## 3. Ecosystem Assessment

AQUATIC AND RIPARIAN HABITAT

We utilized the outputs of the BRAT model to quantify the aquatic and riparian habitat that beaver could add to the Jemez Watershed. Using simple geometric calculations for each dam, the pool behind it, and the riparian corridor next to it, we were able to establish and scale estimates of the impacts of beaver re-establishment on appropriate habitat for special status species in the Jemez Watershed. The results of the analysis demonstrate that as re-established beaver populations increase in size, the acreage of aquatic and riparian habitat increases in kind (**right**). The addition of both of these habitats is important for the management of special status species, specifically the New Mexico meadow jumping mouse and the Rio Grande cutthroat trout.
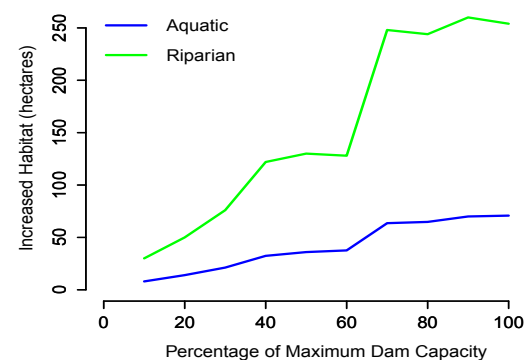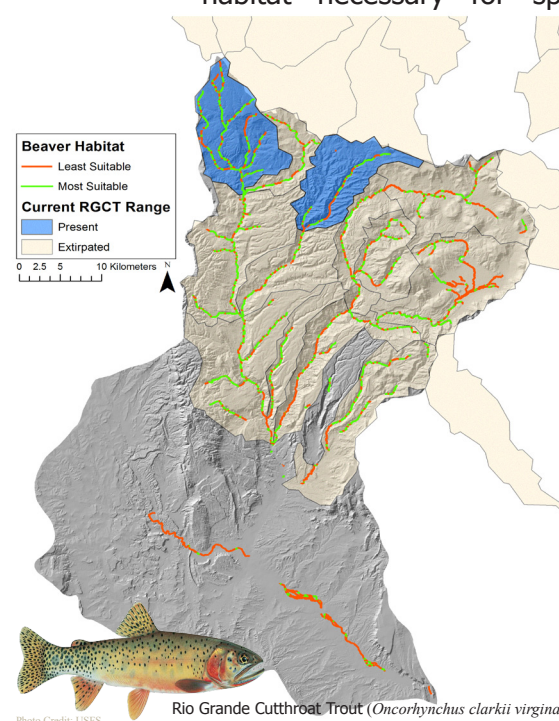

NEW MEXICO MEADOW JUMPING MOUSE

New Mexico Meadow Jumping Mouse (*Zapus hudsonius luteus*)

The New Mexico meadow jumping mouse is a state-endangered species and is proposed for federal listing. It is a semi-aquatic mammal found primarily in riparian habitat along the banks of southwestern streams. The US Fish and Wildlife Service has proposed 55.5 km of three stream reaches for a total of 1,117 hectares of critical habitat within the Jemez Watershed (**right**). These reaches are currently partially occupied by the species. The riparian habitat created by beavers provides ideal habitat for mouse foraging and winter hibernation. A re-established beaver population could provide additional riparian habitat necessary for species conservation.
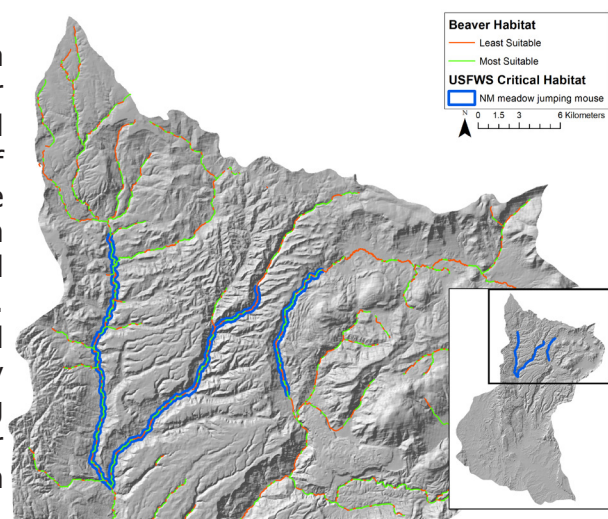
RIO GRANDE CUTTHROAT TROUT

The Rio Grande cutthroat trout (RGCT) is a state-sensitive species, managed by the US Forest Service, and fished recreationally. The species is known to occur in two sub-basins within the Watershed, both of which could support a re-established beaver population (**left**), and was historically found in most of the upper Watershed where it is currently extirpated. We found that beaver, through their dam building activities and subsequent ponding effects, positively influence fish habitat. The ponds provide slow moving water that is ideal for spawning and feeding. The water in the ponds becomes stratified in the summer which protects this temperature-sensitive species, while shade from adjacent riparian habitat increases invertebrate diversity as an over-summer food source. Beaver dams are known to provide a barrier to the passage of invasive trout species in the system, reducing the threat of loss of genetic resilience for the RGCT. With beaver re-establishment, the RGCT may be able to occupy sub-basins where it is currently exirpated.

