**Project Title:** ***Informing Connectivity Conservation Decisions in the British Columbia–Washington Transboundary Region and the Columbia Plateau Ecoregion***

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**Partners:** The Washington Wildlife Habitat Connectivity Working Group (WHCWG; http://waconnected.org) is a science-based collaboration of land and resource management agencies, NGOs, universities, and Washington Treaty Tribes (See Appendix A for partners).The group is co-led by Washington State Departments of Fish and Wildlife (WDFW) and Transportation (WSDOT).

**Project Summary:** We are requesting funding to support the development and implementation of connectivity analyses that will inform conservation action under current and future climates for the British Columbia–Washington transboundary region (Part I), and test assumptions of model predictions in the Columbia Plateau Ecoregion (Part II). Our efforts emphasize connectivity analyses focused on the Okanagan-Kettle subregion, where a transboundary partnership will identify site-specific habitat areas and linkages, including those expected to be most resilient to climate change and future human development. We also build upon previously funded work in the Columbia Plateau to rigorously evaluate expert-opinion based connectivity models with empirical data.

**Need:** Maintaining large, connected landscapes is a primary conservation goal of the Great Northern LCC. However, the U.S.–Canada border bisects the heart of the GNLCC, fragmenting natural lands with political, technical, and legal "barriers" to the conservation and management of wildlife and ecosystems at a regional scale. Connectivity analyses have identified the Okanagan-Kettle subregion (Appendix B) as an area where habitat connectivity has been particularly disrupted by human land-use. The Okanagan-Kettle subregion includes core habitat and linkages for priority terrestrial species identified in the GNLCC Strategic Plan across all three ecotypic areas, including mule deer, grizzly bear, Canada lynx, wolverine, Greater Sage-Grouse, and Burrowing Owl. This subregion also overlaps the scope of the newly formed Cascadia Partner Forum and addresses one of its four early action priority issues. Finally, the Okanagan-Kettle subregion includes the northern-most extent of the Columbia Plateau Ecoregion, and poses a potential bottleneck to climate-driven range shifts of shrubsteppe endemics (Appendix B). Maintaining the Okanagan-Kettle's permeability to wildlife movement will thus be vital for promoting regional resilience to climate change. In response to these concerns, we have met with transboundary conservation stakeholders who have identified an urgent need for analyses that will directly inform site-specific conservation actions. These fine-scale analyses will build upon our statewide connectivity assessment to (1) identify existing linkages, (2) prioritize connectivity restoration efforts, and (3) evaluate linkages that provide the best connectivity opportunities given future land-use and climate change.

For such expert-opinion based modeling efforts, validation with empirical data is critical. Adaptive management demands that new knowledge be incorporated into decision-making processes, and validation of connectivity models with empirical data constitutes the first loop of adaptive connectivity management. We therefore also propose to continue our connectivity model-validation efforts in the

Columbia Plateau Ecoregion, to (1) rigorously validate connectivity models, and (2) set a baseline for future monitoring necessary for adaptive management. This work will test the assumptions we made in the Columbia Plateau to provide further credibility and guidance to applying the science on this landscape, and also inform the modeling methodology and decisions for all future analyses, including those in the transboundary region.

Science products for the proposed work will include a comprehensive suite of maps and reports, as well as innovative delivery including interactive web applications and synthesized GIS data layers. We will make our products widely available through conference and workshop presentations, online mapping tools, and the GNLCC USGS data portal. Ultimately, one of the most valuable products of this work will be the template it provides to guide other transboundary and/or regional landscape conservation planning efforts in British Columbia, Washington, and beyond.

**Objectives:** The proposed transboundary connectivity analysis and the Columbia Plateau model validation work directly support the following GNLCC objectives and functions: (1) *decision support tools/systems or science applications for focused resource conservation*, and (2) *testing assumptions of model projections*.

**Part I: Informing Connectivity Conservation Action under Current and Future Climates for the British Columbia–Washington Transboundary Region.**

**Objective 1: Conduct transboundary connectivity analyses and share results for the Okanagan-Kettle subregion.** The transboundary subgroup will establish an Okanagan-Kettle subregional team with local knowledge to conduct an analysis of existing habitat connectivity. Likely future land-use patterns will be overlaid onto the analysis of existing connectivity patterns to identify and prioritize opportunities to maintain or restore important linkages. This information will be shared in a report made available through web applications, synthesized GIS data layers, and the GNLCC data portal. These products will provide fine-scale information regarding priority areas for habitat connectivity within the Okanagan-Kettle subregion.

