

# Washington Wildlife Habitat Connectivity Working Group - *The Washington Connected Landscapes Project*



Presented by: Joanne Schuett-Hames  
Washington Department of Fish and Wildlife  
Co-lead, WA Wildlife Habitat Connectivity Working Group

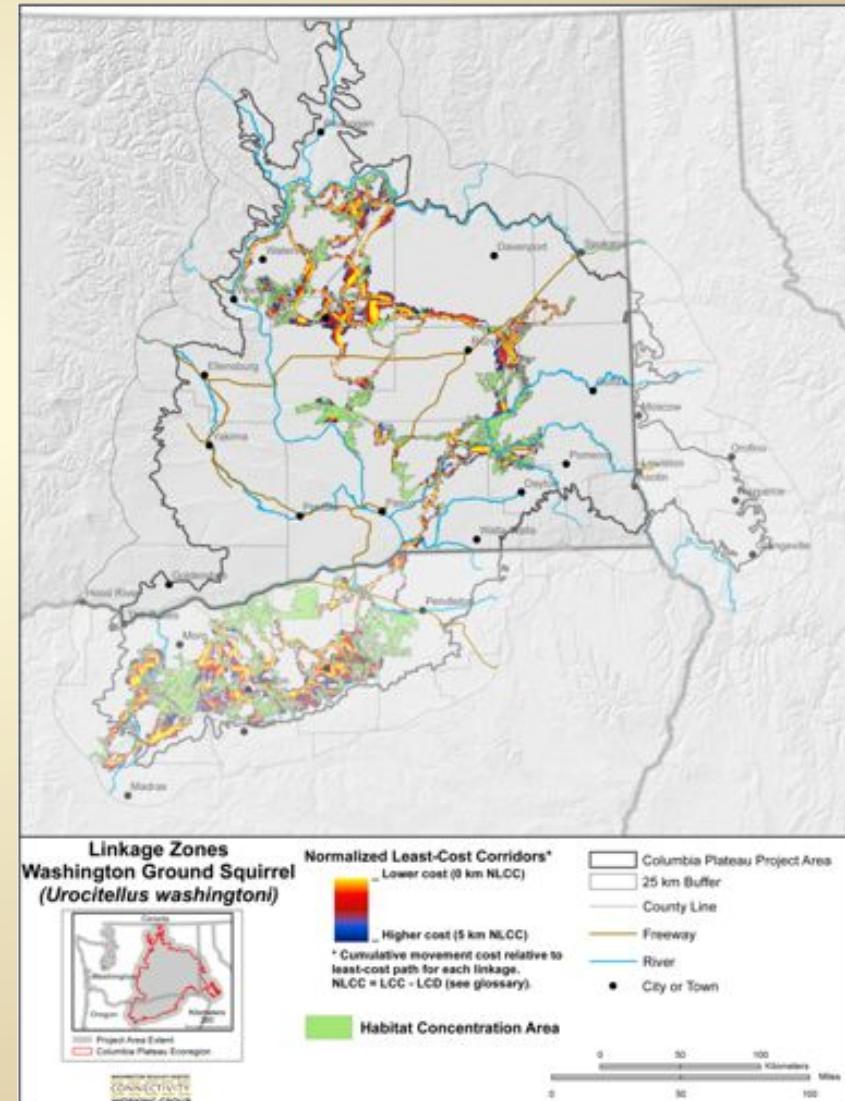
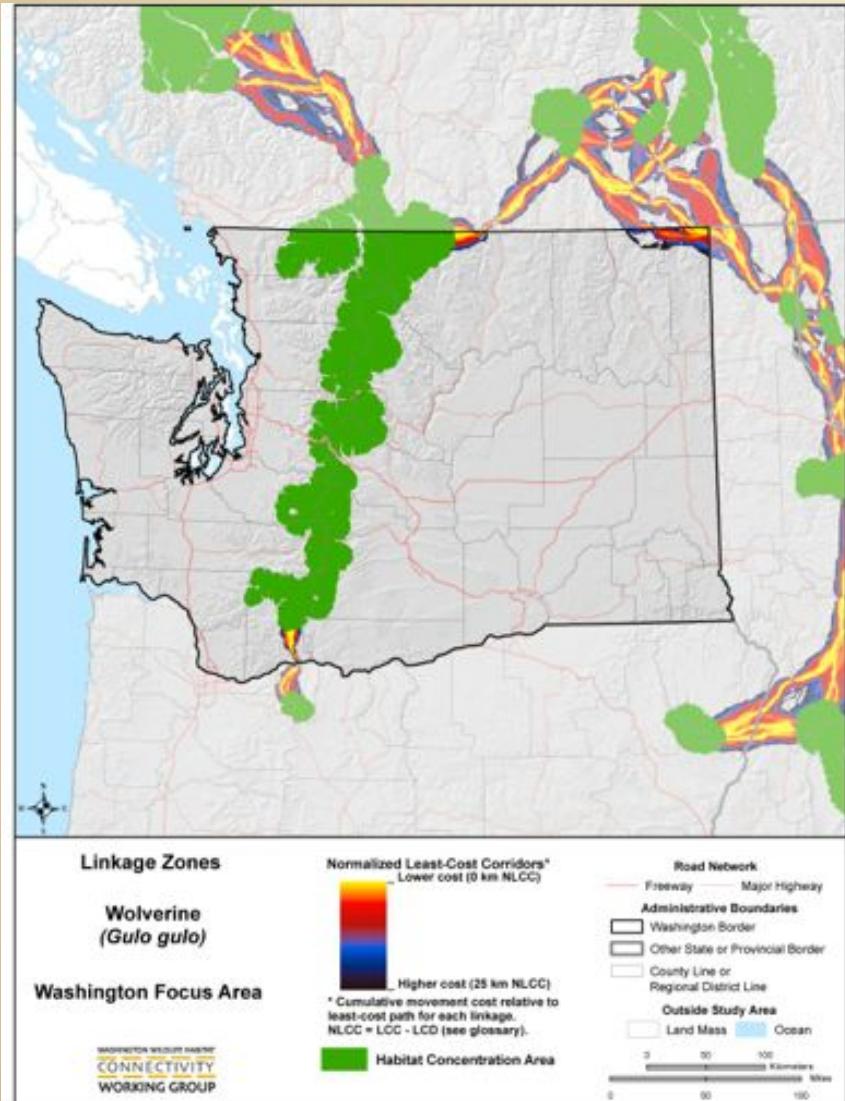
March 6, 2013  
Crown Managers  
Partnership  
Cranbrook, BC

Photo: Rich Watson

# Modeling Transboundary Connectivity

Statewide Scale

Ecoregion Scale



# Transboundary BC / WA Connectivity

## Framework

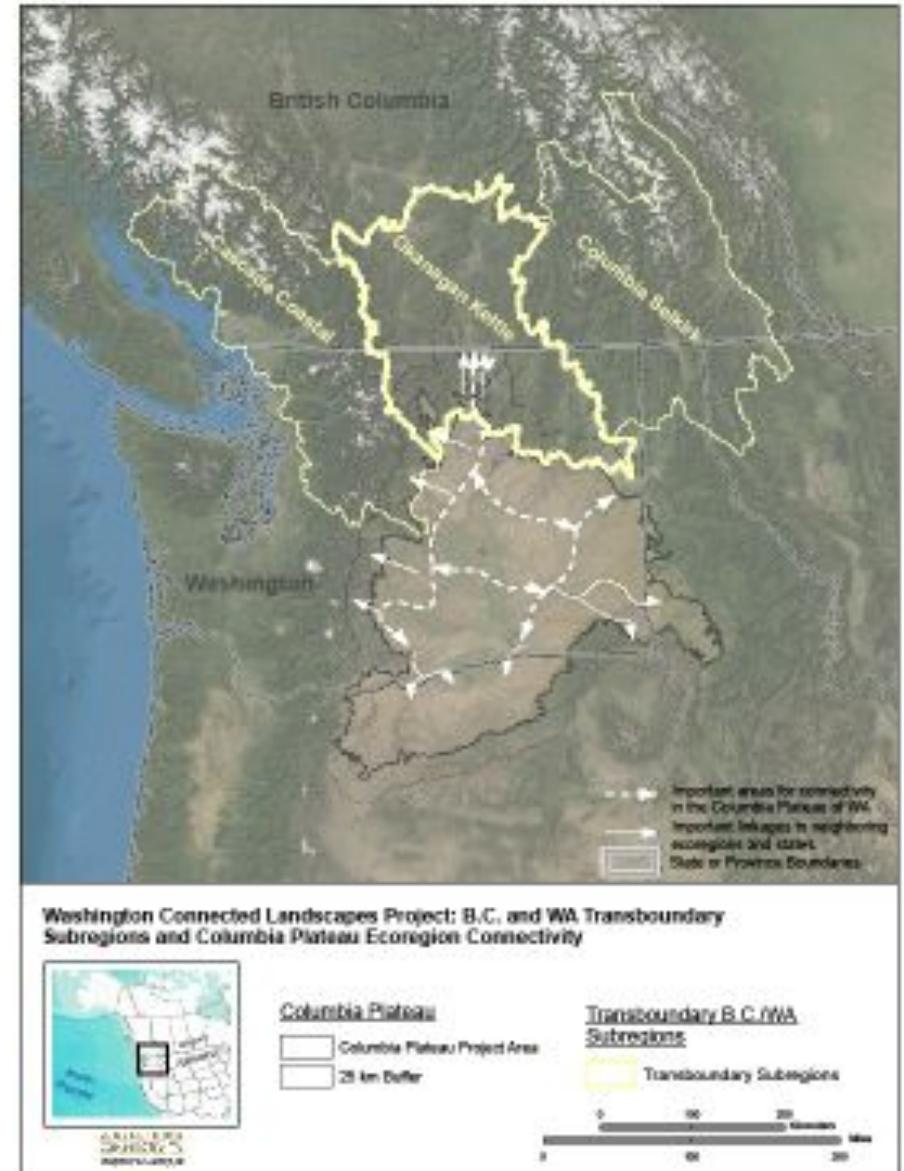
- Transboundary steering committee & analysis workgroups
- Products co-owned by BC & WA participants

## Collaborative connectivity analyses

- Initial focus - Okanagan-Kettle
- Current conditions analyses
- Future land-use patterns
- Identify connectivity priorities

## Climate-connectivity priorities

- WHCWG Climate subgroup / Okanagan-Kettle subregional team / conservation stakeholders
- ID linkages resilient to climate change & likely to promote climate-driven shifts in species ranges.
- User-driven materials to guide climate-connectivity decisions

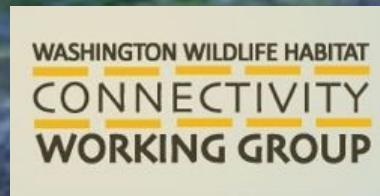


# Overview

- Background: WHCWG
- Approach
- Statewide analyses
- Ecoregion analyses - Columbia Plateau
- Model testing, validation, adaptive management
- Questions?



# Mission Statement



**“To promote the long-term viability of wildlife populations in Washington State through a science-based, collaborative approach that identifies opportunities and priorities to conserve and restore habitat connectivity.”**

# WHCWG Structure

**Full Working Group**  
Science, communications, policy



**Core Team**  
Overall coordination of state  
and ecoregional analyses  
and other work elements



**Subgroups**

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**Implementation  
&  
Communications**

**Current  
Analyses**  
**Focus Areas:**  
- Columbia  
Plateau  
- BC / WA  
Transboundary

**Climate  
Change**

**Interpretation**

**Model  
Testing,  
Validation &  
Adaptive  
Management**

# Acknowledgements:

## Organizations with participants in Core Team & Subgroups of the WHCWG

### Private:

- ❖ Conservation Northwest\*
- ❖ Independent Researchers\*
- ❖ Orianne Society
- ❖ The Nature Conservancy\*
- ❖ The Wilderness Society
- ❖ Washington Conservation Science Institute\*
- ❖ Gifford Pinchot Task Force
- ❖ South Okanagan-Similkameen Conservation Partnership

### Public

- ❖ University of Washington\*
- ❖ Western Transportation Institute\*
- ❖ University of Idaho
- ❖ Washington Department of Fish and Wildlife\*
- ❖ Washington Department of Transportation\*
- ❖ Washington Department of Natural Resources\*
- ❖ Washington State Parks and Recreation
- ❖ B.C. Ministry of Parks
- ❖ Western Governor's Association\*
- ❖ U.S. Bureau of Land Management\*
- ❖ U.S. Fish and Wildlife Service\*
- ❖ U.S. Forest Service\*

*\*Core Team Participant*

# Acknowledgements:

## Funding and In-Kind Support Critical to our Efforts

- ❖ Generous contributions of WHCWG participating organizations, reviewers, and other collaborators
- ❖ Great Northern and North Pacific Landscape Conservation Cooperatives
- ❖ Northwest Wildlife Conservation Initiative, supported by the Doris Duke Foundation
- ❖ U.S. Fish and Wildlife Service (State Wildlife Grants)
- ❖ U.S. Fish and Wildlife Service (WA Recovery Funding)
- ❖ Wildlife Conservation Society, supported by the Doris Duke Foundation
- ❖ Bureau of Land Management
- ❖ Wilburforce Foundation
- ❖ National Science Foundation
- ❖ TransWild Alliance
- ❖ 444S Foundation
- ❖ ARCS Foundation



*Lower Crab Creek Linkage Area*

# Products Summary

## Analyses:

- Statewide connectivity analysis (*WHCWG 2010*)
- Statewide climate connectivity analysis (*WHCWG 2011*)
- Columbia Plateau Ecoregion connectivity analysis (*WHCWG 2012; addendum products under development*)
- Columbia Plateau Ecoregion climate connectivity analysis (*WHCWG 2013*)

## GIS Files:

- Analyses GIS files and metadata (statewide, climate, Columbia Plateau)

## ***Model Testing and Validation Reports to be available in 2013:***

- *Greater Sage-grouse*
- *Black Bear*
- *American Marten*

## Available at:

<http://waconnected.org>

<http://databasin.org> (interactive data layers)

# Products Summary cont.

## GIS Toolkits:

- Linkage Mapper GIS toolkit (*McRae, B.H. & D. Kavanagh 2012*)
- HCA Mapping GIS toolkit (*Shirk, A. 2011*)
- Climate Mapper GIS toolkit (*McRae, B.H. & D. Kavanagh 2013*)
- Barrier Mapper Connectivity Analysis Software (*McRae, B.H. 2012*)
- Centrality Mapper Connectivity Analysis Software (*McRae, B.H. 2012*)
- Pinchpoint Mapper Connectivity Analysis Software (*McRae, B.H. 2012*)



# Extensive Use of Analyses

## Examples:

- WSDOT - state highway retrofits
- USFS & BLM planning
- USFWS --- supporting biological opinions, HCPs, refuge planning
- EPA – using climate results to ID green infrastructure
- WDFW - informing recovery plans
- WDFW, others - guiding on-the-ground species recovery
- WDFW, CNW, others - in support of land acquisitions
- Western Electric Coordinating Council -- transmission line planning
- WGA Crucial Habitat Project – inclusion of connectivity data

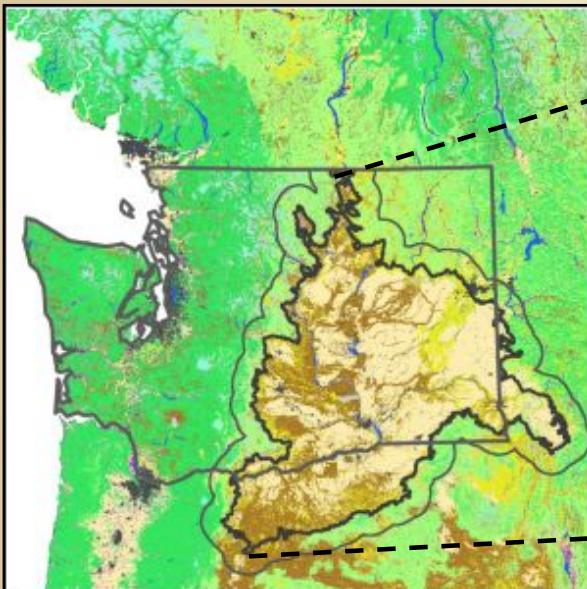


Photo by Gregg Thompson

# Approach: Analysis Scales

Statewide Scale

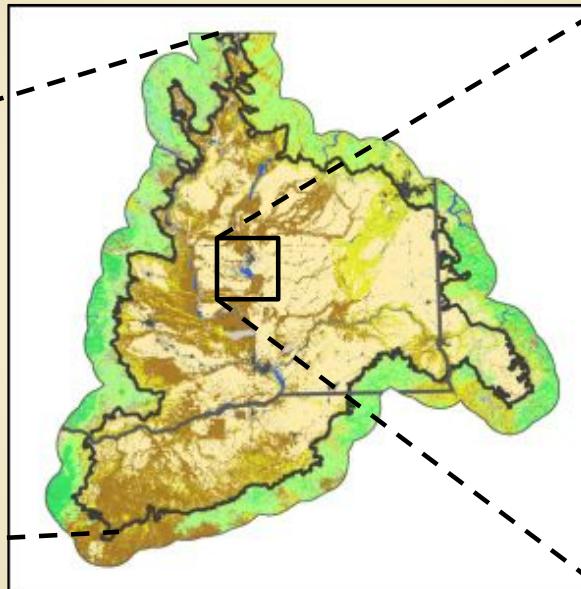
Coarse



Ecoregion Scale

Local Scale

Fine



- Emphasizes wide-ranging wildlife species and broad patterns of ecological integrity
- Identifies areas important for statewide connectivity
- Informs finer-scale analyses

