Chapter 1. Introduction to the Columbia Plateau Ecoregion Analysis

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Human beings live in an increasingly connected world. In the early 1800s, it took Lewis and Clark the better part of three years to travel overland from the Atlantic to the Pacific and back. Today, the same trip takes less than a day. Yet the same infrastructure that now connects and provides resources for an increasing number of people often disconnects the natural world. Our ability to move hinders the connectivity and success of wildlife. Highways, transmission lines, and cityscapes add to the movement barriers already posed by natural features. Unconnected, wildlife are relegated to smaller and smaller islands of suitable habitat with each island increasingly separated from the next occupied island. This fragmentation and lack of connected habitat isolates wildlife populations, increases mortality, lowers genetic heterogeneity, and, ultimately, increases rates of species extirpation and extinction. A well-connected landscape for wildlife is key to supporting more resilient wildlife populations as they face future changes in land use practices, human population growth, and potential effects of a changing climate.

The Washington Wildlife Habitat Connectivity Working Group (WHCWG) was formed with the mission to identify "*opportunities and priorities to conserve and restore habitat connectivity*" for our region's wildlife. To address issues of wildlife habitat connectivity within Washington and adjacent lands, the WHCWG adapted a three-tiered approach focused at statewide, ecoregional, and local scales (Fig. 1.1). The first tier, a broad-scale assessment, was addressed by the *Washington Connected Landscapes Project: Statewide Analysis* (WHCWG 2010). The statewide analysis revealed the Columbia Plateau as an ecoregion where natural vegetation communities were severely fragmented, limiting movement potential for wildlife.

The analysis of habitat connectivity across the Columbia Plateau Ecoregion presented in this report is a second-tier assessment conducted at a finer resolution than the statewide analysis. It bridges broad, statewide connectivity patterns to local and project-level conservation efforts and helps identify where these efforts are warranted. In this ecoregional analysis we describe the current patterns of wildlife habitat connectivity in the Columbia Plateau Ecoregion. We also identify areas important for maintaining these patterns and highlight opportunities for maintaining and enhancing connectivity in this region into the future—furnishing a vision for a connected Columbia Plateau. We foresee this analysis serving as a template for future analyses of other ecoregions, and providing a foundation for assessment and management efforts for wildlife connectivity at the third tier, the local level.

1.1. The Columbia Plateau Ecoregion

Our project area for connectivity analysis includes the Columbia Plateau Ecoregion and those lands within a 25 km buffer around the ecoregion boundary. Because of modeling and data constraints, we do not include in our analysis that portion of the Columbia Plateau extending into British Columbia, Canada. Although we model habitat concentration areas (important habitat areas for wildlife) and linkages (pathways between these areas) in parts of northern Oregon and western Idaho, here we focus our assessment and interpretation of connectivity on that portion of the Columbia Plateau Ecoregion and buffer within the state of Washington (Fig. 1.2).

