HEALTHY STREAMS & RIPARIAN ZONES
UNDERSTANDING THE LANDSCAPE CONTEXT FOR RIPARIAN AREAS, & BEAVER BASICS

SGI / NRCS Workshop
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Cedar City, UT
PREMISE(S)

• We generally want the same things for rivers and streams – we want them to be healthy
• We may respectfully disagree on best way to get there...
• Our intentions are good, but our restoration interventions are generally too expensive to scale
PROBLEM IS SIMPLE TO STATE...

• Scope of stream, river & riparian degradation is massive
• Even with ~ $10 Billion spent annually, barely scratching surface
• We spend disproportionate amount of money on too few miles of streams and rivers
• Leaving millions of miles neglected...
BIG RIVERS ARE IMPORTANT, BUT...

- They constitute < 10% of the 3.5 million miles of streams in US... Regional & Interegional

**Estimate of perennial length of streams and rivers from the NHD (U.S. EPA/WSA).**

The 1st- through 4th-order streams comprise 91% of total estimated stream length in the NHD. The 1st- through 5th-order streams form the basis for the sampling design frame for the WSA.

**Figure 3. Major rivers and streams of the conterminous United States** (NationalAtlas.gov, 2006).

Major rivers comprise only 10% of the length of U.S. flowing waters, whereas the nation’s wadeable streams and rivers comprise 90% of the length of U.S. flowing waters.
WHY ALWAYS TONKA TOYS?

• If you do a google search for restoration, the first images that come up are of Tonka toys in streams.
To keep varied habitat, we need dynamic streams.
Yet, we’re not very good at restoring dynamism.
RIVER HEALTH

• Analogy has been around for at least 25 years...
• Definitions provided by many scientists
• Relevance & appropriateness debated by many scientists
UNDER APPRECIATION OF WHAT IS POSSIBLE

• Prevalence of multi-threaded planforms pre-European Disturbance...
• Extent to which multi-threaded planforms are wood-forced (e.g. channel-spanning jams and beaver dams)
• The stepped nature of ‘forced’ floodplains
• What so many valley bottoms in North America and Europe used to look like

Wohl (2013) Earth Science Reviews
DOI: 10.1016/j.earscirev.2013.04.009
TYPICAL RESTORATION PROCEDURE

• Surgery (channel realignment/grading)

1. *Shaving* and clearing the surface (remove vegetation)

2. *Opening* the system up with (i.e. cutting an access route in)

3. Rearranging what’s inside or *operating* (i.e. the grading)

4. *Stitching* the cut back up (e.g. re-seeding, erosion control, planting)

5. Over fortify channel with preservatives (rip rap) over fear it might *excercise*
DON’T MISUNDERSTAND ME…

- I’m not saying that surgery is always bad or not necessary in some cases
THE RIVER HEALTH ANALOGY...

- What is a healthy diet for a river?
- Different rivers have different metabolisms.
- What is role of exercise in a healthy life-style?
- What is it beaver do? What could BDAs do?
- Premise:
  - Most existing restoration practices akin to medical procedures & treatments
  - Using beaver as a restoration agent is more like helping prepare meals for a system
  - Ultimate goal is ‘system’ can self-prepare its own meals (i.e. self-sustaining) and exercise on its own


A BDA recipe just helps you prepare one dish in a meal
**MANY VARIATIONS OF THE BDA RECIPE**

- Our early recipes overlooked importance of mattress

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Figure 3: Cross section and plan view of generic BDA structure. Actual structure details depend on site-specific channel attributes e.g. channel width and bank height.

Figure 10: A typical starter dam (EF-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 terrace, mimicking a stable beaver dam.
WE NEED A FOODIE MENTALITY IN RESTORATION

- Bigger focus on locally sourced ingredients
- Foster creativity and exploration (e.g. fusion cuisines)
- Celebrate diversity of rivers
- Slow food movement!
BDA MEAL PREPARERS:

Ranchers, volunteer groups, kids and then hand off to beaver (if possible)…
PUTTING IN BDAs STRAIGHT-FORWARD...

These critical tasks take more thought:

• Properly planning where BDAs makes sense (e.g. BRAT)
• Organizing and orchestrating implementation to feed many miles of streams with 100’s to 1000’s of BDAs
• Feeding (hitting) system well enough that it will respond (through its metabolism & exercise) in a way that achieves desired response
• Building realistic expectations and adaptive management plans – who does maintenance?
• Allowing exercise!
SORT OF LIKE THE CARROT...