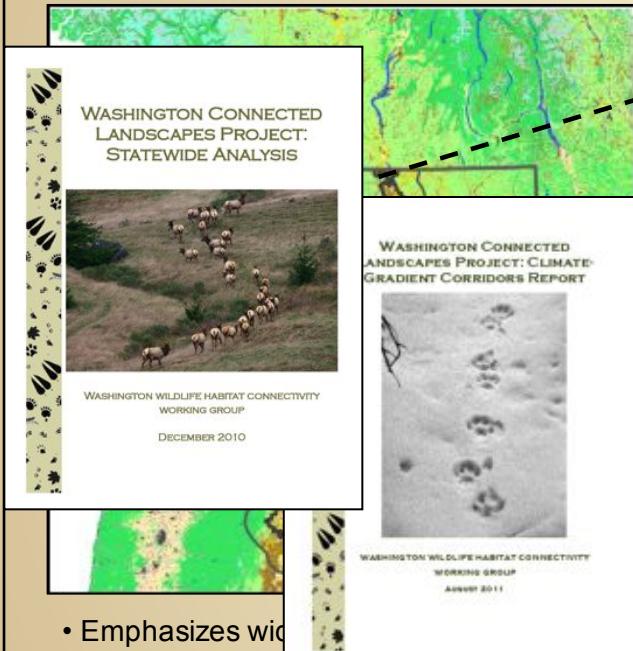
- Emphasizes wildlife species with smaller geographic ranges
- Focuses on particular habitat types
- Increases resolution of HCAs and linkage patterns
- Identifies areas important for ecoregional connectivity
- Identifies areas where local-scale analyses are warranted

- Emphasizes wildlife species with small ranges or local significance
- Can be accomplished by local organizations
- Provides sufficient detail for project-scale action

# Analysis Scales

## Statewide Scale

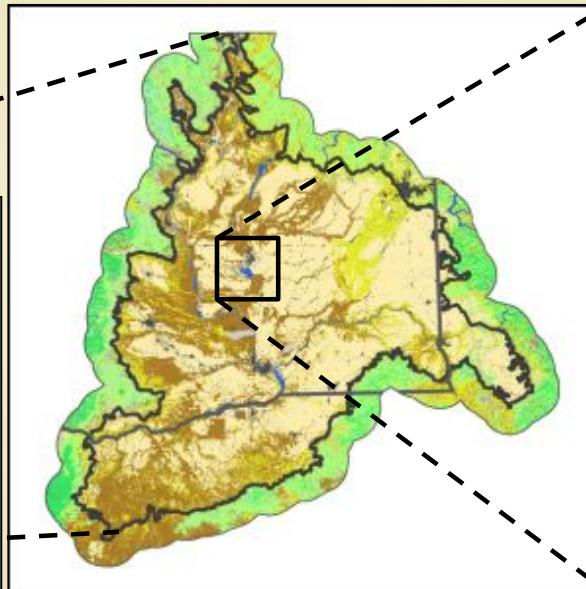
Coarse



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## Ecoregion Scale

Coarse → Fine



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## Local Scale

Fine



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# Analysis Scales

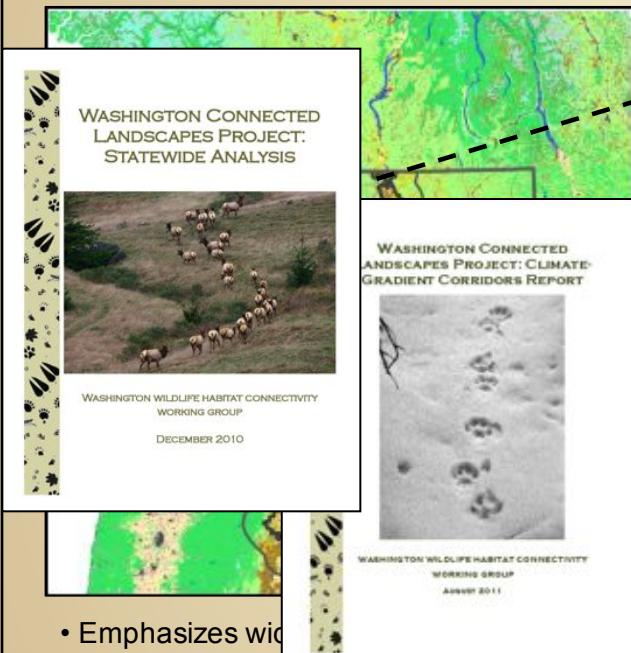
## Statewide Scale

Coarse

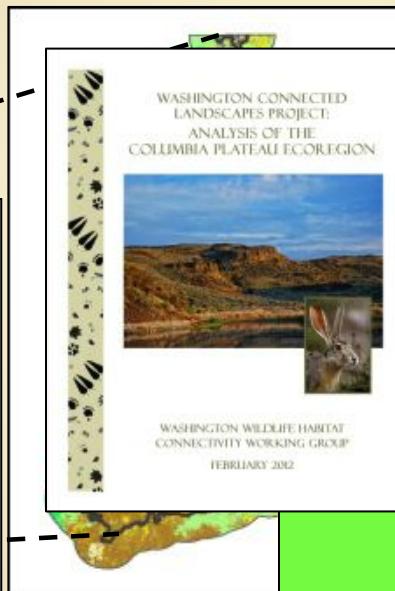
## Ecoregion Scale

## Local Scale

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**Columbia  
Plateau  
Climate –  
Spring  
2013**



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# Analysis Scales

Statewide Scale

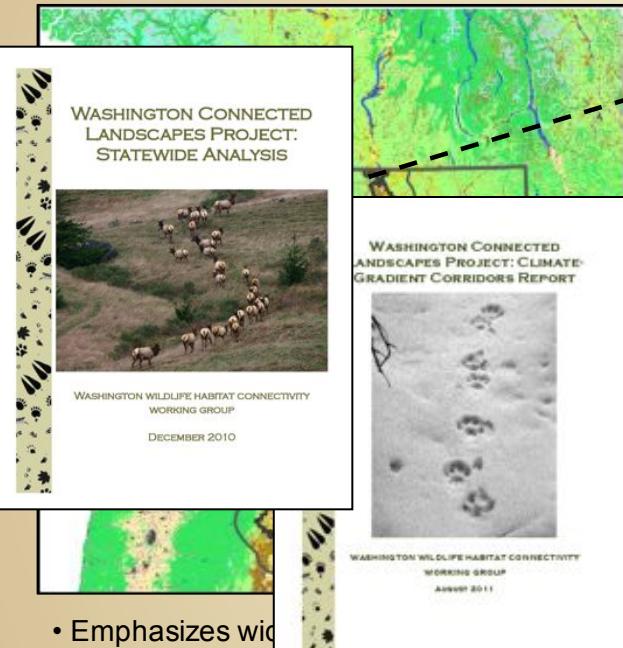
Coarse

Ecoregion Scale

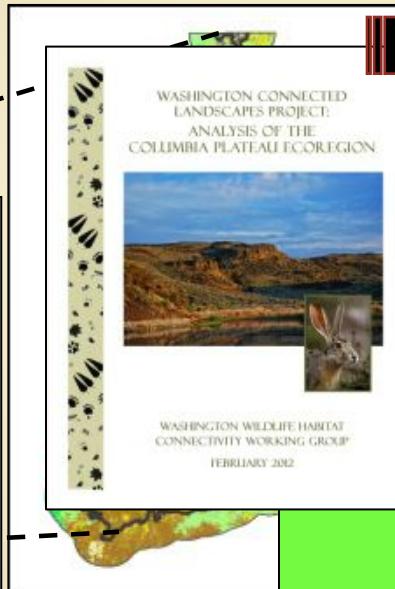
## Phase II Products

Local Scale

Fine



- Emphasizes wide and broad patterns of ecological integrity
- Identifies areas important for statewide connectivity
- Informs finer-scale analyses



- Emphasizes wildlife geographic ranges
- Focuses on particular habitat types
- Increases resolution of HCAs and linkage patterns
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- Emphasizes wildlife species with small ranges or local significance
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# Analysis Scales

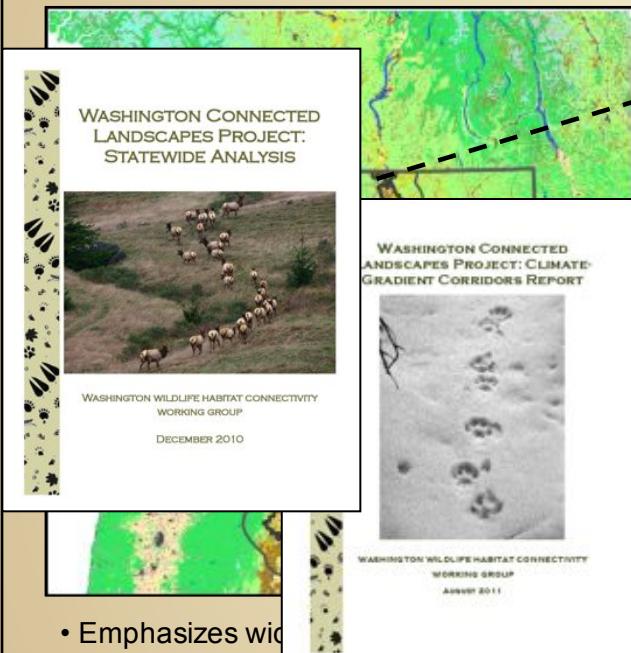
Statewide Scale

Coarse

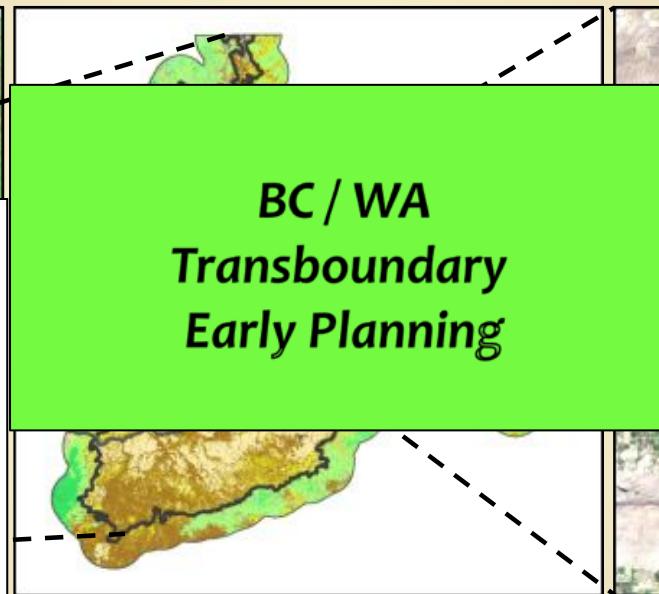
Ecoregion Scale

Local Scale

Fine



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- Emphasizes wildlife species with small ranges or local significance
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# **Statewide Current Conditions and Climate Connectivity Analyses**

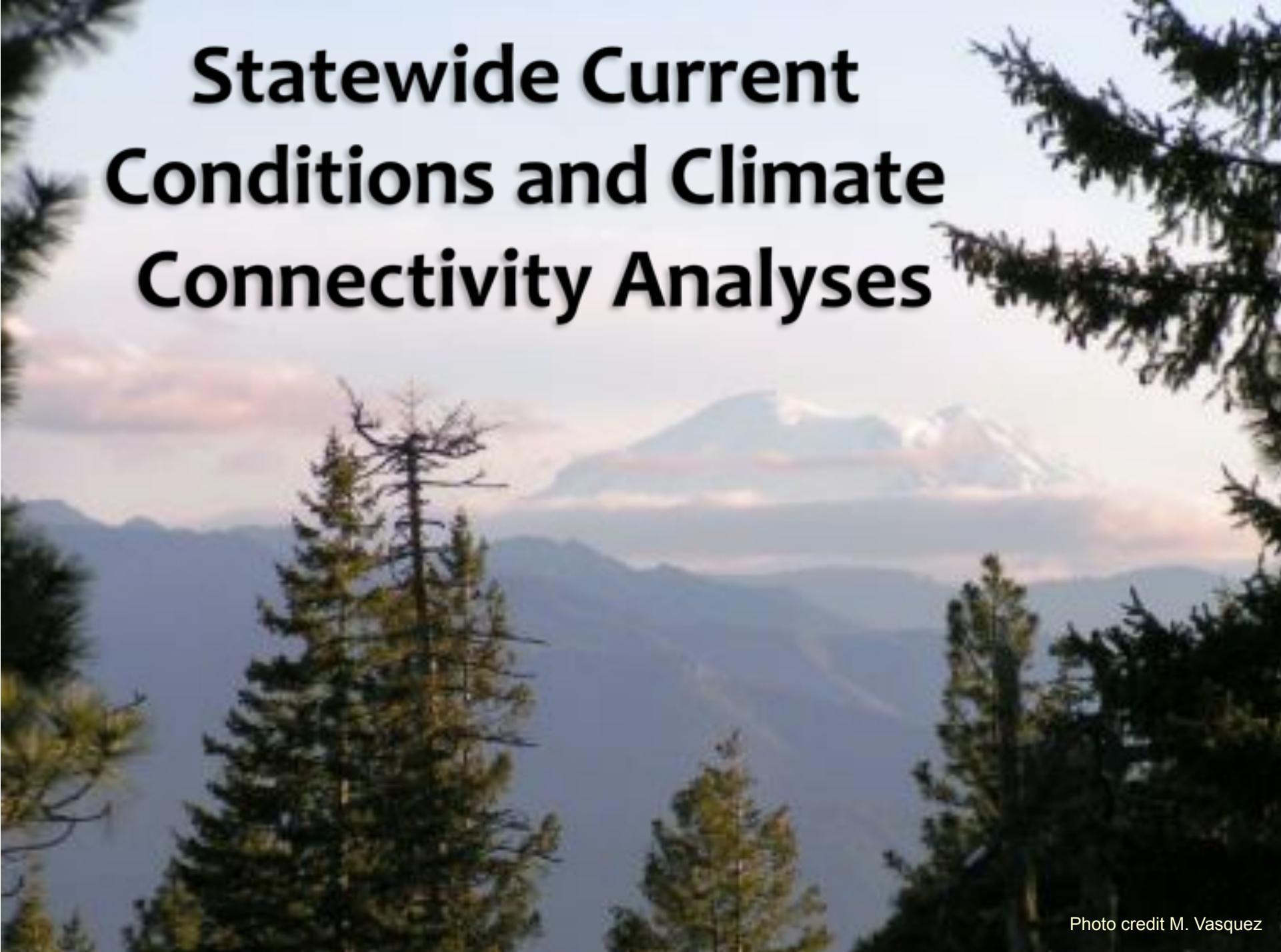
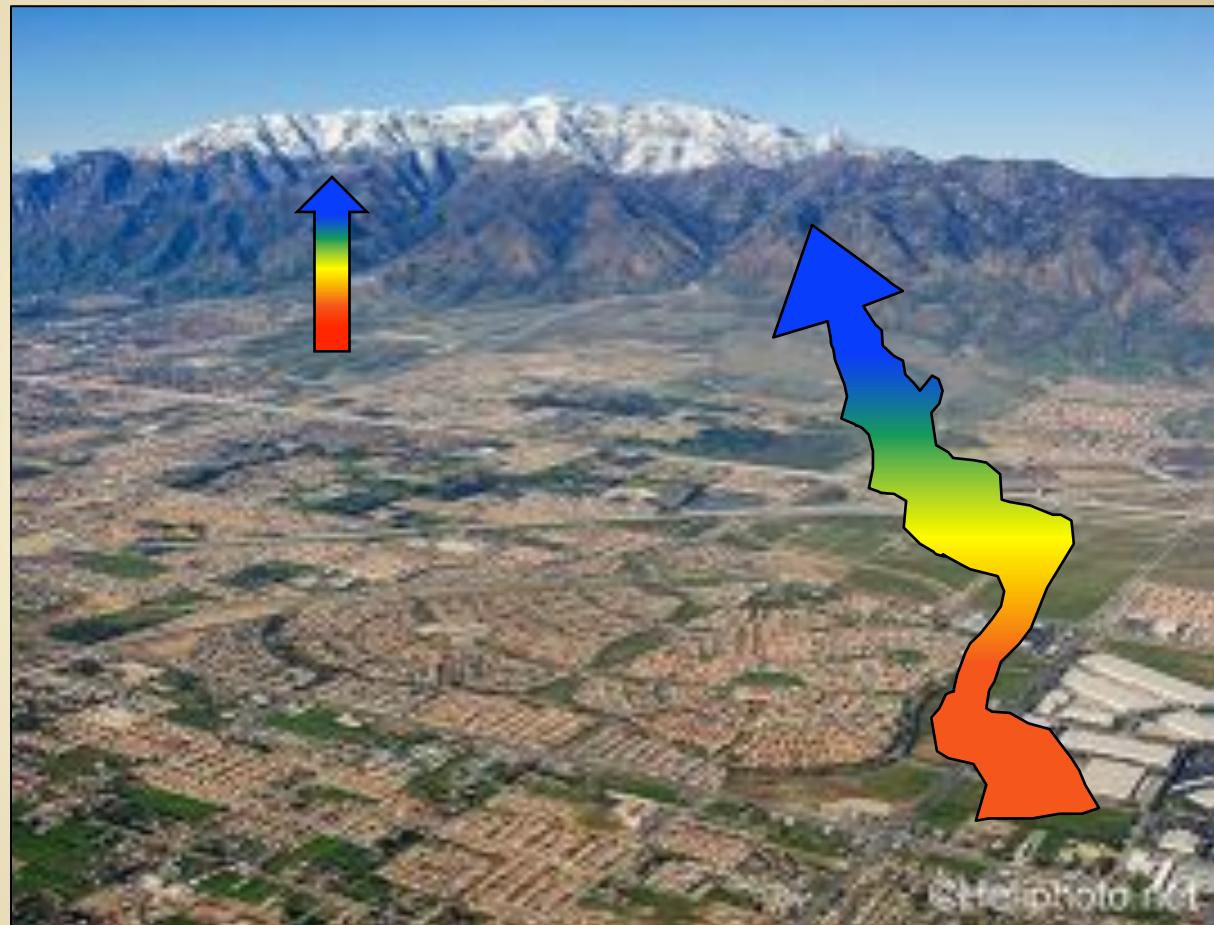


