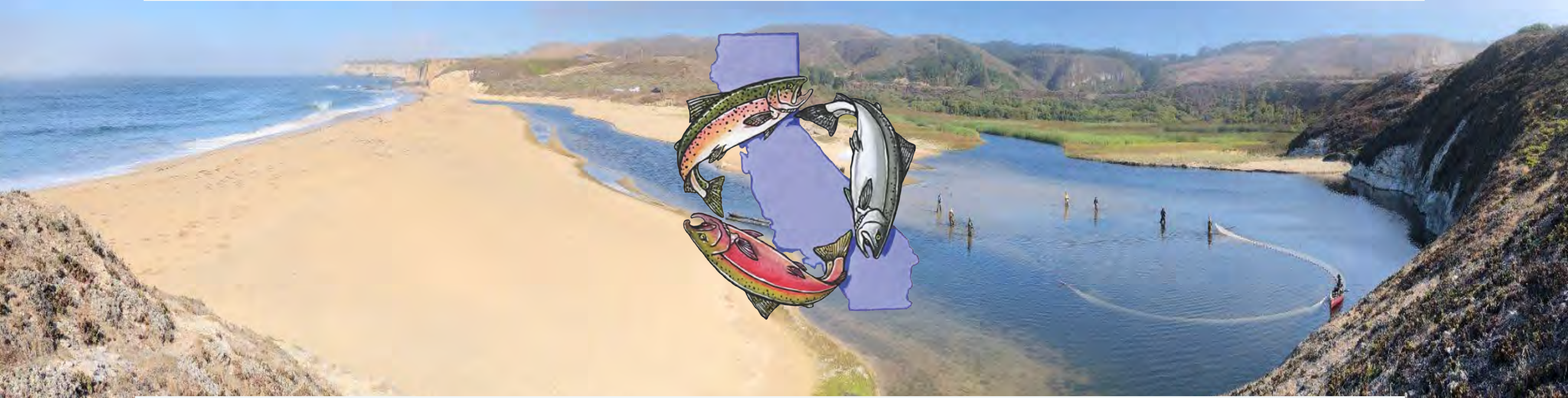
Landscape Scale Process-Based Restoration for Forests, Floodplains, & Fish



A Concurrent Session at the 42nd Annual Salmonid Restoration Conference

Santa Cruz, California, April 29 - May 2, 2025

Session Coordinators: ***Carrie Monohan, PhD*** *Mooretown Rancheria of Maidu Indians;* ***Ben Cook,*** *Trout Unlimited;* ***Karen Pope, PhD*** *Pacifics Southwest Research Station USDA*

Process Based Restoration (PBR) engages dynamic ecological processes and removes constraints to those processes to encourage ecosystems to thrive and recover from disturbance. The theory and application of PBR continues to evolve and grow from site-level to landscape-scale partnerships ready to tackle increasingly intense and variable disturbance regimes. As PBR seeks to work at effective spatial and temporal scales, the PBR community realizes the need to exchange information and collaborate with a broad contingent with expertise at implementing multi-generational ecological and cultural stewardship models at broad spatial scales. New, increasingly variable disturbance regimes require expansive multi-disciplinary and multi-generational collaborations to work at spatial and temporal watershed scales including: innovative techniques for working with onsite materials in low- and high-energy stream reaches to restore resilient hydrologic regimes; practices for working within forests and other upland areas such as beneficial fire; data fluencies and improved prioritization strategies for realizing multiple and multiplying benefits; and integrated scientific approaches for monitoring multivariate long-term responses to both disturbance and restoration. This session invites real-world examples of collaborations employing these toolsets to work across broad spatial and temporal scales to promote ecological uplift and resilience.

Presentations

Landscape-Scale Process Based Restoration for Forests, Floodplains and Fish

Carrie Monohan, PhD

Ben Cook, TU

Karen Pope, PhD

Our Mission

Promote process-based restoration approaches to increase the capacity of degraded river and stream ecosystems to retain water, support biodiversity, create fire resiliency, and adapt to climate change.

We are diverse collaborative of natural resource professionals with a shared mission to promote and advance process-based restoration in California.

Process Based Restoration…Processes for ?

Fire	Soil	Life	Water	Air
Rx Fire Natural Fire Regimes PBAs	Geomorph-ology	Biodiversity Habitat Anadromy	Sink it- Store it- Spread it Natural Flow Regimes	Carbon Sequestration

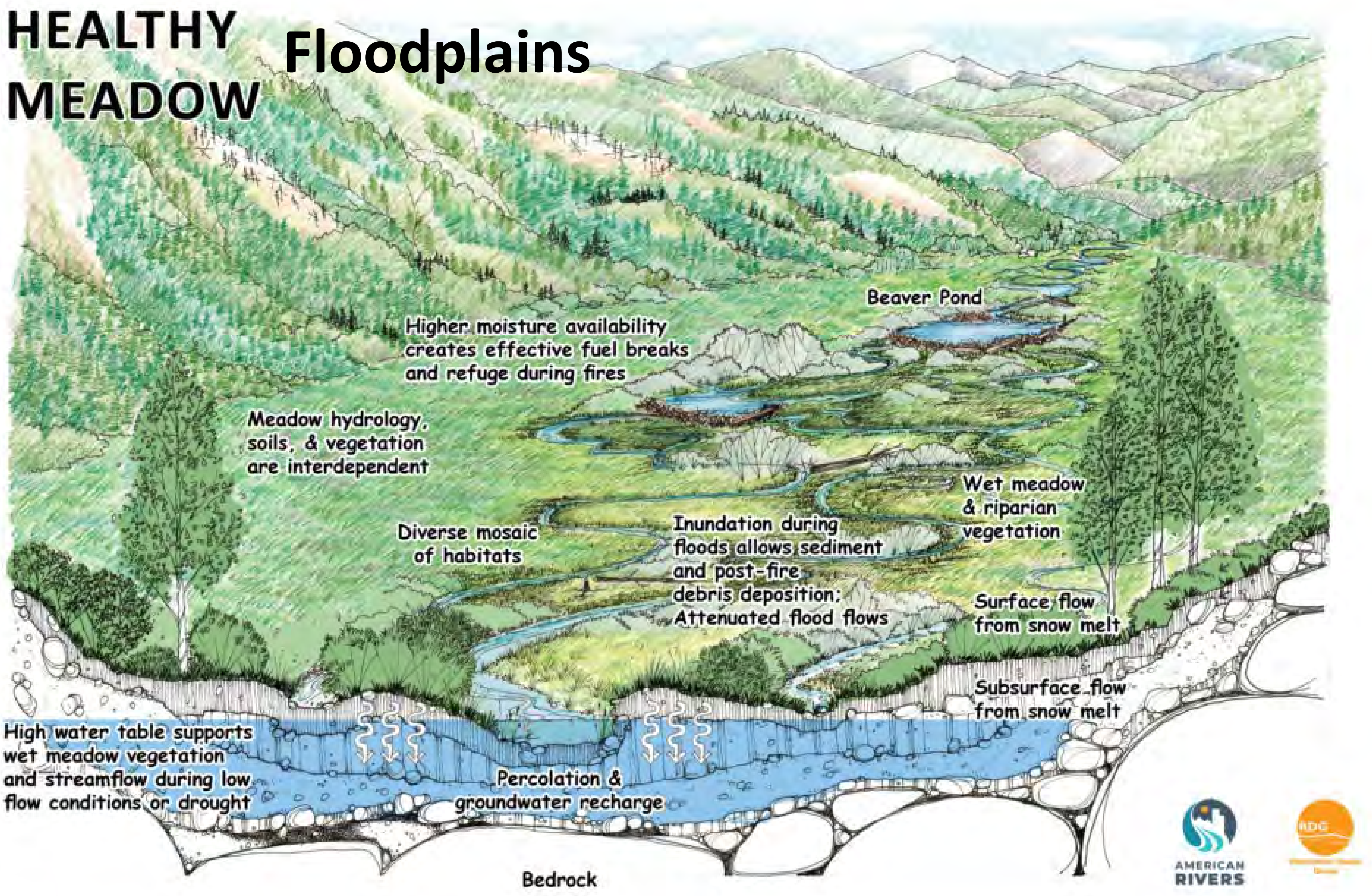
Community Stewardship Systems of Support

Inspired by OAEC, Fuels to Flows

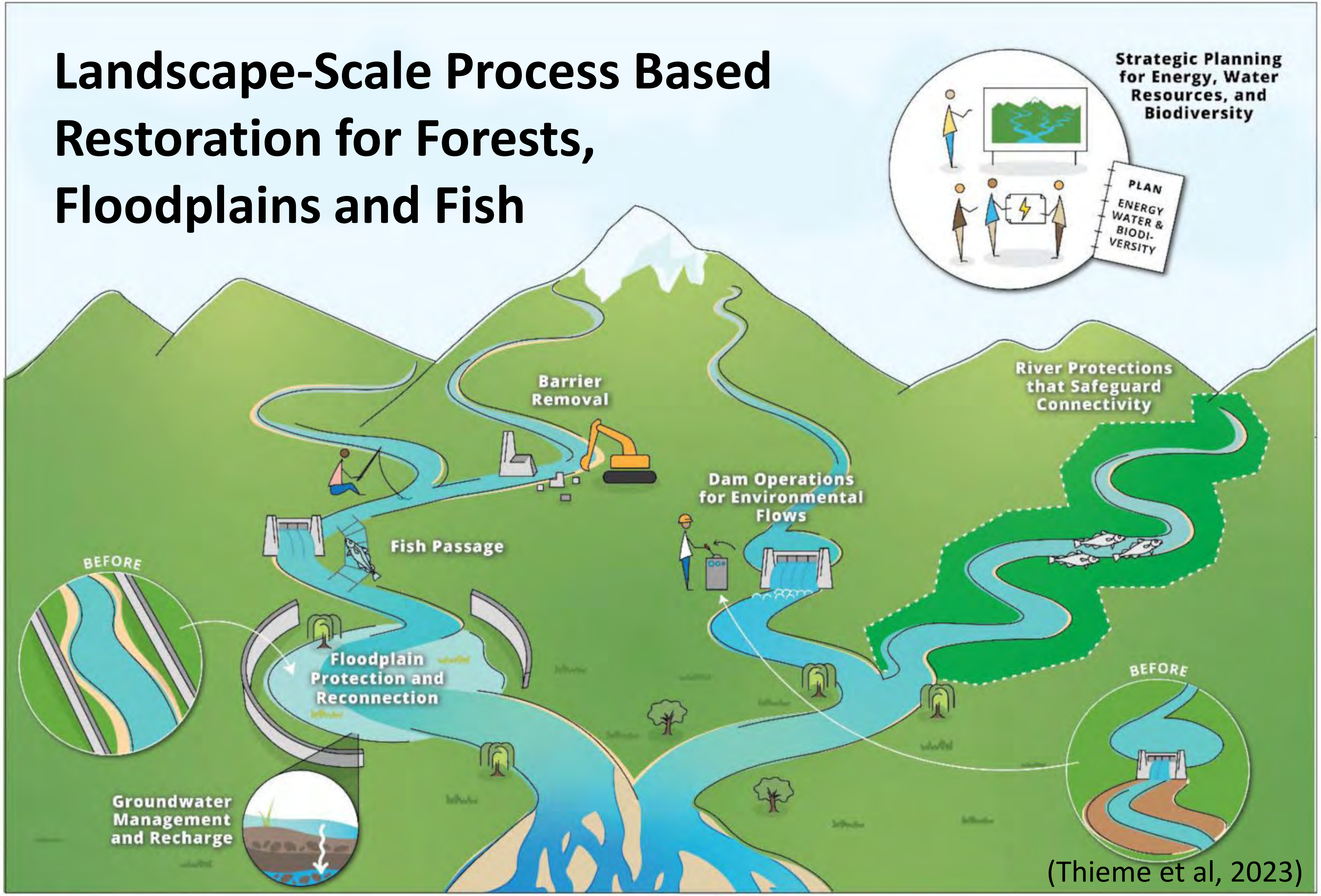
Healthy Forests

Tualatin Soil and Water Conservation District

Floodplains



Landscape-Scale Process Based Restoration for Forests, Floodplains and Fish



(Thieme et al, 2023)

Join us for our annual
Build Like a Beaver Workshop
October in Faith Valley

Contact Paige at

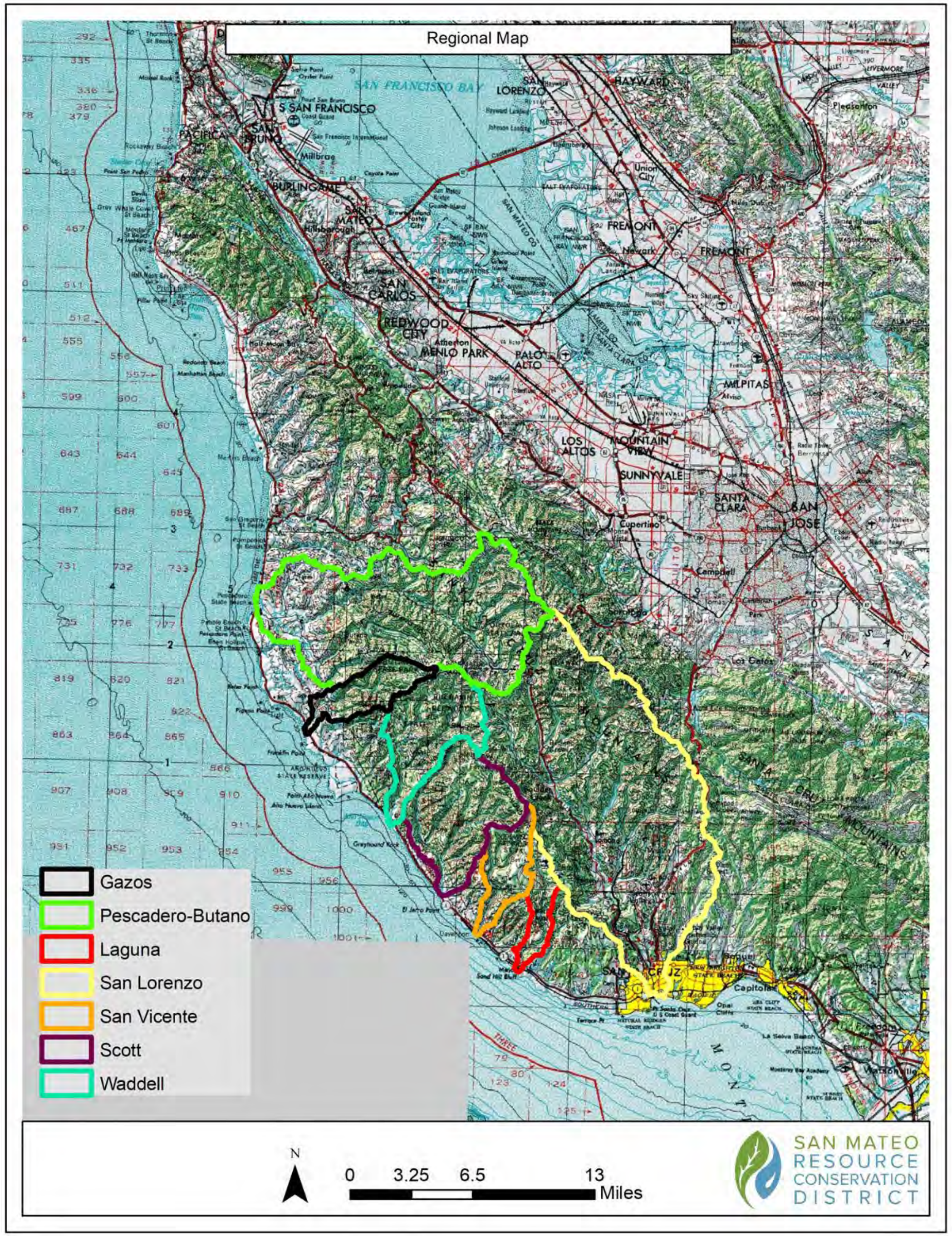
paige@swiftwaterdesign.com

San Vicente Creek Cross-Organizational Collaboration for Watershed-Scale Stream Restoration

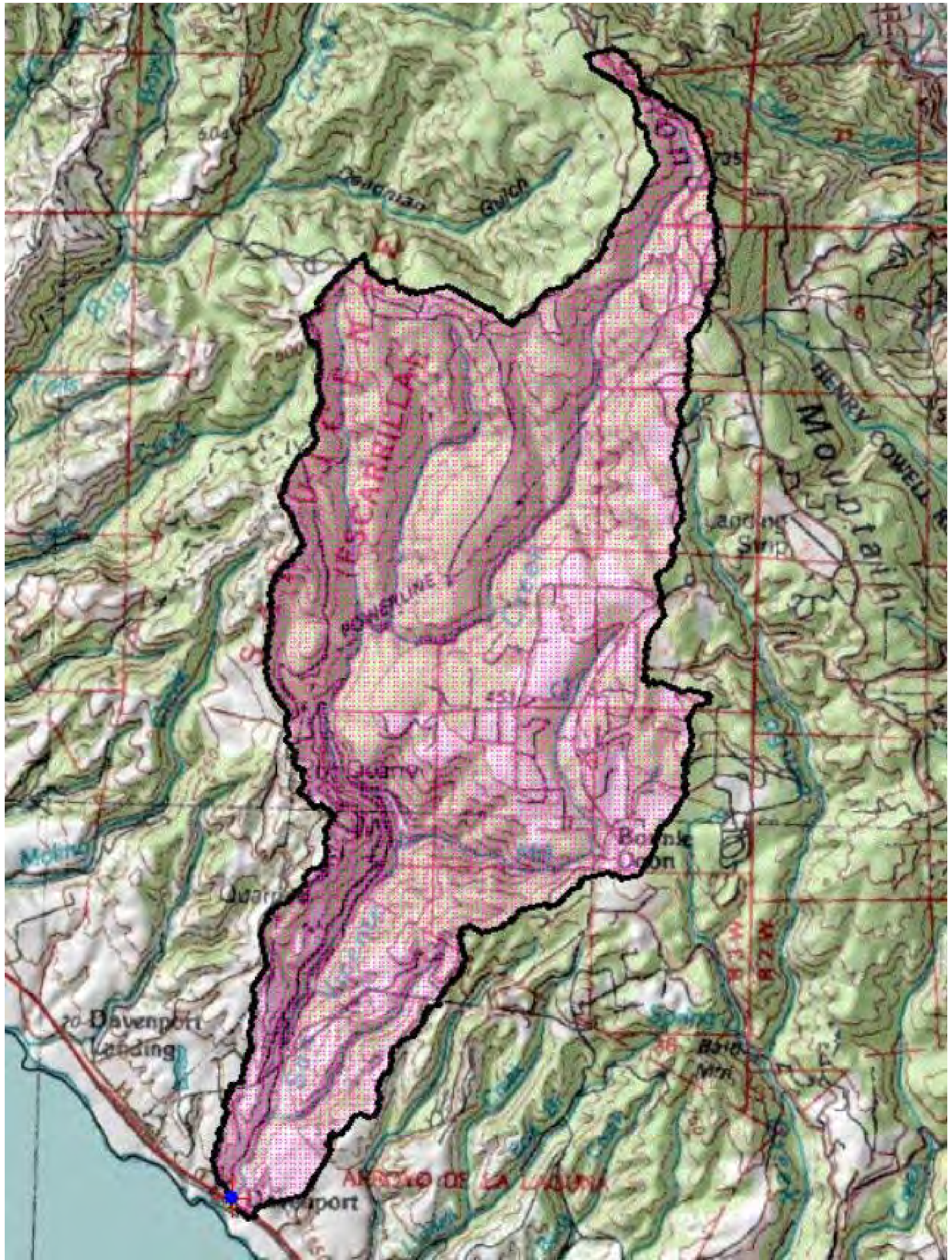
Nadia Hamey

RPF #2788

Hamey Woods



San Vicente Creek



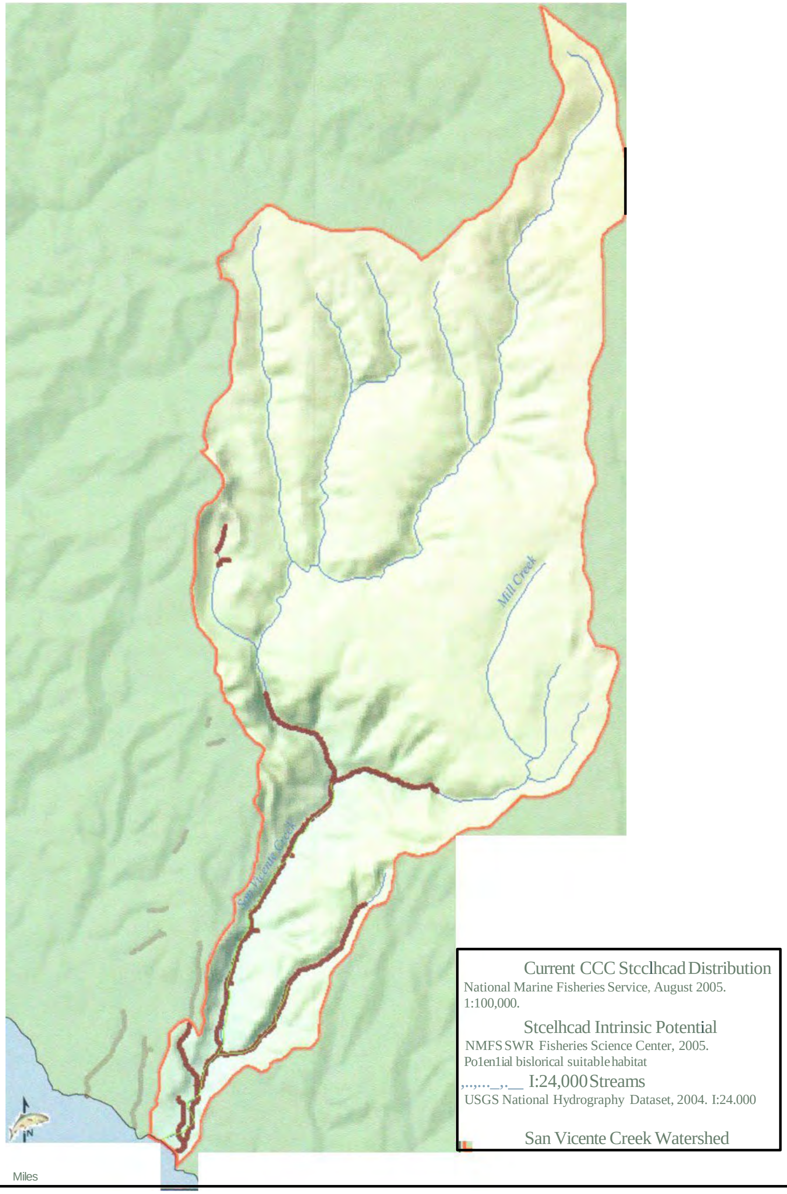
6,972 Acres
2822 Hectares
11 Square Miles

Critical Habitat for:
California Central Coast Steelhead
&
California Central Coast Coho

3 Miles of Stream Accessible

San Vicente Creek Watershed
Steelhead Current vs. Historical

NMFS SWR-HCO
July2008



~1908
Train Trestle over
San Vicente Creek

2022
San Vicente Creek
Tunnel under Highway 1

~1916
Train Trestle over
Upper Jim Creek

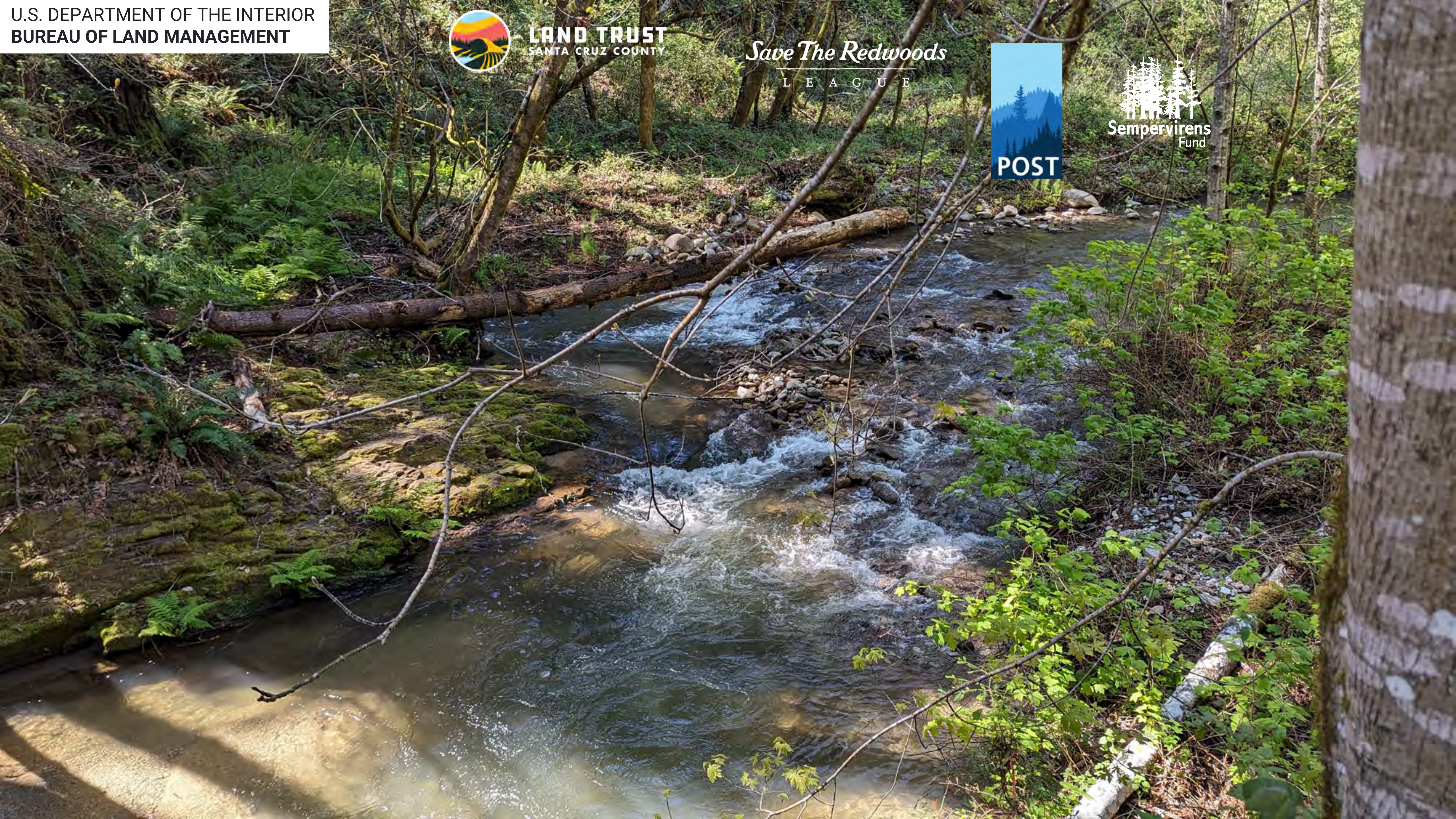
October 26, 2016
San Vicente Creek Tunnel
Barrier to Anadromy

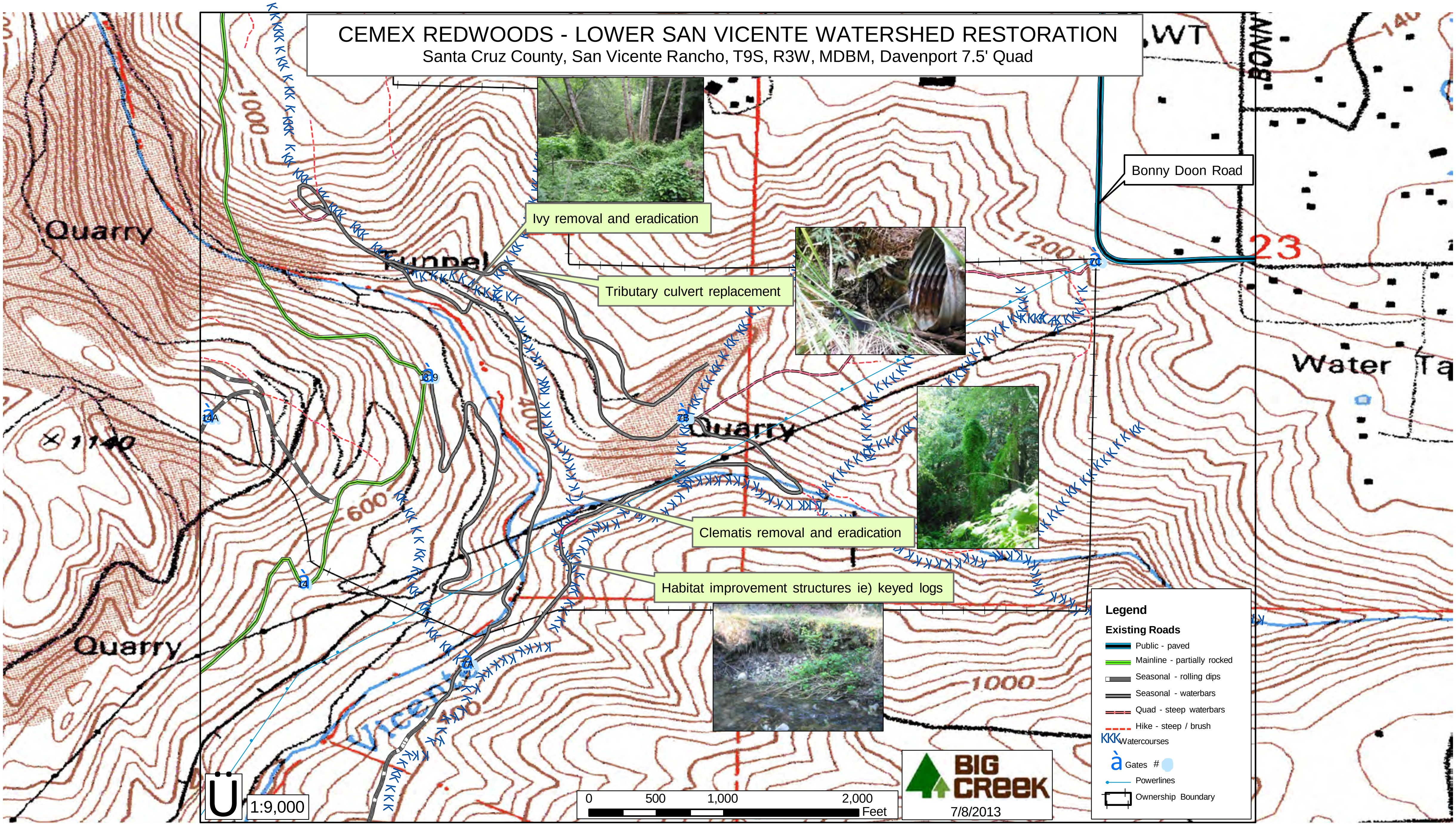
December 12, 2012
Mill Creek

October 10, 2010
Mill Creek Lower Dam

Upper Mill Creek Dam
Barrier to Anadromy

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT




CEMEX REDWOODS - LOWER SAN VICENTE WATERSHED RESTORATION
Santa Cruz County, San Vicente Rancho, T9S, R3W, MDBM, Davenport 7.5' Quad
Ivy removal and eradication
Tributary culvert replacement
Clematis removal and eradication
Habitat improvement structures ie) keyed logs
Bonny Doon Road
Quarry
Tunnel
Water
1200
1000
600
1140
23
14A
13.9
7B
7C
14
7A
Legend
Existing Roads
Public - paved
Mainline - partially rocked
Seasonal - rolling dips
Seasonal - waterbars
Quad - steep waterbars
Hike - steep / brush
Watercourses
Gates #
Powerlines
Ownership Boundary
1:9,000
0
500
1,000
2,000
Feet
BIG CREEK
7/8/2013

Jim Creek

Step-Pools

July 19, 2012
Lower San Vicente Creek
Off-Channel Pond
‘Enhancement’ Project

January 5, 2017

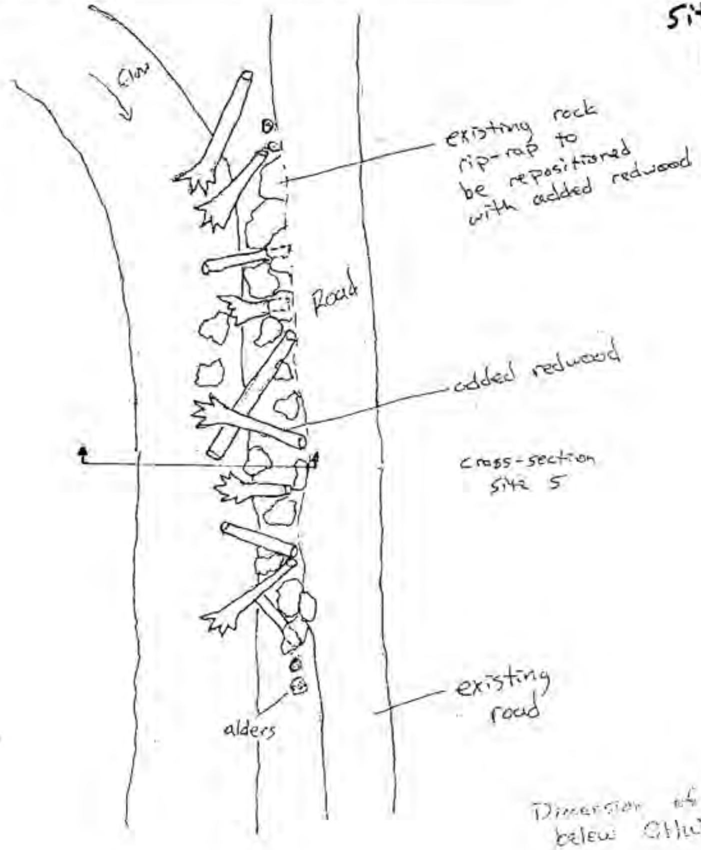
Lower San Vicente

Off-Channel Refugia

1999 40 Large Wood Anchored pieces installed

PROJECT San Vicente
ITEM Site #5
SHEET NO. ___ OF ___ SHEETS
DATE ________ 19__
FILE ________
REF. DRWG. NO. ________
COMPUTED BY ________ CHECKED BY ________

Site # 5
1" = 20'
N ↑



Dimension of activity below OHW 20yd³

Sheet 18 of 25
8/12/98

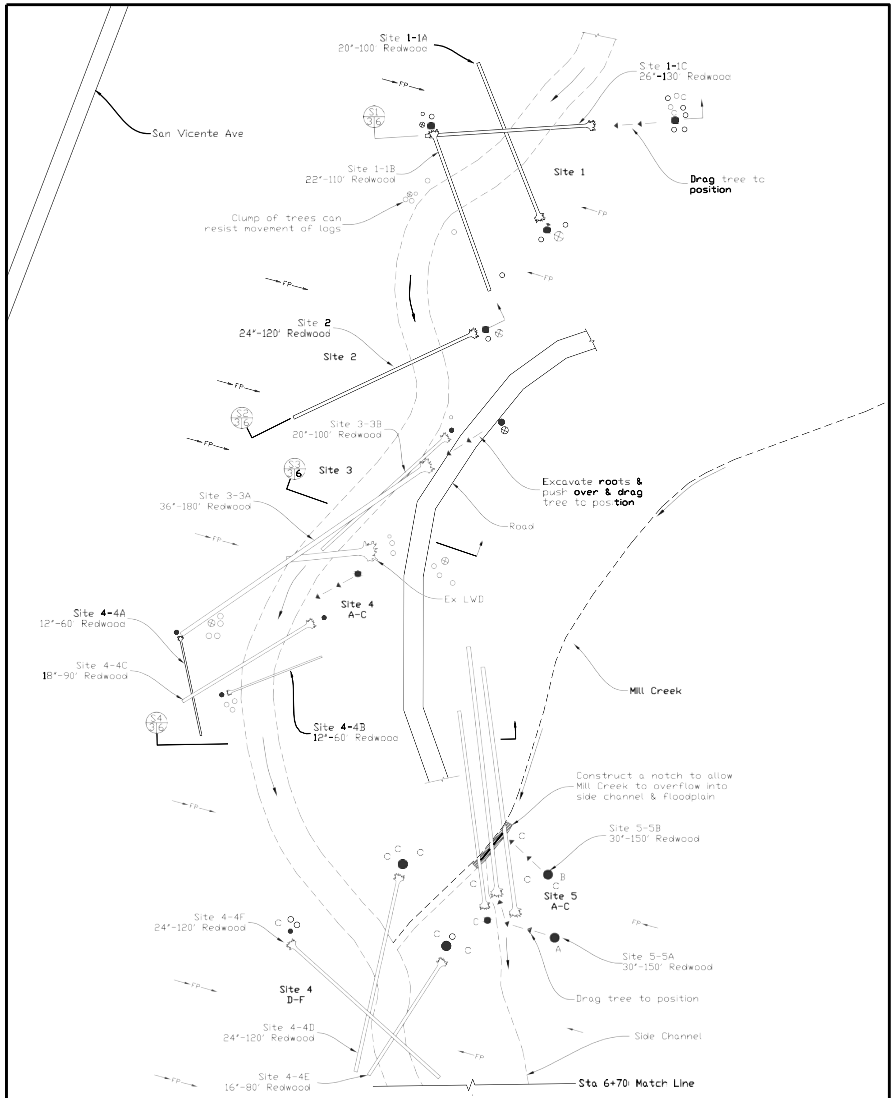
SPD FORM 1 OCT 74 284 EDITION OF 15 DEC 59 WILL BE USED UNTIL EXHAUSTED

ATTACHMENT 3

March 12, 2012
San Vicente Creek/
Mill Creek Confluence
High Flow

September 8, 2017
San Vicente Creek/
Mill Creek Confluence
After AWR

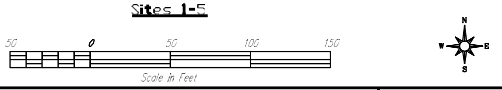
March 25, 2015
LWD Planning



Construction Notes

The intent of the site detail drawings is to show the conceptual strategy and game plan for log positioning and maneuvering. Actual log locations will be a field fit and will be in part determined by how and where the tree falls after being cut down as well as the creek topography and existing vegetation at the time of construction.

