

Final report on Oregon Wildlife Linkage workshops hosted by ODFW in 2007

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Summary: The Oregon Wildlife Movement Strategy is an interagency working group to address barriers to wildlife movement in the state of Oregon. To support these goals, Oregon Department of Fish and Wildlife (with agency partners including the Oregon Department of Transportation, Federal Highways, the U.S. Forest Service, the U.S. Fish and Wildlife Service and others) held a series of workshops throughout the state in 2007. The workshops identified wildlife linkages, which are key movement areas for wildlife, with an emphasis on areas that cross paved roads. Workshop participants identified linkage areas for a suite of focal species, including big game mammals, small mammals, amphibians and reptiles. Participants utilized data layers on vegetation; roads; streams; ownership; and other information to identify linkage areas for the suite of focal species found in their region. The result of the workshops is mapped information about the wildlife linkage areas identified across roads in Oregon. This is a first step in the information gathering process, and areas identified will need additional surveys or on-site assessment before appropriate remedial actions are taken to improve habitat connectivity and wildlife passage across state highways. After the workshops, Wildlife Movement Strategy working group members identified priority linkage areas based on six criteria: (1) areas that are also identified in the OCS as Conservation Opportunity Areas; (2) areas that overlap with ODOT's Wildlife Collision Hotspots dataset; (3) areas that are in proximity to public lands; (4) areas that encompass more than one species; (5) areas that were ranked at the workshops as providing high value to species; and, (6) areas that were identified at the workshops as facing significant threats.

Wildlife linkages can be used by transportation planners, land use planners and conservation practitioners. Identifying these linkage areas helps to refine and prioritize information in ODFW's Oregon Conservation Strategy (OCS) by addressing one of its Key Statewide Conservation Issues: barriers to animal movement. Although this project is only a 'first step' towards addressing landscape level habitat connectivity in Oregon, these results are the best information currently available through professional consensus.

Purpose of this document: This document explains the process and rationale for Oregon's Wildlife Linkage Workshops. It provides suggestions for how partners can make use of the dataset to benefit wildlife connectivity in Oregon, and outlines recommendations to implement wildlife linkage solutions for Oregon.

Background

Wildlife need access to habitat for a variety of essential life needs: daily movements to find food or shelter, access to mates or wintering habitat, or dispersal to maintain healthy populations. Loss of habitat connectivity is a major contributor to loss of species and ecosystem services. Recognizing the urgency of this problem, governors of the Western states have commissioned a report on Wildlife Corridors, and established a Western Governors Wildlife Council to implement the recommendations from that report. The initiative recognizes the importance of habitat connectivity in mitigating for global warming, energy siting, land use, oil and gas, and transportation. The Council will build upon and enhance states' efforts to address wildlife habitat connectivity. These efforts will differ among the western states depending on political and ecological factors.

In Oregon, work towards providing for wildlife connectivity is taking place under the Oregon Conservation Strategy (OCS). The OCS is Oregon's State Wildlife Action Plan (SWAP), part of a big-picture framework for conservation. The Strategy uses the best available science to create a broad vision and conceptual framework for long-term conservation of Oregon's native fish and wildlife, and is intended to be a broad framework for all of Oregon. The Oregon Conservation Strategy has identified 'Barriers to fish and wildlife movement' as one of six Key Conservation Issues in the state.

Several other states have initiated similar collaborative efforts to provide for wildlife habitat connectivity, and these efforts provide reference points for Oregon. For example, Arizona has identified wildlife linkage areas via one large statewide workshop that convened all experts and interested clients. Vermont has completed a Geographic Information Systems analysis to show the best areas to provide for wildlife crossings, identifying high- and low- priority habitat and accounting for habitat types, land use information, roadkill information (where it exists), land ownership and conservation management. The results are now being used routinely in the Vermont Department of Transportation. In Colorado, a non-profit group (Southern Rockies Ecosystem Project) provided oversight over a series of technical workshops to identify linkage areas, and continued to work with agencies and conservation organizations to implement wildlife linkage solutions. A common theme among other state and regional efforts is the recognition that providing wildlife connectivity is important to multiple constituencies.

Inspired by other states' efforts, Oregon Department of Fish and Wildlife and Oregon Department of Transportation have invited other agencies and organizations (including the U.S. Fish and Wildlife Service, Bureau of Land Management, Federal Highway Administration, and conservation organizations) to participate in an interagency working group to address Barriers to Wildlife Movement as a key conservation issue identified in the Oregon Conservation Strategy. The Wildlife Movement Strategy working group has identified a multi-step process for data collection and the development of solutions [Appendix 1]. In 2007, agency partners completed one essential component for the Wildlife Movement Strategy by holding a series of linkage workshops throughout the state. The workshops identified wildlife linkages, which are key movement areas for wildlife, with an emphasis on areas that cross paved roads. This document describes the process and rationale for the development of the linkages dataset.

Procedures

Focal species:

Like the Oregon Conservation Strategy, the Oregon Wildlife Movement Strategy aims to provide the greatest conservation benefit to the greatest number of species via a coarse-filter, habitat-focused approach. However, to focus the workshops, a suite of focal species was identified (see Appendix 2). Similar to other connectivity planning efforts, the list included big game, forest carnivores, amphibians and reptiles. These three categories of animals encompass a broad array of wildlife movement needs. For several of these species, there is also concern about the impacts of habitat fragmentation or the direct impacts of roads on populations (see Appendix 2). The focal species were identified in consultation with ODFW biologists statewide, and by consulting the Oregon Conservation Strategy.

