Role of Beaver in Stream Ecosystems: Overview of beaver life history and habitat requirements

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Overview

- Life history niche
- Beaver diet and food preference
- The colony, the lodge, and the cache
- Dams
- Geomorphological feedbacks
- Ecological feedbacks
Life History Niche

• Largest rodent in North America (up to 90 lbs!)
• Ubiquitous within N. hemisphere temperate ecosystems
• Range from boreal to aridlands
• Habitat generalist; highly adaptable
• Common habitat ingredients: water + wood
  – Northern tundra and treeline range boundary: wood limitation
  – Southern range desert boundary: perennial streamflow and/or wood limitation
Worldwide distribution of beaver

- *Castor canadensis* (N. America)
- Historically, 60–400 million pre-European settlement (Seton 1929)
- Currently, 6–12 million (Naiman et al. 1988), but estimates are crude
- Spatial distribution approaches its historical range
- *C. fiber* (Eurasian beaver)
- More limited current distribution, but expanding back to parts of its historical range

300 year history of beaver extirpation in US - economic, not necessarily biological extirpation

Map courtesy of Jim Sedell, USDA Forest Service (2001)
A HABITAT GENERALIST - AND HIGHLY ADAPTABLE

- Lakes
- Rivers and streams
- Abandoned channels on floodplains
- Wetlands
FROM BOREAL FORESTS....

http://www.for.gov.bc.ca/dfn
...TO DESERTS

http://www.rv-boondocking-the-good-life.com/
EVEN SOME UNLIKELY PLACES...

- Estuaries
- Glacier outwash streams
Beaver Diet: A choosy generalist

- Spring/Summer: herbaceous plants, including aquatic and riparian forbs, grasses, grains and row crops
- Fall/Winter: tubers, bark and cambium of cached woody plants
- Woody plants comprise 86% of winter diet; 16% of summer diet (Roberts and Arner 1984)
- Number of woody species consumed range from 3 at northern range limit to >30 in southern region (Aleksiuk 1970, Hill 1982, Novak 1987)
• Colony unit = 6–8 related individuals
• Avg. litters = 2–5 kits
• Young stay with parents at least 2 years
• Adults (>2 yrs) disperse to establish new lodge, 1 – 25k away from natal site
• 73% females dispersed in spring, 60% males dispersed in fall (Windels 2014)
• Territories marked with scent mounds
• Home ranges tend to follow shorelines in lakes, ~1km in streams
• Colony saturation densities vary with landscape and region
• Max. density ranges 0.5–5 colonies/km² (Hill 1976, Novak 1987, Baker and Hill 2003)
Dispersal Distances

Data compiled by Steve Windels, NPS
Aquatic Habitat is Critical to their Success

• Beaver more agile in water than on land; maximize time in the water

• Ponds provide cover from predators and foraging pathways

• Lodge includes underwater entrance, nest area above water

Photo by Anna M. Harrison
Location, location, location….

- Bank dens vs. aquatic lodges
- Caches are submerged or exposed
Yes, that’s all well and good, but what we’re really here to learn about is...

BEAVER DAMS

- Created to impound water around lodge
- Dam location / repair cued by running water
- Dams constructed of wood and available debris (e.g., plastic, metal)
- Where palatable species are rare, conifers are used more in dams, with hardwoods saved for the food cache (Barnes and Mallik 1996)
World’s largest beaver dam

• Found in Alberta, Canada (2007) using Google Earth
• 850 m; longer than Hoover Dam
Dam/Pond Complexes

- Multiple dams create safe transportation corridors to connect large ponds
- Dams complexes grow over time, allowing beaver access to more food sources
BEAVER ARE LIKE ROTATIONAL CROP FARMERS

- They will selectively work an area hard for 2-3 years
- Then let it lie fallow and move upstream or downstream

Joe Wheaton

1-3 Years of Regeneration

Joe Wheaton
What are the effects of beaver dam building activity on the landscape?

Pollock et al. 2014
DAMS ARE POROUS... & TRANSIENT
DAMS CHANGE NATURE’S CLOCK

Residence time of:
- Water
- Sediment
- Nutrients

What would time distributions look like when -
- Stream Undammed
- Dam present, Dam breached / failed?
DAMS CREATE A DIVERSITY OF HYDRAULIC HABITATS...
CHaMP: Lower Owens 2
Surveyed water extent

- 2011
- 2012
- 2013
- 2014

Groundwater Wells
• Posts

Bridge Ck Thalweg (2014)

Dams spread water out...

Carol Volk
Dams back water up (and down)...

Watershed Elevation 7 Day Average
(Deapature from long term Average Daily)

- Control
- Pre-Treatment
- Post-Treatment
Dam building activity drives the ecological feedbacks that beaver are known for:

- Shallower water table
- Increased groundwater moisture
- Forest species composition and size distribution
- Multi-stemmed growth
- Woody species regeneration

Photo: [www.marinebeavers.org](http://www.marinebeavers.org)
Beaver impacts: increase wetland area

• Beaver change landscape from terrestrial to aquatic
• Most landscape change occurs in first 20 years
• Increased landscape diversity (Wright et al. 2002)
• Waterfowl habitat
• Increased amphibian habitat (Karraker and Gibbs 2009)
Beaver impacts: forest structure

• Removal of understory and canopy trees
• Open up canopy to understory/unpalatable species

Photo by Anna M. Harrison
Multi-stemmed growth habit

Photos: Anna M. Harrison

Not for distribution
(Please contact J. Stella, stella@esf.edu)
Woody Species Regeneration

Harrison & Stella 2010; Not for distribution
(Contact J. Stella, stella@esf.edu)
Ecological Consequences of Beaver Activity

Alza, C.M. 2014
Another Ecological Consequence of Beaver Activity

Alza, C.M. 2014
But what about the down-sides?
Upstream passage of beaver dams (natural and analogs) by adult steelhead trout

- **PIA-2** (km 13.3):
  - 2009: 57% (18%, 17%)
  - 2010: 44% (14%, 12%)
  - 2011: 63% (17%)
  - 2013: 28% (12%)
  - 2014: 37% (15%)

- **PIA-3** (km 27.4):
  - 2009: 18% (17%)
  - 2010: 14% (12%)
  - 2011: 17% (17%)
  - 2013: 24% (24%)
  - 2014: 15% (24%)

- **PIA-4** (km 30.0):
  - 2009: 18% (17%)
  - 2010: 44% (12%)
  - 2011: 49% (17%)
  - 2013: 28% (24%)
  - 2014: 59% (12%)

**Restoration implementation**
Upstream passage of beaver dams (natural and analogs) by juvenile steelhead trout
Temperature difference between treatment and control reaches...
But What Happens When Beaver Dams “Fail”?  

Figure 10: Progression of reach at upper Owens through a period without a dam (A; 2005), with an active, partially breached dam (B; Nov 2009), to an abandon, partially breached dam (C; April 2010).
The Dynamics of Beaver Dam Complexes Form Landscapes

Juxtaposition of functionally different segments modifies network-scale processes, working as bottom-up processes. Segments vary over space and time.

Burchsted et al. 2010