FWS PROJECT TEMPLATE 2012
YEAR 2

Project Title: Document Fine Scale Linkage Areas and Conservation Delivery in the Northern Rockies of US and Canada

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Project Summary (3 sentence target): This project is a multi-year initiative to secure landscape-scale movement opportunities for multiple wildlife species in the Rocky Mountains of Montana and Idaho and adjacent transboundary areas of British Columbia and Alberta. This movement is necessary as wildlife populations move across the Northern Rockies landscape in response to changes in distribution and abundance of habitats and key foods resulting from climate change. This project has a goal of re-linking all the large blocks of public land in the Northern Rockies for more functional and healthy wildlife communities in response to climate change.

Need: Climate change will cause habitats, seasonal ranges and foods to change in aspect, elevation, and latitude. This project will enhance the movement opportunities for wildlife to follow these habitat and food movements across the Northern Rockies landscape. In addition to movement in response to climate-induced changes, long-term viability for most wildlife species will increase if they have the opportunity to move through low elevation areas and cross highways successfully for purposes of dispersal and for genetic and demographic connectivity. Population connectivity will also increase the resiliency of wildlife populations to climate stressors.

Objective: Identify specific wildlife linkage locations across U.S. highways 1, 2, 200, 95 and I-90 in Northwest Montana and North Idaho and Highway 3 in British Columbia. Recommend and implement with partners conservation delivery in these areas on public and private lands, and across highways to make these movement areas more permeable to wildlife. Linkage site identification will allow focus of conservation efforts in the most important remaining linkage areas. Use of these areas by wildlife will increase the resiliency of these species and ecosystems to adapt to climate change by providing access to adjacent habitat and maintain genetic connections for adaptation.

Methods:

1. Utilize existing grizzly bear radio collar data from Highway 3 in British Columbia to develop grizzly bear habitat use models that can be extrapolated to Highways 2 and 200 in northwest Montana.

We have been using GPS telemetry methods on grizzly bears in the US-Canada trans-border region since 2004 and have accumulated a good database of grizzly bear habitat use along BC Highway 3 just north of the US-Canada order. This existing database has been used to develop habitat use models or Resource Selection Function (RSF) models that are in turn used for a variety of ecological and management purposes. In the Highway 3 area we have used these models to identify backcountry high quality grizzly bear habitat, "core" and front country "linkage" habitat. The linkage habitat identifies the best available options for securing linkage zones through human environments, such as settled valleys containing major highways. Along Highway 3, this work underpins an ongoing effort to establish formal Linkage Zones (LZ). Using these data, Canada applies special management to secure these areas for wildlife movements. Actions that have resulted from this work include, direct land purchase of strategic lands for wildlife movement, access management within LZs on public timber lands, refinement of timber harvest protocol to reduce bear mortality and provide security, and the strategic education of landowners within LZs to minimize actions that put grizzly bears and other wildlife species at risk as they move through an area. We want to apply this program to several highway corridors in Northwestern Montana and North Idaho. The first step is to extend RSF models from the US border south across Highways 1, 2, 200, and 95. This will be accomplished using existing GPS telemetry data gathered 2004-2009 north and south of BC Highway 3 and into adjacent US areas. These data will be modeled and extrapolated into the US across Highways 1, 2, 200, and 95. These habitat modeling techniques are all published in the primary scientific literature and are the current standard for habitat modeling using telemetry data (Manley et al. 2002, Nielsen et al. 2004, Proctor et al 2008). The process involves spatially explicit (GIS oriented) logistic regression comparing habitat use (telemetry locations) to extensive random sampling (habitat availability). We model 26 ecological, terrain, land cover, and human-use variables in multi-variable, multi-scale analyses to predict habitat use by grizzly bears. In this project, we will build models using over 34,000 telemetry locations and validate models with an independent set of telemetry locations in the areas where spatial extrapolation occurs. This process results in a data-informed objective and predictive assessment of grizzly bear habitat use across a rather large landscape that will identify backcountry core habitat and front country linkage habitat. We also compare overall habitat characteristics in areas where models are developed and extrapolated to insure extrapolations are valid and reliable.

2. Model existing black bear GPS radio collar data from Highways US 2, BC 3, US 95, and ID 1 to identify black bear linkage habitat that would be also useful to inform conservation linkage management for large carnivores and other wildlife species. Additionally, black bears may be good surrogates for determining linkage in areas with few grizzly bears and we will test this hypothesis by comparing results from both species where they overlap along BC Highway 3.

Because there are few grizzly bears at this time residing in areas closely adjacent to Highways US 2, MT 200, US 95, and ID 1, we may benefit by identifying black bear linkage habitat that would be useful for directing conservation management to improve inter-area connectivity for large carnivores and other wildlife species. We have been deploying GPS radio collars on black bears in the Highways 2, 3, and 95, areas

since 2006 and propose to use that data to model black bear linkage habitat. We have equivalent data for both black and grizzly bears in the Highway 3 area and will compare model predictions for both species to assess linkage habitat similarity. Our preliminary analysis suggests that places where male grizzly bears cross Highway 3 are the same locations where male black bears cross. Protecting linkage habitat through human environments and important connecting valleys may prove beneficial for other wildlife species and the future recovery of grizzly bears in some areas, and for the ability to adapt to climate change at regional and sub-continental scales. The type of analyses that will be used is the RSF modeling described above

3. Continue collaring and monitoring black bears near Highways 200, 95, and I-90 to provide data for further linkage modeling.