Workshop overview:

The approach to the linkage workshops was developed based on reviews and interviews with other states and regions engaged in habitat connectivity planning. Workshop organizers held several planning sessions with agency representatives and road ecology experts, and hosted a technical review session at the joint Oregon-Washington meeting of The Wildlife Society in Spring 2007. Linkage workshops were held in Bend, LaGrande, Alsea, and Roseburg, Oregon, encompassing each of the four ODFW management regions.

To promote group ownership and to increase understanding about different approaches to a common problem, a diverse list of participants were invited to the workshops. Workshop participants included: biologists from state and federal agencies; transportation planners; transportation maintenance; road engineers; conservation organizations; independent biologists; and agency management.

The workshops addressed this key question: “Where is the best place on the landscape to provide for animal movement needs that are essential to life history function, with an emphasis on those areas that cross roads?” Workshop facilitators used this question to focus participants throughout the discussion process. The areas identified at the workshops are based on expert opinion, and will be prioritized using other datasets including ODOT’s Wildlife Collision Hotspots study, which provides one indicator of the adverse effect of roads on wildlife movement. The resulting GIS data layer could be integrated with spatial modeling efforts using information about animal distributions and anticipated movement distances. Other indicators not evaluated in the workshops include habitat fragmentation, species avoidance of busy roads, and changes in dispersal patterns.

Workshop process:

The workshop began with some overview presentations to introduce the issues (see Appendix 3, sample workshop agenda). Participants were first grouped by region (such as basin watersheds; typically 1-2 counties), and identified linkage areas for the focal species using hard-copy base maps (see Appendix 4, sample diagram of breakout groups). Maps were available for each focal species in each region. The second

component of the workshops involved more detailed data collection by species group, and utilized laptop computers to enter data electronically in GIS format. Information used by participants during the workshop included written definitions of terms on the linkage forms and handouts describing the focal species (see Appendix 5, definitions of terms; Appendix 6, linkage form; and Appendix 7, criteria for linkage form). For each linkage area they identified, the participants were asked to identify focal species, characterize type of linkage, barriers, and opportunities, and to rank the value and threats to the focal species (Appendix 6). Participants rotated among maps according to geographic and taxonomic expertise and data availability. In some cases, participants brought supporting documentation or other mapping efforts to provide information about the areas they identified.

Datasets provided at Oregon linkage workshops:

- Waterbodies and/or streams
- COA = Conservation Opportunity Areas from the Oregon Conservation Strategy
- Counties
- Current distribution of Conservation Strategy priority habitats
- Vegetation type using Ecological Systems
- Highways
- Mileposts
- Ownership
- Urban Growth Boundaries
- Oregon Conservation Strategy species modeled distribution (provide by ORNHIC for use as very rough approximations)
- Orthoimagery for the state of Oregon
- ODFW big game winter range

Post workshop steps:

Following the workshop, the planning committee continued to solicit and incorporate information from individuals who were unable to attend. Portland State University student volunteers helped complete digitization and GIS work. Participants were provided an opportunity to review the product in their home agencies or offices. They could provide further documentation, information about their confidence ranking, and any additional information towards filling data gaps. The dataset is based on the best available information known at this time.

Prioritization:

The Linkage Workshops identified over 700 areas that would benefit from addressing wildlife movement needs. However, in response to the financial reality that all linkage areas cannot be addressed at the same time, the interagency working group developed a process to prioritize linkage areas by weighting a suite of attributes.

The prioritization process ranked linkages based on areas that are identified in the OCS as Conservation Opportunity Areas, overlap with ODOT's Wildlife Collision Hotspots dataset, were identified during the workshops important for multiple species, and are connected to public lands (see Appendix 8). Appendix 8 outlines the prioritization criteria.

Results

The complete linkages and priority data sets are available as a GIS shapefile that can be viewed with Arc GIS products (i.e., Arc Info; Arc Map) (to download a copy of the dataset, copy and paste the following link

<https://nrimp.dfw.state.or.us/DataClearinghouse/default.aspx?p=202&XMLname=806.xml>)

GIS permits the comparison of the linkages data sets with other spatial datasets (i.e., habitat mapping; organizational planning datasets for transportation projects; etc). Planners, agencies and some non-profit organizations typically have GIS expertise on their staff and these staff should be consulted to work through any difficulties in accessing the data sets. Maps of the linkage areas can also be viewed as Adobe “pdf” documents, downloadable from the above website.

The linkages data sets represents a “first step” in a larger goal of providing habitat connectivity throughout the state of Oregon. Further work is needed to identify determine specific barriers and opportunities. Wildlife tracking; spatial modeling; land-use evaluations; and collision history are examples of additional data and analyses tasks that will help to refine and focus this process. Specific recommendations for next steps are outlined towards the end of this document.

Who has a role in finding linkage solutions?