- While nutrition science may be able to tell us all the ingredients (nutrients) that make up a good carrot
- For some reason we can’t make an artificial carrot that is as good for us as a real carrot
- From a management perspective, who cares? Just use the damn carrot!
UNDERSTANDING THE LANDSCAPE CONTEXT FOR RIPARIAN AREAS

Bridge Creek, OR
Photo by Nick Weber
READING THE RIVERSCAPE

• Most riparian areas of interest in sage grouse range are associated with streams & rivers

• If you can ‘read’ riverscape, you’re 90% of way towards setting realistic expectations of what is possible (i.e. reference/analogues)

• Lots of jargon and ways to get there… Don’t get hung up on labels! Focus on concepts.


RIPARIAN DIMENSIONS

• Lateral extent determines potential width of riparian area
• Vertical cross section determines water availability
• Longitudinal patterns control fluxes of water, sediment, nutrients and seeds (sources, transfer vs. sinks)

WHAT IS A VALLEY?

The lateral and longitudinal dimensions...

From: Wheaton et al. (2015) – Geomorphology; DOI: 10.1016/j.geomorph.2015.07.010
• The building blocks of a Valley?

VS.

• The building blocks of a Valley Bottom?

From: Wheaton et al. (2015) – Geomorphology; DOI: 10.1016/j.geomorph.2015.07.010
In **confined valley settings** the channel abuts a confining margin >90% of its length.

In **partly confined valley settings** the channel abuts a confining margin 10-90% of its length.
   -- **bedrock-controlled rivers** have channels that abut a confining margin 50-90% of its length.
   -- **planform-controlled rivers** have channels that abut a confining margin 10-50% of its length.

In **laterally unconfined valley settings** the channel abuts a confining margin <10% of its length.
The lateral and vertical dimensions...

- Riparian vegetation associations with different surfaces
- Floodplain = Valley Bottom = MAXIMUM Probable Riparian Extent
- Terraces = Former Floodplains
- Uplands = NON-Riparian

VALLEY MARGINS IN DIFFERENT SETTINGS

- Interesting thing is identifying where different margins overlap
- Fundamental control on channel’s capacity to adjust
- Differentiates reach types
- Sets up planform steering of flows

From: Wheaton et al. (2015) – Geomorphology; DOI: 10.1016/j.geomorph.2015.07.010
DEFINITION OF VALLEY CONFINEMENT

• The percent length of a reach that is in contact with a confining margin on either of its banks

• i.e. – where channel margin intersects valley bottom margin

From: Fryirs et al. (2015) – ESPL; DOI: 10.1002/esp.3893

See: http://confinement.riverscapes.xyz
CONTINUUM OF CONFINEMENT

From: Fryirs et al. (2015) – ESPL;
DOI: 10.1002/esp.3893
EXERCISE 2 - VALLEY SETTING

South Fork Asotin Creek
Reach SF_01
River Mile 1.5 to 2.2
VALLEY SETTING

South Fork Asotin Creek
Reach SF_01
River Mile 1.5 to 2.2
TRACE THE ACTUAL CHANNEL

South Fork Asotin Creek
Reach SF_01
River Mile 1.5 to 2.2
MAP THE FANS

South Fork Asotin Creek
Reach SF_01
River Mile 1.5 to 2.2

Coupled river left fans

Anthropogenically
Disconnected river left fans

Legend
- Mile Markers  - Levee or Berm
- Major Roads    - Connected Floodplain
- Stream Reach   - Disconnected Floodplain
- Confining Rip Rap

N
0 300 600 900 ft
MAP THE CONFINING MARGINS

South Fork Asotin Creek
Reach SF_01
River Mile 1.5 to 2.2
THE MARGIN TYPE TELLS YOU A TON!

- Is margin adjustable?
- What is margin made of?
- Is it a potential or active source of sediment to channel?

From: Fryirs et al. (2015) – ESPL; DOI: 10.1002/esp.3893
THE MARGIN TYPE TELLS YOU A TON!

LATERALLY-UNCONFINED VALLEY SETTING
(G) Lemhi River, Columbia Basin, USA

(H) Mississippi River, USA

ARTIFICIALLY CONFINED
(I) Humboldt River, Nevada, USA

(J) Snake River, Wyoming, USA

• Is margin adjustable?
• What is margin made of?
• Is it a potential or active source of sediment to channel?

