CAN BEAVER DAMS AGGRADE INCISED STREAMS TO THE POINT OF FLOODPLAIN RECONNECTION AND RECOVERY?

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BRIDGE CREEK....

Little incision problem...
BEAVER DAMS JUST DID NOT LAST IN BRIDGE
SO HELP ‘EM OUT... BUY THEM POSTS Ti ME
FOUR STRUCTURE TYPES

1. Starter Dam

Figure 10. A typical starter dam (EP-17 at Sunflower) with willow branches woven between vertical posts and the back side sealed with rock and clay. Note the dam height is sufficient to divert flow onto the A terrace, mimicking a stable beaver dam.

2. Post Line Only

Figure 12. The purpose of a post line is to provide a site where beaver can build a stable dam. They generally create little or no geomorphic changes unless utilized by beaver.

3. Post Line w/ Willow Weave

Figure 11. A post line with wicker weave is similar to a starter dam, but acts more like a weir in that water is allowed to flow through the willow branches such that low flows are not overtopping the structure and the woven branches may not extend to the top of the posts. These may naturally seal up by trapping sediment and organic material moving downstream or they may be utilized by beaver. Note that beaver have started to colonize this PLWW, as evidenced by the chewed stems on the right of the photograph, aligned parallel to the flow.

4. Reinforce Existing

Figure 13. Any active dams within the treatment areas were strengthened with posts to lengthen their functional life, since most dams along the moosed Bridge Creek have been shown to last less than a year (Danner and Beschta, 2003). This structure was one of four dams built in sequence in Lower Owens to form a new colony. Within one year, all four dams had badfitted with sediment, which improved floodplain connectivity and habitat complexity, but made the site unsuitable for beaver. However, because we had installed additional post lines just downstream the beaver were able to use them to build new dams which allowed the colony to persist.
Induce a disturbance (actively)... allow it to unfold (passively) – Figure 17 (Pollock et al. 2011)
TO TEST IDEA...

• 4 Treatments & 6 Controls (25 km)
• Slough of things…
  – BDSS Monitoring
  – Repeat Aerial Surveys
  – **Repeat Topographic Surveys**
  – Beaver Monitoring
  – Fish Habitat Surveys
  – Fish growth, survival & movement
  – Fish diets
STUDY DESIGN: REPEAT TOPOGRAPHY
GEOMORPHIC CHANGE DETECTION

• What can we do with that repeat topography?

• Develop a direct measure of channel aggradation and floodplain reconnection
ANALYSIS DONE IN GCD 5

- **GCD 5** facilitates:
  - Robustly estimate errors in DEMs
  - Determine significance of uncertainty on DoD & Sediment Budget
  - Calculate change in storage sediment budgets (with +/- vol.)
  - Quantitatively interpret and spatially segregate budget

http://gcd.joewheaton.org
BRIDGE CREEK FLOWS...

- Limited gage record (USGS: 14046778)
- Spring snow-melt dominated hydrograph
- 1st Year above average; 2nd Year sustained high flows
DEPTH HETEROGENEITY

- Use depth distributions to look at one form of diversity of hydraulic habitat
- Comparison of restoration treatment (using beaver) & controls
LETS LOOK AT ONE TREATMENT

Pat’s Cabin Reach

• Can it work? **Can beaver really ‘restore’ an incised channel and reconnect it with its floodplain?**
STARTER DAM OCCUPIED...

Installed September 2009, Occupied by November 2009
ANOTHER STARTER DAM OCCUPIED
FLOW FORCED ONTO FLOODPLAIN

Enough aggradation and dam activity at secondary dam to force flow onto floodplain even at moderate flows.
STARTER DAM UPSTREAM OF FAI LED DAM

- Prior to project there was one abandon, breached dam in this reach…
- One year later, there are eleven (15 BDSS)
1st YEAR (2010-2009): OVERALL DoD

Deposition:
- Ponds filling up...
- Transverse gravel bars forming

Erosion:
- Scour pools downstream of structures
- Some lateral erosion

Erosion: 250 m³ +/- 87
Deposition: 312 m³ +/- 98
NET: + 62 m³ (+/- 131)
1st YEAR (2010-2009): BY COMPLEX

- Failure and side channel scour in top dam complex start out in net deficit
- Quick recovery moving downstream
2nd YEAR
(2011-2010):
OVERALL DoD

Deposition:
• Ponds filling up even more...
• More gravel bars forming

Erosion:
• Headcut with dam blowout
• Avulsion/cutoff...

Erosion: 342 m³ +/- 83
Deposition: 846 m³ +/- 228
NET: + 504 m³ (+/- 243)
2nd YEAR (2011-2010): BY COMPLEX

- Top dam and bottom dam complexes major sinks
- 2nd Complex experienced major avulsion… Old-channel sink; new
WHAT WE TAKE AWAY FROM PATS CABIN...

- 1st year budget indeterminant or equilibrium, but ponds filling
- 2nd year budget strong depositional signal despite major headcuts & breaches, ponds full
- Longitudinal patterns highlight role of local supply
- BDSS Pond aggradation rapid and consistent
- Many former terraces are now inset floodplains
ELSEWHERE... WE SEE SIMILAR RESULTS

- 84 Structures installed in four reaches (in 2009); Now ~120
  - 5 Reinforced existing dams
  - 4 Reinforced abandon dams
  - 10 Starter Dams
  - 44 Post lines with Wicker Weaves
  - 21 Post lines only
SUMMARY NET CHANGE IN STORAGE

- Controls Net Degradational
- Treatments Net Aggradational

![Graphs showing total and average storage changes for controls and treatments.](Image)
SO, WHAT ABOUT BDSS IS...

• Cheap?
  - Design in field...
  - $13K for 4 km of installation

• Cheerful?
  - Furry rodent…?
  - It WORKS!

• Transferable?
  - BDSS could be used in other incised streams to reconnect floodplain
  - Need veg
  - Beaver can be used elsewhere… where habitat complexity limiting
CONCLUSIONS

• Rapid colonization of BDSS after installation
• Rapid geomorphic response working with beaver to restore incised channel & reconnect with floodplain in the right direction…. Will it last?
• Dramatic improvements in habitat complexity
• Treatment is cheap…
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