Wildlife Habitat Connectivity Considerations in Fish Barrier correction projects

The corrections to barriers to fish migration present an opportunity to provide connectivity for other species as well. While not legally required, improving conditions for wildlife movements past our highway system is an important goal articulated in WSDOT’s Executive Order 1031.02, Protections and Connections for High Quality Natural Habitats. A key section of the Executive Order refers to WSDOT’s intention to develop criteria and guidance for the construction of wildlife passage structures. WSDOT’s Fish and Wildlife Program developed Habitat Connectivity Investment Priorities as a means to identify and communicate the highway segments that warrant serious consideration for improvements to benefit wildlife passage.

The following excerpt from WSDOT Executive Order E 1031.02, Protections and Connections for High Quality Natural Habitats, applies:

III. Assuring Protection and Preservation

The Washington State Department of Transportation (WSDOT), in partnership with other agencies, organizations, and the public, will assure that road and highway programs recognize, together with other needs, the importance of protecting ecosystem health, the viability of aquatic and terrestrial wildlife species, and the preservation of biodiversity.

To meet these aims, WSDOT intends:

• To promote and support Practical Solutions and Planning and Environmental Linkages (PEL) as processes that identify potentially affected fish and wildlife habitats as early as possible during the planning process for projects and programs and in preparation of regional and statewide long-range transportation plans. PEL seeks to integrate habitat connectivity and biodiversity plans and other available natural resource information. Transportation planning should recognize and respond to particular concerns and opportunities for habitat preservation and the need for habitat connections. The earlier that habitat concerns are taken up in project planning, the likelier that good habitat approaches to state investment in habitat protection and habitat connectivity can be incorporated into projects.

• To make use of the highway prioritization map known as Habitat Connectivity Investment Priorities as a means to locate specific opportunities to restore habitat connectivity already damaged by human transportation corridors. The identified priority highway segments should be the focus of efforts to reduce wildlife-vehicle collisions and improve connectivity. Long-range planning, highway improvement projects, and highway maintenance all have a role in maintaining and improving connectivity in priority areas. Building and maintaining wildlife crossing structures and barrier fencing are effective actions.
• To cooperate and coordinate with other agencies involved in wildlife habitat protection. This aim will provide for compatibility of natural resource and habitat management in adjacent areas so that wildlife connections provided at roadways will link to functional and permanently protected wildlife corridors. WSDOT further intends to continue its involvement with the Washington Habitat Connectivity Working Group to ensure that this coordination endures.

• To support the use of site appropriate native plant species in roadside landscaping and vegetation management and to protect adjacent natural plant communities.

• To develop and follow design criteria for transportation structures that help promote fish and wildlife movement and minimize habitat degradation. WSDOT recognizes the Washington Department of Fish and Wildlife’s manual, Water Crossing Design Guidelines, as a primary source for information on fish passage designs. The Environmental Services Office has expertise and written materials to support wildlife infrastructure design and should be consulted when projects are being developed.

• To protect and enhance important wildlife habitat areas near highways on highway rights of way in ways compatible with highway operations, and to support efforts to promote the traveling public’s awareness and enjoyment of wildlife in the state.

Habitat Connectivity Investment Priorities
In response to the Executive Order and WSDOT’s long range plan, the Fish and Wildlife Program initiated the identification of Habitat Connectivity Investment Priorities. Site specific priorities for investing in highway improvements to benefit habitat connectivity were developed using GIS data related to habitat networks, collision histories, traffic volumes, and adjacency of public land blocks. Investment priority ranks for the entire state highway system are available on WSDOT’s Environmental Workbench.

The entire state highway system was broken up into one mile long segments. Two separate ranks, one for wildlife-related safety and the other for ecological stewardship, were assigned to segments. Ranks were high, medium, low, or none. Less than 2% of highway segments received high ranks for both Ecological Stewardship and Wildlife-related Safety. A high ecological stewardship rank was assigned to 12% of highway segments and 8% received a high wildlife-related safety rank. A medium rank for Ecological Stewardship was assigned to 16% of the highway system and a medium rank for wildlife-related safety was assigned to 24% of the system.

