CULVERT BARRIERS TO LOTIC AQUATIC ORGANISM MOVEMENT IN THE WESTERN UNITED STATES: THE MAGNITUDE OF HABITAT FRAGMENTATION AND APPROACHES TO REMEDIATION

Michael J. Furniss, Pacific Northwest Research Station, Corvallis, OR

Culverted road-steam crossings traditionally have been designed for hydraulic efficiency. Unfortunately, hydraulically efficient road crossings often create barriers to aquatic organism passage by interrupting the continuum of stream form and process. There are hundreds of thousands of culverts installed on streams that impede access to habitat essential for the viability and survival of aquatic biota. The mechanisms for habitat fragmentation by culverts include excessive velocity of flow, inadequate depth, and perching of the outlet creating an insurmountable jump. Modern assessment techniques have been applied over large areas in recent years, and a sampling of the results will be given with estimates of the degree and distribution of the problem in the United States. The U.S. Forest Service is developing a design approach for "stream simulation" that maintains habitat connectivity and geomorphic process. The basics of stream simulation design and alternatives will be described.

The Forest Service has produced a software model – called FishXing-- that facilitates assessing and designing stream crossings. Pronounced "Fish Crossing", this software is designed to assist engineers, hydrologists and fish biologists in the evaluation and design of culverts for fish passage. It is free and available for download at the FishXing website.

FishXing models the complexities of culvert hydraulics and fish performance for a variety of species and crossing configurations. The model has proven useful in identifying culverts that impede fish passage, leading to the removal of numerous barriers. As a design tool, FishXing accommodates the iterative process of designing a new culvert to provide passage for fish and other aquatic species.

FishXing is an interactive software package that integrates a culvert design and assessment model for fish passage. The software models organism capabilities against culvert hydraulics across a range of expected stream discharges. Water surface profiles can be calculated for a variety of culvert shapes using gradually varied flow equations. The program then compares the flows, velocities and leap conditions with the swimming abilities of the fish species of interest. The output includes tables and graphs summarizing the water velocities, water depths, and outlet conditions, then lists the limiting fish passage factors and flows for each culvert.

Version 3 is a complete rewrite of previous versions based on user feedback and our own experience in the field of fish passage and engineering, and is expected to be available in the Fall of 2005.

LINKS

FishXing website: www.stream.fs.fed.us/fishxing
FishXing Manual: http://www.fsl.orst.edu/geowater/FX3/help/FX3_Help.html

Michael J. Furniss
Aquatic and Land Interactions
Forestry Sciences Lab
Pacific Northwest Research Station
3200 SW Jefferson Way
Corvallis, OR 97331
(541) 758-7789
mfurniss@fs.fed.us