Consult with biologists

The linkage areas are the product of expert opinion and in many cases will require on-the-ground surveys to narrow down the most functional linkage areas across the roadway and to confirm sightings of the focal wildlife species. Surveys and monitoring are essential to the success of wildlife passage projects, and to help determine if connectivity provided between two areas actually benefits the focal species. Partners interested in implementing actions to improve linkage areas and to provide for wildlife connectivity should consult with an ODFW or other local biologist to help interpret species needs and for recommended monitoring guidance.

A variety of partners are in a position to take direct action to provide for wildlife connectivity by consulting the linkages data sets. Some suggestions are outlined below.

Conservation Organizations

Conservation organizations are in a unique position to ‘fill the gaps’ in providing for wildlife connectivity. Landowners adjacent to linkage areas may be interested in developing a conservation easement or a management plan for the area, and local conservation organizations such as land trusts are available to facilitate these solutions. Watershed councils and Soil and Water Conservation Districts can incorporate the priority linkage areas in their planning and outreach efforts. The Conservation Registry is a new internet tool for connecting habitat conservation opportunities with potential partners (<http://www.conservationregistry.org/>).

Public land managers

Federal, state, and local land management organizations may be interested in the linkages data sets as tools to help prioritize land management actions on areas including or adjacent to linkage areas, or to guide off-site mitigation actions. Habitat conservation is necessary to retain functionality of linkages.

ODOT and transportation partners

Oregon Department of Transportation has several natural resource agency liaisons, including four ODFW biologists. These personnel are in a key position to recommend wildlife linkage solutions on high priority linkage areas. The liaisons consult on ODOT projects and provide resources to assist with project scoping; develop site- and species- specific passage actions, and help with monitoring.

ODOT biologists can use the linkages data sets as a reference in project scoping and planning to determine whether wildlife linkage solutions are needed for a project given the scope of the project, existing barriers and opportunities, adjacent habitat and land-use, and feasible alternative solutions. ODOT liaisons can also assist in determining suitable placement of alternative solutions or if monitoring surveys are necessary to determine best placement. Supplementary funding from stakeholders such as conservation organizations or other public land managers may be needed because most wildlife and habitat conservation solutions are non-regulated and therefore difficult to fund with traditional transportation improvement programs. This funding needs to be identified on a project-by-project basis. Partnerships for monitoring and maintenance are also important considerations, especially if animal-vehicle collisions are not prevalent. ODOT liaisons and biologists can consult the Best Management Practices guidance document (Oregon Zoo workshop, 2008) for road design solutions, while keeping in mind that wildlife passages considerations vary for each species at each individual site.

Transportation and land-use planners

Planners should consider the linkages data sets early in the planning process to achieve compliance with SAFETEA-LU legislation, as described and discussed at the workshop “Linking Conservation Data with Transportation Planning” (Oregon Zoo workshop, 2008) and in the Western Governors Association Wildlife Corridors Initiative (2008).

Oregon’s fish passage program

Ecological characteristics important for wildlife passage evaluation are also critical considerations in evaluating fish passage. Bridge and culvert modification provides an opportunity to implement low-cost alternatives for wildlife passage. Culverts and bridges can often be designed to promote wildlife movement.

The inventory and assessment of fish and wildlife passage can also be integrated. Information fields to facilitate wildlife passage evaluation could be added to the statewide database on fish passage. Integrating wildlife passage data into the fish passage database is an efficient approach that will be considered as the Fish Passage Inventory project continues. This is an example of how the ODFW is using the linkages dataset and proactive approach outlined in the Oregon Conservation Strategy, and this

approach could be expanded to integrate the dataset with Oregon Department of Forestry, the U.S. Forest Service, and the Bureau of Land Management.

What types of transportation projects may trigger linkage solutions? Some initial ideas

Implementation of solutions for wildlife linkage areas will involve a suite of options ranging from low-cost, opportunistic alternatives such as vegetation manipulation, to more involved projects such as implementing a new crossing structure. Solutions will evolve over time as key partners and funding become established. This section outlines some initial ideas of the workshop conveners.

Solutions for top priority areas:

Highway 97: Recommendations are still being discussed for the section located approximately between Bend and Highway 31, in which the highway is a barrier for mule deer migration. The Lava Butte to South Century Drive project is a three mile stretch of Highway 97 that currently has sections of two, three, and four traffic lanes. Plans are underway to expand the highway through the project area to four lanes. The currently proposed project includes features to minimize deer vehicle collisions and connect habitat on either side of the highway, including fencing along both sides of the highway and two undercrossing structures; one that will be used by wildlife and vehicles and one designed for wildlife alone.

Highway 26 Dayville to Prairie City: Specific methods to address this area have yet to be decided. The biggest problem area is Dayville to Prairie City, where ODOT maintenance remove approximately 500 dead deer from the roadway annually. Deer feed in private agricultural fields on both sides of the highway and cross regularly. Options are being investigated, but are limited by land ownership. The most likely approach will include signage, fencing and crossing structures. Based on the experience of other states, crossings and fencing are some of the most effective methods of reducing deer/vehicle collisions, but construction of overpasses and underpasses will require land acquisition and/or long term agreements with landowners, and loss of land required to build passage structures.

