Assessing Beaver Habitat on Federal Lands in New Mexico

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Executive Summary

The absence of dam-building beaver (*Castor canadensis*) from significant portions of their historic habitat in New Mexico significantly undermines the resilience of aquatic ecosystems and therefore limits climate change adaptation. The dam-building beaver's activities create a diversity of habitats and dams trap sediment, create and maintain wetlands, and modify nutrient and decomposition cycles. The presence of dam-building beaver reduces high flows and downstream flooding that can result in destructive erosion, provides more constant summer flows, elevates the water tables and improves riparian habitat. All these activities offer an effective climate change adaptation tool.

Restoration of wetland and riparian ecosystems by beaver can be a simple, elegant and cost-effective way to restore riparian-wetland habitats and adapt to climate change. Before dam-building beaver populations can be replenished in New Mexico, a systematic and thorough assessment of both potential and suitable habitat and an identification of possible impediments to population recovery are needed. Using GIS technology, we identify all potential, suitable, and occupied dam-building beaver habitats on federal, public lands in New Mexico. These outputs will facilitate efficient relocation of nuisance beaver and restoration of habitat to re-establish and augment wetlands in the state of New Mexico. Field observations conducted in the Jemez River Watershed within the Santa Fe National Forest (SFNF) and the Valles Caldera National Preserve (VCNP) confirmed that the model performs well but that beaver are presently absent from most suitable habitat on the forest.

Results

WildEarth Guardians sent a team to 18 randomly selected sites in the Jemez River Watershed to assess the actual conditions on the ground to validate the model (see appendix D). The field surveys were meant to rate the effectiveness of the model. Because of the generalist ecology of beavers, habitat models such as these are coarse, however the model was accurate in identifying suitable habitat. At five of the 18 sampled points, the modeled variables and field data matched precisely, while at 8 points one variable was misidentified. The fact that statewide data was used makes this number with no or just one error notable. Furthermore, when looking for suitable or potential habitat, project managers will be looking for stream reaches rather than points.

Final maps along with a report documenting all procedures and results were provided to the EPA. From a total of 2,617 miles of perennial streams on federal lands within New Mexico, 2,143 miles or 82% are considered potential dam building beaver habitat. Among this set of streams, the suitability weighting system determined beaver habitat classes: Least Suitable: 359.7 miles, Moderate Suitability: 443.7 miles, Good Suitability: 575.0 miles, and Optimum Suitability: 765.1 miles.

Miles of Perennial Streams in NM	2,617.3	Portion
Potential Beaver Habitat (miles)	2,143.2	82%
Least Suitable Habitat (miles)	359.7	17%
Moderate Suitability (miles)	443.7	21%
Good Suitability (miles)	575	27%
Optimum Suitability (miles)	765.1	36%

Table 1. Miles of Beaver Habitat determined by the Model

Introduction

In 2012, WildEarth Guardians under contract with the New Mexico Environment Department Wetlands Program constructed a spatial model to identify all potential, suitable, and occupied beaver habitats on federal lands in New Mexico.

Beaver, a habitat generalist whose range once spanned from eastern Canada to the arid southwest, are currently absent from a large portion of this original range. In many places because of rarity, they no longer fulfill their ecological engineering functions.

The historic cause of the population decline was demand for pelts in European markets. More recently, beaver have been subject to nuisance claims because of a perception that their dam building activity resulted in a decrease water availability downstream or because increased water levels jeopardized human infrastructure, including mainly roads and bridges.

However, the scientific consensus is clear: dam-building beaver provide multiple ecological and hydrologic benefits. Restoration of wetland and riparian ecosystems by beaver can be a simple and cost-effective means to restore habitat and adapt to climate change. A generally accepted estimate for the restoration of one mile of stream with heavy equipment is $130,000. Dr. Joe Wheaton, at the University of Utah, however has demonstrated 4 km (2.5 miles) of river restoration in Oregon to steelhead habitat for $13,000 with beaver as the central engineering tool. (Wheaton, 2013)

Before dam-building beaver populations can be replenished in New Mexico, a systematic and thorough assessment of both potential and suitable habitat and identification of possible impediments to population recovery was needed. Suitable habitat identified in the model provides viable relocation sites for nuisance beaver away from inappropriate locations and potential habitat will narrow sites on federal lands for restoration of habitat and the reintroduction of beaver.

