Welcome to the Conservation Lecture Series

https://www.wildlife.ca.gov/Conservation/Lectures

Questions? Contact Margaret.Mantor@wildlife.ca.gov

CDFW Conservation Lecture Series

The Conservation Lecture Series is organized by CDFW's Habitat Conservation Planning Branch. The lecture series is designed to deliver the most current scientific information about species that are of conservation concern.

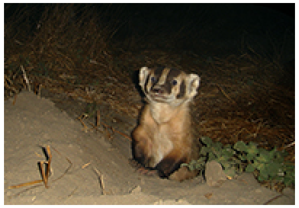
Below is a list of lectures and speakers for the Conservation Lecture Series. Lectures are open to anyone who is interested in participating. Participants may attend in-person or remotely via webinar. Please be sure to register for each class. Lectures are recorded and posted for those unable to attend the day of the event. Visit the archive page to see recordings of past lectures.

Subscribe to receive email updates and invitations to upcoming lectures.

Upcoming Lectures

Coming Soon

American Badgers - August 6, 2015, 1:00-3:00 pm. Presented by Dr. Jessie Quinn



The American badger (*Taxidea taxus*) is a Species of Special Concern in California. Funded by a grant from the CDFW Resource Assessment Program (RAP) Dr. Jessie Quinn studied the population distribution, movement behavior, and pathogen and rodenticide exposure in collaboration with the UC Davis Wildlife Health Center, with support from the OSPR Marine Wildlife Veterinary Care and Research Center. She completed a Species Status Report for the American badger for CDFW in 2009, and more recently completed a book chapter on pathogens and parasites in American badgers that will be included in the upcoming text *Badgers of the World*. Dr. Quinn's lecture will discuss the natural history of the species in California, potential threats to populations, and results of her research.

Location: Natural Resources Building, First Floor Auditorium

1416 Ninth Street, Sacramento, 95814

The Wildlife Society (TWS) Upcoming Events

Videos and Past Lectures

- Design Validation Monitoring Klamath Watershed (D.J. Bandrowski, Aaron Marin, and Rocco Fior)
- Dogs Moving Conservation Forward (Dr. Deborah (Smith) Woollett and Aimee Hurt)
- Black Swans, Brown River (Dr. Viers)
- White-Nose Syndrome in Bats (Wyatt)
- Invasive Watersnakes (Dr. Todd)
- Tricolored Blackbird (Dr. Meese)
- Bighorn Sheep (Dr. Villepique)
- Vegetation and Flora of a Biodiversity Hotspot (Dr. Ayres)
- FoothillYellow-legged Frog (Dr. Kupferberg)
- Spartina and California Clapper Rails (Dr. Strong)
- Townsend's Big-eared Bat (Dr. Johnston)
- California Red-Legged Frog (Alvarez)
- Salmon in the Yolo Bypass (Jeffres)
- White Abalone (Dr. Aquilino)
- Amargosa Vole (Dr. Foley)
- Desert Tortoise (Jones)

Process-based Restoration to Help Farmers and Fish-

Why California Needs 10,000 More (Ecologically Functional) Dams

Michael M. Pollock NOAA Fisheries-Northwest Fisheries Science Center, Seattle Washington
Brian Cluer NOAA Fisheries Western Regional Office, Santa Rosa, California

Topics

- Why dam channels to restore them?
  - Answer: To create stage zero channels
  - Definitions
    - Ecologically Functional Dams
    - Stage Zero Channels or Fluvial Systems
- Stage zero channels
  - Attributes
  - Occurrence on the landscape
  - Ecological Importance
  - Process-based principles for restoring zero order channels and the role of EFDs
  - Examples at multiple scales

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Definitions

- **Ecologically Functional Dams**
  - Natural, semi-permeable instream structures (or their human analogues), which slow transport rates of sediment and water and help to create, restore or maintain stage zero channels
  - Consist of natural materials such as wood and other organic matter, live vegetation, rock, and mud
  - Examples: wood jams, beaver dams, rock slides, debris jams, standing live trees and shrubs, emergent vegetation

Definitions

- **Stage Zero Channels**
  - A dynamically meta-stable network of anabranching channels with vegetated islands, which creates physically and biologically complex habitat that provides high levels of ecological goods and services. Occur across a wide range of stream sizes.
  - Typical characteristic include: well connected floodplains with elevated water tables, multithreaded channels, spatially variable hydrologic regimes and structurally complex aquatic and riparian habitat.

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Hydrological Regime

- Floods diffused over the full width of the floodplain so flood peaks are maximally attenuated. Flood pulses diffused and subdued. High water table and close connection between stream flow and ground water ensures reliable base flows and continuous hyporhesis, though flow in smaller anabranches may be ephemeral

Hydraulics and Substrate

- Multiple channels provide maximum in-channel hydraulic diversity through partition of discharge between branches that widens range of in-channel depth/velocity combinations. Anabranches create multiple slow water margins and channels. Wide range of substrate grain sizes arranged into numerous, well-sorted bed patches.

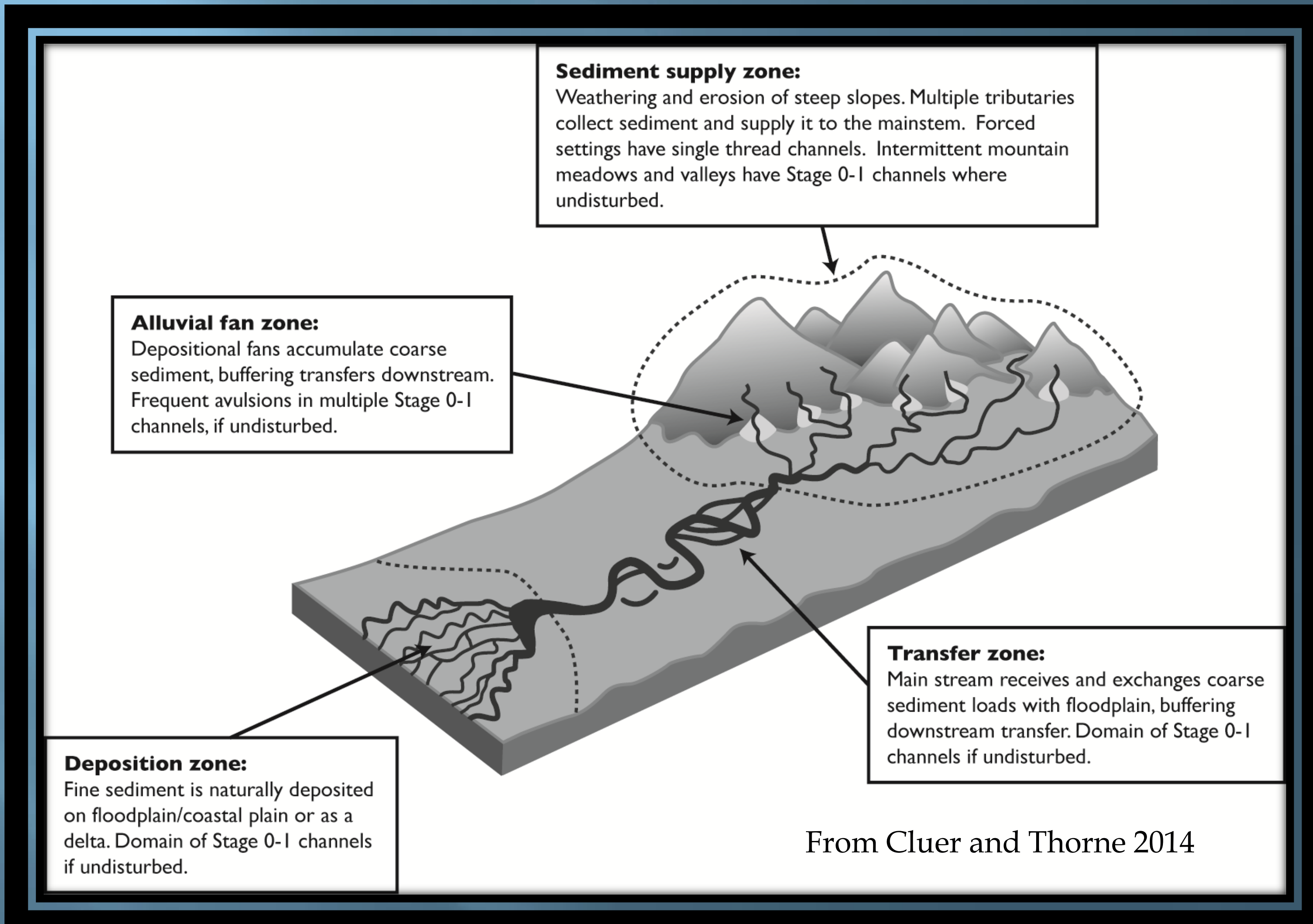
Dimensions and Morphology

- Multiple anabranches, islands and side channels. Morphological features abound in-channel and on the extensive and fully connected floodplain, providing a high capacity to store sediment and wood and supporting diverse wetlands and aquatic habitats. Bank heights are low with stability enhanced by riparian margins, but some unvegetated banks are generated by localized erosion. Network and floodplain are highly resilient to disturbance, buffering the system.

Vegetation

- Frequent, small channel adjustments and high, reliable water table create ubiquitous settings for proliferation and succession of aquatic, emergent, riparian and floodplain plants. Wet woodlands on islands and floodplain supply and retain wood, and widespread vegetation proximal to channels produces abundant leaf litter. When present, beaver use vegetation to build dams and lodges. Biogenic obstructions such as large wood, beaver dams and live vegetation help to create and retain an anabranching channel pattern.

Where Do Stage Zero Channels Occur?



