Beavers as Restoration Agents in Sagebrush Ecosystems

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Beaver As Restoration Agents in Sagebrush Ecosystems

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Outline

1. Riparian zones in sagebrush ecosystems

2. Effects of beaver in riparian zones

3. The BRAT – Beaver Restoration Assessment Tool
   • Applying BRAT to Sage Grouse Habitat in Box Elder County

4. Modeling the potential effects of restoration on hydrology and vegetation
Importance of Mesic/Riparian Areas
Degradation by Incision

Drivers
- Climate, land use, disturbance

Effects
- Vegetation, water table/storage

Increase Roughness

“natural”

VS

check dams

from Pollock et al. 2014
Beaver as Restoration Agents

- Widen channels
- Aggrade sediment
- Raise water tables
- Increase surface water

from Pollock et al. 2014
What About Hydrology?

How can stream restoration affect groundwater and surface hydrology at different spatial scales?

- Disconnected floodplain and groundwater
- Connected floodplain and groundwater
What About Hydrology?

Theoretical Hydrograph

- Attenuate peak flows
- Lengthen spring runoff
- Increase base flows

Month

Discharge

Current

With Beaver Dams

http://khafen74.github.io

Beaver Restoration in Sagebrush Ecosystems

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What is BRAT?
- Beaver dam capacity model
- Where and at what level dams can be sustained

Also Predicts
- Conflict potential
- Restoration potential

**MacFarlane et al. 2015**

*Modeling the capacity of riverscapes to support beaver dams*

_William W. MacFarlane*, *Joseph M. Wheaton*, *Nicolaas Bouwes*, *Martha L. Jensen*, *Jordan T. Gilbert*, *Nate Hough-Snee*, *John A. Shivik*
What do beavers need to survive?

- Water
- Food/Building Material
- Shelter

BRAT – Beaver Restoration Assessment Tool
BRAT - inputs, lines of evidence & data sources

- Evidence of perennial water source
- Nation-wide
- NHD 24K
- 250m reaches

- Nation-wide
- 30 m
- Existing and potential (historic)

Typical flood (Q2): Evidence beaver dam may persist
Base flow (QP80): Evidence beaver dam can be built
Dam Density Output Categories

- **None** – 0 dams: segments deemed not capable of supporting dam building activity

- **Rare** – 1 dam/km: segments barely capable of supporting dam building activity; likely used by dispersing beaver

- **Occasional** – 2-4 dams/km: segments that are not ideal, but can support an occasional dam or even a small colony

- **Frequent** – 5-15 dams/km: segments that can support multiple colonies and dam complexes, but may be slightly resource limited

- **Pervasive** – 16-40 dams/km: segments that can support extensive dam complexes and many colonies
BRAT – Identifying Restoration Potential

- Identify reach-scale restoration potential over large spatial scales
- Determine best case scenario restoration outcomes
- Model restoration results

- BRAT – Beaver Restoration Assessment Tool
- Run for Sage Grouse (Greater and Gunnison) habitat in Utah
Beaver Restoration in Sagebrush Ecosystems

BRAT – Existing Capacity

• ~50% of perennial streams in sage grouse habitat can support frequent or pervasive dam capacity

Maximum Dam Density (dams/km)
- 0 - None
- 0 - 1 Rare
- 1 - 4 Occasional
- 5 - 15 Frequent
- 16 - 40 Pervasive

Box Elder
- 0: 8%
- 1: 12%
- 2 - 5: 30%
- 6 - 15: 43%
- 16 - 31: 590 km (365 mi)

Statewide
- 0: 3%
- 1: 8%
- 2 - 5: 23%
- 6 - 15: 53%
- 16 - 31: 4460 km (2770 mi)
BRAT – Conflict Potential

- Land ownership
- Distance to roads
- Distance to infrastructure
- Conservative estimate

![Map showing probability of conflict with land ownership, distance to roads, and distance to infrastructure as factors.](image)

**Box Elder**
- Probability of Conflict: 0.01 - 0.10 (16%), 0.11 - 0.25 (33%), 0.26 - 0.50 (16%), 0.51 - 0.75 (16%), 0.76 - 1.00 (16%)  
  - Total Stream Length: 590 km (365 mi)

**Statewide**
- Probability of Conflict: 0.01 - 0.10 (13%), 0.11 - 0.25 (17%), 0.26 - 0.50 (50%), 0.51 - 0.75 (25%), 0.76 - 1.00 (12%)  
  - Total Stream Length: 4460 km (2770 mi)
BRAT – Restoration Potential

• ~30% of streams in sage grouse habitat show potential for immediate restoration
Modeling Hydrologic Effects of Restoration

• Determine surface and shallow ground water storage created by beaver dams
• Model inundation depth and extent based on dam height distribution
• Upstream inundation used to create pond extent polygon

\[
\text{Upstream Inundation} = \frac{\text{Dam Height}}{\text{Reach Slope}}
\]

• DEM values < Dam Height extracted from polygon

• Model across different BRAT capacity scenarios
• Currently testing and developing in Temple Fork Watershed with 1m and 10m DEMs
Modeling Beaver Pond Surface Storage

- 50% of BRAT Existing Capacity

Modeled Reach Storage
Cubic Meters
- 0 - 10
- 11 - 50
- 51 - 100
- 101 - 500
- 501 - 1000

Modeled Pond Area
- 95% LCL
- Mean
- 95% UCL

Preliminary Results
Take Aways

• In many cases beaver provide a means to meet geomorphic, hydrologic, and biotic restoration goals

• Network tools allow preliminary analysis of potential restoration zones at large spatial scales

• Modeling the hydrologic effects of beaver dams creates opportunities to identify the possible effects of restoration

• The cumulative effect of beaver dams along a stream network is not fully understood
Thank You!

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