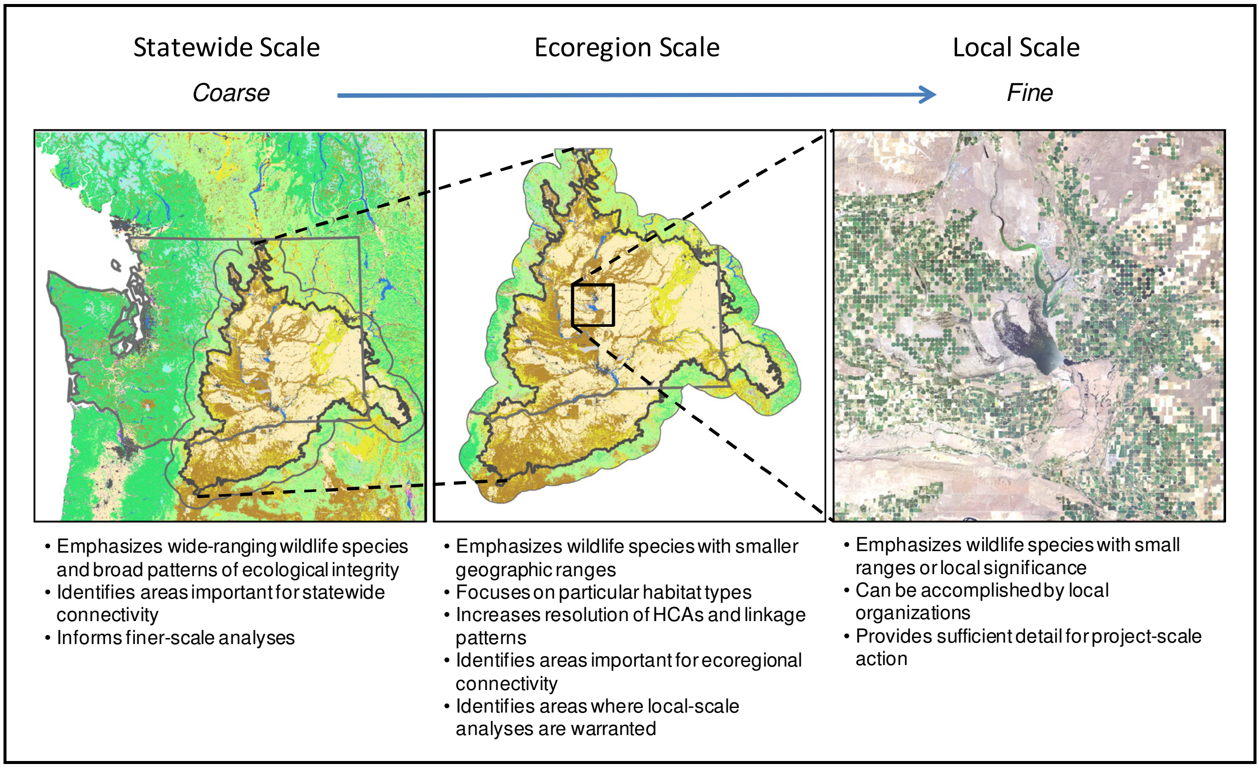

Figure 1.1. Scales of wildlife habitat connectivity analyses in Washington.

The Columbia Plateau is the largest ecoregion in Washington and occupies nearly one-third of the state. It is dominated by the Columbia River and its tributaries and bordered by the Cascade Range and the Rocky and Blue mountains. A complex geologic history of volcanic activity, glaciation, and glacial floods has created a landscape of glacial deposits, coulees, channeled scablands, and rolling areas of deep soil. The semi-arid climate of the Columbia Plateau supports native shrubsteppe vegetation as well as other drought-tolerant plant communities. The impact of human activity is high here: more than half of the shrubsteppe has been converted to agriculture, primarily dryland wheat—but also irrigated crops—while other areas have been altered by development and infrastructure. The remaining native habitat is often fragmented and on shallow soils less amenable to agriculture. Hydroelectric energy production is important to the area’s economy, and in recent years wind energy production has become more common, especially in southern portions of the ecoregion. The imprint of development and agriculture is reflected in the substantial number of Washington’s Species of Greatest Conservation Need found here. While this landscape may still provide connectivity for many species of wildlife, future changes in land use practices, human population growth, and potential effects of a changing climate underscore the need for a better-connected landscape—one that allows for continued and future movement of wildlife throughout the Columbia Plateau.