From Cluer and Thorne 2014

Stage Zero Examples

Salmon River, Idaho

Stage Zero Examples

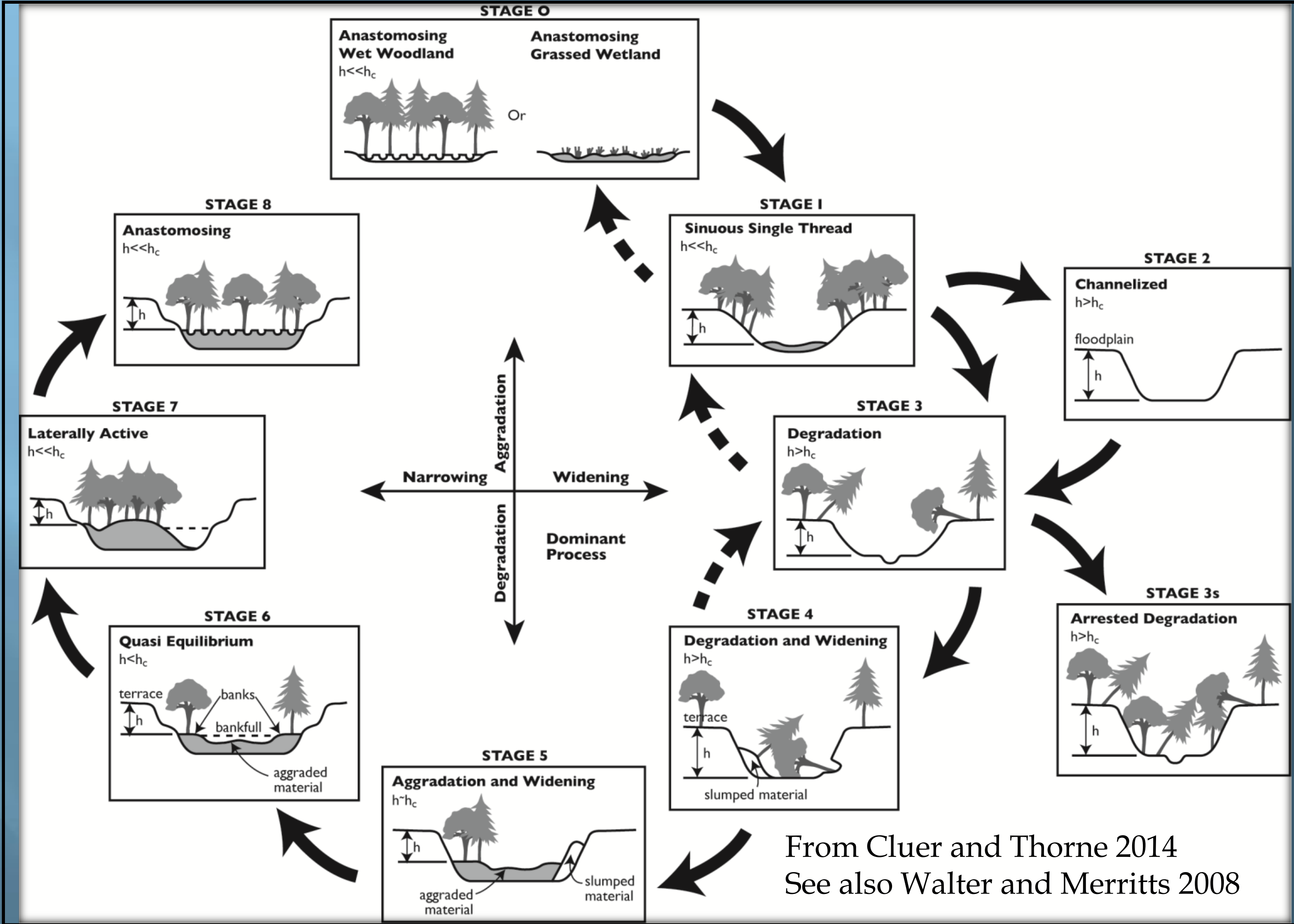
Stage Zero Examples

Peel River, Canada

Stage Zero Examples

- Wenaha River Tributary, Eastern Oregon

The Stage Zero Channel as a Recovery Goal



From Cluer and Thorne 2014
See also Walter and Merritts 2008

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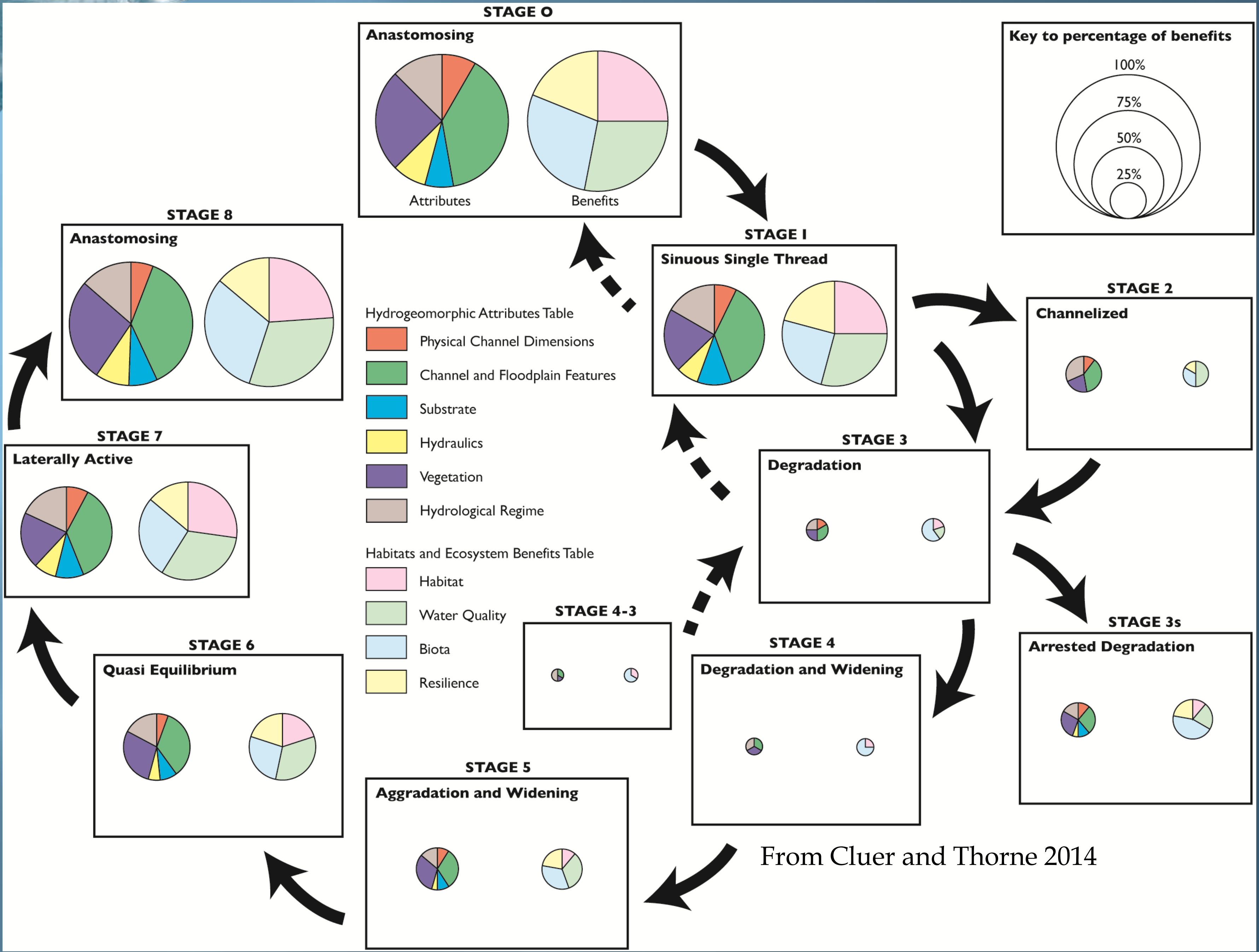
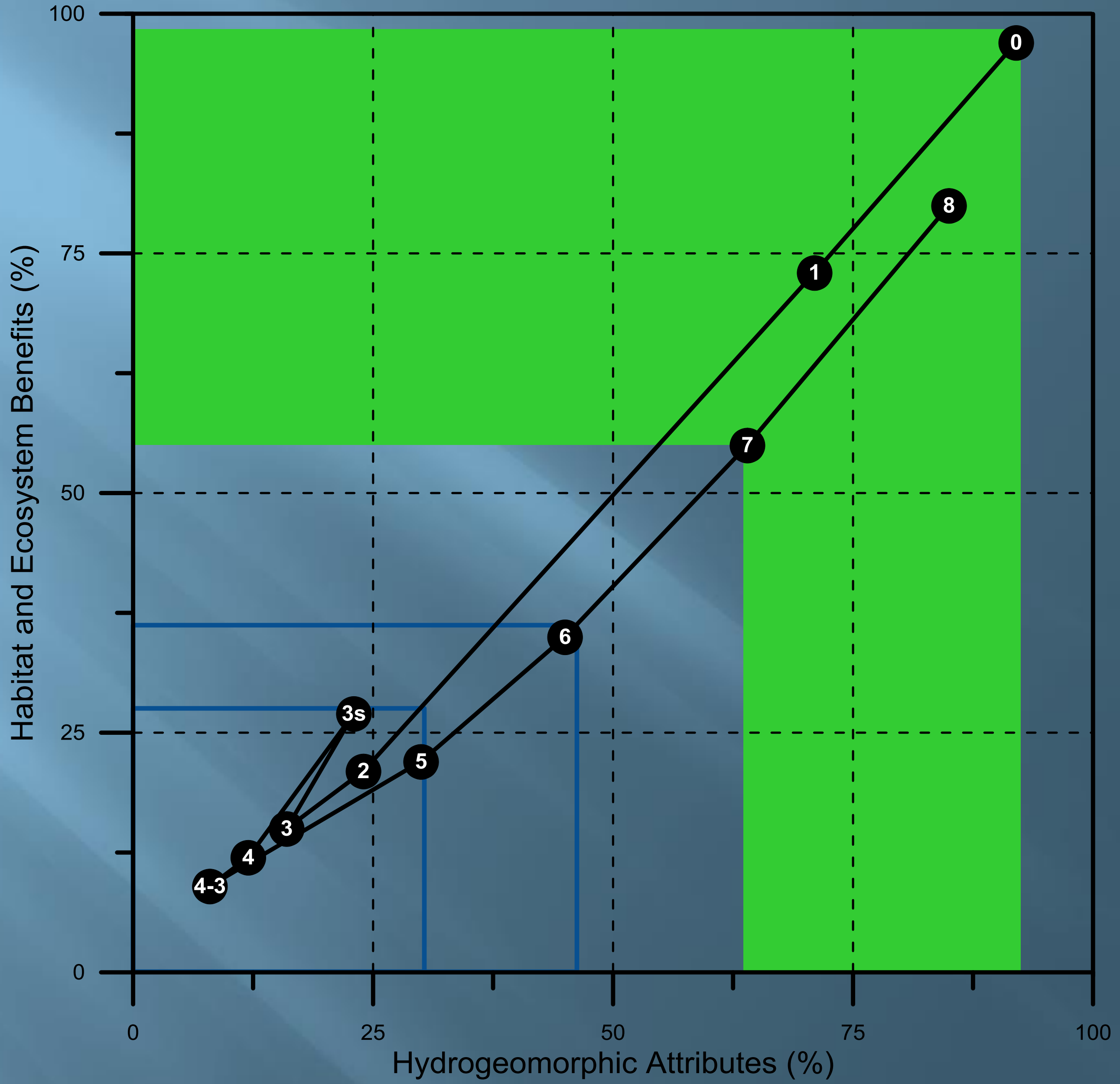
Habitat and Ecosystem Benefits Table

Stage	0	1	2	3	3s	4	4-3	5	6	7	8
Habitat											
Flood Refugia	3	2	0	0	0	0	1	1	1	2	2
Drought Refugia	2	3	0	0	0	0	0	0	1	3	2
Exposed tree roots	3	1	0	1	1	1	0	0	1	1	3
Water Quality											
Clarity	3	2	1	0	0	0	0	1	2	2	3
Temperature amelioration (shade and hyporheic flow)	3	3	1	1	2	0	0	1	2	3	3
nutrient cycling	3	2	1	0	0	0	0	1	1	2	3
Biota											
Biodiversity (species richness and trophic diversity)	3	2	0	1	1	1	1	1	1	2	3
Proportion of Native Biota	3	2	1	1	1	1	1	1	1	2	3
1st and 2nd Order Productivity	3	2	1	1	2	1	0	1	2	2	3
Resilience											
Disturbance	3	3	1	0	1	0	0	1	1	2	2
Flood and Drought	3	2	0	0	1	0	0	1	2	1	2
Results											
possible	33	33	33	33	33	33	33	33	33	33	33
sum	32	24	6	5	9	4	3	9	15	22	29
ratio	97%	73%	18%	15%	27%	12%	9%	27%	45%	67%	88%

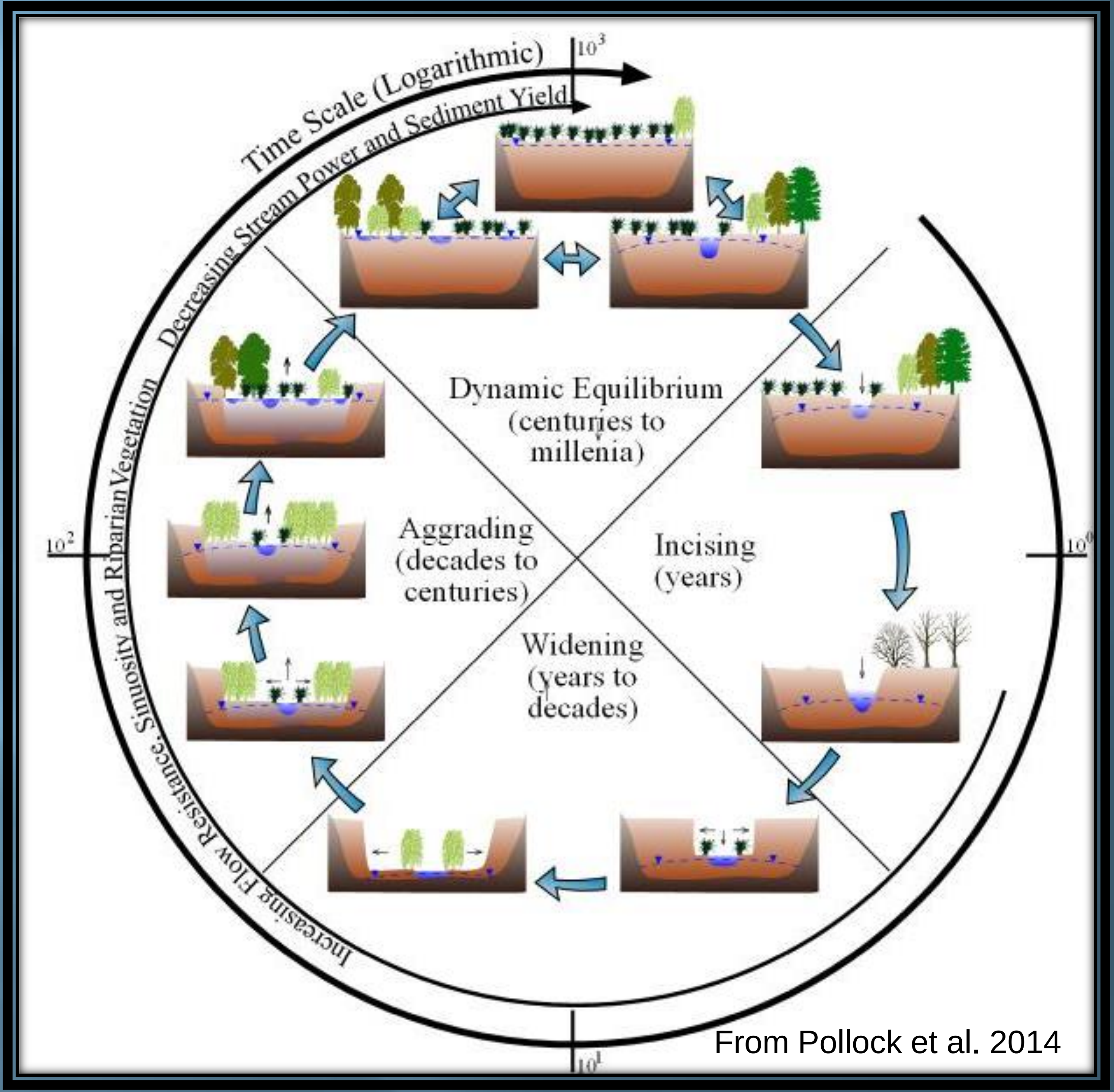


From Cluer and Thorne 2014



100
75
50
25
0
0
25
50
75
100
Habitat and Ecosystem Benefits (%)
Hydrogeomorphic Attributes (%)
0
1
2
3
3s
4
4-3
5
6
7
8

Natural Recovery Rates Can be Long



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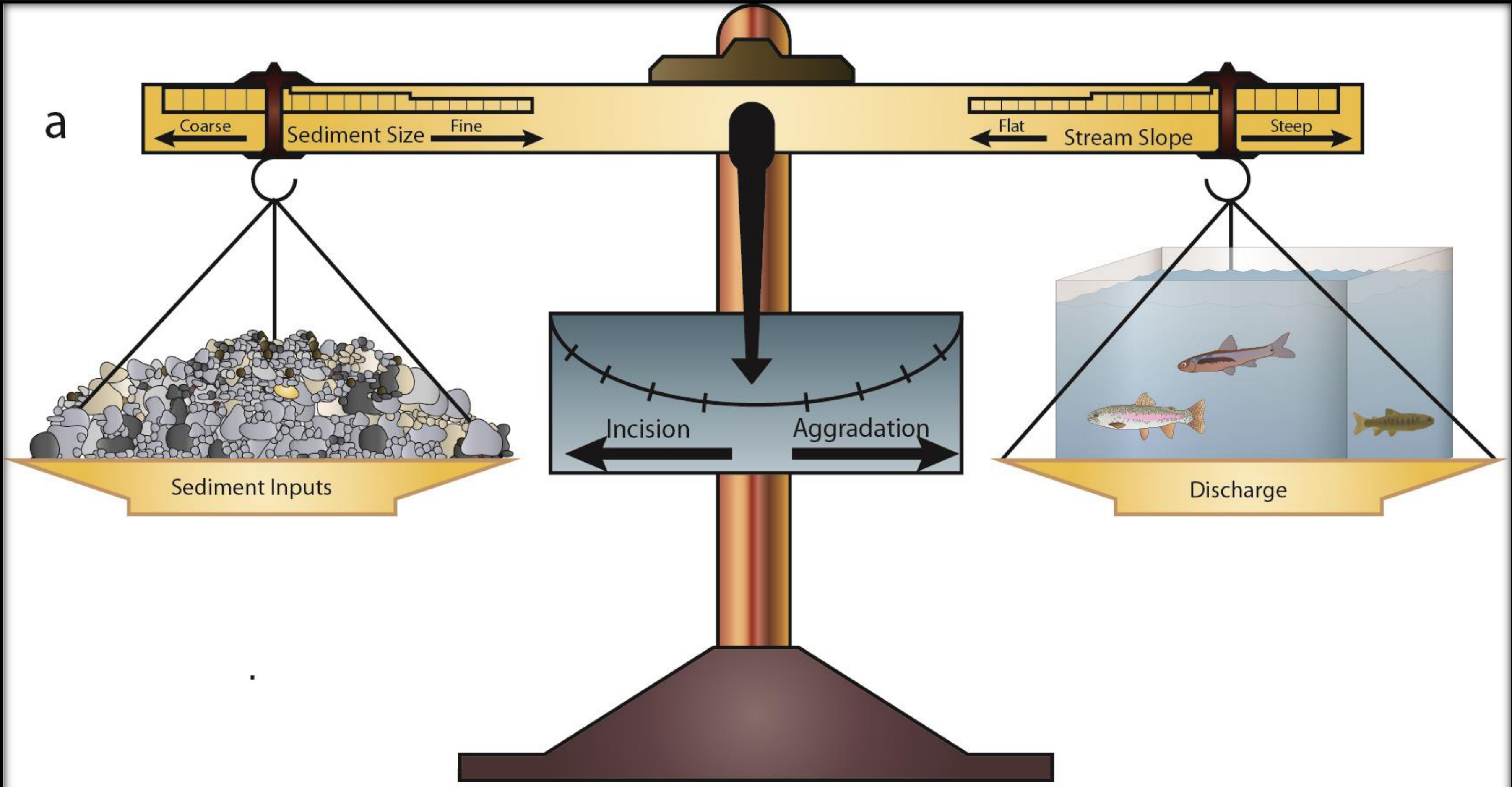
Take Home Messages

- Degraded streams have limited ecological function
- The scale of restoration needs to be commensurate with the scale of the actions that caused the degradation
- Meaningful restoration needs to occur on a time frame relevant to recovery time frames for target species (e.g. salmon) so as to avoid extinction

Principles for building Stage Zero System



$Q_s d_{50} \propto Q_w S$

From Pollock et al. 2014

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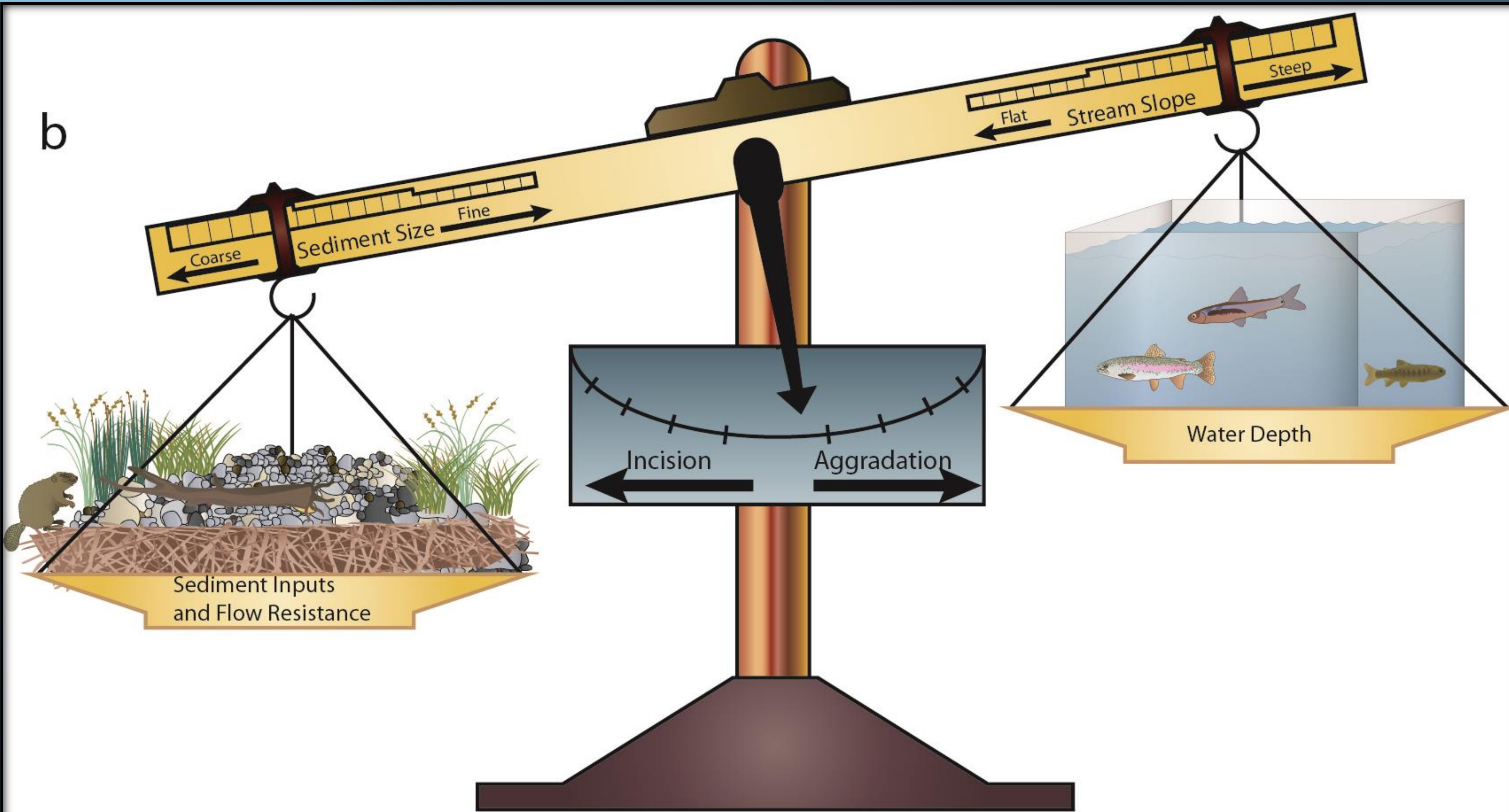
Increased Flow Resistance is Essential