Highway 84 Sandy River to Hood River: The ODOT Scenic Area plan for this area addresses the barrier that the highway poses to a variety of wildlife. The highway limits access between the mountains to the south and many wetlands and ponds to the north. However, based on recent focused road-kill studies by ODOT and the statewide wildlife collision hot spot analysis, animal-vehicle collisions are neither prevalent nor focused in any particular location. Therefore solutions to improve habitat connectivity will require further surveys and coordination with all interested parties.

Interstate 5 in Southern Oregon: Based on the ODOT statewide wildlife collision hot spot study, there are more deer/vehicle collisions along this stretch of highway than anywhere else in Oregon. The reason for the problem area and potential solutions still need to be evaluated.

Species-specific solutions:

Consult species-specific guidelines about dispersal ability and home range (contact Wildlife Movement Strategy working group members for more details or to see summary of species dispersal capabilities compiled 12/16/06). Assess topology and drainage for any existing structures (culverts, etc) that could provide crossing. As appropriate, investigate the placement (location and spacing) of crossing structures based on site and species specific and highway maintenance considerations.

Working in linkage areas that are near Conservation Opportunity Areas:

If the linkage area is near a Conservation Opportunity Area (COA) identified in the Oregon Conservation Strategy, see the on-line COA Explorer <http://nrimp.dfw.state.or.us/coaexplorer/viewer.htm> for partners and documents to consult for additional information about potential partners in conservation. Work with local partners to explore opportunities for easements, land management plans, or engaging local volunteer groups to maintain crossings or other mitigation actions. Include a specific budget for these mitigation efforts, including wildlife crossings if biological surveys and site specific conditions indicate crossings are warranted.

Riparian corridors:

If the linkage area is within or near riparian habitat, see Oregon Plan Riparian Assessment Framework; Fish Passage guidelines; and Forest Practices guidelines to ensure that plans to improve passage are in agreement with long term riparian corridor planning goals. If the linkage area does not contain any riparian habitat, consider other factors to determine a course of action: what were the workshop-ranked priorities for threats to the linkage area? Are there local partners (i.e., Oregon Hunters chapters; 1000 Friends chapters; Friends of Refuge; etc) ready to implement solutions?

Opportunistic solutions for other linkage areas:

Areas that are not identified as priority linkage areas can still provide significant benefits to wildlife. For these areas we recommend opportunistic, lower cost alternatives. For example, if a bridge or culvert replacement is planned within a linkage area, consult with biologists to determine structural features that could enhance wildlife connectivity. ODOT liaisons and staff biologists will be aware of ways to augment existing transportation projects to facilitate wildlife movement, and in consultation with ODOT maintenance and road engineers, can determine where existing crossing structures, such as bridges, could be modified to facilitate wildlife movement. Bridge replacement and bridge repair projects provide an excellent opportunity to implement wildlife linkage solutions, especially when floodplain connectivity is also a project concern. Providing additional width between bridge abutments, for instance, would complement bridge project objectives through reduced abutment maintenance, elimination of scour, and protection of sensitive riparian habitats.

Challenges and recommendations for further work on this project

(1) Challenge: Implementing linkage solutions will require additional funding, or some re-allocation of existing resources. Oversight of this work could be accomplished by a dedicated position, similar to the Fish Passage Coordinator position at ODFW. Such a position could continue work with the conservation community, as well as work with state agency transportation, land use and energy partners. The position would provide oversight to linkage solutions and ensure that adaptive management occurs, and would provide coordinated public involvement to the project. A budget to provide “seed funding” to contribute towards monitoring or technology transfer of wildlife linkage solutions would enhance the effectiveness of this position.

Possible recommendations for funding:

1. The Western Governor’s Association policy resolution on Wildlife Corridors and Crucial Wildlife Habitat has established a Western Wildlife Habitat Council and called for further work on wildlife corridors, emphasizing their importance to land use planning, transportation and energy siting, and wildlife adaptations as climate change occurs. Additional funding to support the initiative is under discussion.

Possible recommendation for funding:

2. See recommendations in Mark Van Putten & David Burwell: “Integrating wildlife action plans with transportation planning and projects: A first look” (2007; presented at North American Wildlife Management conference, & submitted for publication), a review of authorized federal transportation funding allocations to states including private – public partnerships; the federal Transportation Enhancement Program; and context- sensitive approaches to streamline project planning. Other ideas include: private foundations; National Fish and Wildlife Federation; and resource legacy foundations

Possible recommendation for funding:

3. Pursue a new Policy Option Package for ODFW to house wildlife connectivity coordinator position in 2011 legislative session. This would be comparable to the level of investment in several other Western states (e.g., California, Washington, Arizona). The position would work closely with the ODOT, but would also take the opportunity to work with a suite of other partners under the leadership of the Oregon Conservation Strategy. Use funding sources developed above.

Recommendation for agency coordination:

4. Continue to use the Linkages data sets to consider wildlife movement needs early in the project planning process. Work with ODOT long-range planners and others in ODOT Planning to identify the relevant information from the linkages dataset.

(2) Challenge: Public involvement and support will need to be maintained to implement a crossing project. Successful wildlife connectivity efforts in other states such as Colorado, Montana and Washington have reached out to a broad constituency including local groups, conservation organizations, hunters groups and concerned individuals.