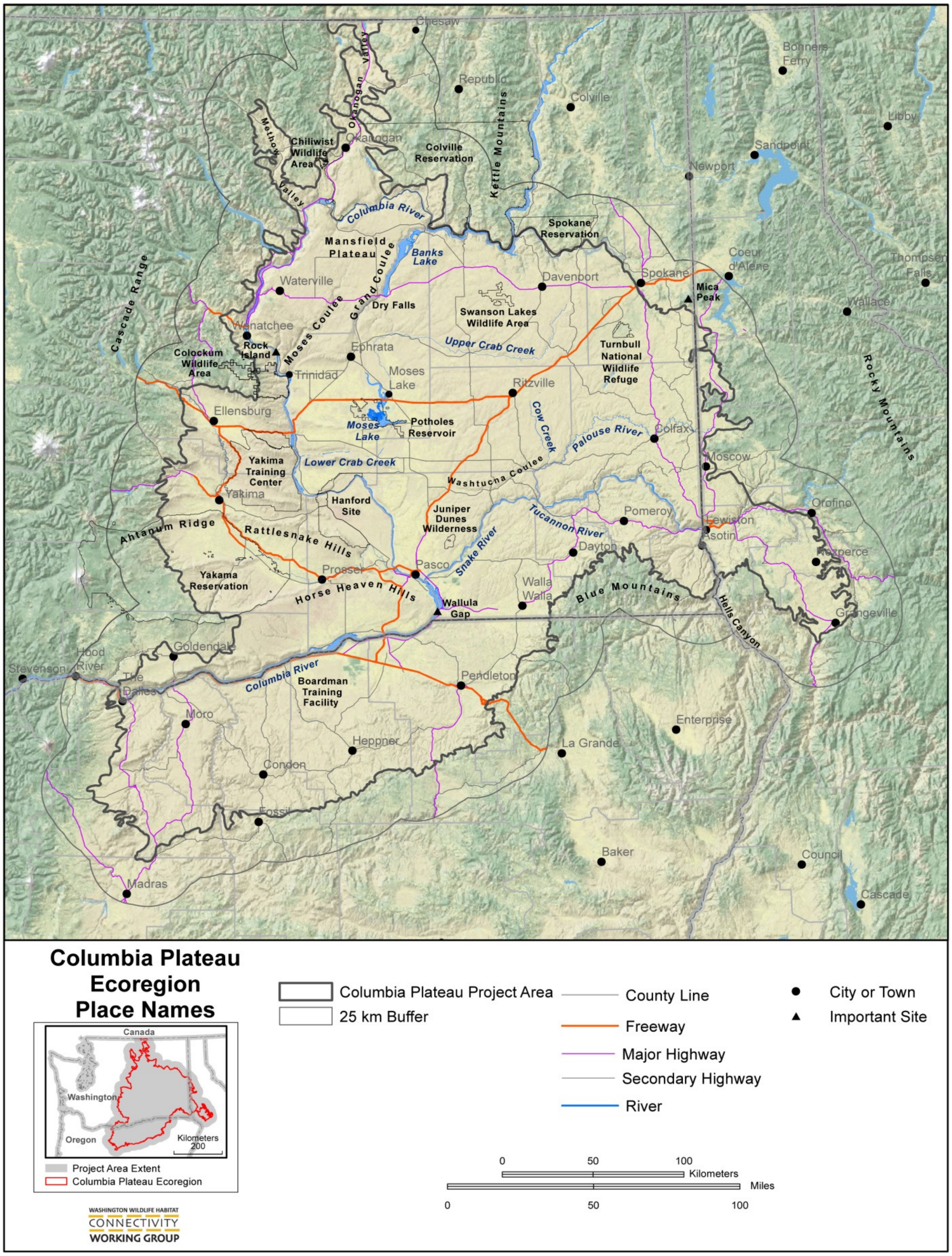

Figure 1.2. The Columbia Plateau Ecoregion showing common geographic features and place names.

1.2. Goal

Our goal for this connectivity analysis of the Columbia Plateau Ecoregion is to identify the most important areas for maintaining and enhancing wildlife habitat connectivity across the ecoregion. We anticipate that this analysis will provide a strong foundation for prioritizing conservation efforts, guiding development of detailed linkage design at the local scale, and encouraging future validation of connectivity models.

1.3. Analysis Approach

This ecoregional analysis follows the organizational structure, methodology, and approach outlined in the *Washington Connected Landscapes Project: Statewide Analysis* (2010). We urge readers who are unfamiliar with our methods, or who need to refresh their understanding of connectivity analyses, to consult the statewide analysis (available from http://www.waconnected.org). As suggested above, the statewide analysis provides context and technical details that will enhance your ability to interpret and apply the products, such as maps, produced through this analysis and described in this document.

As in the statewide analysis, the ecoregional analysis applies focal species and landscape integrity approaches to model patterns of habitat connectivity. The focal species approach is closely related to functional connectivity for particular species; its strength lies in the consideration given to the ways that each species contributes to our understanding of connectivity. The challenge for this approach lies in integrating results across focal species. Also, modeling is labor intensive, and connectivity patterns may not adequately represent needs of some non-focal species. The landscape integrity approach seeks to identify the best available routes to maintain movement for wildlife and ecological processes across the landscape by modeling connectivity across large, contiguous areas that retain high levels of naturalness (limited human impact). However, its results do not assess specific ecological functions, can be difficult to validate, and are more challenging to communicate. By taking a two-pronged strategy to model connectivity we gain the advantages associated with both approaches while addressing shortcomings associated with using each approach alone.