Sites 1-5



Sheet 3 of 6 | Drawing No. 2017-06 | File No.

NRCS
Natural Resources Conservation Service
United States Department of Agriculture

San Vicente Creek Large Wood Habitat Enhancement Project

Site Details 1-5

Stream Habitat Improvement & Management (395) — Santa Cruz County

Designed	Mark Barnett	Mar 2017
Drawn	Mark Barnett	Mar 2017
Checked		
Approved		

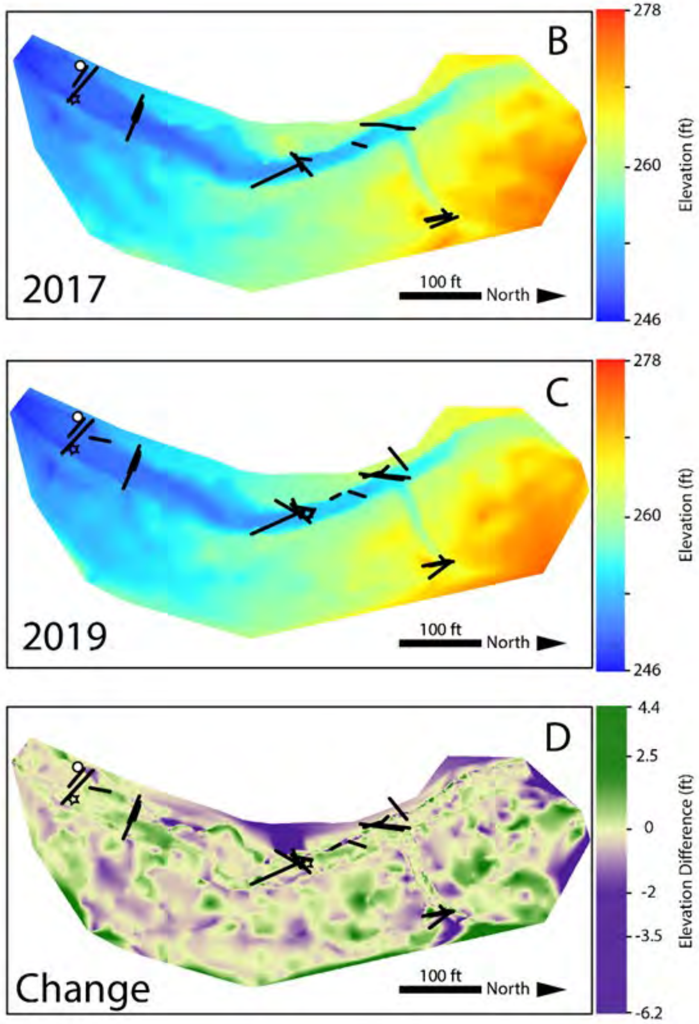
September 6, 2017
Mill Creek Overflow
Channel Excavation

September 6, 2017
Mill Creek Overflow Channel Excavation/ Large Wood Installation

February 4, 2019
Mill Creek Overflow
Post-Construction

February 4, 2019
Mill Creek Overflow
Winter Storm Activation

Photo Monitoring
Cal Poly, Swanton Pacific Ranch
Forestry and Watershed Apprentice Program
Wood Enhancement Project Photo Monitoring



Pre-construction

Post-construction

May 2018

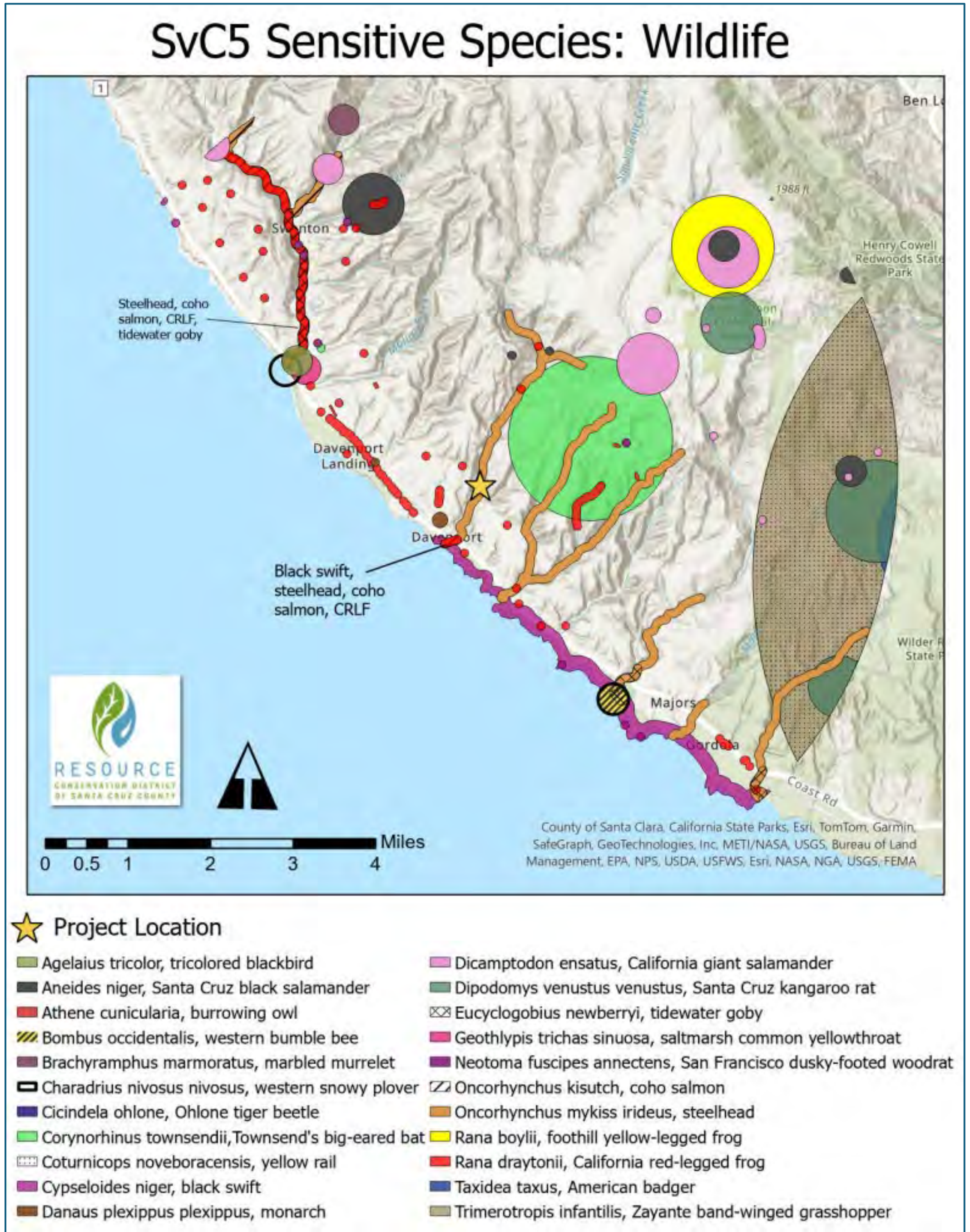
Fall 2019

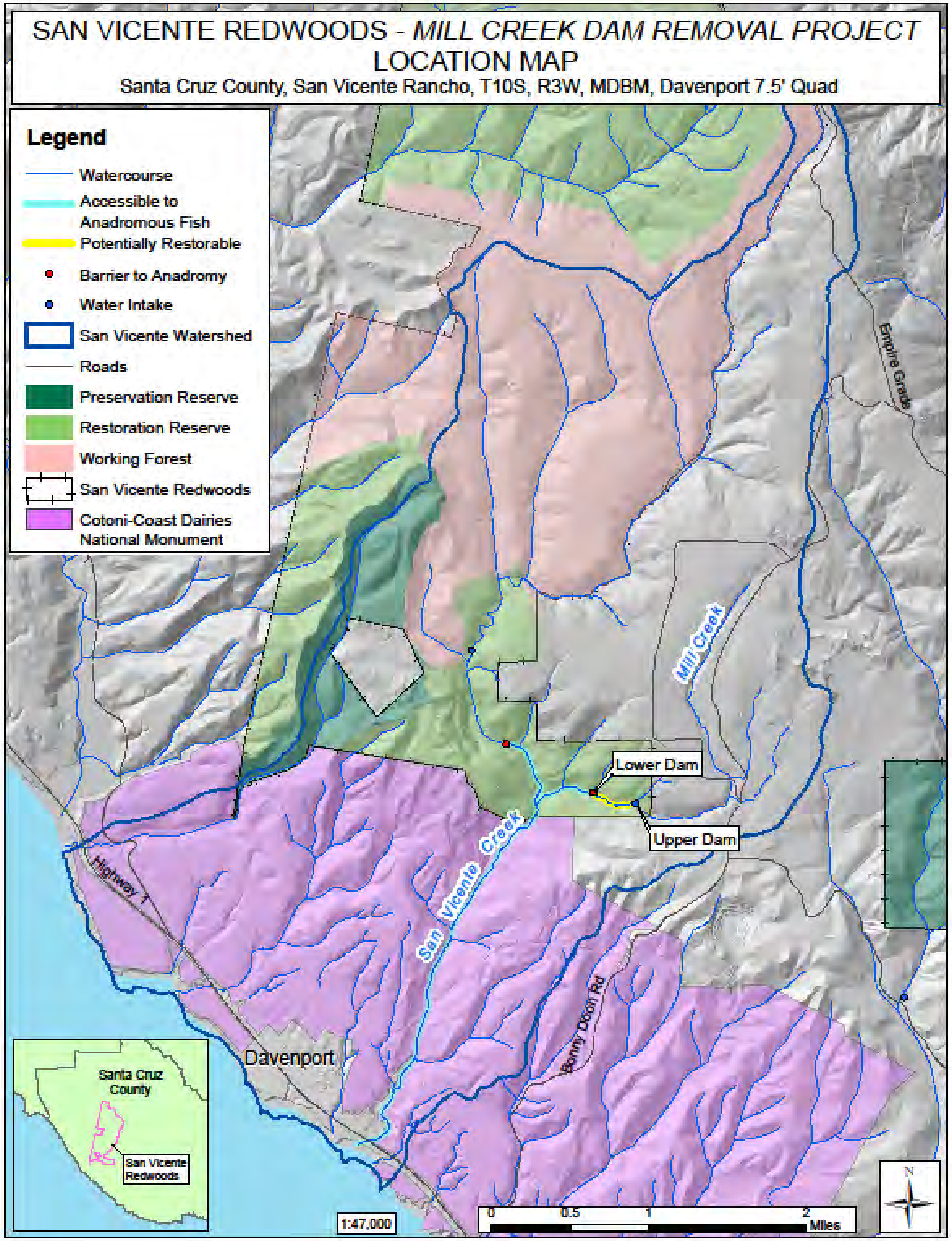
Photo Monitoring
Cal Poly, Swanton Pacific Ranch
Forestry and Watershed Apprentice Program
Wood Enhancement Project Photo Monitoring

Pre-Construction

Post-Construction

Map of Special-Status Wildlife







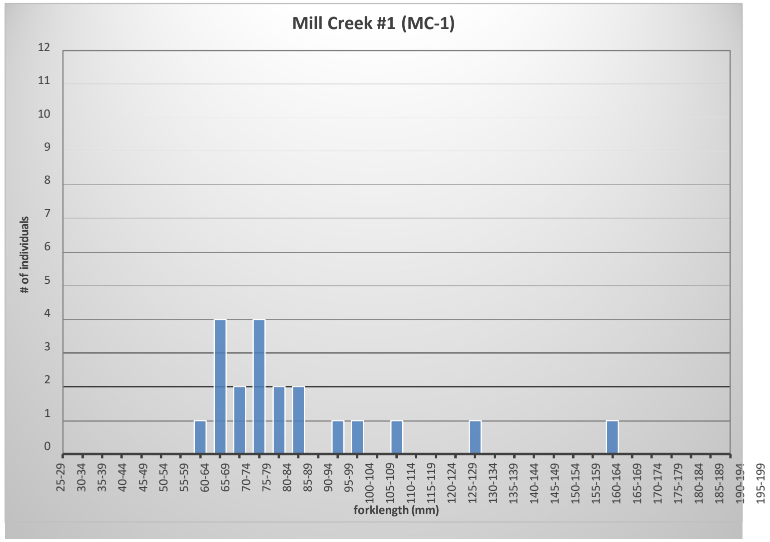





San Vicente Redwoods Juvenile Salmonid Monitoring Program 2022-2024

Prepared by: Mike Podlech, Aquatic Ecologist

With Field Assistance From: California Department of Fish & Wildlife, *Alnus* Ecological, Amah Mutsun Land Trust



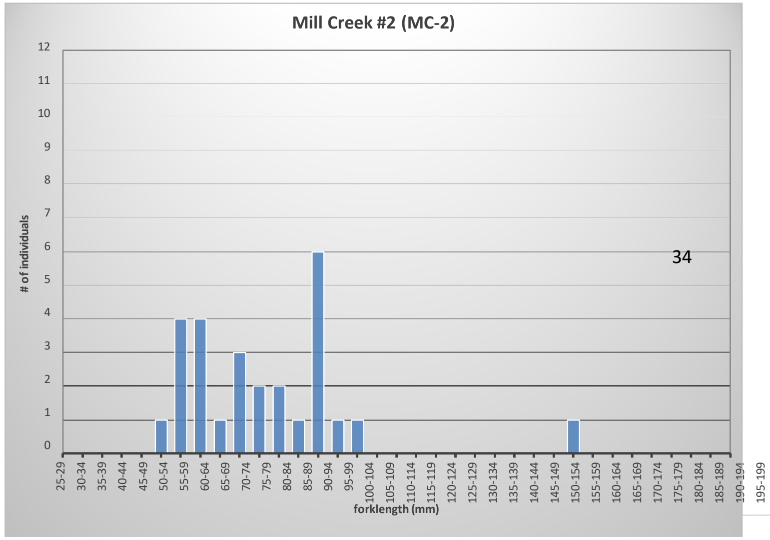
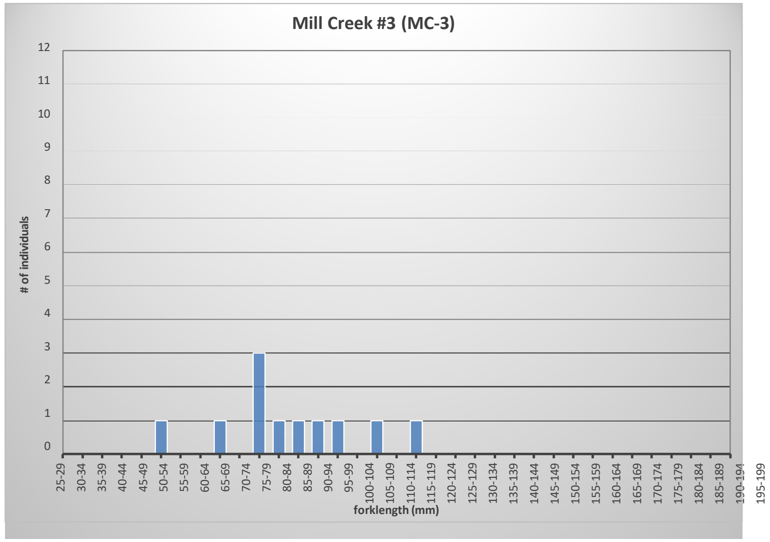


Figure 3. Forklength Distributions of Juvenile Steelhead at Four Sampling Sites on the San Vicente Redwoods Property, September 2024



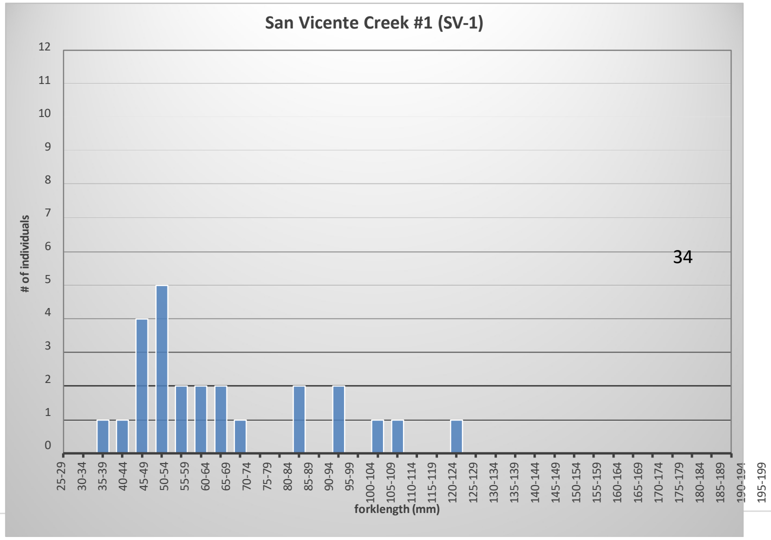


Figure 3 (cont.). Forklength Distributions of Juvenile Steelhead at Four Sampling Sites on the San Vicente Redwoods Property, September 2024

Mill Creek Dam

- Juvenile Salmonid and Habitat Monitoring

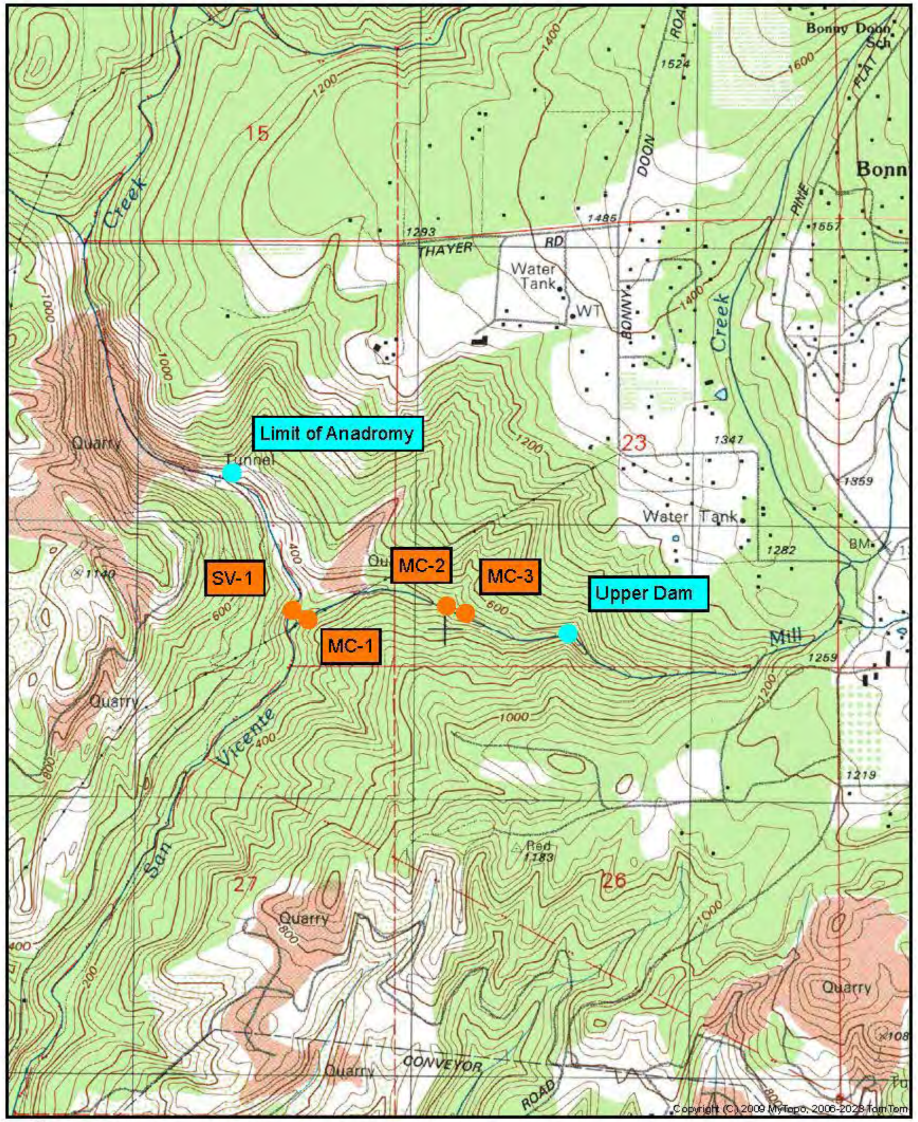


Figure 1. Sampling Sites and Fish Passage Barriers on the San Vicente Redwoods Property

Photo 1. MC-1

Photo 2. MC-2

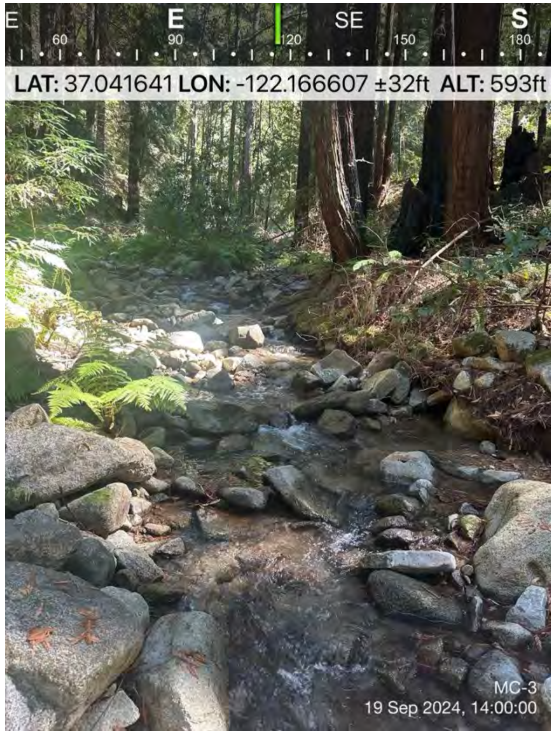


Photo 3. MC-3

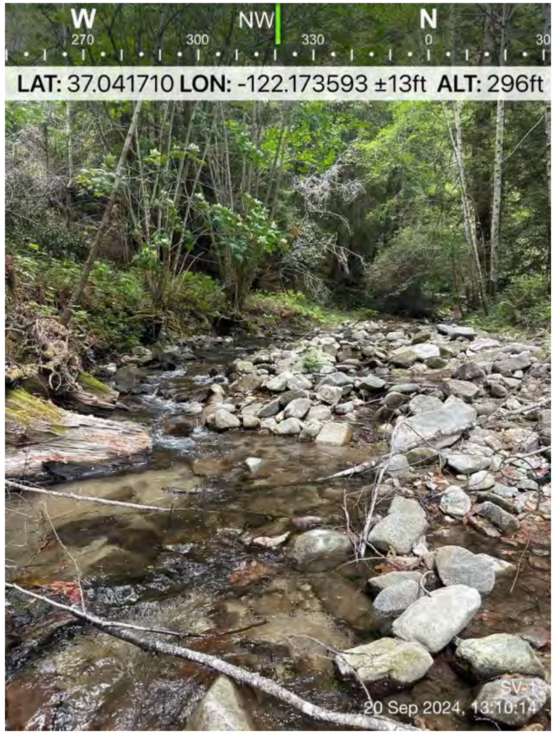


Photo 4. SV-1

January 28, 2015
Lower San Vicente
Floodplain
Clematis Removal Trials

2018-2021

Invasive Species Control

-Clematis

-Cape Ivy

Monitoring Transects

October 26, 2016,

Riparian Acacia Removal

Monitoring

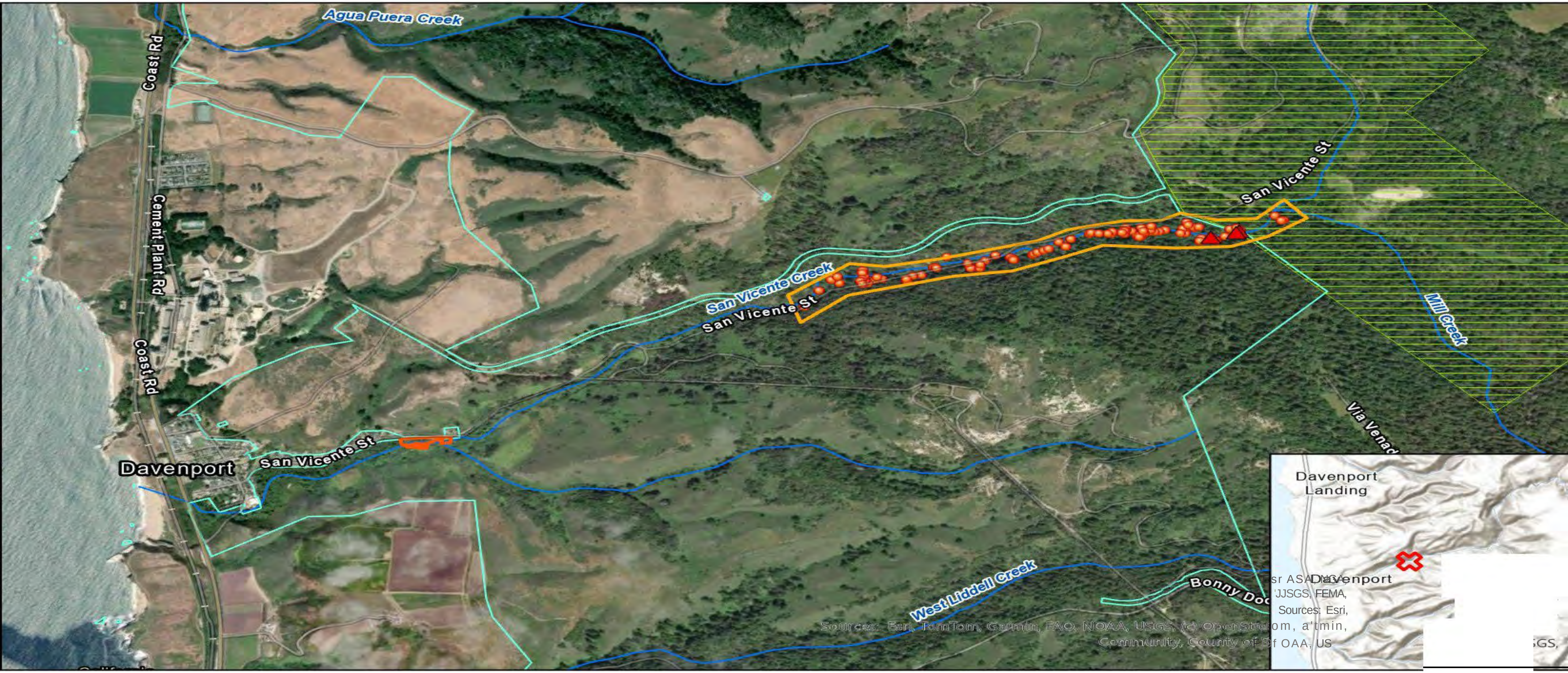
- Juvenile Salmonid Monitoring
- Clematis Monitoring Transects
- Electrofishing Surveys
- San Jose State University Research
- UCSC and Doris Duke Scholars Macroinvertebrate Studies

2021

NOAA - Fish relocation efforts

San Vicente Creek Future Accelerated Wood Recruitment/ Redwood Thinning

San Vicente Creek Instream and Riparian Restoration Project Phase 1



Legend

Accelerated Recruitment	San Vicente Redwoods
Trees Tagged for Felling	Cotoni-Coast Dairies NM
Invasive Plant Removal	

0 0.130.25 0.5 0.75 1 Miles

RESOURCE CONSERVATION DISTRICT OF SANTA CRUZ COUNTY

Accelerated Wood Recruitment Project

The following tree selection considerations were observed during tree marking:

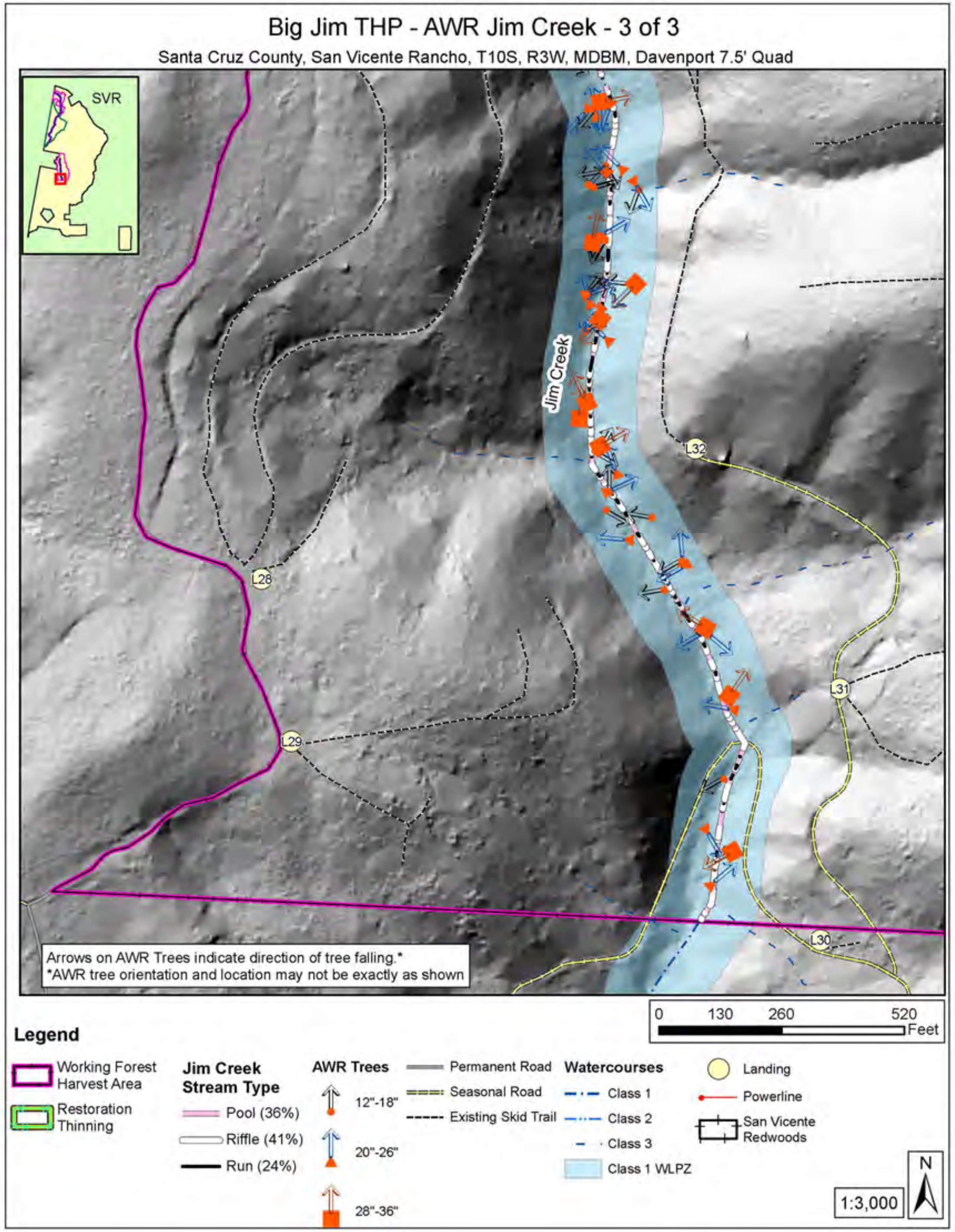
1. Trees that are **safe** to fall.
2. Trees that are **second-growth coast redwood** for instream longevity.
3. Trees that are amongst the **median size class** distribution found within the riparian forest stand.
4. Trees that are **unlikely to fall** naturally into the channel in the near future, such as bankside, leaning trees.
5. Trees that are **not located** within or adjacent to an **unstable area**.
6. Trees that are a **part of a group** or clonal group to minimize effects on streambank stability and promote stump sprouting.
7. Trees that do **not contribute significantly to stream shade** where it is currently at or below WLPZ canopy retention standards.
8. Trees that do **not provide significant habitat** for terrestrial species (ex: nest and den trees)
9. Trees that can fall with **minimum breakage**.
10. Trees that are minimum **1.5 to 2 times the bankfull width** in height or could be felled in a way that they can be wedged between existing trees or stumps and be more likely to remain in place and continue to function. LWD less than 1.5 times channel width is suitable if placed upstream of appropriately sized logs to form a log cluster.
11. **Consider risks** to known downstream infrastructure if felled trees moved out of the project reach.


Agua Puera C
San Vicente Creek
Davenport
San Vicente St
Coast Rd
West Liddell Creek
Liddell Creek
California Coastal National Monume
San Francisco
San Jose
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, USGS
Esri, NASA, NGA, USGS, FEMA, Sc
USGS, © OpenStreetMap c
Cotoni-Coast Dairies NM
San Vicente Redwoods
Trees Tagged for Felling
Floodplain Restoration
Invasive Removal
Accelerated Recruitment
0 0.1 0.2 0.4 0.6 0.8
Miles
N

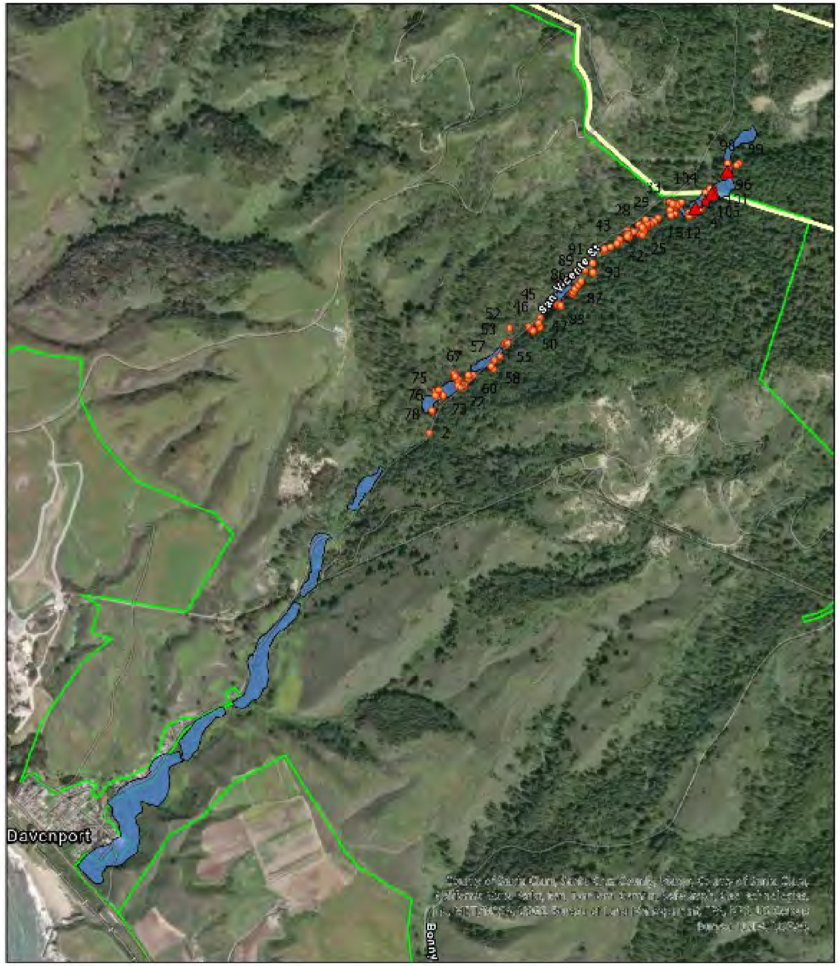
Jim Creek

Pre-Fire AWR Marking Tally

Redwood		Tanoak (Restoration Reserve only)	
DBH (in)	**Count**	**DBH (in)**	**Count**
8	4	**8**	0
10	20	**10**	2
12	44	**12**	7
14	60	**14**	11
16	57	**16**	8
18	62	**18**	10
20	44	**20**	1
22	29	**22**	3
24	35	**24**	3
26	15	**26**	3
28	10	**28**	1
30	5	**30**	0
32	4	**32**	1
34	3	**34**	0
36	1	**36**	0
Total	**393**	**Total**	**50**



San Vicente Creek Streamwood Enhancement Project



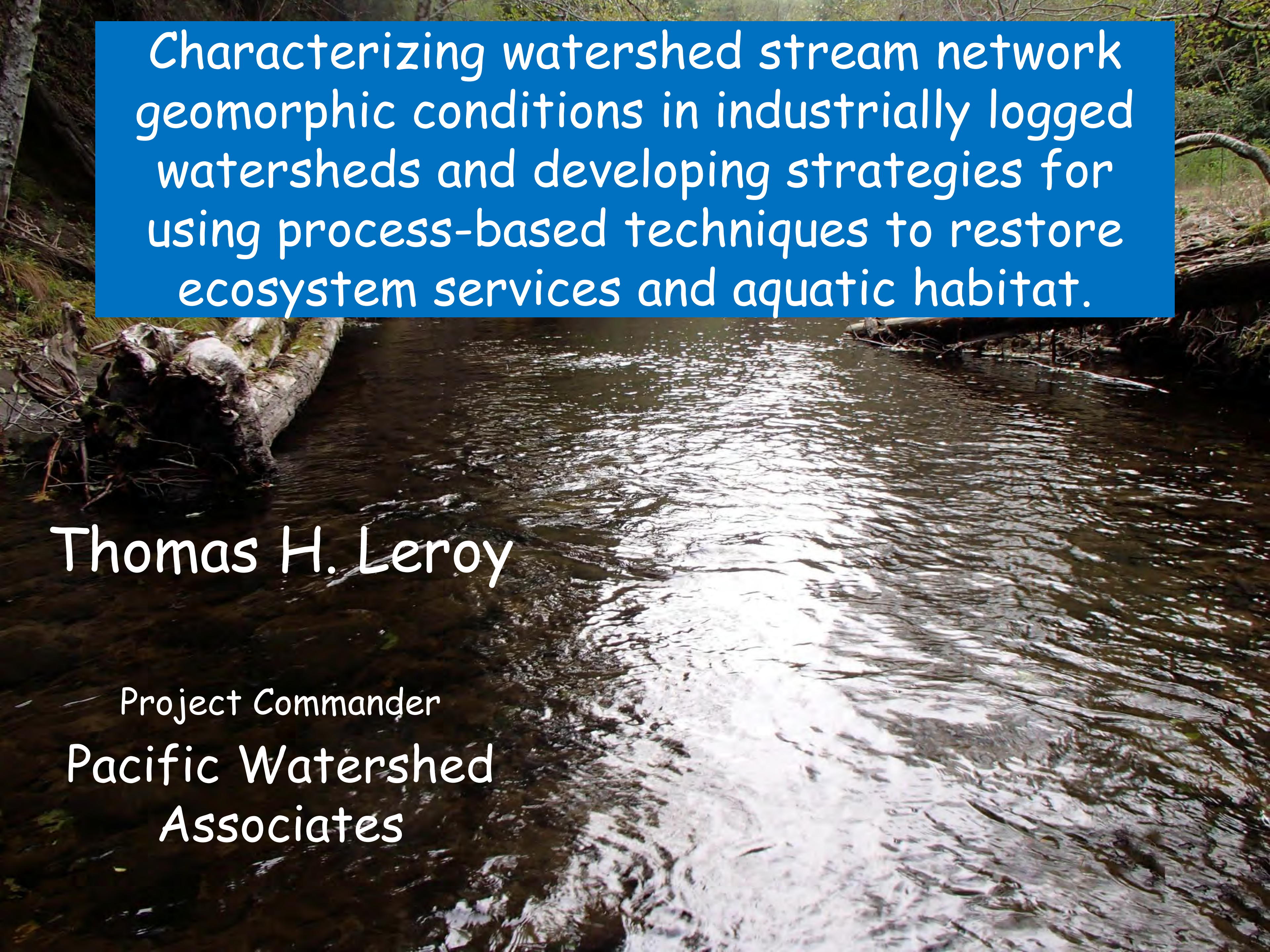
Legend

Jim Robins - IWRP TAC and technical advisor to the RCDSCC
Mike Podlech – fisheries biologist
Kristen Kittelson – County fisheries expert
Dave Hope – County fisheries expert
Daniel Nylen – RCDSCC
Kelli Camara – RCDSCC
Sara Sternberg - RCDSCC
Ben Cook – fisheries expert
Sean Hayes – NOAA fisheries biologist
Chris Blencowe – AWR expert
Ken Smith – Timber faller
Dr. Gabet – SJSU
Brian Dietterick – Cal Poly – SLO
Jon Jankovitz – NOAA
Kit Crump - NOAA
Ian Bornarth – Photographer (time lapse)
Dave Sands – Go Native Restoration
Chuck Kozack – Go Native
Beatrix Jimenez-Helsley – Sempervirens Fund
Ian Rowbotham – Sempervirens Fund
Chad Moura - UCSC
Abe Borker – UCSC
Amah Mutsun Land Trust

Thank you!