$nQ_sd_{50} \alpha D_WS$

From Pollock et al. 2014

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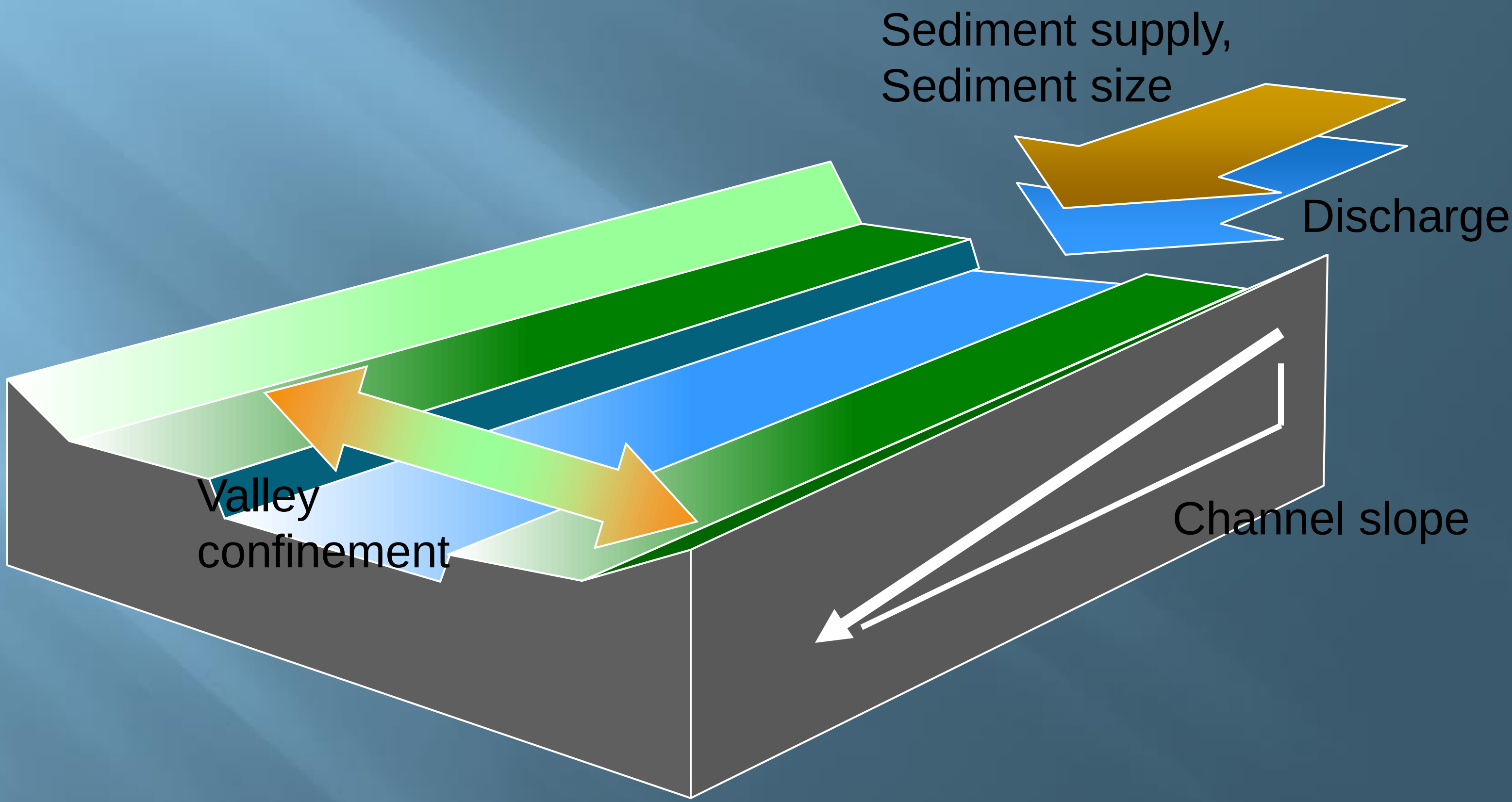
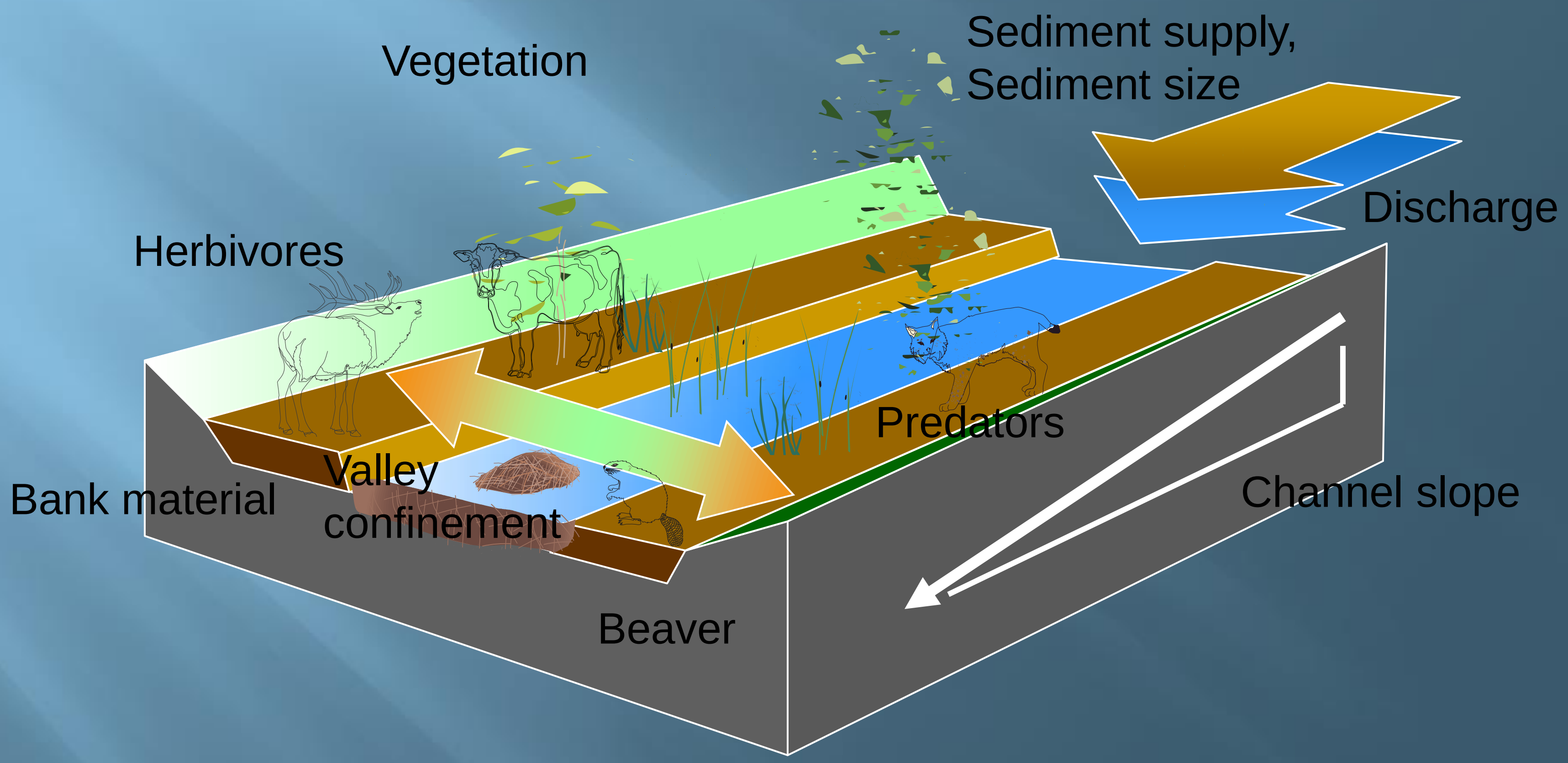
Factors Controlling Stage Zero Channel Formation



Factors Controlling Stage Zero Channel Formation



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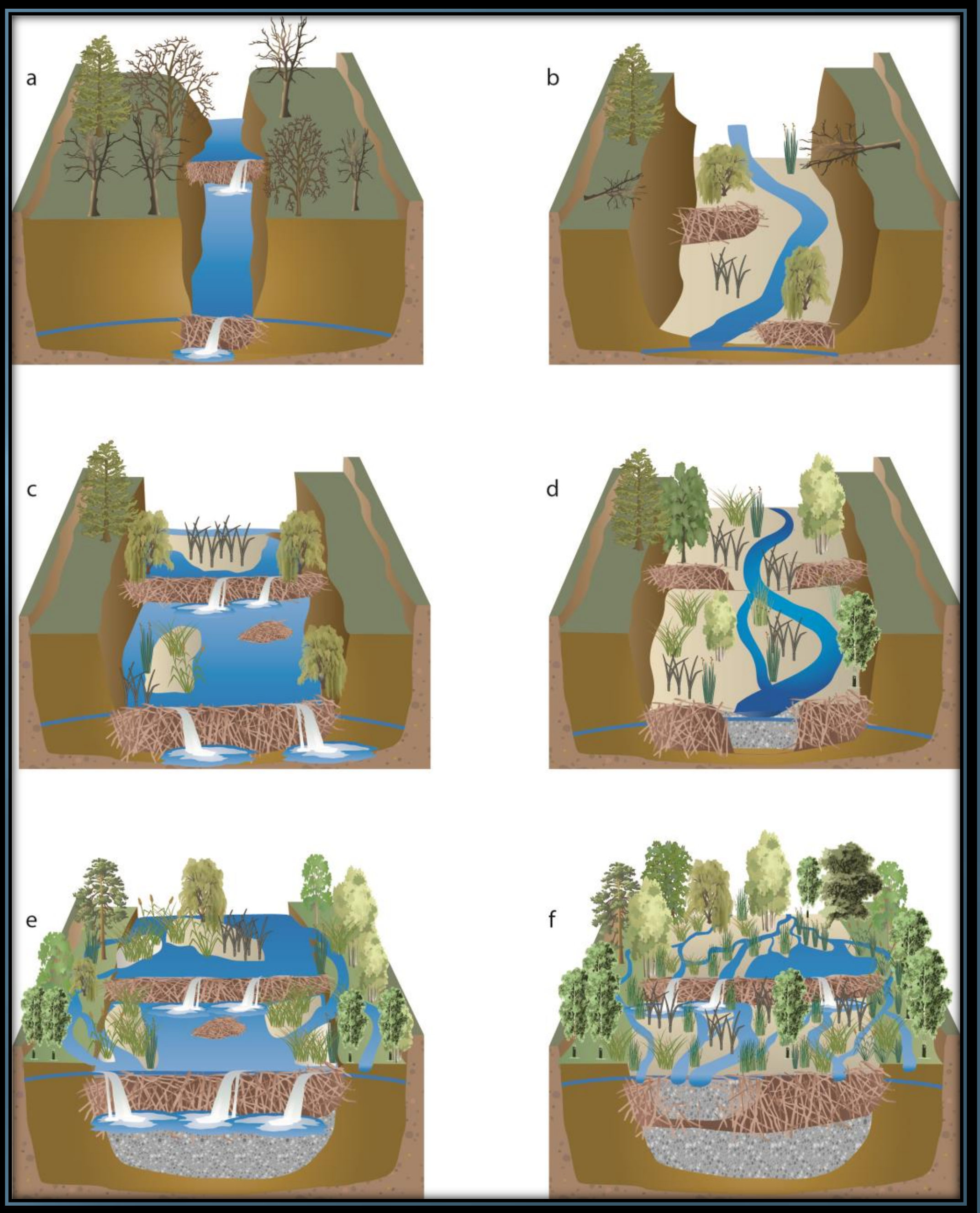
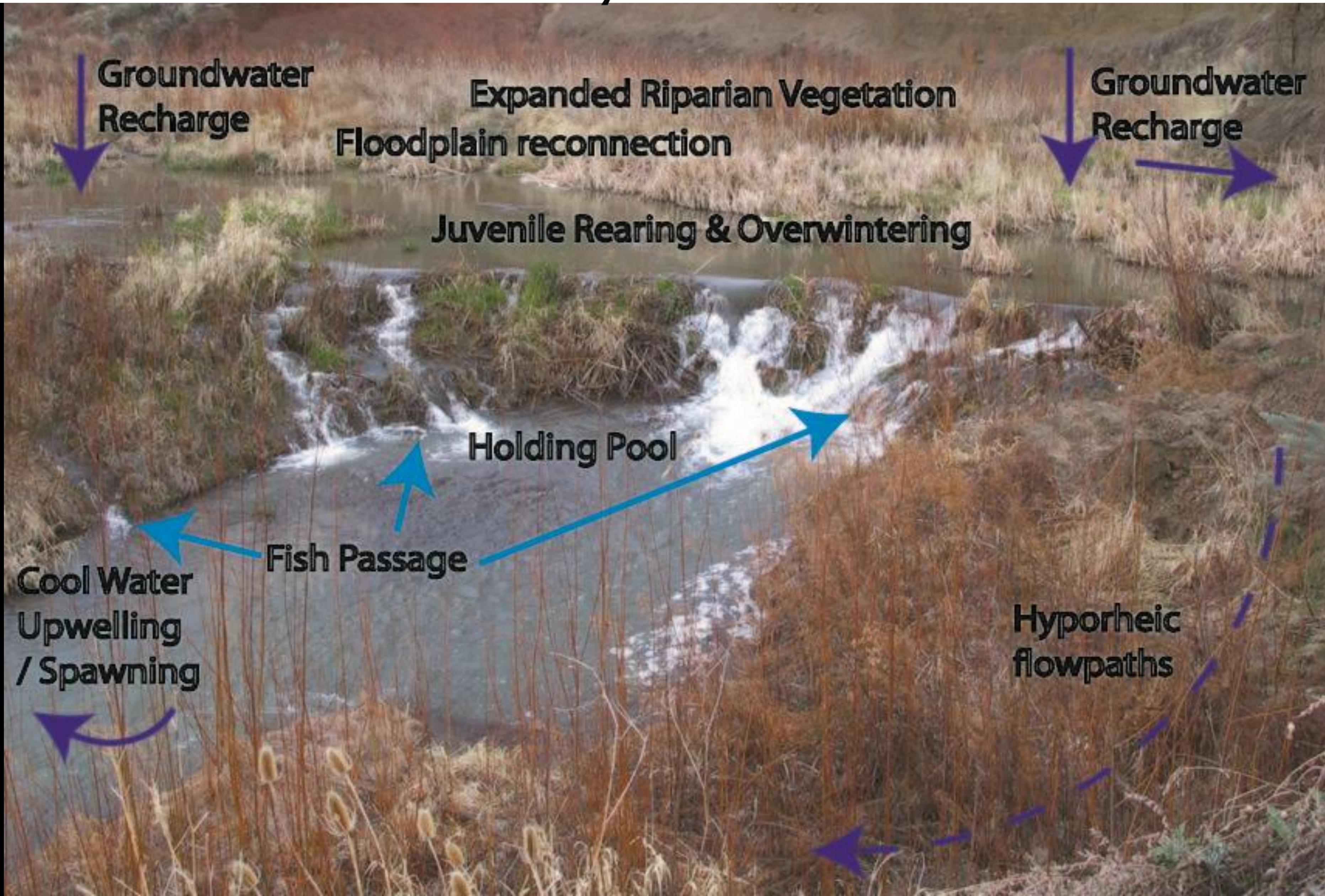
Beaver Dams

-Can reduce recovery times from Stage 1 to Stage 7-8/0 systems by 1-2 orders of magnitude (year to decades instead of decades to centuries)