**Objective 2: Identify transboundary climate-connectivity priorities.** The WHCWG Climate Change subgroup will work in collaboration with the Okanagan-Kettle subregional team and conservation stakeholders to identify linkages likely to be resilient to climate change and to promote climate-driven shifts in species ranges. Transboundary climate-connectivity results will be synthesized with spatial data layers generated in Objective 1, and user-driven decision support materials will be developed to guide regional climate-connectivity decision-making.

**Part II: Testing Assumptions of Model Predictions in the Columbia Plateau Ecoregion.** The GNLCC-funded model validation projects in the Columbia Plateau Ecoregion are ongoing. Adaptive management depends on understanding (1) whether we have accurately modeled important habitat areas for wildlife, and (2) how landscape characteristics influence the linkages between them. Model validation analysis results for Greater Sage-Grouse will soon be used to update the grouse landscape resistance model, and inform transmission line planning and farm bill programs.

**Objective 1: Develop a Washington-specific habitat model for sage-grouse based on occurrence data collected in the Columbia Plateau and a suite of habitat covariates.** Range-wide habitat models perform poorly in Washington at predicting presence and absence of Greater Sage-Grouse likely due to unique aspects of the Columbia Basin. By focusing our analysis on Washington, and using additional spatial data layers developed by the WHCWG for the Columbia Plateau, we hope to gain insight into Greater Sage-Grouse occupancy in this ecoregion. For this second year funding request we propose to develop a Washington-specific habitat model for Greater Sage-Grouse to (1) determine connectivity to

newly identified habitats, and (2) identify habitat factors most influential in shaping current patterns of sage-grouse occupancy in the Columbia Plateau.

**Objective 2A-2B: Validate habitat models of focal species tied to sage-steppe ecotypes.** Habitat models were used to delineate habitat concentration areas (HCAs[1]) in our connectivity analyses for the Columbia Plateau Ecoregion. Western rattlesnake, Washington ground squirrel, and white- and black-tailed jackrabbit are focal species characteristic of dominant sage-steppe ecosystems that rely on multi-generational movement, and gene flow in linkage corridors between HCAs, for functional landscape connectivity. We propose in this second year of funding to continue the model validation analyses for these focal species to inform adaptive management in the Columbia Plateau.

**Methods:** The requested funding plus the leveraged funds detailed in the attached budget will allow us to complete the tasks listed in this section, and thereby fulfill the above objectives.

**Part I: Informing Connectivity Conservation Action under Current and Future Climates for the British Columbia–Washington Transboundary Region.**

**Objective 1: Conduct transboundary connectivity analyses and share results for the Okanagan-Kettle subregion.**

Key cooperators: WDFW, WCSI, UW, USFS-PNW, USFWS, CNW, TNC, WSDOT, BCMoE, BC Parks, BCMFLPNRO, SOSCP, UVic.

***Task 1.1.*** *Conduct habitat connectivity analyses.* We will: (1) convene our collaborative transboundary team; (2) develop a strategy for making data logically consistent across the border; (3) gather and cross-walk transboundary spatial data layers (including future land-use patterns); (4) develop resistance surfaces, habitat concentration areas, cost-weighted distance surface, linkages, and connectivity networks for focal species and landscape integrity; and (5) further prioritize fine-scale linkages given local stakeholder needs.

***Task 1.2.*** *Summarize results and develop products to best inform conservation planning.* We will work closely with the subregional team and stakeholder groups to summarize analysis results, produce products, and provide decision support in ways that best informs on-the-ground conservation and meets the needs of local managers.

***Task 1.3.*** *Share documents and web-based products.* We will present our results to a wide range of groups, including scientists, groups interested in applying these methods in other areas, and entities who will use these results to inform their resource conservation and management efforts. We will make resulting maps and guidance documents widely available via a report(s), conference and workshop presentations, and online tools.