Steelhead Kerfuffle
November 12, 2021

Characterizing watershed stream network geomorphic conditions in industrially logged watersheds and developing strategies for using process-based techniques to restore ecosystem services and aquatic habitat.

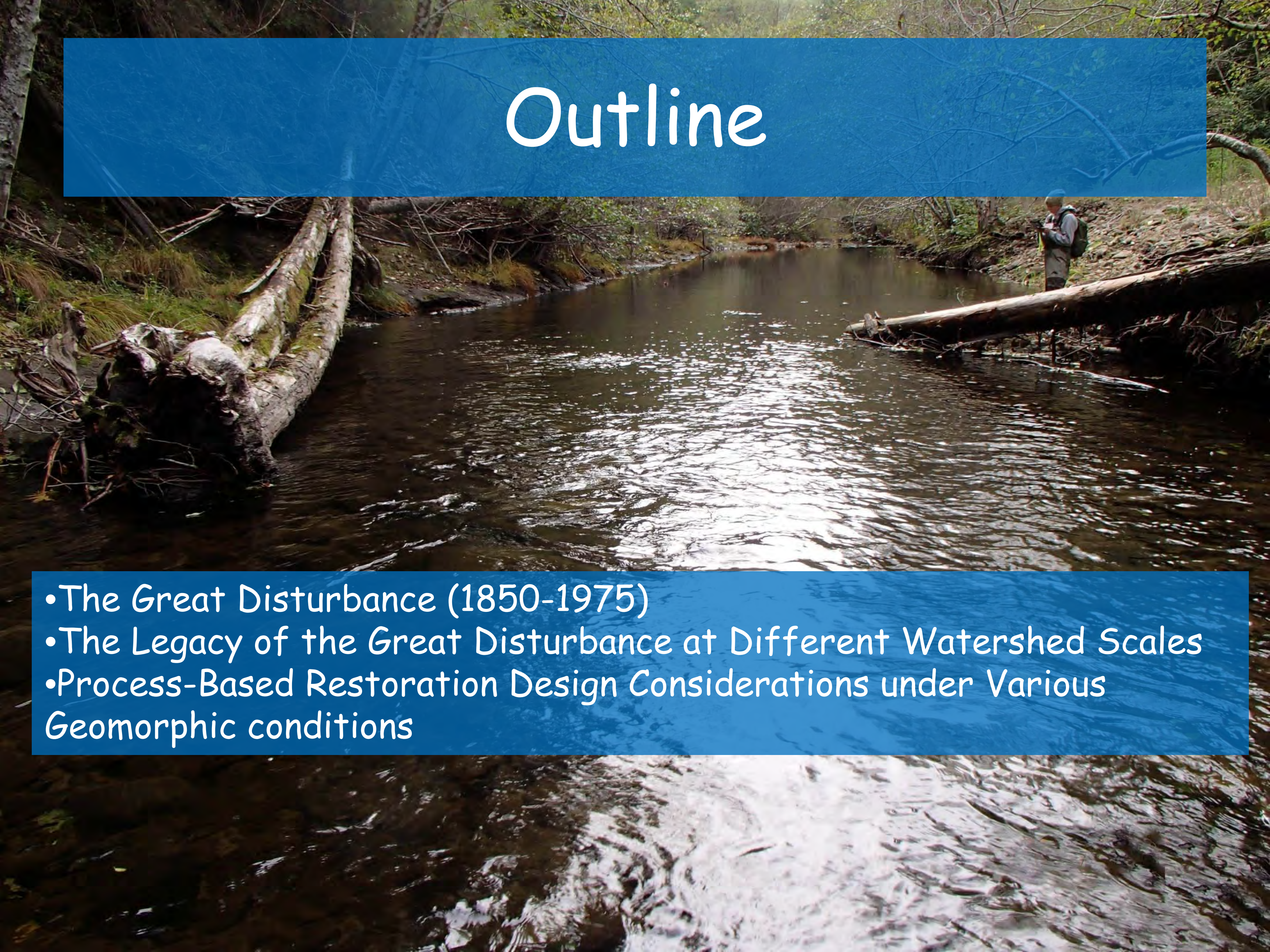


Thomas H. Leroy

Project Commander

Pacific Watershed Associates


People and organizations that helped develop these thoughts
CDFW
Redwood Forest Foundation
CA State Parks
ERWIG
Trout Unlimited
Brian Cluer
Richard Geinger
Dan Resnik
Many others



Outline

- The Great Disturbance (1850-1975)
- The Legacy of the Great Disturbance at Different Watershed Scales
- Process-Based Restoration Design Considerations under Various Geomorphic conditions

Takeaways

- Undisturbed stream processes function in a dynamic equilibrium. After large landscape scale disturbance events, they get knocked out of equilibrium and, through extended time periods, gravitate to a new equilibrium by adjusting to their new conditions until they settle into a new dynamic equilibrium.
- Understanding where your project stream is in this post disturbance adjustment phase, and the current trajectory of the recovery process, is critical to developing a good restoration project.
- Evaluate your project stream reach and determine if the channel evolution model for your project area should include a phase of sediment deposition.
- Different sized stream reaches respond and recover differently to large disturbance events.

Brief Summary of the Most significant Impacts From The Great Disturbance

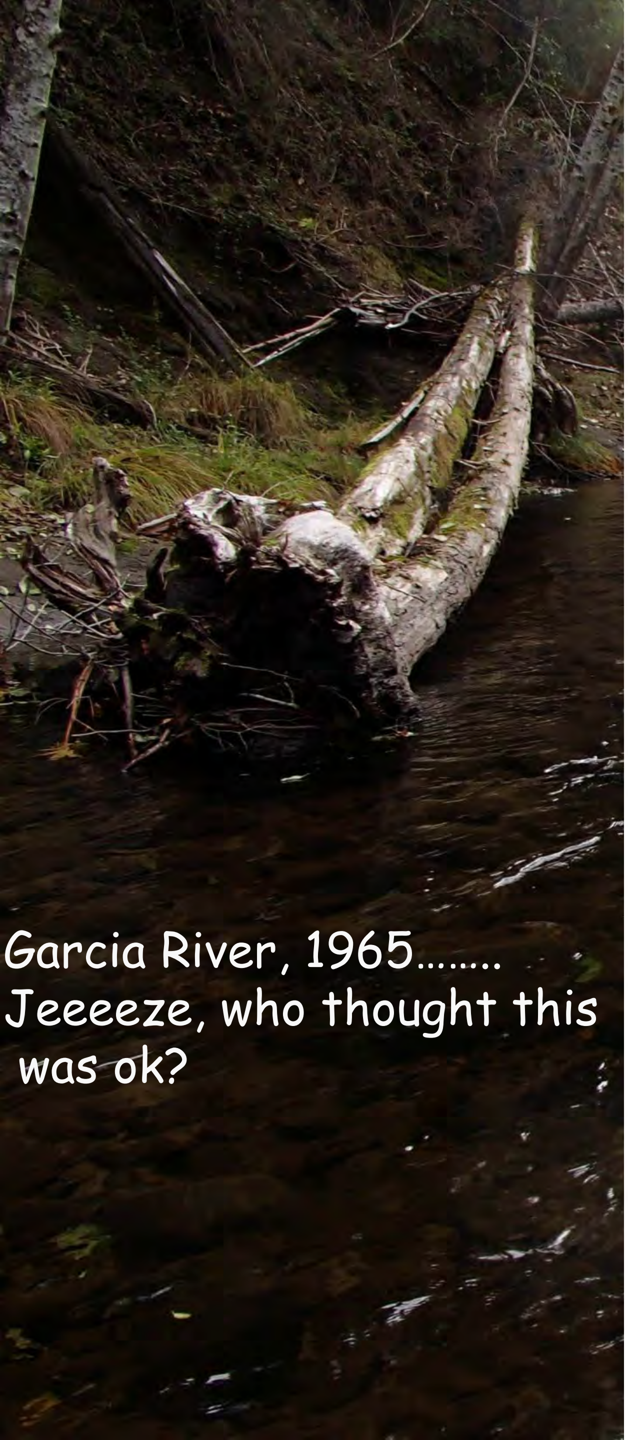
<u>Surface water hydrology</u>- Road and skid road systems tend to unnaturally increase storm runoff into the stream network…..

<u>Shallow groundwater hydrology</u>- Roads and skid roads are often cut into the hillside to the extent that they intercept and drain shallow groundwater…

<u>Watershed scale sediment budgets</u>- Initially, huge volumes of sediment were discharged into the watershed stream networks…Now, many stream reaches are incised and sediment starved! ….How the heck does this happen?

- Impacts to sediment inputs
- Impacts to sediment routing
- Impacts to sediment deposition

<u>Roughness elements generally eliminated from many watercourses</u>- geomorphic simplification of stream channel landforms and removal of large woody debris, allows local stream energy to scour and route material rather than resort the material locally into complex channel landforms that become the basis for habitat….


Garcia River, 1965........
Jeeeeze, who thought this
was ok?


1:20,000
-22-65
FF-20

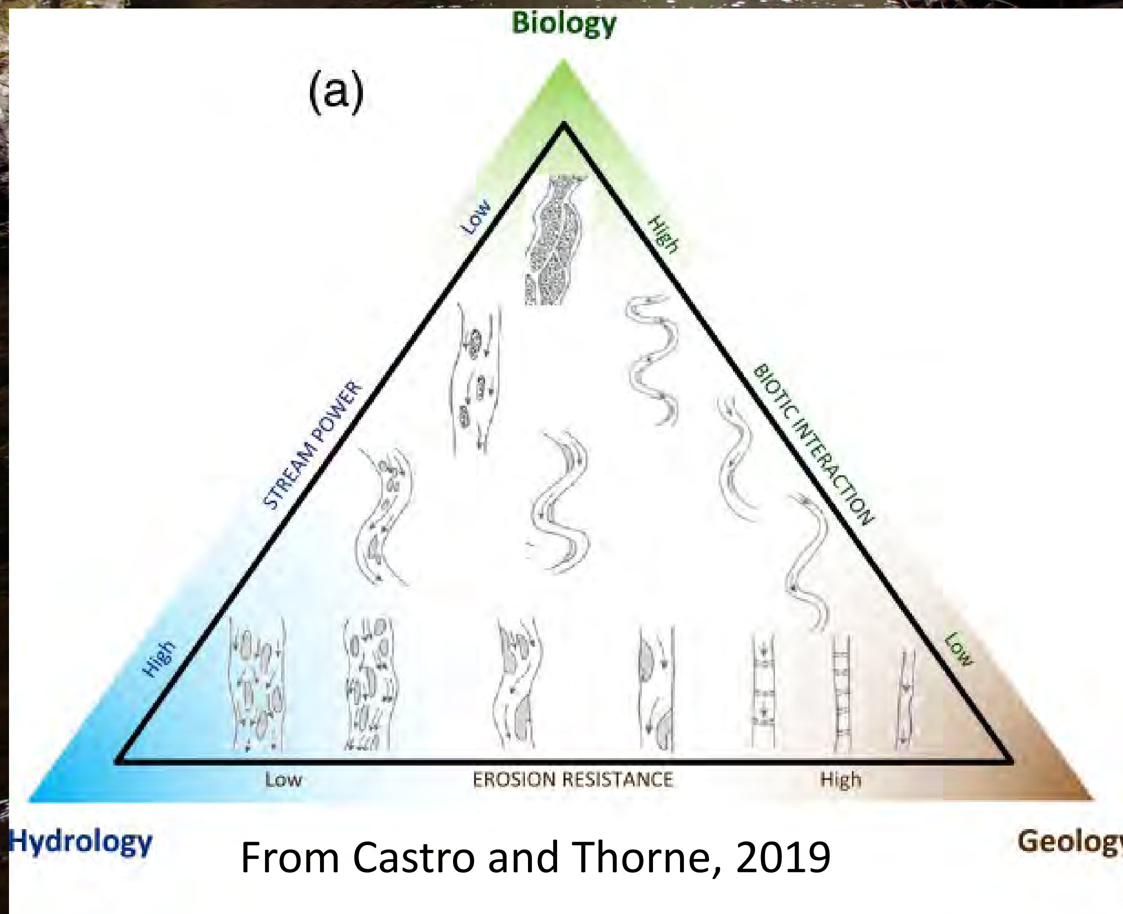
Redwood Creek, Northern California Circa 1970

Rowdy Creek, Northern California

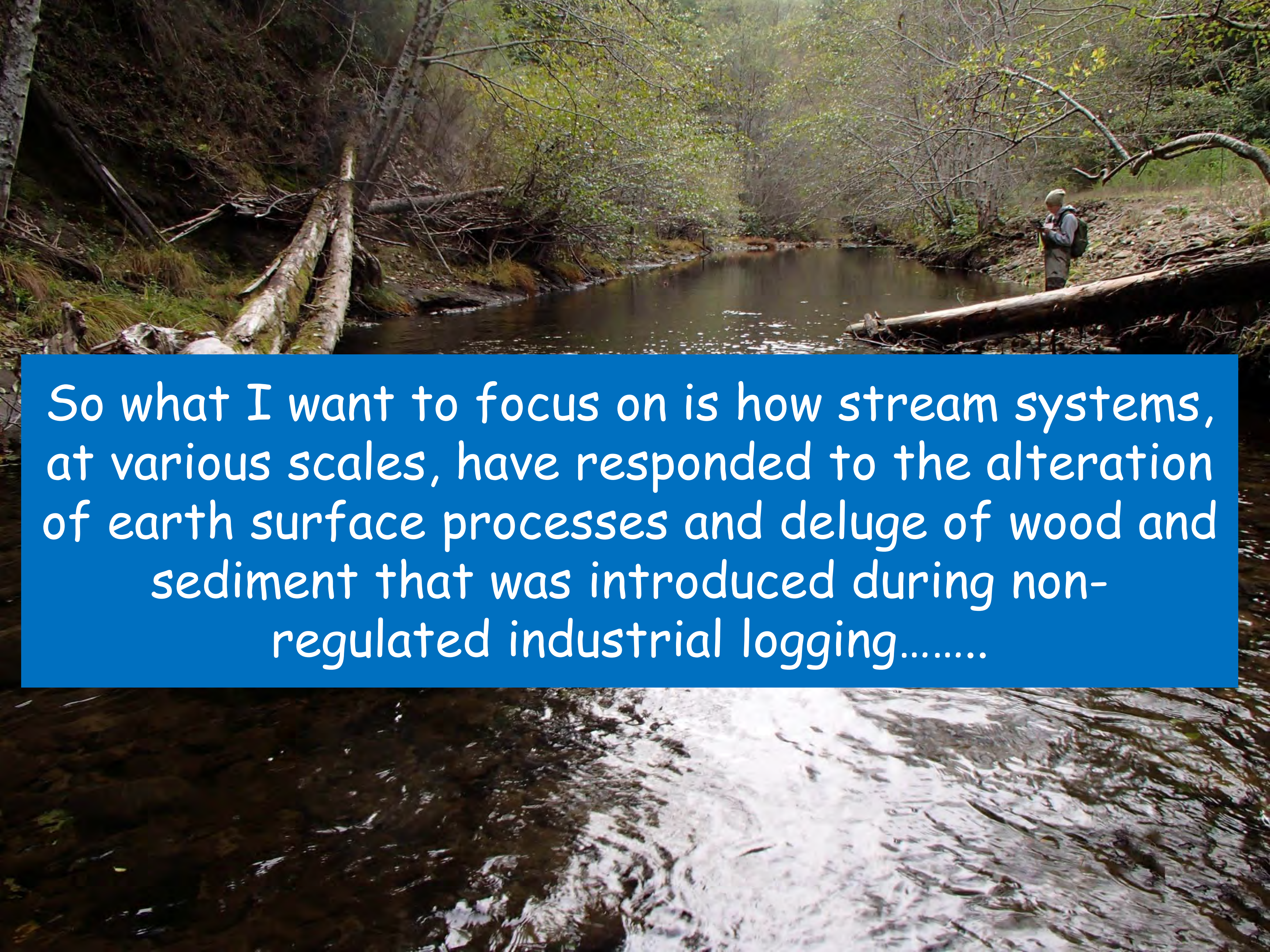
What governs stream morphology in the coastal watersheds of Northen California?

And in turn available aquatic habitat

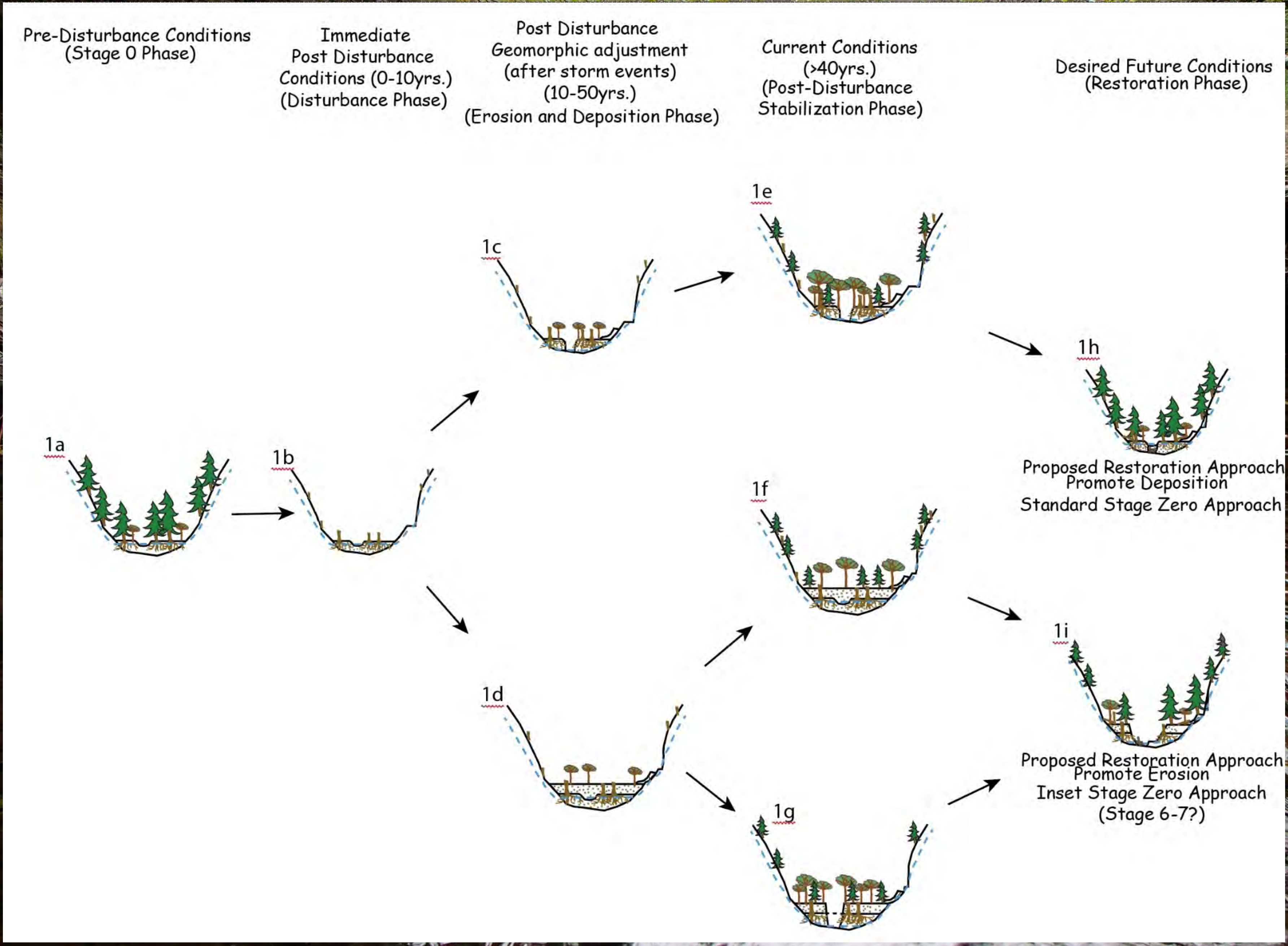
Water, Wood, and Sediment



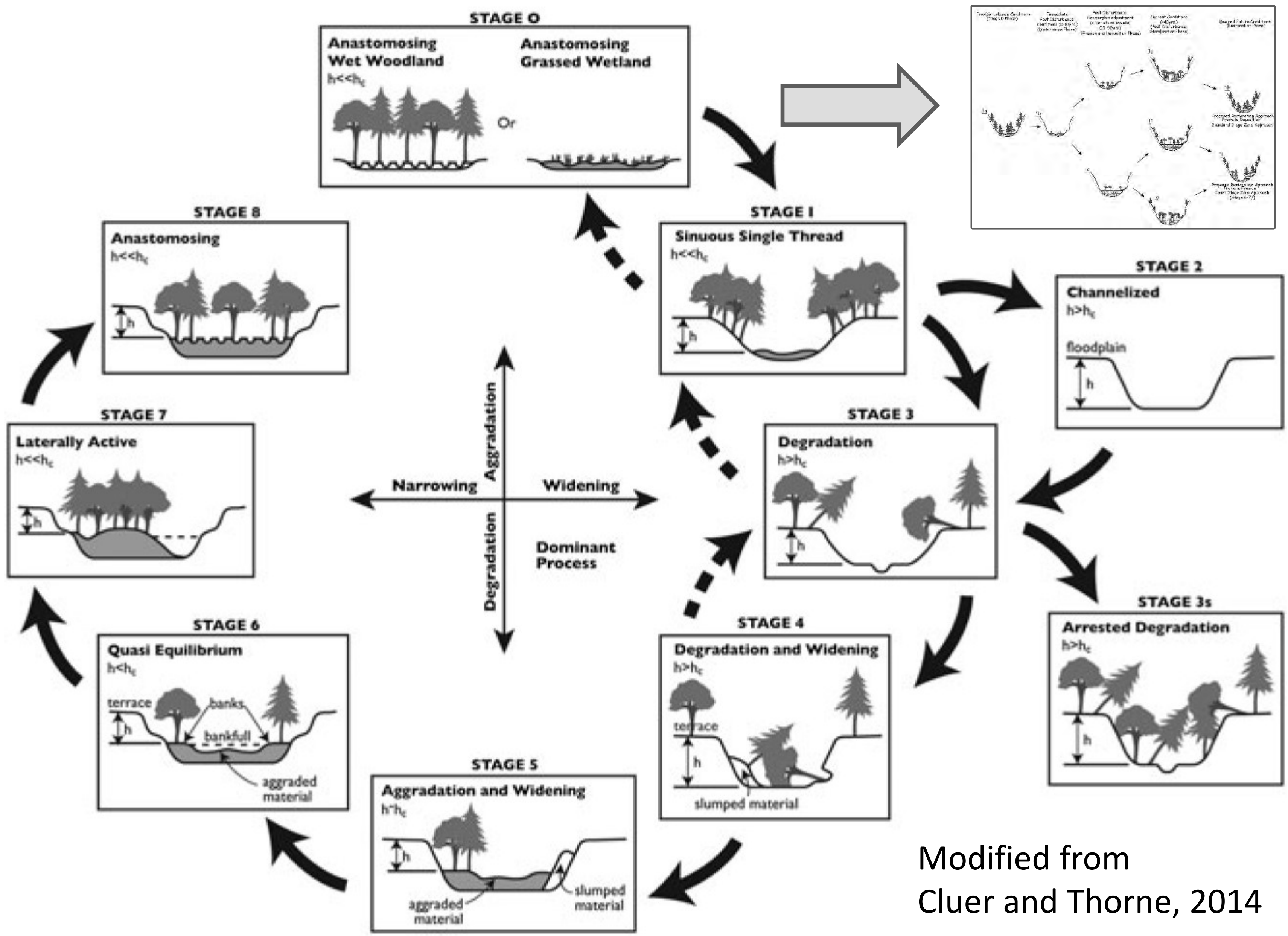
From Castro and Thorne, 2019


So what I want to focus on is how stream systems, at various scales, have responded to the alteration of earth surface processes and deluge of wood and sediment that was introduced during non-regulated industrial logging…….

Channel Evolution Model - High Energy Environment



Shamelessly Updated Stream Evolution Model



Modified from
Cluer and Thorne, 2014

The Aftermath of the Great Deluge

(Post-Deluge Fluvial-Geomorphic Adjustments)

(1) Small fish bearing streams, <500 acres of watershed area, tend to be incapable of routing the accumulated large woody debris.

(2) Medium sized fish bearing streams, 500-5000 acres, exhibit the power to entrain and resort the accumulated woody debris and sediment and hence develop fluvial geomorphic landforms suitable for anadromous fish habitat.

(3) Larger stream systems, 5000-500,000 acres and estuaries, tend to be areas of sediment deposition where earthen material routed from the upper watershed tends to persist on the landscape.

The Aftermath of the Great Deluge

Think about the sediment and wood associated with the Great Deluge as a slug or wave moving through the watershed system

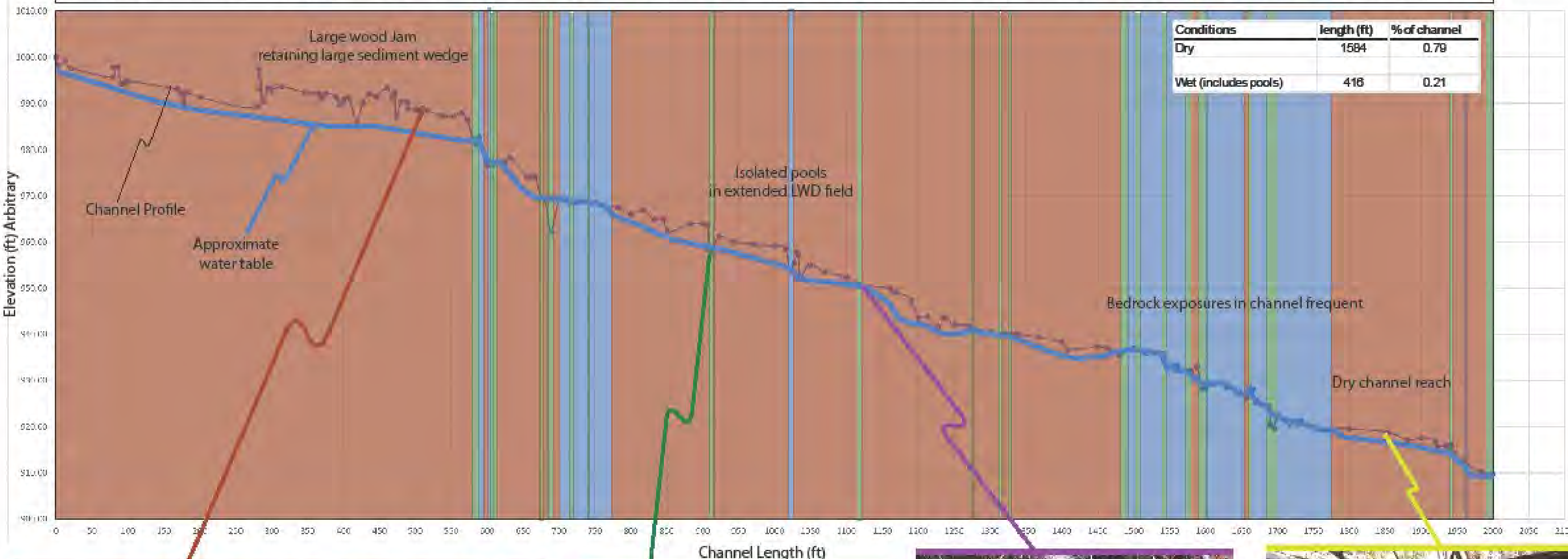
(Small Streams, >500 acre watershed area
Current existing conditions

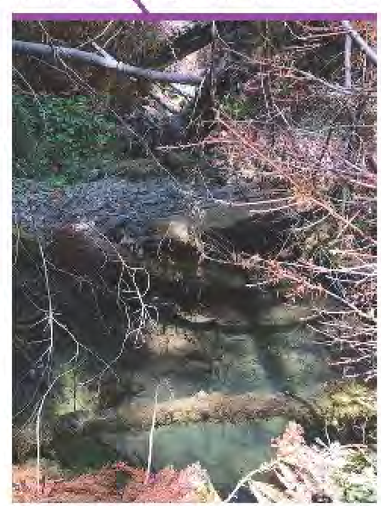
(1)Small fish bearing streams tend to exhibit an uneven distribution of large wood and sediment where intermittent large wood jams retain a disproportionate amount of channel substrate while stream reaches in between the large wood jams exhibit signs of channel incision and larger more angular substate.

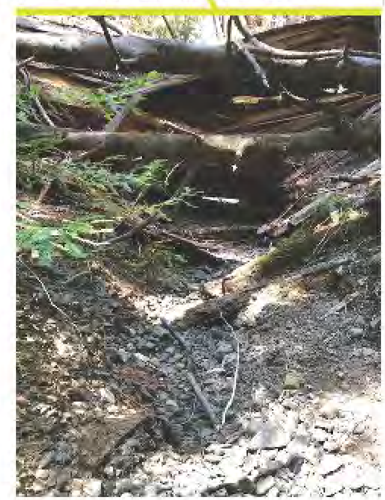
(2) The large wood jams in these systems tend to be flow dependent, temporal fish barriers.

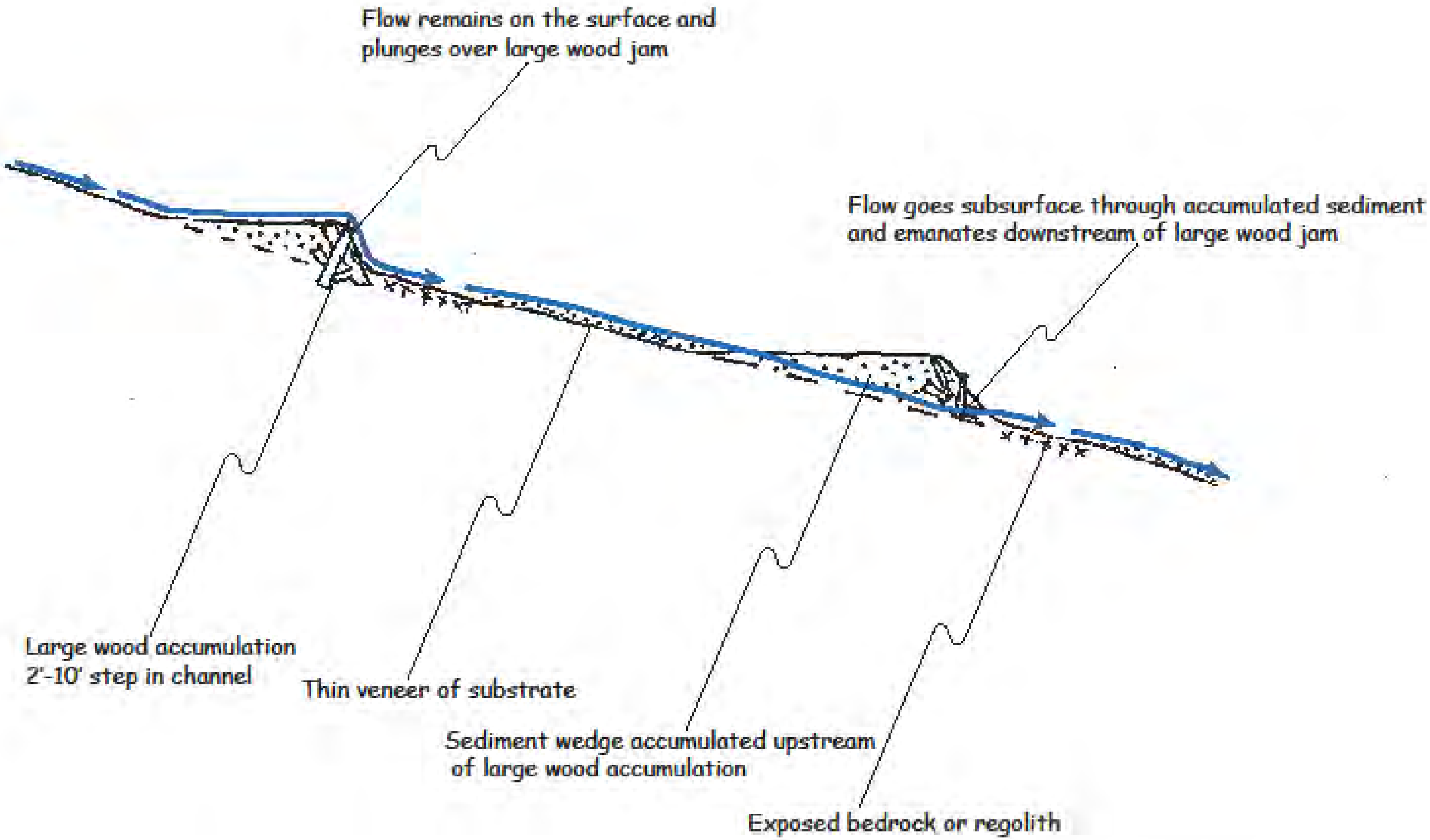
Long Profile and Wet/Dry Mapping

Long profile and wet/dry mapping results in Kline Gulch, Mendocino County California. Note the approximate elevation of the water table and the observed late summer intermittent surface flow conditions. These geomorphic conditions are a result of post-deluge adjustments of the stream system where sediment was mostly routed out of the system but the stream does not have the power to route the large wood accumulations









Conceptual stream profile of a small stream after significant disturbance and post-disturbance adjustments

Incised stream channel in Yale Creek, note roots protruding from both sides of the channel banks

Stream channel in Yale Creek exhibiting sediment aggradation and subsequent incision

Stream channel in Yale Creek exhibiting minor incision, note the basal flare on the redwood stump

(Small Streams, Restoration Considerations)

Important Surveys and thoughts to inform designs

(1) Characterize the distribution and magnitude of large wood and substrate accumulations
(2) Document the surface water conditions throughout the summer
(3) OG Redwood stumps can help identify reaches of historic incision/aggradation
(4) Long profiles can help delineate stream reaches exhibiting sediment deposition/erosion
(5) The large wood jams in these systems tend to be flow dependent, temporal fish barriers
(6) Think of the Great Deluge as a slug or wave of increased sediment supply that has swept through any given stream reach

Prudent Restoration Approaches

(1) Base restoration approaches on identification of which CEM phase you're in
a) If the channel is fully or partially incised into a thick anthropogenic sediment deposit, consider restoration approaches that promote lateral scour and development of inset landforms to form complex habitat and employ stream energy
b) If the channel is incised into a native surface, consider approaches that raise the channel bed by retaining channel substrate……(Stage zero)

(2) Redistribute large wood and substrate in areas of heavy accumulation/retention into areas of channel incision (Think mass balance rather than removing high spots). The wood and substrate in most channels are a resource to be embraced and reused
(3) Keep your wood, sediment and energy on your property as long as possible
(4) As always, careful what you wish for……….