Photo credit M. Vasquez

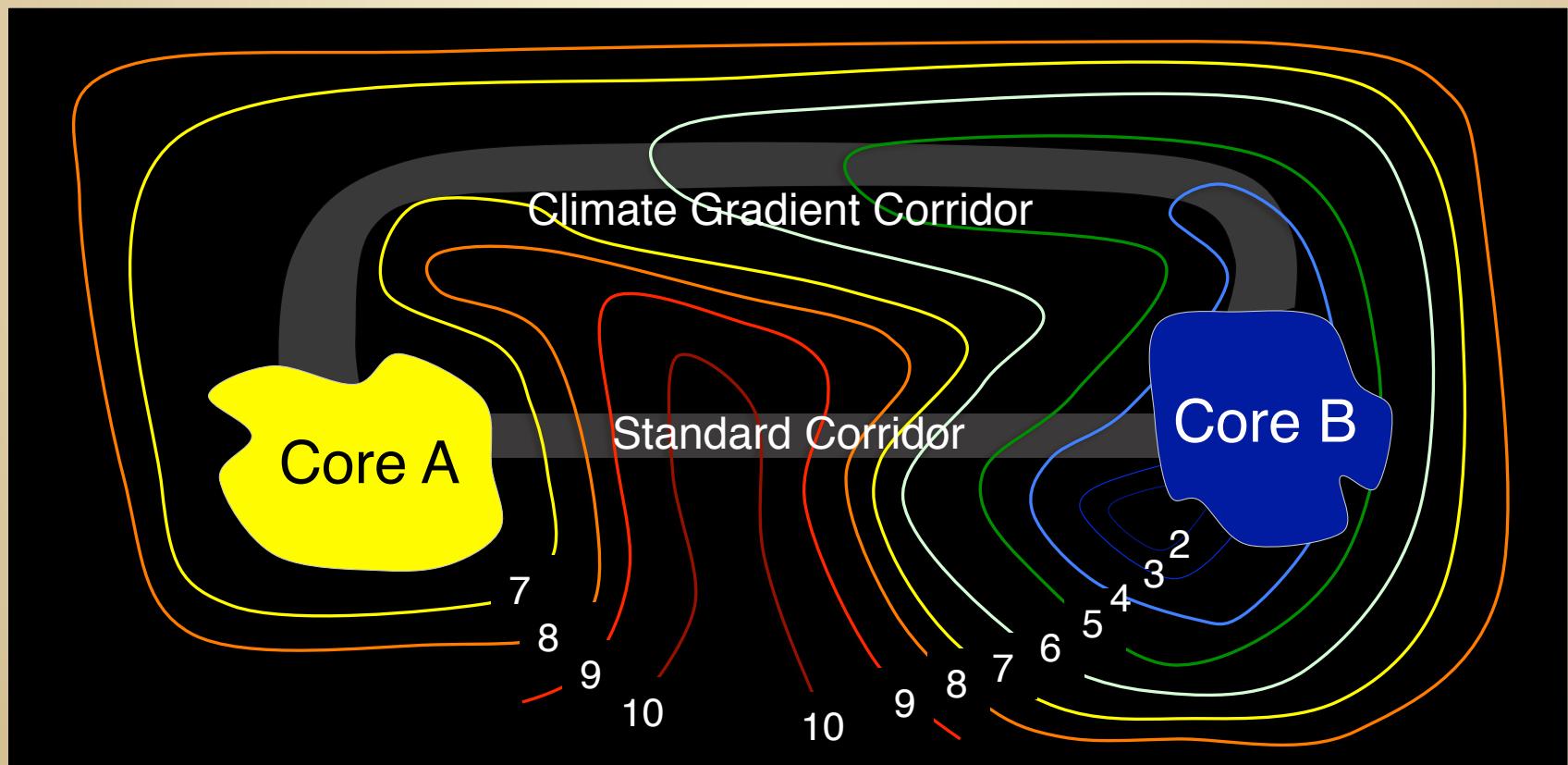
# Statewide Climate Gradient Corridors

- Connectivity along climatic gradients that species ranges may follow as they track changing climate
- Methods include least cost paths, incorporating temperature and landscape integrity



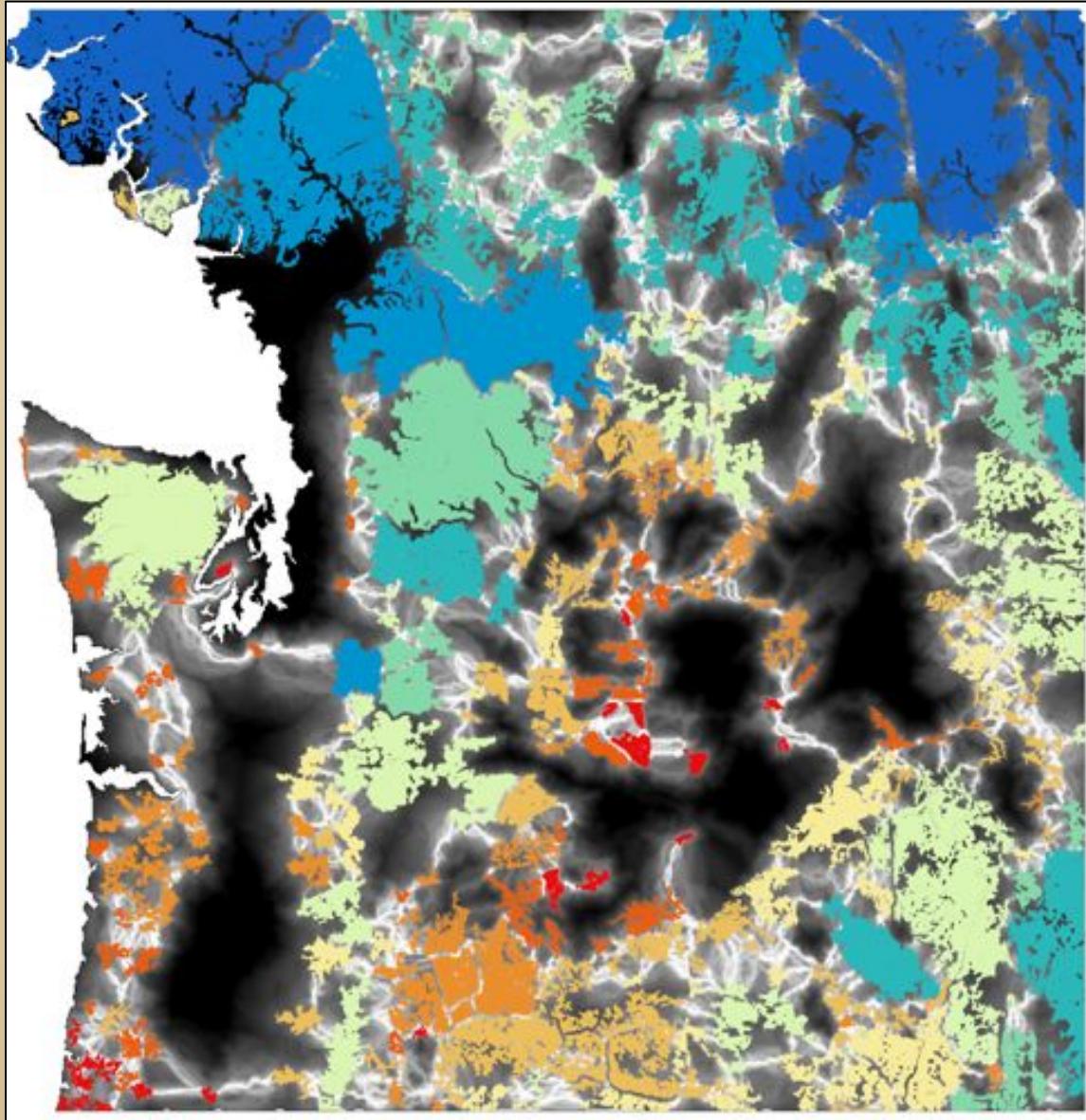
# A pathway through a changing climate

- Connect warm areas to cool
- With corridors that:
  1. Avoid areas of heavy land use
  2. Minimize changes in temperature

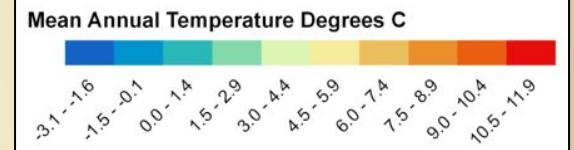


Slide courtesy of Meade Krosby (UW)

# Climate Gradient Corridor Network



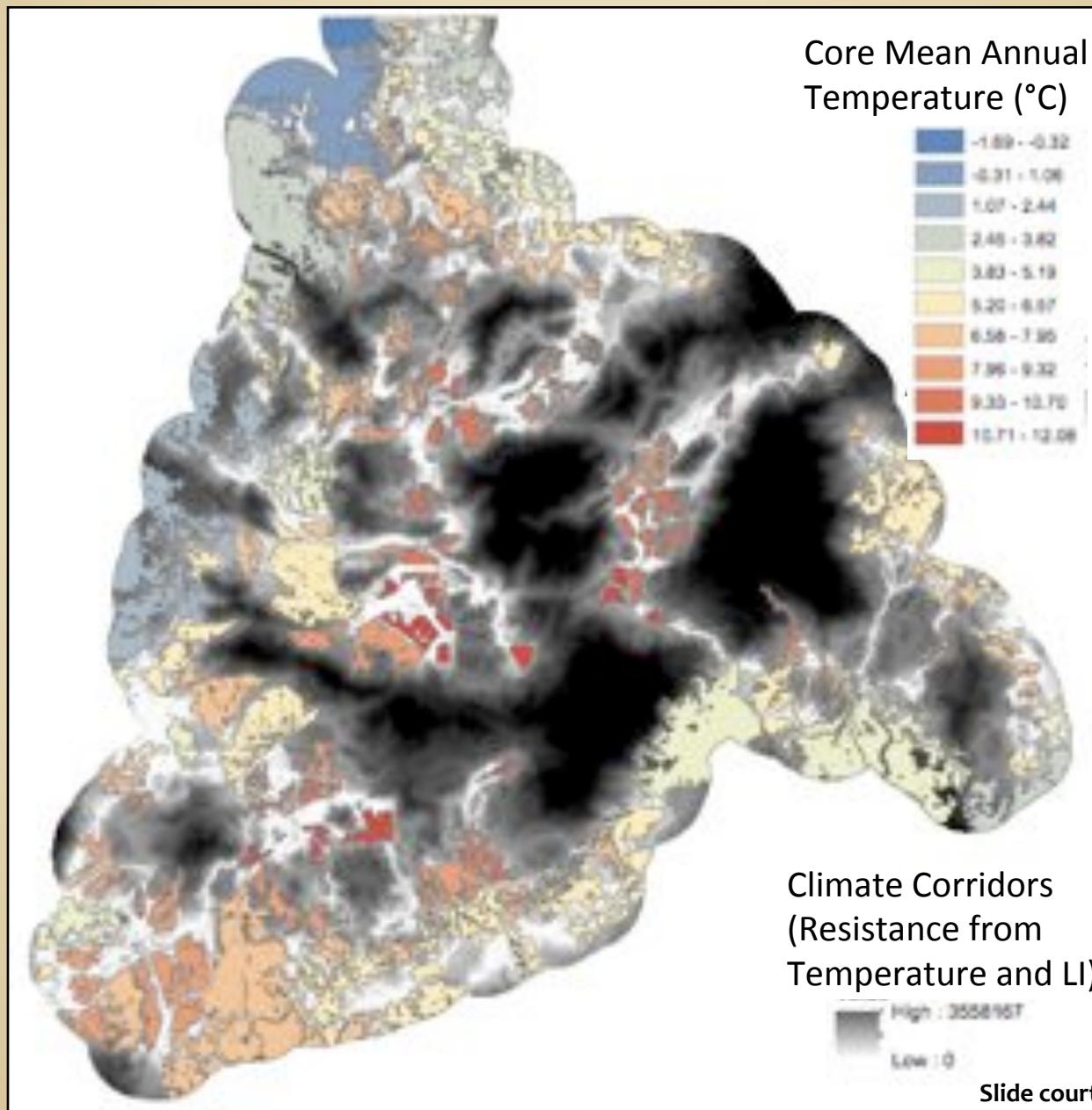
Patch Temperature



Corridors



# Columbia Plateau Climate Corridor Network

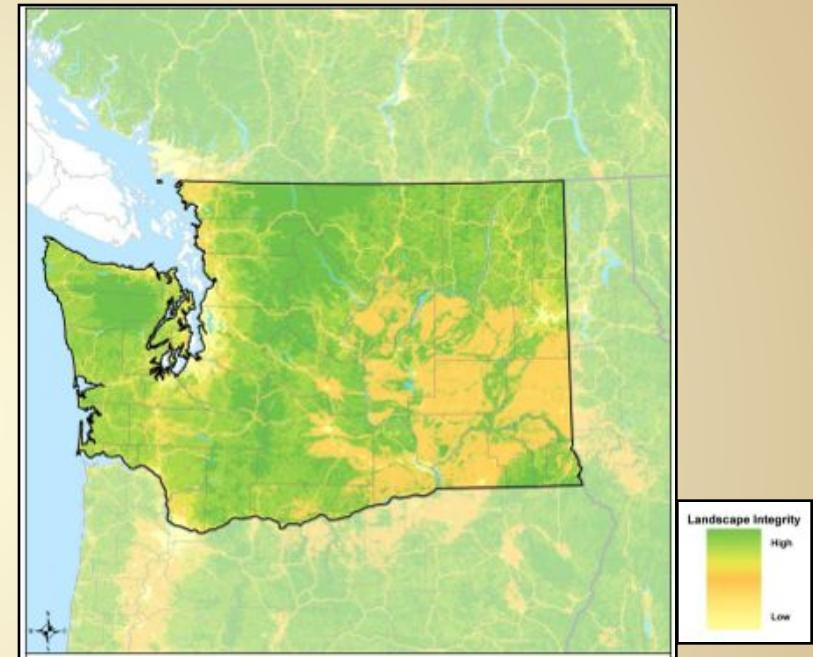


# **Current Conditions: Two Modeling Approaches**



## **Focal Species**

- Depicts connectivity based on the habitat associations and behavior of species
- Represents functional needs of many species