Methods

WildEarth Guardians assembled a Technical Steering Committee (TSC) with expertise in beaver and wetland ecology identified and ranked the habitat features that

would be most valuable for determining successful dam building beaver habitat. The TSC also identified threats or obstacles to beaver reestablishment.

Spatial data representing the identified habitat factors was acquired in order to develop a simple beaver habitat model. The model was applied to all federal lands throughout New Mexico by overlapping the habitat features with federal land spatial coverage. Using ESRI's ArcGIS software, potential and suitable beaver habitat was modeled.

First, all perennial streams were identified, eliminating streams that flow seasonally. Within New Mexico, there are a total of 2,617.3 miles of perennial streams on federal lands. Potential beaver habitat was then determined by combining stream order with stream slope (both data sets clipped to only include federal lands). Eliminating all streams that had a slope greater than 15% further limited the set of suitable streams (Allen, 1983). Finally, this subset was reduced to include only stream orders 1-5 (Howard 1985 and Suzuki 1998). Stream order is a ranking of the size of a stream from 1 to 12. A small seasonal creek is a 1, the Mississippi River a 10, and the Amazon River a 12. Beaver can and do live in streams of larger orders, but are unable to build dams. (See appendix A)

Suitable habitat was determined by weighting 5 different factors that determine the viability of habitat for beaver. These were stream order (30% of final ranking), stream gradient (30% of final ranking), existing vegetation cover (13.3% of final ranking), canopy cover (13.3% of final ranking), and road density (13.3% of final ranking). Each stream reach was given a value for each factors, and a weighted average was computed to determine habitat viability. For instance, a reach with high-quality riparian habitat would receive a score of 10 (the highest) for existing vegetation type, but would receive a 5 for agricultural vegetation, a 3 for grassland, or a 1 for sparsely vegetated (among other vegetation types). This score would make up 13.3% of the final ranking of the reach. High canopy cover, low road density, and suitable stream order and gradient were given high scores. Every stream reach on federal land was classified in this way, and the final map of beaver habitat can be found in Appendix B. A list of data sources can be found in Appendix C.

Conclusion

The WildEarth Guardians' 2011 report titled *Beaver and Climate Change Adaptation in North America* illustrated the many ways beaver affect the environment and their potential role in climate change adaptation strategies. This report allowed WildEarth Guardians and partners to identify suitable habitat for the relocation or reintroduction of beaver and areas that, when restored, will support beaver on federal lands in New Mexico. Finally, government agencies and NGO's can identify potential sites for restoration and reintroduction.

The data used in the model is based on publicly available datasets, many of which cover the entire country. Those which don't, such as the stream data set provided by the New Mexico Environment Department and the elevation data, provided by New Mexico

Resource Geographic Information Systems, can easily be substituted with data from ESRI or the USGS. Land and wildlife managers, non-profits, and state agencies in other parts of the country on both public and private land can simply replicate this model. With the potential environmental benefits beavers provide this model will prove useful.

Project Team

Bryan Bird, the Wild Places Program Director for WildEarth Guardians in Santa Fe, NM. Bryan received his masters in conservation biology from New Mexico State University in 1995 and undergraduate degree in biology from the University of Colorado, Boulder in 1990. Bryan has undertaken conservation research and planning in Mexico, Central America and the Southwestern United States for nineteen years. Bryan has been researching the ecosystem services of beaver and recently published a comprehensive literature review and report titled *Beaver and Climate Change Adaptation in North America: A Simple, Cost-Effective Strategy*.[1]

Kurt Menke, a Certified GIS Professional (GISP) with 16 years of experience in the field. He received a Master's degree (MA) in Geography from the University of New Mexico in 2000. Kurt has extensive experience modeling potential wildlife habitat via both inductive and deductive approaches. Kurt has also facilitated numerous professional mapping workshops to gain consensus from experts on mapping protocols. Kurt has a unique skill in presenting complex information in a map format that is easily comprehended by laypersons and non-specialists.