Recommendation to enhance public involvement: The Wildlife Movement Strategy working group should continue coordinating with the conservation community using the Oregon Conservation Strategy as an “umbrella” for communications. Work with existing conservation networks, such as “Missing Linkages (SC Wildlands)”, and place-based groups like 1000 Friends to build partnership and buy-in. Use the inter-agency Wildlife Movement Strategy working group to grow these relationships among varied constituents. The working group develop “who’s who” document for the group and direct queries to expertise.

(3) Challenge: To implement solutions, additional information will be required for almost all linkage areas identified in the dataset. The linkage areas identified in the datasets are “coarse-scale” professional opinion and in most cases will require on-the-ground surveys to confirm sightings and refine linkage area information for the focal wildlife species identified. Monitoring data is crucial to understand how wildlife are using the linkage area before projects are implemented. Long-term monitoring will inform future decisions regarding wildlife crossing structures and fencing installations.

Recommendation for monitoring: Monitoring should occur associated with individual crossing projects, in consultation with the ODOT/ODFW liaisons and with other consulting biologists. The most informative type of monitoring would involve pre-project surveys and long-term post-project surveys. Monitoring information is needed to take an adaptive management approach to learn from what works and what doesn’t. Provide oversight to link results to adaptive management.

(4) Challenge: Roadside vegetation can influence wildlife linkages and animal-vehicle collisions. Roadside vegetation can contribute to high rates of animal-vehicle collisions by attracting animals to feed next to roads and obscuring visibility, particularly when dense or tall vegetation is in close proximity to the traveling lane. However, roadside and adjacent vegetation can be used to lead animals to existing crossings by mowing, planting low growing shrubs or other use of attractants. Highway planting is a significant investment of funds, but offers an opportunity to use native plants to promote ecological resilience to invasives. Further complicating this issue is that wildlife species can have different forage requirements: what can facilitate movement for one species can be a barrier to another.

Recommendation for vegetation management guidance: Transportation partners (ODOT and local road departments) need guidance on types of roadside vegetation treatments planting that can reduce animal-vehicle collisions while providing suitable habitat at safe crossing opportunities. Effective guidance on vegetation planting will need to be local. Local experts to be consulted on projects include: ODFW district biologists, local federal agency (USFS, BLM) botanists or vegetation managers; and consultation with local seed banks (i.e., Deschutes Seed Bank), the Native Seed Network, and/or the Native Plant Society of Oregon, as appropriate. Ongoing efforts by

ODOT to identify sustainable native roadside vegetation mixes should incorporate these wildlife concerns. ODFW/ODOT liaisons and the Oregon Wildlife Movement Strategy working group are in the best position to implement this recommendation.

(5) Challenge: the work presented here is only one step in a complex, long-term process to provide for wildlife connectivity in Oregon, and was necessarily limited in scope.

Recommendation for further work:

1. Geographic Information Systems (GIS) – based modeling work could complement the expert opinion information collected at the workshops, although this work would require additional funding or resources. Working with Portland State University graduate program in Geography could provide possible collaborators. The Wildlife Movement Strategy working group could provide outreach on the linkages data sets to other agency partners so that the results can be connected with efforts including the Willamette Synthesis Project (TNC); Interagency Mapping and Analysis Project (USFS); and ODOT mapping systems.

Recommendation for further work:

2. Future work on this project could include the assessment of bird habitat and bird requirements. The Wildlife Movement Strategy workgroup could consult with Audubon Society and others who developed Important Bird Areas; Heritage Center datasets on rare bird locations; and other information on migratory bird stopover locations. This work could be done in collaboration with Partners in Flight or other birding associations. This would broaden the scope of the current work.

Acknowledgements

Miranda Wood, Jon Bowers and Matt Lawhead provided technical expertise and oversight to the Geographic Information Systems, database and web applications work. Cilla Coe, Pat Matthews, Gini Stoddard, Michelle Guay, Laura Hoffman, Eric Riley, Ann Kreager, Mike Gebben, Sid Tyler, Carrie Heisler, Vicky Teeters and Kristina Wright provided essential GIS technical support. The USFS, Federal Highway Administration, ODOT and ODFW provided resources to support the linkage workshops.

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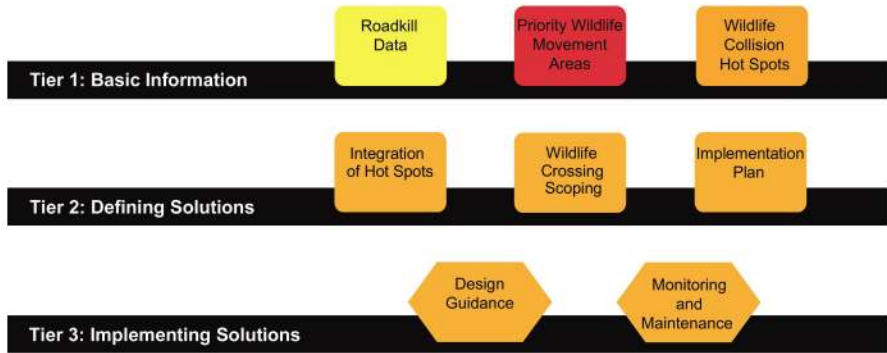
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Appendix 1: Approach to data collection for the Oregon Wildlife Movement Strategy