Existing Conditions

Medium sized streams, 500-5000 acres

Current existing conditions

(1) Medium sized fish bearing streams tend to exhibit a complex history of sediment and large wood accumulation followed by resorting of the accumulated material into fluvial-geomorphic landforms scaled to the watershed area

(2) These channel reaches can exhibit elevated fluvial-geomorphic landforms that are a legacy of the initial deluge and subsequent resorting and not a result of stochastic runoff events.

(3) These stream reaches have the power to route both sediment and large wood out of the system often resulting in relatively simplified channel morphology and poor substrate conditions…They can also create some massive log jams….

(4) These reaches are where anadromous fish populations tend to have consistent access and are afforded a mosaic of complex habitat

(5) These are the channel reaches where CDFW habitat inventories and associated restoration manual activities have the most relevancy

(6) Many of the desired future conditions in these channel reaches can be achieved by adding large wood to the system and allowing natural processes to develop a mosaic of complex landforms….Process-based restoration!!!

(7) Many of these reaches could use riparian restoration to accelerate the natural process of large wood recruitment to the stream channel


Log Jam

Large wood and sediment accumulation

Large wood jam creating step (temporal, flow dependent fish barrier) in a stream channel

Blown out wood jam


Moody Creek log jam fish barrier,
View looking upstream at log jam


Moody Creek
log jam
fish barrier,
View from upstream of
the jam in aggraded
channel reach

Anderson Creek, in SF Eel Watershed

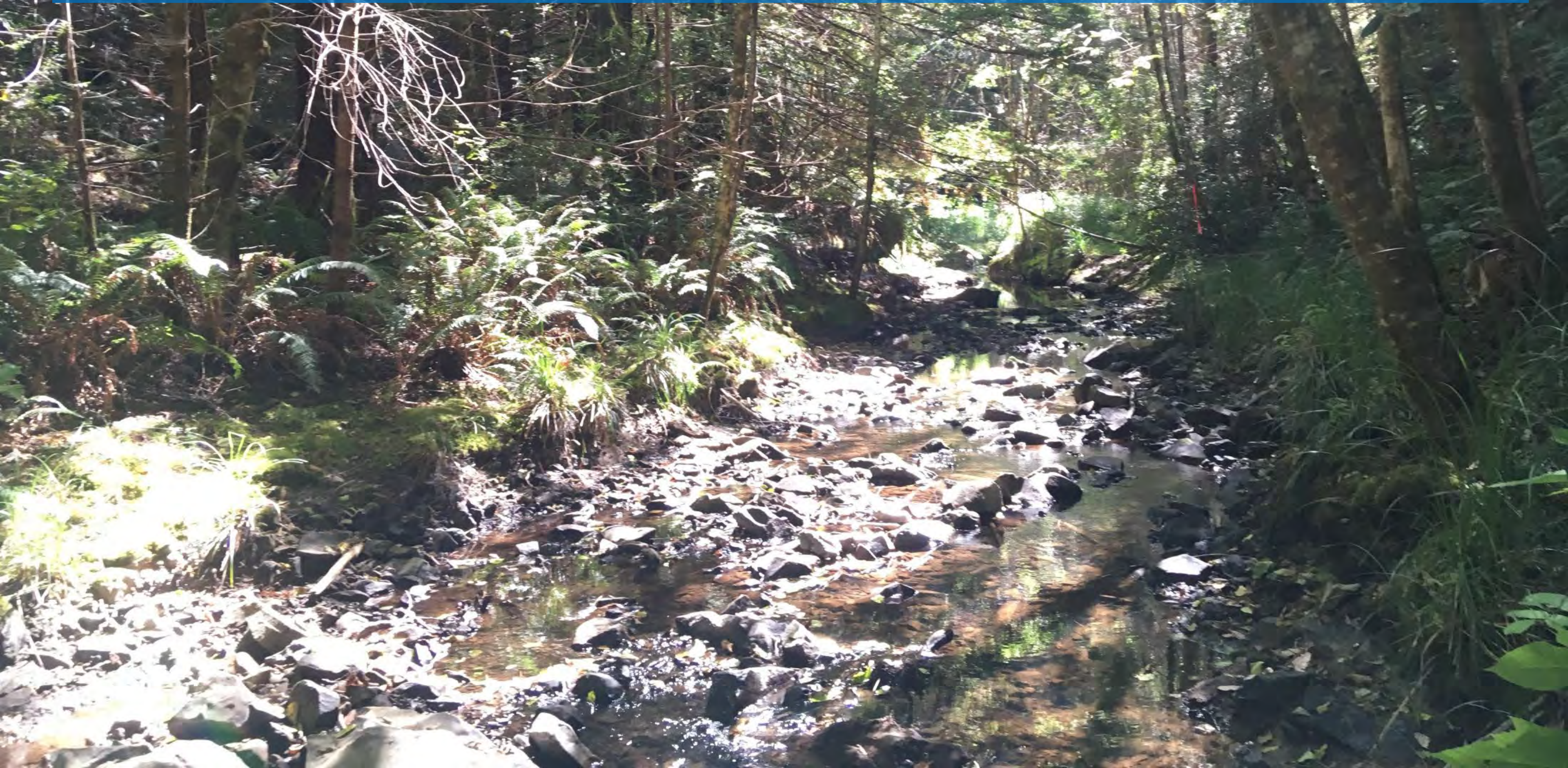
Note a few things

(1) The channel has blown out a lot of the good spawning gravel and eroded down to coarse alluvium

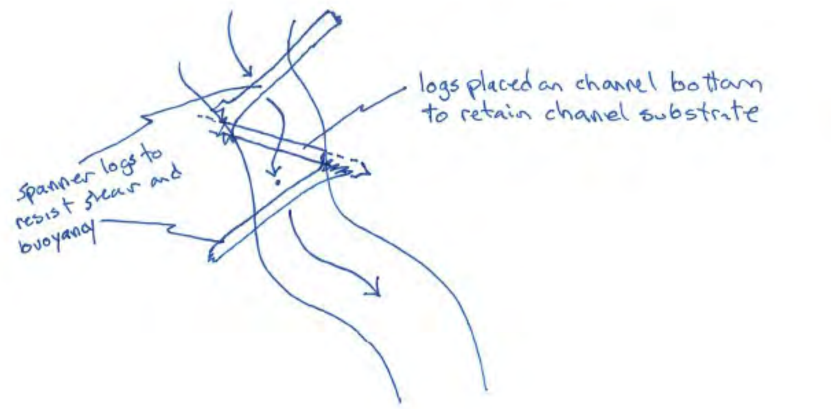
(2) Scouring pools in this situation will be challenging

(3) There is a serious lack of fluvial geomorphic complexity

(4) A large wood loading project could address most of these issues



The "LeJuan" Structure

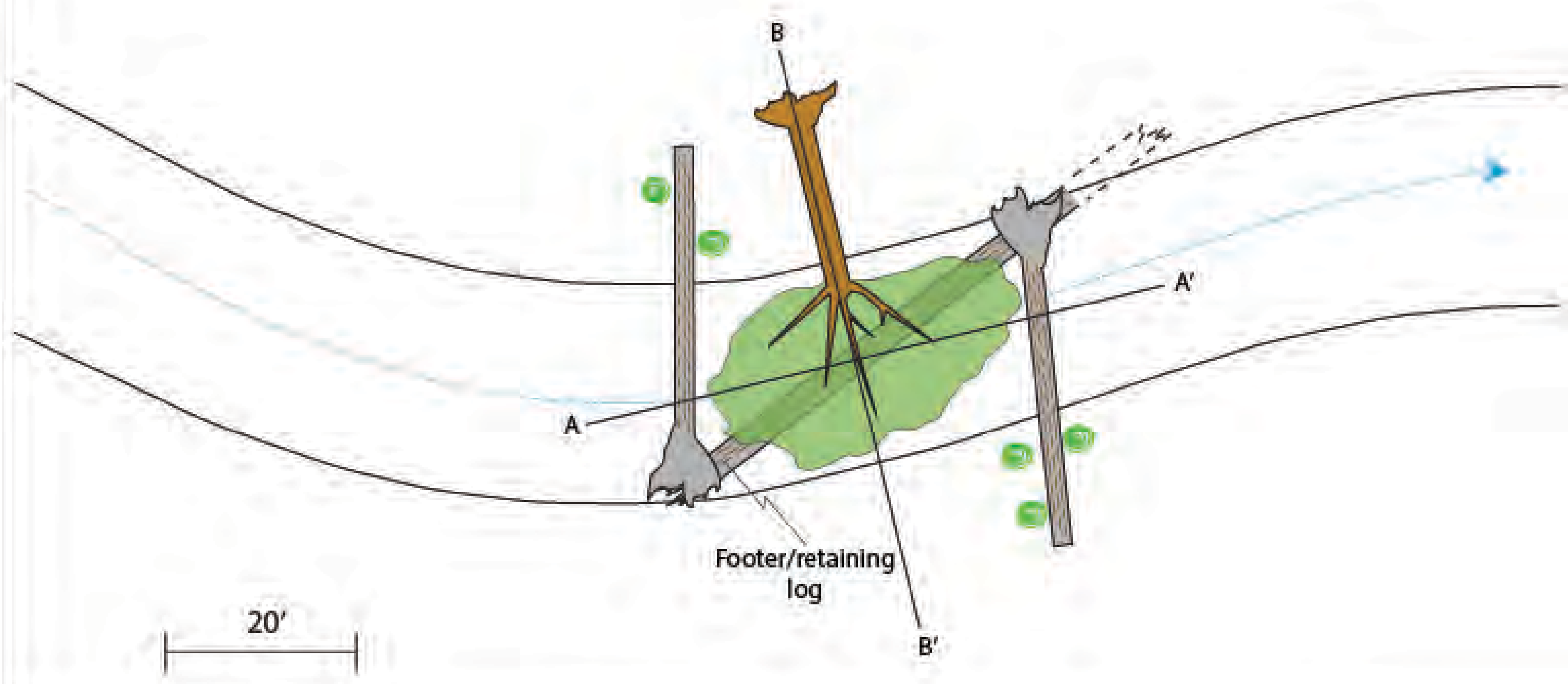


More LeJuan structures

Note there are 3 LeJuan structures in this photo

And more……

Natural tree canopy recruitment



April, 2025

Pacifc Watershed Associates
Typical drawing

Instream Tree Canopy Structure ITS

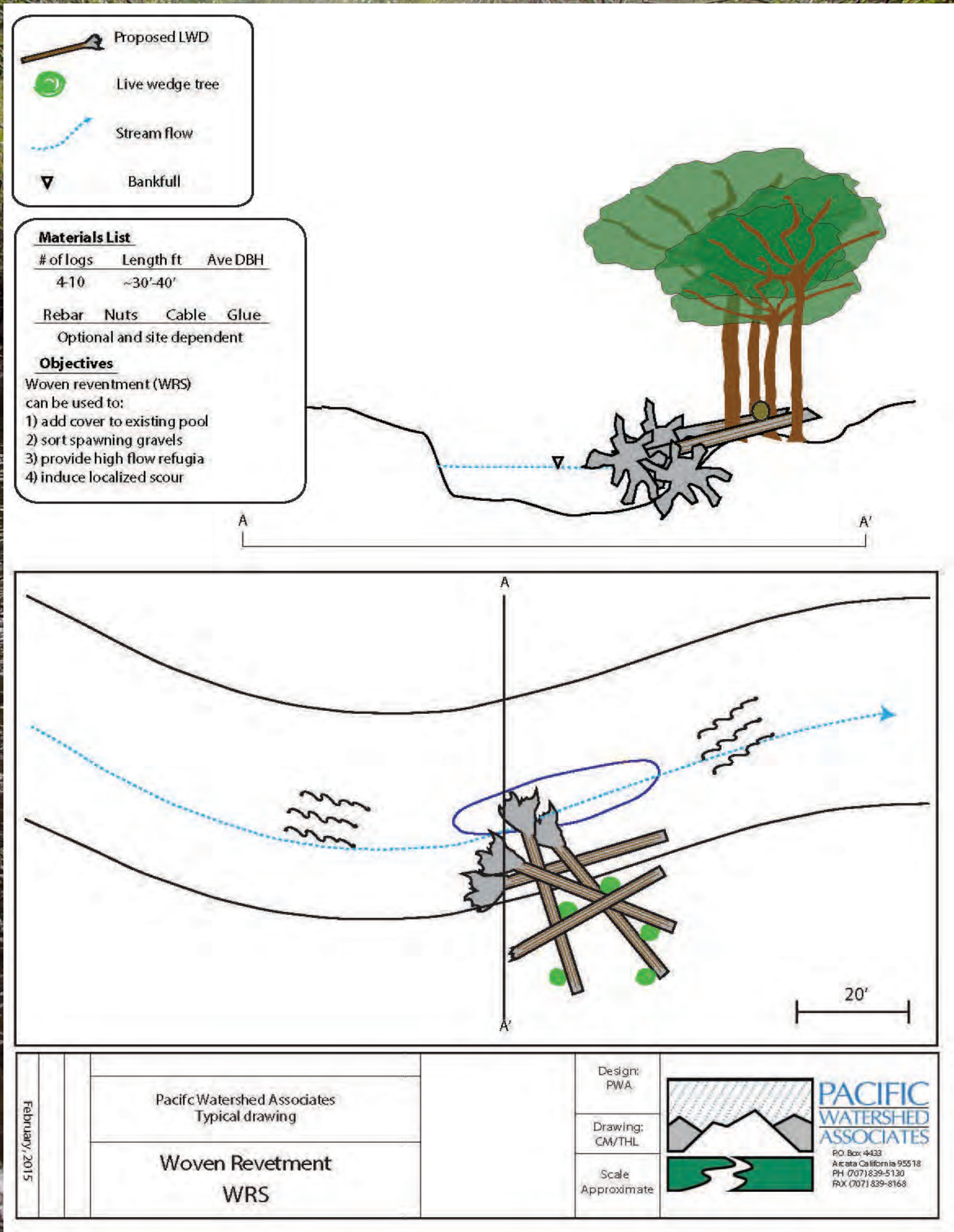
Design: PWA

Drawing: MR

Scale Approximate

PACIFIC WATERSHED ASSOCIATES
P.O. Box 4433
Arcata California 95518
PH (707) 839-5130
FAX (707) 839-8168

Revetments


Proposed LWD
Live wedge tree
Stream flow
Bankfull
Materials List
# of logs Length ft Ave DBH
4-10 ~30'-40'
Rebar Nuts Cable Glue
Optional and site dependent
Objectives
Woven reventment (WRS)
can be used to:
1) add cover to existing pool
2) sort spawning gravels
3) provide high flow refugia
4) induce localized scour
A
A'
20'
February, 2015
Pacifc Watershed Associates
Typical drawing
Woven Revetment
WRS
Design:
PWA
Drawing:
CM/THL
Scale
Approximate
PACIFIC
WATERSHED
ASSOCIATES

Take away thoughts

(Medium sized streams- restoration approach)

(1) These channel reaches exhibit a wide range of geomorphic conditions, characterize the reaches in the context of historic disturbances to identify appropriate restoration approaches

(2) Focus your reach scale efforts on improving habitat conditions based on identified limiting factor analysis. Adding large wood, in the right places, can address most limiting factors.

(3) If you need to retain channel substrate do it at a reach scale and consider employing LeJuan style wood jams with instream tree canopy structures

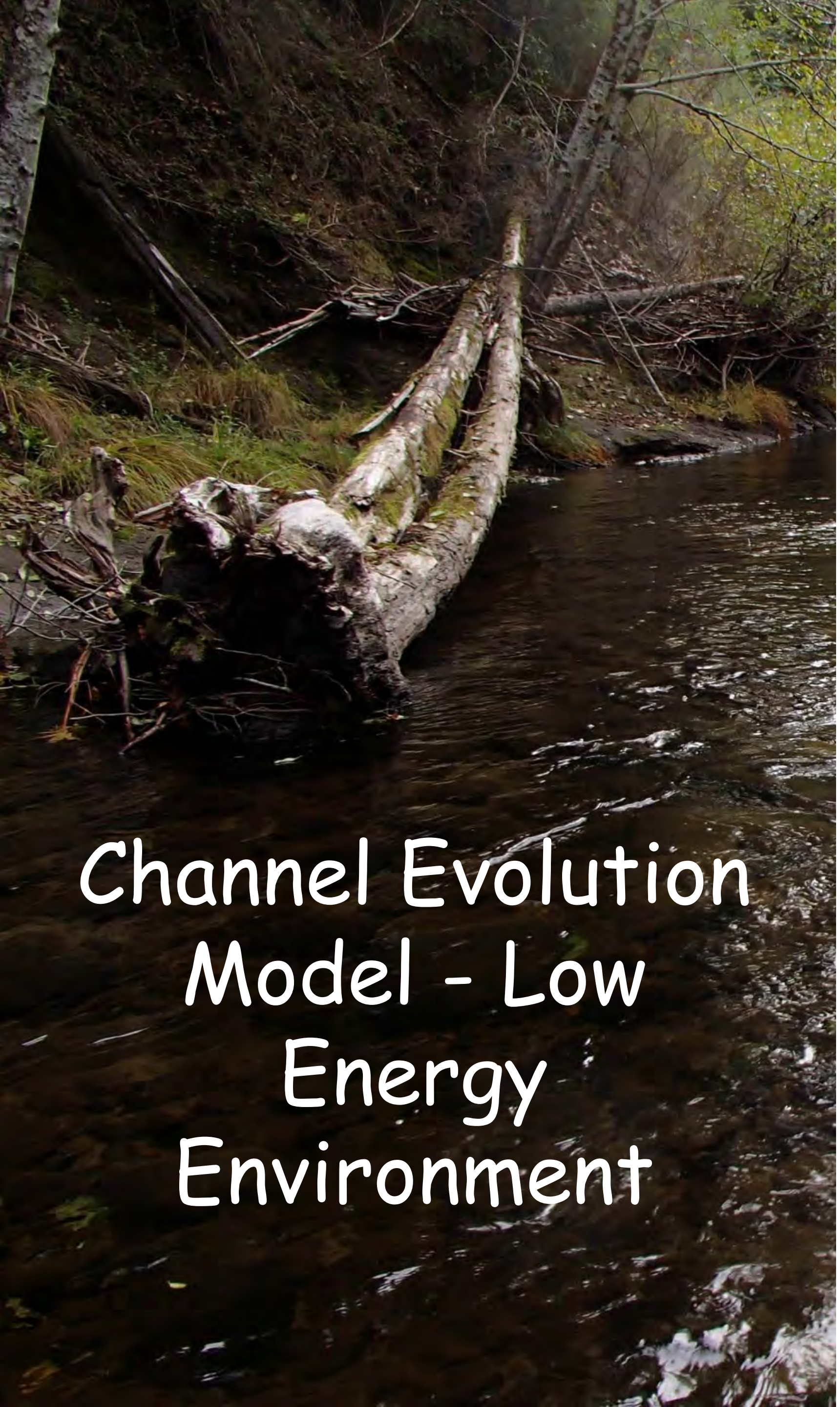
(4) Employ revetment structures in areas of known spawning to maintain channel substrate but provide cover for both adult and juvenile fish

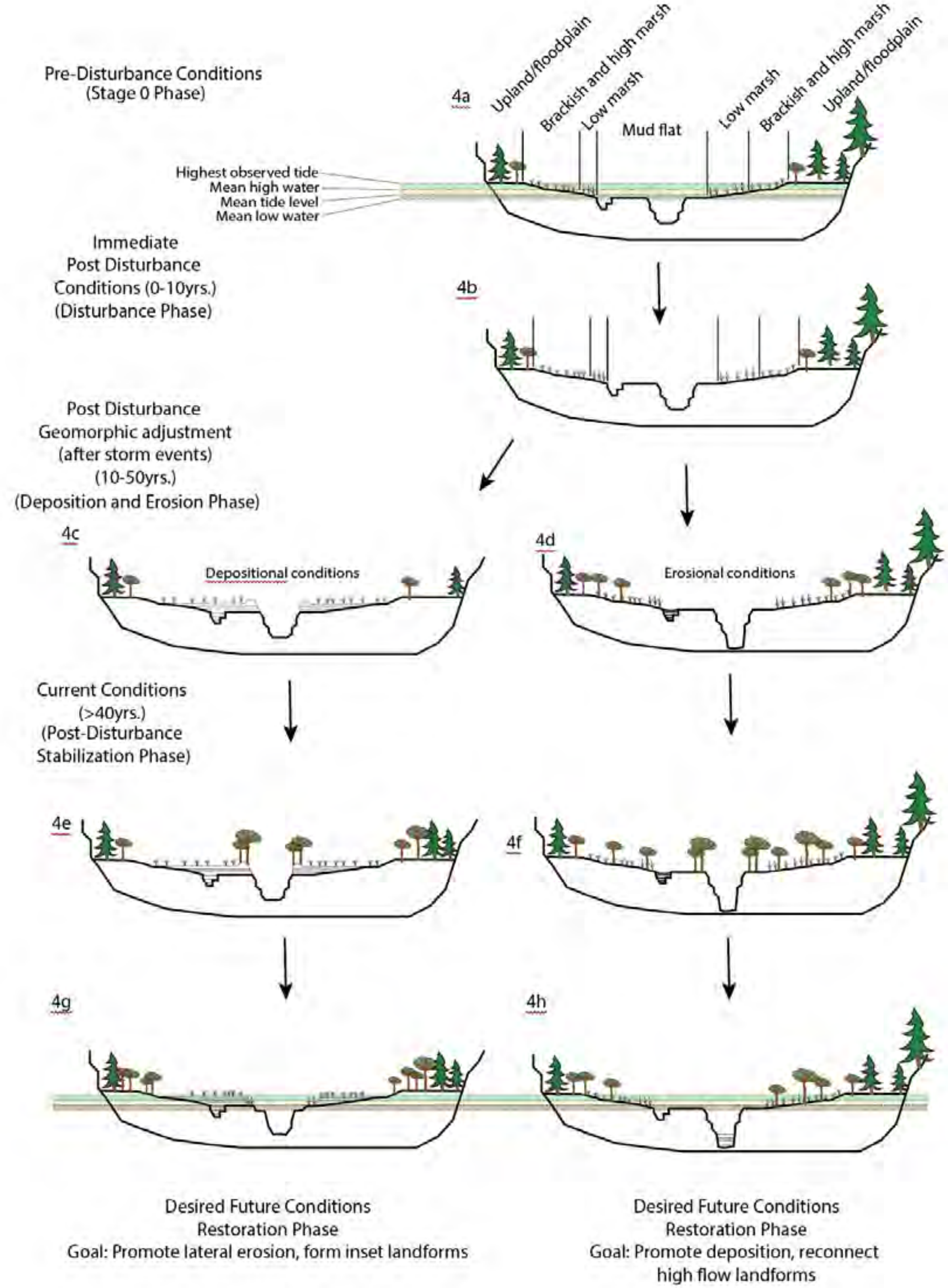
(5) Design riparian restoration treatments to conduct while implementing instream wood loading projects

Existing Conditions
(Larger streams/Estuaries, Current existing conditions)

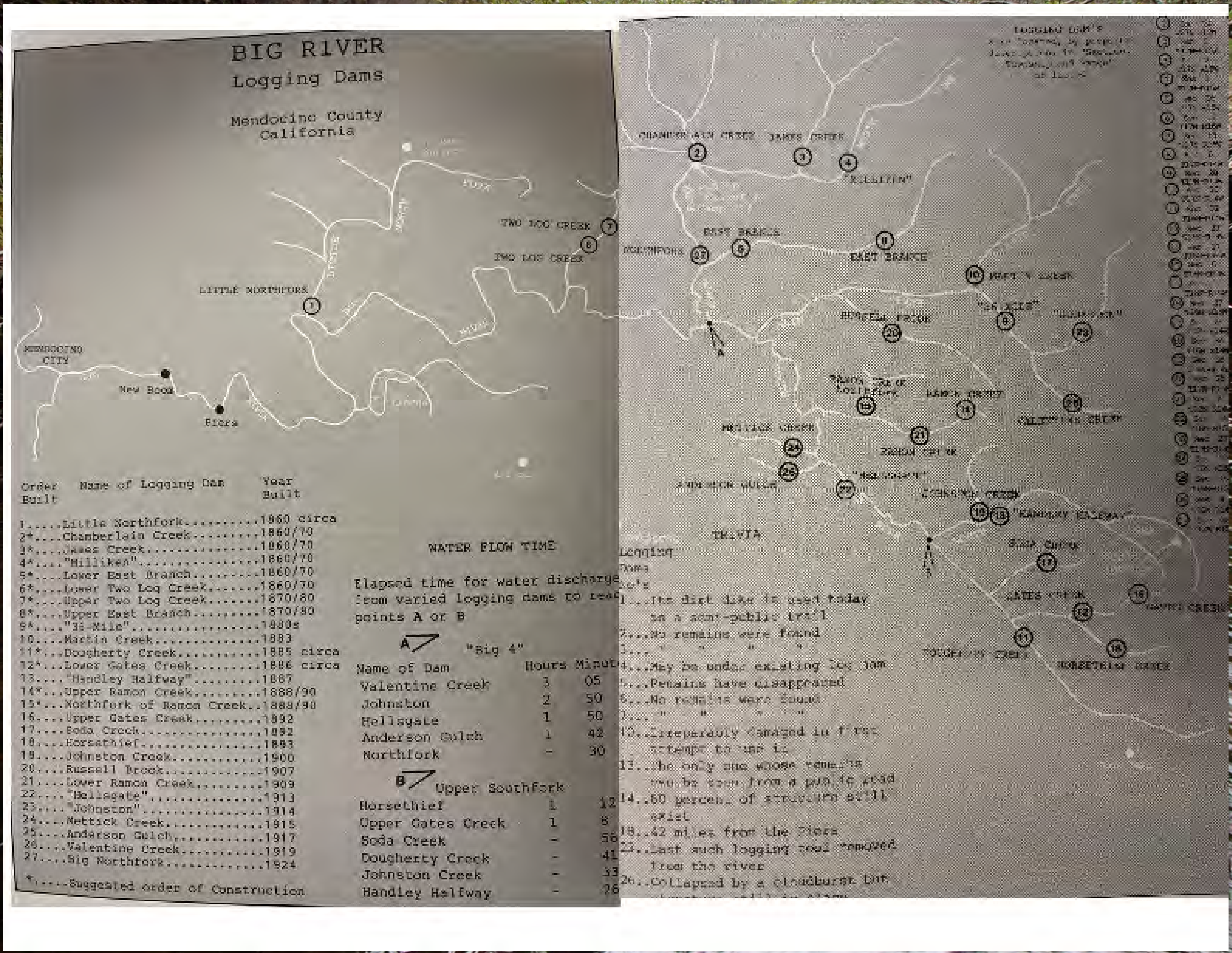
(1) Large fish bearing streams and estuaries tend to exhibit a complex history of sediment accumulation but may not retain or exhibit the large wood component of the great deluge.
(2) Sediment accretion in the upper parts of the watersheds tend to be in the form of pool infilling and simplified channel geomorphology.
(3) Sediment accretion in the lower parts of these watersheds tend to be in the form of elevated floodplains and conversion of mud flats and low marsh to high marsh or floodplains in the estuaries.

Channel Evolution Model - Low Energy Environment



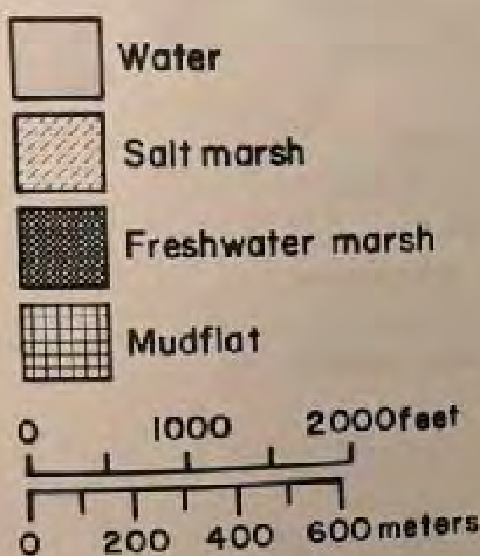


Big River – Historical logging map



Big River – Historical logging activities

Big River Estuary- A story of the Simplification of a Complex Intertidal Marsh



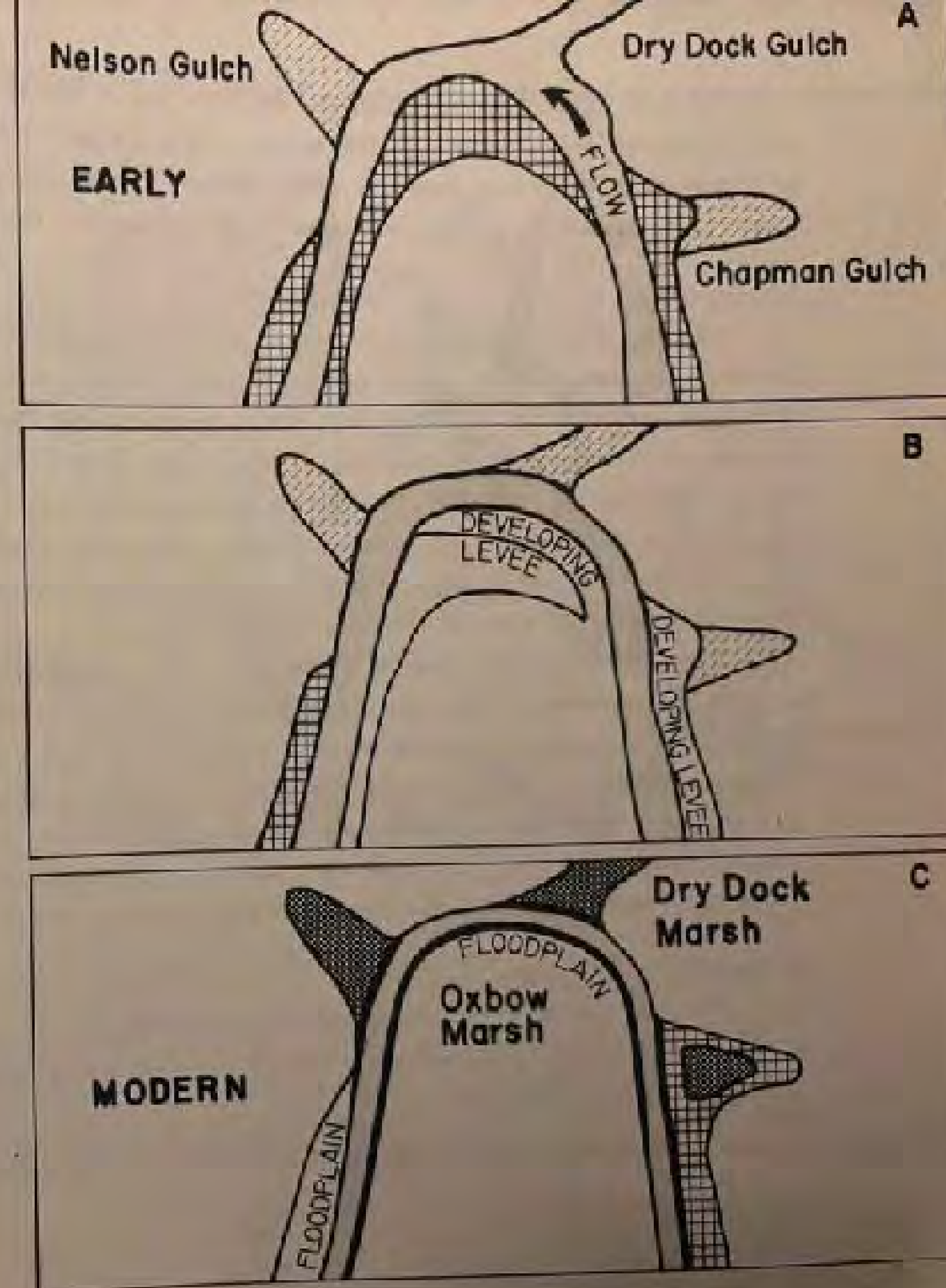


Figure 5. Hypothetical development of Oxbow Marsh. The modern marsh is represented as mudflat in early estuary. The levee develops as the river deposits fill the upper estuary, isolate the mudflats, and cut off saltwater inflow. Heavy lines in box C indicate levees.

Big River Estuary- Conceptual aggradation model

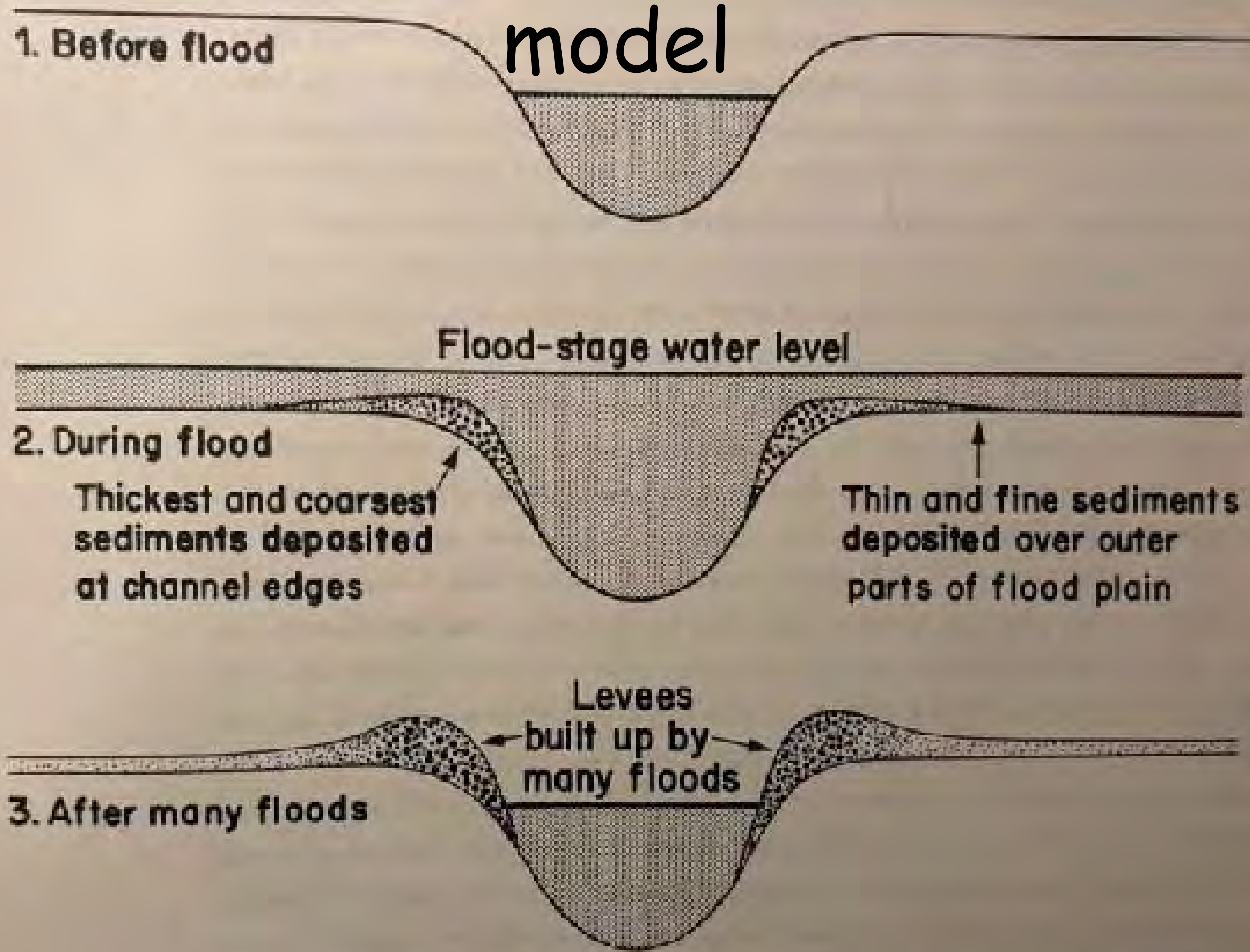
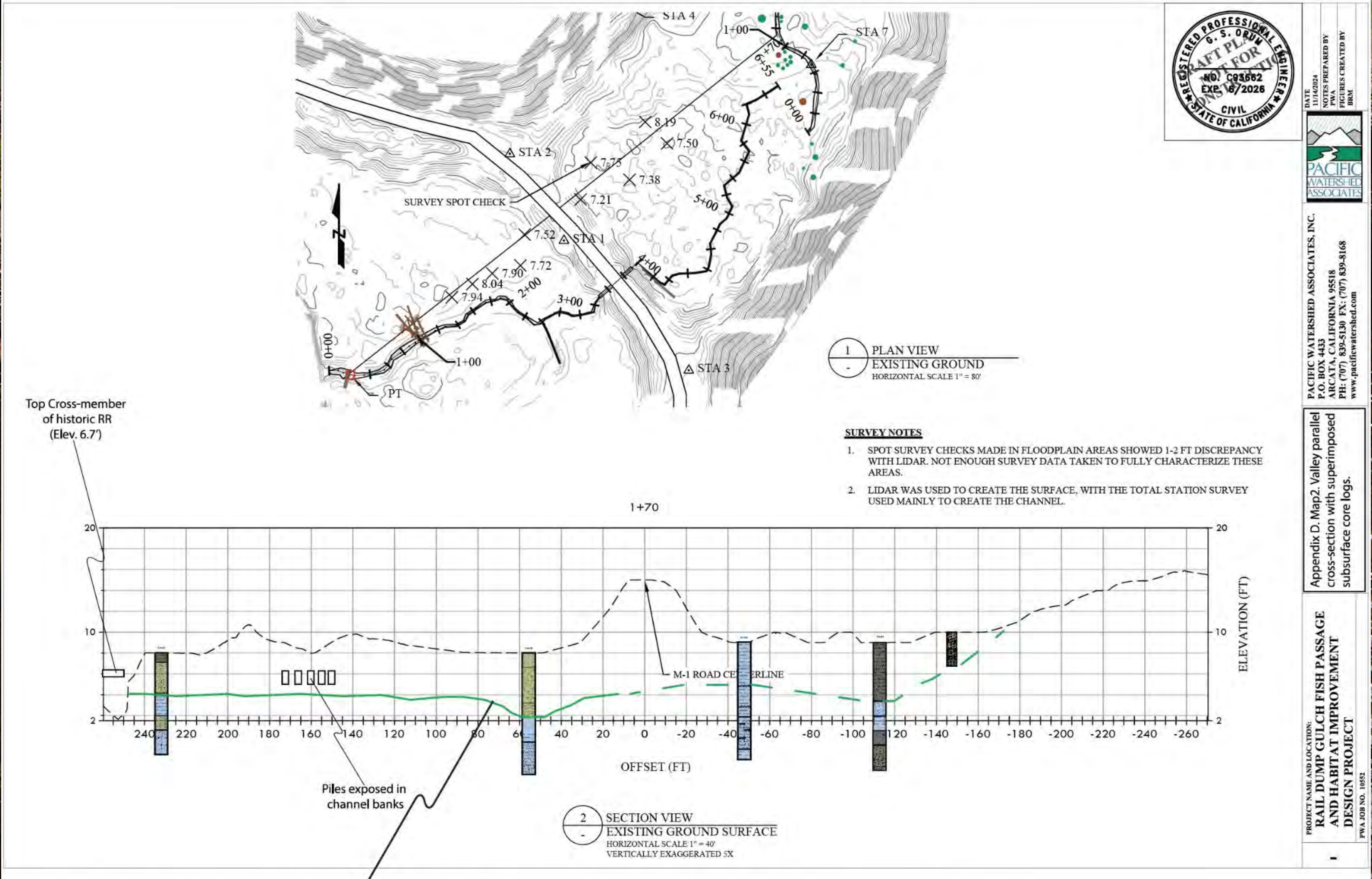


Figure 7. Formation of levees by river floods. As a river in flood stage overflows its banks, it rapidly decreases in velocity away from the channel and so drops most of its sediment, the coarser parts near the channel and the finer parts as a thinner layer of silt and clay over most of the floodplain. Successive floods build up the levees to ridges many meters high. Figure redrawn after diagram by F. Press and R. Siever in Earth, W. H. Freeman and Company, p. 313.