Debra Budrow, an Environmental Scientist specializing in wetlands, streams, and ecological restoration. She has a M.S. in Environmental Sciences from Johns Hopkins University and an MBA from Duke University. This combination of training and experience allows her to contribute not only to the science of a project, but also to the procedural methodology, data collection and analysis, and production of multiple levels of reporting depending upon the audience. During this project, she led the team of interns by instructing the methodology, supervising the collection and input of data, and analyzing the effectiveness of the model.

Student interns **Drake Hebert** and **Andrew Nguyen**, UC Santa Barbara Bren School of Environmental Science, and **Janelle Roybal**, New Mexico State University, collected field data to groundtruth the beaver habitat assessment model on federal lands in the Jemez Mountains and assisted with writing reports.

Acknowledgements

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[1] http://www.wildearthguardians.org/site/DocServer/Beaver_and_Climate_Change_Final.pdf?docID=3482

invaluable participation. We would also like to thank the members of the technical steering committee for their contributions to the review of the model. The contents of this document do not necessarily reflect the views and policies of the EPA, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Citations

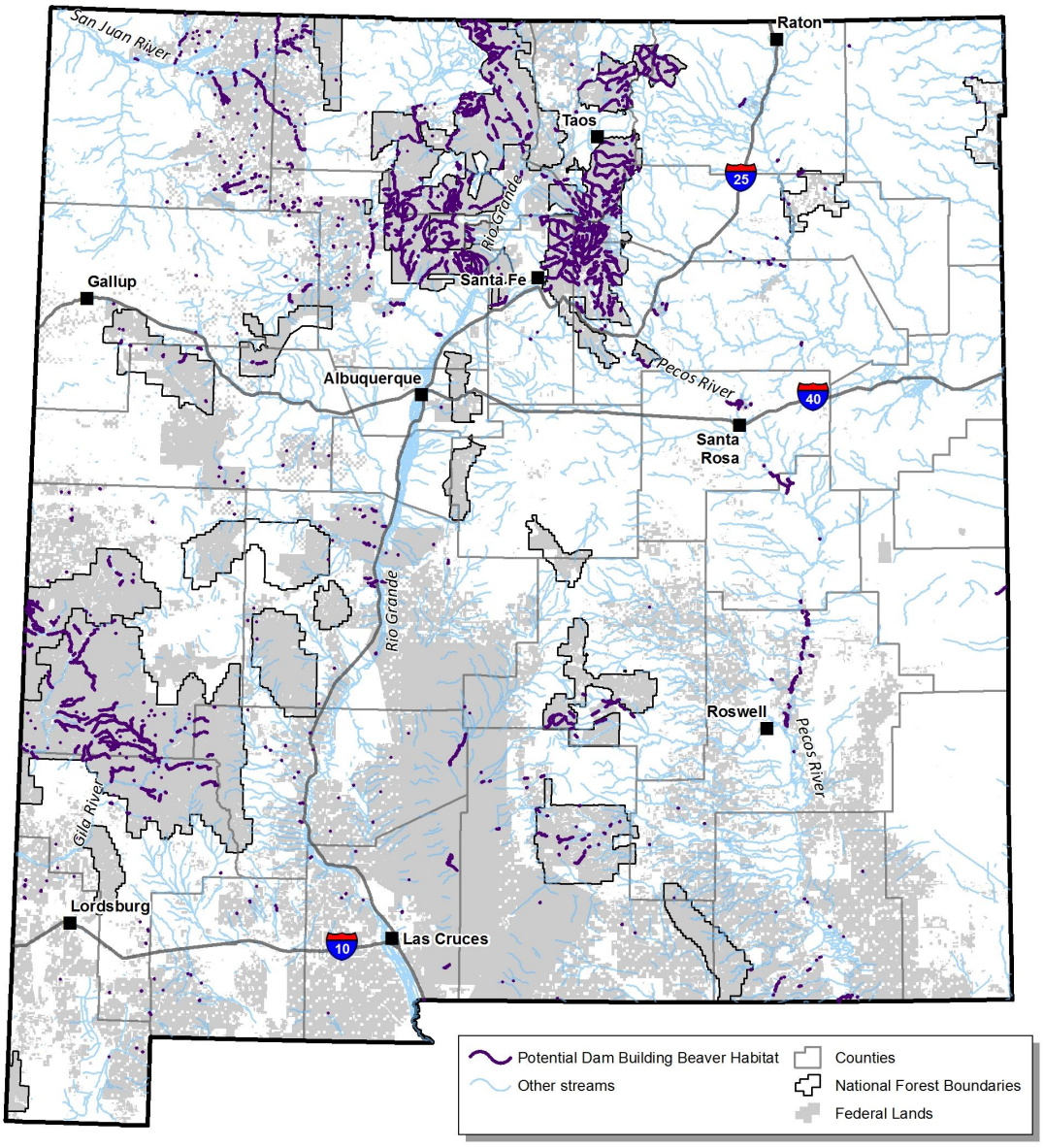
Allen, A. 1983. *Habitat Suitability Index Models: Beaver.* U.S. Dep. Inter., Fish and Wildl. Serv. FWS/OBS-82. 10:30 Revised 20p.