Discussion
Structure size: Recent research has demonstrated that a number of factors influence wildlife use of structures for crossing roads. Factors include the species (deer, elk, moose, bear, cougar, small mammals, etc.), presence of wildlife fencing, size and shape of the structure, volume of noise from passing vehicles, substrate in the structure, terrain leading to the structure, characteristics of vegetation around the openings of the structure and the amount of human use.
(Allen 2011; Clevenger and Waltho 2000; Schwender 2013). The size and shape of the structure can be described by an openness index (O.I.) which is calculated by multiplying the width (horizontal width or span) by the height (vertical height) of the structure and dividing the product by the length of the structure (See Figure 1 for dimension definitions). The O.I. has been reported in the literature for a number of structures and a minimum O.I. of 0.6, based on measurements in meters, is reported to pass mule deer (Reed and Ward 1985). The equivalent openness, based on measurements in feet, is 2. The openness values that follow are based on measurements in feet.

**TABLE.** Examples of the Openness Index and suitability for different wildlife.

<table>
<thead>
<tr>
<th>Width</th>
<th>Height</th>
<th>Length</th>
<th>Openness</th>
<th>Species suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>4ft</td>
<td>4ft</td>
<td>50ft</td>
<td>0.3</td>
<td>Bobcat and smaller</td>
</tr>
<tr>
<td>6ft</td>
<td>6ft</td>
<td>50ft</td>
<td>0.7</td>
<td>Bobcat and smaller</td>
</tr>
<tr>
<td>10ft</td>
<td>10ft</td>
<td>50ft</td>
<td>2.0</td>
<td>Deer and smaller</td>
</tr>
<tr>
<td>10ft</td>
<td>10ft</td>
<td>100ft</td>
<td>1.0</td>
<td>Bobcat and smaller</td>
</tr>
<tr>
<td>20ft</td>
<td>10ft</td>
<td>100ft</td>
<td>2.0</td>
<td>Deer and smaller</td>
</tr>
<tr>
<td>30ft</td>
<td>20ft</td>
<td>100ft</td>
<td>6.0</td>
<td>Deer and smaller</td>
</tr>
<tr>
<td>50ft</td>
<td>12ft</td>
<td>50ft</td>
<td>12.0</td>
<td>Deer and smaller</td>
</tr>
<tr>
<td>60ft</td>
<td>15ft</td>
<td>50ft</td>
<td>18.0</td>
<td>Elk and smaller</td>
</tr>
</tbody>
</table>

WSDOT has monitored thirty-two structures for at least one year and has determined the O.I. for all of them. Bridges tend to have the highest O.I., ranging from 2.2 to 687.8, while culverts (including box, arch, and round) ranged from 0.07 to 2.9. Ten of the monitored structures, or 31%, were regularly used by elk. Elk are only using bridges with an O.I. ranging from 17.1 to 687.8.

Deer have been documented using 27 of the 32 monitored structures (84%). Structures with the highest deer passage rates had moderate O.I. ratios (2.9, 12.8, and 2.4). The lowest O.I. with consistent documented deer use was a long box culvert located in a well-vegetated ravine with an O.I. of 0.9. One structure with an O.I. of 3.0 saw very little use by deer. This is a culvert with extremely high carnivore use, and the assumption is that high carnivore use reduces use by prey species such as deer. The WSDOT data demonstrates that there are many factors that will influence the use of a structure by wildlife.

While there are many factors that contribute to the acceptance of a structure by wildlife, the O.I. will be used as an indicator of the dimensions of the structure and its potential to pass wildlife. Based on the O.I. and monitored structures with documented use
by deer, we recommend a minimum 10 ft vertical clearance and 20 ft width for most structures. However, increases in one or both dimensions are necessary for exceptionally long structures, generally anything over 100 ft, and for structures that need to be attractive to elk (see Table). See Figure 1 for dimension definitions.

Approaches to integrating habitat connectivity considerations in fish passage projects are covered in a document posted to WSDOT’s intranet:
http://wwwi.wsdot.wa.gov/NR/rdonlyres/A736EEBF-D1EE-4A38-8F26-EA99C2C6BBF5/0/FishPassConsiderations.pdf

Example project photos and plans can be found here:
http://sharedot/eng/dev/envs/fishwl/Photos/Forms/AllItems.aspx

A variety of other resources related to structure size and jumpout and wildlife guard design are available here:
http://wwwi.wsdot.wa.gov/Environment/FishWildlife/HabConnGuidance.htm

References


