WASHINGTON CONNECTED LANDSCAPES PROJECT: STATEWIDE ANALYSIS

EXECUTIVE SUMMARY

WASHINGTON WILDLIFE HABITAT CONNECTIVITY WORKING GROUP

DECEMBER 2010

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Mission Statement of the Washington Wildlife Habitat Connectivity Working Group

Promoting 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.

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Washington Wildlife Habitat Connectivity Working Group

Core Team: Kelly McAllister (Co-lead, WSDOT), Joanne Schuett-Hames (Co-lead, WDFW), Brian Cosentino (WDFW), Bill Gaines (USFS), John Gamon (DNR), Sonia Hall (TNC), Joshua Halofsky (DNR)*, Karl Halupka (USFWS), Lynn Helbrecht (WDFW), Meade Krosby (UW), Robert Long (WTI), Brad McRae (TNC), Albert Perez (WSDOT), Leslie Robb (Independent Researcher), Andrew Shirk (Independent Researcher), Peter Singleton (USFS), Joshua Tewksbury (UW), Jen Watkins (CNW)

Statewide Analysis Modeling Team: Brian Cosentino (WDFW), Kelly McAllister (WSDOT), Brad McRae (TNC), Tristan Nuñez (UW), Albert Perez (WSDOT), John Pierce (WDFW), Joanne Schuett-Hames (WDFW), Andrew Shirk (Independent Researcher), Peter Singleton (USFS)

Statewide Analysis Focal Species Leads: Mike Atamian (WDFW), Karin Divens (WDFW), Howard Ferguson (WDFW), Bill Gaines (USFS), Karl Halupka (USFWS), Kelly McAllister (WSDOT), Cliff Rice (WDFW), Leslie Robb (Independent Researcher), Chris Sato (WDFW), Joanne Schuett-Hames (WDFW), Andrew Shirk (Independent Researcher)

Statewide Document Technical Editors: Leslie Robb (Lead Technical Editor, Independent Researcher), Erin Moore (Supporting Technical Editor, CNW), Chris Sato (Graphics, WDFW)

Statewide Document Lead Writers: Brian Cosentino (WDFW), Karl Halupka (USFWS), Kelly McAllister (WSDOT), Brad McRae (TNC), Joanne Schuett-Hames (WDFW), Jen Watkins (CNW)

Statewide Document Contributing Writers: Mike Atamian (WDFW), Karin Divens (WDFW), Howard Ferguson (WDFW), Bill Gaines (USFS), Sonia Hall (TNC), Meade Krosby (UW), Tristan Nuñez (UW), Albert Perez (WSDOT), John Pierce (WDFW), Cliff Rice (WDFW), Leslie Robb (Independent Researcher), Chris Sato (WDFW), Andrew Shirk (Independent Researcher), Peter Singleton (USFS)

Statewide Document Cartography Team: Brian Cosentino (Lead, WDFW), Kelly McAllister (WSDOT), Sandy Moody (WSDOT), Albert Perez (WSDOT), John Talmadge (WDFW)

Communications and Implementation Subgroup: Jen Watkins (Lead, CNW), Kristy Brady (UW), John Carleton (WDFW)*, Marion Carey (WSDOT), Sarah Gage (Biodiversity Council), Lynn Helbrecht (WDFW), Kelly McAllister (WSDOT), Jasmine Minbashian (CNW), Douglas Peters (WACommerce), Joanne Schuett-Hames (WDFW), Robin Stanton (TNC), Nancy Warner (IRIS), Cynthia Wilkerson (TWS)

Focal Species Subgroup: Kelly McAllister (Lead, WSDOT), Mike Atamian (WDFW), Brian Cosentino (WDFW), Karin Divens (WDFW), Amy Eagle (WDFW)*, Howard Ferguson (WDFW), Bill Gaines (USFS), Karl Halupka (USFWS), Albert Perez (WSDOT), Cliff Rice (WDFW), Leslie Robb (Independent Researcher), Chris Sato (WDFW), Joanne Schuett-Hames (WDFW), Andrew Shirk (Independent Researcher), Derek Stinson (WDFW), Matt Vasquez (USFS)*

Modeling Subgroup: Brad McRae (Co-lead, TNC), Joanne Schuett-Hames (Co-lead, WDFW), Brian Cosentino (WDFW), Bill Gaines (USFS), Meade Krosby (UW), Robert Long (WTI), Kelly McAllister (WSDOT), Tristan Nuñez (UW), Albert Perez (WSDOT), John Pierce (WDFW), Chris Sato (WDFW), Joe Scott (CNW), Andrew Shirk (Independent Researcher), Peter Singleton (USFS), Joshua Tewksbury (UW), David Wallin (WWU)

Landscape Integrity Subgroup: John Pierce (Lead, WDFW), Rex Crawford (DNR), John Gamon (DNR), Meade Krosby (UW), Josh Lawler (UW), Brad McRae (TNC), Tristan Nuñez (UW)

Peer Review Planning Subgroup: Peter Singleton (Lead, USFS), Rob Fimbel (WSPRC), Kelly McAllister (WSDOT), Brad McRae (TNC), John Pierce (WDFW), Joanne Schuett-Hames (WDFW), Joshua Tewksbury (UW)

Mapping and GIS Data Subgroup: Brian Cosentino (Lead, WDFW), Albert Perez (WSDOT), Matt Vasquez (USFS)*

Climate Change Subgroup: Meade Krosby (Lead, UW), Brad McRae (TNC), John Pierce (WDFW), Josh Lawler (UW), Lynn Helbrecht (WDFW), Tristan Nuñez (UW), Peter Singleton (USFS), Joshua Tewksbury (UW)

**Former member.*

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Peer Reviewers

Paul Beier, PhD
Northern Arizona University

Nick Haddad, PhD
North Carolina State University

Jodi Hilty, PhD
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David Theobald, PhD
Colorado State University

