Climate Corridors and Refugia Modeling

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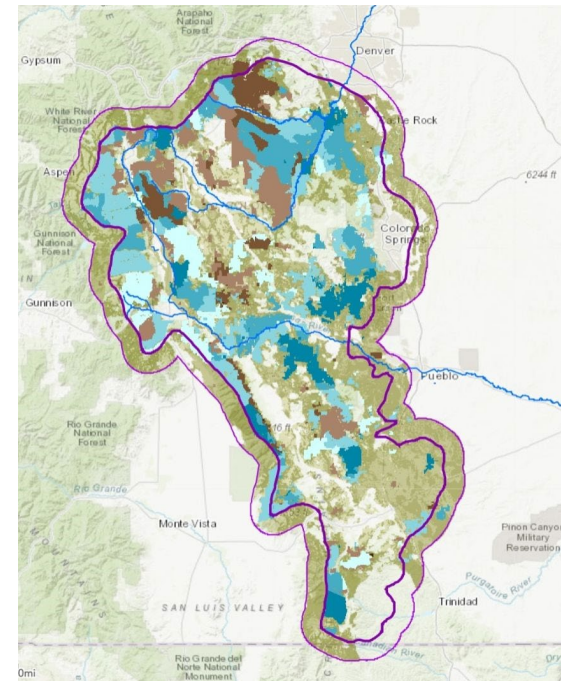Document Prepared May 11, 2022

Overview

About four years, Wild Connections started a project to identify climate corridors and refugia in their region in Central Colorado. The goal of this project is to help Wild Connections prioritize their advocacy and restoration work in Central Colorado in a way that will make a difference now and in the future as the region is impacted by Climate Change.

Wild Connections is working with Rocky Mountain Wild to perform a geospatial analysis that will identify this network of climate refugia and corridors that connect them. Climate refugia are areas where biodiversity, a healthy natural variety of animal and plant species, will persist as the climate changes. Corridors provide linkages between these areas that are crucial for seasonal movement and dispersal of animals and plants including shifts necessitated by climate change.

The project approach is based on the important work by Oswald Schmitz and others titled *Conserving Biodiversity: Practical Guidance about Climate Change Adaptation Approaches in Support of Land-use Planning* (see the full reference at the end of this document). This approach suggests modeling a number of different adaptation approaches across varying ecological levels: species and population level, ecosystem level, and landscape level. Using multiple modeling approaches can help to fill gaps in any single approach. This modeling effort combined local knowledge from those who know the region the best with data from state and federal agencies and incorporated regionwide and national science-based modeling efforts from The Nature Conservancy and NatureServe.

Wild Connections Climate Refugia Modeling Results

This document presents the datasets used for this effort, how they were weighted and combined to create models for the various adaptation approaches and how those were then combined to create a model that shows the most important places to preserve and restore as climate refugia and as corridors to connect them.

Model Components

Model Component/ Adaptation Approach	Description	Data Sources	Data Combination/Scoring
Climate Resilience	The capacity of a site to maintain biological diversity, productivity, and ecological function as the climate changes.	**Ecosystem and Landscape** The Nature Conservancy Resilient Sites. A site's Resilience Score estimates its capacity to maintain species diversity and ecological function as the climate changes. The score was determined by evaluating and quantifying physical characteristics that foster resilience, particularly the site's landscape diversity and local connectedness. The score is refined for each ecoregion and geophysical setting type.	**TNC Resilient Sites**: Modified scores to a scale of 0 to 1.
Ecological Connectivity	Movement corridors and stepping stones of suitable habitat allow seasonal movements (migration), dispersal by new generations, and shifts as climate change cause habitats to move	**Species and Population** • Colorado Parks and Wildlife (CPW) identified migration corridors for big game (bighorn sheep, elk, pronghorn, and mule deer) **Landscape** The Nature Conservancy Climate Flow categorized Movement areas classified based on the amount and concentration of flow. Diffuse flow spreads out to follow many different and alternative pathways. Concentrated flow are pinch points through narrow areas. Constrained flow allow some movement.	**CPW Migration Corridors**: anywhere with one or more migration corridors. **TNC Climate Flow**: • 0 No flow score • 1/3 low diffuse flow • 2/3 diffuse flow medium to high or linkage/constrained flow • 1 diffuse climate flow or concentrated climate flow/climate linkage **Ecological Connectivity Final Score**: Same as TNC Climate Flow except anywhere with a CPW Migration Corridor gets the higher of 2/3 or the TNC Climate Flow score.