Rio Grande Cutthroat Trout (*Oncorhynchus clarkii virginalis*)

Source: WildEarth Guardians, 2014; USFWS 2013; Trout Unlimited 2013

Group Project Brief

Spring 2014

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BEAVER (Castor canadensis) IMPACT ON WATER RESOURCES IN THE JEMEZ WATERSHED, NEW MEXICO

On the Web at http://www.bren.ucsb.edu

Background and Significance

Water is a valuable resource in New Mexico. Beavers are widely reputed as ecosystem engineers that generally alter the dynamics of a stream system. WildEarth Guardians wished to investigate the impacts of re-established beaver on water resources in the Jemez Watershed, located in north-central New Mexico, as it was historically home to large beaver populations. In early 2014, the New Mexico Senate called for a state-wide beaver management plan for the state, highlighting the need for further study of beaver as solutions to water scarcity concerns.
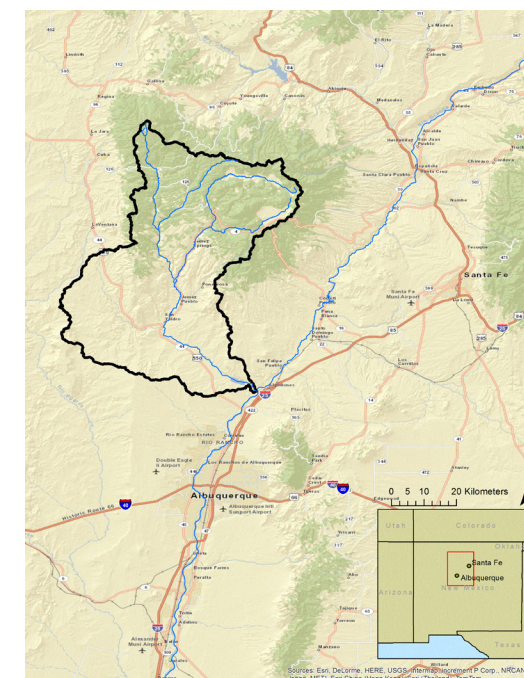
Project Objectives

1. Beaver Capacity Evaluation
- Can the Jemez Watershed currently support a beaver population? How many dams would these beaver build?

2. Hydrologic Modeling
- How do beaver dams affect the flow and timing of the stream network in the Jemez Watershed?

3. Ecological Assessment
- Can beaver create aquatic and riparian habitat in the Jemez Watershed? Can this habitat support special-status species?

Conclusions

Photo Credit: http://linguistlespy.com/2012/07/09/to-beaver-away

- The Jemez Watershed can support a re-established beaver population and their dam building activites.

- Beaver dams affect stream flow and timing by attenuating peak flows and increasing stroage and summer baseflow.

- Beaver dams increase aquatic and riparian habitat to provide habitat for and potentially support 15 special-status species.
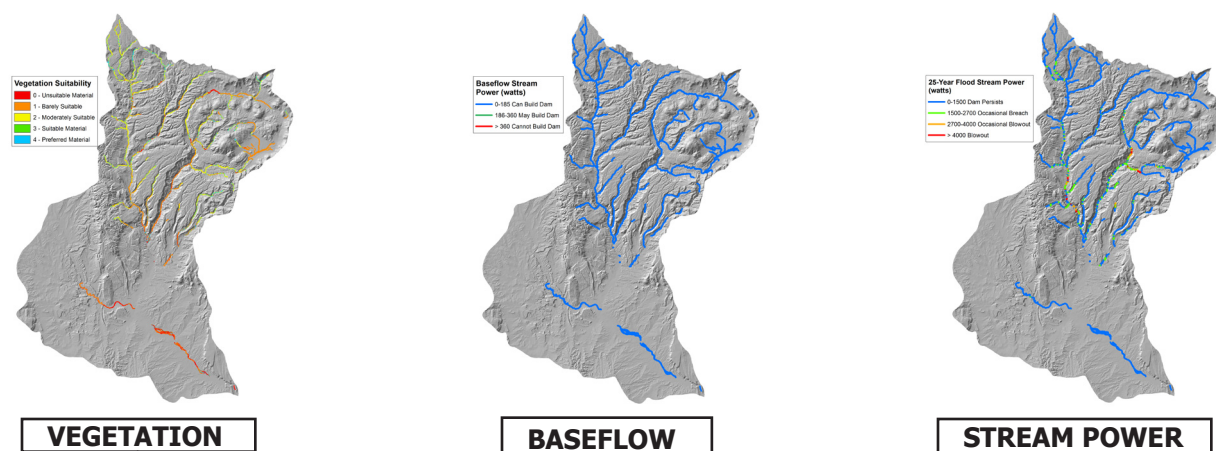
Acknowledgements