## **Landscape Integrity**

- Emphasizes connectivity of areas where human influence is most limited
- Based on indicators of natural conditions

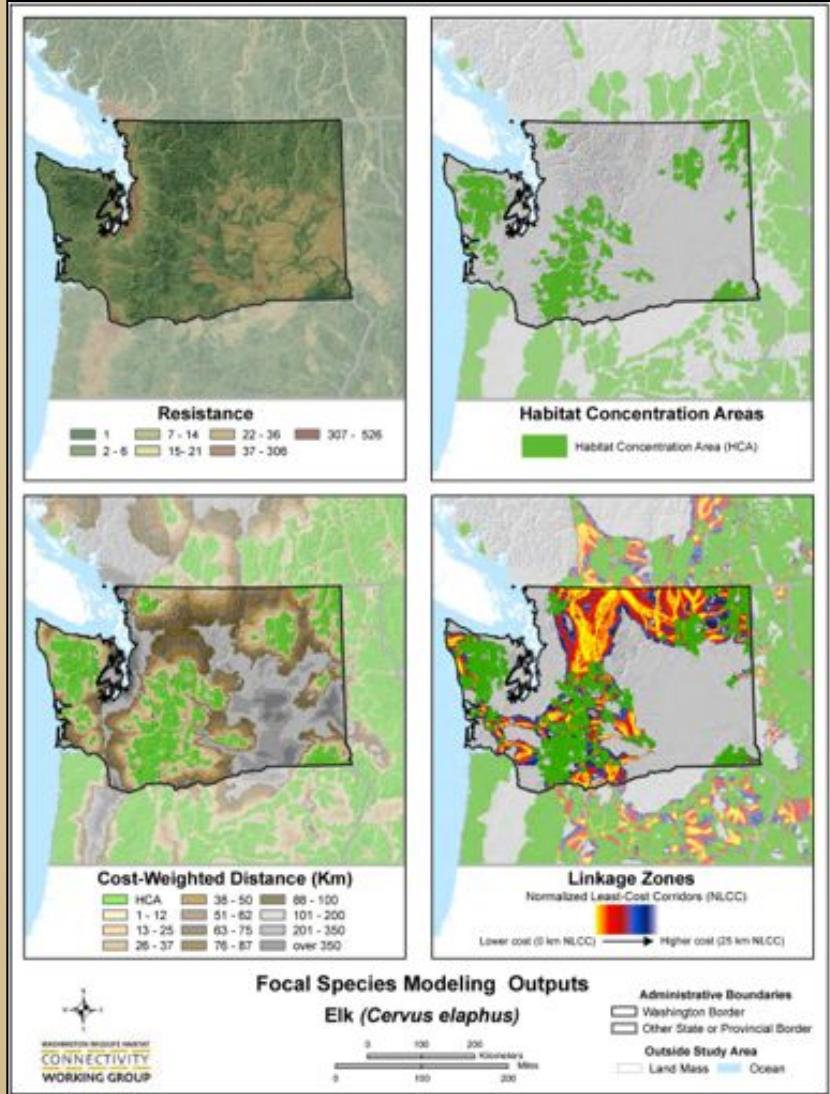
# Statewide Connectivity Analysis (Current Conditions): Methods

Focal Species      Landscape Integrity

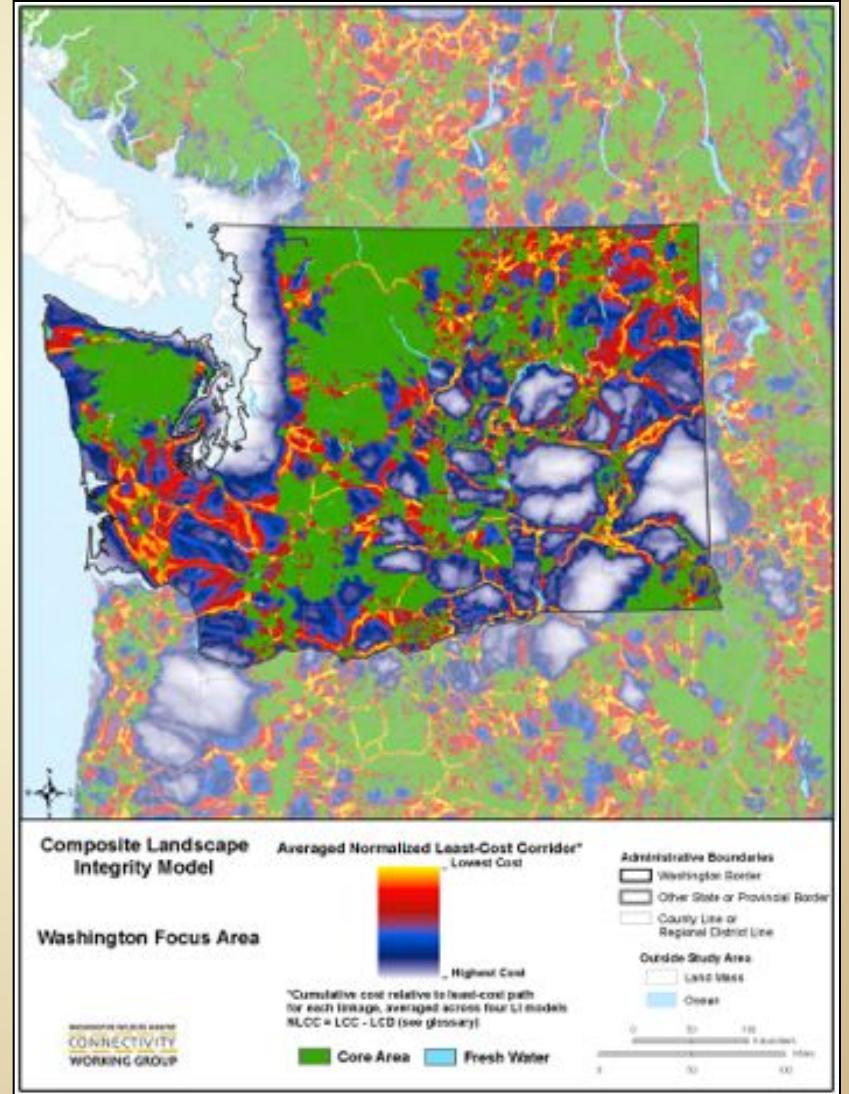


# Statewide Products Examples

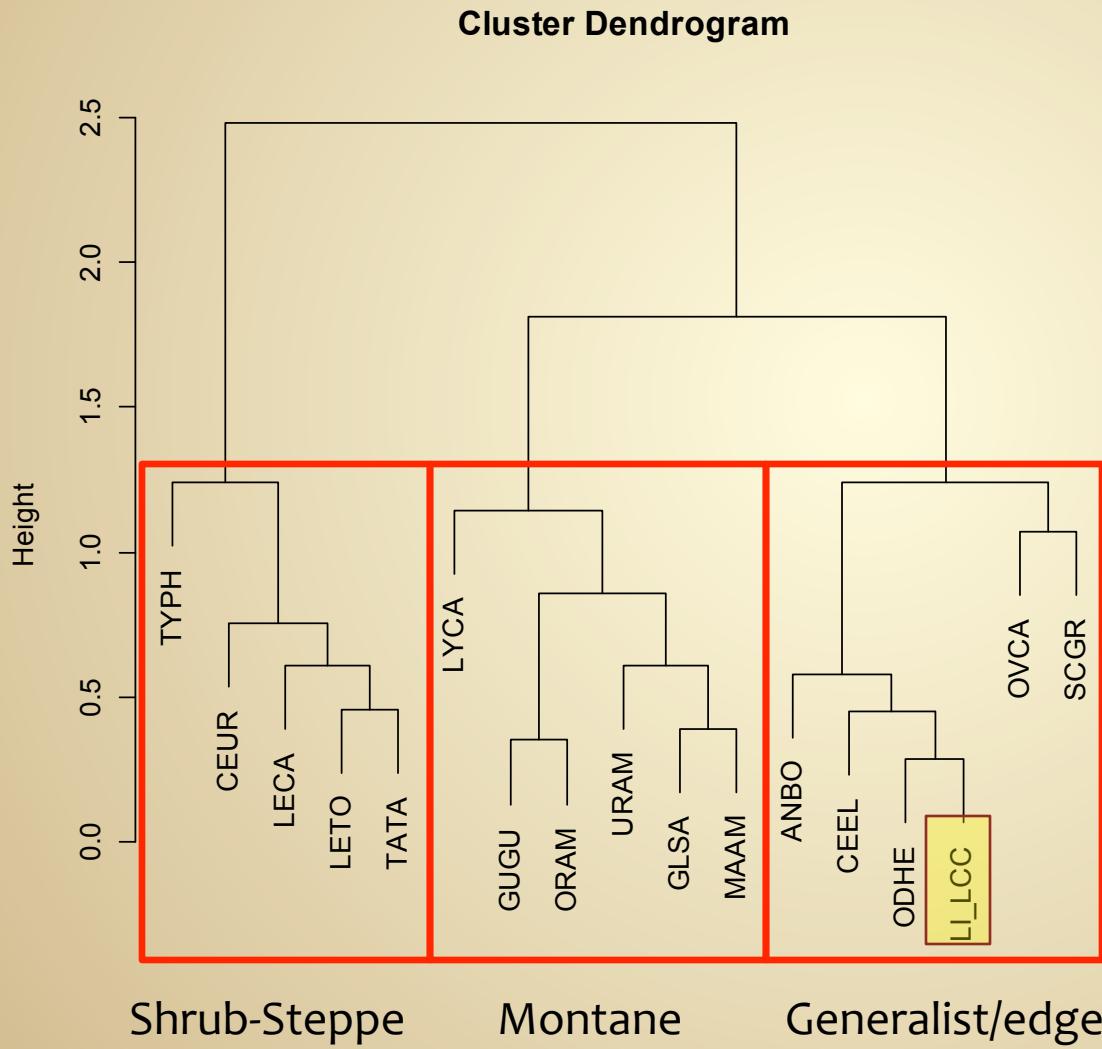
## Focal Species



## Landscape Integrity



# Statewide Connectivity: Correspondence Analysis across Species



## Shrub-Steppe Associates

TYPH	Sharp-tailed Grouse
CEUR	Greater Sage-Grouse
LECA	Black-tailed Jackrabbit
LETO	White-tailed Jackrabbit
TATA	Badger

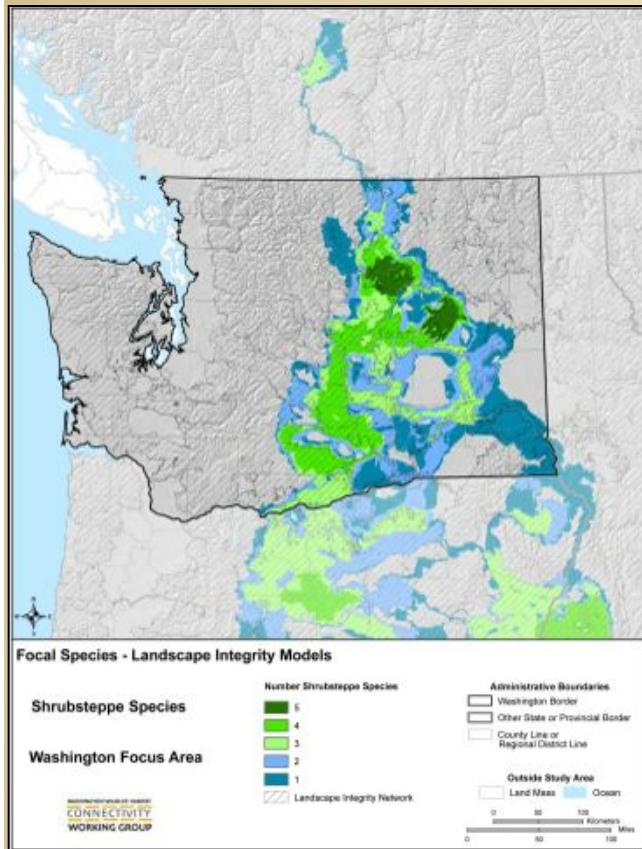
## Montane Associates

LYCA	Lynx
GUGU	Wolverine
ORAM	Mountain Goat
URAM	Black Bear
GLSA	Flying Squirrel
MAAM	Marten

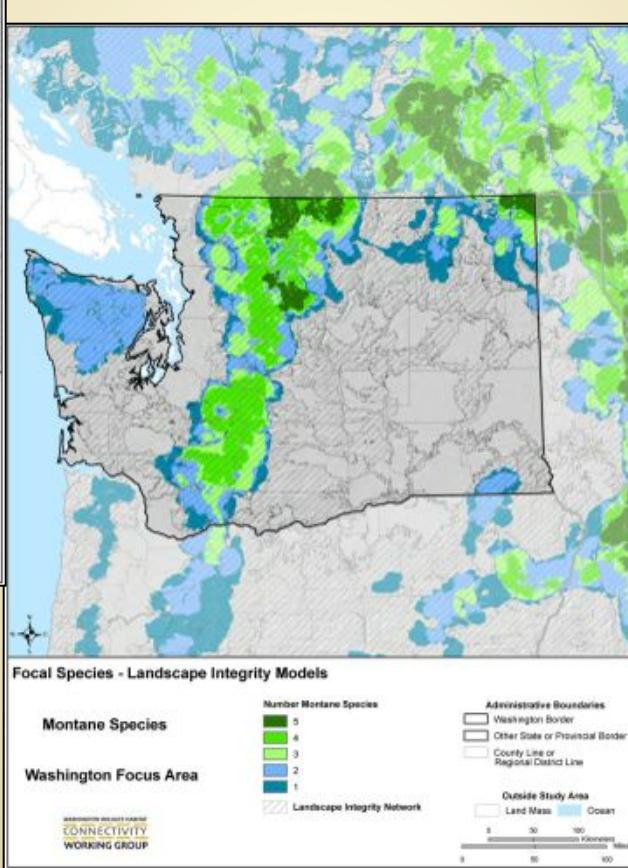
## Habitat Generalists & Edge Spp.

