Culvert Design for Fish and Other Aquatic Organisms

Southeast Fish and Aquatic Species Assessment Workshop
November 15-16, 2006
Kozmo Bates, KB@AquaKoz.com

This presentation focuses on ***stream simulation*** as a method to design stream-road crossings for passage of aquatic organisms.

Streams and roads are linear systems with primary functions of transporting material and organisms across the landscape. Being narrow and linear, they are both highly susceptible to blockages. The junctions of streams and roads can pose obstacles to the other's continuity. In the past, most road-stream crossing design has aimed at protecting the road and minimizing traffic interruptions. Less attention has been given to protecting stream functions, such as sediment transport, fish and wildlife passage, or the movement of woody debris. Not surprisingly many culverts significantly disrupt the movement of aquatic organisms and contribute to impairment of aquatic habitats.

Stream simulation is a method of designing crossing structures with the aim of creating a channel within the structure that is similar to the natural channel. When channel dimensions, slope, and streambed structure are similar, water velocities and depths will also be similar. Thus, the simulated channel should present no more of an obstacle to aquatic animals than the adjacent natural channel.

Culverts designed for fish passage in the past have traditionally been designed by the "hydraulic method." This method is based on a number of hydrologic, hydraulic, and biological estimates, all with uncertainties. The method is described briefly in the presentation as a comparison to stream simulation.

Depending on the stream, many species of aquatic organisms may be blocked and significant damage may be caused to the channel and aquatic habitat. These impacts may be due to blocking the downstream transport of sediment and large woody debris and by fixing the channel in one place vertically and laterally.

Stream simulation supports the ecosystem-based approach to road-stream crossing design and aims to provide full aquatic organism passage; that is, all aquatic and semi-aquatic species should be able to travel through with no greater impediment than the natural channel would offer. The crossing, therefore, acts as neither a barrier nor a filter that passes only certain individuals, species, or life stages. Moreover, because a stream simulation crossing accommodates the full channel width, it does not block the downstream transport of sediment or woody debris. In these ways, stream simulation provides access for all aquatic species in the stream and long-term sustainability of the entire aquatic community.

Much of the work in this presentation was developed in collaboration with:
- Bob Barnard, Washington Department of Fish and Wildlife
and the USFS AOP project:
– Kim Clarkin, San Dimas Technical Development Center
– Bob Gubernick, USFS Tongass National Forest
– Dan Cenderelli, USFS Stream Systems Technology Center
– Kim Johansen, USFS Siuslaw National Forest
– Mark Weinhold, USFS White River National Forest