Steps to Address Wildlife Movement and Road Crossings in Oregon



Yellow = ODOT; Red = ODFW; Orange = Multi Cooperation (ODFW, ODOT, USFWS, USFS, State Parks, BLM, Local Governments)

Appendix 2: Oregon Wildlife Movement Strategy – focal species list

Map (1) Large mammals:

	Reasons for identifying as a Focal Species	Conservation Strategy species?	Optional comments
Mule deer	Human safety concerns; potential concern for impact of roads on animals	No	Winter range identified; Wildlife Collision information collected by ODOT
Elk	Human safety concerns	No	Winter range identified; Wildlife Collision information collected by ODOT
Pronghorn	Potential concern for impact of roads on animals	No	ODFW planned effort to improve distribution mapping beginning ~ Fall 2007
Black bear	Human safety concerns; potential concern for impact of roads on animals	No	See Habitat distribution map in ODFW Bear Management Plan
Columbia white tailed deer	Conservation concerns. Small populations. Habitat loss	Yes	

Map (2) – Medium & small – sized mammals:

	Reason for identifying as a focal species	Conservation Strategy species?
American marten	Habitat fragmentation; concern for impact of roads on animals	Yes
		<i>Special needs identified in Conservation Strategy:</i> associated with late – successional mixed conifer habitats with multi-layer stands, but can use a variety of conifer forests as long as a high density of snags and logs are available for den sites and foraging.
		<i>Limiting factors identified in Conservation Strategy:</i> Low survival rates in fragmented forests
Fisher	Habitat fragmentation; concern for impact of roads on animals	Yes
		<i>Special needs identified in Conservation Strategy:</i> Found in mature closed canopy forests often along riparian corridors; uses hollow logs or brush piles for den sites; preys on small mammals including porcupines.

		<i>Limiting factors identified in Conservation Strategy:</i> Large home range required; low rate of reproduction; specific habitat requirements for dens
Western grey squirrel	Habitat fragmentation; concern for impact of roads on animals	Yes
		<i>Special needs identified in Conservation Strategy:</i> Oak woodland and savanna; mixed oak – pine – fir woodlands; older trees with large limbs; continuous canopy for movements
		<i>Limiting factors identified in Conservation Strategy:</i> Habitat loss and fragmentation; vegetation changes due to fire suppression; residential and urban development.
		<i>Data gaps identified in Conservation Strategy:</i> dispersal patterns and need for canopy control corridors.
White tailed jackrabbit	Habitat fragmentation; Concern for impact of roads on animals	Yes
		<i>Special needs identified in Conservation Strategy:</i> Bunchgrass grasslands
		<i>Limiting factors identified in Conservation Strategy:</i> Distribution naturally limited by habitat; habitat loss and degradation (shrub encroachment)

Map (3) – Amphibians & reptiles:

	Reason for identifying as Focal Species	Conservation Strategy species?
Western painted turtle	Concern for impact of roads on animals or nesting sites; small populations; declining populations; edge of range	Yes
		<i>Special needs identified in Conservation Strategy:</i> Marshy ponds, small lakes, slow moving streams and quiet off-channel portions of rivers; prefer muddy bottoms with aquatic vegetation; need open ground for nesting. Need logs and/or vegetation for basking
		<i>Limiting factors identified in Conservation Strategy:</i> loss of aquatic and nesting habitats (conversion, invasive species)
Northwestern pond turtle	Concern for impact of roads on animals or nesting sites; small populations	Yes
		<i>Special needs identified in Conservation Strategy:</i> Marshes, streams rivers, ponds and lakes. Sparsely vegetated ground nearby for digging nests. Basking structures such as logs
		<i>Limiting factors identified in Conservation Strategy:</i> Loss of aquatic and nesting habitats (conversion, invasive plants; long period for young in nests)
Columbia	Concern for	Yes

spotted frog; Oregon spotted frog	impact of roads on animals; small populations; declining populations; range retraction	<i>Special needs identified in Conservation Strategy:</i> permanent pond, marsh and meandering streams through meadows for breeding and foraging; especially with bottom layer of dead and decaying vegetation
		<i>Limiting factors identified in Conservation Strategy:</i> Slow to reach reproductive maturity; invasives (predation, competition); siltation; lowering of water tables through downcutting of stream channels
Western toad	Concern for impact of roads on animals; declining populations	Yes
		<i>Special needs identified in Conservation Strategy:</i> Wetlands, ponds and lakes for breeding; extensive, sunny shallows with short, sparse or no vegetation for egg laying and for tadpole schools to move widely as they forage on organic mud and surface diatoms
		<i>Limiting factors identified in Conservation Strategy:</i> Loss of breeding habitat due to changes in water level management; pathogens; siltation; roadkill adjacent to major breeding sites; recreational impacts. Explosive breeders
Red legged frog	Concern for impact of roads on animals; small populations; declining populations	Yes
		<i>Special needs identified in Conservation Strategy:</i> Ponds and wetlands with shallow areas and emergent plants; access to forest habitats (wetland, upland)
		<i>Limiting factors identified in Conservation Strategy:</i> Loss of egg laying habitat; predation and competition from invasive species
Foothill yellow legged frog	Concern for impact of roads on animals; declining populations	Yes
		<i>Special needs identified in Conservation Strategy:</i> Special needs: Slow moving streams with coarse substrate gravel bars, bedrock substrate with potholes and low flow backwaters
		<i>Limiting factors identified in Conservation Strategy:</i> Range in OR shrunk because of habitat loss from inundation and other hydrologic modifications; loss of gravel bars and low flow nursery areas; sedimentation
General habitat for herptiles (amphibians and reptiles) was identified in most workshops, rather than species-by-species approach.		