**Objective 2: Identify transboundary climate-connectivity priorities.**

Key cooperators: UW, WDFW, USFS, TNC, BC Parks, UVic.

***Task 2.1.*** *Identify areas most likely to continue providing connectivity as climate changes.* We will synthesize available climate impacts models to evaluate the vulnerability of linkages identified by Objective 1, in order to (1) identify those most likely to be resilient to changing climate, and (2) inform management of critical linkages shown to have high climate vulnerability.

***Task 2.2.*** *Identify connectivity areas most likely to facilitate climate-driven species range shifts.* We will synthesize existing transboundary climate-connectivity models (e.g., climate-gradient corridors, species temporal corridors), in order to (1) identify those areas most likely to facilitate climate-driven species range shifts, as determined by the models most appropriate for user needs, and (2) synthesize these results with the linkages identified in Objective 1.

[1] Habitat areas that are expected or known to be important for focal species.

***Task 2.3.*** *Develop and share documents and web-based products for transboundary climate-connectivity analysis.* We will work with WHCWG transboundary partners to develop climate-connectivity adaptation plans tailored to the conservation goals of anticipated end-users. We will make resulting maps and guidance documents widely available via a report(s), conference and workshop presentations, and online mapping tools (e.g., Databasin, WHCWG website).

**Part II: Testing Assumptions of Model Predictions for the Columbia Plateau Ecoregion.**

Detailed proposals for projects listed below are available from http://waconnected.org/gnlcc-2013/.

**Objective 1: Develop a Washington-specific habitat model for sage-grouse based on occurrence data collected in the Columbia Plateau and a suite of habitat covariates**.

***Task 1.1.*** *Develop and evaluate a habitat model for sage-grouse.* Key cooperators: WDFW, USFS.

***Task 1.2.*** *Validate the habitat model identified in Task 1.1 using a k-fold crossvalidation approach.* Key cooperators: WDFW, USFS.

***Task 1.3.*** *Identify potentially suitable unoccupied core habitat areas and evaluate their connectivity to currently occupied habitat; model pinch points and barriers that constrain connectivity to potential new habitats.* Key cooperators: WDFW, USFS.

***Task 1.4.*** *Prepare a detailed final report.* Key cooperators: WDFW, USFS.

**Objective 2A: Validate habitat models of focal species tied to sage-steppe ecotypes: *Genetic analyses of white- and black-tailed jackrabbit populations.***

***Tasks 2A.1–2A.2.*** *Collect fecal pellets in primary modeled HCAs to determine presence/absence of black-tailed and white-tailed jackrabbits.* Key cooperators: WDFW, SCC, DoD, USFWS, NAU.

***Tasks 2A.3–2A.5.*** *Establish, update, and maintain project database.* Key cooperators: WDFW.

***Tasks 2A.6–2A.7.*** *Conduct genetic analyses of fecal pellets.* Key cooperators: WDFW, NAU.

***Task 2A.8.*** *Review, evaluate and conduct preliminary analysis of DNA data.* Key cooperators: WDFW, NAU, USFS.

***Task 2A.9.*** *Apply landscape genetic techniques to connectivity model validation for each jackrabbit species.* Key cooperators: WDFW, NAU, USFS.

***Task 2A.10.*** *Prepare final report detailing landscape genetic analyses for each jackrabbit species.* Key cooperators: WDFW, NAU, USFS.

***Tasks 2A.11–2A.14.*** *Prepare final report detailing update of connectivity models for each jackrabbit species based on results from landscape genetic analyses.* Key cooperators: WDFW, USFS.

**Objective 2B: Validate habitat models of focal species tied to sage-steppe ecotypes: *Genetic sampling of Washington ground squirrel and western rattlesnake populations.***

***Task 2B.1.*** *Collect tissue samples from Washington ground squirrels in known core areas.* Key cooperators: WDFW.

***Task 2B.2.*** *Collect tissue samples from western rattlesnakes in the vicinity of ground squirrel samples.* Key cooperators: The Orianne Society.

***Task 2B.3.*** *Collect tissue samples from western rattlesnakes around wind installation infrastructure.* Key cooperators: The Orianne Society.

