Mary Mahaffy, Science Coordinator
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30 December 2012

Dear Dr. Mahaffy,

The following is a final report for the cooperative agreement between US Fish and Wildlife and the University of Montana for the grant titled: "North Pacific Forest Landscape Corridor and Connectivity Project: Assessing Landscape and Species Vulnerability" M65710 with a start date of 09/01/11 and ending data of 09/30/13.

Overview

Land and resource managers in the North Pacific Landscape Conservation Cooperative (NPLCC) currently lack conservation planning tools that can directly feed into the planning, design, delivery, and monitoring of ecosystems across all levels of biodiversity from genes to ecosystems. The North Pacific Forest Landscape Corridor and Connectivity Project utilized a landscape connectivity simulator (UNICOR) and a genetic simulation program (CDPOP) to model the functional (dispersal and genetic) connectivity in the North Pacific Landscape. The outputs from these programs indicated areas with high potential for landscape and genetic isolation and low probability of dispersal and colonization. In addition, this project was designed to provide spatially-explicit predictions of current and potential future patterns of fragmentation, prioritization of keystone corridors for protection and enhancement, and identification of places that may require habitat restoration or assisted migration to maintain viability. Data delivery and visualization tools were provided through dynamic interactive web map applications. Our goal was to provide a framework for spatial corridor and connectivity pathway products that can be used to assist in conservation and management decisions.

Through this novel framework, we provided pilot results and modelled the functional connectivity for two habitat-specific groups (montane and sub-alpine) across the NPLCC under climate regime shifts for 2000 and 2080. We provide results in a web-based decision support system and data repository that allow for interactive exploration of potential changes in landscape connectivity.

Methods and Results

The North Pacific Forest Landscape Connectivity Project uses three main geospatial layers as inputs into the creation of resistance map grids. One-km was decided as the resolution for the final resistance grids. The three primary geospatial layers used in this analysis were a digital elevation model (DEM), a vegetation layer, and a human footprint layer. Due to the geographic extent of the North Pacific Landscape Conservation Cooperative, digital elevation models from different sources had to be used to create one seamless DEM. The digital elevation models were obtained from the Shuttle Radar Topography Mission (SRTM), the United States Geologic Survey, and the Government of the Yukon Territory. Each digital elevation model dataset was resampled to a common pixel size (one km) and mosaicked into a seamless digital elevation layer. The Human Footprint geospatial layer was obtained from the Socioeconomic Data and Application Center (SEDAC) and resampled to one km. Each Human Footprint pixel represents an amount of human activity ranging from one to 100 with 100 being represented as the being the most heavily influenced by human activity. The Nielson Drapek Biome Cover was the land cover used for this project. This dataset was also resampled to the one km spatial resolution. Once all of the datasets were resampled to a common spatial resolution of one km, they were clipped to the boundary of the NPLCC study area and given a custom Albers Equal Area projection.

Once all of the datasets were compiled into a common resolution and projection, a series of steps were taken to create the final resistance girds. The Nielson Drapek vegetation values were reclassified for each year and condition. Focal statistics were then run on the resistance grid combinations using a five by five window that calculated the mean of the window. This process was used to smooth out the sharp edges in the resistance grids. The digital elevation grid was then scaled into a high and low resistance level. The high and low resistance levels were based on the pixel's elevation. The same process was used for the human footprint layer. The human footprint and elevation grids were combined into a four way combination. These layers were then combined with the eight Nielson Drapek land cover biome layers. A Python geoprocessing script was then written to loop through all of grids in the directory and for each grid find the maximum value in the grid as well as created an output with the maximum value in the grid replacing any cell with no data and left the original input value for all cells with data. The output grid raster files were then converted to ascii text files and finally renamed with a .rsg extension. The files were then ready for input into UNICOR.

The North Pacific Forest Landscape Connectivity Project (NPFLCP) has created innovative and useful geospatial applications that highlight connectivity of montane conifer and subalpine species in the North Pacific Landscape Cooperative. The NPFLCP has launched a project website containing information about the project, web maps, dynamic geospatial tools, and resources. The website is available at http://npflcc.dbs.umt.edu/.