1. Beaver Capacity Evaluation

**VEGETATION**   **BASEFLOW**   **STREAM POWER**

BRAT
Beaver Restoration Assessment Tool

The BRAT model classifies reaches within perennial streams based on their suitability for beaver dam building activity. First, BRAT investigates the vegetation suitability in the studied reaches. Then, at baseflow and during floods, BRAT categorizes reach suitability in the Jemez Watershed based on the frequency of dam failure due to stream power, as shown **above**.

Much of the Jemez Watershed in its current state is suitable for beavers to build dams and could thus support a re-established beaver population. The results are presented in the figure to the **right**. At maximum capacity, 38% of reaches in the Jemez Watershed would support frequent dam building activity, totaling to over 450 kilometers of suitable river habitat.

The inset **below** shows the dam building capacity of the Jemez at 10% of its maximum capacity, which models an initial re-establishment population. At this population density, much of the watershed is no longer expected to harbor significant dam building activity; however, dam building is expected to occur in some reaches.
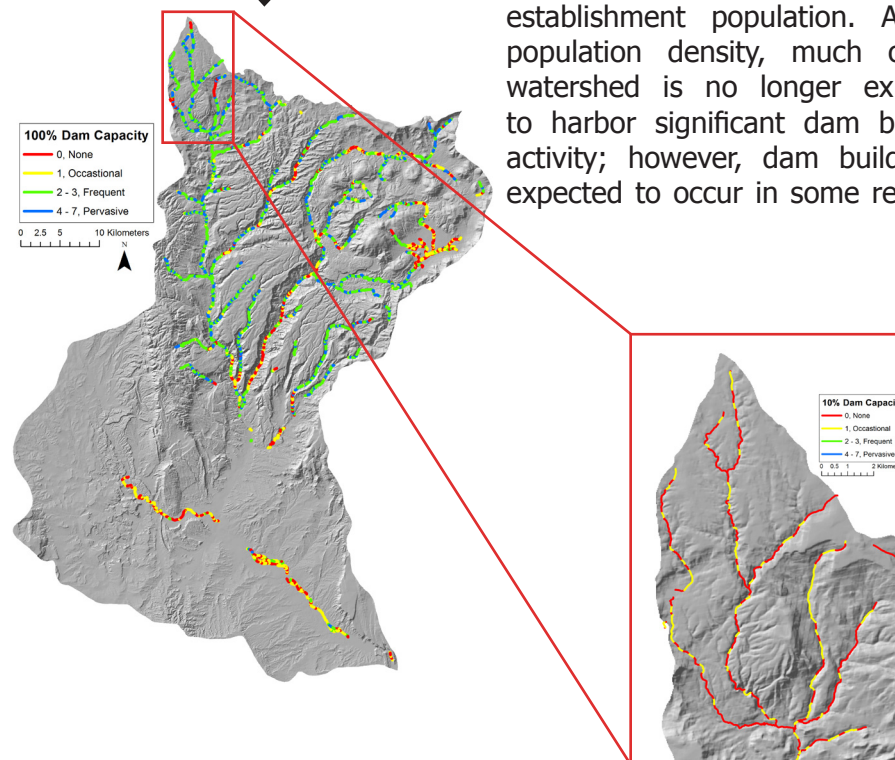
The outputs from the BRAT model framed the ecosystem assessment objective and determined specific counts and locations of dams within the watershed for input into the hydrological model.