Big River Estuary- A story of the Simplification of a Complex Intertidal Marsh



Possible approximate ground surface prior to the Great Deluge, dashed where really approximate.........

Big River Estuary- Historic RR

Big River Estuary- Rail Dump Marsh


Big River Estuary-
Historic RR
Alignment

(Large Streams/Estuaries, Restoration Considerations)

Important Surveys and thoughts to inform designs

(1) Use subsurface investigations to understand depositional history as well as Geotech..
(2) Take advantage of historical documents to understand estuary changes through time
(3) Understand how changes to earth surface processes in the upper watershed impact your project area in the lower watershed/estuary
(4) Use archeological features to understand historic depositional sequences
(5) Think about the Great Deluge as a slug or wave of sediment that has a beginning and end but has left remnants of its passing along the stream corridor

Prudent Restoration Approaches

(1) Base restoration approaches on identification of which SEM phase you're in

a) If the channel is fully or partially incised into a thick anthropogenic sediment deposit, consider restoration approaches that promote lateral scour and development of inset landforms to form complex habitat and employ stream energy

b) If the channel is incised into a native surface, (highly unlikely in an estuary) consider approaches that raise the channel bed by retaining channel substrate……(Stage zero)….

(2) Keep in mind that many estuaries have been simplified by conversion of mud flats and low marsh to high marsh and floodplain…Its this loss of complex vertical habitats that can really degrade aquatic habitat and limit productivity of an estuary.
(3) Consider whole scale lowering of marsh/floodplain surfaces in addition to constructing complex channel networks and off-channel landforms…

Channel Deposition and Incision

Long Term Community Stewardship

Garrett Costello

Symbiotic Restoration

CDFW Conducts First Beaver Conservation Translocation in Nearly 75 Years

December 13, 2023

Site Preparation

- Improve habitat with PBR
- Plant willows
- Protect/remove roads & culverts
- Reduce herbivory competition. Exclusion fencing etc.

Willow Planting

Adopt-A-BDA

- Assign trained groups or individuals to projects.
- Apply for funds to support program
- Schools/classes can also apply
- Businesses sponsorship
- Strong sense of place, local stewardship, affordable, effective
- Oversight will include GPS based map prescriptions, photo monitoring, and resource management concerns

Permitting

- Include adaptive mgmt into original permit.
- Watershed scale permits
- Restoration mgmt permit
  - No expiration
  - No fees
- Tribal forest stewardship act

First Steps

- Develop plan with details for agencies and partners
- Inventory of meadows that would be a good fit
- Identify funding
- Pair volunteers/orgs to meadows/BDA’s

Barriers

- Extending grant funds or applying for funding to support this project
- Permits expire and cost $
- Liability

How Can You Help?

- Include local community in your restoration project from the start
- Consider beaver relocation and preparing site for beaver
- Work with me to develop this program!

Bringing Prescribed Burn Associations into Process-Based Restoration

(Bringing PBAs into PBR!)

Lenya Quinn-Davidson
UC Agriculture and Natural Resources





Available online at www.sciencedirect.com

ScienceDirect

Forest Ecology and Management xxx (2007) xxx–xxx

ELSEVIER

Forest Ecology and Management

www.elsevier.com/locate/foreco

Prehistoric fire area and emissions from California's forests, woodlands, shrublands, and grasslands

Scott L. Stephens *, Robert E. Martin, Nicholas E. Clinton

Division of Ecosystem Science, Department of Environmental Science, Policy, and Management, 137 Mulford Hall, University of California, Berkeley, CA 94720-3114, USA

Received 16 February 2007; received in revised form 2 June 2007; accepted 6 June 2007


Take a simple idea,
and take it very seriously



2017: Importing the Prescribed Burn Association (PBA) model to California from Nebraska

Humboldt County Prescribed Burn Association

- Started in 2017
- More than 300 people involved
- Diverse perspectives and politics, shared vision
- ~2,500 acres of good fire since 2017
- 13+ volunteer fire departments involved
- Burn trailer

Susie Kocher
@UCsierraforest

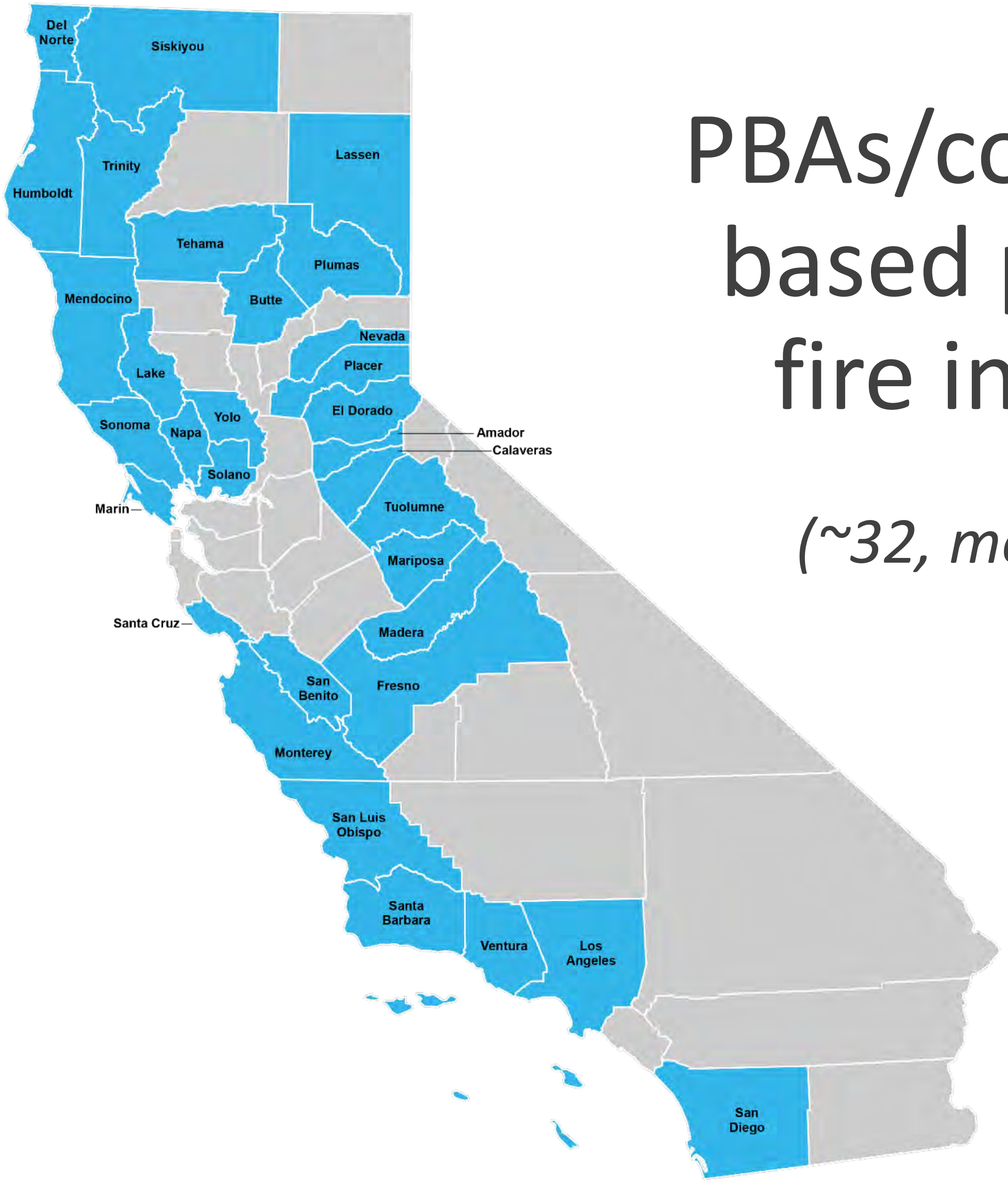
"How do you prescribe burn a million acres in California? With a million landowners." Chris Paulus Rx Fire Academy workshop today.

California PBAs

- Grassroots, community-led movement
- Everyone is welcome
- Prescribed fire doesn't need to be expensive or overly bureaucratic…
- …but it should be fun, and it should involve food and drink!

Photo by Zeke Lunder

Photo by Miller Bailey



PBAs/community-based prescribed fire in California

(~32, mostly since 2017)

Forest Service Halts Prescribed Burns in California. Is It Worth the Risk?

By Danielle Venton Oct 24 Save Article





Photo by Henri Holbrook


Photo by Kai Ostrow

CALIFORNIA DEPARTMENT OF FORESTRY AND FIRE PROTECTION
SB 926: PRESCRIBED FIRE CLAIMS FUND PILOT PROJECT

PROGRAM GUIDELINES JUNE 19, 2023

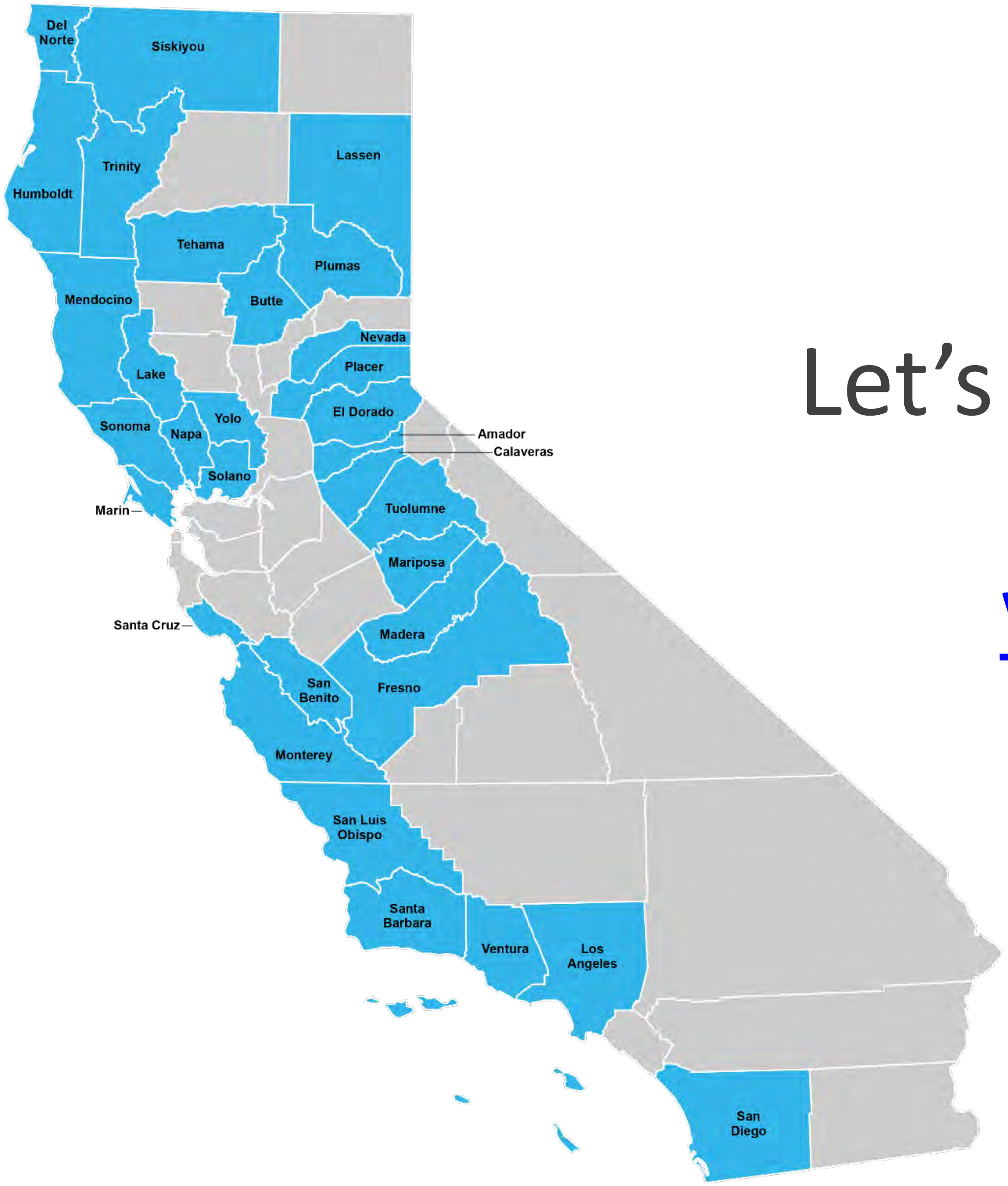
Policy changes for private lands burning

- CA state-certified burn boss program
  (SB1260, Jackson 2018)
- Changed liability standard for fire suppression costs
  (SB332, Dodd 2021)
- $20 million Prescribed Fire Claims Fund to fill insurance gap
  (SB926, Dodd 2022)

Cultural Burning

- Cultural burning officially recognized and defined in state law
  SB332 (Dodd 2021) &
  AB642 (Friedman 2021)
- Cultural practitioners on par with federal and state burn bosses
  SB332 (Dodd 2021)
  SB926 (Dodd 2022)
- Potential for Tribal authority over permitting
  SB310 (Dodd 2024)


The remarkable power of giving people more than they expect
UN REASON ABLE HOSPI TALITY
WILL GUIDARA
ANATOMÍA
WTREX



Get involved!

Let's bring PBAs into PBR!

www.calpba.org

Thank you!

Lenya Quinn-Davidson
UC ANR Fire Network Director
lquinndavidson@ucanr.edu

UC ANR
FIRE NETWORK

SRF| 2025

STRUCTURAL CHARACTERISTICS OF BEAVER COMPLEXES AND IMPLICATIONS FOR BEAVER-BASED RESTORATION

Presented by Caroline Gengo
Co-authors: Sarah Yarnell, Doug Kelt, Rob Lusardi
Funding from The Nature Conservancy and CDFW

PRESENTATION OVERVIEW

BACKGROUND

2021 Childs Meadow, Tehama County CA

BACKGROUND

2024 Childs Meadow, Tehama County CA

BACKGROUND

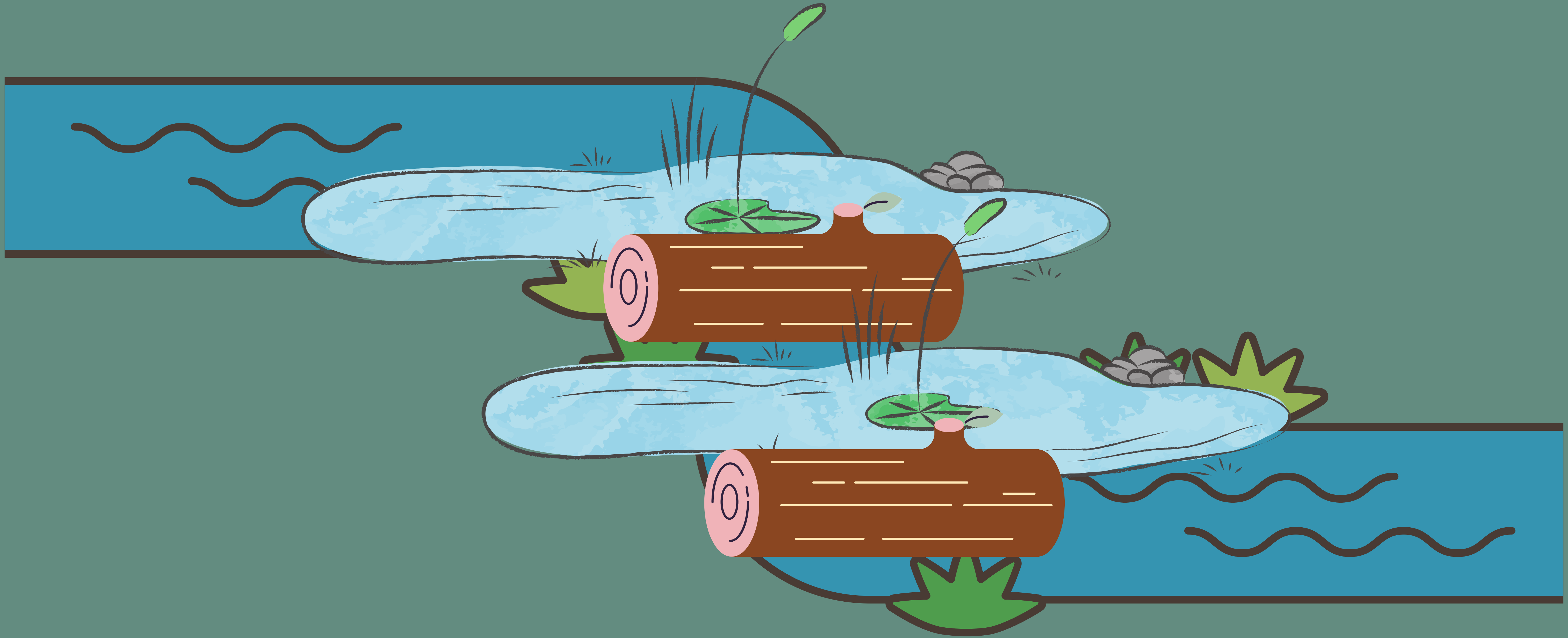
BACKGROUND

2021 Childs Meadow, Tehama County CA

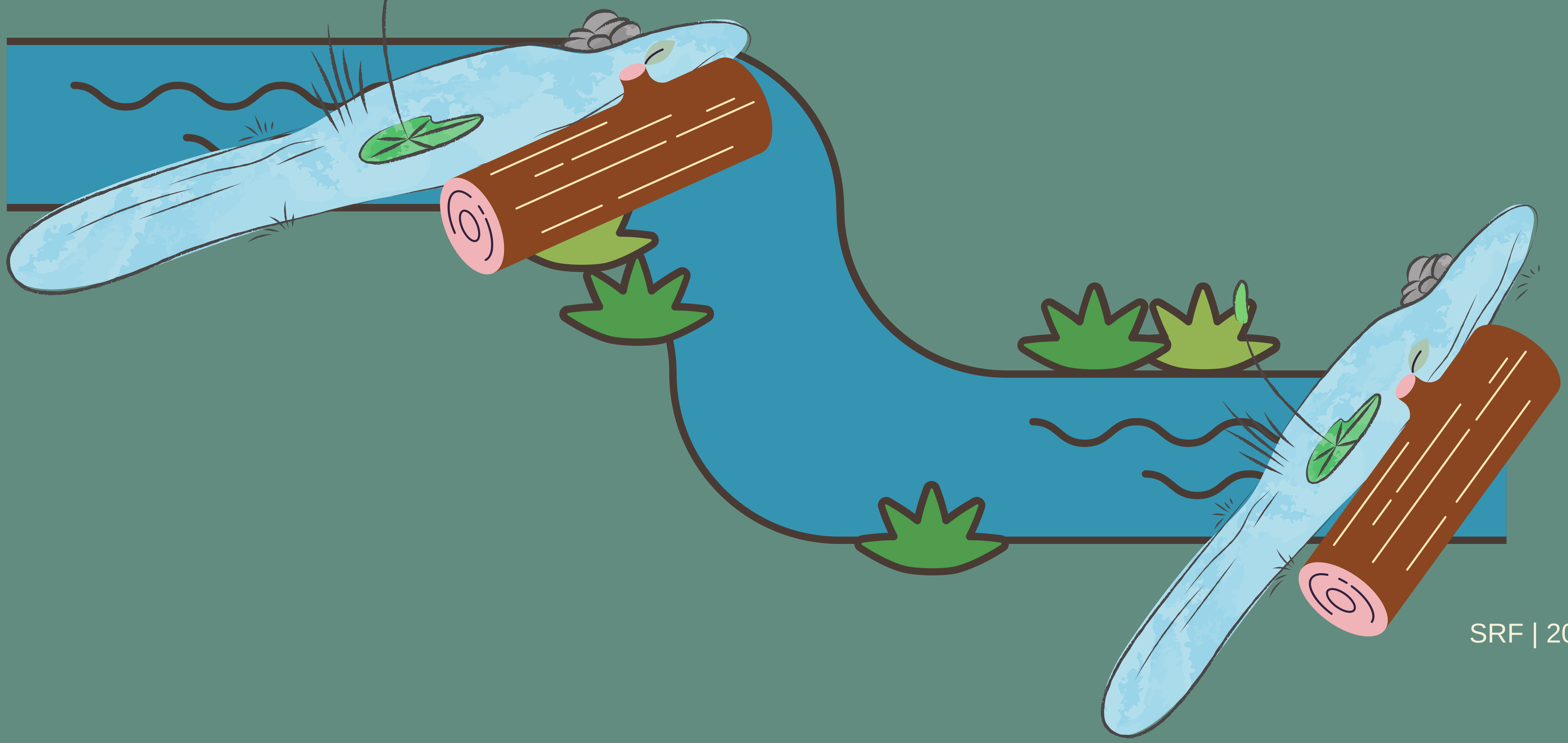
BACKGROUND

BACKGROUND

BACKGROUND

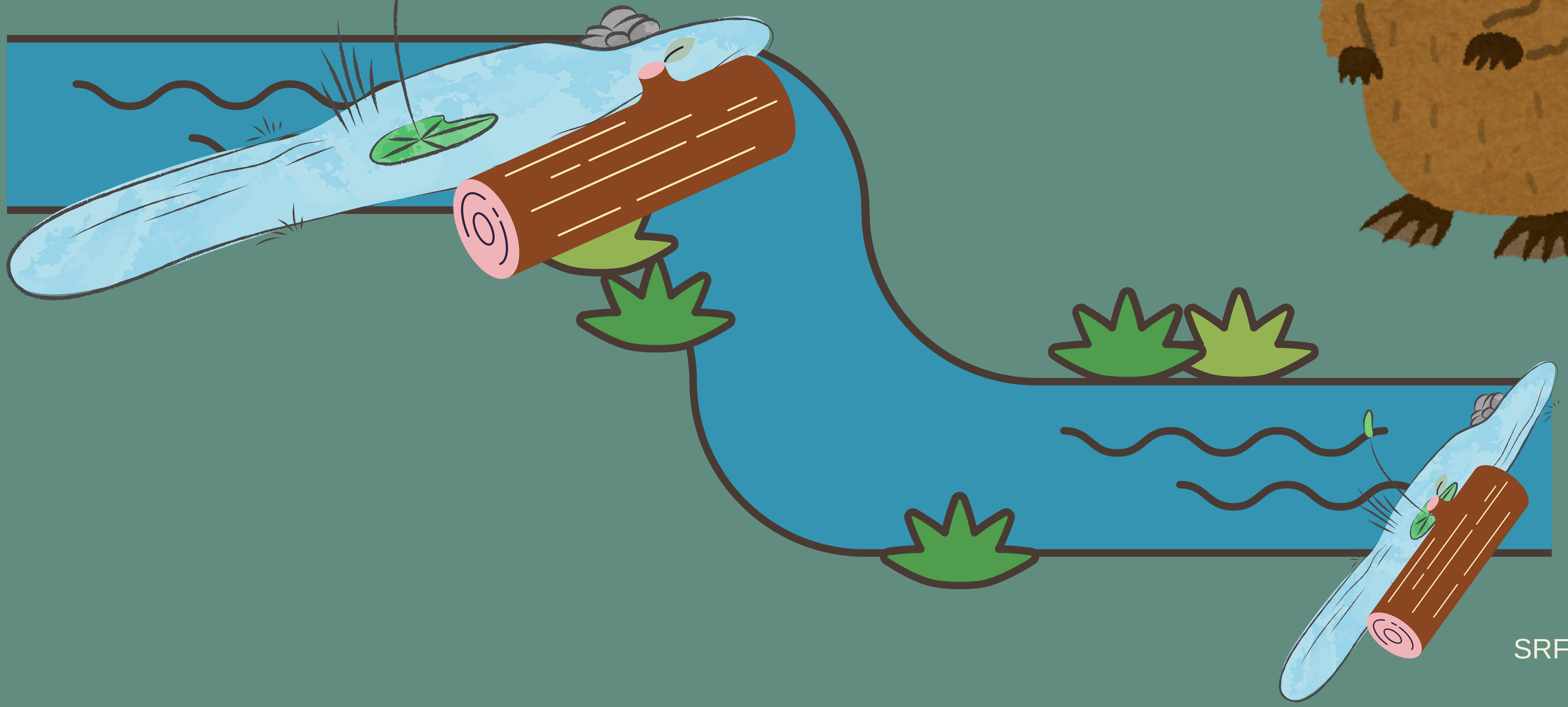


BACKGROUND



SRF | 2025

BACKGROUND



SRF | 2025

QUESTIONS

01

What **spacing** do we see between dams in beaver-maintained systems?

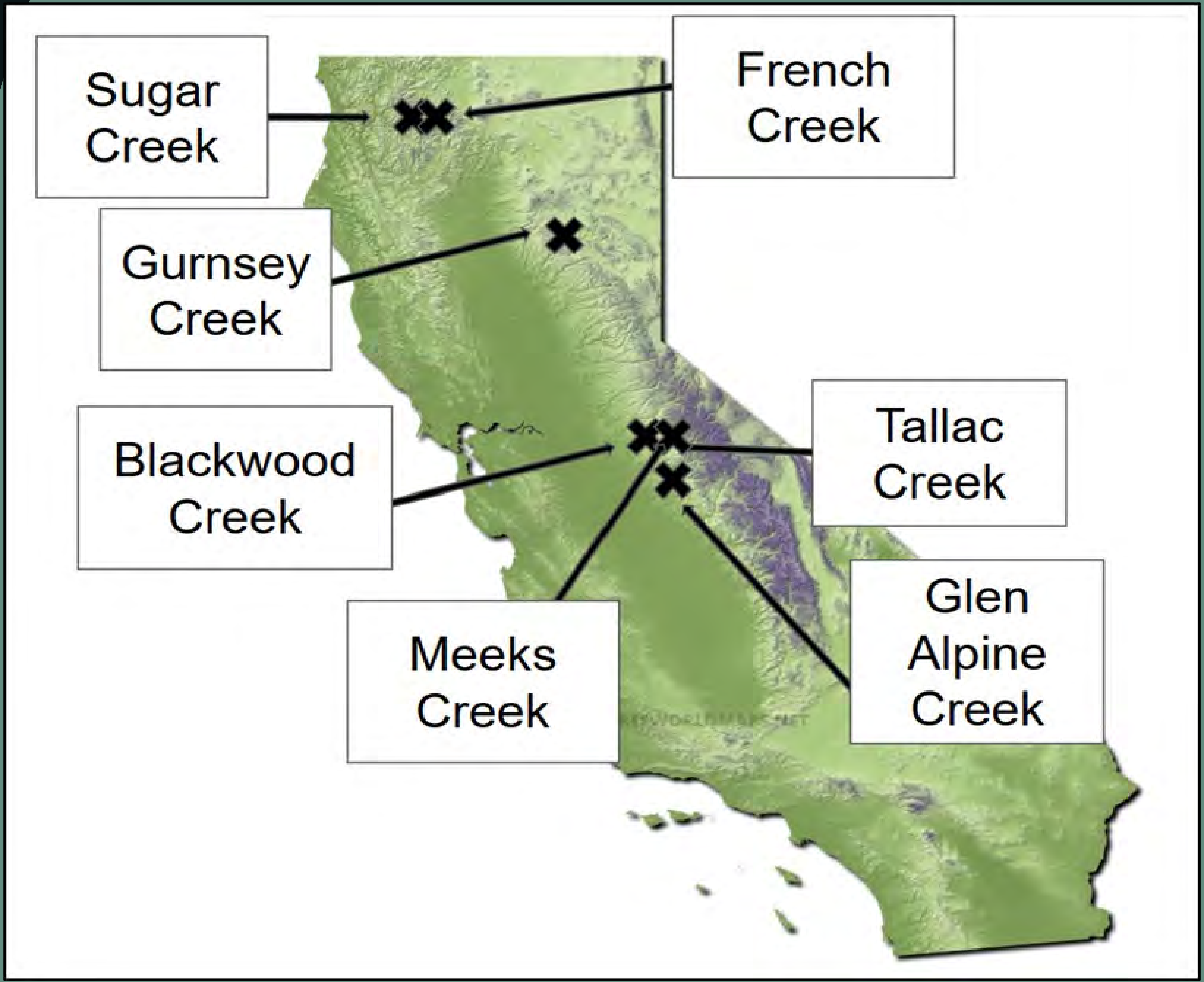
02

What common **structural characteristics** do we see in beaver dams?

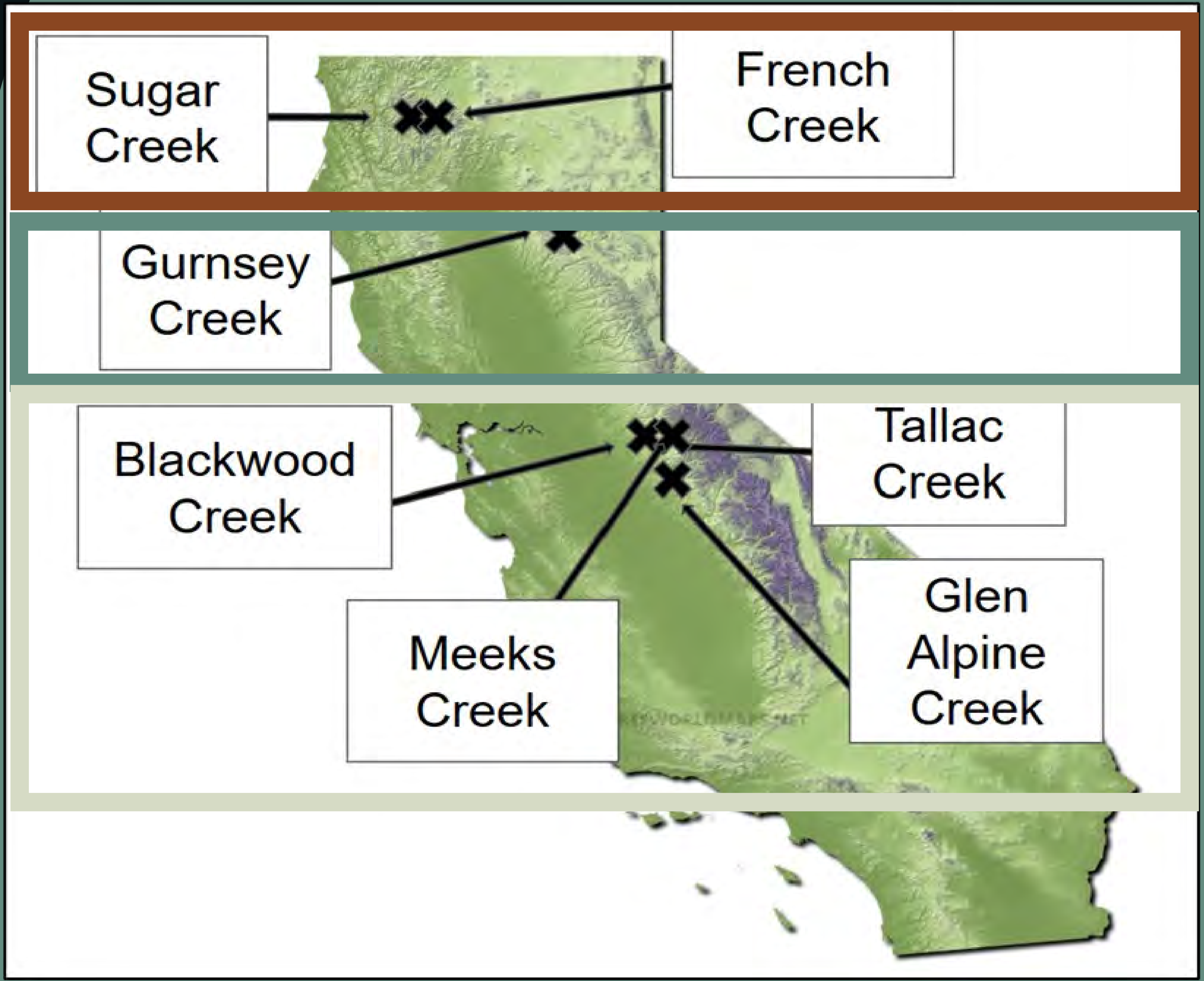
03

How does the dam spacing and structural characteristics of beaver-maintained systems relate to observed **in-stream habitat characteristics** ?