From:
Fryirs et al. (2015) – ESPL;
DOI: 10.1002/esp.3893

Check out: Confinement Tool in GNAT:
http://gnat.riverscapes.xyz/
NATURAL CAPACITY FOR ADJUSTMENT

- Plausible limits on what adjustments are possible
- Geomorphic context matters
  - Confinement
  - Sediment Supply
  - Flow Regime
  - Vegetation
  - Land use
  - History

From Brierley & Fryirs (2005)
THE BEAVER PREMISE

Share some lessons about managing riparian areas from a rodent, and one of our most experienced ecosystem engineers.
FOCUS IS RIPARIAN RESTORATION....

• This is a workshop about restoring riparian areas → … but, mimicking what beaver do (e.g. beaver dam analogues) or promoting them to do it for us is cheaper!

• We are here to learn about an old (1930’s) conservation strategy & some new restoration strategies using beaver

• To do this, we need to
  - Know a bit about beaver biology/ecology
  - Focus on their ingenuity as ecosystem engineers (dam building)
  - Understand where in the landscape such strategies makes sense (NOT EVERYWHERE)

From [http://thestickytongue.org/](http://thestickytongue.org/)

From [http://eol.org/data_objects/5898738](http://eol.org/data_objects/5898738)
SOME THINGS TO THINK ABOUT...

• The ecosystem engineer is very experienced
• Sage grouse have co-evolved with this engineer
• The science is conceptually solid... but fairly qualitative
• Precautionary Principle?
• The cost is one of the most compelling arguments from a restoration perspective
AT END OF WORKSHOP...

• You will not be a beaver expert
• You will know enough to be dangerous
• You will *hopefully* know what critical questions to ask
• You hopefully have an idea about where to start…
  - How much of an ‘expert’ you need to be depends on the stakes and type of partnership
  - In low-risk situations, beaver can be the expert for us
BEAVER ECOLOGY & DAM BUILDING

I. Bit of Beaver Biology

II. Why do Beaver Build Dams?

Bridge Creek © Wheaton

From: http://www.howstuffworks.com/beaver-dam.htm
A HABITAT GENERALIST, AND HIGHLY ADAPTABLE

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

Fred Hirschmann—Science Faction/Getty Images

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

http://www.rv-boondocking-the-good-life.com/
COMMON HABITAT INGREDIENTS:
WATER + TREES

• Northern tundra
  Wood limitation
  Central range (high recolonization densities)

• Southern Deserts
  Water and/or wood limitation

Slide from John Stella
BEAVER COLONY

- 5–8 in family
- Avg. litters = 2–5 kits
- Learn the ropes
- Kicked out at 2 years
WHAT DO BEAVER EAT?

• Incisors (big front teeth) grow continuously
• Woody plants ~85% of winter diet; ~15% of summer diet
• Spring/Summer: herbaceous plants
• Fall/Winter: tubers, cached woody plants

Photo: C. Demers, SUNY-ESF
A BEAVER FOOD CACHE...
WHY GO FOR THE BIG ONES?

Fresh wood shavings...
CAN THEY MOVE A WHOLE TREE?

Practice logs for kits?

Future part of dam?
RANDOM OR SYSTEMATIC?

All bark chewed off
BEAVER ARE LIKE ROTATIONAL CROP FARMERS

- Selectively work an area 2-3 yrs
- Let it recover, and move nearby
I. History
II. Bit of Beaver Biology
III. Why do Beaver Build Dams?

From: http://www.howstuffworks.com/beaver-dam.htm
SO WHY DO THEY BUILD DAMS?
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

Slide from John Stella
LODGES

• Bank lodge vs. Central Above Ground

Bank den *(Colorado Natural Heritage Program)*

Mid-stream lodge in Hinsdale County, CO *(Colorado Natural Heritage Program)*

Mid-lake lodge
AN EXPOSED LODGE

- They dig lots of tunnels
LEFT OVER FOOD CACHE...

Lodge w/ underwater entrance

Left over food cache from winter
DAMS IN SERIES
WHY SO MANY DAMS?

• Easier access to food
• Easier to move wood around
• Not all eggs in one basket
WHAT PURPOSE DOES THIS SECONDARY DAM SERVE?
DAM COMPLEXES....
Of the things we just talked about (foraging, harvesting, dam building, lodges, etc.) what do you see?
TAKE AWAYS...

• Beaver need water and wood... not dams
• Beaver can survive in many different environments
• Most critical requirements:
  - Underwater entrance to lodges (water depth)
  - Herbaceous or woody vegetation for nutrition
  - Woody vegetation to wear down incisors
• Where streams or rivers don’t provide habitat they need, they build dams (ecosystem engineers)