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Dave Anderson (WDFW), Keith Aubry (USFS), Jeff Azerrad (WDFW), Rocky Beach (WDFW), Liz Bedl (WF), James Begley (WTI), Lisa Bellefond (TNC), Jeff Bernatowicz (WDFW), Dave Brittell (WDFW), Howard Browers (USFWS), Nathan Burkepile (YNW), Steve Buttrick (TNC), Ted Clausing (WDFW), Julie Conley (SP), Jack Connelly (IDFG), Yvette Converse (USFWS), Jeff Copeland (USFS), John Fleckenstein (WDNR), Rich Finger (WDFW), Scott Fitkin (WDFW), Sanders Freed (TNC), Patty Garvey-Darda (USFS), Rose Gerlinger (CCT), Jon Germond (ODFW), Jessica Gonzales (USFWS), Angie Haffie (WSDOT), Tony Hamilton (BCME), Audrey Hatch (WDFW), Lisa Hallock (WDFW), Marc Hayes (WDFW), Jeff Heinlen (WDFW), Janet Hess-Herbert (MTFW&P), Greg Hughes (USFWS), Larry Irwin (NCASI), Bruce Johnson (ODFW), Denise Joines (WF), Aaron Jones (TNC), Jay Kehne (CNW), Gina King (YNW), Trevor Kinley (Sylvan Consulting Ltd.), Mike Knapik (BCMW), Gary Koehler (WDFW), Jesse Langdon (TNC), John Lehmkuhl (USFS), Bill Leonard (WSDOT), Mary Linders (WDFW), Mike Livingston (WDFW), Reese Lolley (TNC), Jason Lowe (BLM), Eric Lund (WDFW), Jim Lynch (Fort Lewis), Aimee MacIntyre (WDFW), John Mankowski (GOV), Scott McCorquodale (WDFW), Holly McDonough (USFWS), Kit McGurn (CNW), William Meyer (WDFW), Ruth Milner (WDFW), Erin Moore (CNW), Woody Myers (WDFW), Robert Naney (USFS), Jerry Nelson (WDFW), Leslie Nelson (TNC), Regan Nelson (formerly with TNC), Theresa Nogeire (UW), Mark Nuetzmann (YNW), Dede Olson (USFS), Donald Parks (SC), Leslie Parks (WWU), Mark Penninger (USFS), Kristeen Penrod (SCW), Cathy Raley (USFS), Aaron Reid (BCME), Darryl Reynolds (BCME), John Richardson (Fort Lewis), Kevin Robinette (WDFW), Bill Robinson (TNC), Elizabeth Rodrick (WDFW), John Rohrer (USFS), Harry Romberg (SC), Mike Schroeder (WDFW), Carol Schuler (USFWS), Jennifer Schwartz (HCPC), Gregg Servheen (IDFG), Erica Simek (TNC), Winston Smith (USFS PNW), Joanne Stellini (USFWS), Jim Stephensen (YNW), Tory Stevens (MOE), Katrina Strathmann (YNW), Leona Svancara (UI), Tara Szkorupa (BCME), Emily Teachout (USFWS), Mark Teske (WDFW), Michelle Tirhi (WDFW), Bob Unnasch (TNC), Gregory Utzig (Kutenai Nature Investigations Ltd.), J. A. Vacca (BLM), Matt Vander Haegen (WDFW), David Volsen (WDFW), Paul Wagner (WSDOT), Dave Ware (WDFW), Wendy Ware (WDFW), Rich Weir (Artemis Consulting), Dave Werntz (CNW), Richard Whitney (CCT), Todd Wilson (USFS PNW), Elke Wind (E. Wind Consulting), Miranda Wood (ODFW), George Wooten (CNW), Helmut Zahn (WDFW ret.), Stephen Zylstra (USFWS)

Executive Summary

Animals move across landscapes to find food and other resources, migrate between seasonal habitats, find mates, and shift to new habitats in response to environmental changes. The ability to successfully move between habitats is essential for the long-term survival of many wildlife species, from large, migratory species such as elk (*Cervus elaphus*) and mule deer (*Odocoileus hemionus*), to smaller animals like white-tailed jackrabbits (*Lepus townsendii*), Greater Sage-Grouse (*Centrocercus urophasianus*), and western toads (*Anaxyrus boreas*). Landscape connectivity is also important for maintaining other natural processes such as nutrient cycling and seed dispersal. Maintaining and restoring connectivity is a key conservation strategy to preserve ecological processes and maintain the genetic and demographic health of wildlife populations. Connected landscapes will help wildlife weather future habitat changes resulting from natural disturbances such as fire, or from other factors including human population growth, development, and climate change.

The state of Washington, like other states, faces pressures that have compromised the connectivity of habitats and wildlife populations. The imprint of development, transportation, and agriculture on the landscape is prevalent and many wildlife habitats have been highly fragmented. And, despite being the smallest western state, Washington has the second highest human population. Sustaining wildlife habitat connectivity, while at the same time meeting the needs of people and communities, is an increasingly difficult challenge.

The Washington Wildlife Habitat Connectivity Working Group

In this context it became apparent that piecemeal efforts to avoid habitat fragmentation would not be successful in maintaining landscape connectivity over time. An effective program to maintain or improve connectivity requires a statewide approach using the best available science to guide coordinated action by many agencies and organizations. The Washington Wildlife Habitat Connectivity Working Group (WHCWG) was formed to address this need.

The WHCWG is a voluntary public-private partnership between state and federal agencies, universities, tribes, and non-governmental organizations. The WHCWG is co-led by the Washington Department of Fish and Wildlife (WDFW) and the Washington Department of Transportation (WSDOT). The mission statement of the WHCWG is "*Promoting 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*."

The WHCWG has also responded to the Western Governors' Association initiative to identify key wildlife habitats and migration corridors. We work in collaboration with the Western Governors' Association Wildlife Corridors Initiative and our analyses are part of Washington's contributions to this effort.