STUDY LOCATIONS



STUDY LOCATIONS

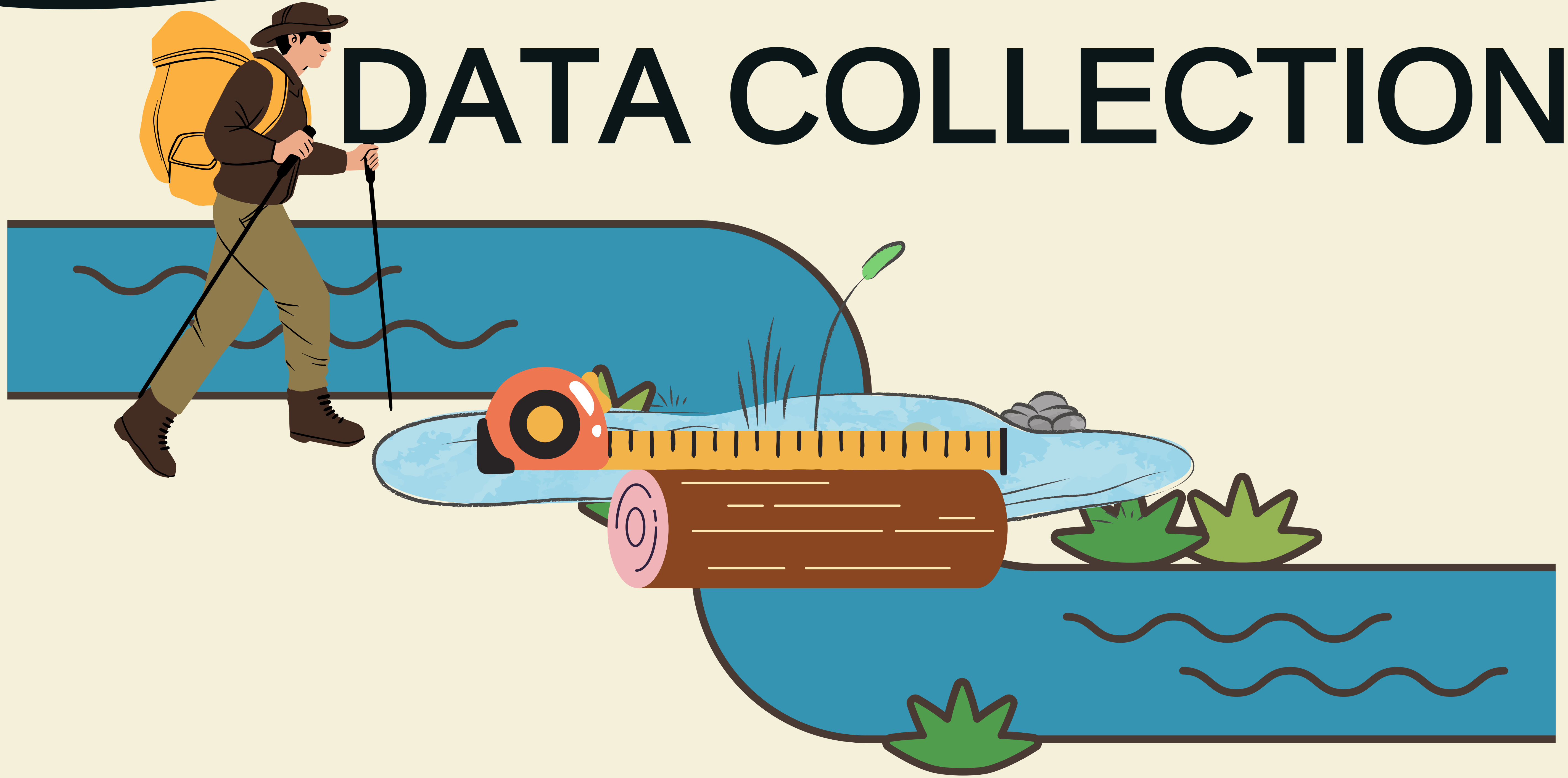


Scott Tributaries:
7 dams

Lassen:
53 dams

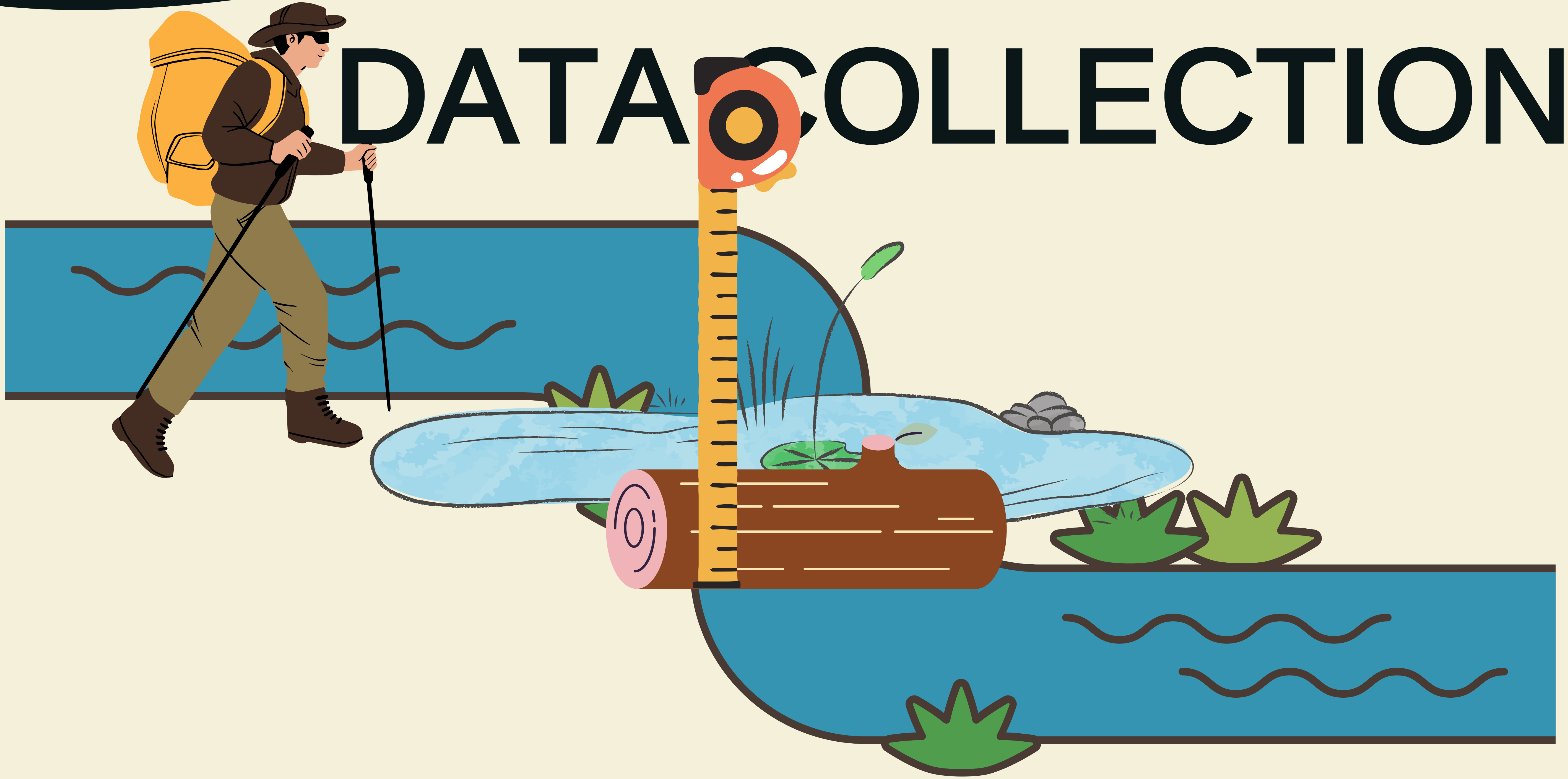
Tahoe Basin:
81 dams

DATA COLLECTION



SRF | 2025

DATA COLLECTION



SRF | 2025

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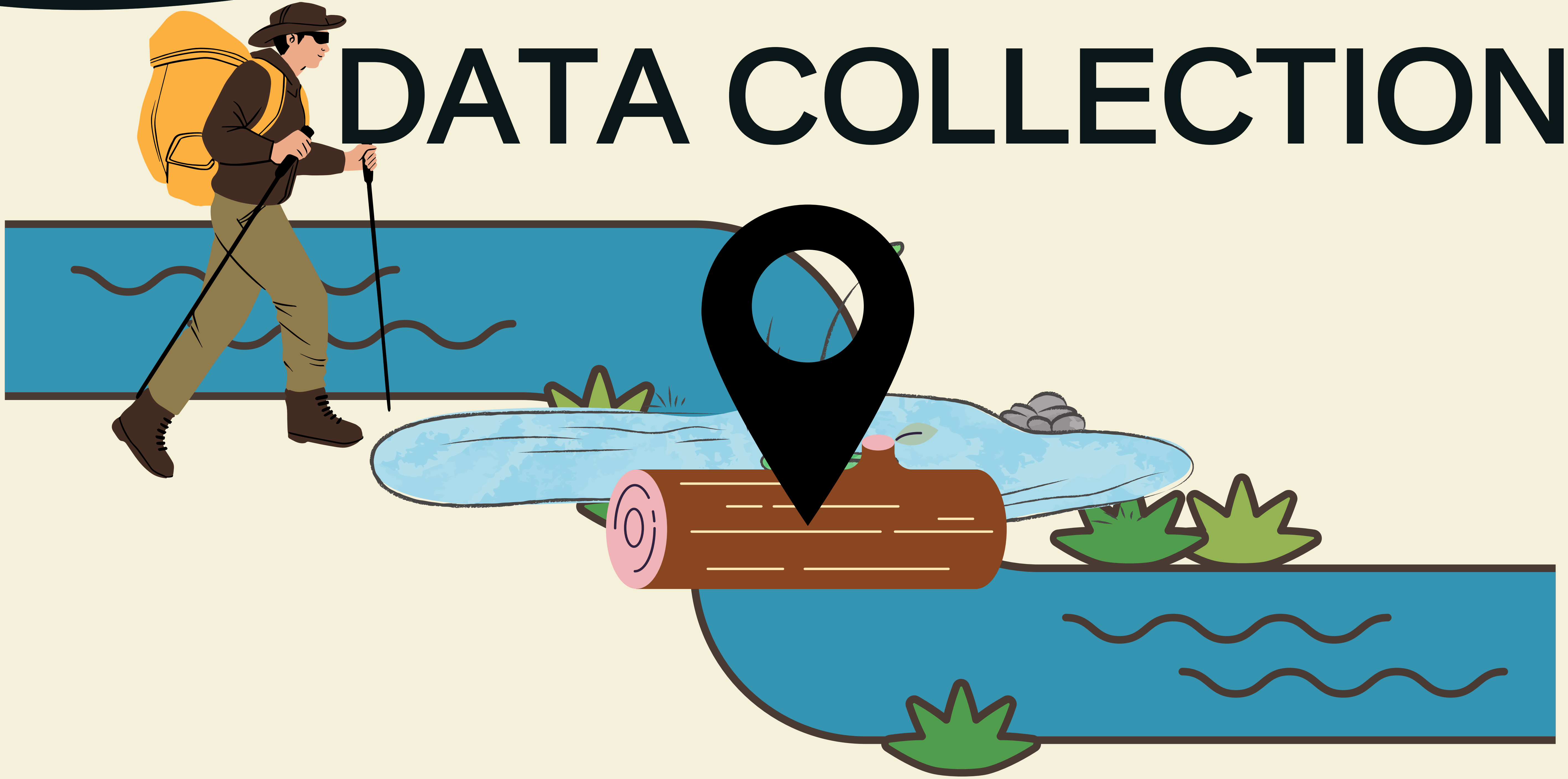
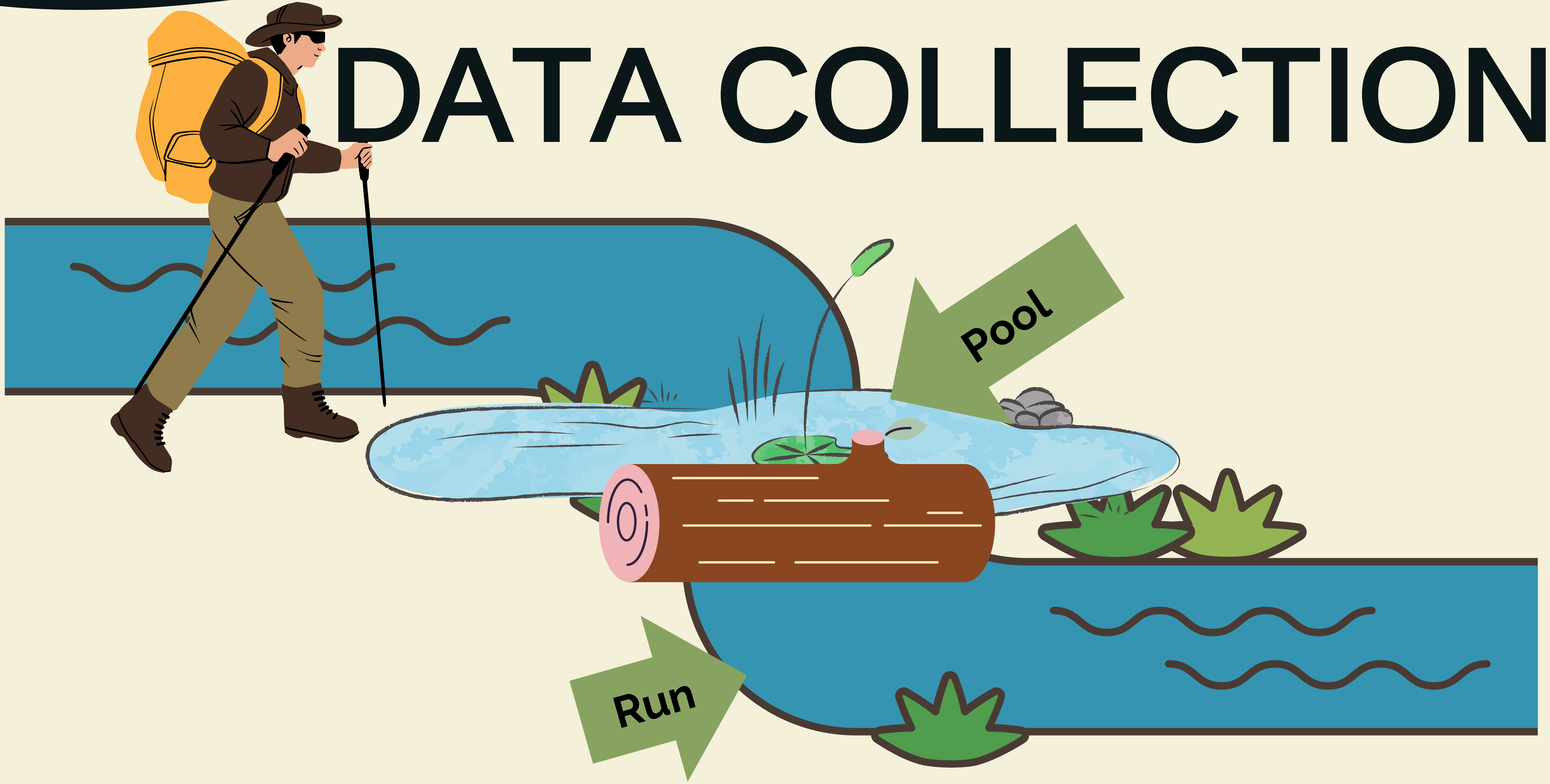


SRF | 2025

DATA COLLECTION



DATA COLLECTION

Gurnsey Creek, Tehama County

DATA COLLECTION

Blackwood Creek, Placer County

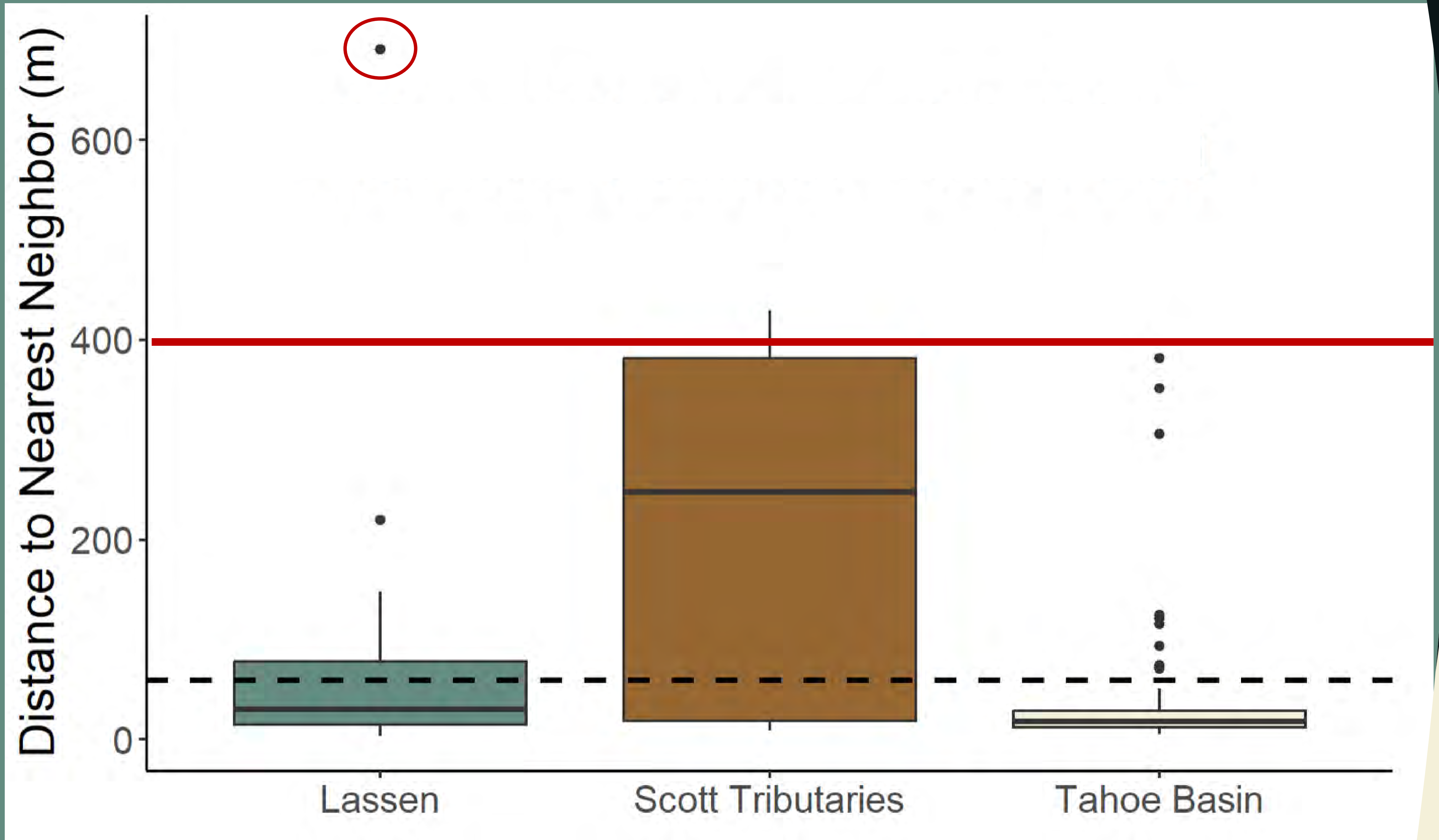
QUESTIONS

01	02	03
What **spacing** do we see between dams in beaver-maintained systems?		

RESULTS

01 02 03

What **spacing** do we see between dams in beaver-maintained systems?



Distance:

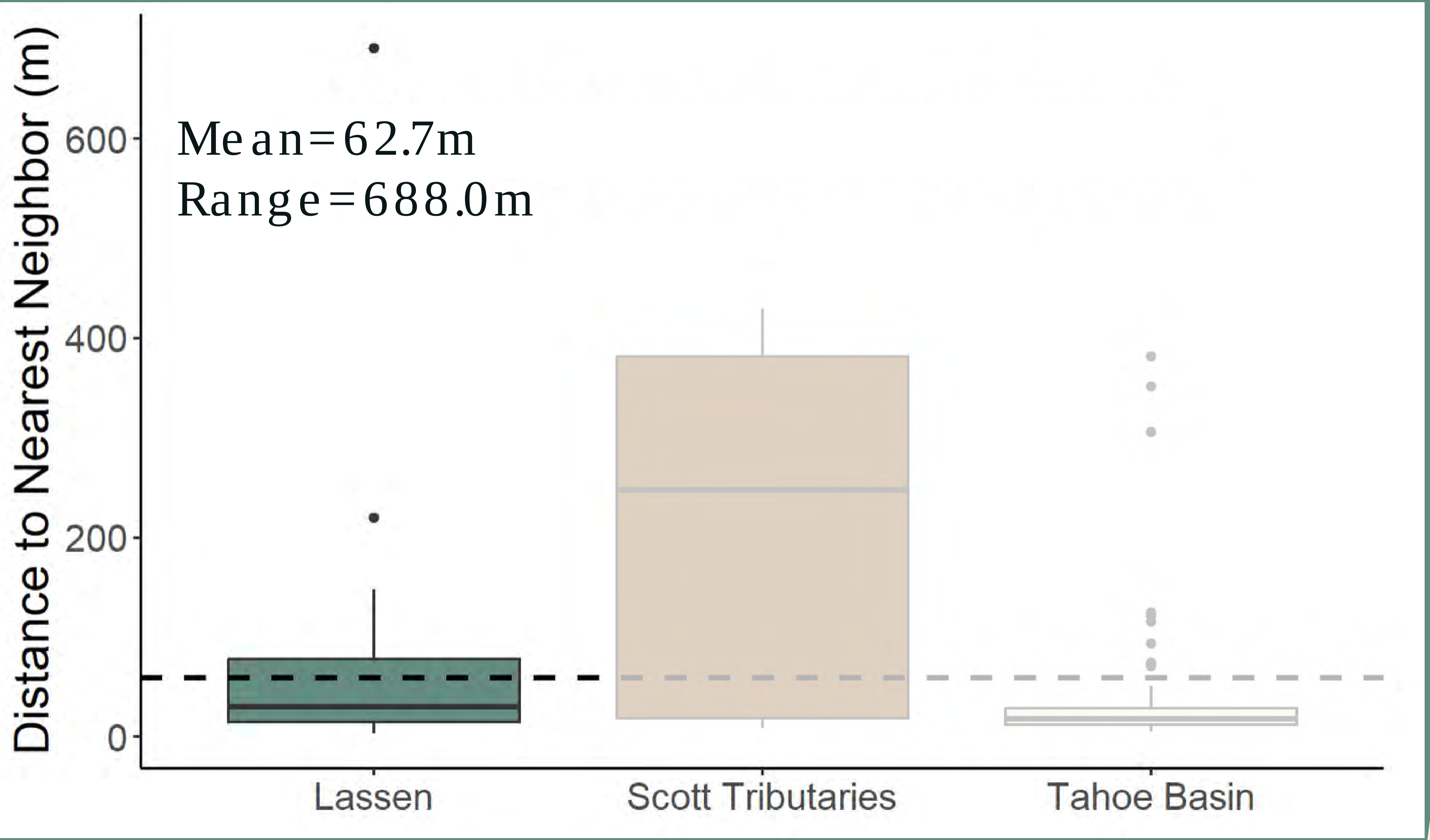
Overall mean = 58.51m

Overall range = 688.0m

RESULTS

01 02 03

What **spacing** do we see between dams in beaver-maintained systems?



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RESULTS

01 02 03

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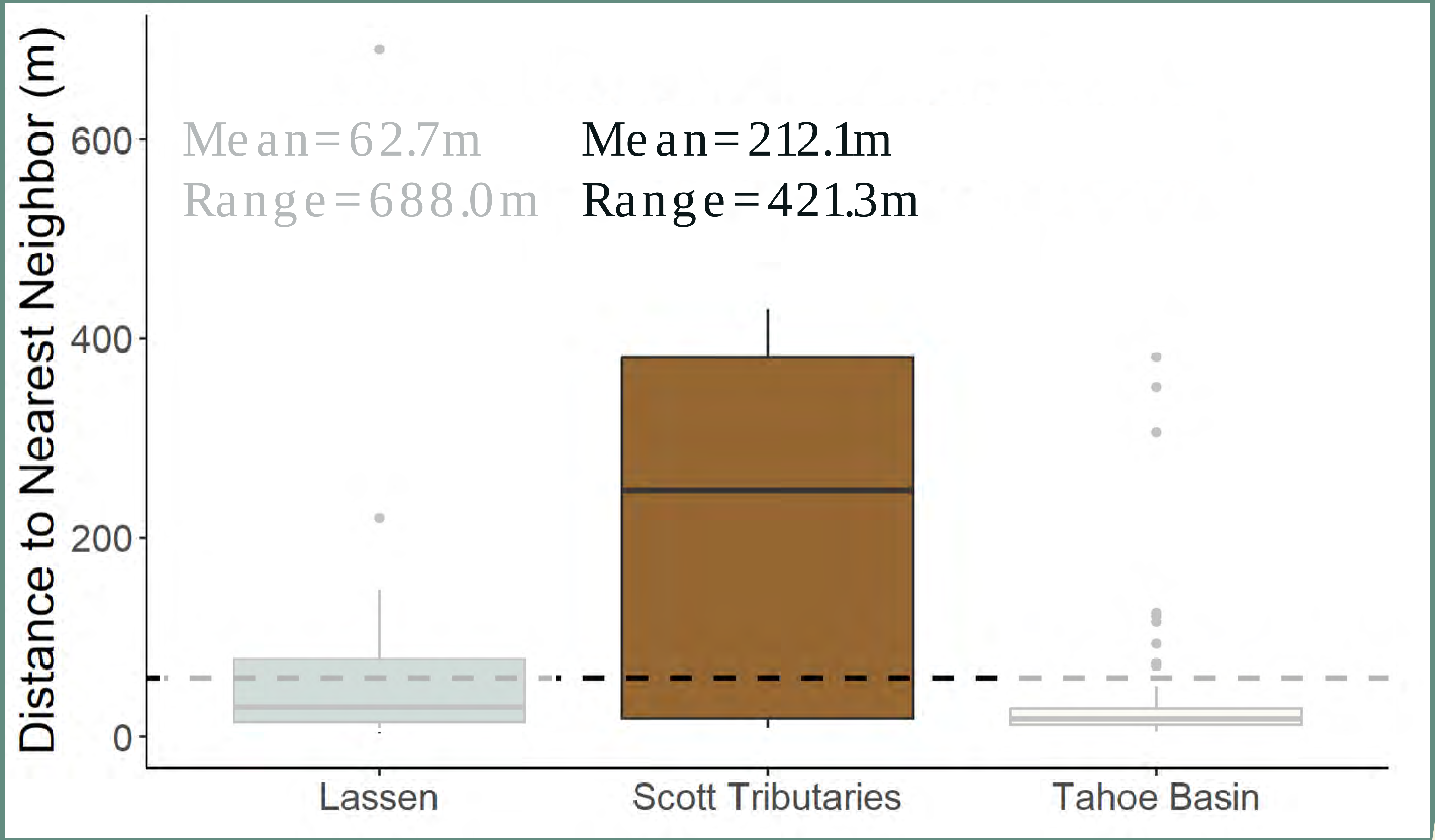

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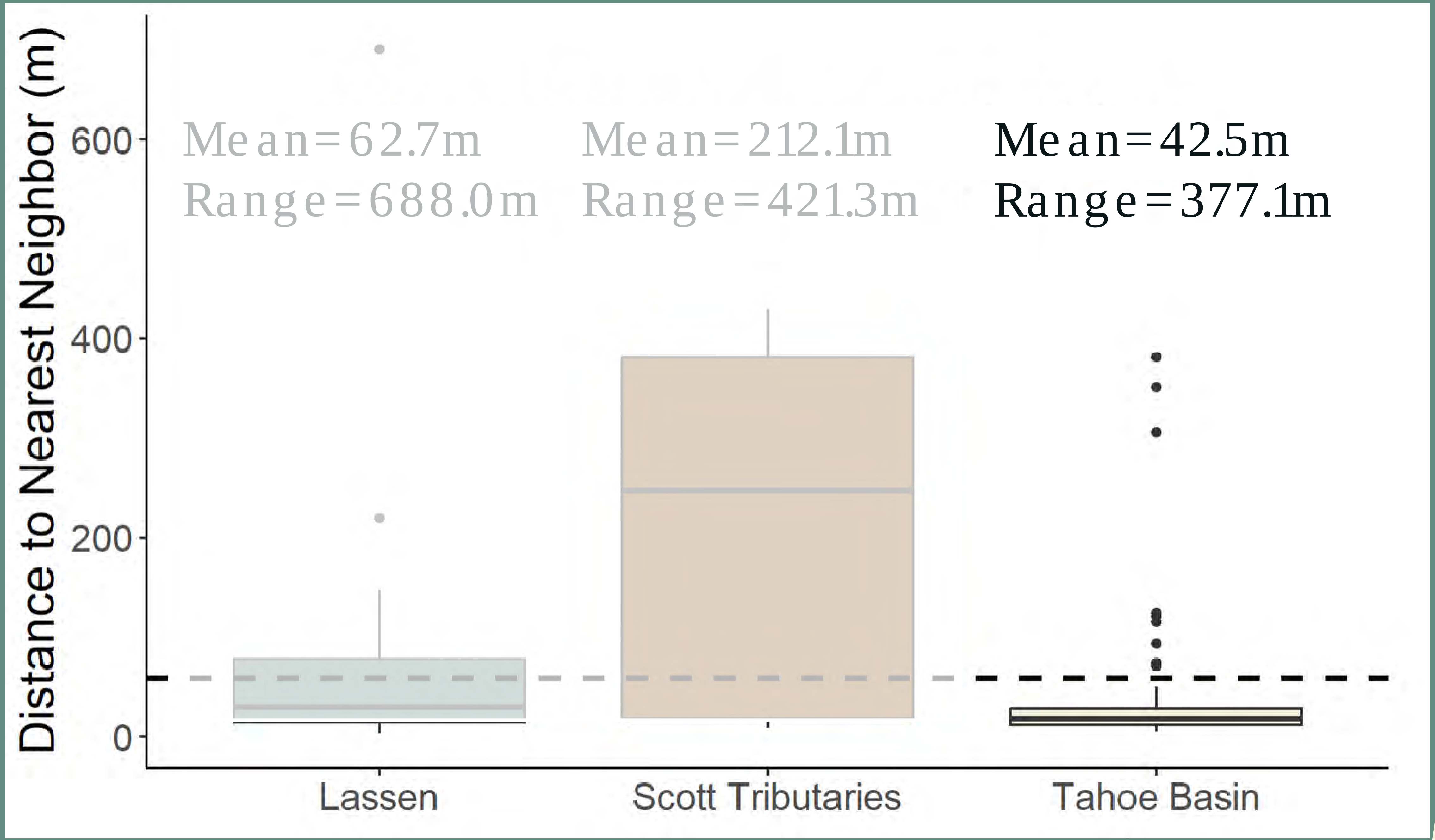

Distance:

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Overall range =688.0m

RESULTS

01 02 03

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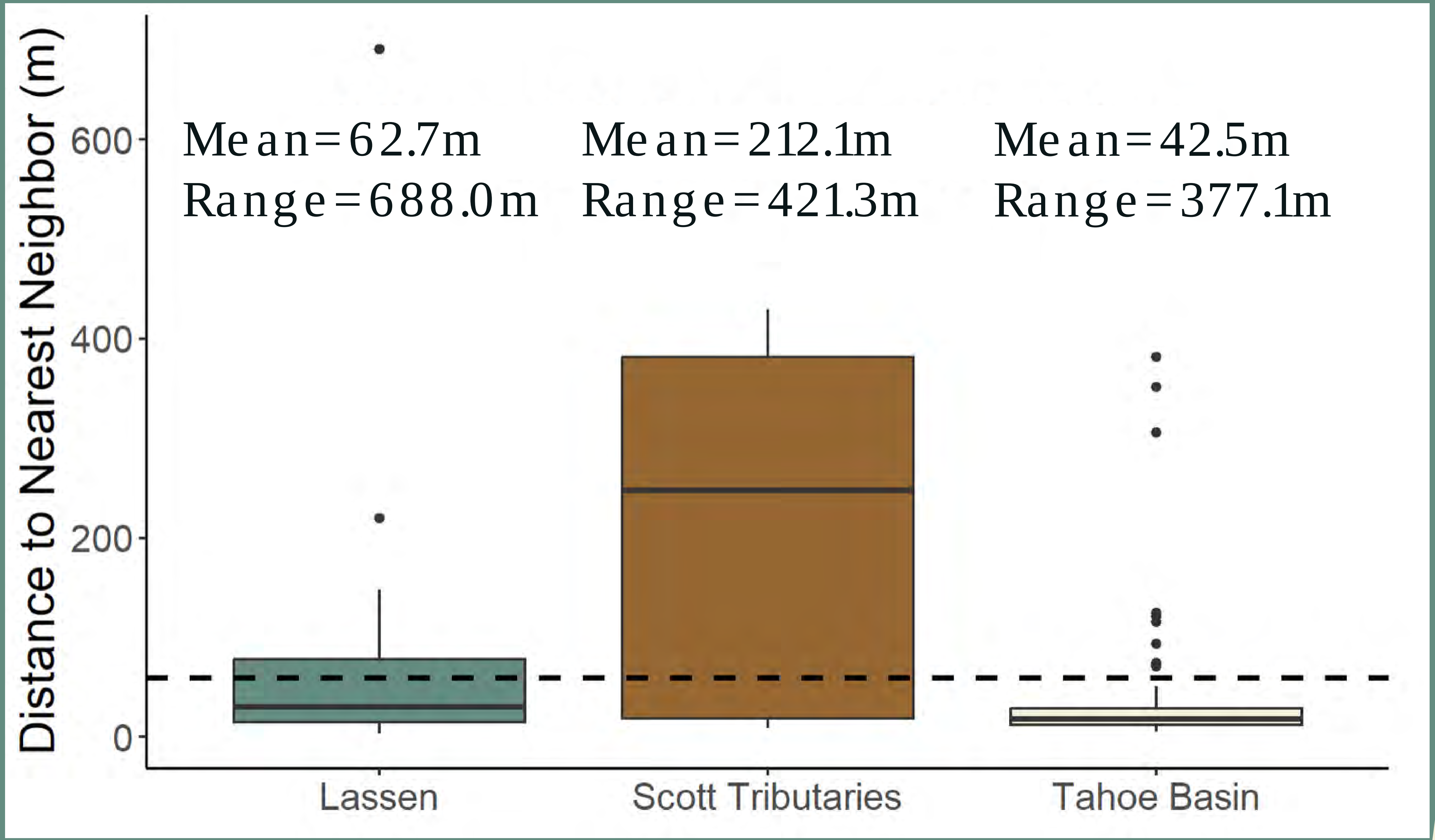


Distance:

Overall mean =58.51m

Overall range =688.0m

QUESTIONS

01	02	03
What **spacing** do we see between dams in beaver-maintained systems?	What common **structural characteristics** do we see in beaver dams?	

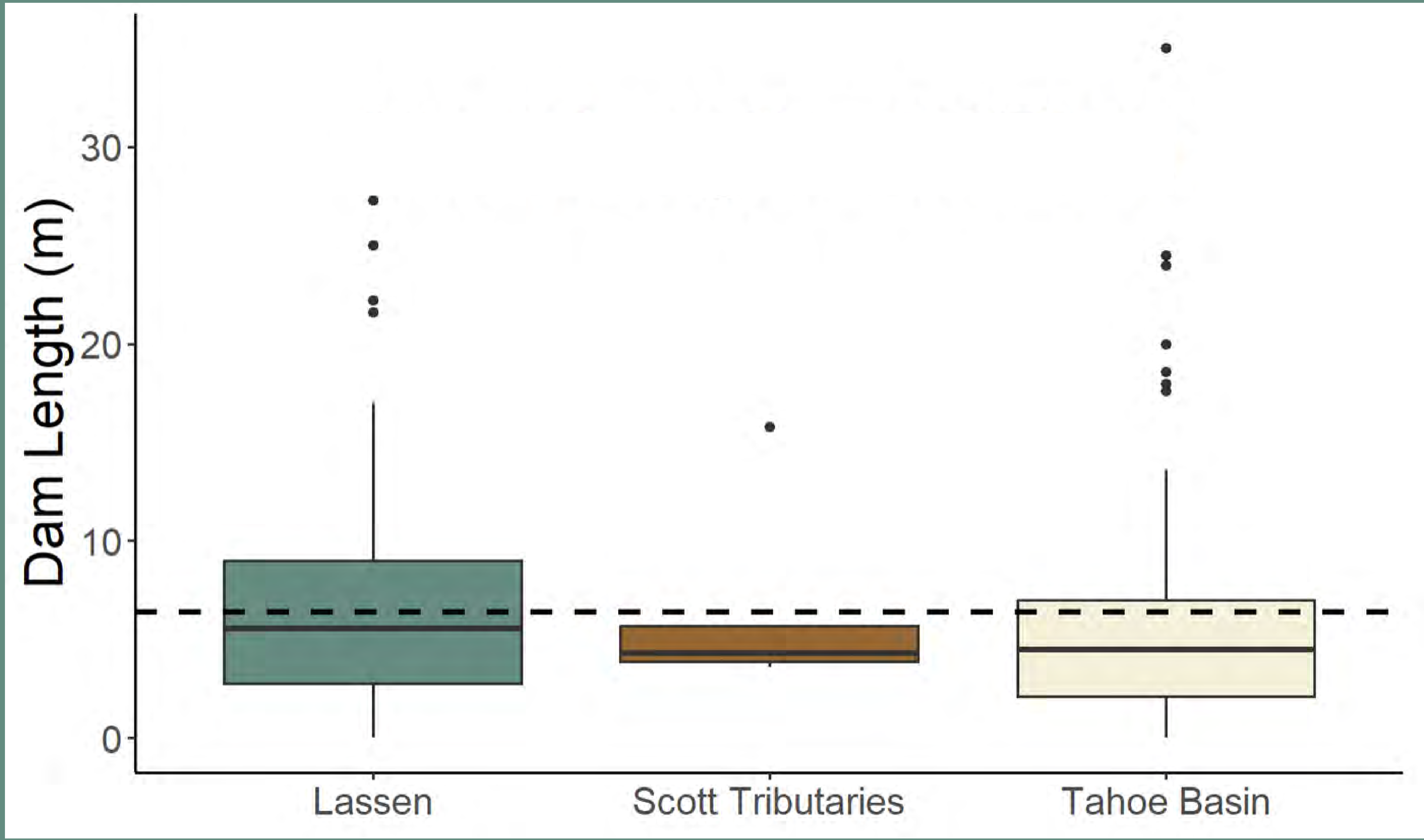
- ➢ 58.5 m mean
- ➢ 688 m range

Site Specific Variation

RESULTS

01 02 03

What common **structural characteristics** do we see in beaver dams?



Length:

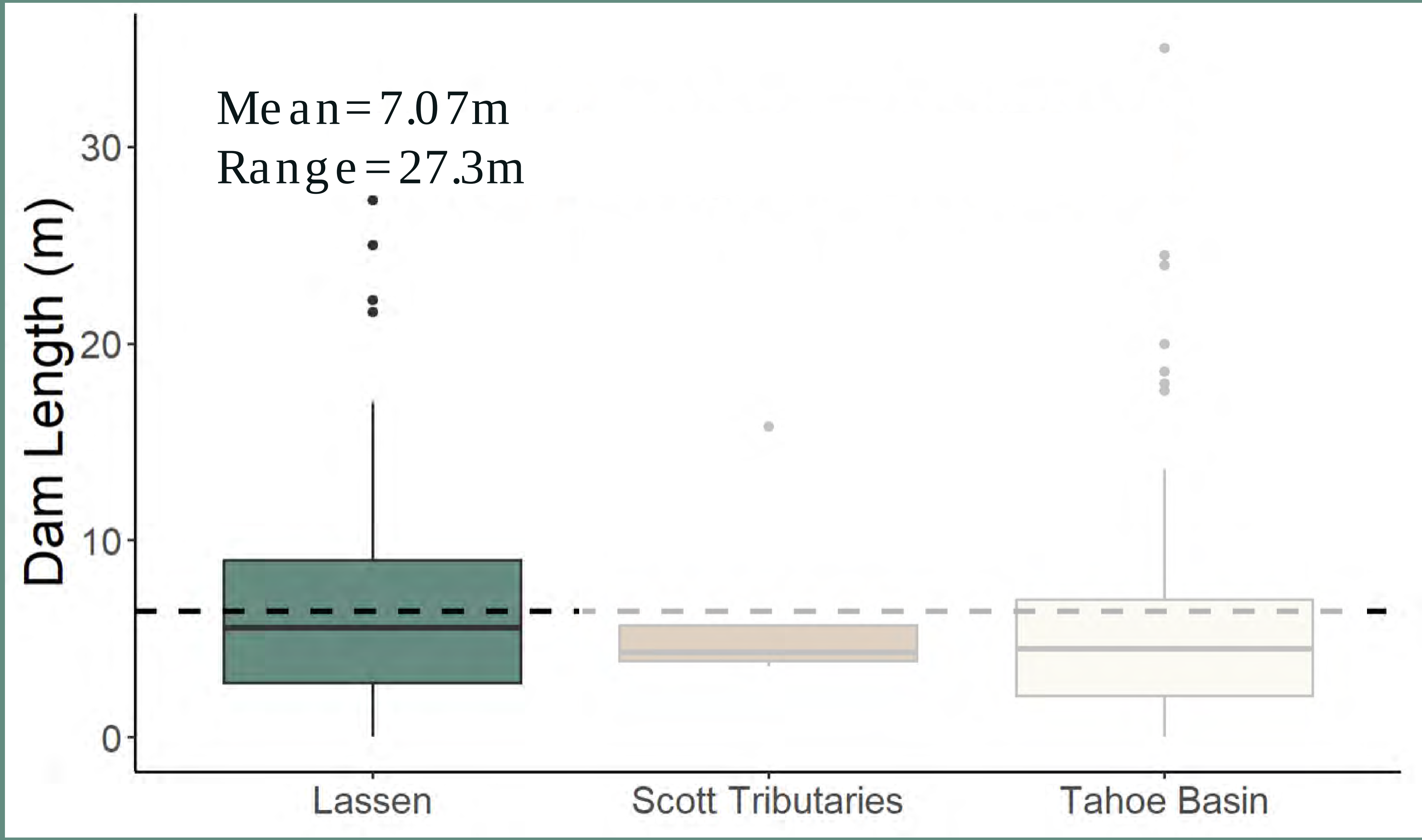
Overall mean = 6.38m

Overall range = 35m

RESULTS

01 02 03

What common **structural characteristics** do we see in beaver dams?