Howard, R. and Joseph Larson. 1985. *A Stream Habitat Classification System for Beaver.* Journal of Wildlife Management. 49: 19-25.

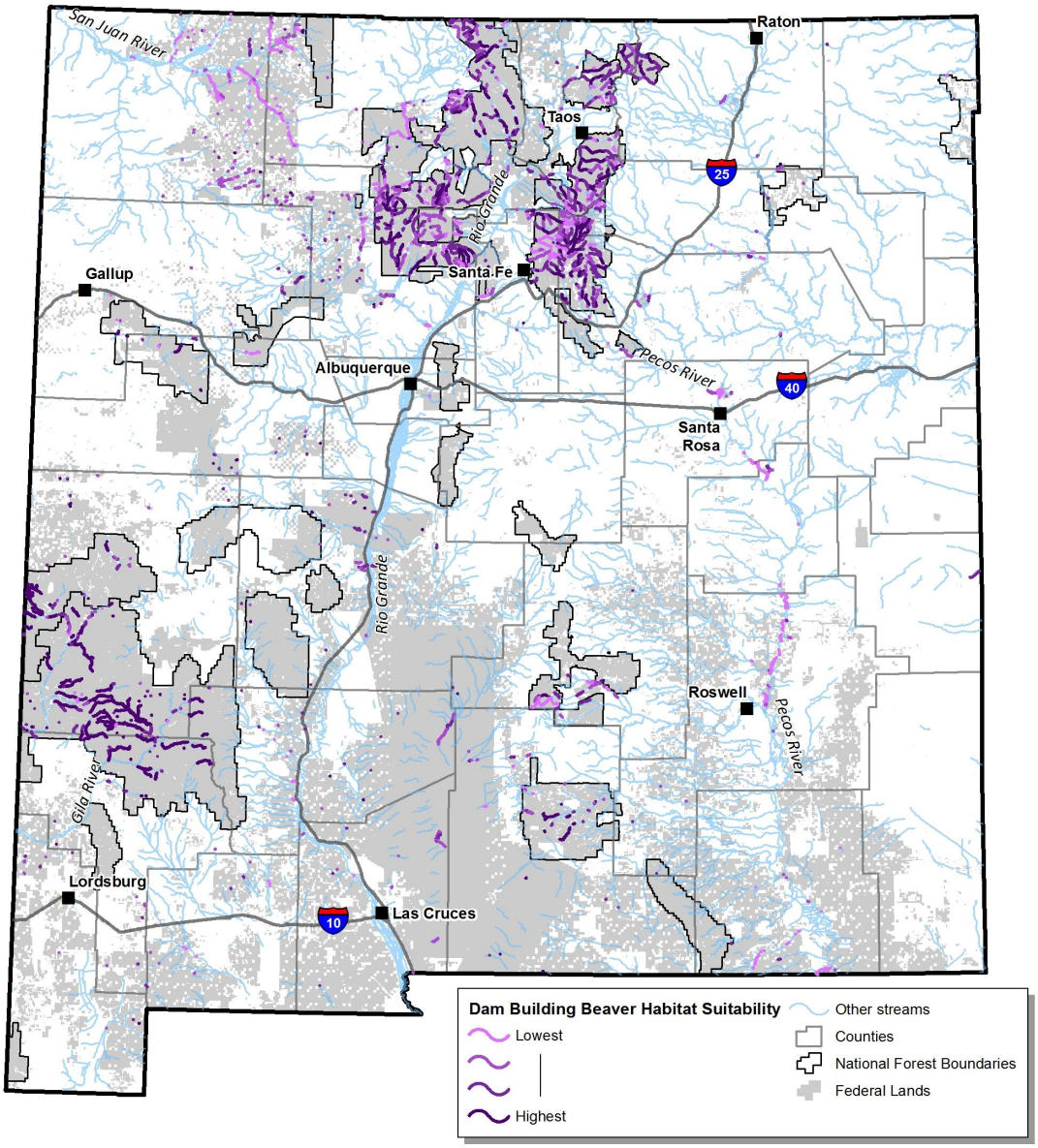
Suzuki, N. and William C. McComb. 1998. *Habitat Classification Models for Beaver (Castor canadensis) in the Streams of the Central Oregon Coast Range.* Northwest Science. 72: 102-110.