The Washington Connected Landscapes Project

It became clear that we needed a systematic approach with multiple components and a sustained effort to support our mission statement. We call this approach the *Washington Connected Landscapes Project*. The primary thrusts of the project at this time include: (1) scientific analyses of connectivity issues at different spatial scales for current and future landscape conditions, (2) development of suitable analytical methods and tools necessary to support these analyses, (3) coordination with transboundary partners to maintain connectivity across Washington's borders, (4) research and adaptive management to test and improve our models, and (5) outreach and education about connectivity to a broad array of stakeholders. This statewide report of the WHCWG is the first scientific analysis product of the Washington Connected Landscapes Project.

The Statewide Analysis

Assessing the current condition of wildlife habitat connectivity in the state is an important step for connectivity conservation. This statewide analysis quantifies current connectivity patterns for Washington State and neighboring areas in British Columbia, Idaho, and Oregon. It provides the foundation for analyses of connectivity at three spatial scales: (1) the statewide scale using connectivity maps and data presented here, (2) ecoregional scale connectivity analyses, and (3) detailed local analyses and linkage designs. The data and analysis techniques we've presented also provide the foundation for assessing changes brought about by energy development, climate change, and human population growth.

This document includes descriptions of the methods and results of the statewide analysis, lessons learned while completing the analysis, and planned future work of the WHCWG. It also gives guidance for interpreting and using these products. Appendices provide greater detail about species models, modeling methods, and GIS tools produced by the working group.

A primary product of our statewide analysis are maps which depict linkage networks, including areas of suitable habitat and the best remaining linkages connecting them. Sometimes those linkages include good habitat, such as stepping stones of small but exceptionally high-quality habitat patches. Other times the models may identify what is the best, albeit marginal, swath of land through poor or degraded habitat.

The maps that accomplish this were derived from two modeling approaches. Our *focal species* approach produced linkage networks for 16 representative species, while our *landscape integrity* approach produced networks of lands exhibiting high degrees of landscape integrity and relatively intact natural areas with low levels of human modification.

Focal Species

We selected focal species using criteria designed to favor species with geographic ranges, habitat associations, and vulnerabilities to human-created barriers that made them representative of the habitat connectivity needs of many terrestrial species at a statewide scale. That is, we intended the linkages identified for our 16 focal species to benefit a broad array of species sensitive to habitat fragmentation. The focal species we chose represent not only diverse vegetation types, but varied life histories as well. They include animals that need large areas to meet their needs, like American black bears (*Ursus americanus*), elk, and wolverines (*Gulo gulo*). They also include smaller species whose habitat has become fragmented, such as northern flying squirrels (*Glaucomys sabrinus*) and white-tailed jackrabbits. And they include less mobile species such as western toads.

Our results for each focal species include maps of: (1) overall resistance to movement across the landscape, (2) important habitat patches (habitat concentration areas – HCAs), (3) cost-weighted distance, which depicts how resistance to movement accumulates while traversing the landscape outward from HCAs, and (4) modeled linkages between HCAs (Fig. ES.1; see Chapter 3). Close inspection of maps for each focal species can provide insight into baseline connectivity conditions in different parts of Washington State.

Landscape Integrity

Our landscape integrity approach to modeling connectivity seeks to identify the best available areas to maintain connectivity for animal movement and ecological processes. To implement this approach, we first identified large, contiguous areas that have retained high levels of "naturalness" (i.e., core areas characterized by a relatively light "human footprint"). Then, we identified linkages of highest landscape integrity between core areas. These linkages tend to avoid urban, residential, and industrial zones, transportation infrastructure, and agricultural lands. Note that our landscape integrity models are intended to be broad scale and are not tailored to specific categories of wildlife species.

Products of this analysis include maps of: (1) landscape integrity scores (Fig. ES.2); (2) linkages based on four different landscape integrity resistance models each reflecting different sensitivities to human-modified landscapes (See Chapter 3); and (3) composite landscape integrity linkages using the four different sensitivity levels (Fig. ES.3).

Many landscape integrity linkages coincided with focal species linkages, and the landscape integrity maps complemented the focal species results in that they represented connectivity conditions across our entire study area in a single map. For example, the maps allow one to compare the relatively natural conditions in the Olympic and Cascade Mountains with more converted lands in the eastern Puget Trough, the Interstate 5 (I-5) transportation corridor, and the Columbia Plateau in eastern Washington.