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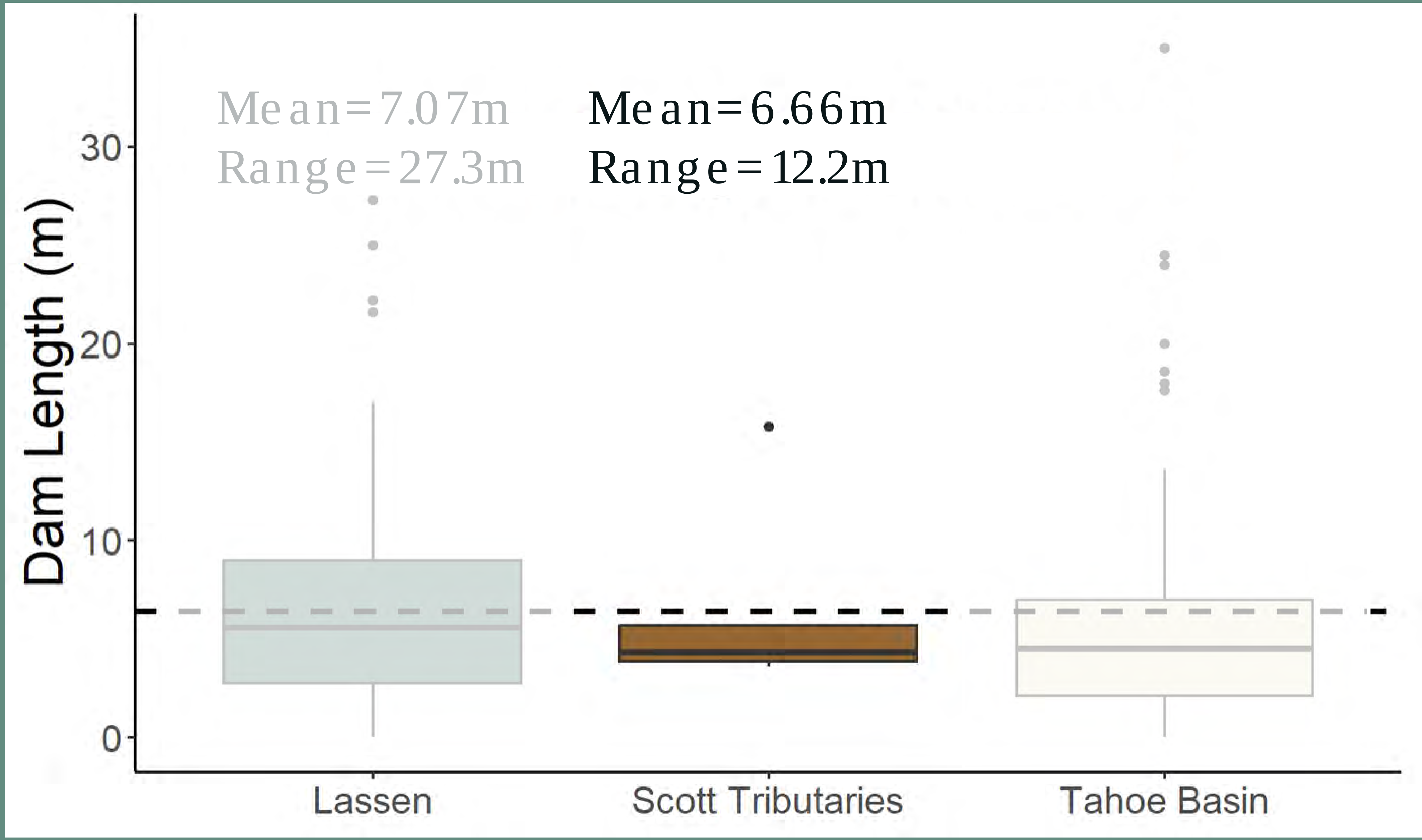

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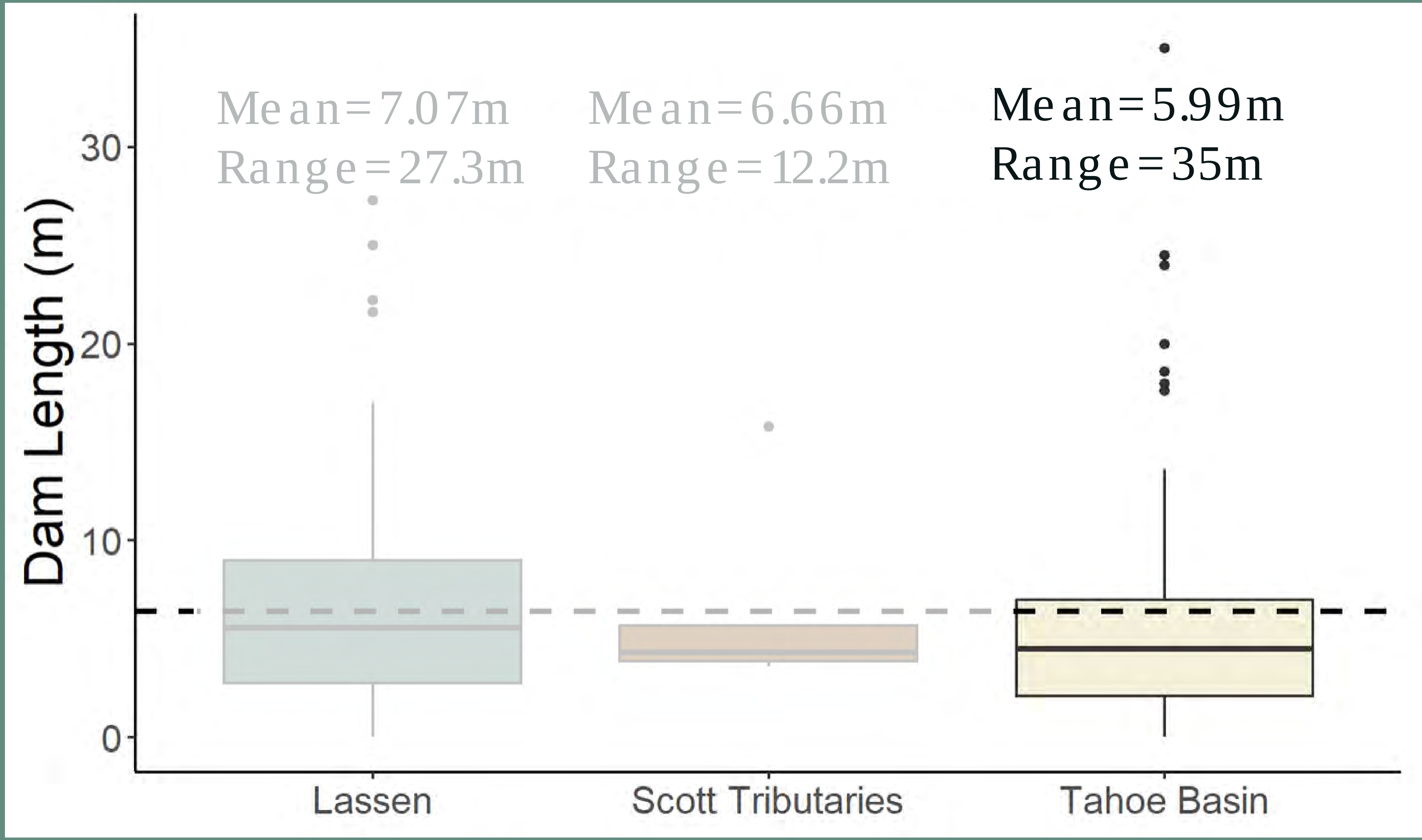

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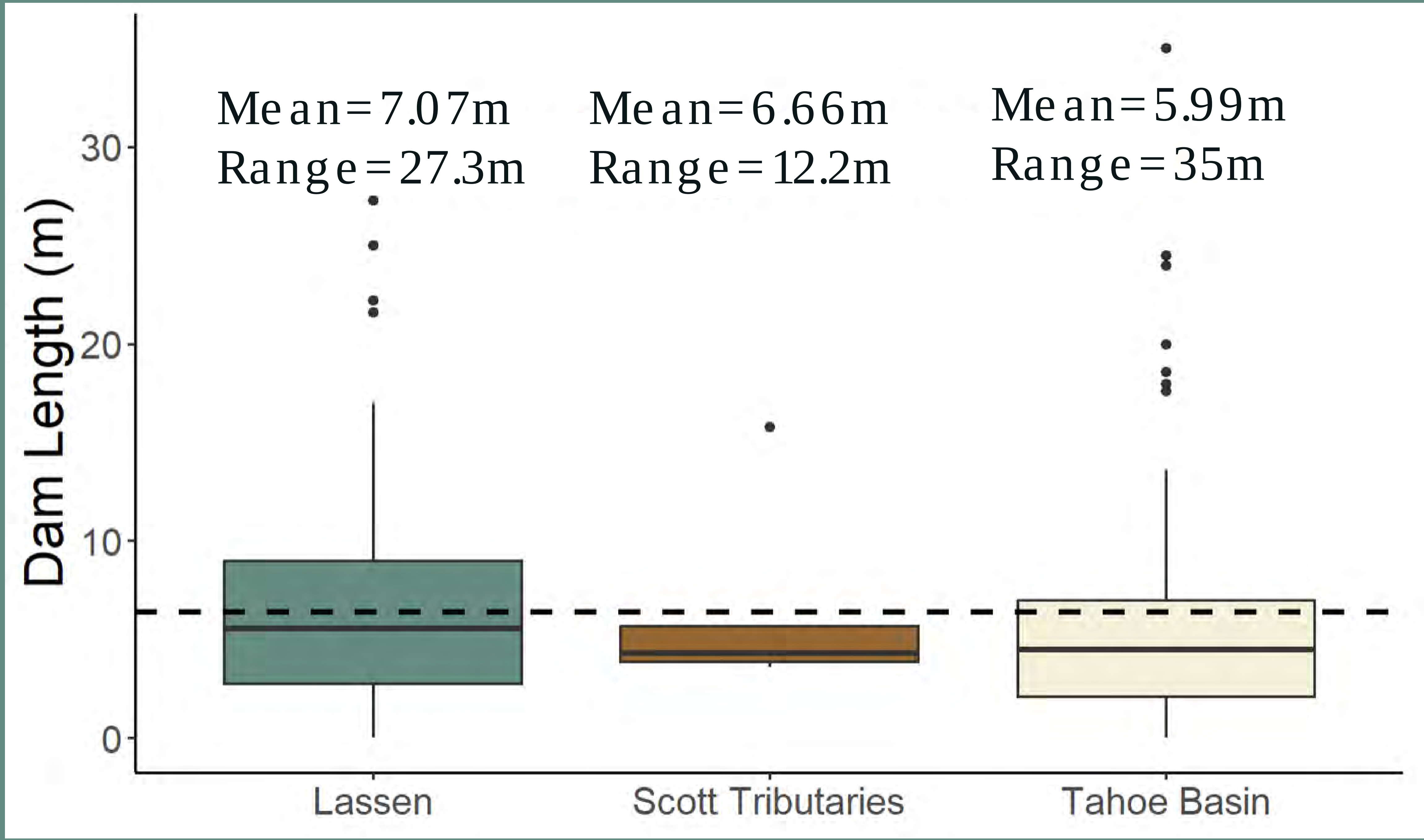

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RESULTS

01 02 03

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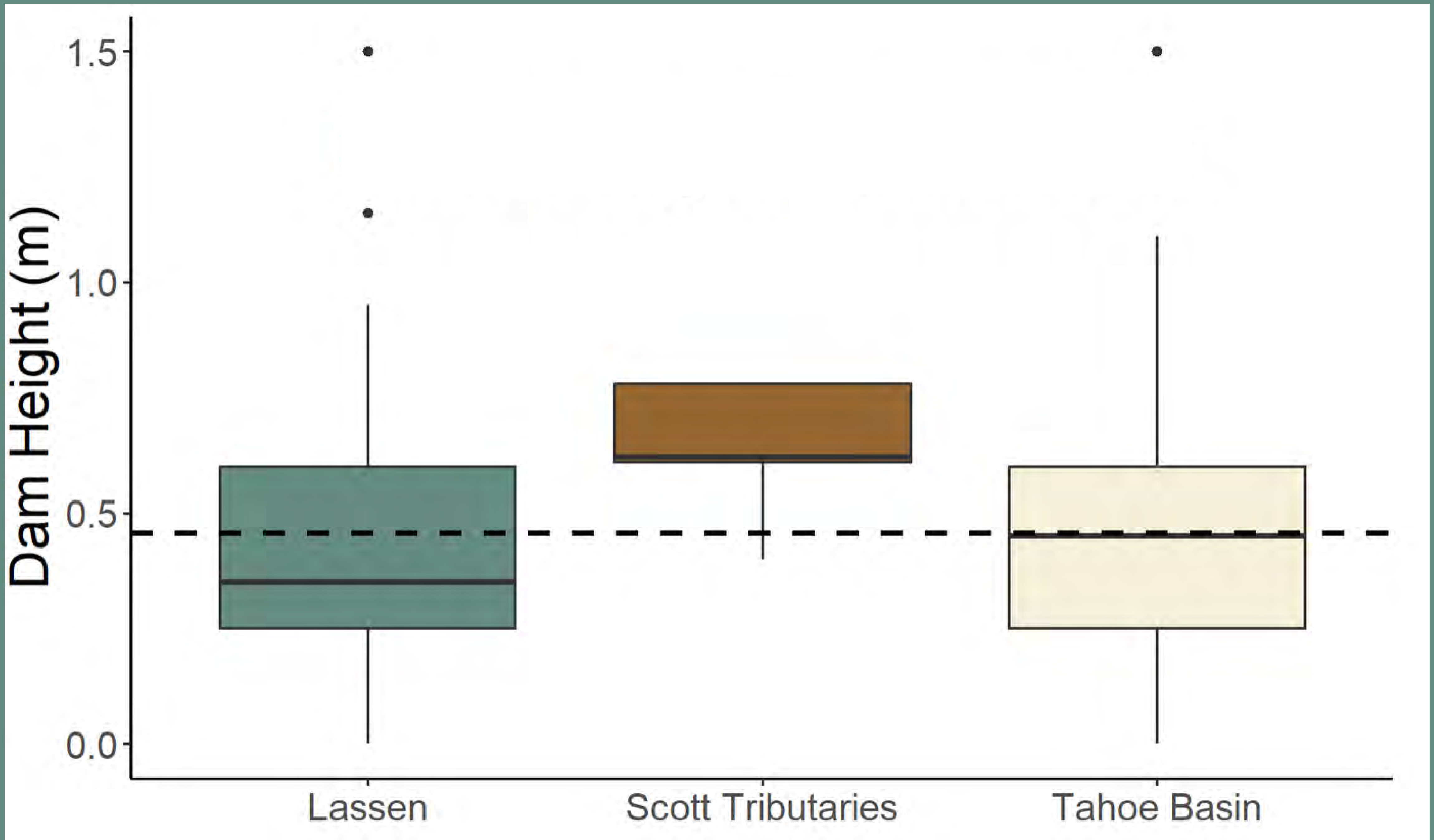


Height:

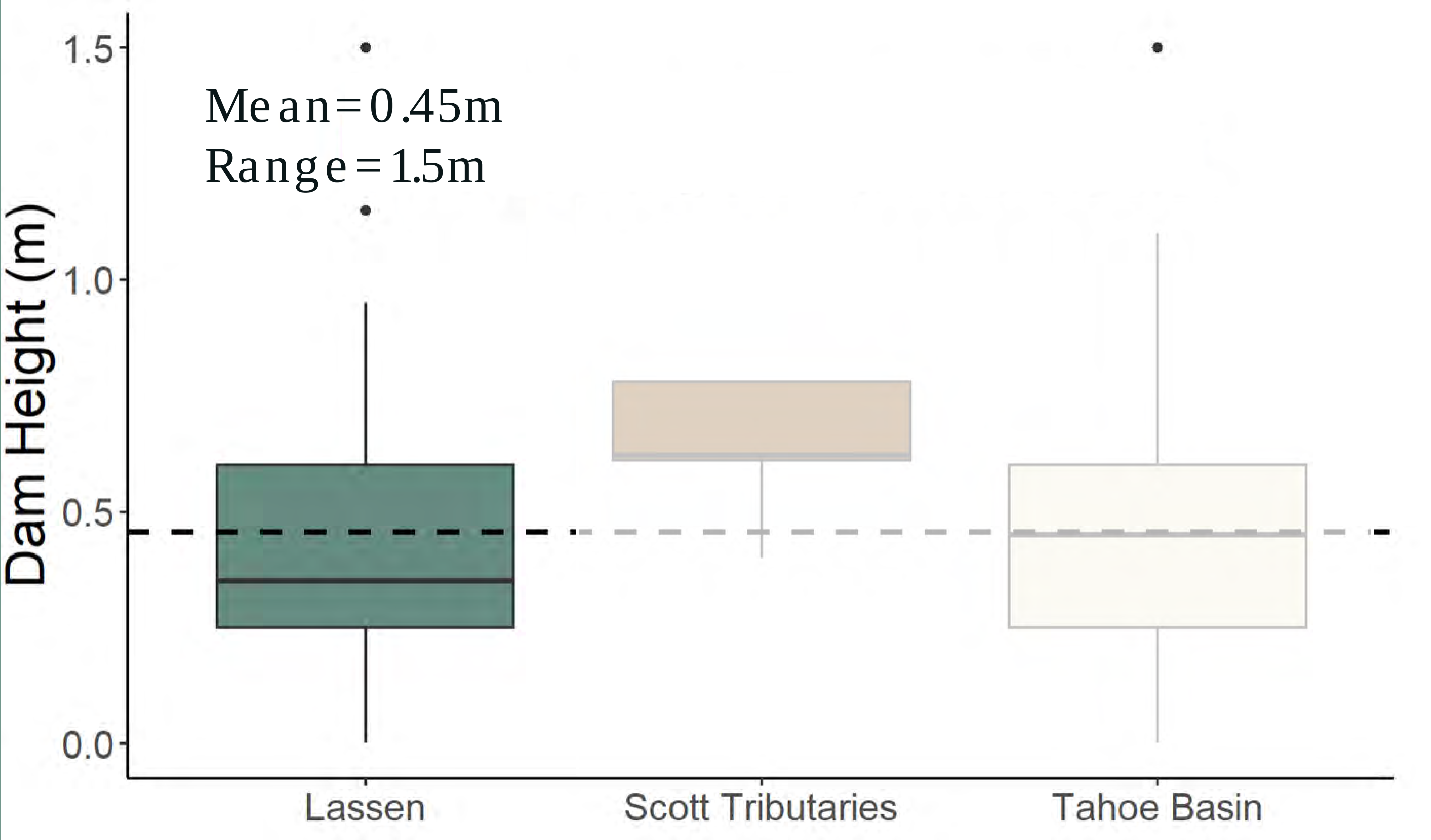
Overall mean = 0.46m

Overall range = 1.5 m

RESULTS

01 02 03

What common **structural characteristics** do we see in beaver dams?



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RESULTS

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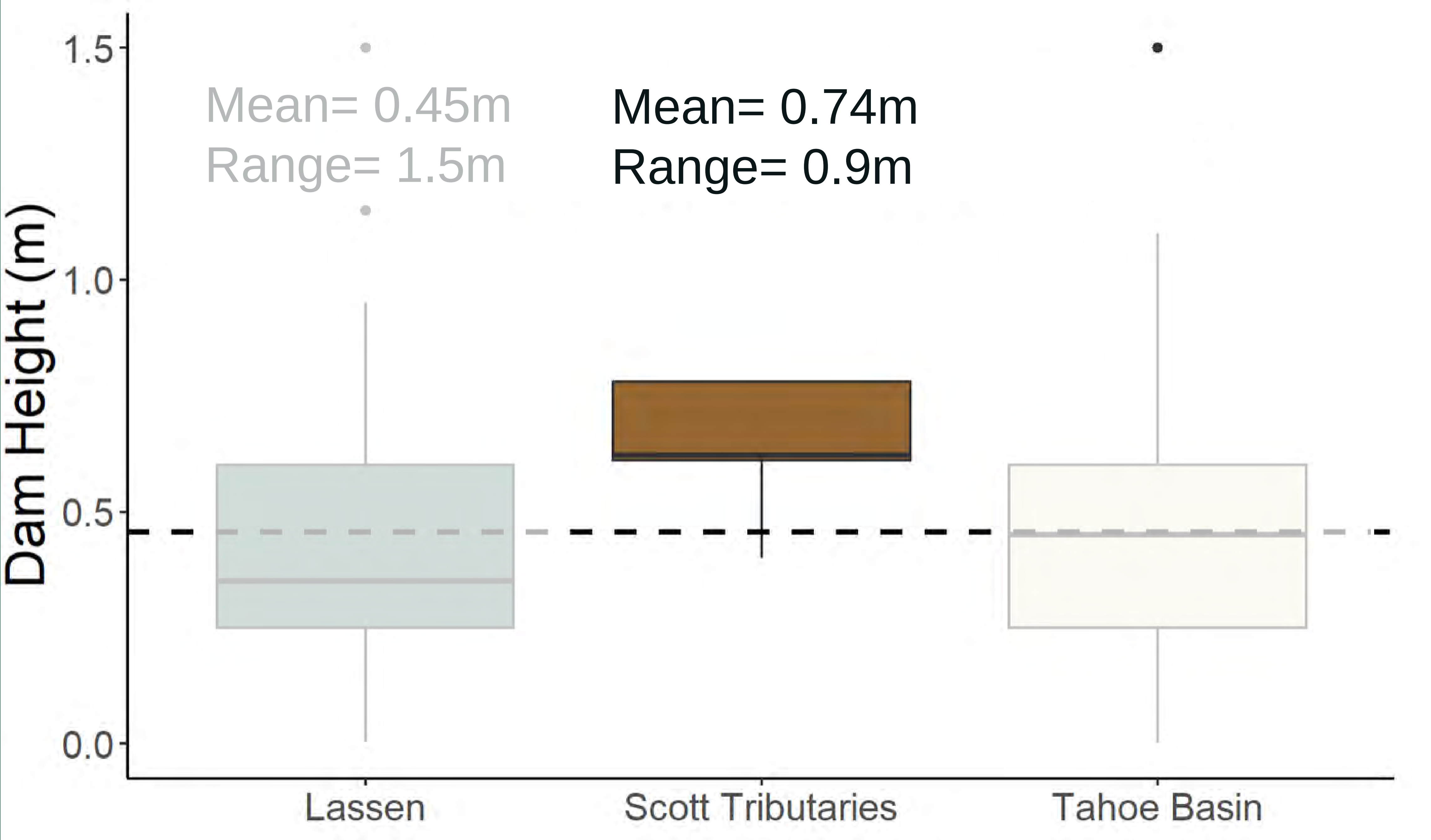

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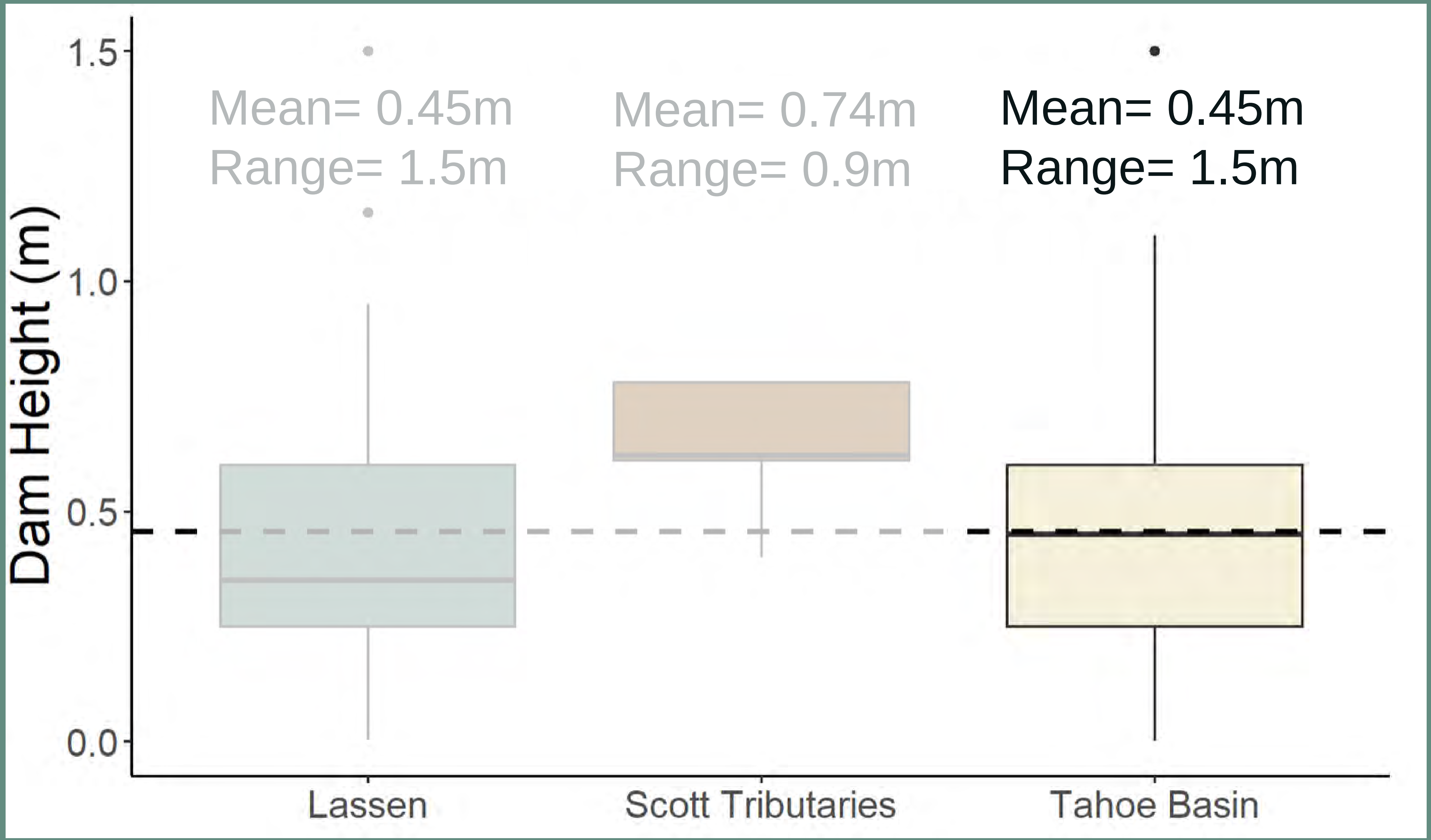

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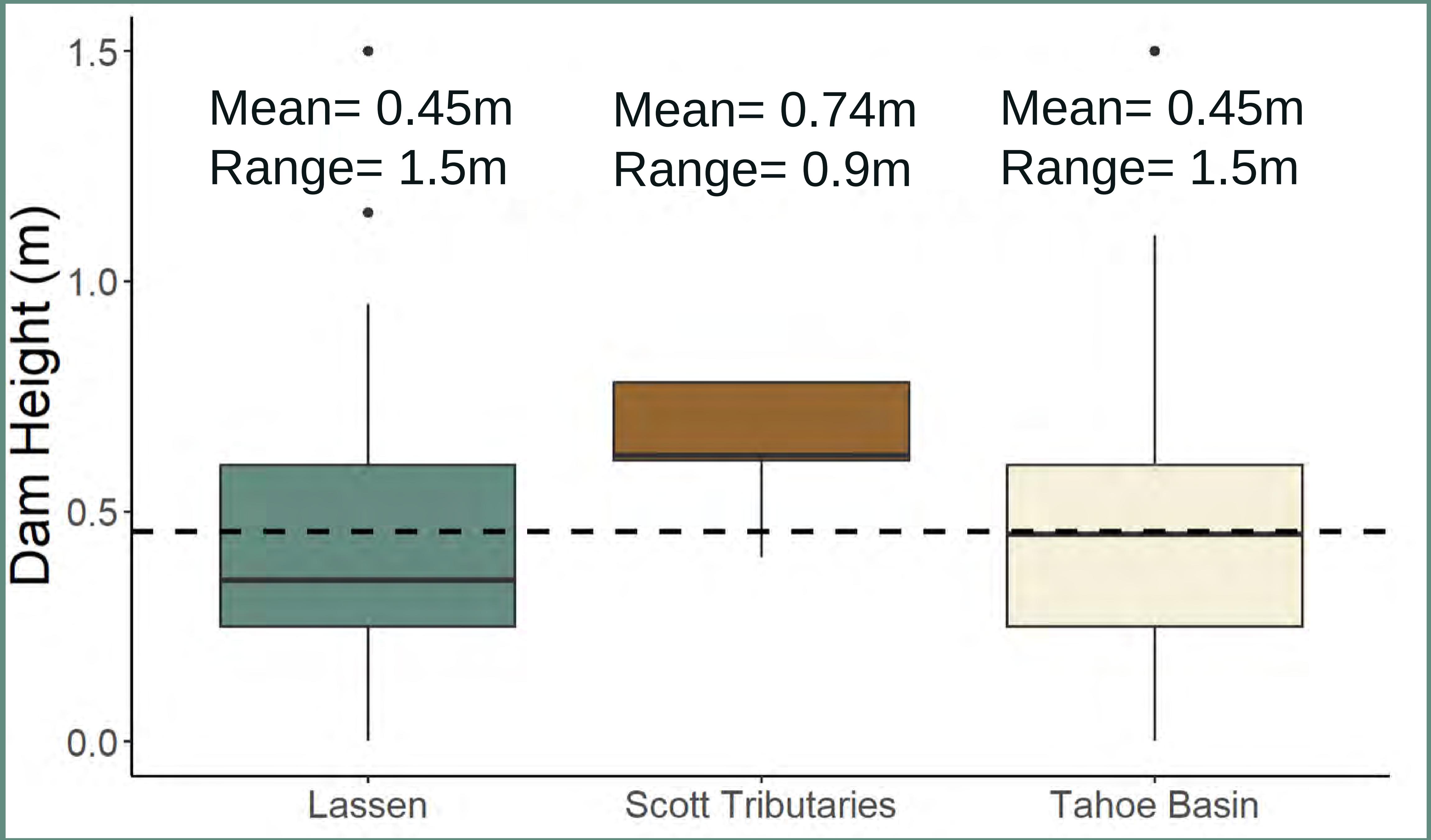
01 02 03

What common **structural characteristics** do we see in beaver dams?



Height:

Overall mean = 0.46m

Overall range = 1.5 m

QUESTIONS

01	02	03
What **spacing** do we see between dams in beaver-maintained systems?	What common **structural characteristics** do we see in beaver dams?	Site Specific Variation

01

What **spacing** do we see between dams in beaver-maintained systems?

- ➢ 58.5 m mean
- ➢ 688 m range

02

What common **structural characteristics** do we see in beaver dams?

- ➢ 6.4m mean length, 35m range
- ➢ 0.5m mean height, 1.5m range

03

Site Specific Variation

QUESTIONS

01

What **spacing** do we see between dams in beaver-maintained systems?

- 58.5 m mean
- 688 m range

02

What common **structural characteristics** do we see in beaver dams?

- 6.4m mean length, 35m range
- 0.5m mean height, 1.5m range

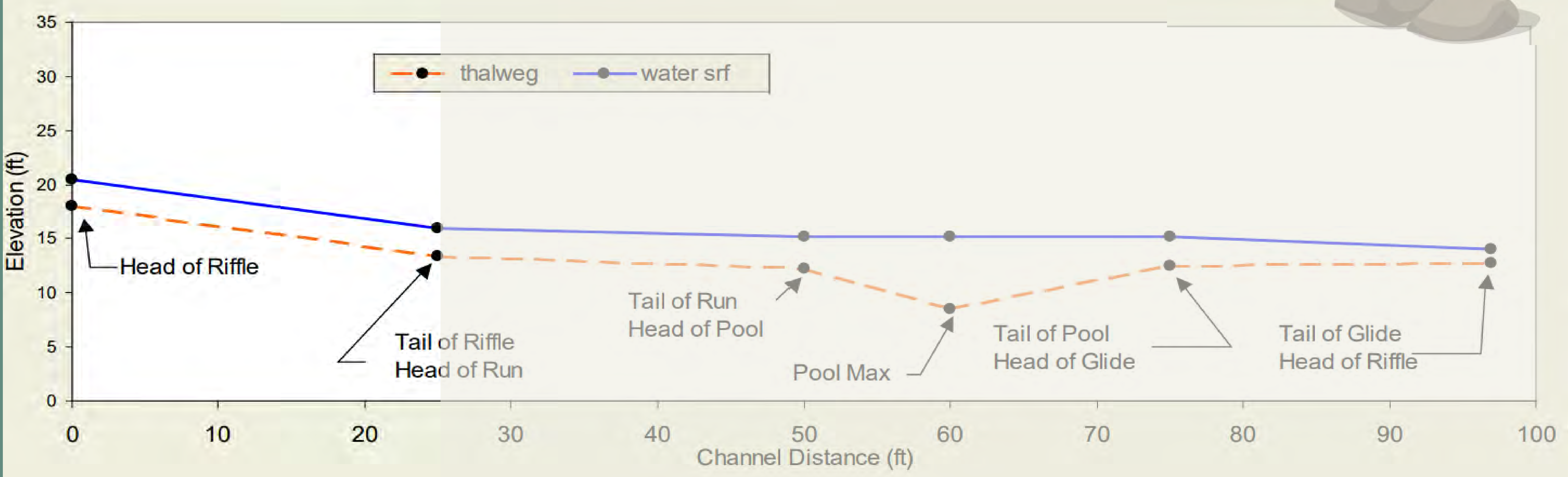
03

How does the dam spacing and structural characteristics of beaver-maintained systems relate to observed **in-stream habitat characteristics** ?