Fourteen GPS radio collar were placed on black bears at each study area around Highway 95 and I-90 during 2011. Several collars were lost to hunter harvest during the fall of 2011 and those collars will be replaced during 2012. Bears will be trapped during May and June with collars expected to be collected during October of 2012. Four of twelve collars placed on black bears near Highway 200 during 2009-11 are still functioning and will be retrieved during October of 2012. Any grizzly bears captured would also be collared, but probability of grizzly bear capture in this area is low. Habitat layers for GIS analysis will be assembled and location data from bears will be modeled with logistic regression to predict where high probability of use habitat extends to or across Highways 95, 200 and I-90. These are the same methods used to model grizzly bears and black bears on Highways 2 and 3 further north. All activities will be coordinated with the Montana Department of Fish, Wildlife, and Parks, Idaho Fish and Game Department, Montana and Idaho Departments of Transportation, and the Kootenai, Idaho Panhandle, and Lolo National Forests.

4. **Conduct genetic analysis of parent / offspring relationships for the purpose of documenting inter-area migrants and breeding. This process will develop and demonstrate a means of monitoring effective population linkage while providing a baseline regional dataset for future monitoring efforts.**

Genetic analyses from broad-based sampling now allow us in many instances to detect bears that migrate from one area to another (Proctor et al 2012a). However, functional connectivity of inter-area migrants requires breeding. Very recently we have developed a method for detecting successful breeding activity of those migrant grizzly bears in the US-Canada trans-border region. We are doing this through definitive parent-offspring analyses. When genotypes of sufficient quality (21 loci for grizzly bears in our region) are used, parentage can be determined with a high level of confidence. Because of our work over the past 6 years, we have an extensive dataset of genotypes for almost all the bears in the region. We have recently begun expanding our newly collected genotypes to 21 loci (up from 15) and have been developing pedigrees for our study animals in the Canadian trans-border area. We have documented the reproductive histories of many animals including those of migrants, and animals that temporarily move into adjacent areas to breed. This type of analysis was used by Kasworm et al. (2007) to document breeding success of bears used to augment the Cabinet Mountains population in NW Montana. The technique offers great promise of monitoring the success (or otherwise) of our management efforts at increasing regional grizzly bear connectivity. We propose to expand all our remaining regional genotypes up to 21 loci and complete a thorough regional trans-border analysis of intra- and inter-area breeding. Besides demonstrating the ability of this methodology to effectively monitor movements and breeding activity, this work will provide a baseline database for future linkage

monitoring efforts. Genotyping would be carried out at the Wildlife Genetics International laboratory in Nelson BC (used by almost all bear projects in the region). We will carry out the parentage analysis and produce a report documenting our results and demonstrate its future use as a monitoring tool.

We will conduct a similar analysis as described above but on black bear genetic samples collected in the US Highway 2 area. GPS telemetry data suggests the Highway 2 transportation corridor maybe fragmenting black bears. Preliminary genetic analysis suggests that the only analytical tool for detecting fragmentation, and therefore monitoring future connectivity, will be a 20 locus pedigree analysis. We have already run 100 Highway 2 black bears to 20 loci, but have another 100 black bear samples within 30 km of Highway 2 on hand that will be analyzed to 20 locus genotypes. Our preliminary analysis of 100 individuals (50 on each side of Highway 2) showed no mother-offspring dispersal events as evidence of demographic linkage by female movement across the highway (supporting the fragmentation hypothesis), but detected 2 cases of an offspring and its father on opposite sides of the highway, indicative of genetic linkage by males. Currently our sample sizes are too small to draw rigorous conclusions, but more genetic samples have already been collected in previous field efforts. This analysis would demonstrate the ability of genetic analysis to detect fragmentation (complementing the telemetry results) and monitoring future connectivity of black bears. The pedigree analysis is necessary because population structure analysis techniques do not detect fragmentation for the abundant black bears (no genetic drift even with fragmentation). Once this technique is demonstrated to be useful for black bears, we would consider applying it to other regional highways. Ultimately, the same field sampling and genetic analysis would simultaneously monitor connectivity of black and grizzly bears.