The NPFLCP has developed six web based mapping applications. All of these applications, except the genetic connectivity time series application, were built using the ArcGIS Viewer for Flex 3.0 and ArcGIS API for Flex 3.0. The first web mapping application allows users to view the North Pacific LCC domain and view possible threats to this LCC. Possible threats include oil and gas development, as well as the expansion of pine beetle. The second web mapping application allows users to view Montane Conifer connectivity of areas of high elevation and high human footprint in the North Pacific Landscape Conservation Cooperative study area. This application provides Montane Conifer Connectivity for 2000 and 2080 (A1B). The next three web mapping applications provide connectivity pathways for Montane Conifer (low human footprint, low elevation), Subalpine (high human footprint, high elevation), and Subalpine (low human footprint, low elevation) for 2000 and 2080 (A1B). Each of these applications shows considerable change in the connectivity patterns in 2080. Figure 1 shows an example of Subalpine low human footprint, low elevation difference from 2000 to 2080. The sixth web mapping application allows users to view genetic connectivity and projected change in genetic connectivity for a short-range, species-specific disperser in the ecotypes, montane conifer and subalpine. This application was developed using the ArcGIS Online for Organizations application and allows a user to view the time sequence on the map. Large spatial changes can be seen in each species time series.

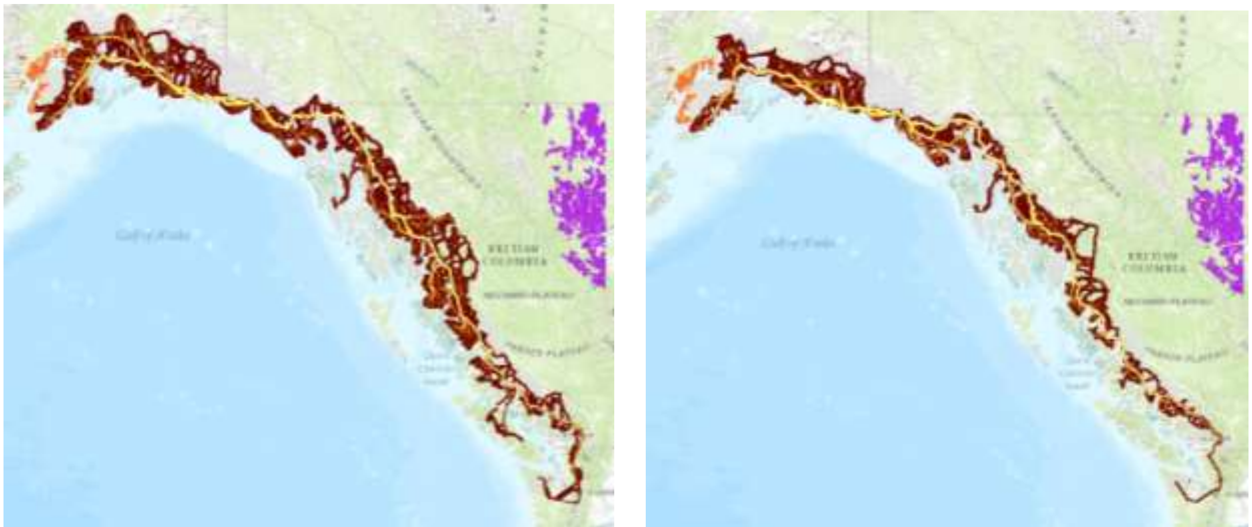

Figure 1: Subapline low elevation and low human footprint. Left figure shows pathways for subalpine ecotype in 2000 and right figure is the connectivity for 2080.

<u>Summary</u>

The NPFLCP project team did not face any problems in creating the GIS web mapping applications. Future work here should be to continue to add more scenarios for additional ecotype-specific species of interest as well as provide validation of these functional of connectivity models which will require empirical data. The NPFCLP hopes to create more web mapping applications and tools based on the needs of the communities.

The team is working on two publications from this project. (1) “A web-based interactive mapping framework for understanding population connectivity and conservation for ecotype-specific species” geared for framework and decision-based support planning and (2) “Evaluating the Sufficiency of Protected Lands for Maintaining Wildlife Population Connectivity in the Northern Pacific”. For the latter, little is known about how the network of protected lands may maintain connectivity for a broad spectrum of species expressing different habitat requirements and dispersal abilities. Through this project, we have generated starting layers for habitats and protected lands. The goal of the paper is to evaluate the degree to which predicted connected habitat for each of different hypothetical organisms in the North Pacific overlaps the network of protected lands.

Sincerely,

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