Incorporating Wildlife Corridors into Transportation Projects: Design Techniques to Protect Wildlife Habitat and Natural Passageways

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Themes

• Mission & goals
• “Ecological integrity”—what it means
• Incorporating ecological integrity in transportation planning
  – The River Continuity Project
  – Critical Linkages: Evaluating Landscape Connectivity in Massachusetts
The Mission of The Nature Conservancy:

“To protect, the plants, animals and natural communities that represent the diversity of life on earth by protecting the lands and waters they need to survive”
Ecological Integrity

...the long-term capability of an ecological community to sustain its composition, structure and function and thus also its resiliency to stress...
Elements of ecological integrity for freshwater ecosystems

- Hydrology
- Physical habitat structure
- Water chemistry
- Connectivity
- Biological composition and interactions
Hydrology

Flow Regime
  • Timing
  • Frequency
  • Magnitude
  • Duration

Species are adapted to specific regimes...
Habitat suitable for Fallfish

Site4.shp

0.3 cfs

0.5 cfs

1.0 cfs

Piotr Parasiewicz
Physical habitat

Habitat Complexity provided by:

• Vegetation
• Bed material
• Dead wood
• Bed features—pools, riffles, steps, cascades
• Migration of channel over time
Water Chemistry

Water chemistry regime:

- Dissolved oxygen
- Temperature
- Nutrients
- pH
Connectivity

River species need different habitats:
– Seasonally
– Through life history
– Refuge from events
– Genetic diversity

Types of connectivity:
– Upstream-downstream
  • Instream
  • On bed
  • On banks
  • Along floodplain
– With floodplain
Adult Spawning Migrations
Spawning Habitat

Eggs & Alevin

Requirements:

• Clean, well oxygenated gravels
Salmon Fry

Requirements:

• Margin habitats with slow-moderate current
• Sufficient invertebrate prey
• Interstitial spaces
Early Parr

Requirements:

• Habitat with moderate-swift current
• Sufficient invertebrate prey
• Adequate interstitial spaces
Requirements:

• Overwinter cover
• Require larger shelters
• Appropriate water chemistry
• Ability to emigrate from natal streams at certain times of the year

At this stage salmon make extensive movements seeking appropriate winter habitat
Smolts

Atlantic Salmon Smolts
Upstream Movement into Tributaries
(total Atlantic salmon, brook trout, brown trout)

Data: Ben Letcher, Conte Anadromous Fish Research Lab

Graph showing the number of fish moving upstream into two different tributaries from June 2002 to March 2004. The graph includes data from a perched culvert and an open culvert. The y-axis represents the number of fish, and the x-axis represents the months from June 2002 to March 2004.
Biological composition/interactions
Occurrence of some species is dependent on the presence of others.

Freshwater mussels are dependent on specific fish hosts to complete their life cycles.
Interdependence—predator/prey

- River otter: keystone predator
- Complex habitat needs
  - Highly mobile & territorial
  - Large intact riparian zone (100-500m)
  - Complex vegetation structure—fallen trees, thickets, tall grass
Incorporating ecological integrity in transportation planning: tools
The River Continuity Project

- Assessing crossings & dams
- Prioritizing barriers to mitigate
- Site-based solutions
- Policy strategies to prevent future fragmentation

www.streamcontinuity.org
### List of Road Stream Crossings:

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<th>ID</th>
<th>Town</th>
<th>Stream</th>
<th>StreamID</th>
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<th>Standard</th>
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Culvert Problems

Passage problems at culverts can include:

- low flow depth
- outlet drop
- high velocity
FIGURE 7. RESTORATION PRIORITIES

CROSSINGS:
- Red: Priority 1
- Orange: Priority 2
- Brown: Priority 3
- Black: Priority 4
- Green: Not a Barrier
- Grey: No Data

DAMS:
- Red: Priority 1
- Orange: Priority 2
- Brown: Priority 3
- Black: Priority 4
- Green: Not a Barrier

Map produced by TNC, June 2006
Data sources: TNC & Riverways

Restoration Priorities
Implementation: Restoration Projects
MA Stream Crossing Standards (2005)
MA River Continuity Partnership

• Crossings should simulate streams
  - Span 1.2x stream width
  - Natural bed material
  - Match velocity and depth
Validating the River Continuity Project

• Compare accuracy & precision by volunteers vs trained technicians; different flows
• Compare scoring with Fish Xing & 2 “coarse screens”
• Can we use data to predict likely barriers?
• Evaluate standards & recommend updates
• Products 6/30/09
STREAM SIMULATION: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings

Critical Linkages Study

- species + community data = index of ecological integrity
- All communities—terrestrial, wetland, aquatic
- Assess & protect connections
- Mitigate barriers
- Protect land
- Avoid priority areas for new construction
Connected Landscape map of western Massachusetts showing areas of high ecological integrity and potential wildlife corridors.

(The dashed box shows area of inset on the following slide.)
Area of inset map from slide one.

Schematic of analysis that can be done manually in CAPS.

Shows hypothetical change in “highly connected” habitat after allowing for wildlife passage at a specific location.

Schematic of optimization analysis to be developed shows best location for wildlife passage to mitigate impacts of Route 8
many individuals. However, as discussed previously, each agency stands to gain from an ecosystem approach, and work toward common ground is worthwhile.

For this reason, a well-defined process is critical to creating a practical crediting and debiting system. In most cases, the valuation process and outcomes should be based on decisions made earlier in the integrated planning process by the agencies and partners. One way to avoid stumbling blocks would be to define importance based on how much a project contributes to maintaining or increasing connectivity or conservation. Another way would be to consider how a project improves predictability and transparency; a project could be regarded as more important if it raised the level of agencies’ trust that commitments will be honored as negotiated (predictability) or that it enhanced public involvement (transparency).

**Conservation Assessment and Prioritization System (CAPS)**

CAPS, a computer software program developed by the University of Massachusetts, is designed to assess the biodiversity value of every location based on natural community-specific models, and prioritize lands for conservation action based on their assessed biodiversity value in combination with other relevant data. The tool has been used in a pilot effort to evaluate the indirect impacts of a proposed highway project on habitat and biodiversity value for aquatic and wetland communities within the context of other development in the area. For more information, visit www.umass.edu/landeco/research/caps/caps.html.

**Examples of Prioritizing Resources**

As with the Wildlife Action Plan planning process, some States may already have effective processes for establishing and prioritizing the importance of ecosystem resources; examples include Florida, New Mexico, Oklahoma, and Utah. (Descriptions of each follow.) In these States, an interagency team could use the existing methods and apply them at a landscape level.
Critical Linkages Funding and Other Support Provided by:

Federal Highway Administration/ Mass Highway
The Nature Conservancy

CAPS Funding and Other Support Provided by:

MA Office of Energy & Environmental Affairs
Federal Highway Administration
US Environmental Protection Agency
MA Natural Heritage & Endangered Species Program
The Nature Conservancy
MA Department of Environmental Protection
The Trustees of Reservations
Massachusetts Audubon Society

http://www.masscaps.org