***Task 2B.4.*** *Prepare a detailed final report.* Key cooperators: The Orianne Society, WDFW.

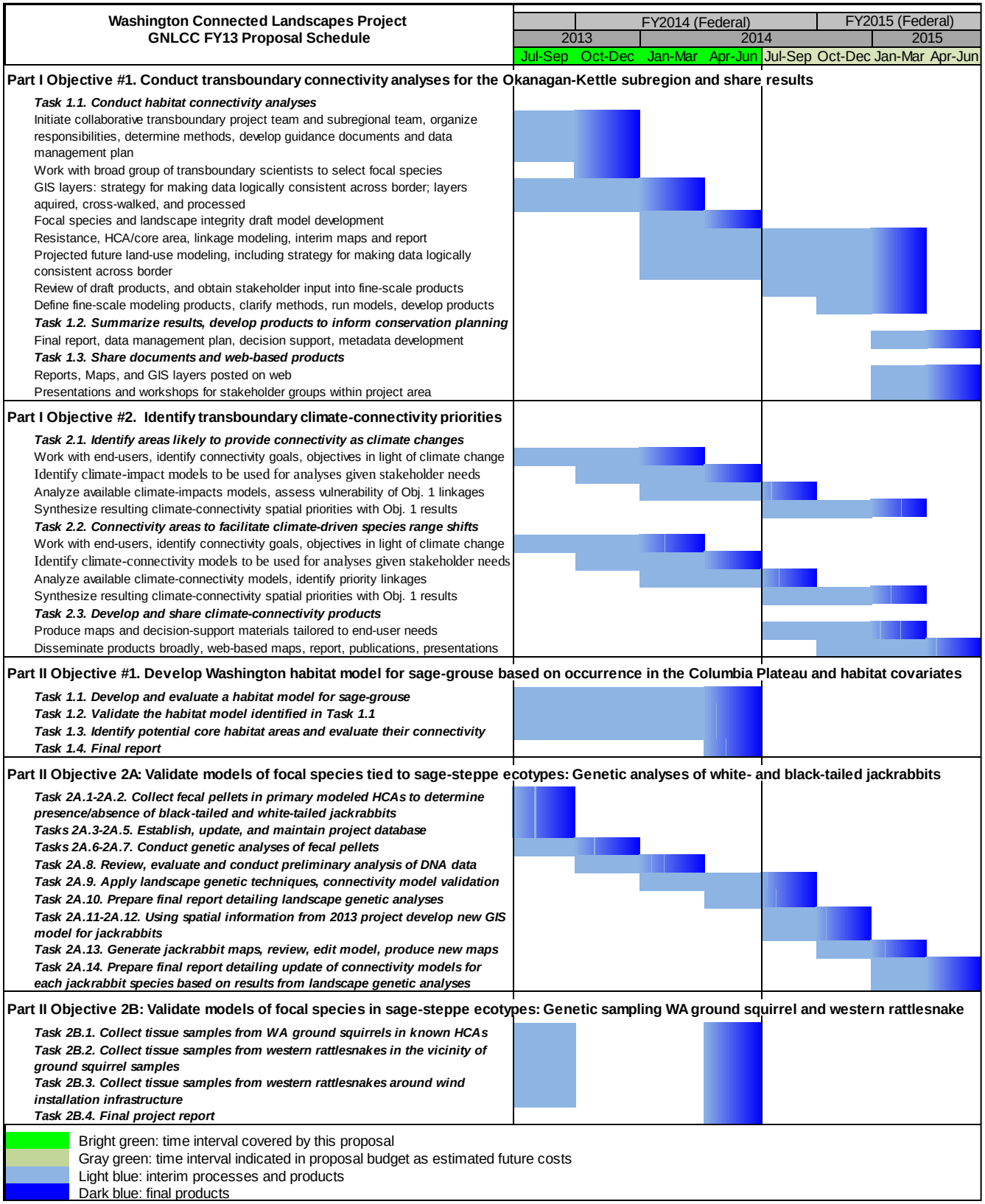
**Deliverables:**

| Task # | Description | Due Date |
|---|---|---|
| **Part I Objective 1: Conduct transboundary connectivity analyses and share results for the Okanagan-Kettle subregion.** | | |
| 1.1 | • Collaborative transboundary project initiated, and focal species are selected.<br>• Draft transboundary GIS spatial data layers gathered, cross-walked, and processed.<br>• Focal species and landscape integrity draft model development. | DEC 2013<br>MAR 2014<br>JUN 2014 |
| **Part I Objective 2: Identify transboundary climate-connectivity priorities.** | | |
| 2.1–2.2 | • Diverse stakeholder climate-connectivity goals and objectives identified.<br>• Climate-impact and climate-connectivity models to be used for analyses identified, given stakeholder goals and objectives. | MAR 2014<br>JUN 2014 |
| **Part II Objective 1: Develop and evaluate a habitat model for sage-grouse.** | | |
| 1.1–1.4 | Final report titled "Connectivity of potential new habitat areas for Greater Sage-Grouse to existing habitat in the Columbia Plateau Ecoregion."<br>• A spatial habitat suitability model for Greater Sage-Grouse in Washington.<br>• Linkage model connecting new habitat areas to existing HCAs.<br>• Updated pinch-point, centrality, and barrier models to include potential new habitat areas. | JUN 2014 |