Appendix 3: Example workshop agenda

Linkage workshop for ODFW Southwest Region - Wednesday August 15, 2007
Umpqua National Forest office, 2900 Stewart Parkway [Diamond Lake meeting room] Roseburg

Overarching workshop question:

“Where is the best place on the landscape to provide for animal movement needs that are essential to life history function, with an emphasis on those areas that cross roads?”

Desired outcome: A map-based product that identifies linkage areas for a suite of focal species in the ODFW Southwest Region

Agenda:

8:00	Welcome	ODFW
<i>Opening session and perspective on identifying wildlife linkages:</i>		
8:05	Public lands perspective	Sandra Jacobson, Wildlife Biologist, U. S. Forest Service
8:20	Federal Highways perspective	Michelle Eraut, Environmental Program manager
8:35	Oregon Department of Transportation perspective	Howard “Hal” Gard, Geo-Environmental Section Leader
8:50	Oregon Department of Fish and Wildlife perspective	Steve Denney, ODFW Southwest Regional Manager
9:05	Workshop ground rules and instructions	Audrey Hatch and Simon Wray, eastside ODOT coordinator for ODFW
9:30	Morning break	
9:50	Morning work session:	Breakout groups identify landscape – level linkages by animal type: <ul style="list-style-type: none"> • Large mammals (including big game) • Medium – and small – sized mammals • Amphibians & reptiles
12:00	Lunch break	
1:00	Afternoon work session:	Watershed breakout groups identify local – level linkages
3:00	Afternoon break	
3:15	Afternoon work session continues	Watershed breakout groups continue to identify local – level linkages
4:30	Wrap – up discussion: Report from each workgroup	
5:00	Adjourn	

Appendix 4: Example diagram of breakout sessions (Roseburg linkage workshop)

Linkage workshop breakout groups

Watershed breakout group:	Use animal linkage maps (created during morning session):			Facilitator & GIS support:
	Large mammals	Small mammals (forest carnivores)	Amphibians & reptiles	
Central Point area				Sandra Jacobson, Kathy Roberts Eric Riley
Gold Beach area				Simon Wray Ann Kreager, Mike Gebben
Roseburg area				Audrey Hatch Matt Lawhead

Appendix 5: Definitions of terms

Linkage is defined in the literature as “an arrangement of habitat that enhances the movement of animals or the continuity of ecological processes through the landscape” (Bennett 1999; cited in Gutzwiller 2002). For ODFW’s planned linkage workshops in 2007, a linkage is defined as an area on the landscape that provides for animal dispersal and/or genetic interchange (for example, where they need to move from one location to another to get food, cover or access to mates). A linkage includes a range of habitat configurations; linkage areas are not necessarily uniform in shape. A linkage is identified for a specific population of a species of interest.

A linkage **may** provide some of the following, more specific attributes:

- **Habitat permeability** – refers to the *ability* of species to move freely across the landscape (vs. a linkage, which refers to the *place the animals need* to move around freely; a linkage is one way to provide for permeability)
- **Connectivity** – refers to our human visualization (perception) of how connected the landscape is; usually refers to specific habitat (vs. a linkage, which is a *place that provides for connectivity*, among other things)
- **Corridor** – linear habitat, embedded in a dissimilar matrix, that connects two or more larger blocks of habitat; typically proposed for conservation because it enhances wildlife populations in the larger habitat blocks (i.e., Beier and Noss 1998) (vs a linkage, which is a *larger area that is essential* to an animals’ life history; linkages might encompass some corridors)
- **Core habitat areas** – refers to efforts to identify large blocks of unfragmented habitat for a specific species of interest.

Migratory linkage: provides for dispersal/daily movement; seasonal or life history needs; migratory needs to maintain crucial life history functions

Complementary habitat: discrete spatial areas within an individual's home range so that movement is required to fulfill basic life history needs such as breeding, foraging, water, or hibernation

Landscape-level linkage: large, regional connection between habitats that facilitates animal movement between different sections of a landscape; provides for linkage beyond the immediate/local range of a focal species; and/or linkage that is important in the larger landscape context of a species’ range; not necessarily constricted, but essential to maintain connectivity function in the ecoregion/region

Historic or previously functioning linkage (“missing linkage”): used to function, but functionality has been removed by structure/alteration

Imminently missing linkage: without action in the near future, the linkages’ functionality will be reduced; it is in danger of becoming a “missing linkage”

Connectivity choke-point : Narrow area or “funnel” in the landscape that indicates potential importance for conservation attention

Appendix 6: Linkage information form

Breakout group name: <regional maps>

Breakout group participant names:

Focal species:

Black tailed deer Columbia white tailed deer

Elk Bear

Fisher Marten

W. gray squirrel General 'herp' habitat

Painted turtle Pond turtle

Red legged frog Foothill yellow legged frog

Coastal tailed frog Western toad

Snake (i.e., rattlesnake)