Source: Macfarlane WW and Wheaton JM, Utah State University, 2013

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2. Hydrologic Modeling
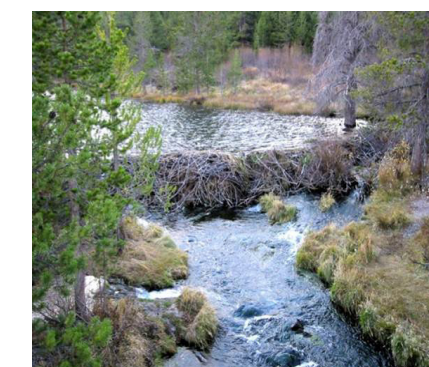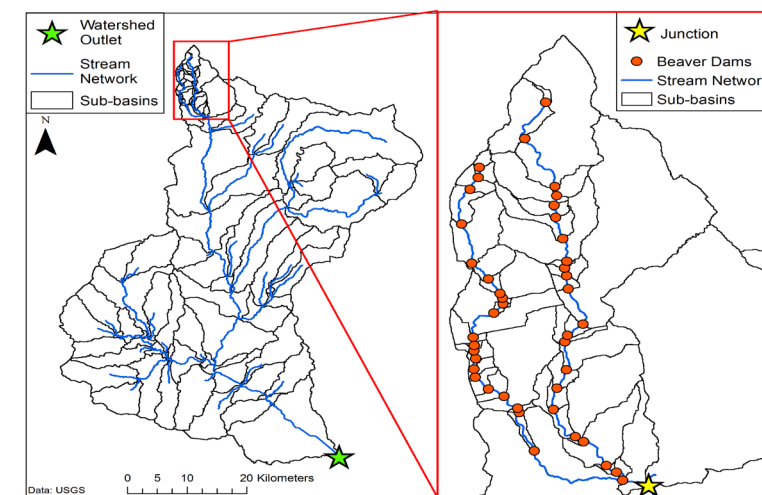
Typical beaver dam and pond

We used HEC-HMS to parameterize the hydrologic characteristics of the Jemez Watershed and capture the watershed's response to precipitation data, producing a calculated hydrograph. Then, the calculated hydrograph was compared to observed hydrographs at the outlet of the watershed (**above left**) for calibration. Finally, we used the calibrated model to simulate beaver re-establishment to the Rio de Las Vacas sub-basin, which was found to have highly suitable beaver habitat and is owned by the US Forest Service, making it an ideal site for re-establishment. Forty two (42) beaver dams, representing a re-established population's dam building activity as determined by BRAT, were added to the calibrated model in the Rio de las Vacas sub-basin (**above left**). Each dam was modeled as a one meter (1 m) high porous structure where the water could pool behind the dam, flow through the dam, flow over the top of the dam, and evaporate from the pool surface (**above right**). Our results showed that each beaver dam lead to increased storage while slowly releasing water through seepage, thus prolonging local river flow.
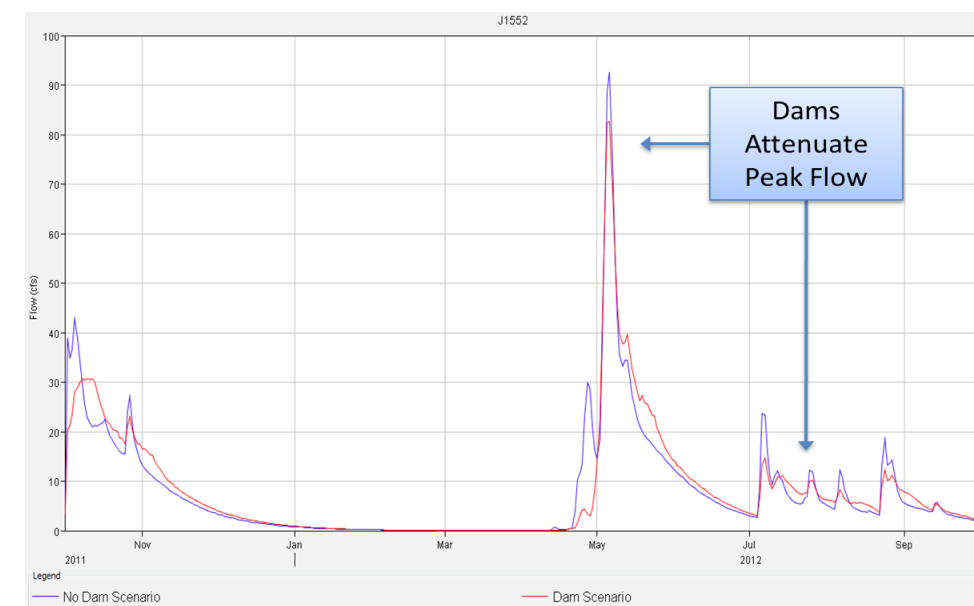
We compared the hydrographs of the "dam" and "no dam" scenarios at the junction below the Rio de la Vacas region to observe the impact of beaver dams on flow volume and timing of the stream network. The results indicate a clear attenuation of peak flow between 5 and 30% with a corresponding increase in baseflow between 5 and 15% for the re-establishment dam density scenario (**above**).

Source: US Army Corps of Engineers, Hydrologic Engineering Center - Hydrologic Modeling Software (HEC-HMS), 2014