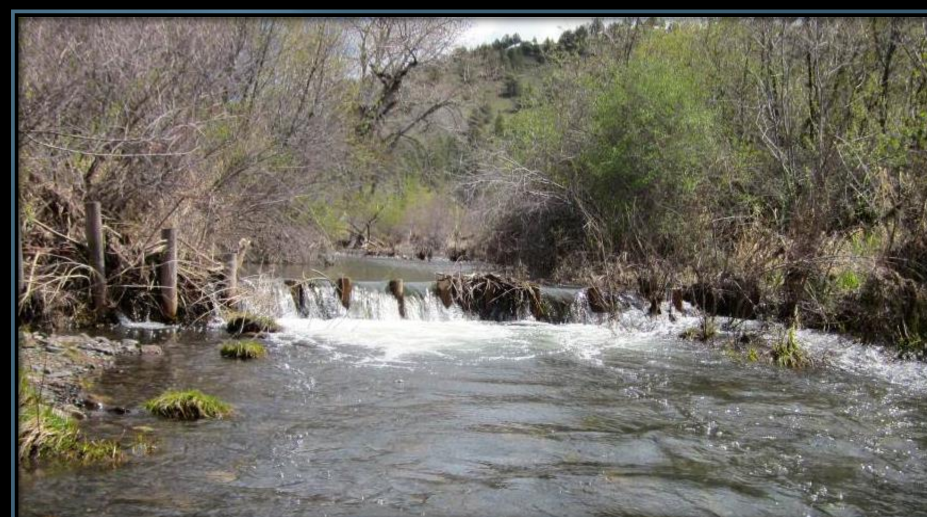


From Pollock et al. 2014

Beaver dams create complex habitat that provide many benefits

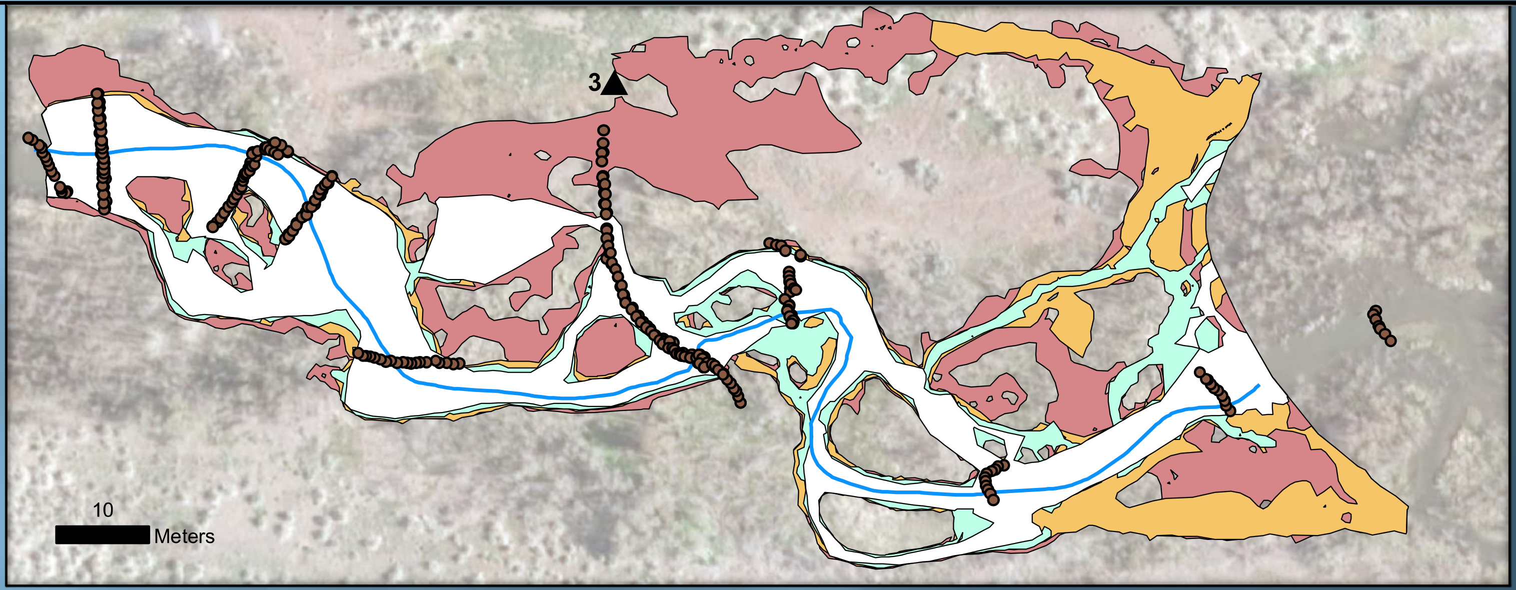


Beaver Dams and Beaver Dam Analogues



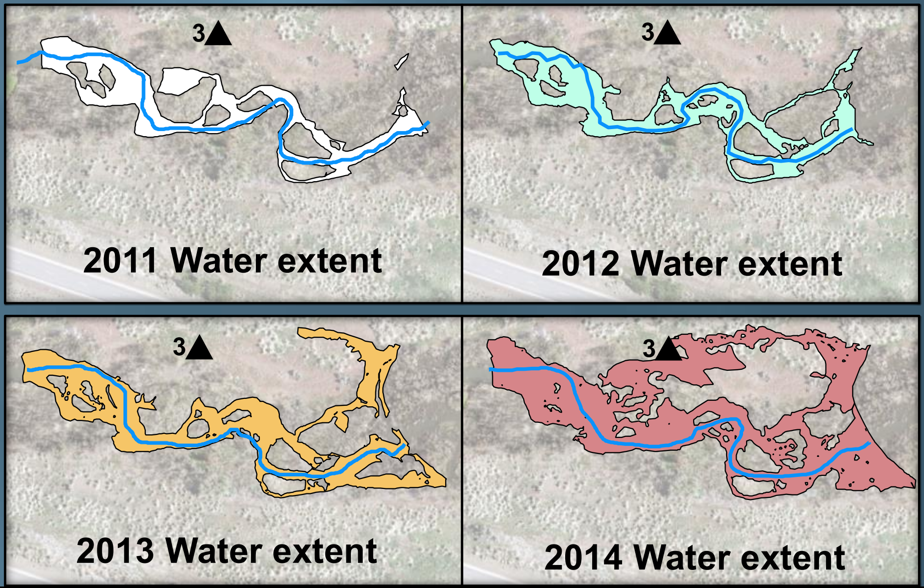
Beaver and BDAs creating a zero order “channel”

Beaver and BDAs-a 5 year sequence



Carol Volk, Unpublished

Since 2009, a combination of BDAs and beaver turned a narrow single thread channel with an infrequently inundated floodplain into a multi-threaded channel with water levels close to the floodplain surface most of the year



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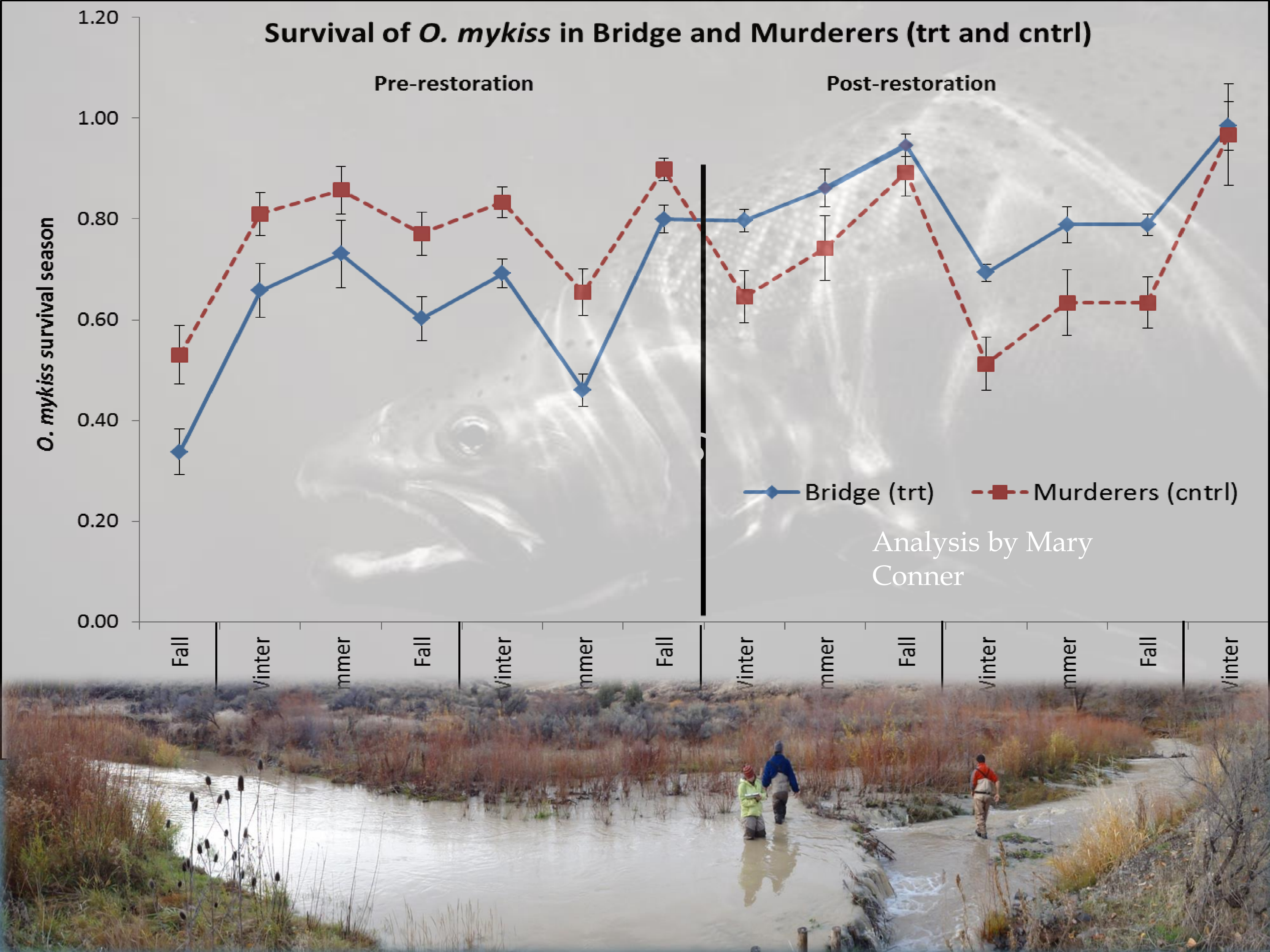
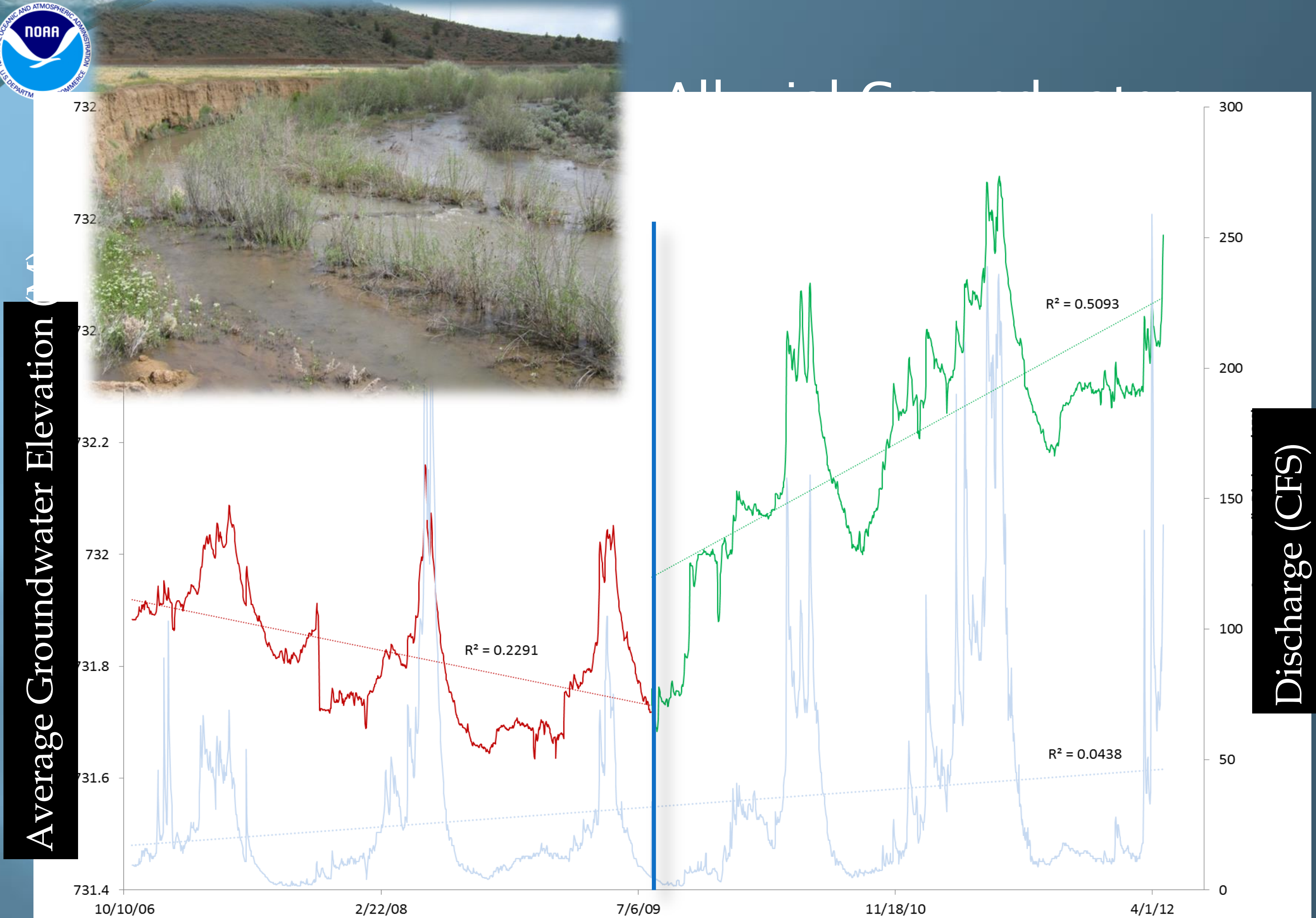
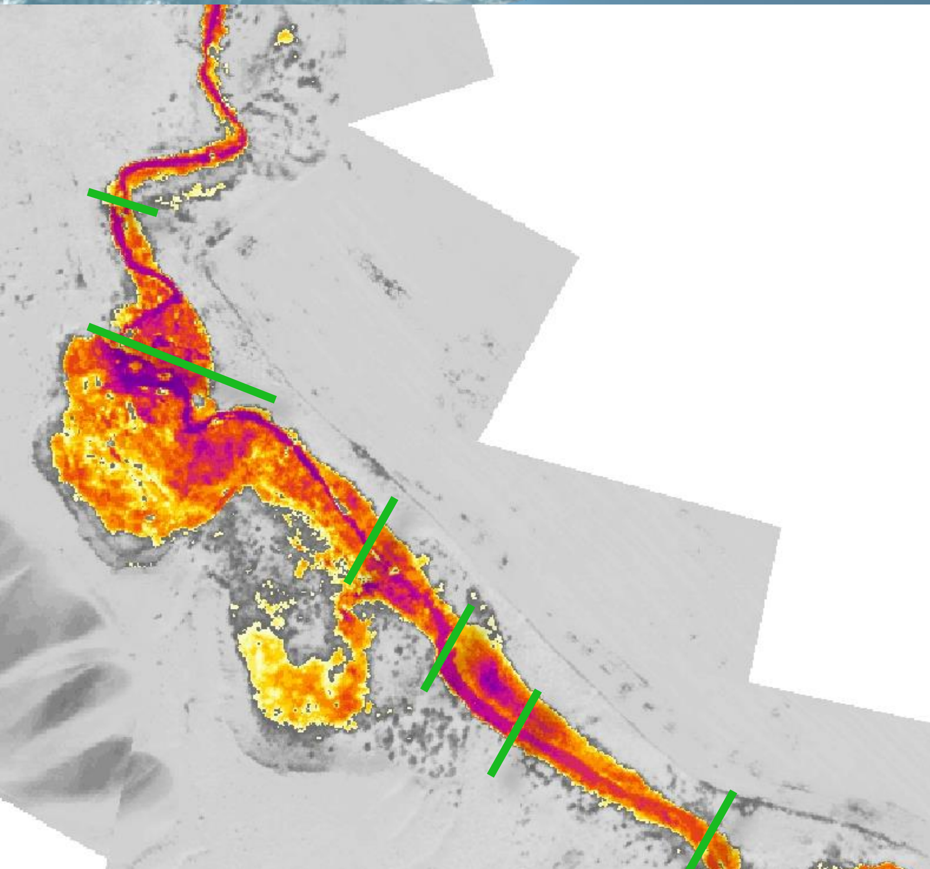
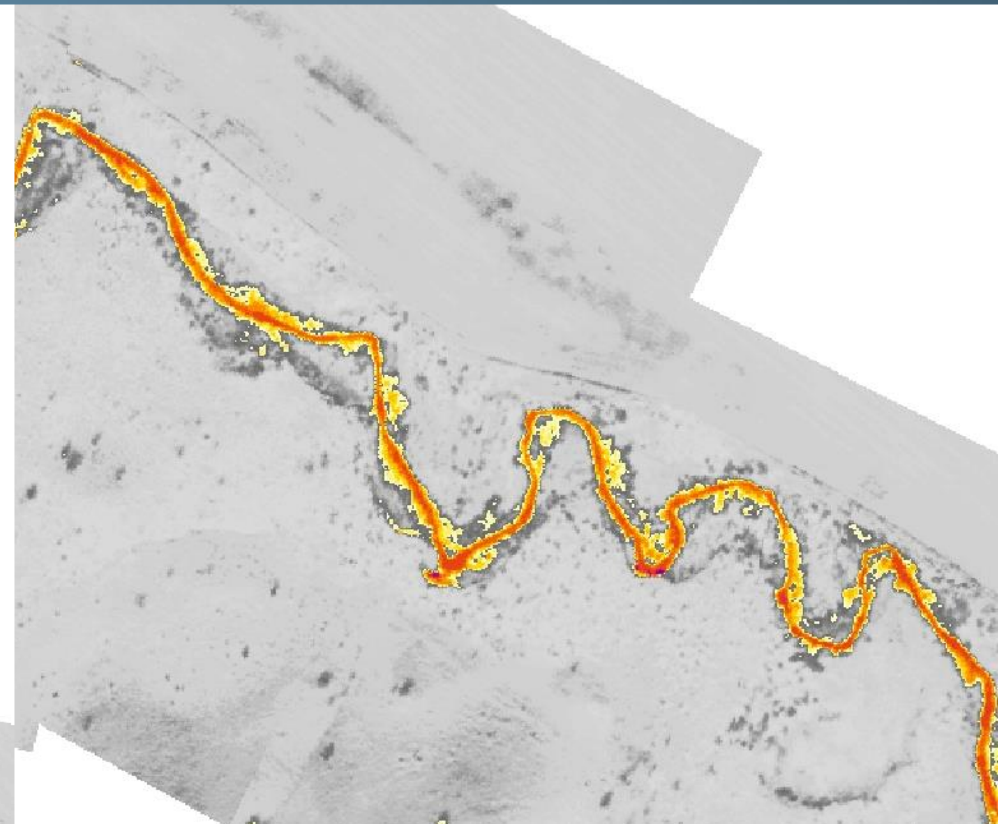