ANBO	Western Toad
CEEEL	Elk
ODHE	Mule Deer
OVCA	Bighorn Sheep
SCGR	Western Grey Squirrel

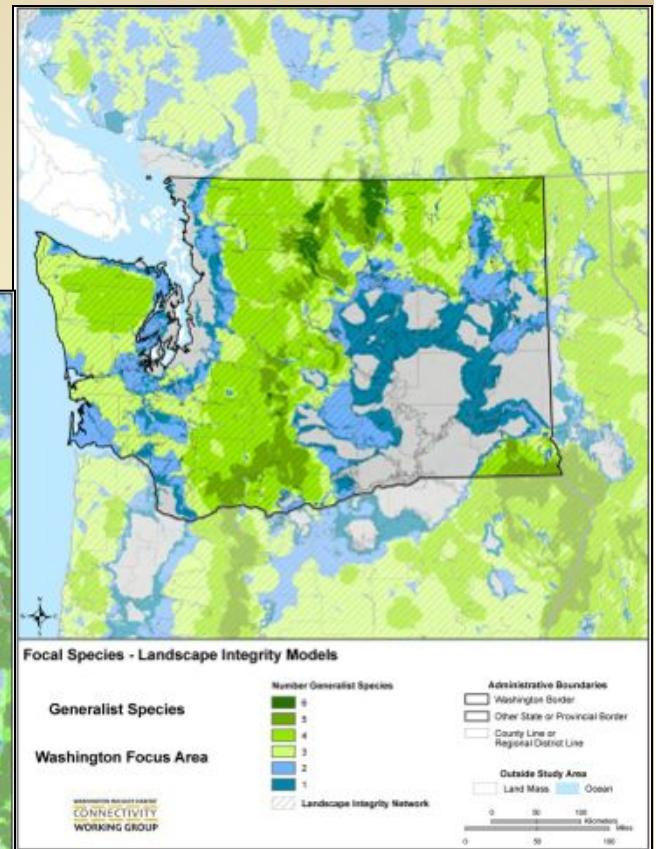
# Statewide Guilds



Shrub-Steppe  
(5 species)



Montane  
(6 species)



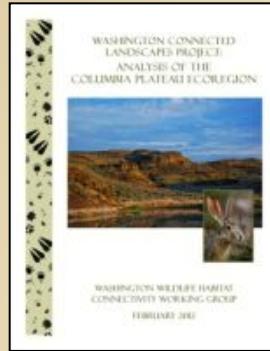
Generalist/Edge  
(5 species and  
landscape integrity)

# **Columbia Plateau Ecoregion Phase I Current Conditions Connectivity Analyses**



Photo by Joe Rocchio

# Columbia Plateau Ecoregion Current Conditions Connectivity Analysis: Phase I



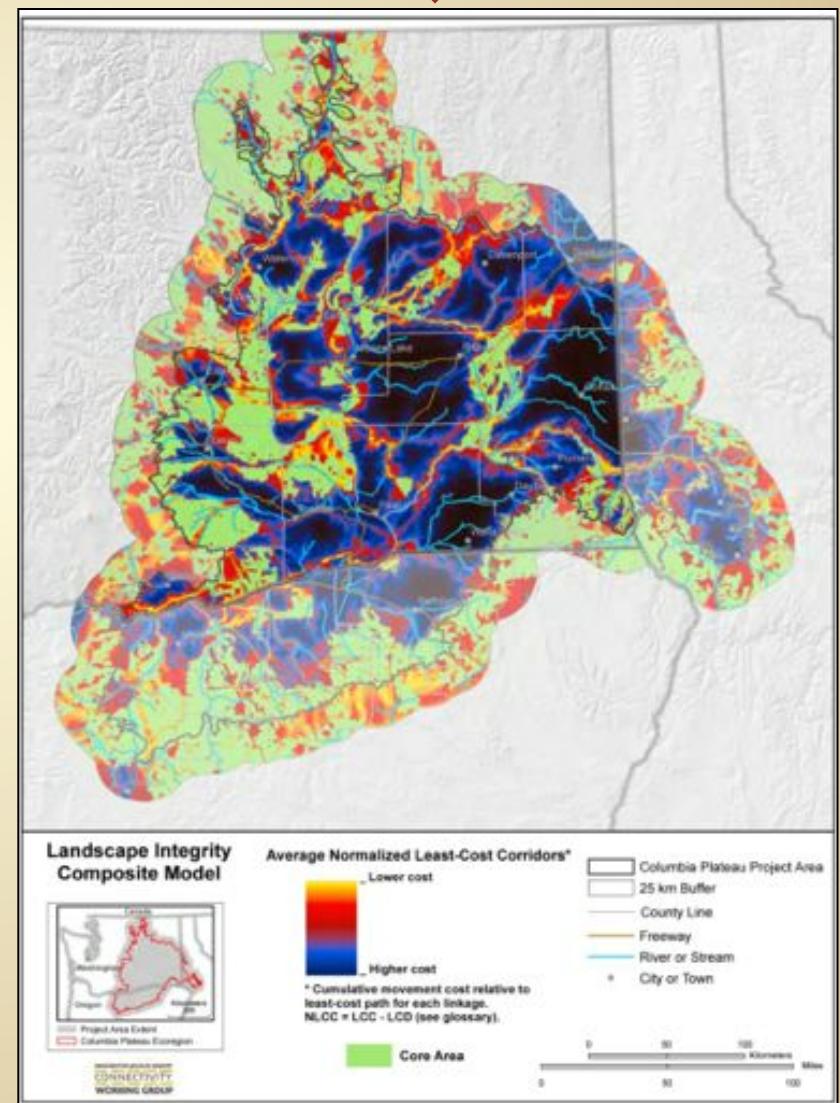
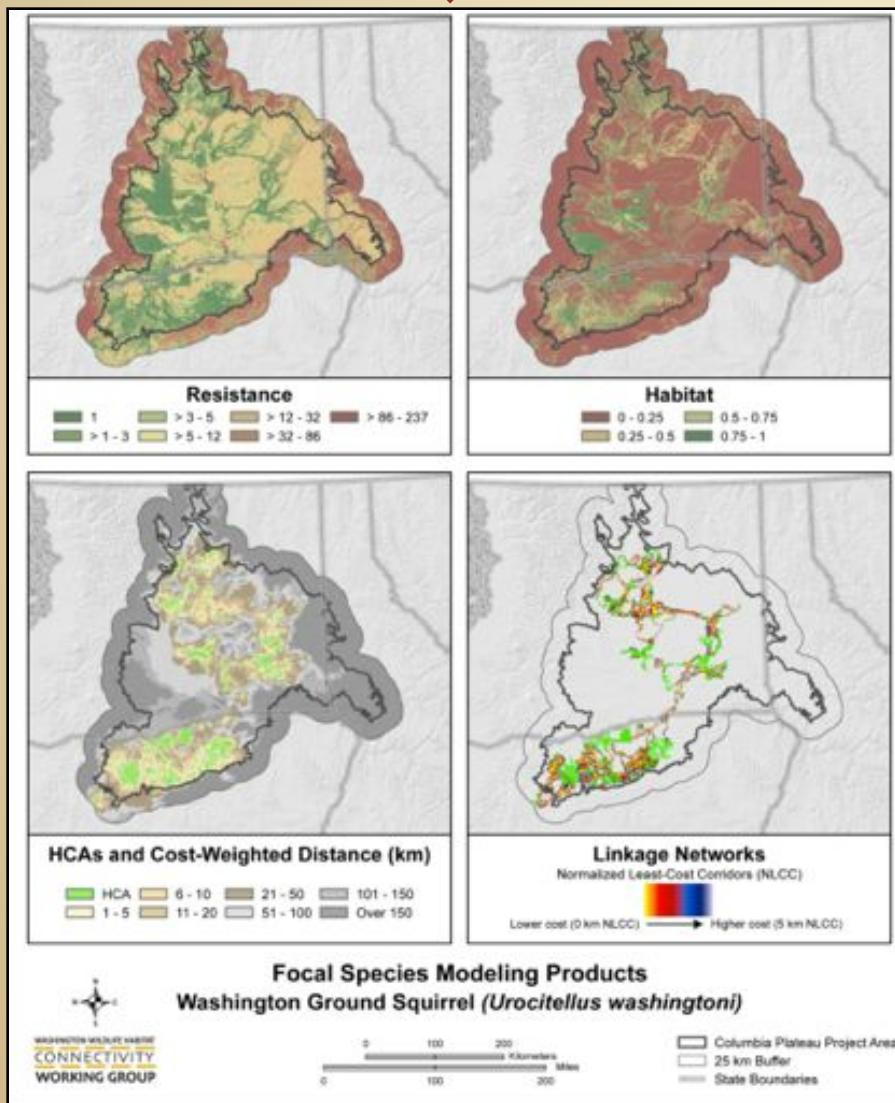
- 11 focal species chosen specifically for this ecoregion
- Includes species with smaller home ranges and movement distances
- Additional data layers-- powerlines, windturbines, irrigation, agricultural detail, soils, topographical complexity
- 30m cell size (vs. 100m)
- Extensive participation of regional field biologists and other experts