| **Part II Objective 2A: Validate habitat models of focal species tied to sage-steppe ecotypes: *Genetic analyses of white- and black-tailed jackrabbit populations.*** | | |
| 2A.1–2 | • Fecal pellet samples collected in primary modeled HCAs to determine presence/absence of black-tailed and white-tailed jackrabbits. | SEP 2013 |
| 2A.3–5 | • Project database; established, updated, and maintained. | SEP 2013 |
| 2A.6–7 | • DNA analysis of rabbit fecal pellet samples. | DEC 2013 |
| 2A.8 | • Preliminary analysis of rabbit genetic data. | MAR 2014 |
| **Part II Objective 2B: Validate habitat models of focal species tied to sage-steppe ecotypes: *Genetic sampling of Washington ground squirrel and western rattlesnake populations.*** | | |
| 2B.1–4 | Final project report(s) detailing:<br>•Collection of tissue samples from 15–20 individuals at 6–10 ground squirrel colonies and 6–8 rattlesnake dens.<br>•Collection of tissue samples from individuals at 4–7 rattlesnake dens adjacent to operating wind installations. | JUN 2014 |

**Statement of Compliance:**

The Project Coordinator and Principal Investigators for this funding request have read Great Northern Landscape Conservation Cooperative Information Management, Delivery, and Sharing Standards and agree to comply with those standards if the proposal is selected. We cannot release to the Public Domain data for Species deemed Sensitive by WDFW, *Policy-5210 Releasing Sensitive Fish and Wildlife Information* and data under contract such as proprietary energy or defense data.