Survival of O. mykiss in Bridge and Murderers (trt and cntrl)
Pre-restoration
Post-restoration
O. mykiss survival season
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Bridge (trt)
Murderers (cntrl)
Analysis by Mary Conner
Fall
Fall
Fall
Fall
Fall

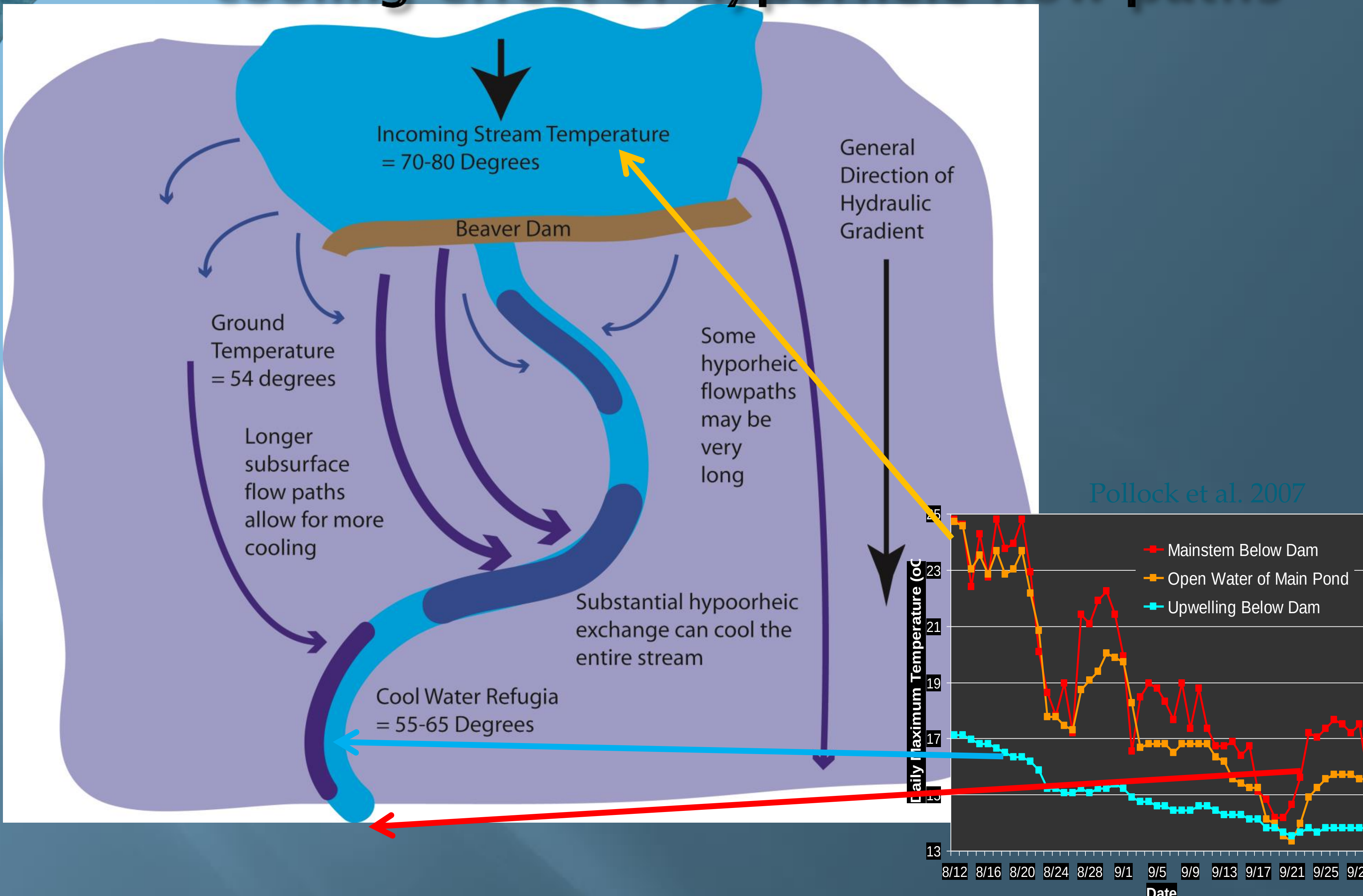


Time (2006-2012)





Plan view of a beaver dam showing cooling effect of hyporheic flow paths



Pollock et al. 2007

Wood Jams

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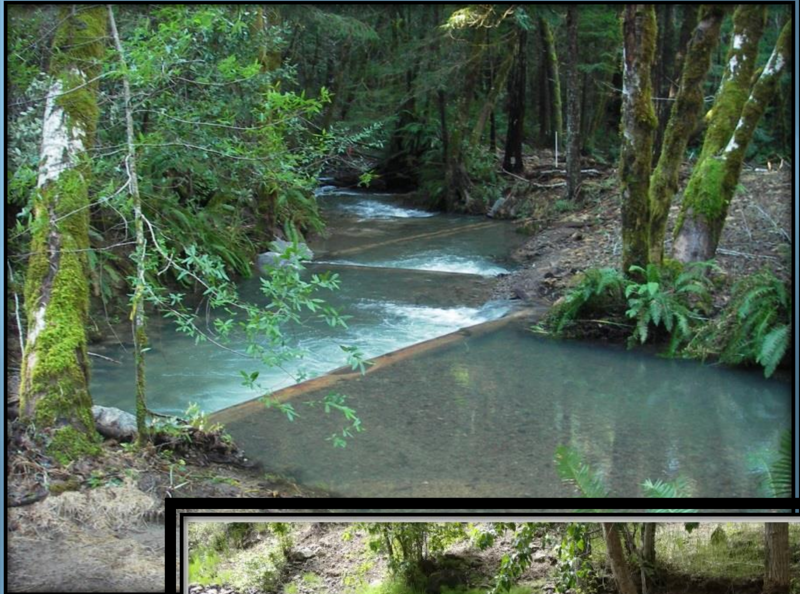
Wood Jams

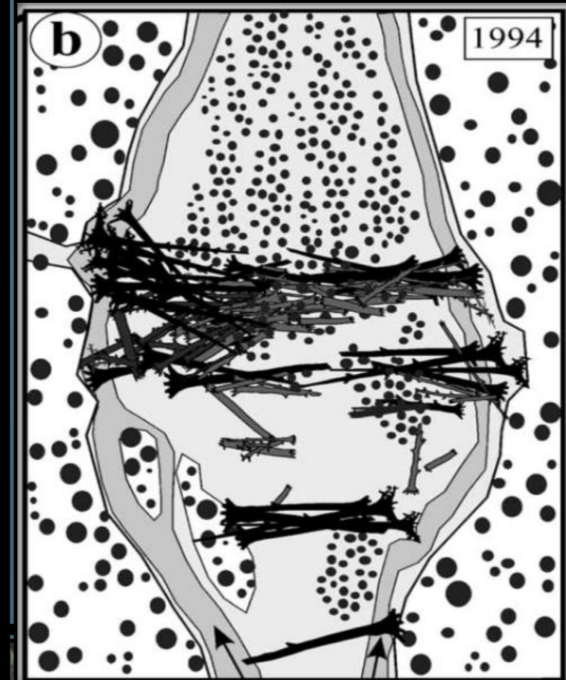

Hunter Ck-First
flows 2014

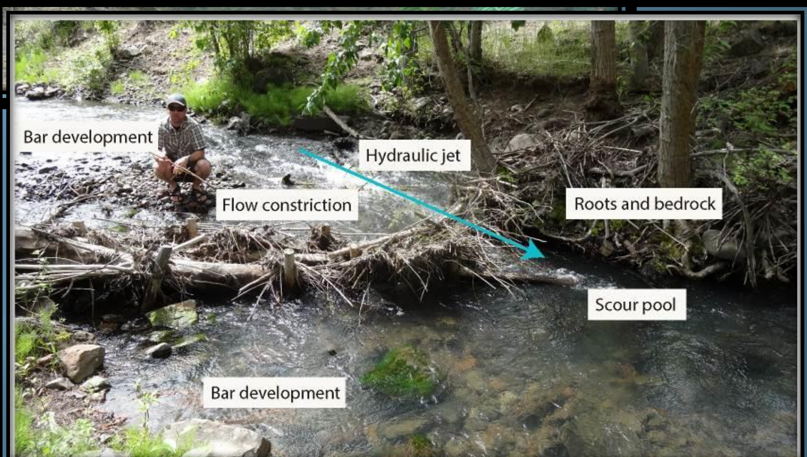

Post 5-yr RI flood WY15
Courtesy of Rocco Fiori

Wood-based Stage Zero Restoration Tools

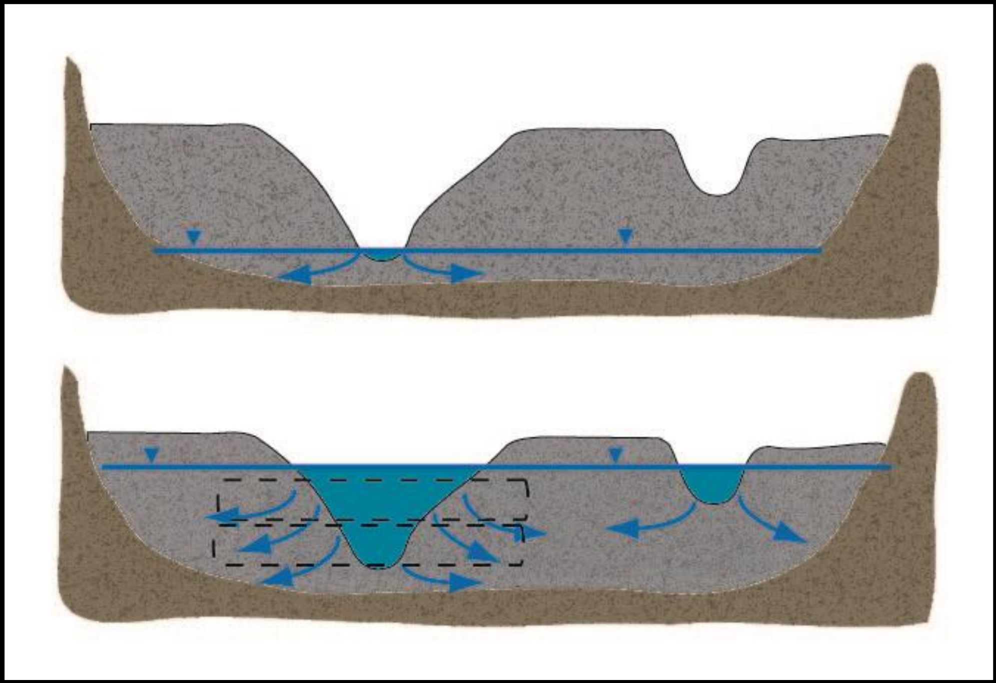
Log Steps (USFS-many locales, T. McKee-Mattole R., CA)
Wood Jams (Many locales, e.g. Rocco Fiori, Klamath River, CA)
Gravel Dams (Campbell Ranch-Silvies R., OR, CDA Tr., ID)
Meander Dams (Quivira Coalition, NM)
Constriction Dams (N. Bouwes-Asotin R., WA)
Choke Dams (P. Devries-Idaho)

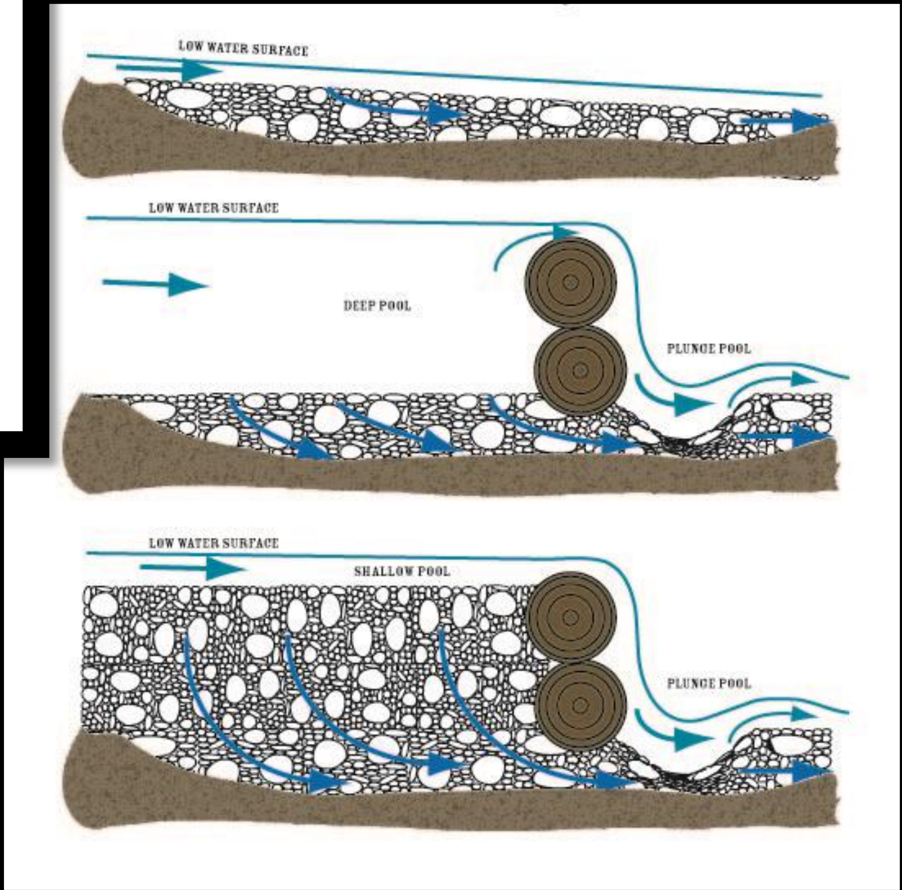






Process-based restoration restores processes, not specific habitat types





What types of structures are appropriate?

Location	Off-channel ponds	Beaver Ponds	log steps, Over-flow	Log steps, Under-flow	Bank Input Debris	Valley Jams	Flow Def-lection Jams	un-stable logs	bar-apex jams	mean-der jams	log rafts	Debris flow jams
	Non-mobile-->					Combination-->		Transport-->				
Low-gradient Habitat												
Tributary channel, unconfined, unentrenched	x	x	x	x	x	x	x	x				x
Tributary channel, confined			x	x	x	x		x				
Tributary channel, entrenched			x	x	x	x	x	x				x
Mainstem channel, unconfined, unentrenched	x	x			x	x	x	x	x	x	x	
Mainstem channel, confined					x	x		x				
Mainstem channel, entrenched					x	x	x	x	x	x	x	
Estuary-distributary channels	x	x	x	x			x	x				
Estuary-main channel								x	x	x	x	
Medium Gradient, confined tributary habitat			x	x	x	x		x				
High gradient, confined tributary habitat			x	x	x	x		x				

What are your goals? (coho as an example)

	Beaver Ponds	Valley Jams	Log Steps-OF	Log Steps-UF	Bank Input	Flow Deflection Jams	Bar-Apex Jams	Meander Jams	Log Rafts	Bench Jams	Unstable Wood
Stream size	S	<50m BFW, < 500m VW	S (< 10 m)	S (< 10 m)	All	S, M	M,L	M,L	L	S	All
Slope	<8%	2-20%	1-70%	1-70%	All	<4%?	<3%	<3%	<2%?	6-20%	
Confined/Unconfined/Entrenched	All	C/U/E	C/U/E	C/U/E	C/U/E	U	U	U	U	C	C/U/E
Geomorphology	_										
Floodplain reconnectivity		X	X						X		
bedrock to alluvium conversion		X	X						X		
Increased planform complexity	X	X			X	X			X		
Increased spawning gravel depths		X	X	s		s	x	x	X		
Decreased spawning gravel mobility		X	X			X			X		
multichannel formation	X	*				s	x		X		
Sediment storage/aggradation	X	XX	XX				X		X	XX	
Hydrology/Hydraulics	_										
Extensive slow-water habitat	XX								X		
Increased streamflow/GW recharge	X	X	X						X		
Hyporheic exchange	X	X	X	s		x	x	x	X		
Thermal refugia	X	X	X						X		
Upstream backwater pool	X		s						X		
Downstream scour pool	X	X	X						?		
Under or lateral scour pool				X	X	X	X	X	X		
Biology/Other	_										
Increase riparian vegetation	X	X	X				X		X	xx	
Improved food production	X	X	X						X		
Cover	X	X	X	X	X	X	X	X	X		X
wetland formation	X								X		

Types of "Dams" that Build Stage Zero Channels/Valleys-Scaling Up

- Beaver Dams
- Live Vegetation
- Large Wood
- Levee Setbacks
- Landslides
- Alluvial Fans
- Sea Level (Rise)
- Tectonics