Many of the data layers mapped in the statewide analysis were updated and used in this ecoregional analysis (See Chapter 2 and Appendix D). In addition, we compiled and mapped data layers that were not available or not feasible to include in the statewide analysis such as soils, topographic complexity measures, railroads, transmission lines, wind turbines, and irrigation canals.

1.3.1. Focal Species Modeling

We selected 11 species to represent the connectivity needs of a broader assemblage of wildlife, as well as the major vegetation classes, and threats to wildlife connectivity and persistence in the Columbia Plateau Ecoregion (See Appendix E). During the selection process we considered species' sensitivity to landscape features such as development, agriculture, and roads, as well as to energy development, fire impacts, and climate change. We chose species with different movement capabilities, such as mule deer (*Odocoileus hemionus*) and Washington ground squirrel (*Urocitellus washingtoni*), as well as those with diverse habitat needs, like tiger salamander (*Ambystoma tigrinum*) and Greater Sage-Grouse (*Centrocercus urophasianus*). Five of the focal species we selected for connectivity modeling at the ecoregional scale were also included in the statewide analysis: mule deer, Greater Sage-Grouse, Sharp-tailed Grouse (*Tympanuchus phasianellus*), white-tailed jackrabbit (*Lepus townsendii*), and black-tailed jackrabbit (*L. californicus*). Inclusion of these five species in the connectivity modeling for the Columbia Plateau allowed us to examine how closely complementary the coarse-scale statewide analysis and the finer-scale ecoregional analysis might be.

For each focal species, we prepared a detailed account (See Appendix A) of the connectivity modeling analysis. These accounts discuss the biology and ecology of the focal species in the context of their movement and connectivity across the landscape and provide the rationale for specific modeling decisions. The accounts also include connectivity modeling results and maps, accompanied by interpretation and insights drawn from the connectivity patterns. Modeling products—connectivity maps—for the focal species include: (1) landscape resistance to movement, (2) habitat value—relative habitat suitability of the landscape, (3) habitat concentration areas (HCAs)—important habitat areas to connect, (4) cost-weighted distance (CWD)—cumulative cost of resistance as species move outward from HCAs, and (5) modeled linkages—movement pathways between HCAs. We provide linkage statistics, such as linkage length and quality metrics (See Appendix B) for users to evaluate the linkage quality and degree of connectivity between specific HCA pairs.

1.3.2. Landscape Integrity Modeling

Landscape integrity can provide a measure of the relative degree of human disturbance on the landscape. We followed the landscape integrity approach outlined in the statewide analysis (WHCWG 2010), modified to include additional data layers. We produced alternative landscape integrity resistance models to reflect different sensitivities to human modifications, such as roads. Landscape integrity modeling products include maps of (1) landscape resistance for alternative models, (2) landscape integrity core areas, and (3) linkages among core areas for alternative resistance models.

1.3.3. Linkage Networks

The focal species and landscape integrity approaches identify habitat concentration areas and core habitats, respectively, and areas of the landscape important for connecting them. A linkage network consists of the combination of all the habitat concentration areas and the linkages modeled for focal species, or core areas and modeled linkages for landscape integrity (WHCWG 2010; see also Glossary). We have organized the species and landscape integrity networks into three composite networks:

1) *Upland Network*—Species most closely associated with upland shrubsteppe habitat (these are Sharp-tailed Grouse; Greater Sage-Grouse; Townsend's ground squirrel, *Urocitellus townsendii*; Washington ground squirrel; black-tailed jackrabbit; white-tailed jackrabbit; and least chipmunk, *Neotamias minimus*).
2) *Drainage/Aquatic and Canyon Network*—Species closely associated with aquatic, riparian, cliff, canyon, and talus habitats (beaver, *Castor canadensis*; tiger salamander; and Western rattlesnake, *Crotalus oreganus*).

3) *Generalist/Landscape Integrity Network*—Species that have broad coverage across the Columbia Plateau and the buffer (mule deer) and the landscape integrity network.