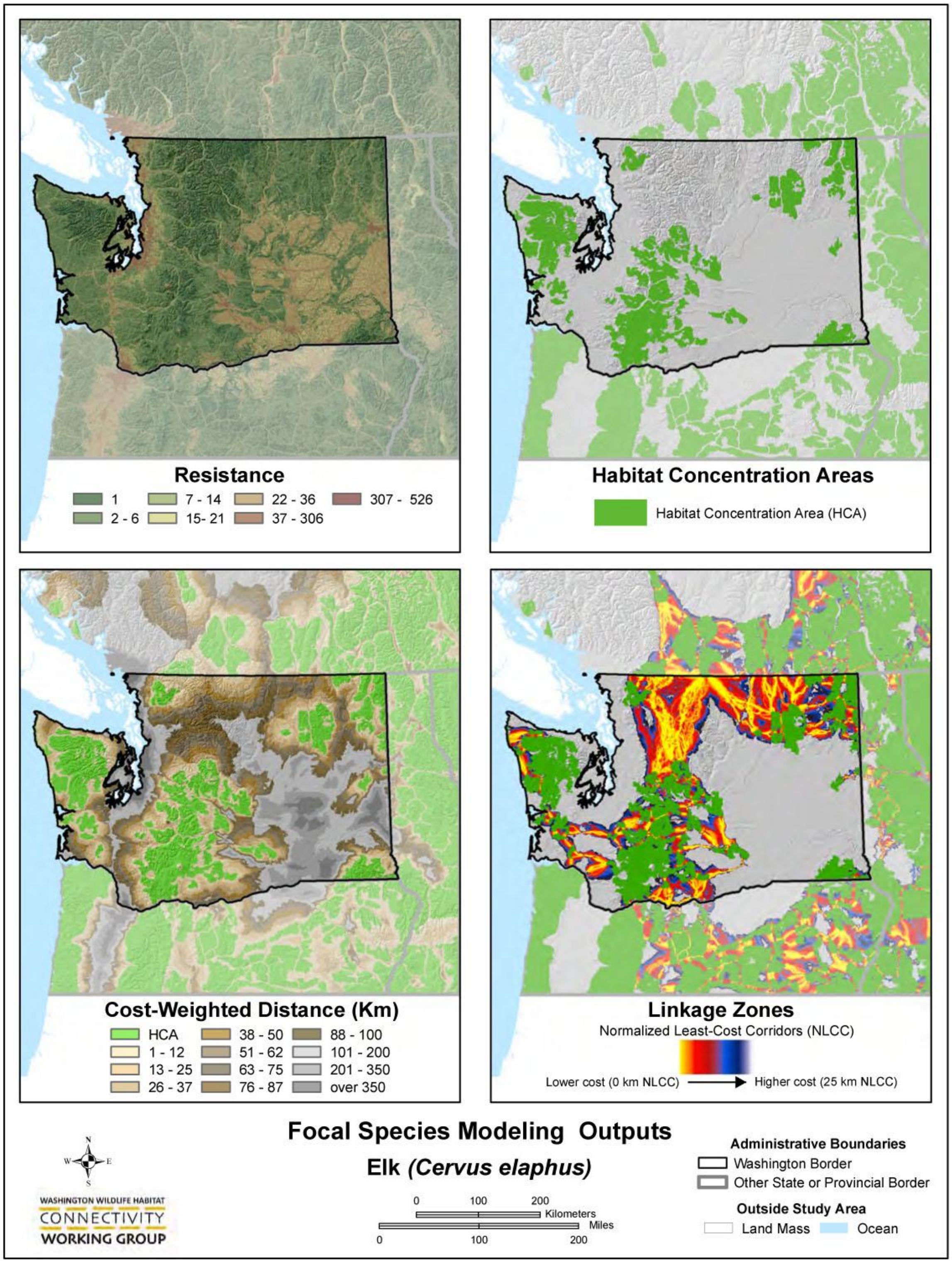

Figure ES.1. Example overview of map products for elk showing progression from landscape resistance (top left) and habitat concentration areas (top right) to the cost-weighted distance (bottom left) and linkage zones (bottom right). The cost-weighted distance map illustrates how the ease and extent of movement changes as elk travel outward from HCAs. The linkage zone map highlights the "easiest" (of least landscape resistance) movement pathway for elk to travel between adjacent HCAs.

