

## 2. Preliminary Results of a Beaver Dam Inventory and Beaver Dam Capacity Estimates in the Tualatin River Basin

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### Goals and Objectives

Beavers and their dams can substantially change the storage and movement of water through a stream reach. The magnitude of this change is, in part, a function of the number and type of dams plus stream characteristics. If beaver activity is to be considered as a flow-management aid, then understanding the locations where beavers currently are building dams and the potential locations and number of dams that beavers could build in the future would help inform how managers approach the management of beaver activity and prioritize habitat restoration actions that may support dam building by beavers.

For this component of the Tualatin beaver study, USGS:

- 1) Created a partial inventory of beaver dams by conducting strategic beaver dam surveys and compiling existing dam observations from basin partners.
- 2) Estimated and validated potential beaver dam capacity in Tualatin River basin streams by modifying an existing beaver dam capacity model that accounts for physical controls on where beavers can build dams.



**Figure 1.** Beavers in the Tualatin River basin. Photo by Erin Poor, USGS.

### Methods

#### Beaver Dam Inventory

- USGS conducted a beaver dam field inventory on about 14 km of urban streams, including Fanno and Rock Creeks.
- USGS met with 13 groups and organizations in the Tualatin River basin to compile their data on dam locations and reaches with recent beaver activity. Contributors to the inventory included Bio-Surveys LLC, Bonneville Environmental Foundation, City of Portland Bureau of Environmental Services, Clean Water Services, Tualatin Hills Park and Recreation District, Tualatin River Watershed Council, Tigard Public Works, USDA Natural Resources Conservation Service, Portland Parks and Recreation, The Wetlands Conservancy, Tualatin Riverkeepers, Portland State University, and the U.S. Fish and Wildlife Service.

#### Beaver Dam Capacity

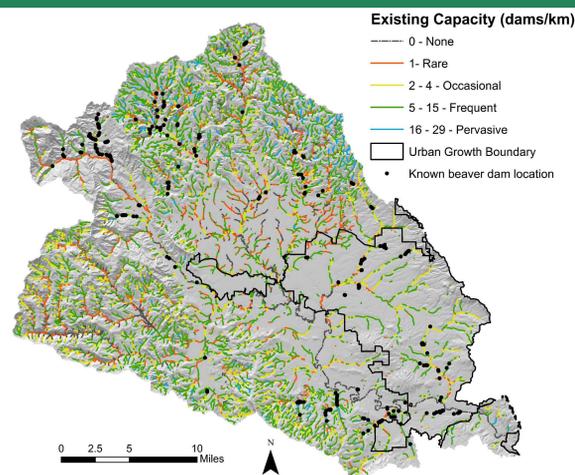
- McFarlane and others (2017) developed the Beaver Restoration Assessment Tool (BRAT) to estimate the potential density of beaver dams along stream reaches and identify locations for targeting beaver restoration strategies.
- USGS modified the original BRAT model (developed for steep, snow-melt dominated Utah streams) to better account for the hydrology and constraints on beaver dam building in low gradient, rain-dominated Tualatin Basin streams.
- The modified BRAT combines hydrologic, topographic, and vegetation data (table 1) in a fuzzy inference system to calculate potential dam density based on: 1) the presence of sufficient water to build a dam at low flow, 2) the likelihood that a dam is destroyed at high flow, and 3) the availability of vegetation preferred by beavers for food and dam building.
- The modified BRAT results were validated with data from the partial beaver dam inventory.

**Table 1.** Inputs for the modified BRAT model.

Dataset	Description
USGS National Hydrography Dataset (NHD)	Data identifying the perennial stream network
USGS Regional ungaged streamflow equations (Cooper, 2005)	Equations used to estimate low-flow stream power and bank-full stream power
USGS/USFS LANDFIRE vegetation data	Vegetation data used to assess potential beaver food and dam-building materials
10 m Digital Elevation Model (DEM)	Data used to calculate stream slope