Other: _____

Linkage number:

Brief description (i.e., general habitat type; land cover; land ownership; drainage):

1. What type of linkage is provided for the focal species (Check all that apply):

- (1) Landscape – level linkage
- (2) Migratory link
- (3) Population link (provides for genetic interchange)
- (4) Complementary habitat (daily or seasonal movements)
- (5) Historic or previously functioning linkage (“missing linkage”)
- (6) Imminently missing linkage
- (7) Connectivity choke-point
- (8) Other type of linkage: _____

2. What are the most significant barriers to animal movement within the linkage area:

- (1) Development (i.e., urbanization; planned changes in zoning)
- (2) Roadways
- (3) Natural barriers (i.e., lava beds; etc)
- (4) OHV trails
- (5) Vegetation management
- (6) Concrete median on highway
- (7) Other: _____

3. Score the value of this linkage for this focal species [see definitions and criteria page for guidance]:

- | | | | | |
|-------------|---|----------------|---|------------------|
| 1 | 2 | 3 | 4 | 5 |
| (low value) | | (medium value) | | (critical value) |

4. Score the overall threat to connectivity:

- | | | | | |
|--------------------|---|-------------------|---|-------------------------------|
| 1 | 2 | 3 | 4 | 5 |
| (no threat/secure) | | (moderate threat) | | (severe threat/loss imminent) |

5. What specific opportunities are available to restore, establish or protect the linkage (check all that apply):

- (1) Local support (see question 5a below to provide specific information or suggestions)
- (2) Acquisition potential (see question 5b below to provide specific information or suggestions)
- (3) Conservation easement
- (4) Road design, modification or crossing
- (5) Other: _____

5a. List local supporters, if known:

5b. List potential acquisition agencies or organizations, if known:

6. What existing features facilitate animal movement through the linkage area (check all that apply):

- (1) Waterway
- (2) Riparian habitat
- (3) Continual habitat coverage
- (4) Underpass/bridge
- (5) Other: _____

Appendix 7: Explanation of criteria used on linkage form (handout at workshops)

Linkage form Question 3: Criteria on how to score the value of the linkage for each focal species:

1 = “relatively low value”: linkage provides some connectivity benefit to this focal species, but there are ample, known alternatives to meet the needs of this species

2 = the linkage provides some connectivity benefit for the focal species, but there are some known alternatives to meet the needs of this species

3 = “medium value”: linkage provides significant connectivity benefit for the focal species, but other alternatives can be identified to meet the needs of this species

4 = linkage provides significant connectivity benefit for the focal species, and few alternatives can be identified to meet the needs of this species

5 = “critical value”: linkage provides critical connectivity benefit for the focal species; may provide known individual and/or population level connectivity for this species

Linkage form Question 4: Criteria on how to score the overall threat to connectivity

1 = “no threat/secure”: currently no threats to connectivity function are known or identified. Linkage habitat is healthy, dominated by native species and requires little active management to maintain

2 = potential threat to connectivity is unlikely, or likely to only slightly impair connectivity function in a limited portion of the linkage. Threat is reversible and requires only limited mitigation/restoration. Examples may include cattle grazing in a portion of a linkage or low level, non motorized recreation.

3 = “moderate threat level”: threat is likely to moderately degrade connectivity function of the linkage; threat abatement is feasible, but may require more active restoration or mitigation techniques. Examples may include some channel alterations or low – density development; roads, high density residential development. Road kills may be common within the linkage

4 = threat is likely to seriously degrade connectivity function of the linkage; threat abatement is feasible but requires intense intervention. Examples may include development of recreational facilities (ski area, golf course) or road expansion. May observe higher levels of road kill

5 = “severe threat/loss imminent”: threat is likely to irreversibly eliminate the linkage; examples may include high density residential or commercial development, highway expansion, or dams in critical locations

Appendix 8: Criteria used to prioritize the linkage areas data set

Developed October 2008

Areas that also include Conservation Opportunity Areas, as defined in the Oregon Conservation Strategy, 2006:

- Select areas within or including a Conservation Strategy COA

Areas that are also identified as ODOT Wildlife Collisions Hotspots

- Overlay with ODOT Roadkill hotspots dataset:
 - Top tier: In a Roadkill Hot spot value of High
 - 2nd tier: In a Roadkill Hot spot value of Medium
 - 3rd tier: In a Roadkill Hot spot value of Low

Land Ownership:

- Prioritize areas that offer the potential for long-term conservation management:
 - Top tier: Select areas in state or federal land ownership, or that border on state or federal land ownership
 - 2nd tier: Select areas in city or county land ownership, or that border on city or county land ownership

Areas that encompass multiple focal species:

- Select areas that encompass multiple focal species or groups of focal species

Workshop-scored “threat value”:

- Look at Linkage area – Threat Value:
 - Top tier: Select areas with threat value of 4 or 5
 - 2nd tier: Select areas with threat value of 2 or 3
 - 3rd tier: Select areas with threat value of 1 (or ‘not marked’, if any)

Workshop-scored “value to the focal species”

- Look at Linkage area – Species Value:
 - Top tier: Select areas with species value 5
 - Select areas with species value 3 or 4
 - Select areas with species value 2, 1, or ‘not marked’