maintaining riparian corridors can: reduce inputs of finer substrate particles into streams, limit stream bank erosion, increase habitat diversity, increase substrate stability, and buffer stream water temperatures. These findings will aid in recovery efforts by helping
managers to better define and evaluate conservation criteria, leading to a better informed recovery effort.