1.4. Interpretation

By modeling habitats and linkages important for an array of wildlife species, we have created a vision for a connected landscape across the Columbia Plateau. These ecoregional level results, following up on a connectivity analysis that began at the statewide scale (WHCWG 2010; see Fig. 1.1), are intended to help prioritize connectivity conservation both ecoregionally and locally. The Columbia Plateau connectivity results, based on spatially explicit connectivity data, lend themselves to multiple uses, including essential decision making for conservation-based wildlife planning.

It is important for users to understand the strengths and limitations of this ecoregional analysis so that the results can be interpreted correctly and used effectively. We identify some of the strengths and weaknesses here and encourage the reader to refer to the statewide report (WHCWG 2010) for a more in-depth discussion. The analysis: (1) creates a vision of a connected landscape by modeling habitats and linkages for an array of wildlife species and landscape integrity, (2) provides information to help organizations incorporate connectivity into conservation efforts while meeting organizational goals and priorities, (3) delivers the foundation for linkage design analyses that can guide actions to enhance connectivity, and (4) affords opportunities for validation of model assumptions and predictions. There are limitations to the analysis which may include: (1) errors and limitations in spatial data, (2) reduced applicability outside the Columbia Plateau project area, (3) incomplete assessment of important habitats or linkages, (4) insufficient detail to prioritize habitats or linkages at a finer scale, and (5) lack of adequate field data to validate all model assumptions. Despite these limitations, this analysis is a powerful tool that provides a solid foundation for interpretation of connected landscapes as well as opportunities for future work.

1.5. Application

This analysis is a landscape modeling effort that reflects our best estimate of modeled pathways for potential movement in the Columbia Plateau Ecoregion. We provide a great deal of information in this analysis and rely on readers to select from this array the information that is most pertinent to their specific interests and applications. We encourage users to delve into the focal species and landscape integrity resistance models most relevant to their questions and objectives. Likewise, the landscape integrity resistance models and connectivity products for each focal species each provide singular information about movement opportunities available in the Columbia Plateau Ecoregion. There are a great many ways to use these species and analysis products to address a wide variety of potential applications. Our composite network analysis is one way of integrating different types of information. Other approaches to integration are possible, and we hope readers will develop and share new ideas about how to synthesize the information we provide to promote practical connectivity conservation.

1.6. Document Organization

Our analysis results may be viewed from different perspectives, from broad patterns of connectivity across the entire ecoregion (See Chapters 3 and 4) to species-specific linkages between individual HCAs (See Appendices A and B). This complexity and breadth provides a wealth of opportunities for application to multiple uses, but presents challenges for full discussion and consideration within a single document. Thus, we have synthesized our focal species and landscape integrity results to highlight important patterns of connectivity across the ecoregion. This approach is intended to help prioritize areas important for the conservation of connectivity in the Columbia Plateau, and give direction for validation and more detailed linkage design. We provide examples of these patterns to illustrate ways in which users can apply our results to inform their own decision making. Our examples are not intended to be all-inclusive and users should explore other considerations. We stress the importance of the document's Appendices as they provide additional detail and insight to our analysis.

We have organized the Columbia Plateau Ecoregion analysis into five chapters, followed by a glossary of terms and five Appendices. In Chapter 2 we provide a detailed account of the methods used including: analysis area, focal species selection, data development, habitat modeling, resistance modeling, habitat concentration areas, and linkage modeling for focal species and for landscape integrity. In Chapter 3 we present the results of our analysis and in Chapter 4, an assessment of the key patterns and insights. We pose the larger patterns of landscape connectivity across the landscape that are illustrated by the focal species and landscape integrity modeling, and consider the recurrent patterns of connectivity in the Columbia Plateau. We provide examples of opportunities for conserving connectivity in the ecoregion. Chapter 5 outlines future work and tenders conclusions and next steps.

The Appendices provide supporting information and substantiate in greater detail the aspects of this analysis. Appendix A is partitioned into individual connectivity modeling accounts, providing natural histories, modeling overviews, connectivity mapping products, and interpretations for each of the focal species. In Appendix B we provide modeling statistics, such as habitat concentration and core area values, and linkage length and quality. Appendix C is a file of focal species and landscape integrity resistance and habitat values, and other parameter values used during the model runs.