Wheaton JM. 2013. Cheap and Cheerful Stream & Riparian Restoration- With Beaver? Webinar to National Riparian Service Team.

Appendix A - Potential New Mexico Beaver Habitat on Federal Lands



Appendix B - Suitable New Mexico Beaver Habitat on Federal Lands



Appendix C -Data Sources

- The NHDPlus version 2 dataset was used to represent streams. This dataset was provided by the NM Environment Department. The website for the NHDPlus program can be found here: http://www.horizon-systems.com/nhdplus/

- Slope was generated from a statewide digital elevation model (DEM). The data was obtained from NM-RGIS (http://rgis.unm.edu). A series of 30 meter resolution DEM's were mosaicked together to form a seamless DEM for the state.

- To represent existing vegetation type (EVT) and canopy cover (CC), data was obtained from the LANDFIRE program (http://www.LANDFIRE.gov/NationalProductDescriptions21.php). These data have a 30 meter resolution matching that of the slope dataset.

- Wildfire burn severity was obtained from both the Monitoring Trends in Burn Severity (MTBS) program and the Burned Area Reflectance Classification (BARAC) program; this gave coverage of wildfires over the last 5 years.

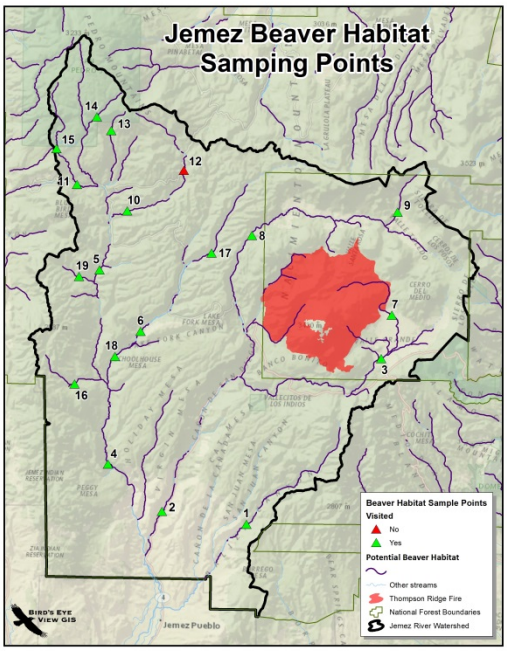
- The 2012 TIGER roads layer was used to generate a statewide roads dataset (http://www.census.gov/geo/maps-data/data/tiger-line.html). The roads were obtained by county and merged into a seamless statewide layer.

- Watershed boundaries were obtained from the Resource Geographic Information System Program (RGIS - http://rgis.unm.edu/).

- Landownership was obtained from the NM BLM office (http://www.blm.gov/nm/st/en/prog/more/geographic_sciences/spatial_data_metadata.html).

Appendix D – Jemez River Watershed Beaver Habitat Sample Points

Potential Beaver Habitat



Suitable Beaver Habitat