### Beaver Dam Inventory Results

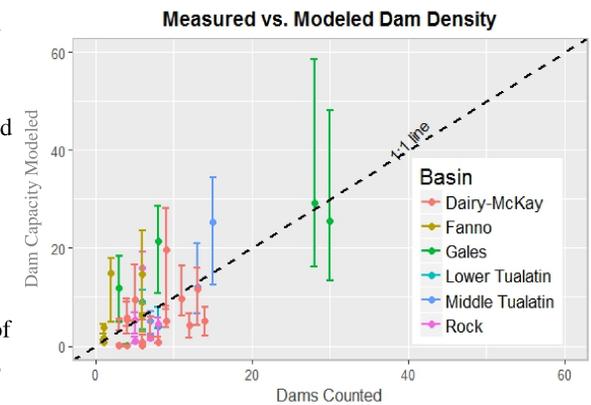
- USGS documented 49 dams along 14 km (~9 miles) of 8 urban streams.
- The locations of more than 300 beaver dams and 100 reaches with signs of beaver activity were documented in the Tualatin River basin (Smith, 2017 a,b; fig. 2).
- Dams and reaches with beaver activity are present throughout the basin, including on the valley bottom and in streams within the urban growth boundary.
- The beaver dam inventory is a partial inventory of beaver dams between 2013 and 2016, and is not a complete census.



**Figure 2.** Partial inventory of beaver dams in the Tualatin River basin with beaver dam capacity estimates from the modified BRAT model.

### Beaver Dam Capacity Prediction and Validation

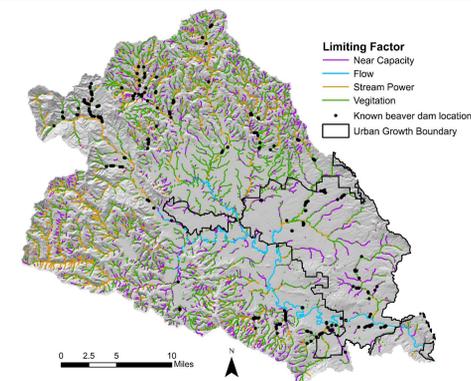
- Urban reaches offer substantial dam-building capacity for beavers. For example, BRAT estimates a potential capacity of over 1,400 dams along Rock and Fanno Creeks (fig. 2).
- Comparison of the beaver dam inventory and BRAT results showed that the BRAT model explains ~60% of the variance in observed dam distributions (fig. 3).
- Beaver dam capacity is frequently overestimated compared to the inventoried dam distribution (fig. 3). Overestimation is expected because biological factors, such as migration, trapping, predation, and other physical habitat characteristics, such as the availability of pool habitat, also influence beaver dam building (Petro and others, 2015), but are not taken into account in the original and modified BRAT model.
- Results suggest no apparent bias in the dam-capacity estimates between urban and non-urban streams (fig. 3).



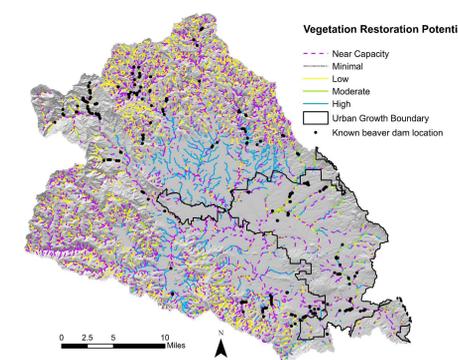
**Figure 3.** Comparison of BRAT-predicted beaver dam capacity to known beaver dam counts from the partial dam inventory in the Tualatin River basin. Error bars in the dam capacity are estimated from the modeled ranges.

### Physical Factors Potentially Limiting Beaver Dams

- BRAT postulates that the density of beaver dams is limited by several physical factors (fig. 4), including:
  - High flow, high stream gradient, and stream power, and/or lack of appropriate vegetation;
  - Excessive depth or velocity in Tualatin River main channel; and
  - Lack of vegetation for building material or food.
- The BRAT results can be used to examine the potential physical limiting factors, thus helping managers to understand where restoration actions might allow successful beaver colonization and dam building.
- Where vegetation is a limiting factor for beaver dam building, an analysis of vegetation restoration potential also can be used to help target stream reaches for restoration (fig. 5).



**Figure 4.** Map of potential physical factors limiting beaver dam building in the Tualatin River basin.



**Figure 5.** Map of vegetation restoration potential for beaver dam building in the Tualatin River basin.

### Considerations for Future Studies

- BRAT may be incorporated into management approaches to predict and manage potential conflicts between beaver dam-building activity and human land uses and infrastructure.
- BRAT assumes that the primary factors limiting beaver-dam abundance are flow, gradient, and vegetation. However, other factors, such as predation, trapping, and migration, influence where beavers can build dams. These factors were not considered as part of the analysis.
- Vegetation data are derived from 30-m Landsat data; thus, abrupt changes in vegetation/land-use may not be well represented in BRAT. A comparison of results using unpublished 5-m imagery shows little variation in vegetation type and distribution (for most areas) using finer scale results.

### Literature Cited

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