Report as of FY2007 for 2006MT108B: "Student fellowship: Effects of road culverts on eastern Montana prairie fish assemblages"

Publications

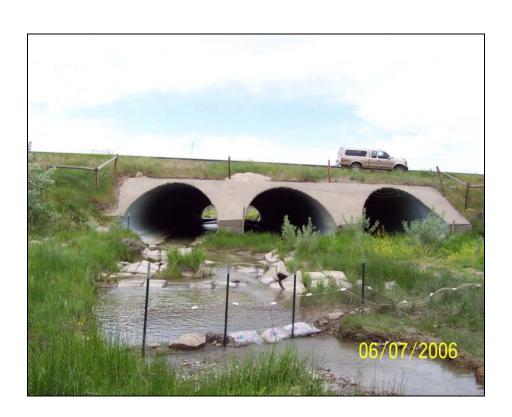Project 2006MT108B has resulted in no reported publications as of FY2007.

Report Follows

2006 Water Center Fellowship:
Progress Report

Effects of Road Culverts on Eastern Montana Prairie Fish Assemblages

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<u>Abstract</u>

Road culverts can serve as obstacles to fish migrating between seasonal habitats. The development of new roads, as well as the repair and upgrade of existing roads has led to research addressing the effects culverts have on fish populations. The majority of this research has focused on salmonid species, but the total effect road culverts have on species continuity in small, prairie streams is largely unknown. This study examines the effects road culverts have on prairie fish assemblages in the lower Yellowstone River drainage. Because many of the diverse number of fish species found in prairie streams are small bodied, and likely poor swimmers, culverts may act as significant barriers to passage. Culvert characteristics that limit passage include outlet drop, high water velocity, and insufficient water depth. Several tributaries of the Yellowstone River with a variety of culvert crossings will be examined. Passage abilities of prairie-fish species will be assessed indirectly using software models, and directly using mark-recapture experiments. The longitudinal distribution of fish species will also be examined for trends related to restricted passage. This study will ultimately provide insight into the effects culverts are having on an assemblage of fish that not only represents a recreational resource, but also contributes the overall diversity of a "healthy" ecosystem. Fish managers and engineers alike could also gain valuable information on the relationships of culvert type and discharge on fish passage efficiency. This could lead to more effective culvert designs and installations.

<u>Accomplishments for 2006</u>

Objective 1: Examine the physical and hydraulic characteristics of culverts associated with fish passage.

- Installed water height data loggers at five culverts in PVC stilling wells. Stream discharge was recorded throughout the summer to create a stage-discharge relationship. These data will be used to estimate water velocities in the culverts, and will be used for both the indirect and direct assessments of fish passage.
- Physical dimensions and channel cross sections associated with each culvert were measured. These data will be used for the FishXing software model (indirect assessment).
- Mark-recapture experiments were conducted at two different flow levels at all five culverts. This was done to examine the effects of water depth and water velocity on fish passage.

    $\Rightarrow$ Preliminary results show that fish movement was not significantly different through culvert versus natural reaches ($P>0.05$). This suggests that water depths and velocities found in these culverts were similar to those of natural stream reaches.

Objective 2: Examine how species and total length of fish affect passage capabilities.

- As mentioned above, mark-recapture experiments were conducted twice at each culvert crossing. The predominant three to four species captured in the vicinity of the culvert were used for each experiment. Species included: creek chub *Semotilus atromaculatus*, brassy minnow *Hybognathus hankinsoni*, flathead chub *Platygobio gracilis*, longnose dace *Rhinichthys cataractae*, sand shiner *Notropis stramineus*, and white sucker *Catostomas commersoni*.

  ⇒ Preliminary results show that fish movement through culverts was similar to that of natural reaches for all species tagged throughout the study. One exception to this finding occurred during very low flow conditions. In this case, movement of longnose dace was lower through a culvert reach than through its corresponding reference reach. During this experiment, other species (creek chub and white sucker) successfully passed the culvert. This suggests that passage conditions may be different for each species of fish.

- Fish of different size classes were used during each mark-recapture experiment to examine the effects of body length on passage capability. Because some species' maximum length was equal to the minimum tag length, only creek chub and white sucker were able to broken down into different size classes.

- The FishXing software will be used to indirectly assess fish passage for each species used in the mark-recapture experiments (where available) to compare against the results of our direct observations (mark-recapture).

Objective 3: Examine how passage capabilities influence the longitudinal distribution of prairie fish.

- A total of 13 sites were sampled for fish species composition and relative abundance in both Clear (10 sites) and Sand Creeks (3 sites). The sites were sampled twice throughout the summer to account for some species recruiting to the gear as the summer progressed. Sites were 300m in length, and were sampled using 6.35mm mesh seines. The sites were selected so that three equally spaced sites were located above and below each stream crossing. The exception to this was in Sand Creek, where only one site was established above the crossing due to lack of water. Additionally, on Clear Creek only one site can be found above the uppermost crossing due to access complications. At each site, habitat variables including thalweg depth, wetted width, and dominant substrate were measured as well.

  ⇒ Preliminary results show few differences in species richness and relative abundance above/below each culvert crossing. This suggests that in these streams, culverts are having little effect on the spatial distribution of fish.

$\Rightarrow$ Preliminary results show little difference in the habitat variables measured above/below culvert crossings.

Additional work conducted:

- Capture efficiency using seines and backpack electrofishing appeared to vary in relation to in-stream habitat and turbidity. Therefore, capture efficiency was measured at a subset of mark-recapture sites. To determine capture efficiency, reaches upstream and downstream of the culvert were closed at either end using 6.35-mm mesh block nets. 30 fish per reach were then marked with a pelvic fin clip, and placed in their respective reaches. Duration of these studies was the same as the direct assessment experiments. After 48 hours, the same method of recapture (seining and electrofishing) was used to collect the fish in each reach. Fish were counted and examined after each pass with the seine and with the electrofisher. Percent recapture efficiency was calculated as the total proportion of fish recaptured after three passes of seining and three passes of electrofishing.

- Visible Implant Elastomer (VIE) tags were chosen as the method of marking because of their adaptability to a number of species and size classes, and because we felt they would have the least effect on fish swimming capability. Interspecific body type and color difference, as well as tagging error, can affect the retention of VIE tags. The unknown loss of tags can adversely affect mark-recapture experiments. Therefore, a pilot study to determine the retention of VIE tags was necessary. This study involved tagging 30 fish representing the predominant species and size classes, and placing them in a cage with 30 unmarked fish in the stream for 48 hours. Fish were then examined by a field technician for VIE tags, and a percentage representing retention rates after 48 hours was calculated.

  $\Rightarrow$ Results from this pilot study show 100% retention and easy identification of VIE tags after 48 hours. Species tagged included creek chub and white sucker.