# Columbia Plateau Ecoregion Products

## Focal Species

## Landscape Integrity



# Products

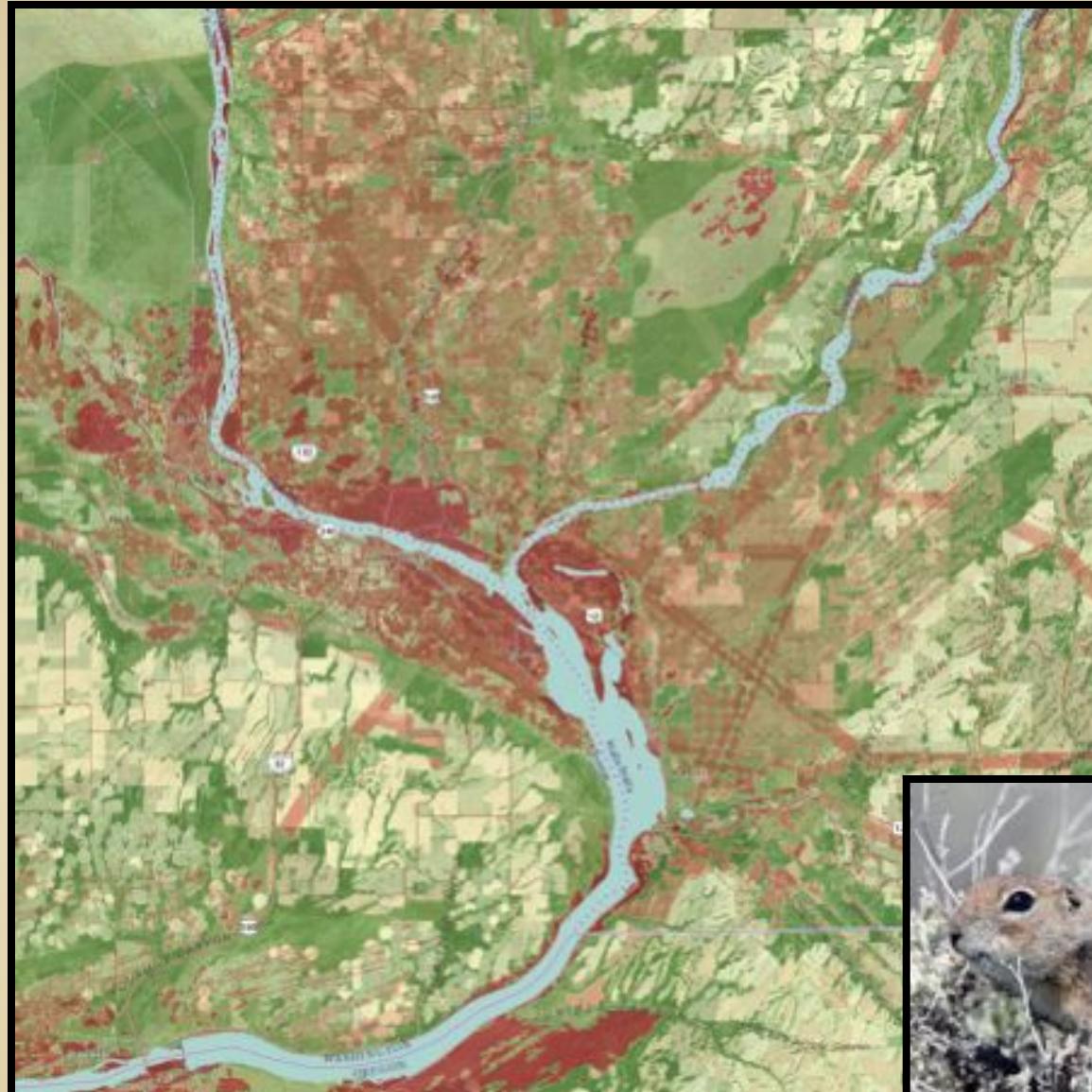
## Habitat Models



Slide courtesy of Andrew Shirk

# Products

## Habitat Models



**Habitat Value**  
High  
Low

Slide courtesy of Andrew Shirk

# Products

## Resistance Models



*Photo by Woodrow Myers*

Slide courtesy of Andrew Shirk

# Products

## Resistance Models

### Resistance



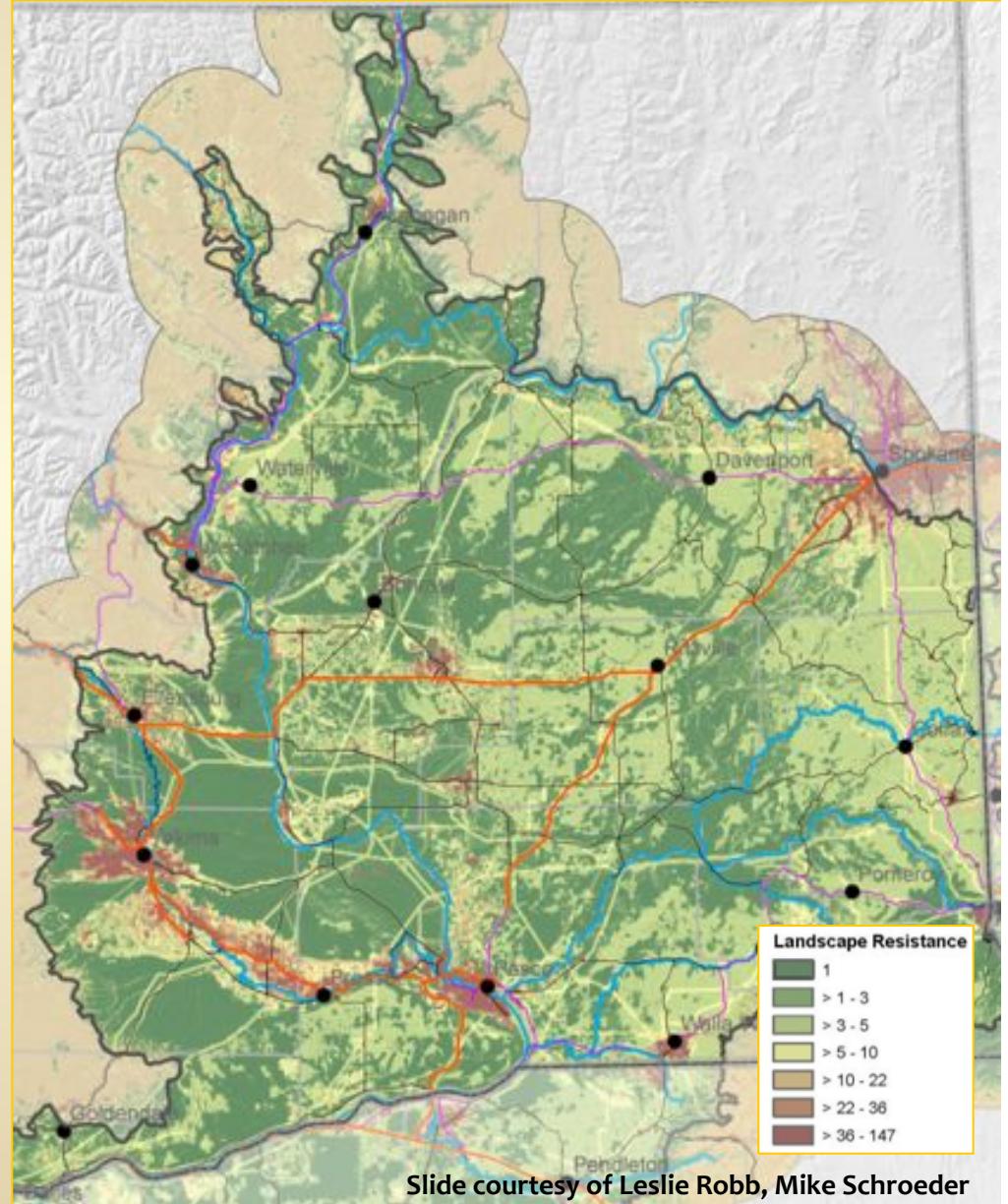
*Photo by Woodrow Myers*

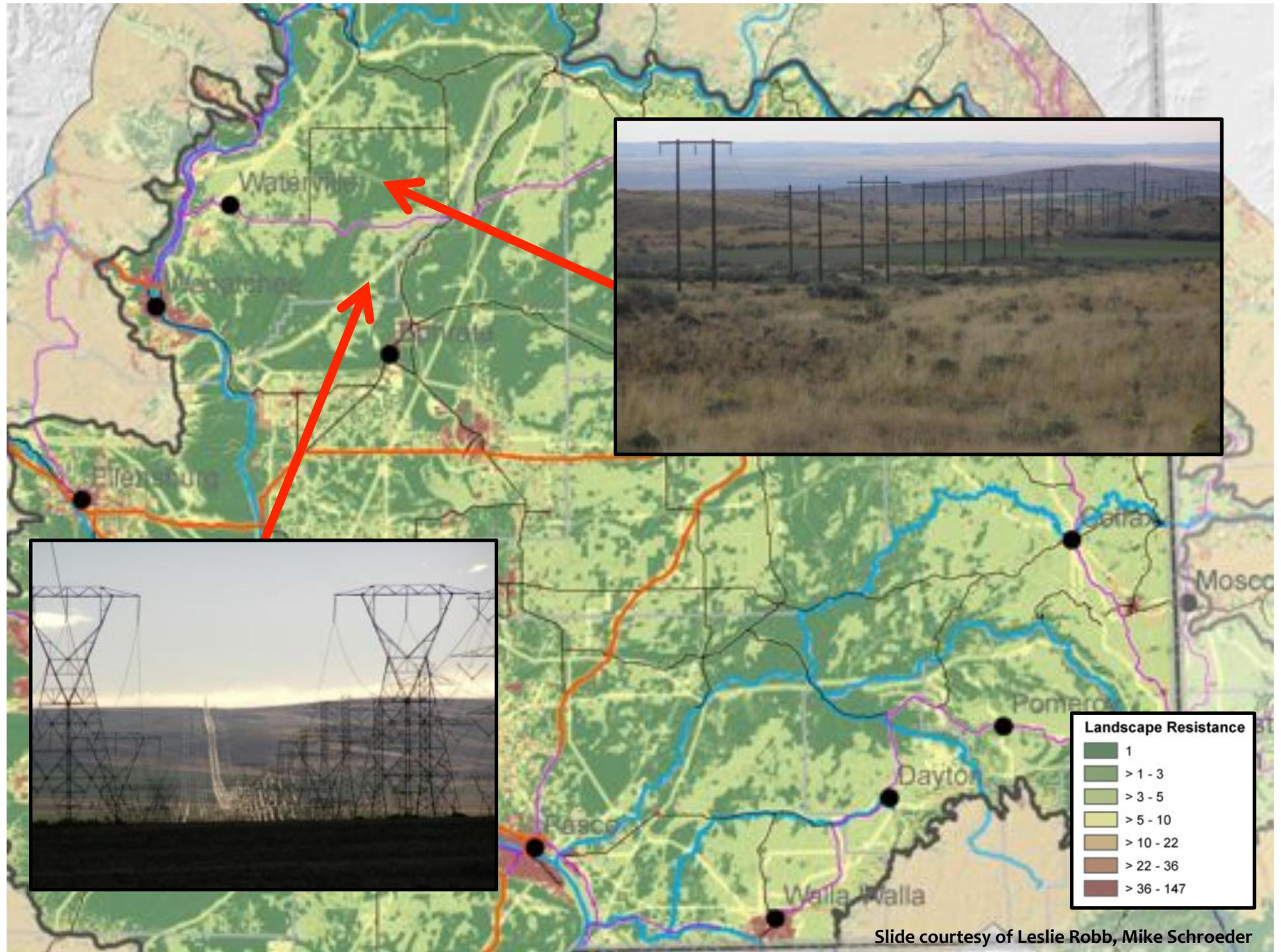
Slide courtesy of Andrew Shirk

# Greater Sage-Grouse – Resistance Surface



Right: light yellow lines represent linear features such as transmission lines

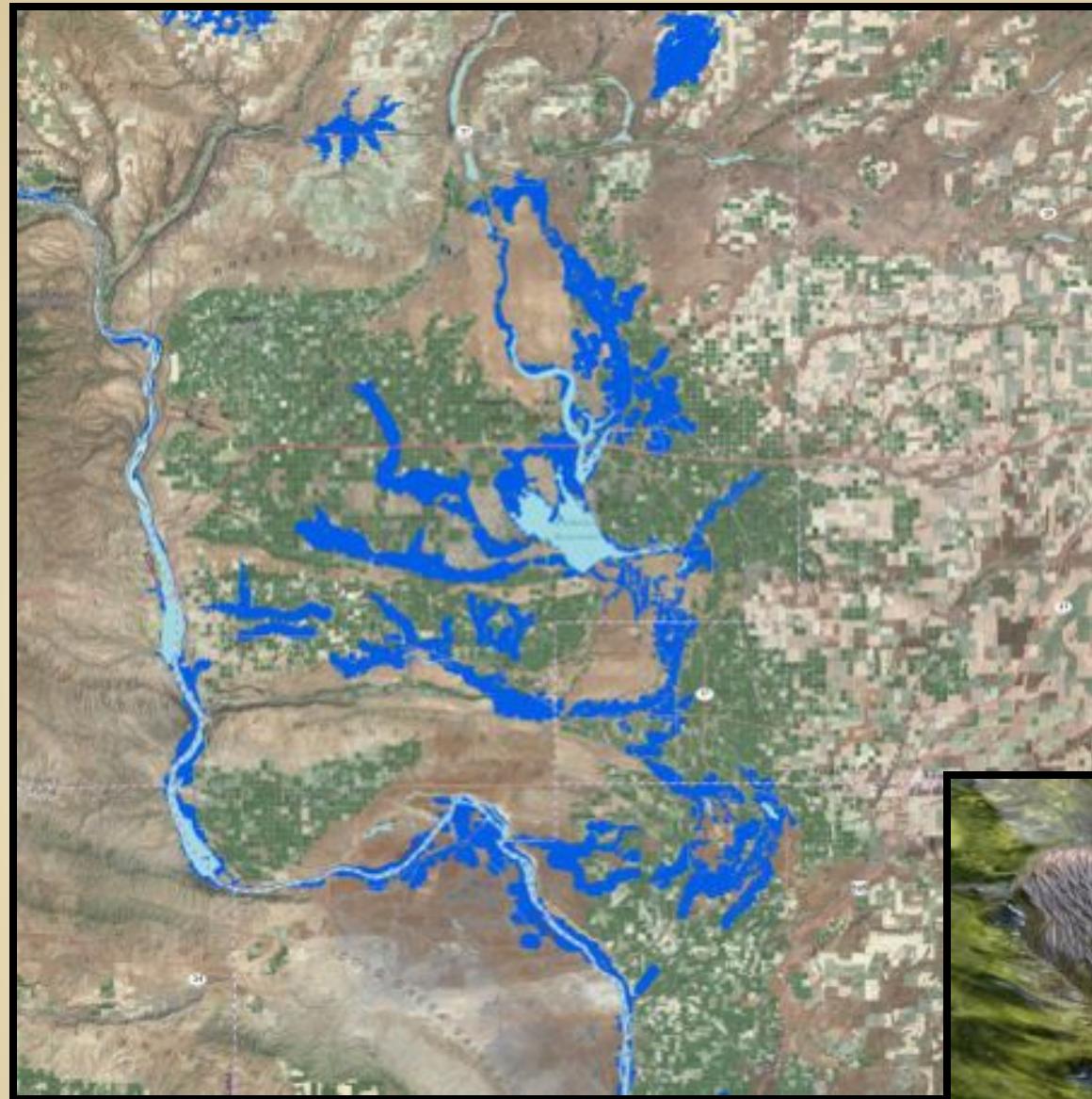




# Products

CWD  
Models

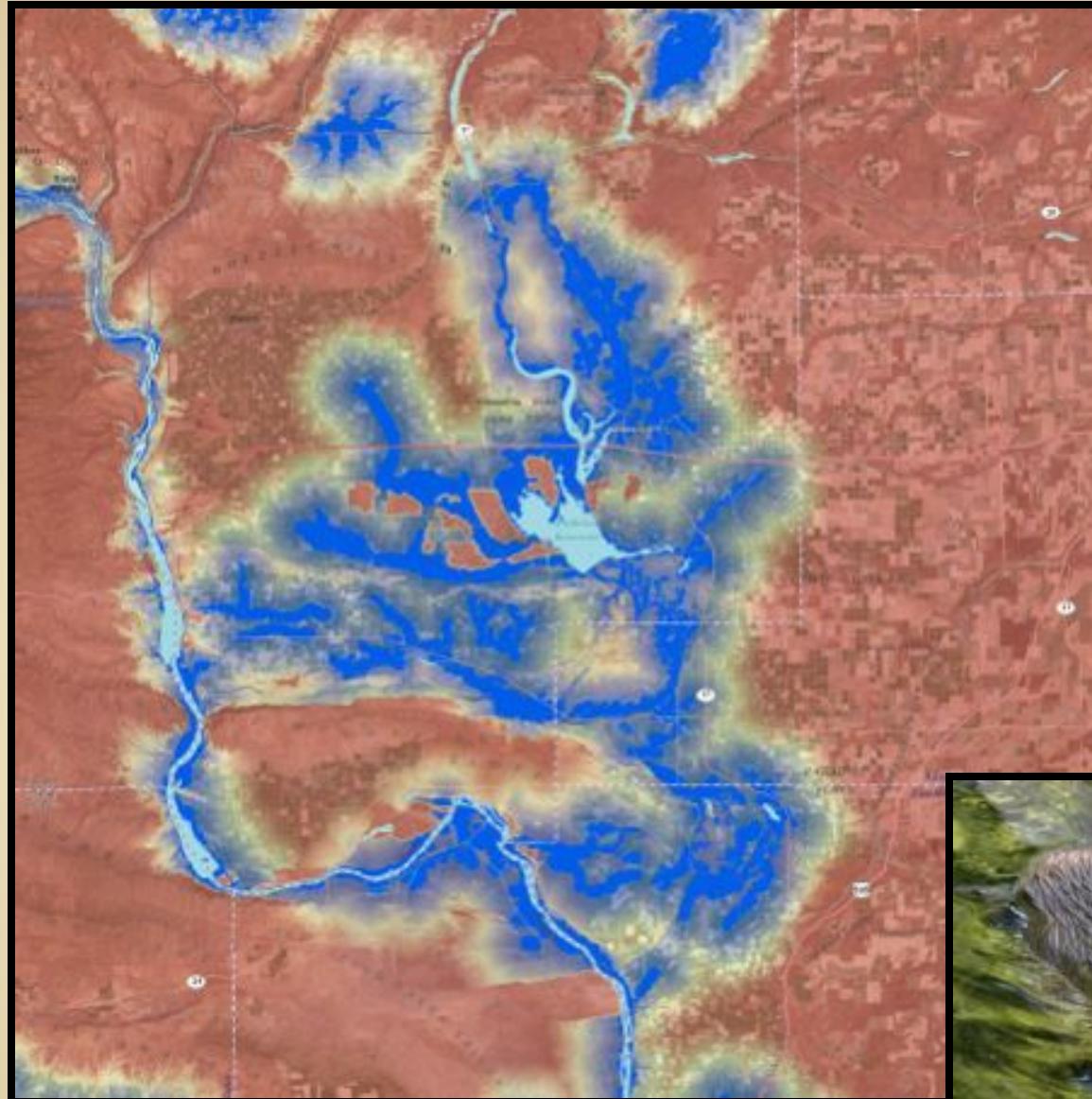
 HCA



Slide courtesy of Andrew Shirk

# Products

CWD  
Models



Slide courtesy of Andrew Shirk

# Products

*Linkage  
Models*

 HCA

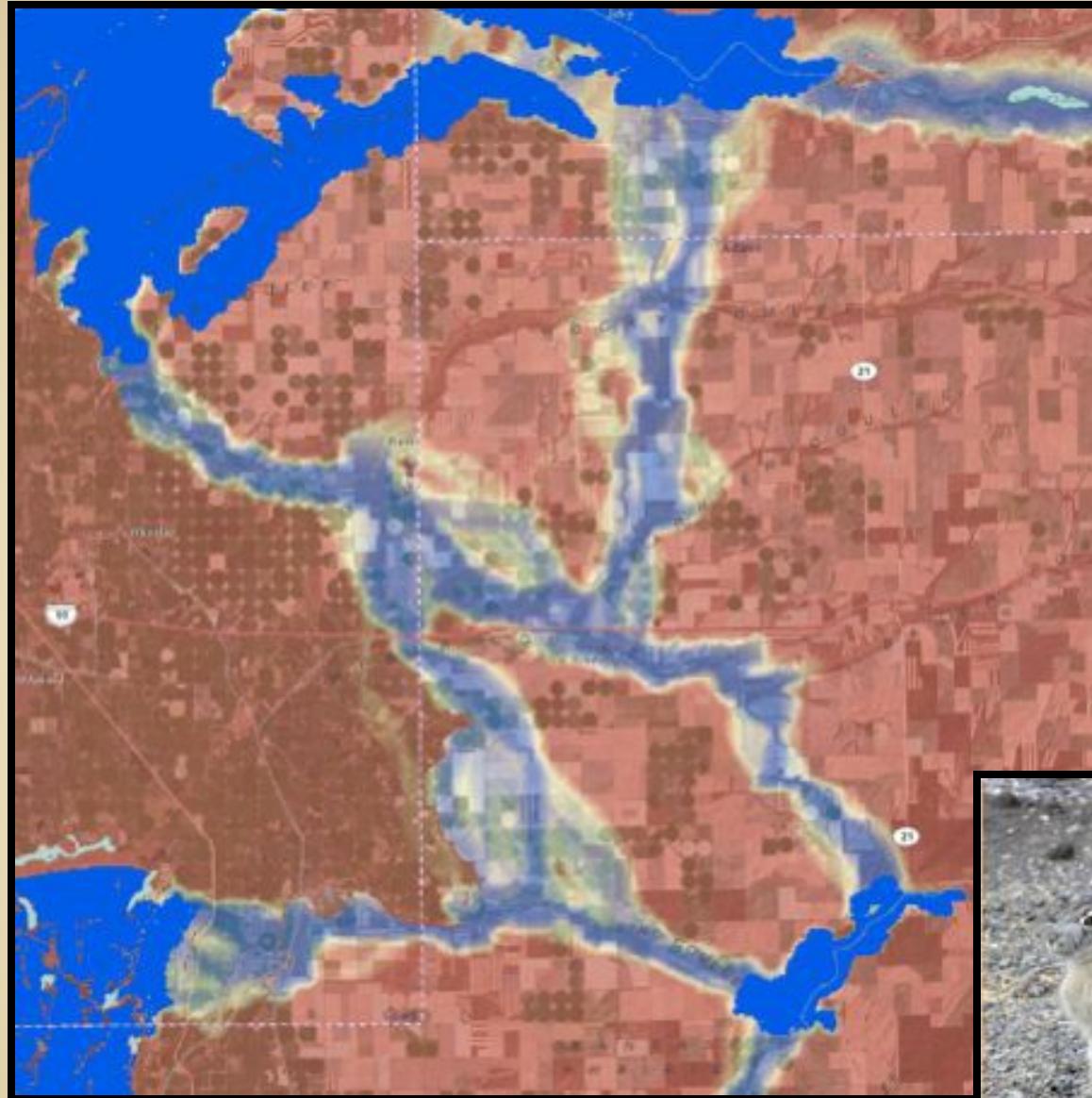


Slide courtesy of Andrew Shirk

# Products

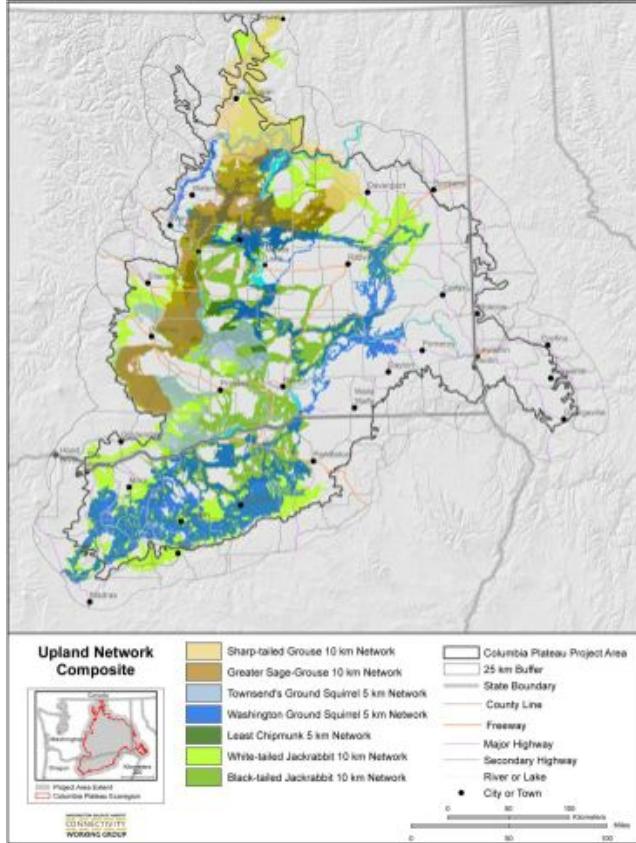
## *Linkage Models*

 HCA  
**Linkage Value**  
 Low  
 High

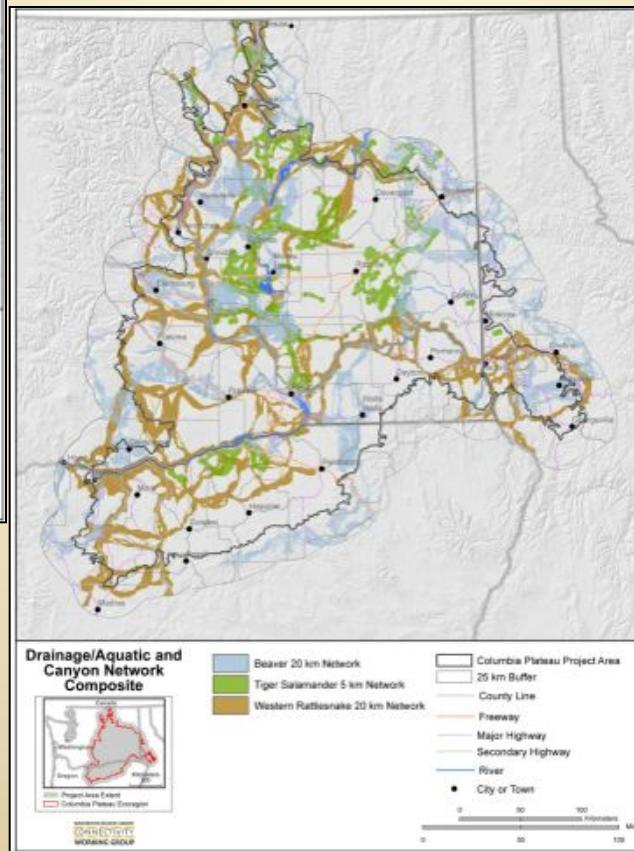


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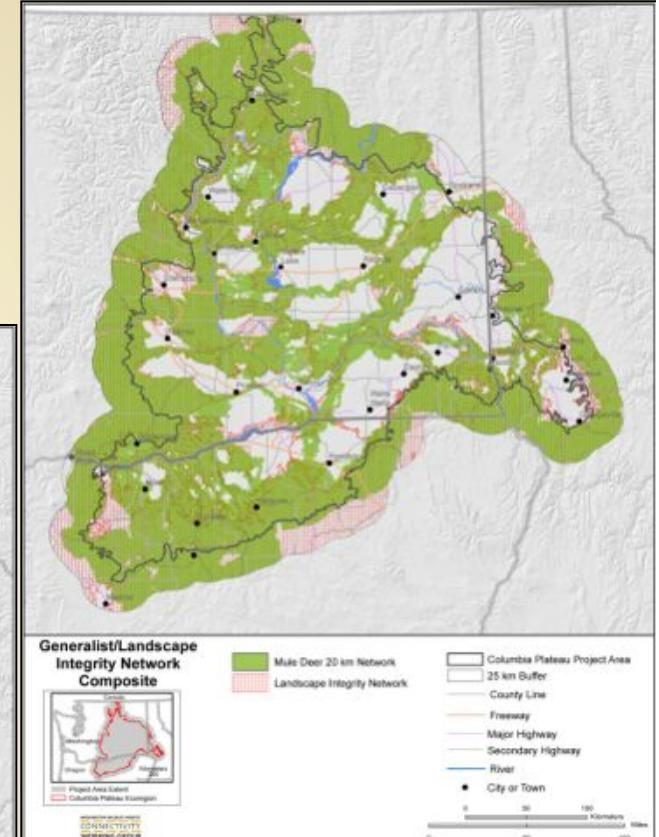
# Columbia Plateau Connectivity Networks



Upland Network  
Composite  
(7 shrub-steppe species)



Drainage/Aquatic and  
Canyon Composite  
(3 species)

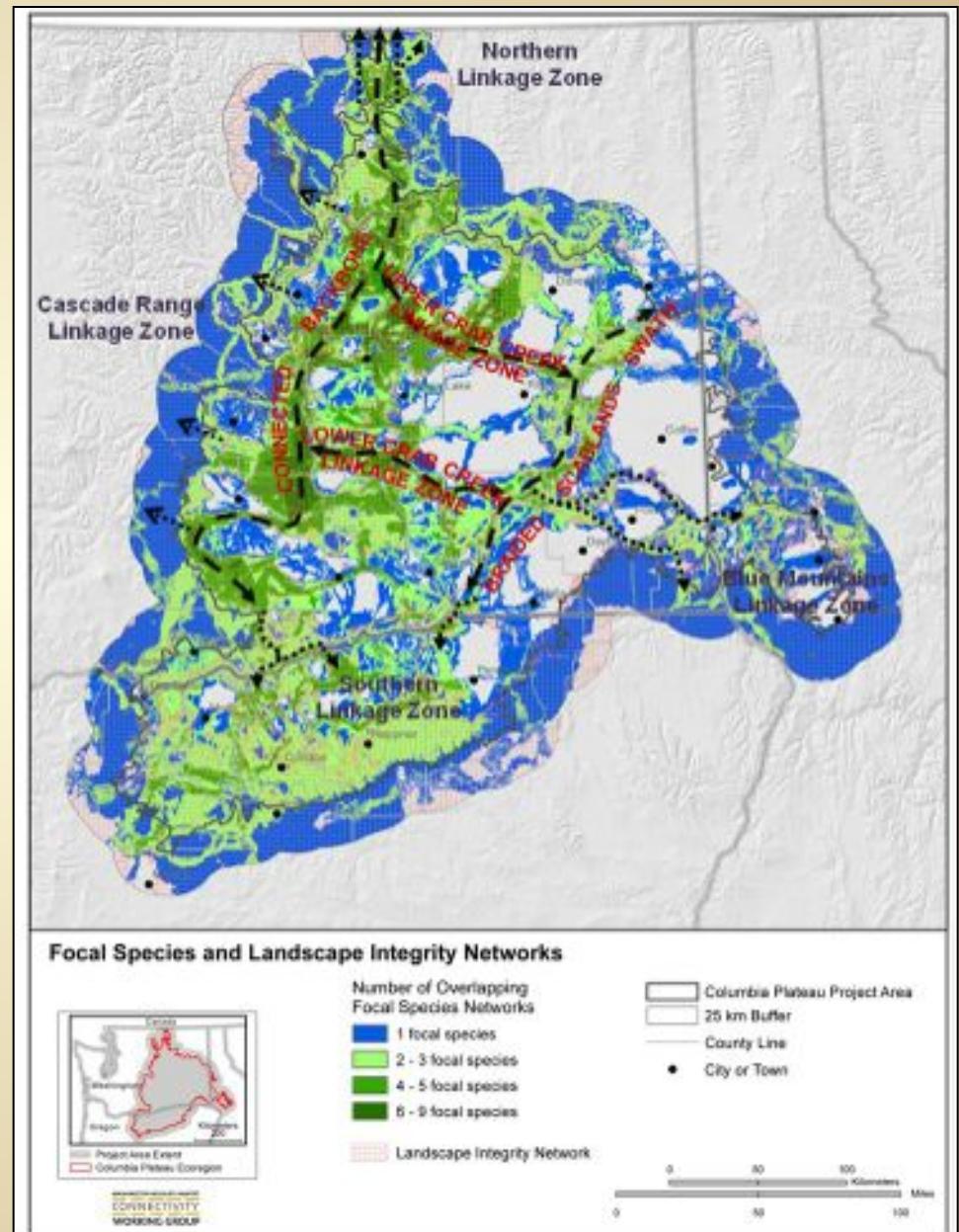


Generalist/Landscape  
Integrity Composite  
(1 species and LI)

# Vision for a Connected Columbia Plateau

## Major linkage zones of the Columbia Plateau Ecoregion

- Solid colors reflect the number of focal species' networks particular areas include
- Hatching represents the landscape integrity composite network
- Dashed arrows highlight important areas for connectivity in Washington
- Dotted arrows highlight important linkage zones to neighboring ecoregions and states





# **Columbia Plateau Ecoregion**

## **Phase II Analyses**

- Linkage Network Centrality
- Linkage Pinch-Points
- Barriers and Restoration Opportunities

Photo by Joe Rocchio

# Columbia Plateau Phase II Goal

*“Bridge Columbia Plateau Ecoregion connectivity analysis results and products to detailed products for use by managers, biologists, and others that seek to implement wildlife habitat connectivity”*



*Photo by Ryan Shaw*