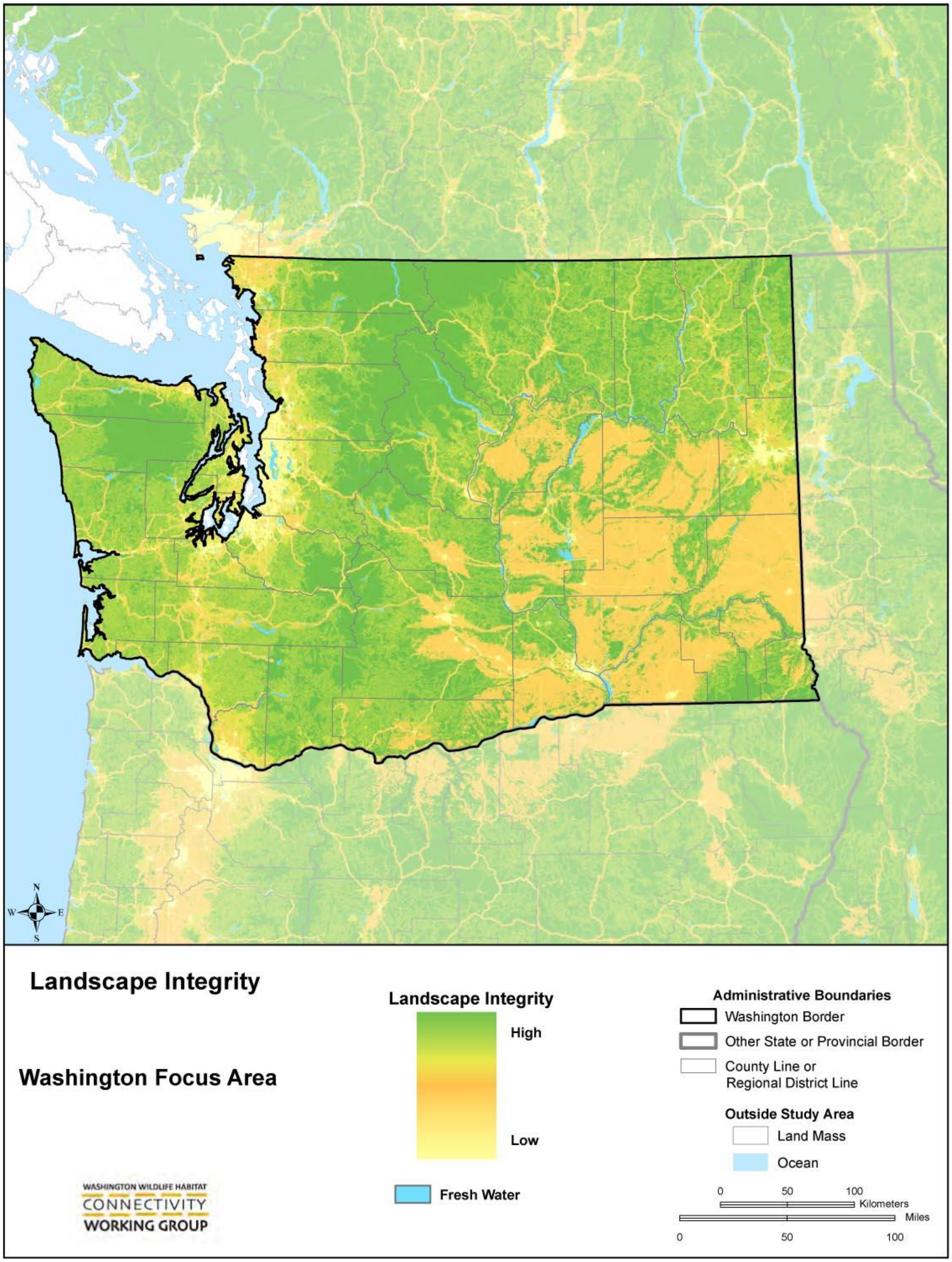

Figure ES.2. Landscape integrity map. Areas of highest landscape integrity have the lowest human footprint (e.g., natural land-covers, low housing density, and minimum roads).

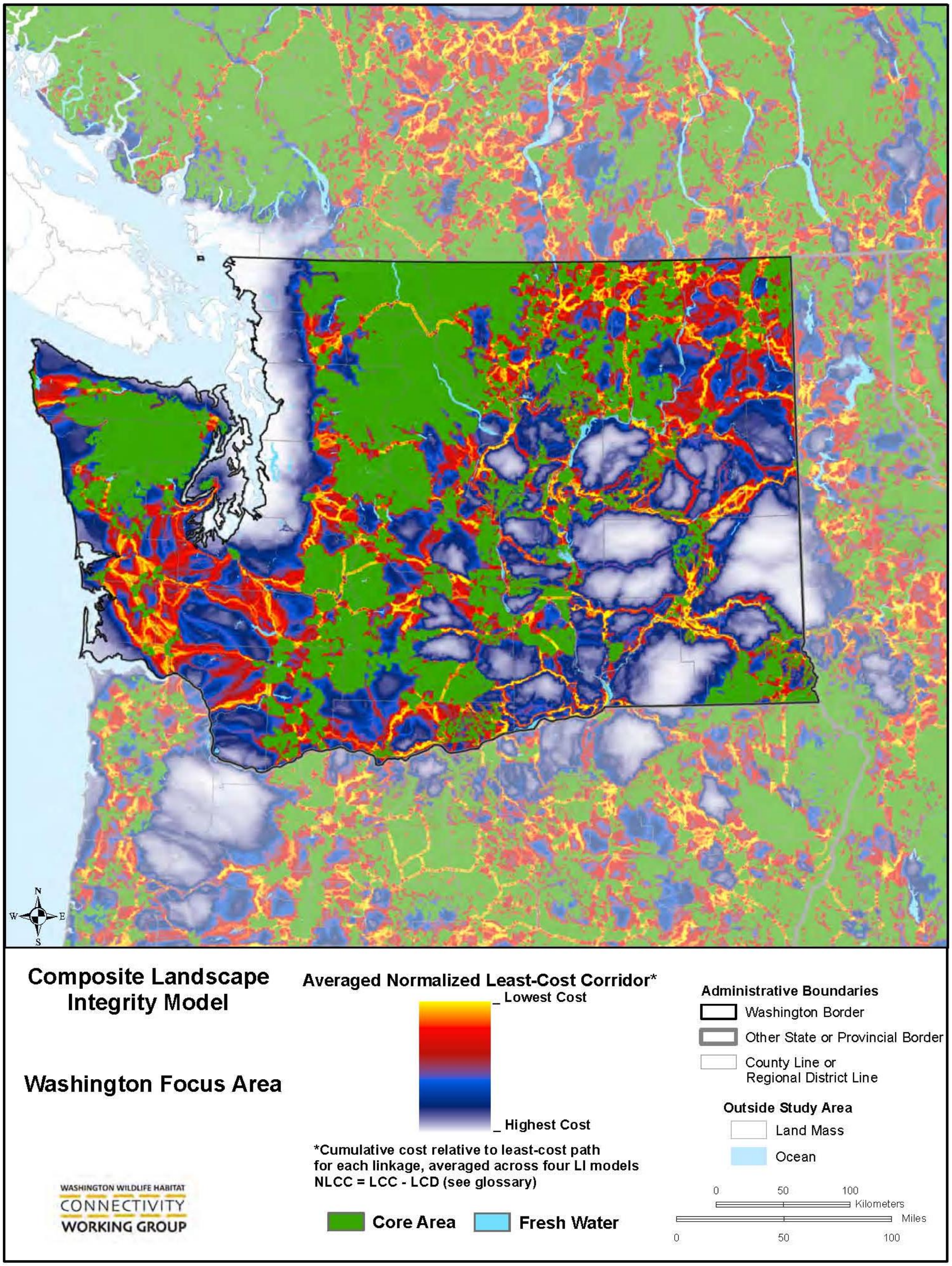

Figure ES.3. Composite landscape integrity linkage map which combines four sensitivity models. Cost values indicate relative ease of movement within each linkage.

Linkage Networks

Our 16 focal species and landscape integrity analyses yielded diverse patterns of wildlife habitat and landscape connectivity. We investigated the consistency between the analyses to compare results and to identify common patterns through the use of linkage networks. These networks depict a connected system of landscape conditions representing the best remaining habitat and the connecting lands that link it all together. The linkage networks we've modeled are comprised of habitat concentration areas or landscape integrity core areas, the linkage zones that connect them, and a cost-weighted distance buffer surrounding the HCAs or core areas (See Chapter 2).

Based on this investigation, our focal wildlife species can be grouped and mapped as three different connectivity guilds: (1) generalist (including species such as mule deer and western toads; Fig. ES.4); (2) montane (including species such as American black bears and wolverines; Fig. ES.5); and (3) shrubsteppe (including species such as American badgers (*Taxidea taxus*) and white-tailed jackrabbits; Fig. ES.6).