Increasing Time Scales

Key Functions:
- Increase flow resistance,
- Lower slope
- Reduce stream power/unit width

Levee Removal

- Can (re)create stage zero systems if channel is at grade or perched
- In incised systems, flow/sediment obstructions can accelerate habitat recovery

Eel River, California

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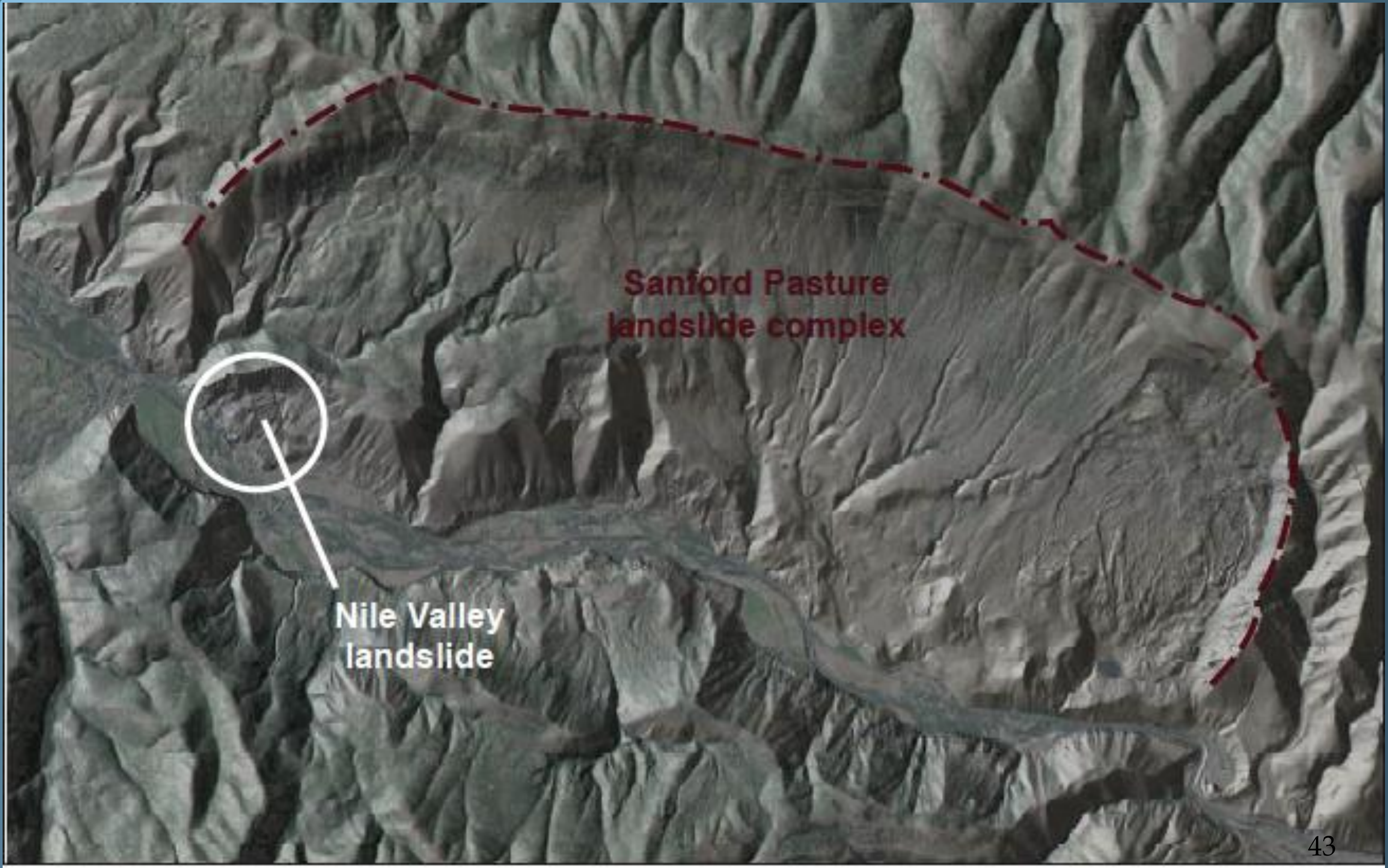
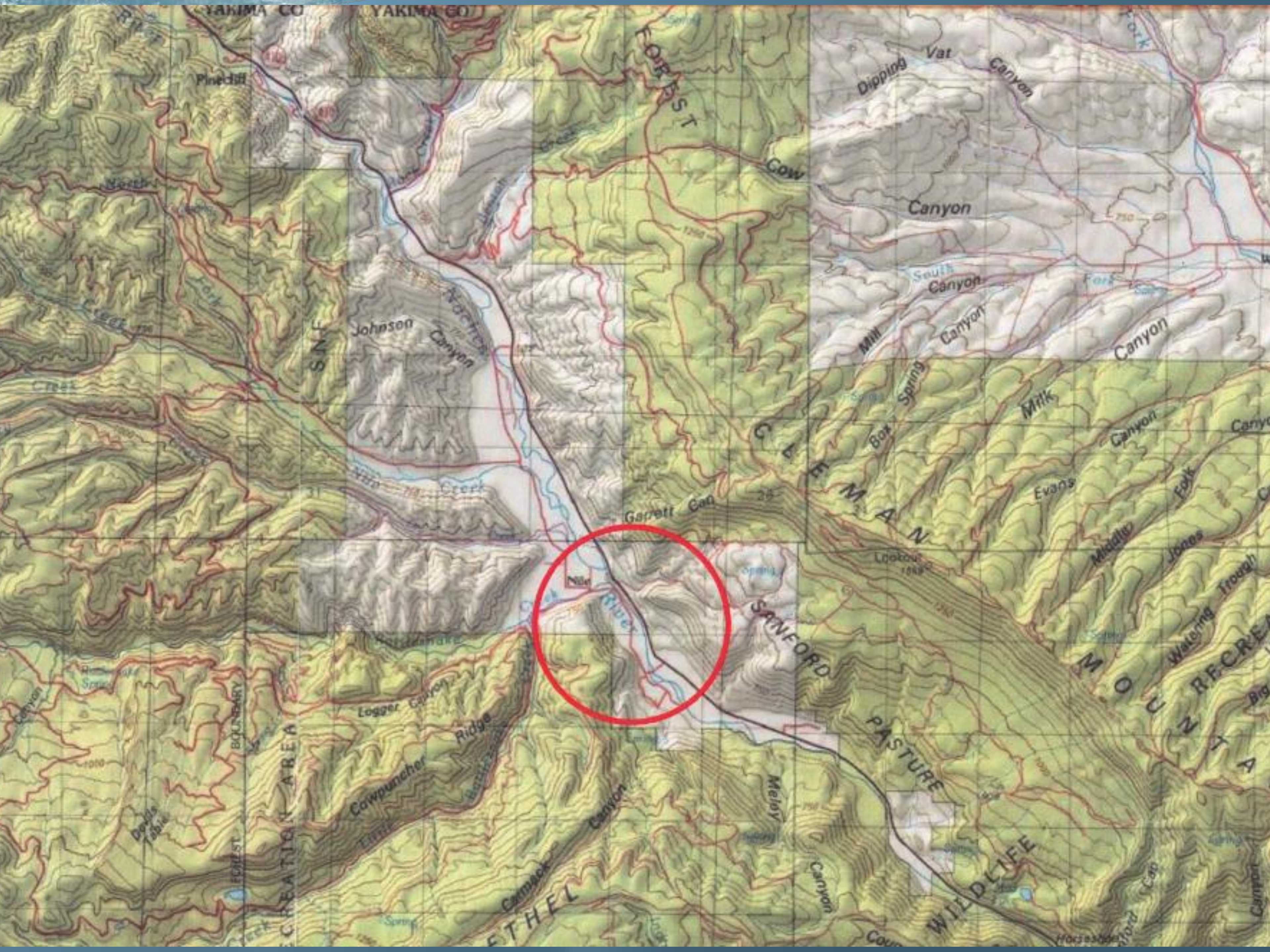
Landslides-Naches River, WA (Nile Valley)





YAKIMA CO
YAKIMA CO
Pinedell
FOREST
Dipping Vat Canyon
Cow Canyon
South Fork
Canyon
Mill Canyon
Canyon
Johnson Canyon
Naches
Nile Creek
Garrett Can
Box Spring
Milk Canyon
Evans
Middle Fork
Jones
Watering Trough
C L E M A N
M O U N T A
Lookout
Nile
River
SANFORD PASTURE
WILDLIFE
Logger Canyon
Cowpuncher Ridge
Meloy Canyon
Canyon
Cormack
BOUNDARY
FOREST
Dodds Table
RECREATION AREA
BETHEL
RECREA

Landslides Create Good Salmon Habitat

Controls on valley width in mountainous landscapes: The role of landsliding and implications for salmonid habitat

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[2]Department of Geological Sciences, University of Oregon, Eugene, Oregon 97403, USA
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[4]U.S. Forest Service Pacific Northwest Research Station, Corvallis, Oregon 97331, USA

ABSTRACT

A fundamental yet unresolved question in fluvial geomorphology is what controls the width of valleys in mountainous terrain. Establishing a predictive relation for valley floor width is critical for realizing links between aquatic ecology and geomorphology because the most productive riverine habitats often occur in low-gradient streams with broad floodplains. Working in the Oregon Coast Range (western United States), we used airborne lidar to explore controls on valley width, and couple these findings with models of salmon habitat potential. We defined how valley floor width varies with drainage area in a catchment that exhibits relatively uniform ridge-and-valley topography sculpted by shallow landslides and debris flows. In drainage areas >0.1 km², valley width increases as a power law function of drainage area with an exponent of ~0.6. Consequently, valley width increases more rapidly downstream than channel width (exponent of ~0.4), as derived by local hydraulic geometry. We used this baseline valley width–drainage area function to determine how ancient deep-seated landslides in a nearby catchment influence valley width. Anomalously wide valleys tend to occur upstream of, and adjacent to, large landslides, while downstream valley segments are narrower than predicted from our baseline relation. According to coho salmon habitat-potential models, broad valley segments associated with deep-seated landsliding resulted in a greater proportion of the channel network hosting productive habitat. Because large landslides in this area are structurally controlled, our findings indicate a strong link between geologic properties and aquatic habitat.

sediment by providing space for the formation of debris flow fans. In addition, low-gradient broad valleys with old-growth forest store the great majority of above-ground and below-ground carbon in mountain streams (Wohl et al., 2012). Understanding the links between hillslope processes and riverine habitat is particularly important for Pacific salmon (*Oncorhynchus* spp.) because these fish are intricately tied to Pacific Rim topography (Montgomery, 2000; Waples et al., 2008).

The goals of this paper are twofold. First, we seek to define an empirical relation between valley width and drainage area (akin to hydraulic geometry for river channels) in a setting with negligible influence from variable rock properties and deep-seated landslide activity. Our approach uses high-resolution topography generated from airborne lidar to define this baseline

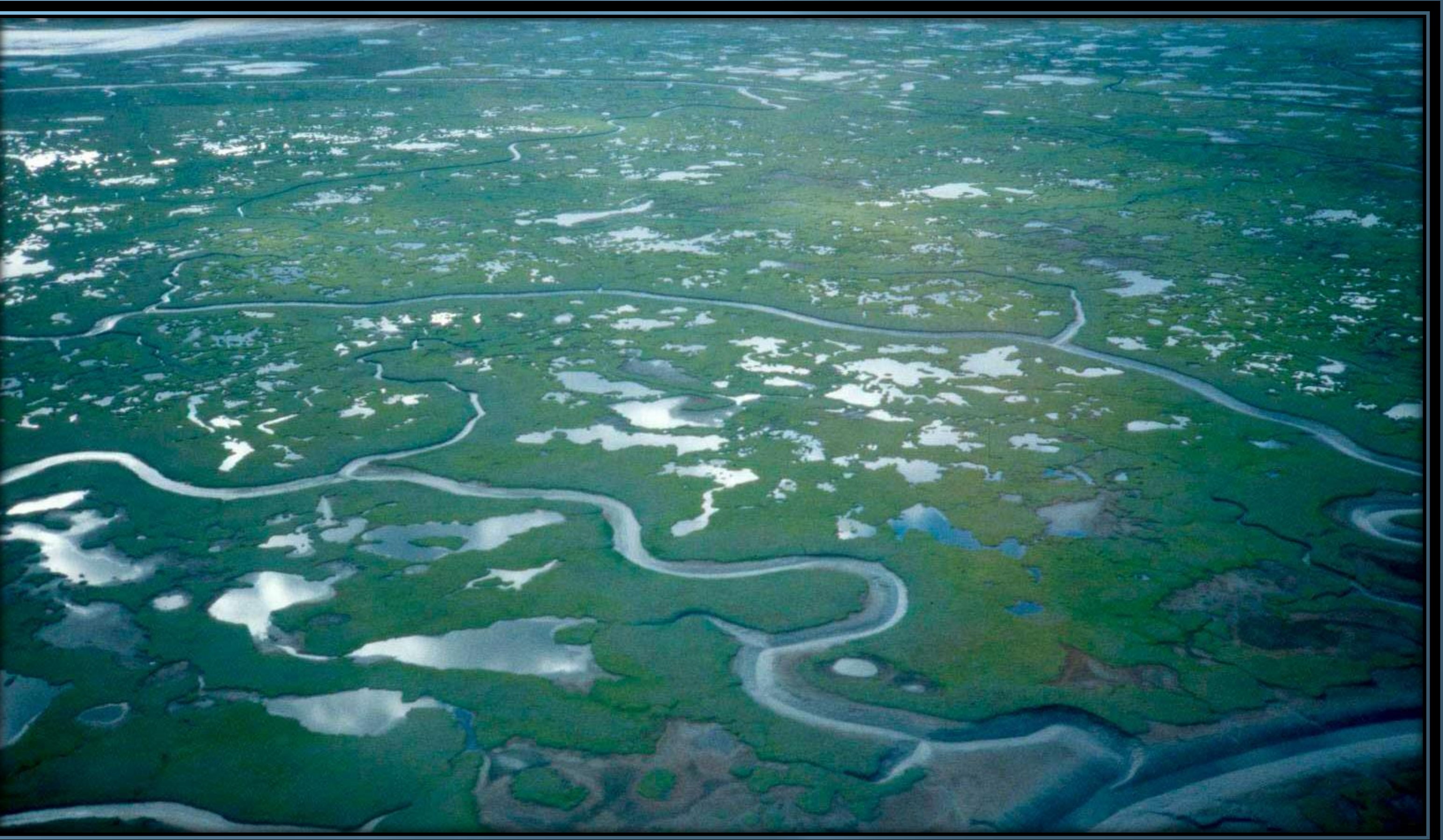
Sea level- the ultimate dam

Taku River (southeast) Alaska

Kuskokwim River, Alaska

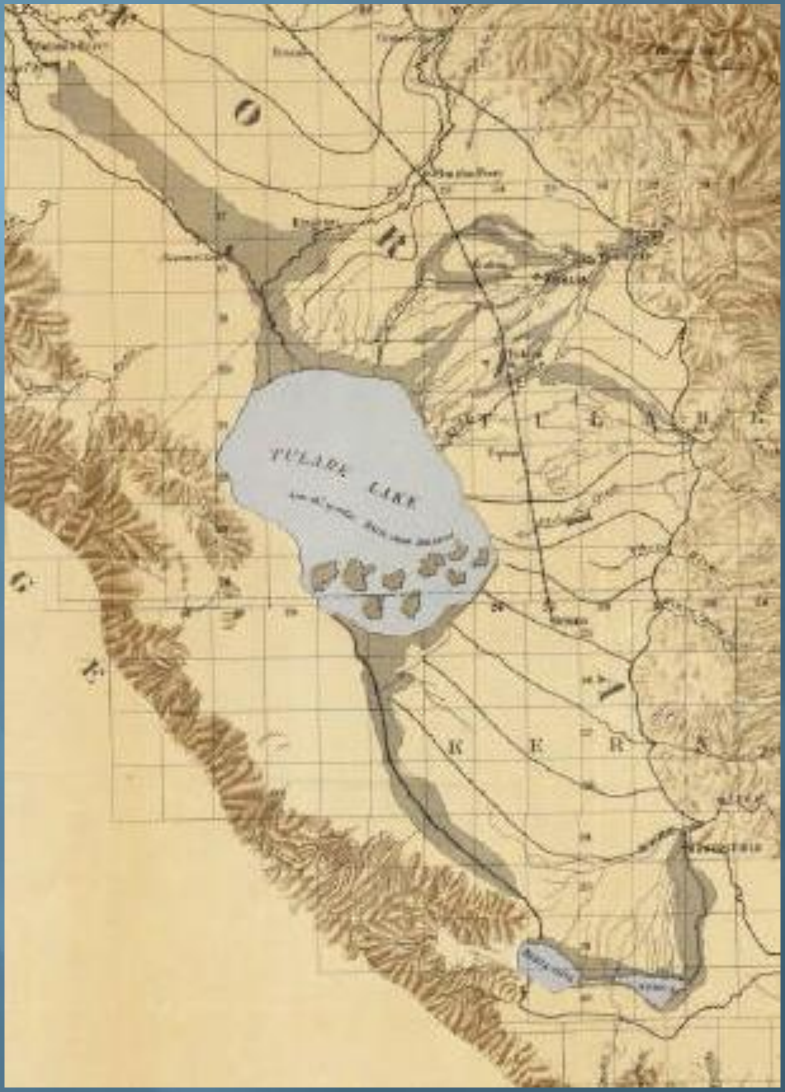
MacKenzie River, Canada

Yukon River, Alaska



Sacramento-San Joaquin Rivers-150 ybp

150 years ago, 5% of California was "wetlands", mostly in the Central Valley, really more of a wetland-river complex.