Model Component/ Adaptation Approach	Description	Data Sources	Data Combination/Scoring
Current Biodiversity	Identify important locations for animal and plant species and the ecosystem types they rely on today	**Species and Population** • Colorado Parks and Wildlife mammal, birds, and aquatic habitat areas identified as High Priority Habitat (HPH) in Colorado Oil and Gas Conservation Commission (COGCC) rules • U S Fish and Wildlife Service Critical Habitat for Preble's meadow jumping mouse • U S Fish and Wildlife Service Critical Habitat for Mexican spotted owl • Suitable Habitat for Pawnee montane skipper (critical habitat was proposed in 1978 but is not available, using suitable habitat as a stand in) **Ecosystem** • Colorado Natural Heritage Program (CNHP) Potential Conservation Areas (PCA) **Landscape** • NatureServe Richness of Imperiled Species of the US	**Species and Populations** • CPW/COGCC High Priority Habitat no ground disturbance habitat (HPHC): 1 for any habitat single or overlapping • CPW/COGCC High Priority Habitat • High Priority Habitat COGCC Density Limits (HPHD) or High Priority Habitat Consultation (HPHE1) (making HPH_D_E1): 1 for any habitat single or overlapping • Critical habitat Preble's meadow jumping mouse (ZHP_CH): 1 • Critical habitat Mexican spotted owl (SOL_CH): 1 • Suitable Habitat for Pawnee montane skipper (HLM_SH): 1 • Final score: (3 * ZHP_CH + 3 * SOL_CH + 3 * HLM_SH + 2 * HPHC + HPH_D_E1) / 9 (maximum value in practice) **Ecosystems** Score 0 to 1 based on the PCA Biodiversity Significance, 0 = no PCA, 0.2 for General Biodiversity Interest to 1 for Outstanding Biodiversity Significance. **Landscapes** Score 0 to 1 based on the number of imperiled species with suitable habitat at a location (maximum of 10 in the Wild Connections region). **Current Biodiversity Score**: Add the three models above and divide by 3.

| Intact Natural Landscape | Large, intact, natural landscapes, also called core areas, along with movement corridors are key to maintaining high levels of biodiversity | **Landscape**
• CNHP Landscape Disturbance Index (LDI)
• Possible Wilderness Characteristics
   o Designated Wilderness
   o Bureau of Land Management (BLM) Wilderness Study Areas (WSA)
   o BLM identified Lands with Wilderness Characteristics (LWC)
   o U.S. Forest Service Roadless Areas (Colorado Roadless Rule) including Upper Tier
   o Wild Connections Conservation Plan (WCCP) Recommended Wilderness | All developed land has a score of 0.
LDI less disturbed areas (LDI < 100) are scored from 0.1 to 1 based on size of unfragmented patch.
LDI less disturbed areas are ranked based on likelihood of wilderness characteristics. Agency identified wilderness characteristics (Designated Wilderness, WSA, LWC, upper tier roadless, and WCCP Recommended Wilderness score highest, then other roadless lands and non-federal lands (wilderness characteristics not evaluated), with the lowest score for remaining federal lands)
Intact Natural Landscape Final Score:
0.7 * CNHP LDI +
0.3 * Possible Wilderness Characteristics |

Refugia Model

The refugia model is created by combining the component models as follows:

Refugia = (2 * Resilience + Connectivity + Biodiversity + Natural Landscape) / 5

Resilience is given a higher weight than other components because it is key characteristic for climate refugia.

Ranking Areas

The Wild Connection region in Central Colorado was divided into areas that could serve as climate refugia or climate corridors if they are protected. Wild Connections did extensive mapping of public lands in this region and created a citizens' management plan for the region called the *Wild Connections Conservation Plan* (WCCP). The management areas identified in the WCCP and subsequent mapping and evaluation by Wild Connections strongly influenced this step. The following types of areas were identified:

- Currently Protected Areas: Congressionally designated Wilderness areas, Wilderness Study Areas, and National Monuments.
- Recommended Wilderness: Wild Connections identified National Forest areas and Bureau of Land Management (BLM) identified Lands with Wilderness Characteristics

- Other Recommendations: Other protective management recommendations in the WCCP including core areas, connectivity areas, wildlife areas, and quiet recreation areas.
- Other public lands: State parks, state wildlife areas, and other federal, state, and local lands
- Private conservation lands: Includes land trust areas and conservation easements

Each area is then ranked for the refugia model and for each of the component models (resilience, connectivity, biodiversity, natural landscape). First the average (mean) score for the model across the area is calculated. Then the component is ranked for the area based on how that score compares to the statistics for that model across the entire region.

Rank Value	Rank	Criteria
0	0 - Poor	Component score is below the mean
1	1 - Fair	Component score is between the mean and 0.5 standard deviation above the mean
2	2 - Good	Component score is between 0.5 and 1.0 standard deviation above the mean
3	3 - Better	Component score is between 1.0 and 1.5 standard deviation above the mean
4	4 - Best	Component score is greater than 1.5 standard deviation above the mean

When this model is finalized, Wild Connections plans to advocate to protect areas that can serve as climate refugia and corridors by educating the public and influencing land management agencies.

References

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