We found broad consistency between the linkage patterns identified by the focal species and landscape integrity approaches. Further examination of the overlap between networks mapped for different focal species, and between focal species and landscape integrity networks, should help calibrate estimates of how well these networks are likely to serve broader suites of species.

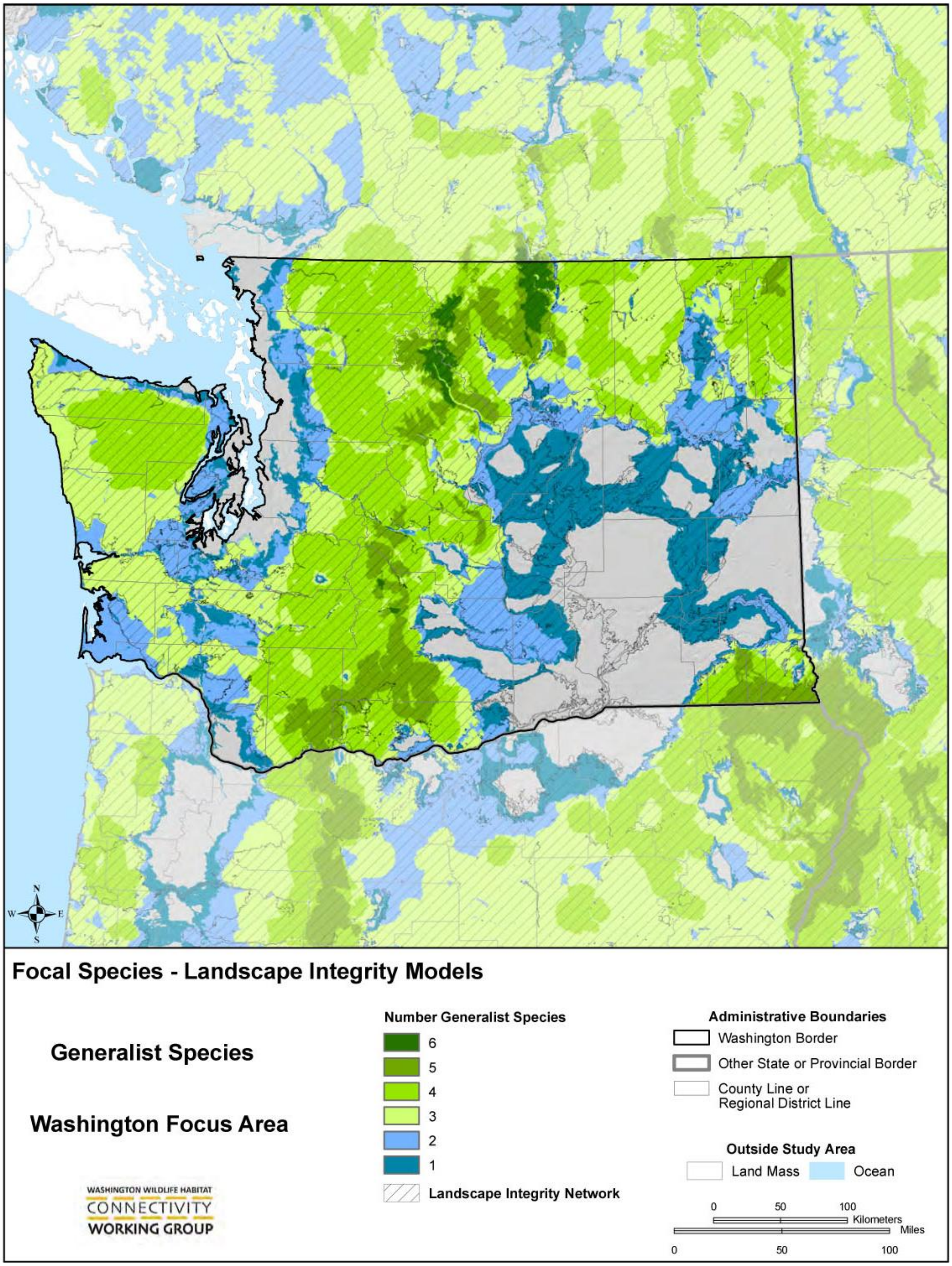

Figure ES.4. Composite focal species and landscape integrity map for generalist connectivity guild. Includes species that can inhabit a variety of habitats such as mule deer and western toads.