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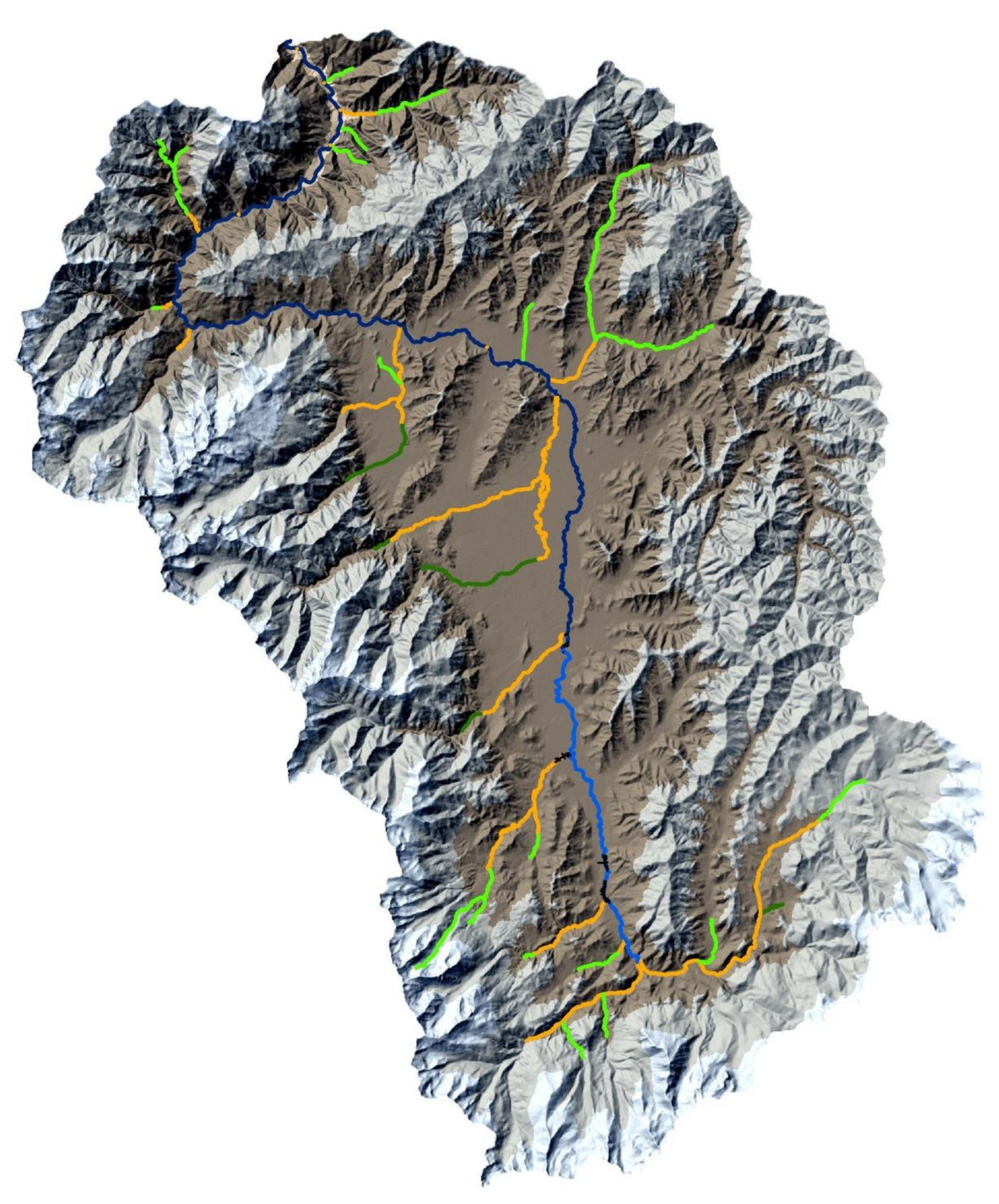
A Tectonic "Dam"-Scott River, Klamath Basin



Okavango River, Botswana

Sudd Swamp, South Sudan

Sea Level Rise-
A Grade Changer

If all the ice melts, >200 ft sea level rise

- 1-3 m rise predicted by 2100, but predicted rates keep increasing.
- Circa 5000 yrs for 200 foot rise (big error bars), but on the scale of the rise and fall of civilizations
- Need sediment to counteract rising seas.

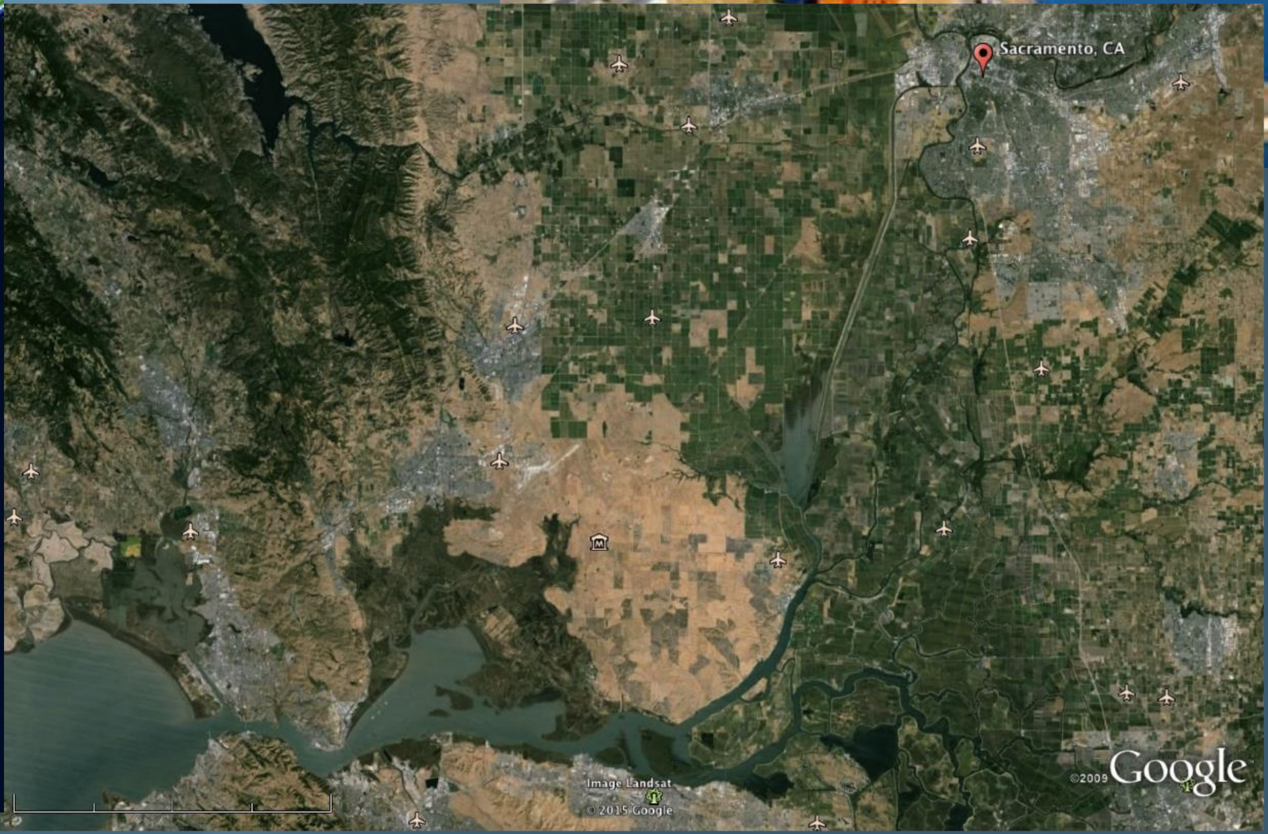
National Geographic 2014

Really Big Low Head Dams as Tide Barriers-

-St Petersburg-16 mi

Venice-1.5 mi (3 openings)

Carquinez Strait? -1 mi



Current Water Management Paradigms are Causing Substantial Long-term Problems

-Is this a map of the past or a blueprint for the future?

-A 150 Year Restoration Plan? (Delta is currently sinking)

-No farms, no food, and…
No water no farms,
No sediment, no farmland

-Floods are inconvenient but droughts destroy civilizations

Conclusions

- Sediment is a resource
  - No sediment = no alluvial valleys
  - Base flow water elevation is key design feature
- Three components to stream restoration
  - Sediment, Water and Biota
- These processes play out at multiple spatio-temporal scales to:
  - Lower stream and valley slopes
  - Lower stream power per unit width
  - Increase retention rates of both sediment and water
  - Benefit Fish, Benefit Farmers

Take Home Messages

- Putah Creek, California

- Degraded streams have limited ecological function
- The scale of restoration needs to be commensurate with the scale of the actions that caused the degradation
- Restoration needs to occur on a time frame relevant to recovery time frames for target species (e.g. 100 years for salmon) so as to avoid extinction

Regulatory Issues

- **In terms of adverse effects-spatial and temporal scales of effects needs to be reconsidered**
  - **Short-term v. long-term**
  - **Fine-scale v. coarse scale**
  - **Individual v. population**

Regulatory Scenarios-BDs/BDAs

1. Unknown what is in pond above BD nonC/ESA adult Chinook in pool below, no “human visible” fish passage
2. C/ESA juvenile coho in pond above BD C/ESA adult coho in pool below, no “human visible” fish passage.
3. C/ESA juvenile coho abundant in pond above BD C/ESA juvenile coho in pool below, no “human visible” fish passage.
4. Scenario 3 but below BDA, stream is drying up, and the last remaining wet reach is just below the beaver dam.

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4. Scenario 3 but below BD, stream is drying up, and the last remaining wet reach is just below the beaver dam.
5. BD increases total amount of good habitat, but also increases total habitat that that is less good (e.g. temp, DO issues)

Stage Zero Restoration:
= Process discontinuity management
= habitat management,
Does not = continuity management

- Sediment = Essential ingredient
  - Deposition and sorting
  - Aggradation
  - Erosion and avulsions
  - Sediment = a resource
  - No Sediment = No Valley floor
- Water
  - Flow diffusion
  - Groundwater recharge
  - Hyporheic exchange
  - Long inundation periods
  - Less distinction between wetlands and channels and floodplains

Stage Zero Attributes or Tendencies

- Multi-threaded or no definable channels (vegetation)
- Common in unconfined, low-gradient valleys
- Low stream power/unit width
- Wide range of hydrologic conditions
- Abundant off-channel habitat w/long inundation periods
- Elevated water tables
- Wide range of Velocity/Depth combinations
- Blurred line between wetlands and channels
- Biological flow resistance in channels, on banks and on stream adjacent surfaces (e.g. floodplains and mid-channel islands)
  - Aquatic vegetation
  - Emergent vegetation
  - Live trees and shrubs
  - Dead trees
  - Beaver dams-dead trees and shrubs (N. Hemisphere)

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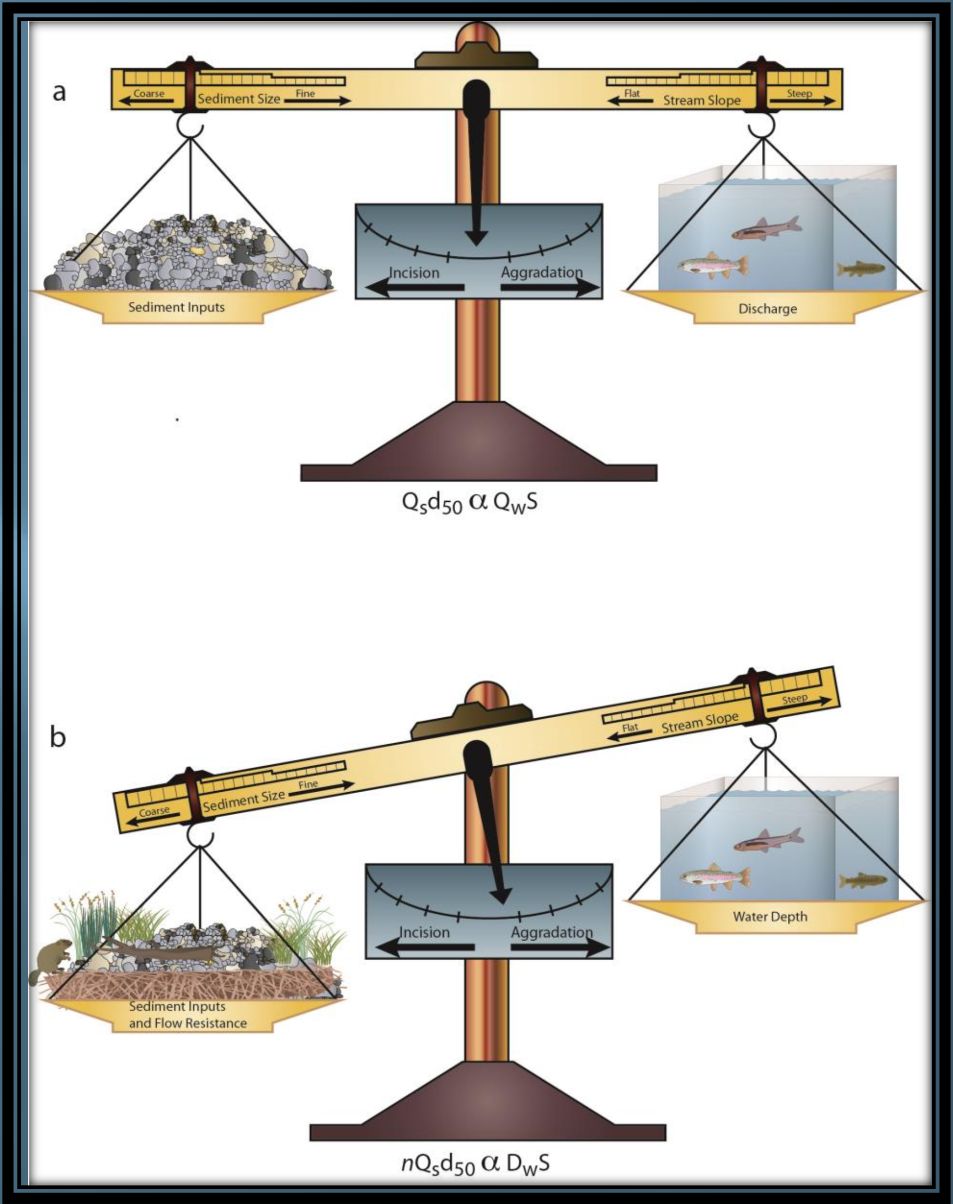
Continuity of Sediment Transport or Habitat formation?