# Linkage Network Centrality

Metric that ranks the relative importance of a linkage or habitat concentration area for keeping the overall network connected.



*Photo by Gregg Thompson*

# Linkage Network Centrality

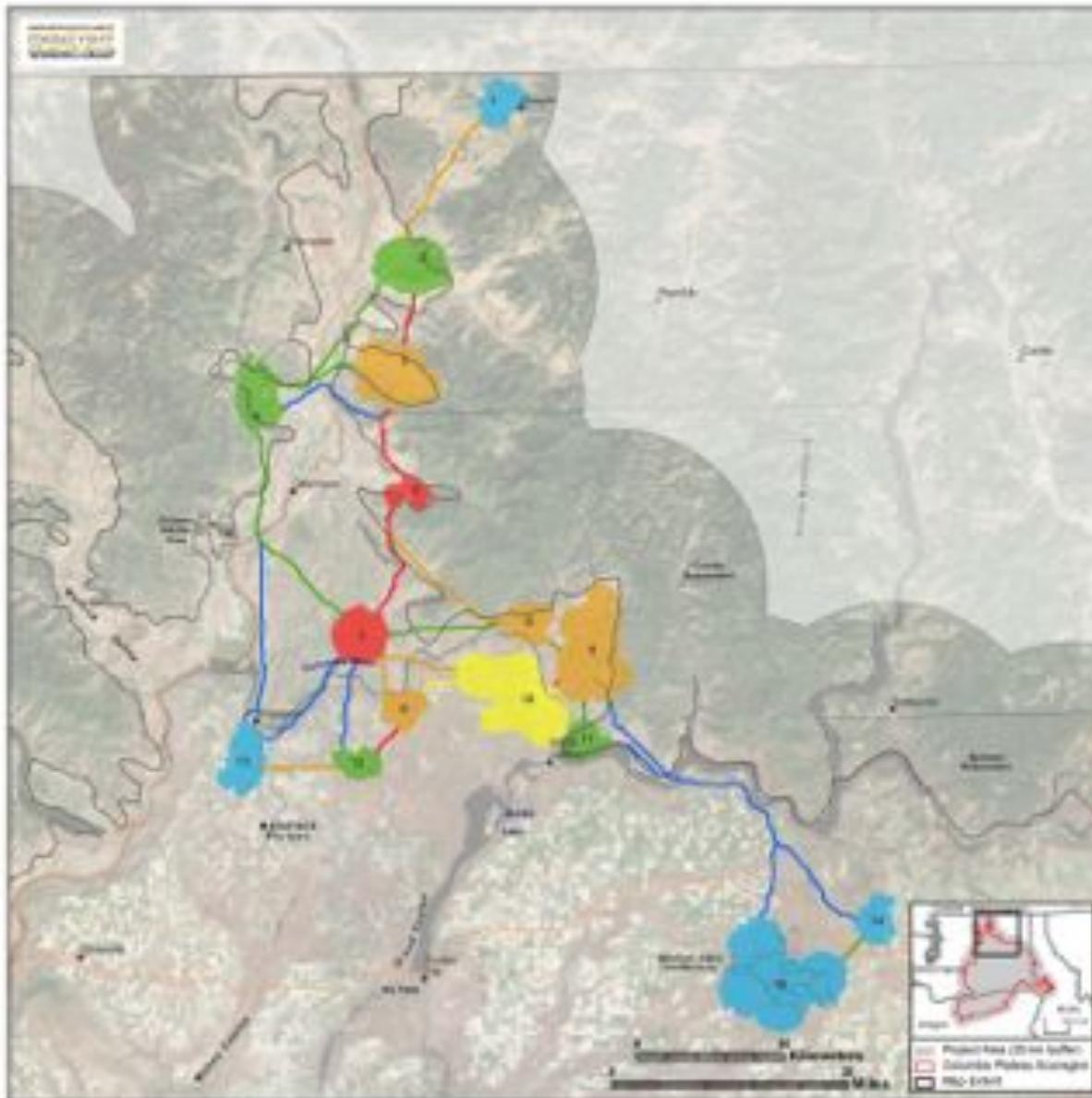


Figure 2.3. Linkage Network Centrality for Sharp-tailed Grouse (*Tympanuchus phasianellus*).

## WHAT IS CENTRALITY?

Centrality is a measure of how an entity or subset of linkage is functioning, the overall connectivity network, connected. For our analysis, we calculated central flow centrality using the Linkage Mapper Toolset (available at <http://www.usgs.gov/centrality>).

## WHY IS CENTRALITY IMPORTANT?

The connectivity network is comprised of habitat concentrations areas (HCAs) and linkages for movement of animals between them. Linkages are HCA roads; high connectivity are expected to be the "professionals" for connectivity. For example, if a linkage with high centrality is removed, it would species may only having its population separated into two populations.

## HOW IF CENTRALITY AFFECTS ON THE MAP?

- Centrality tool uses depth-based on flow quantity (flow equal 1 unit). However, sharp sparser habitats areas shown in yellow (flow 10% of this sparser), and red (flow remaining 10%).
- Linkages and HCA clusters to emerge also have relatively high network centrality, while dense isolated HCA and groups tend to be on the periphery of the network.

## TOPICS OF CONCERN AND INVESTIGATION WITH RESPECT TO CENTRALITY

- Where are important areas for landscape fragmentation considerations?
- Where should further disturbance be avoided (i.e. be avoided?)
- What HCA might be important for gene conservation efforts (e.g., used for re-introductions and reintroduction of populations)?

Note: This map depicts modeled HCAs and linkages (see notes at <http://www.usgs.gov/centrality>). It's likely "to avoid the least centrally sites because field surveys are necessary to ensure site off-road and linkage are useful. It's included here to highlight habitat to help understand fragmentation connectivity. However, our priority sites for field surveys on these will change over time.



# Linkage Pinch-Points

“Bottlenecks” where wildlife movement is funneled within linkages. Areas vulnerable to being severed.



*Photo by Michael A.  
Schroeder*



*Photo by Rob  
Bennetts*

# Linkage Pinch-Points

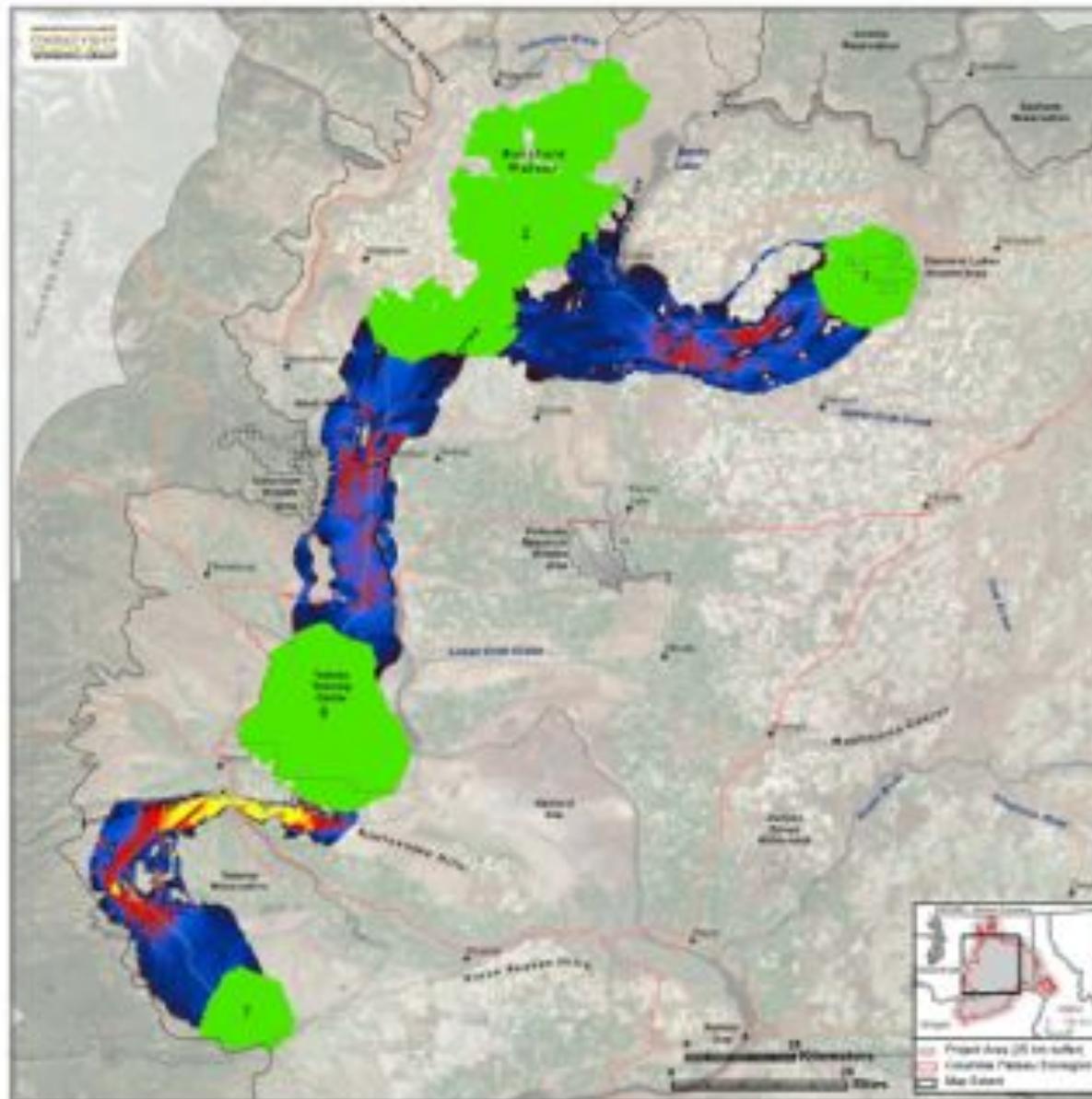


Figure 3.4. Linkage Pinch-Points for Greater Sage-Grouse (*Centrocercus urophasianus*).