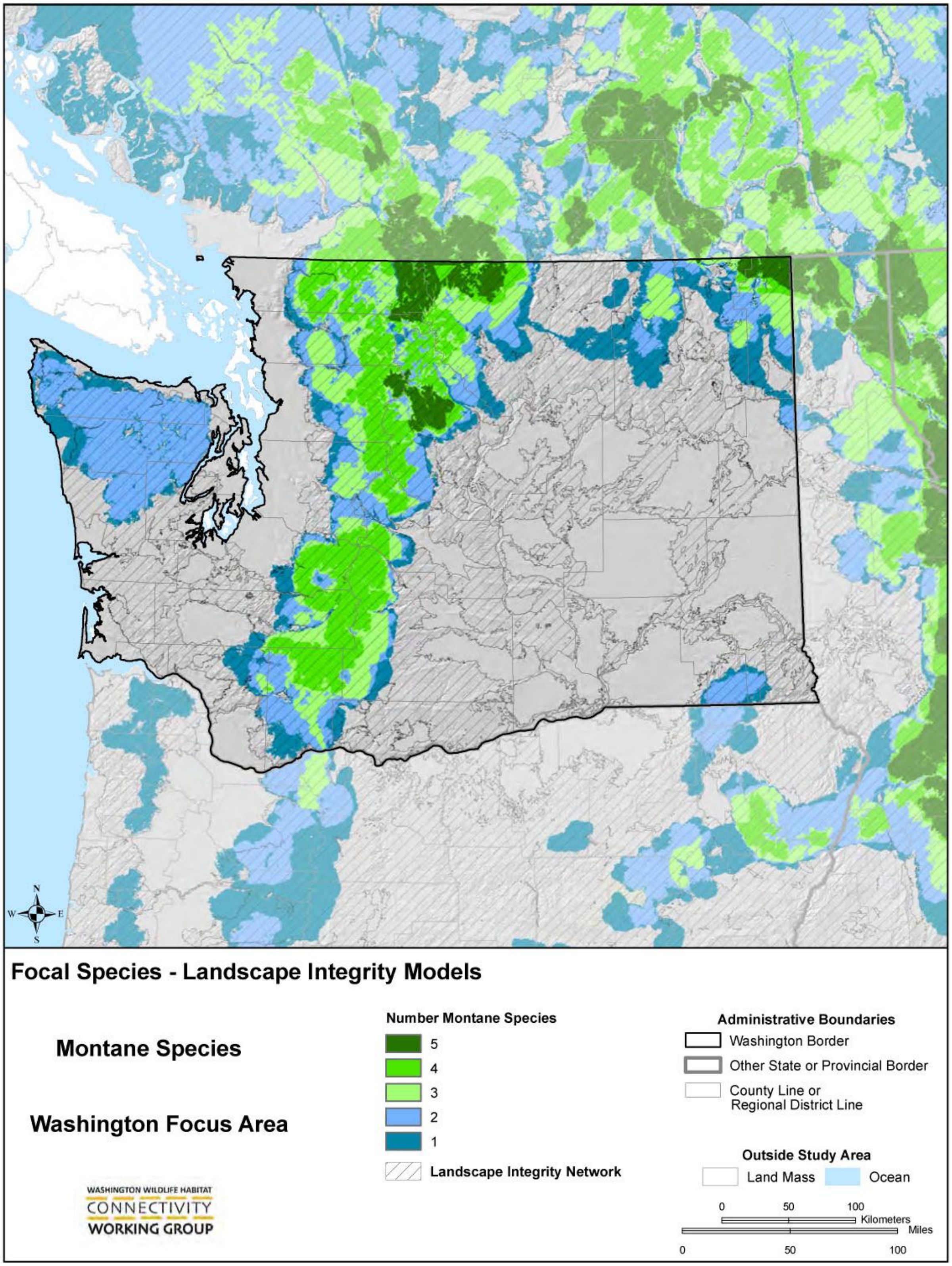

Figure ES.5. Composite focal species and landscape integrity map for montane connectivity guild. Includes species found in forests and mountainous areas such as American black bears and wolverines.

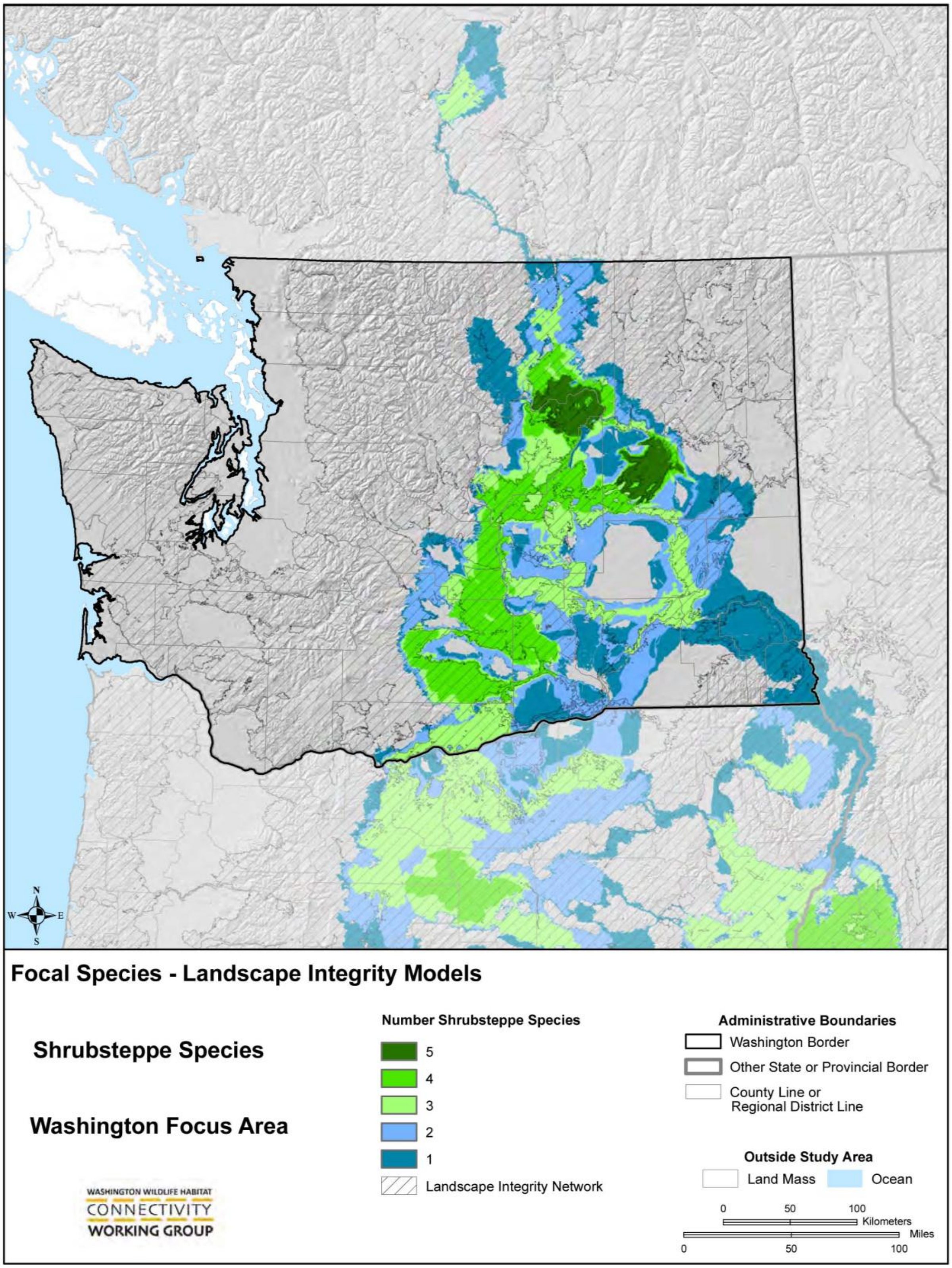

Figure ES.6. Composite focal species and landscape integrity map for shrubsteppe connectivity guild. Includes arid lands species such as American badgers and white-tailed jackrabbits.