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Restoration "Toolkit" for Building Stage Zero Channels/Valleys

- Beaver Dams
- Live Vegetation
- Large Wood
- Levee Setbacks
- Landslides
- Alluvial Fans
- Sea Level Rise
- Tectonics

Increasing Time Scales

These Tools:

- Increase Flow Resistance,
- Lower Slopes
- Reduce Stream Power/Unit Width

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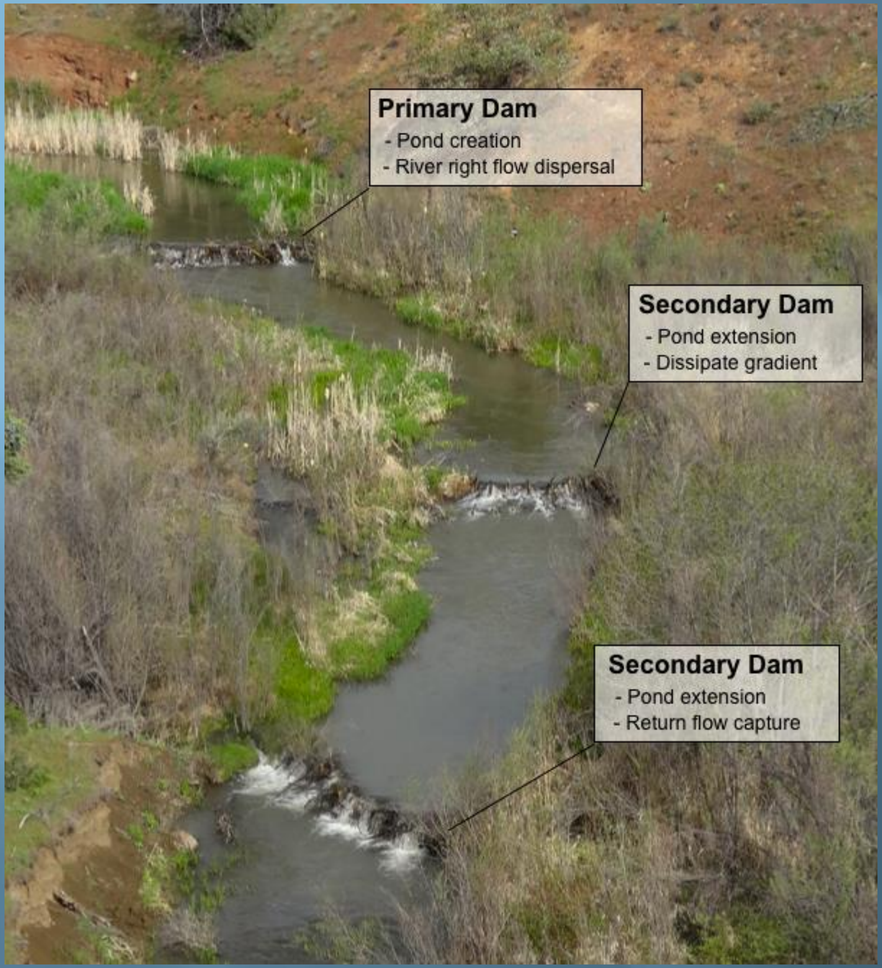
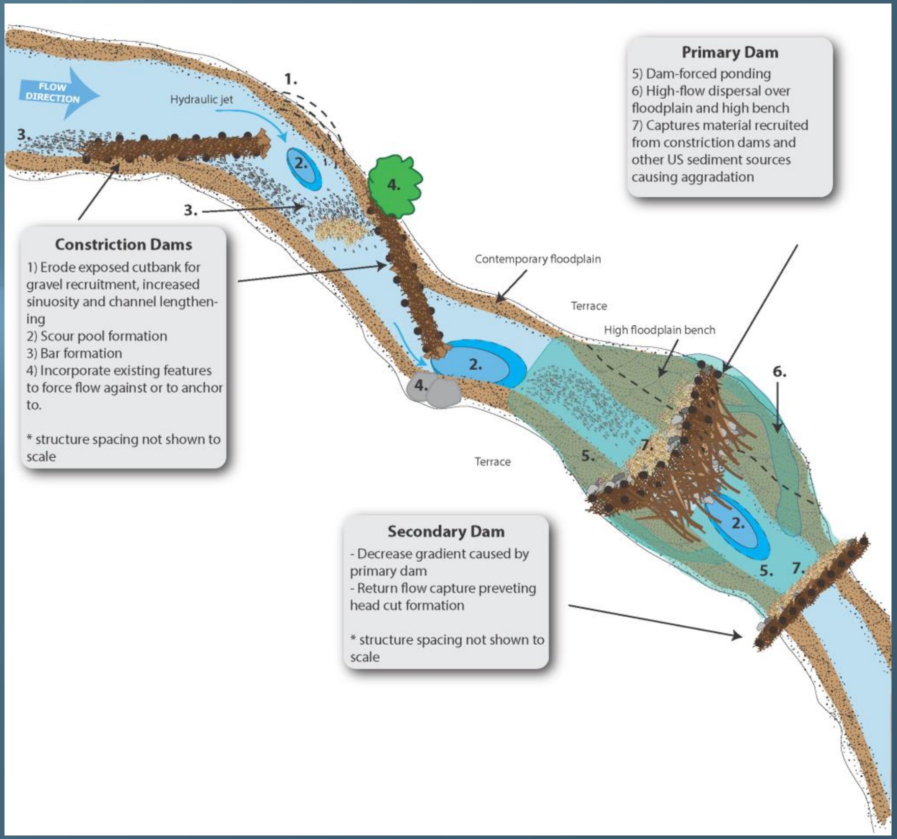
BDAs work together





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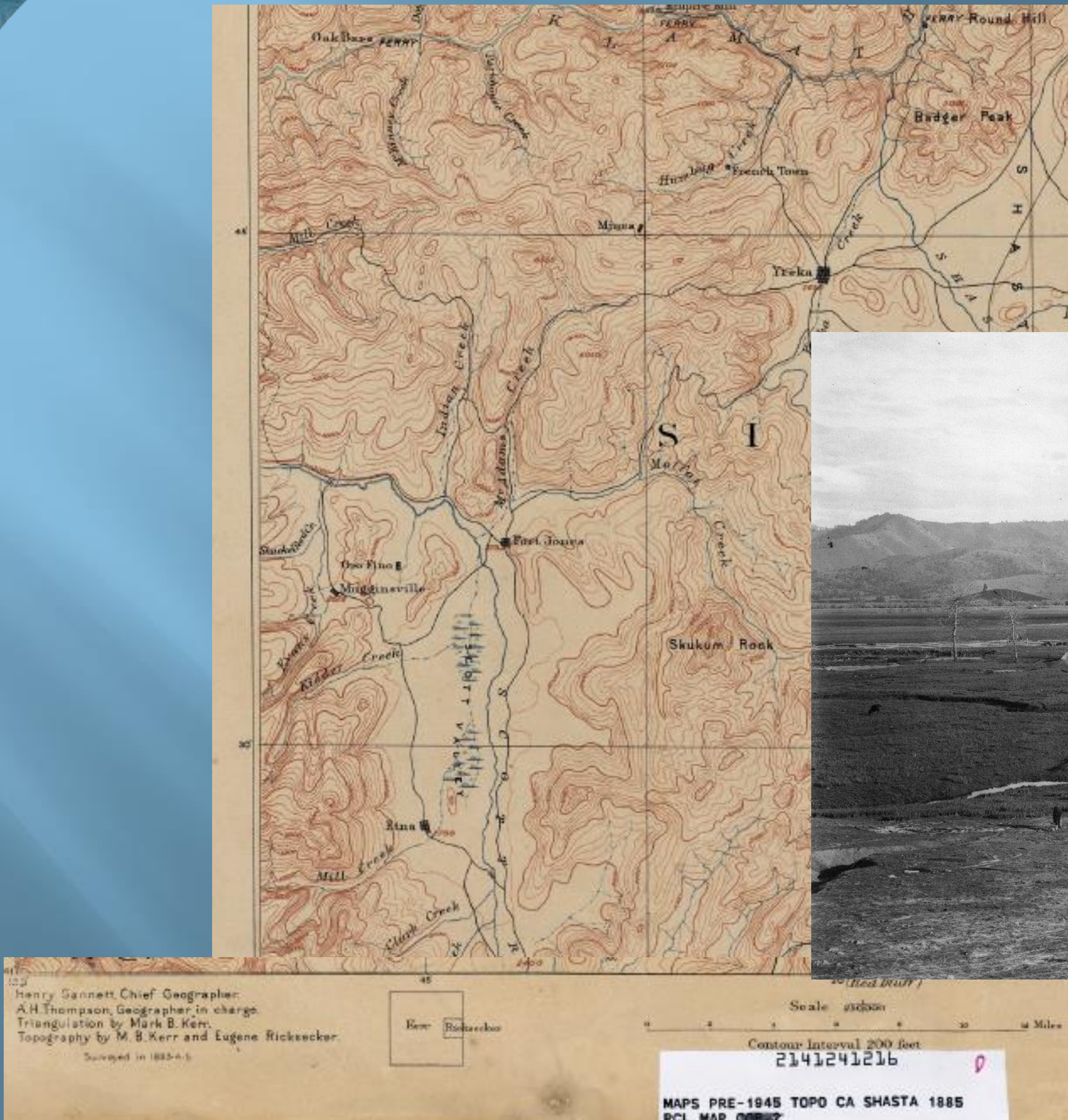
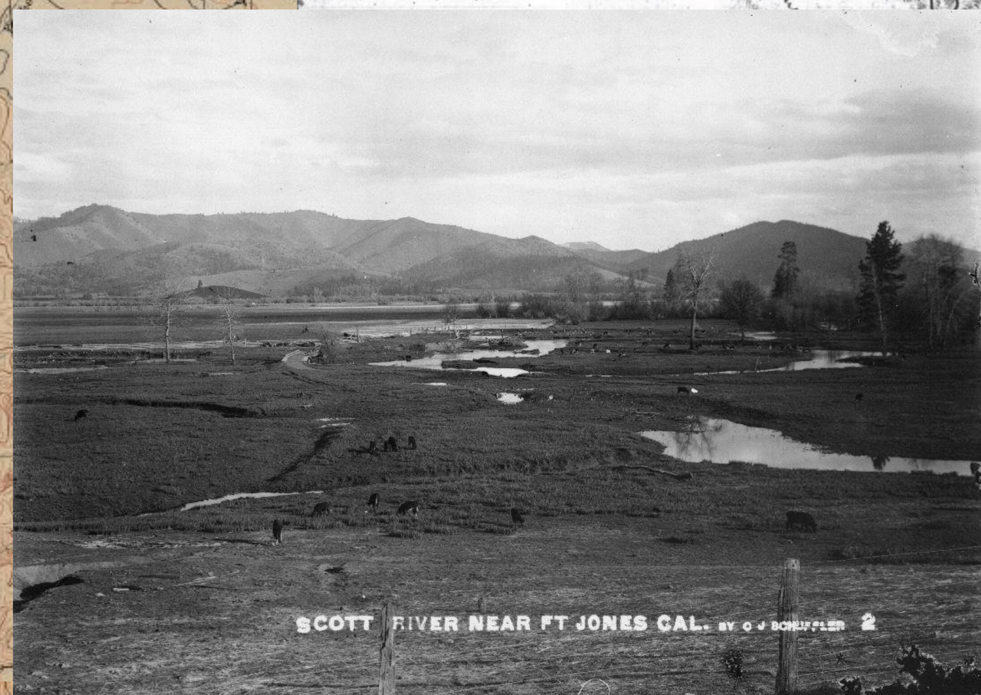
Historical data helpful: e.g. extensive wetlands and beaver dams in Scott Valley



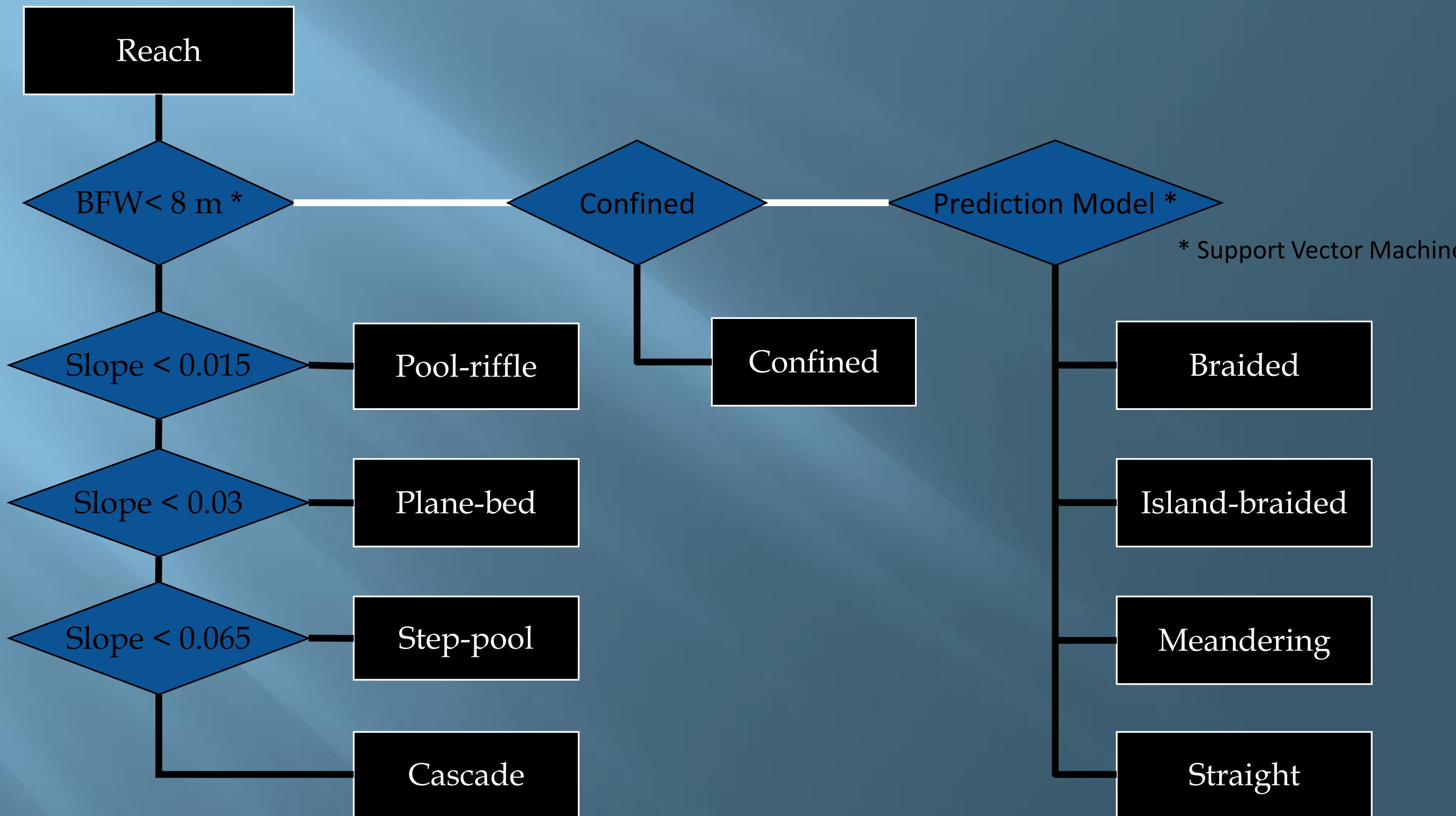


Courtesy of Siskiyou County Museum, surveyed 1883-1885

Beaver and riparian vegetation have been part of stream ecosystems for a long-time, so we are currently in a somewhat unique situation

Photos Courtesy of Carol Evans BLM

Where are you in the network?

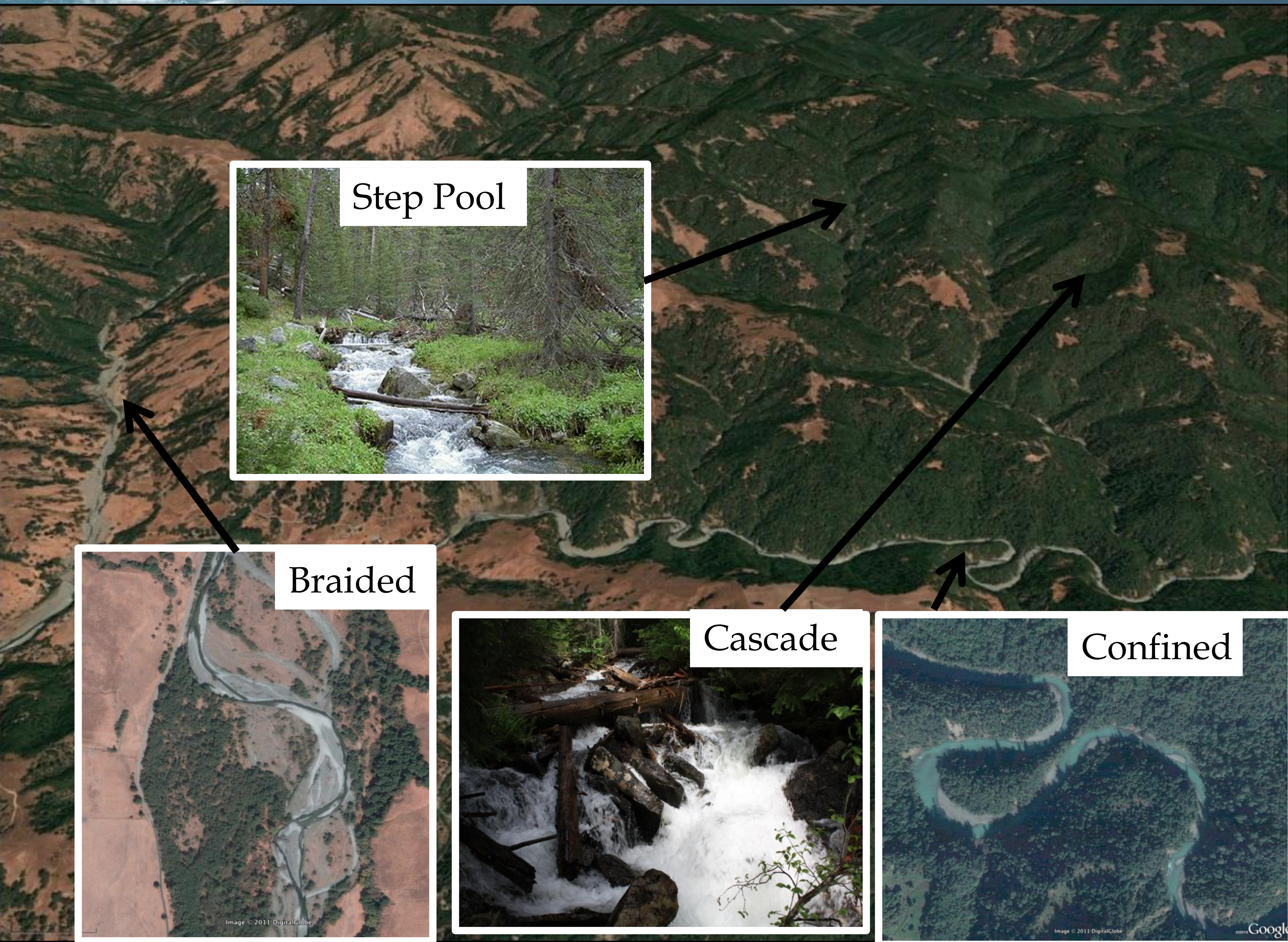


Small “Mountain” Channels

Montgomery and Buffington (1997)

Large Unconfined Channels

Beechie and Imaki (in review)


Step Pool
Braided
Cascade
Confined