Deliverables:

1. Submit the results of the grizzly bear habitat modeling process and the identification of linkage and core areas for Highways US 2, MT 200, US 95, and ID 1 based on data gathered around Highway 3 in British Columbia for peer review to a scientific publication by May 1, 2012. A published paper would be expected within 2013. In addition to identifying linkage and core areas the report will recommend appropriate conservation actions such as land acquisition, conservation easements, linkage oriented management, sanitation, and public outreach.
2. Provide reports with results of the black bear habitat modeling process and the identification of linkage areas for Highways US 2, BC 3, US 95, and ID 1 based on local black bear data gathered previously. In addition to identifying linkage areas the report will recommend conservation actions such as land acquisition, conservation easements, linkage oriented management, sanitation, and public outreach. Modeling efforts for black bears will be compared with grizzly outputs from deliverable 1 (above) to describe similarities and differences. Progress report provided by May 1, 2013.
3. Collar and monitor black bears adjacent to Highway MT 200, I-90, and US 95 to provide a database for modeling black bear linkage habitat across those highways. Annual progress reports will be provided by March 31. All black bear monitoring data from highways 2, 3, 95, 200, and I-90 will be analyzed and modeled to produce a map of linkage and core areas with appropriate conservation actions such as land acquisition, conservation easements, linkage oriented management, sanitation, and public outreach. A final report will be submitted by December 31, 2013

4. Conduct genetic-based parent-offspring analysis with expanded grizzly bear genotypes that will result in our ability to detect and therefore monitor movements and breeding of bears across landscape fractures. We will provide a report and a scientific publication submitted for peer review by December 31, 2012 detailing this procedure and our results for grizzly bears across the fragmenting Highways BC 3 US 95, and ID 1 separating the Purcell and Selkirk Mountains. We will conduct the required lab work and genetic-based parent-offspring analysis for black bear in the Highway 2 area during 2012. We would provide a report of this work detailing the ability of the pedigree analysis to detect fragmentation and monitor future connectivity by March 31, 2013.

Schedule: Progress on the above goals and deliverable has been made and is detailed in our recent annual Progress Report (Servheen et al. 2012).

1. Analysis, modeling, and grizzly bear linkage zone identification for Highways US 2, MT 200, US 95 and ID 1 is complete and we are about to submit this work to a peer-reviewed scientific journal. Projected submission date, May 1, 2012. (Proctor et al. 2012b, Servheen et al. 2012). A published paper would be expected within 2013.
2. Analysis, modeling, and black bear linkage zone identification for Highways US 2, BC 3, US 95, and ID 1 is underway and we are waiting for final GPS data sets from a few collared black bears in the Highway 95 area. We anticipate a final data set for this analysis by fall of 2012. Progress reports by May 1, 2013. (Servheen et al. 2012)
3. Black bears have been (2011) and will continue to be collared around Highways MT 200 and I-90 during spring and early summer of 2012 with collar collection in October of 2012. Data analysis, modeling and reporting would occur by spring of 2013. We continue to annually sample both sides of linkage zones by hair snagging and genetic analysis with annual progress reported in our recent Progress Report. Final results from all black bear highway modeling efforts reported by December 31, 2013.
4. Grizzly bear genetic analysis would occur during 2011 (this analysis is now complete) with a report detailing parent-offspring results and a genetic linkage monitoring plan by December 31, 2012. (Servheen et al. 2012). This analysis is being prepared for publication in a peer-reviewed scientific journal, to be submitted by March 2013. The genetic analysis for the Highway 2 black bears would be complete with a report by March 31, 2013.

Literature Cited

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Overview of detailed 2012 budget:

Deliverables #1, #2, and #4. Grizzly bear and black bear Hwy 1, 2, 200, 95, and I-90 linkage modeling and genetic monitoring analysis and technique development	**Annual Cost**
Subcontract for GIS modeling, data analysis, bear monitoring, and genetic data analysis. (This includes salary, travel and per diem, office costs, and GIS mapping costs)	
Project Biologist (Dr. Michael Proctor) 400 hours @ $100 hr	40,000[1]
2 grizzly bear biologists (GIS modeling, data analysis, bear monitoring)	In kind[3]
TOTAL Deliverables #1, #2, and #4.	$40,000 [1]

Deliverable #3. Black Bear Hwy 200 and I-90 Monitoring for Linkage Identification	**Annual Cost**
Salaries	
Project biologist for aerial radio collar monitoring, data analysis, report preparation	In kind[3]
Experienced bear capture personnel to support effort and per diem	In kind[3]
1 Field Crew Leader at $16/hour for 8 months	$22,186[2]
1 Field Assistant at $14/hour for 6 months	$14,560[2]
1 temporary field assistant at $12/hour for 3 months	$6,240[1]
Fringe benefits	
19.5% fringe - 1 Field Crew Leader for 8 months	$4,326[2]
19.5% fringe - 1 Field Assistant for 6 months	$2,839[2]
19.5% fringe - Temporary Field Assistant for 3 months	$1,217[1]
Travel	
Per diem for 2 field workers above	$5,580[2]
Per diem for 1 field worker above	$1,260[1]
Operations:	
Capture drugs	$2,000[1]
Misc capture supplies	$8,000[1]
Genetics lab analysis	$25,000[1]
TOTAL Deliverable #3.	$ 93,208[1+2]

[1] Items for funding requested in this proposal
[2] These items funded by an existing cooperative agreement with the University of Montana by GNLCC in 2011.
[3] These will be FWS staff personnel from the Grizzly Recovery Program.