Observations and Insights

Key findings of the statewide analysis include:

- Two different analysis approaches (focal species and landscape integrity) identified broadly consistent habitat connectivity patterns in Washington.
- Synthesis of the focal species connectivity modeling results highlighted three overlapping linkage networks: the generalist species network, montane species network, and the shrubsteppe species network.
- Previously undocumented patterns of potential habitat connectivity for shrubsteppe species within the Columbia Basin were highlighted in this analysis.
- The Okanogan Valley provides habitat connectivity values for all three linkage networks.
- This analysis identified broad-scale landscape patterns that may provide the best opportunities for restoring habitat connectivity along I-5 south of Olympia.
- Additional work is needed in southwestern Washington to adequately map connectivity patterns due to the complex patterns of land ownership and land use history in that area.

Our analyses provided valuable insights into current patterns of wildlife habitat connectivity in Washington. We noted some wildlife habitats are well connected and others are discontinuous across parts of Washington State and its borders. We identified fewer habitat areas and linkages in areas of extensive urban development such on the east side of Puget Sound within the Puget Trough-Willamette Valley ecoregion. A similar example is the agricultural development in the Columbia Plateau ecoregion of eastern Washington. Here, our analyses of landscape integrity and focal species revealed previously undocumented landscape patterns that may contribute to habitat connectivity for shrubsteppe species. Habitat connectivity patterns in southwestern Washington remain uncertain due to the effects of complex patterns of land ownership and the historical emphasis on commercial timber production.

Many important habitat areas and connecting landscapes are found on public lands, such as those in the Cascade and Olympic Mountains. Private lands also contribute important habitat areas, and frequently help link wildlife habitats on public lands.

Major highways hinder movement of wildlife, and their impacts are worsened by associated development. For example, I-5 between Olympia and the Columbia River, together with development along it, is a potential barrier to wildlife movement. This analysis has highlighted areas along I-5 where broad-scale landscape patterns may provide the best opportunities for restoring habitat connectivity. Similarly, Interstate 90 (I-90) across Snoqualmie Pass creates a major disruption to north-south movement of wildlife in the Cascades, and has been recognized by WSDOT as a priority for implementing wildlife-friendly crossing structures. Some of the habitat linkages we identified provide passage around natural obstacles, such as large lakes and mountain ranges. For example, a linkage along the south shore of Hood Canal is the only terrestrial path linking the Olympic and Kitsap Peninsulas, and this passage is constrained by human development. Other examples of linkages around natural obstacles are found in the most rugged sections of the Cascade Mountains, where high peaks are impassable to most species, highlighting the importance of low-elevation passes and valley bottoms for wildlife movement.

Comparing our results to observed movements of focal and non-focal species, or to the relative success of restoration efforts, will constitute important tests of the effectiveness of our choice of focal species, our modeling approaches, and the spatial data upon which our analyses are based. These tests of the usefulness of our results at different spatial scales and for different wildlife species of concern will help to focus and refine future connectivity modeling efforts.

Interpreting and Using the Analysis

The products and data from this statewide analysis convey a wealth of information relevant to conservation of Washington's wildlife, but they rely on imperfect data, knowledge, and assumptions. We strongly suggest that readers thoroughly understand our methods and the limitations of those methods prior to applying our results: we cover this extensively in Chapter 4. To better understand underlying landscape conditions and how they are represented in the final linkage maps, we also suggest that readers view our products in the order of their creation: (1) base information, (2) resistance maps, (3) habitat concentration and core area maps, (4) cost-weighted distance maps, and (5) linkage maps.

The results of the statewide wildlife habitat connectivity analysis can be used to inform:

- The Western Governors' Association Wildlife Corridors Initiative.
- The Washington State Department of Fish and Wildlife's Wildlife Action Plan, while allowing for ecoregional analyses to continue to contribute to these plans at a finer scale.
- Implementation of safe wildlife passage structures and complementary measures by the Washington State Department of Transportation in accordance with Executive Order 1031 (e.g., enlarged culverts, wildlife overpasses, and fencing).
- Land management plan revisions and decisions for public lands in Washington State, including our national forests, state parks and forests, and state and federal arid lands.
- Decision-making by conservation organizations.
- Local governments about opportunities to protect habitat connectivity and initiate coordination regarding finer-scale analyses for comprehensive planning.
- Investments through state and federal grant programs for conservation of habitat and working lands (e.g., Washington Wildlife and Recreation Program, Land and Water Conservation Fund, and Farm Bill incentives).

Conclusions

This science-based document is an important tool to inform work to maintain, restore, and conserve habitat connectivity in Washington State and bordering areas. Thoughtful interpretation of this analysis is crucial, including an understanding of its limitations. This analysis is intended to provide information for conserving connected landscapes at the broadest scale and to provide a context for finer-scale analyses; all regions of Washington will require finer-scale analyses to identify habitats and linkages important to local wildlife populations. Moreover, this initial analysis only considers current habitat conditions, and must be complemented by additional products such as those that incorporate the effects of climate change. Our document establishes a foundation for detailed approaches, which are next steps in the Washington Connected Landscapes Project.

Partnership and collaboration have been instrumental in the completion of this statewide analysis and will be all-important to sustaining momentum to complete subsequent analyses at the ecoregional and local scales. Continued and expanded efforts by this partnership and by others is vital to completing the additional analyses needed to translate the information within this document into site-scale planning.