Spatial habitat variation in a Great Plains river: effects on the fish assemblage and food web structure

by

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ABSTRACT

Improperly designed stream crossings may prohibit movement of stream fishes by creating physical or behavioral barriers and may alter the form and function of stream ecosystems. A mark-recapture and geomorphological study was conducted to evaluate fish passage and stream morphology at three types of vehicle crossings (compared to control sites) located on streams in the Flint Hills of Northeast Kansas. We investigated five concrete box culverts, five low-water crossings (concrete slabs vented by one or multiple culverts), and two single corrugated culverts. A total of 6,433 fish were marked April to May 2007 and 709 were recaptured June to August 2007. Fish passage occurred at all crossing types, but upstream movement of recaptured fish was higher at controls (41.1%) than at crossing reaches (19.1%) for low-water crossings. Control sites had more species in common upstream and downstream than did crossings. There was reduced overall abundance of fish upstream at low-water crossings, commonly percids and centrarchids. A comparison of channel and road crossing dimensions showed that box culverts and corrugated culverts would be more effective than low-water crossings at transporting water, sediments, and debris during bankfull flows, and fish passage at base flows. Upstream passage of Topeka shiner (*Notropis topeka*), green sunfish (*Lepomis cyanellus*), red shiner (*Cyprinella lutrensis*), and Southern redbelly dace (*Phoxinus erythrogaster*) was tested through three simulated crossing designs (box culverts, round corrugated culverts, and natural rock) across 11 different water velocities (0.1 m/s to 1.1 m/s) in an experimental stream. Upstream movement did not differ among designs, except natural rock crossings had lower movement than box or corrugated culverts for red shiners. A greater proportion of Topeka shiners moved upstream at higher velocities. These results suggest that crossing type affects fish passage and the morphology of the stream, although water velocity in different crossing designs alone may not be a determining factor in fish passage. Low-water crossings had the greatest impact on fish community and movement, but barriers to fish movement are likely caused by other variables (e.g. perching). Use of properly designed crossing structures has great promise in conserving critical stream habitat and preserving native fish communities.