#### #WHAT ARE PINCH-POINTS?

Pinch-points are "bottlenecks" where wildlife movement is limited within linkages. Pinch-point modeling methods are based on electric circuit theory. It assumes linear sources or very strong non-constraints in the linkage and represent areas most vulnerable to being severed (see here or <http://www.usgs.gov/LinkageMapper>). Pinchpoints can be the result of both natural and human-made linkage factors.

#### #WHAT ARE PINCH-POINTS IMPORTANT?

Pinch-points are a conservation priority to the degree where loss of a small area could disproportionately compromise connectivity along a link of biological importance. Loss of these areas may serve as pathway nodes, or regional off-road movement nodes.

#### #WHAT ARE PINCH-POINTS IN THE COLORADO PLATEAU?

- Human concentrations areas (HCAs) are indicated in green, while the linkages are depicted in a yellow to blue color ramp.
- High and low inclusion indicates to highly constrained areas by movement within linkages.
- Blue areas are not necessarily "better" areas of the linkage but rather places where resources or similar sources bring together the landscape.

#### TYPE OF QUESTIONS AND ANSWERS FROM MAP PRESENTATION

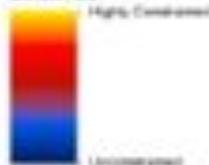
- Where along linkages is potential movement highly or moderately constrained?
- Are there areas where alternative movement routes may not be available?

To determine the relative importance of pinchpoints in different linkages, users should consider the pinch-point map in conjunction with other measures, such as connectivity.

Note: The maps do not consider HCs and linkages from more at large, unconsolidated areas. While we try every the best available data sources, please realize to maximize the utility and linkages are reliable. We included areas in Oregon and Idaho to help model transboundary connectivity. However, our prediction may be inaccurate in those adjoining areas.

#### Linkage Pinch-Point

##### Current Flow



Highly Constrained Area (HCA)  
Least-Cost Path (LCP)

#### Boundaries and Population Centers

- Colorado Plateau Project Area
- Colorado Plateau Project Area 20 km Buffer
- State or Provincial Boundary
- City or Town
- Impound Site

The data presented on this map are subject to use constraints as described in NMGDS metadata documentation.

# Barriers/Restoration Opportunities

Barriers are areas of the landscape that impede movement. If barriers are restored or enhanced we may improve connectivity.



Photo by Khanh Tran



Photo by Michael A. Schroeder

# Barriers/Restoration

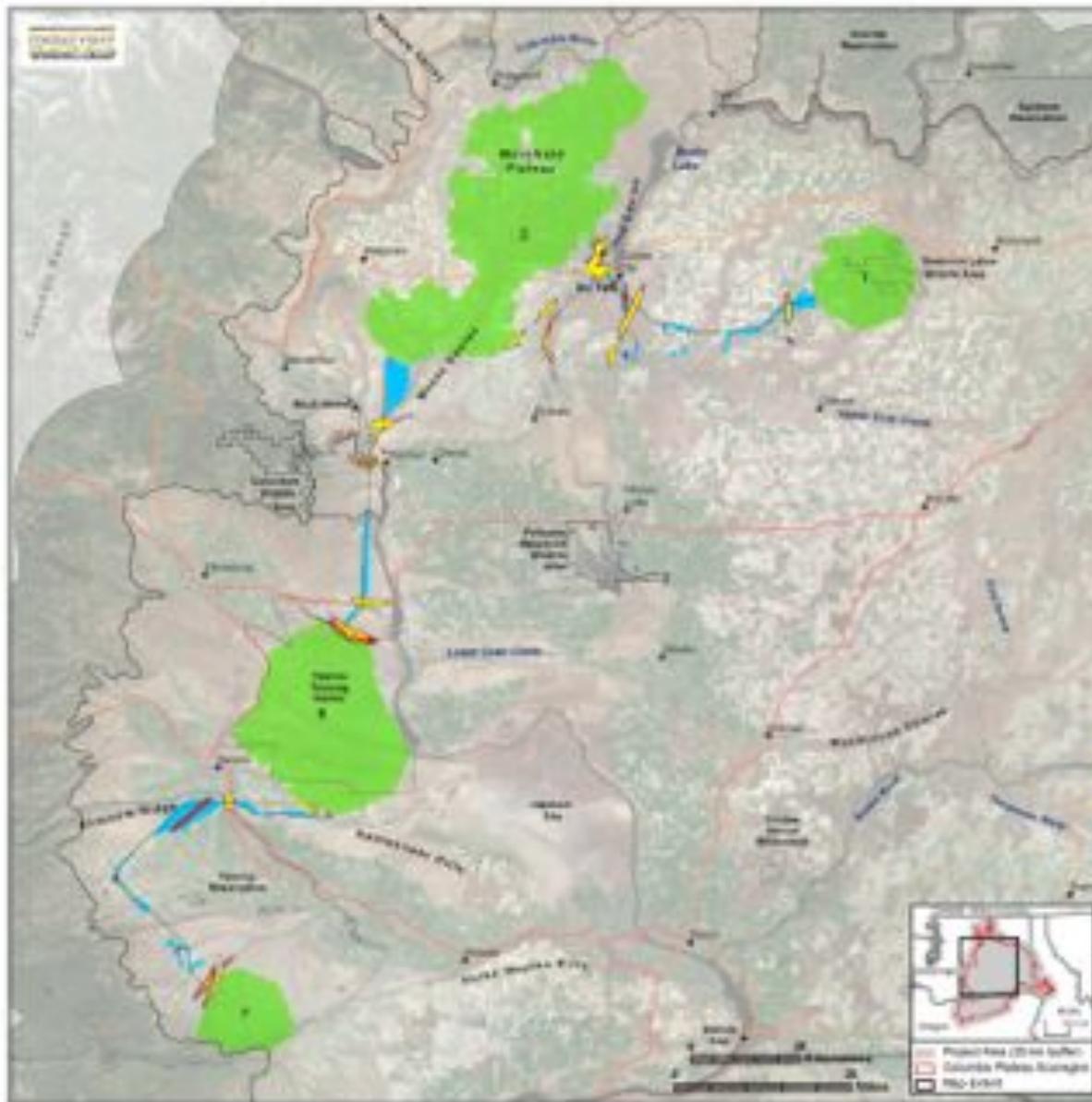


Figure 3.6. Barriers and Restoration Opportunities for Greater Sage-Grouse (*Centrocercus urophasianus*).

## WHAT ARE BARRIERS?

Barrriers are areas where landscapes become impeded, which is associated with reduced habitat availability due to urban, oil and gas, mining, roads, etc. <http://www.usda.gov/ceq/landowner/> Identify and rank barriers by their impact and quality; this serves to quickly communicate major impacts to communities. Barriers may be physical or anthropogenic, and they may be natural (e.g., areas of high barrier include things like rivers, mountains, highways, areas of high density). Not all barriers are necessarily

## WHAT ARE RESTORATION AND RESTORATION OPPORTUNITIES FOR THE PROJECT?

- The barrier is past the point of improvement (area where they have no influence to continue continuous persistence naturally). The areas are shown as the equal proportion indicated in the colors of yellow, red, and blue.
- Barriers highlighted yellow areas are places that, if removed or enhanced, may yield the greatest improvement in potential persistence of sage grouse HCA.
- Areas highlighted blue may yield moderate improvement in potential persistence if removed.
- Barriers identified for priority mitigation purposes have the potential to produce early effects in a timeline between 10-20 years of removal.

## WHAT ARE GROWTH/DEVELOPMENT AND RESTORATION OPPORTUNITIES FOR THE PROJECT?

- Where can linkage will conservation efforts have the greatest effect on connectivity?
- Where can alternate linkage pathways (e.g., around through avoidance of key areas) instead of "fixing" barriers?

Note: All types of barriers to movement are identified on this map since most barriers evaluate the feasibility of such removal from a practicality.

Note: This map only is provided for CCA and managers (see notes on <http://www.usda.gov/ceq/>). While we used the most accurate data source, please exercise to ensure the HCA and Linkage area exists. It's included here for diagnostic status to help evaluate/assess relationship connectivity. However, our priorities in map are due to areas in close proximity areas.

### Barrier Impact / Restoration Improvement Scores

- Yellow: Highest
- Red: High
- Blue: Moderate

### HQAs and LCPs

- High Concentration Area (HCA)
- Leaded Coal Path (LCP)
- High Concentration-Free HQD project blocks on the map indicate HQD control

### Boundaries and Population Centers

- Columbia Plateau Project Area
- Columbia Plateau Project Area 25 km Buffer
- State or Provincial Border
- Tribes
- Major Highways
- City or Town
- Important Site

The data portrayed on this map are subject to several constraints as described in HQDRC's methods documentation.

# Model Testing, Validation, and Adaptive Management



*Photo by Michael A. Schroeder*

# Conceptual Approach

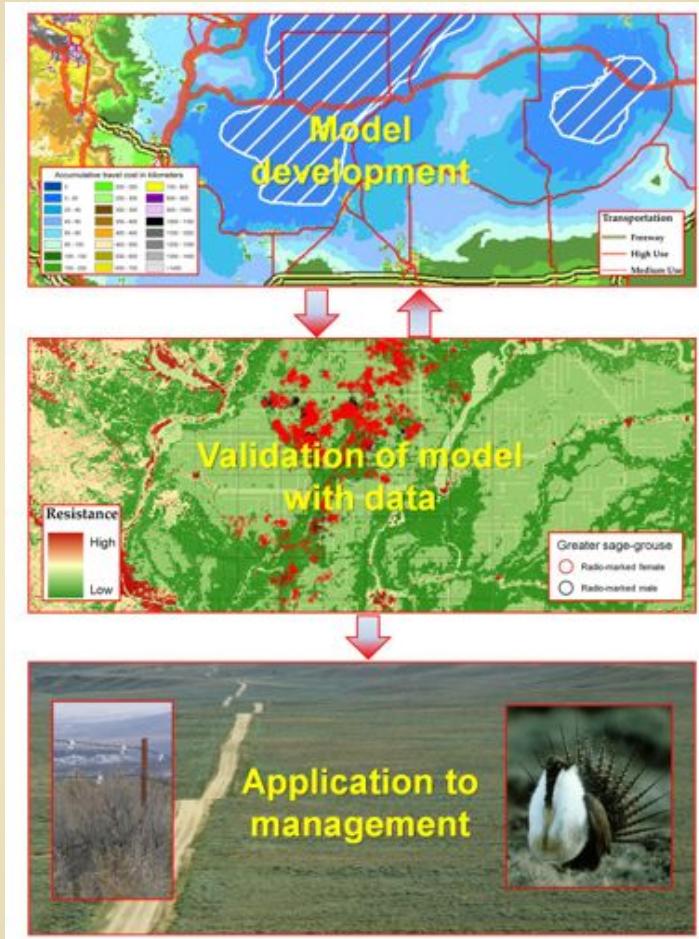


Figure: Greater Sage-grouse model validation. (Credits: Mike Schroeder, Leslie Robb)

# Three Categories



## Limited locational and/or genetic data available

- Need: field data to improve confidence in range location(s) and extent
- Need: genetic data to identify population structure
- Examples: Black bear, American Marten, Black-tailed Jackrabbit, White-tailed Jackrabbit, Least Chipmunk

• Photo credit: Robert Long, Paula MacKay



## Using (and/or supplementing) existing data sets to test accuracy of models

- Need: test model outputs to identify how well they represent field data
- Need: for species such as Greater Sage-Grouse, this will directly support essential conservation needs
- Examples: Greater Sage-Grouse, Mule Deer

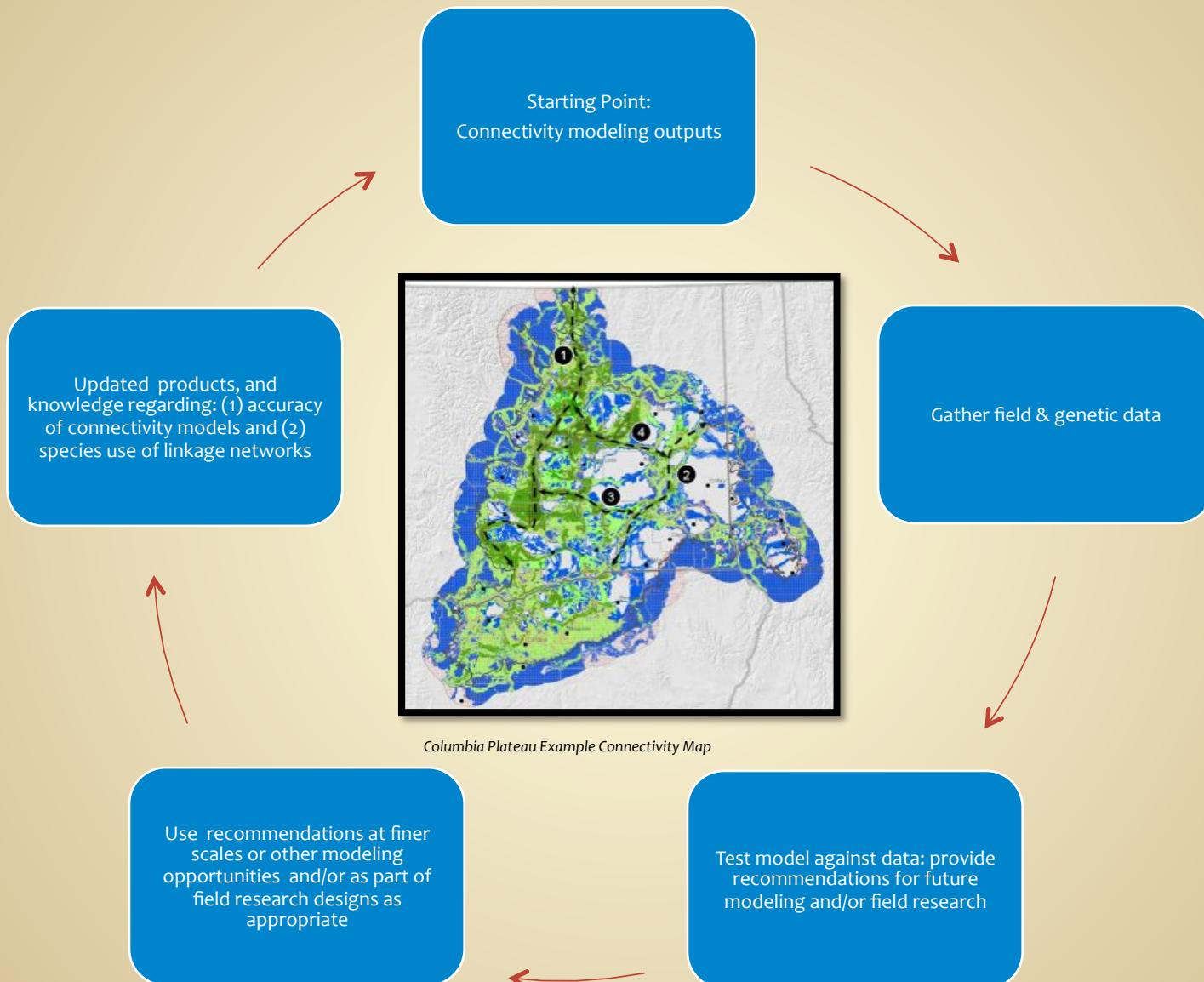
• Photo credit: Khanh Tran



## Ensuring linkages are effective for species movement

- Need: On the ground conservation effectiveness; we need to know corridors and permeable landscapes function successfully for a spectrum of movement needs, including seasonal migrations, and gene-flow between populations
- Example: A. Gregory research in Douglas County to determine whether an existing corridor is effective at maintaining genetic connectivity , and linking gene flow to landscape attributes

# Work Flow



WASHINGTON WILDLIFE HABITAT  
**CONNECTIVITY**  
WORKING GROUP



Questions?



[www.waconnected.org](http://www.waconnected.org)