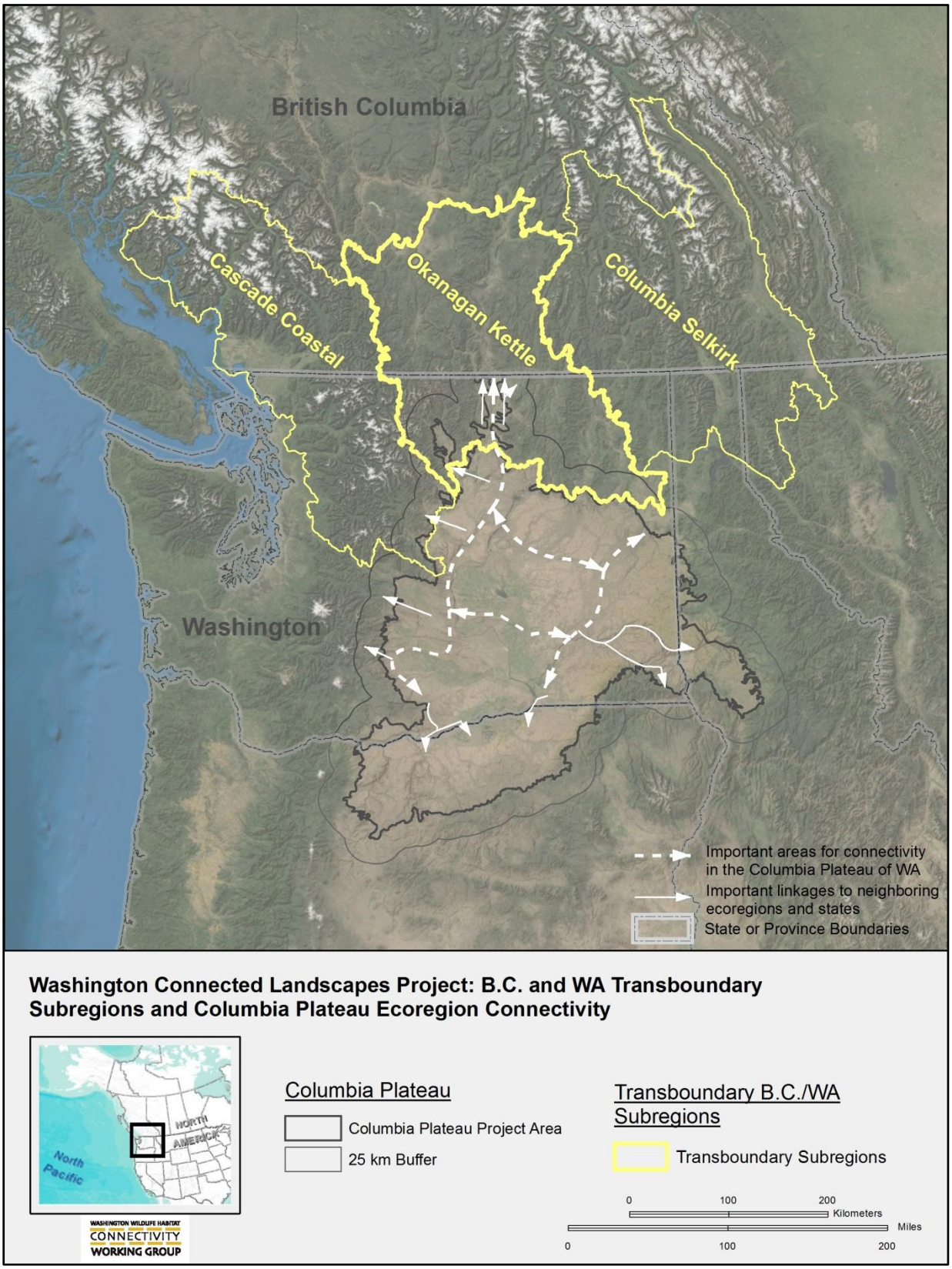
## Schedule:


Washington Connected Landscapes Project
GNLCC FY13 Proposal Schedule
FY2014 (Federal)
FY2015 (Federal)
2013
2014
2015
Jul-Sep
Oct-Dec
Jan-Mar
Apr-Jun
Jul-Sep
Oct-Dec
Jan-Mar
Apr-Jun
Part I Objective #1. Conduct transboundary connectivity analyses for the Okanagan-Kettle subregion and share results
Task 1.1. Conduct habitat connectivity analyses
Initiate collaborative transboundary project team and subregional team, organize responsibilities, determine methods, develop guidance documents and data management plan
Work with broad group of transboundary scientists to select focal species
GIS layers: strategy for making data logically consistent across border; layers aquired, cross-walked, and processed
Focal species and landscape integrity draft model development
Resistance, HCA/core area, linkage modeling, interim maps and report
Projected future land-use modeling, including strategy for making data logically consistent across border
Review of draft products, and obtain stakeholder input into fine-scale products
Define fine-scale modeling products, clarify methods, run models, develop products
Task 1.2. Summarize results, develop products to inform conservation planning
Final report, data management plan, decision support, metadata development
Task 1.3. Share documents and web-based products
Reports, Maps, and GIS layers posted on web
Presentations and workshops for stakeholder groups within project area
Part I Objective #2. Identify transboundary climate-connectivity priorities
Task 2.1. Identify areas likely to provide connectivity as climate changes
Work with end-users, identify connectivity goals, objectives in light of climate change
Identify climate-impact models to be used for analyses given stakeholder needs
Analyze available climate-impacts models, assess vulnerability of Obj. 1 linkages
Synthesize resulting climate-connectivity spatial priorities with Obj. 1 results
Task 2.2. Connectivity areas to facilitate climate-driven species range shifts
Work with end-users, identify connectivity goals, objectives in light of climate change
Identify climate-connectivity models to be used for analyses given stakeholder needs
Analyze available climate-connectivity models, identify priority linkages
Synthesize resulting climate-connectivity spatial priorities with Obj. 1 results
Task 2.3. Develop and share climate-connectivity products
Produce maps and decision-support materials tailored to end-user needs
Disseminate products broadly, web-based maps, report, publications, presentations
Part II Objective #1. Develop Washington habitat model for sage-grouse based on occurrence in the Columbia Plateau and habitat covariates
Task 1.1. Develop and evaluate a habitat model for sage-grouse
Task 1.2. Validate the habitat model identified in Task 1.1
Task 1.3. Identify potential core habitat areas and evaluate their connectivity
Task 1.4. Final report
Part II Objective 2A: Validate models of focal species tied to sage-steppe ecotypes: Genetic analyses of white- and black-tailed jackrabbits
Task 2A.1-2A.2. Collect fecal pellets in primary modeled HCAs to determine presence/absence of black-tailed and white-tailed jackrabbits
Tasks 2A.3-2A.5. Establish, update, and maintain project database
Tasks 2A.6-2A.7. Conduct genetic analyses of fecal pellets
Task 2A.8. Review, evaluate and conduct preliminary analysis of DNA data
Task 2A.9. Apply landscape genetic techniques, connectivity model validation
Task 2A.10. Prepare final report detailing landscape genetic analyses
Task 2A.11-2A.12. Using spatial information from 2013 project develop new GIS model for jackrabbits
Task 2A.13. Generate jackrabbit maps, review, edit model, produce new maps
Task 2A.14. Prepare final report detailing update of connectivity models for each jackrabbit species based on results from landscape genetic analyses
Part II Objective 2B: Validate models of focal species in sage-steppe ecotypes: Genetic sampling WA ground squirrel and western rattlesnake
Task 2B.1. Collect tissue samples from WA ground squirrels in known HCAs
Task 2B.2. Collect tissue samples from western rattlesnakes in the vicinity of ground squirrel samples
Task 2B.3. Collect tissue samples from western rattlesnakes around wind installation infrastructure
Task 2B.4. Final project report
Bright green: time interval covered by this proposal
Gray green: time interval indicated in proposal budget as estimated future costs
Light blue: interim processes and products
Dark blue: final products

## Appendix A: Washington Wildlife Habitat Connectivity Working Group (WHCWG) Partners

Member organizations of the WHCWG include: Washington Department of Fish and Wildlife (Co-lead, WDFW), Washington State Department of Transportation (Co-lead, WSDOT), The Nature Conservancy (TNC), Conservation Northwest (CNW), Washington Department of Natural Resources (DNR), US Forest Service (USFS), US Forest Service–Pacific Northwest Research Station (USFS-PNW), US Fish and Wildlife Service (USFWS), Western Transportation Institute (WTI), Bureau of Land Management (BLM), Washington Conservation Science Institute (WCSI), and University of Washington (UW). Additional partners include: The Orianne Society, Department of Defense (DoD), Northern Arizona University (NAU), Spokane Community College (SCC), British Columbia Parks (BC Parks), South Okanagan-Similkameen Conservation Program (SOSCP), British Columbia Ministry of the Environment (BCMoE), University of Victoria (UVic), and British Columbia Ministry of Forests, Lands and Natural Resource Operations (BCMFLPNRO).

**Appendix B:**


British Columbia
Cascade Coastal
Okanagan Kettle
Columbia Selkirk
Washington
Important areas for connectivity in the Columbia Plateau of WA
Important linkages to neighboring ecoregions and states
State or Province Boundaries
Washington Connected Landscapes Project: B.C. and WA Transboundary Subregions and Columbia Plateau Ecoregion Connectivity
North Pacific
NORTH AMERICA
WASHINGTON WILDLIFE HABITAT CONNECTIVITY WORKING GROUP
Columbia Plateau
Columbia Plateau Project Area
25 km Buffer
Transboundary B.C./WA Subregions
Transboundary Subregions
0 100 200
Kilometers
Miles
0 100 200