IMPAIRMENTS TREATED BY BEAVERS
(Case projects- Bridge Creek)

- Channel incision/ disconnected floodplains
- Water storage
- Low flows (bump up surface water)
- Riparian expansion
- Habitat complexity for fish
  - Habitat complexity for amphibians
  - Habitat complexity for birds (e.g. sage grouse)
  - Increase forage and water for cattle or wild ungulates
- Sediment storage
- Nutrient recycling
Oregon, USA

John Day Basin

Bridge Creek Watershed
- 710 km$^2$

Mitchell, OR

John Day Basin

Bridge Creek

Bridge Creek Watershed

Bear Creek

West Branch

Gable Creek

Mid-Columbia Steelhead
Bridge Creek
ca. 1993

CHANNEL INCISION
Cluer and Thorne, 2014
CHANNEL INCISISON RECOVERY

Incised Channel

- Simplified and static channel
- Low habitat quality

Channel in Equilibrium

- Sediment output = inputs
- Complex and dynamic channel
- Floodplain and groundwater connectivity
- High habitat quality

$10^3$ years
Dam Persistence

1988 - 2005

Demmer and Beschta, 2008

% of Dams

Years to Abandonment
BDAs

Beaver Dam Analog Structures

Mean Annual Flood Height

Incision Trench

Disconnected Terrace

30 - 50 cm
INCISION RECOVERY WITH BEAVER DAMS

Natural Beaver Dams

Phase 2 - Trench Widening

Phase 3 - Channel Aggradation

Phase 4 - Dynamic Equilibrium

Greater dam density

Reduced trench widening

Pollock et al. 2014 BioScience
RESTORATION IMPLEMENTATION

4 Treatment Reaches ~ 1 km

114 Total BDA Structures
ACTIVE BEAVER DAMS

Treatment reach
- Lower Owens
- Meyers Camp
- Pats Cabin
- Sunflower

Restoration implemented

Active beaver dam density (Dams/km)

Survey year

AGGRADATION AND POOL FORMATION
FLOODPLAIN FREQUENTLY INUNDATED
WATER TABLE ELEVATION CHANGE

1’-3’ increase in the height of the water table
COMPRESSED DIEL TEMPERATURE RANGE

-~ Treatment reach - Dam influenced
-~ Control reach - No dams

Before dam establishment

After dam establishment

2008

2013

August 9th - 17th

LONG TEMPERATURE PROFILE
August 2014

- ○ Temperature Logger
- ● Above and Below Treatment

Max Temp (°C) - Aug 15th, 2014

Downstream 👈 River Kilometer ➔ Upstream
CHANNEL TEMPERATURE HETEROGENEITY

Beaver/BDA impounded

Unimpounded

Temperature measurement location
Beaver dam

Flow
0 m
10 m
20 m

Beaver/BDA impounded

Unimpounded

Temperature (°C)
25
20
15
10
22
23
24
25
26
27
Jul

Jul 5 - 2015
12:00
18:00
• Repeat high resolution (10 cm) imagery before & after 2009 treatment
IF SIGNAL IS MEANINGFUL...

WE OUGHT TO BE ABLE TO DETECT IT FROM SPACE
BRIDGE CREEK NDVI ANALYSIS

Silverman et al. In Prep

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BRIIDGE CREEK NDVI ANALYSIS

Silverman et al. In Prep

~20% increase
productivity
natural storage
resiliency

ACTIVE BEAVER DAMS

- 2008 = 22 (pre-BDAs)
- 2016 = 164!
BRIDGE CREEK FISH POPULATION MONITORING

- 3 Annual M-R Surveys - 9 yrs
- ~ 50,000 Juveniles Pit-tagged
- 4 Passive Instream Antennas
- Adult Steelhead Trap
JUVENILE *O. mykiss* DENSITY

- Bridge Creek (treatment)
- Murderers Creek (control)

Density (no/100m)

Pre-manipulation

Post-manipulation

Bridge - Murderers Density

Bouwes et al. 2016 *Scientific Reports*
168% increase in abundance
52% increase in survival
172% increase in production
BARRIERS???
Passive Instream Antenna

- 4 Instream Antennas
- Adult Steelhead Trap

78,000 PIT-tagged *O.mykiss*
2009
Pre-restoration

22 Beaver Dams

17% Passage

Passage

BDA Treatment Reach
Passive Instream Antenna
Adult Trap
Intact BDA / Beaver Dam

John Day River
Bridge Creek
Beaver Creek
West Branch
Gable Cr.

Flow

Area enlarged

0 1.25 2.5 5 km

N
Beaver Dams

2016 Post-restoration

164 Beaver Dams

29% Passage
BDA PROJECTS ARE YOUNG

Long-term impacts unknown?