Surveyed at Low Flows

RIFFLE

Shallow Depths, High Velocity, Small Slope



Vermont Stream Geomorphic Assessment 2004

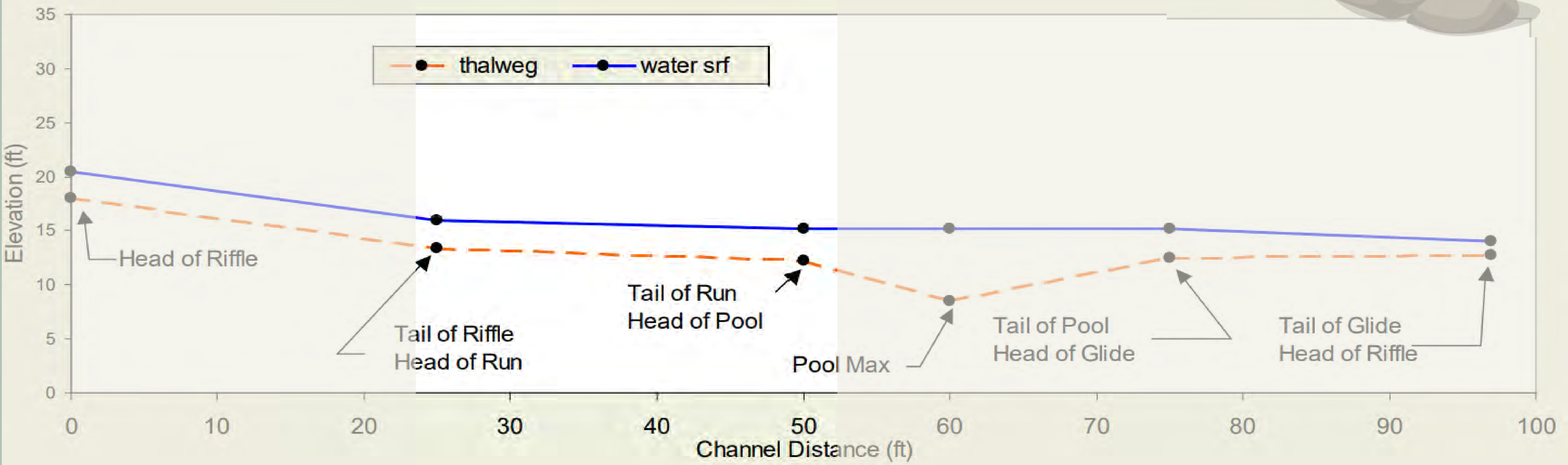
Surveyed at Low Flows

RUN

RIFFLE

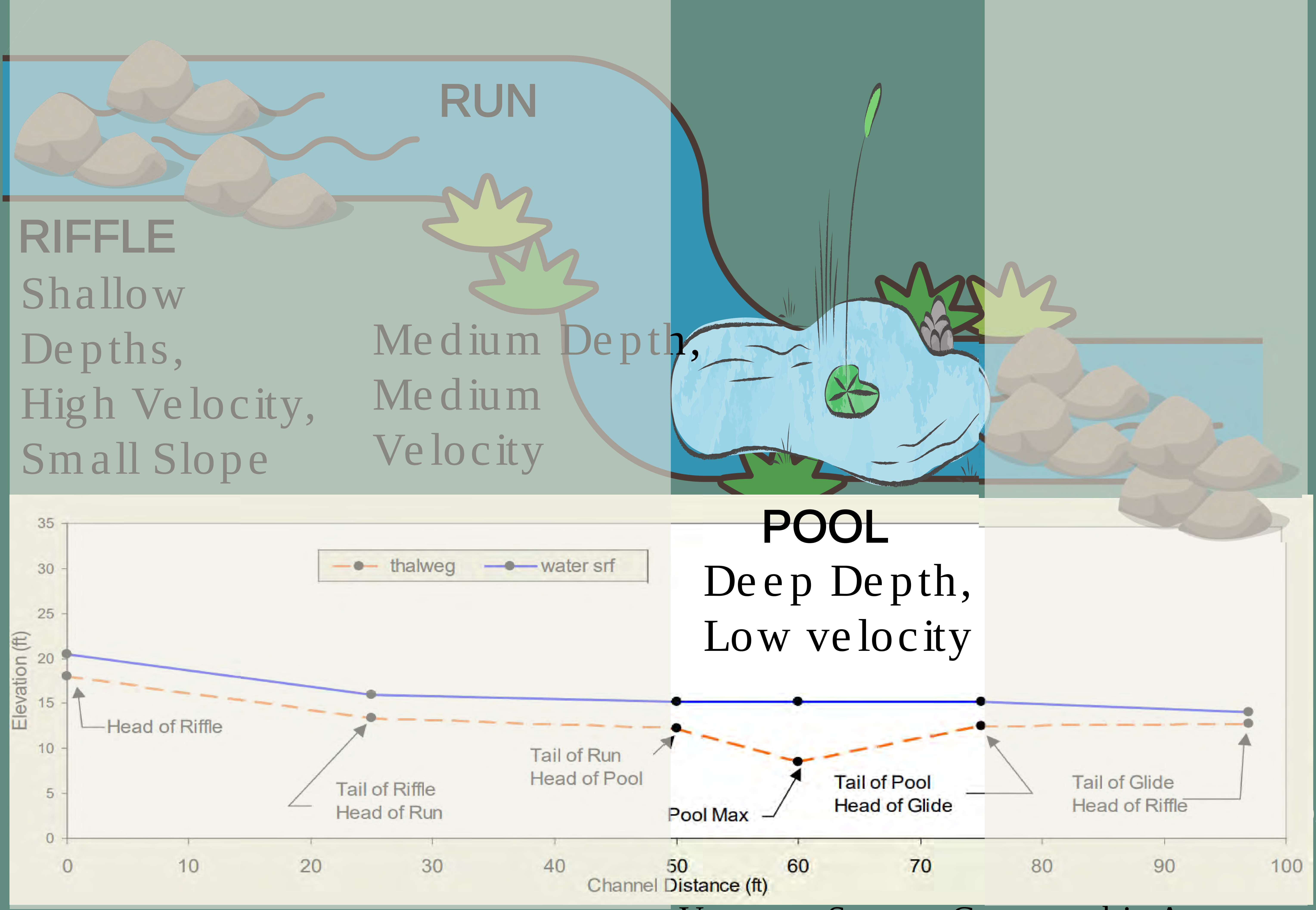
Shallow Depths, High Velocity, Small Slope

Medium Depth, Medium Velocity



Vermont Stream Geomorphic Assessment 2004

Surveyed at Low Flows



Vermont Stream Geomorphic Assessment 2004

Surveyed at Low Flows

CASCADE

Fast Velocity,
Shallow Depth,
Large Slope

RUN

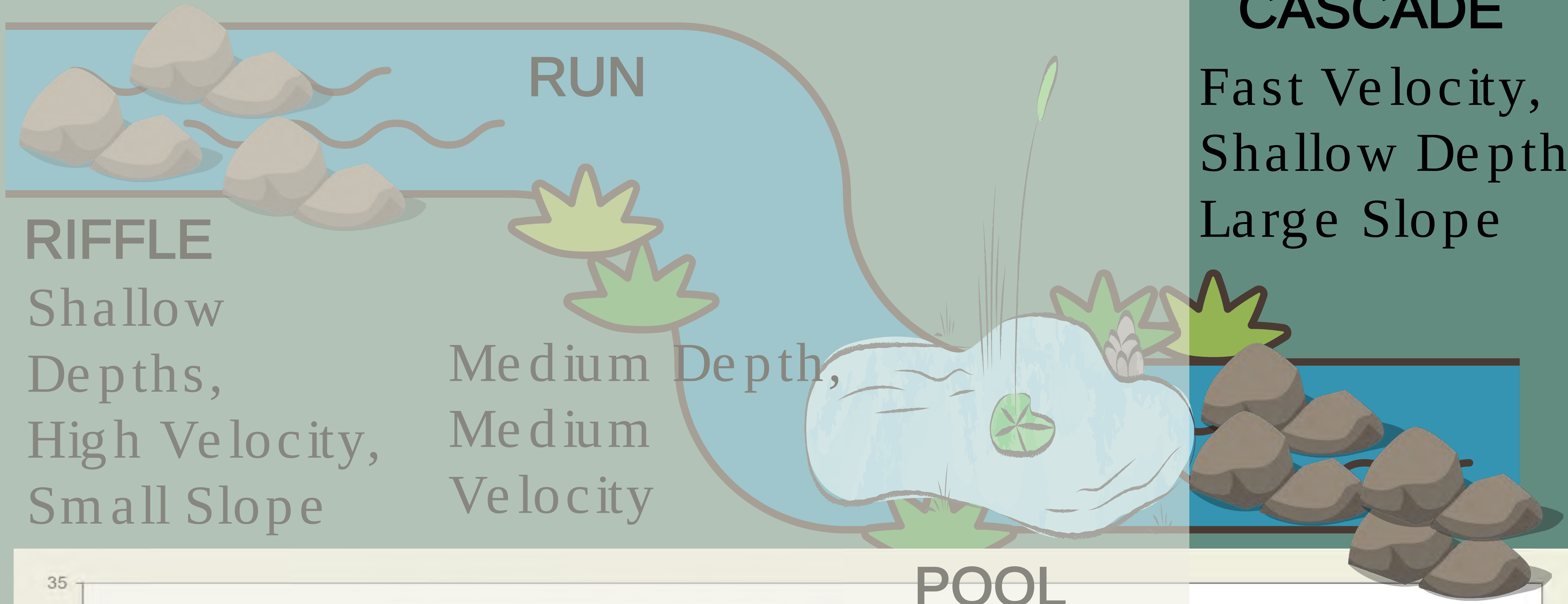
Medium Depth,
Medium
Velocity

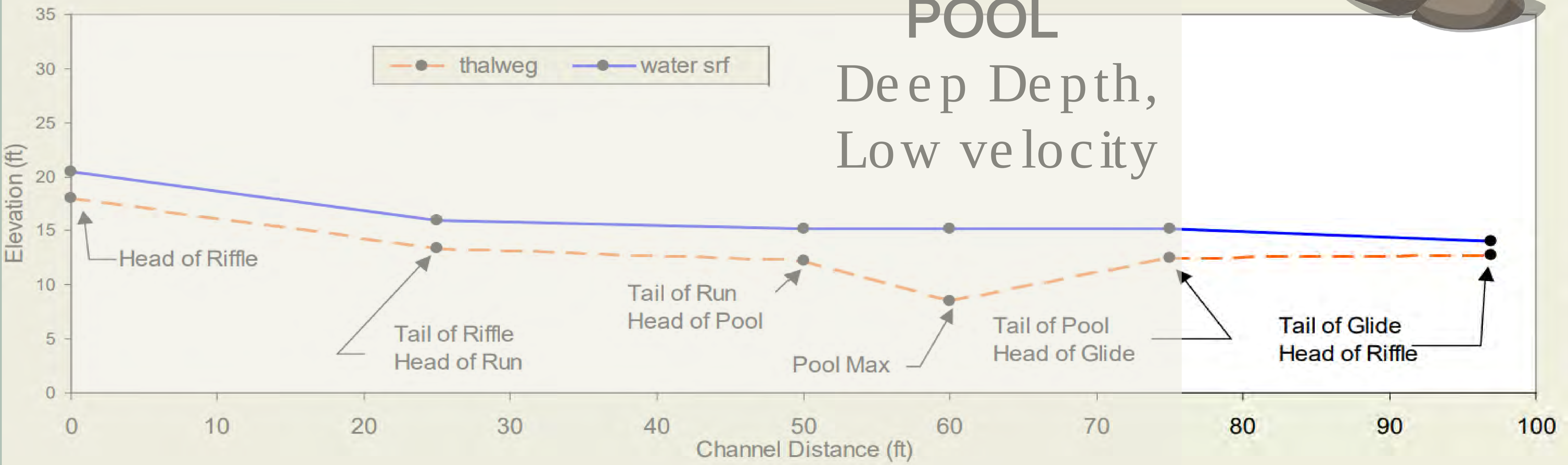
RIFFLE

Shallow
Depths,
High Velocity,
Small Slope

POOL

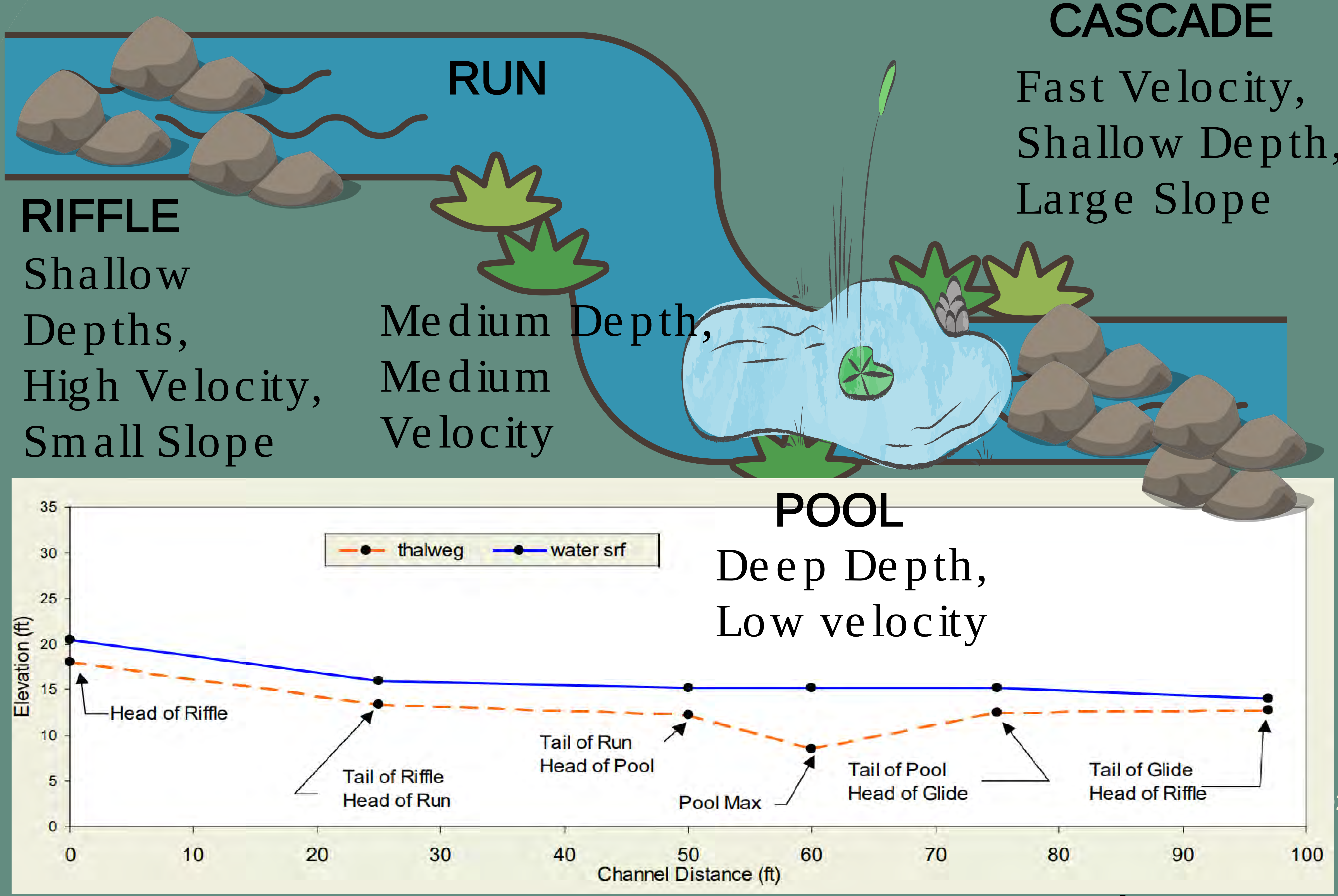
Deep Depth,
Low velocity



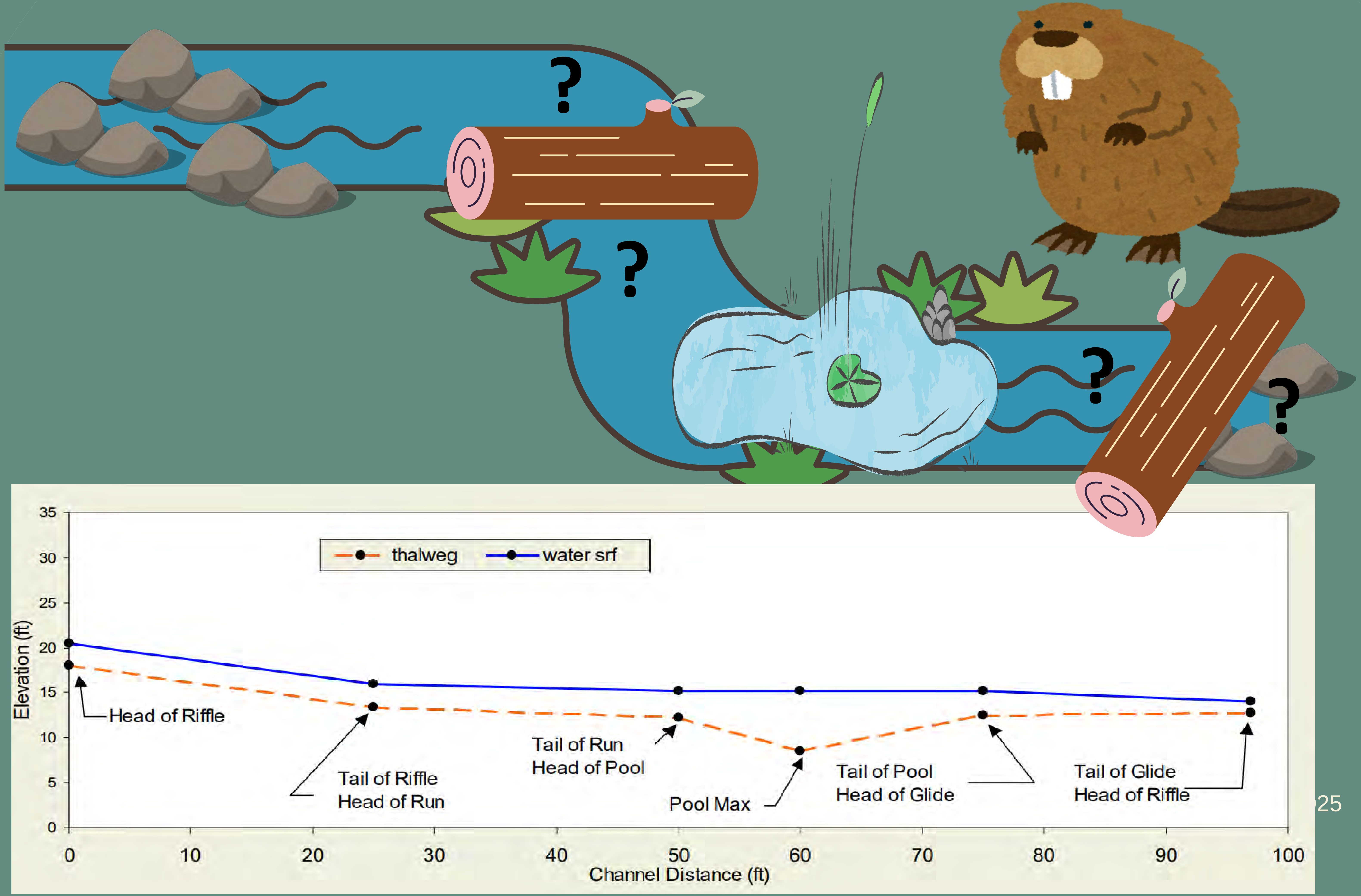


Vermont Stream Geomorphic Assessment 2004

Surveyed at Low Flows

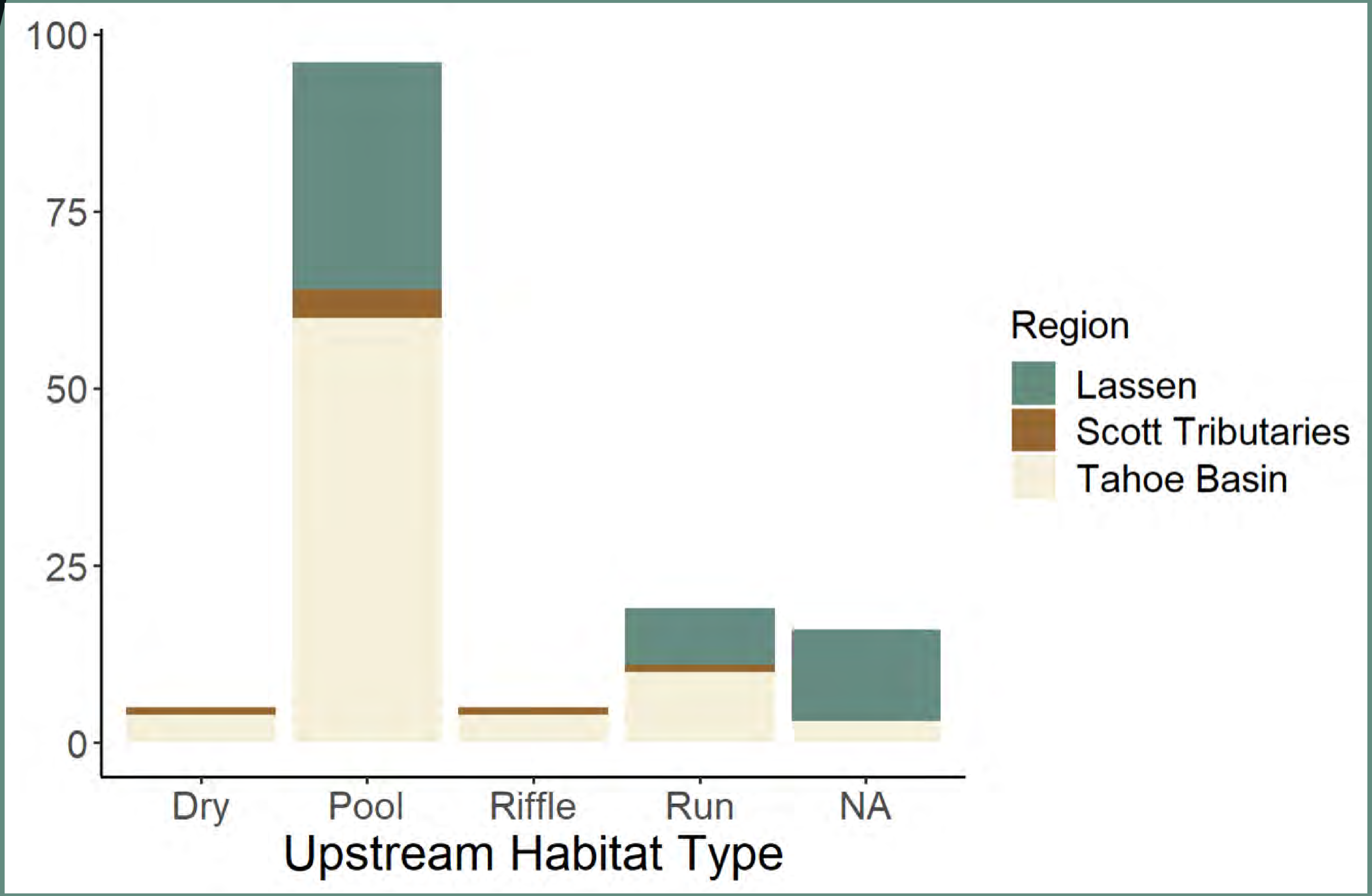


Vermont Stream Geomorphic Assessment 2004


?
?
?
?
thalweg
water srf
Elevation (ft)
35
30
25
20
15
10
5
0
Head of Riffle
Tail of Riffle
Head of Run
Tail of Run
Head of Pool
Pool Max
Tail of Pool
Head of Glide
Tail of Glide
Head of Riffle
0
10
20
30
40
50
60
70
80
90
100
Channel Distance (ft)

RESULTS

01 02 03



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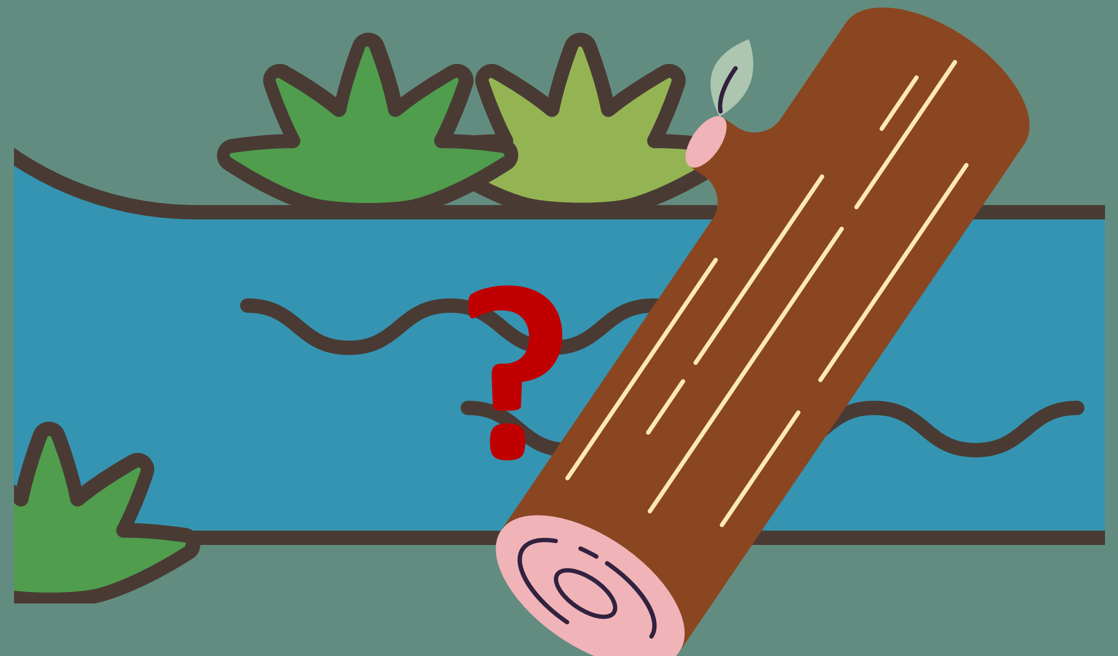

RESULTS

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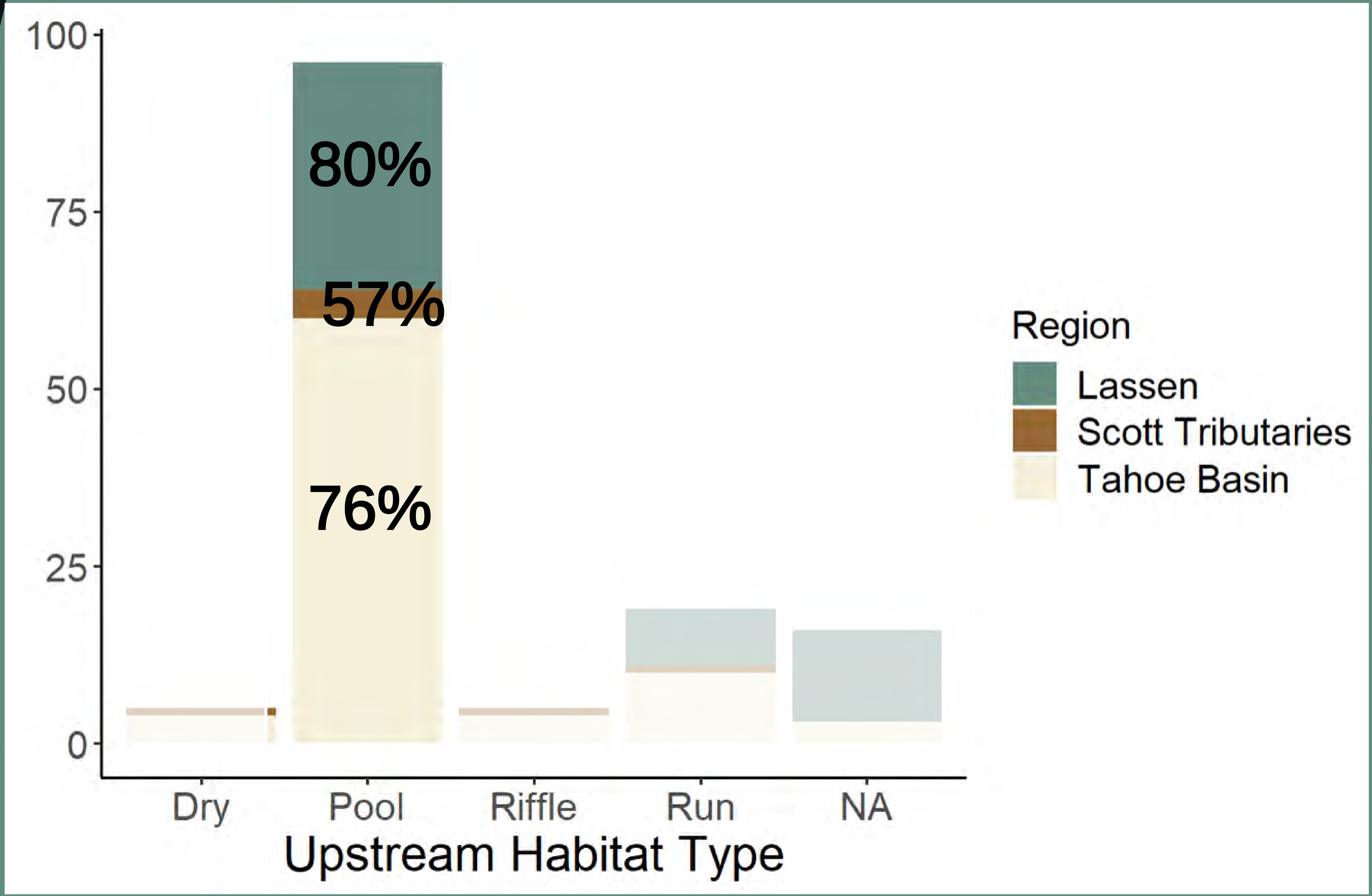

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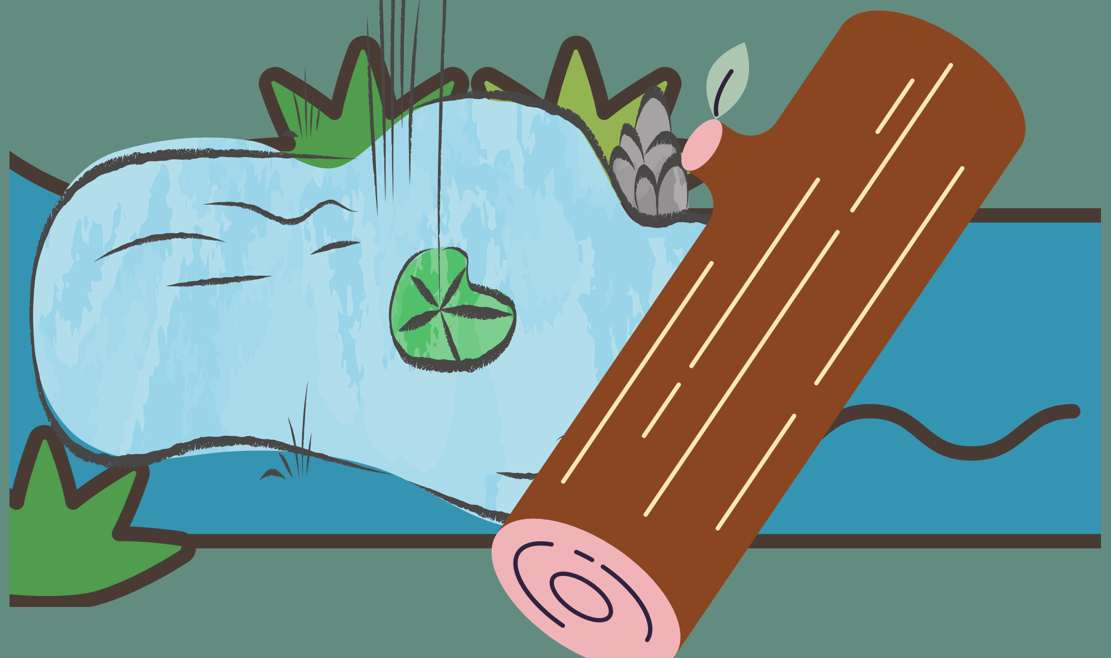

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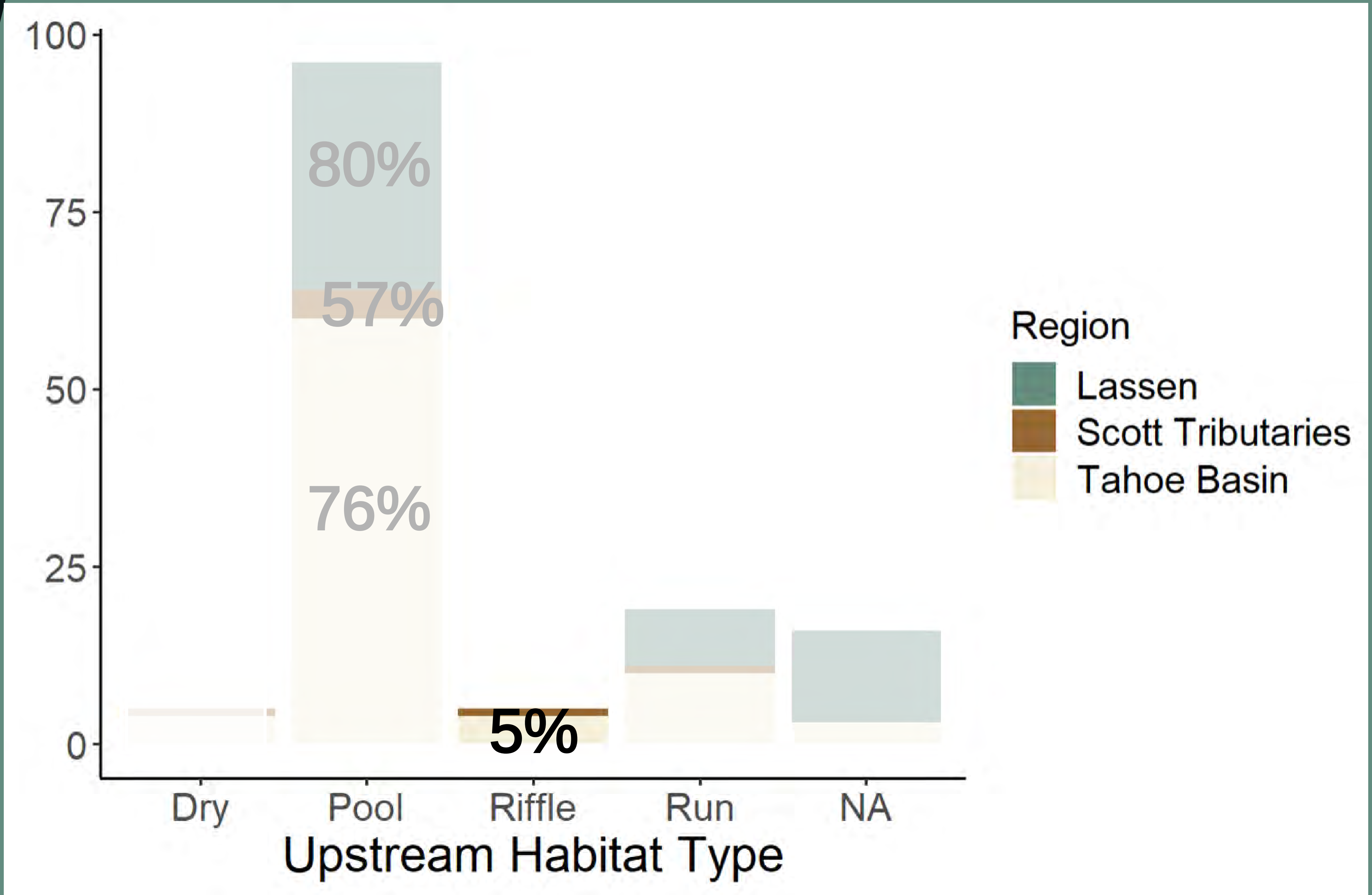

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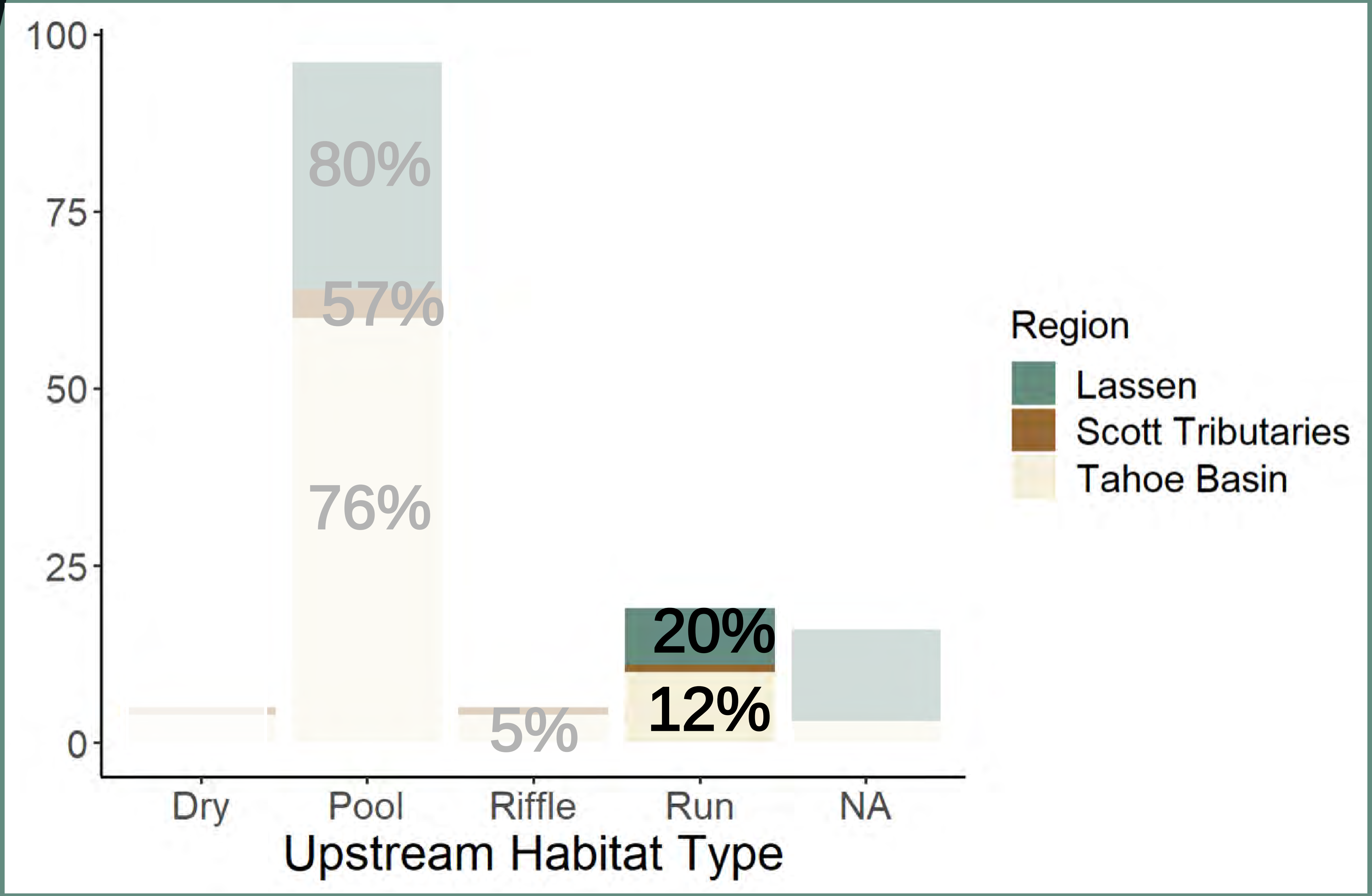

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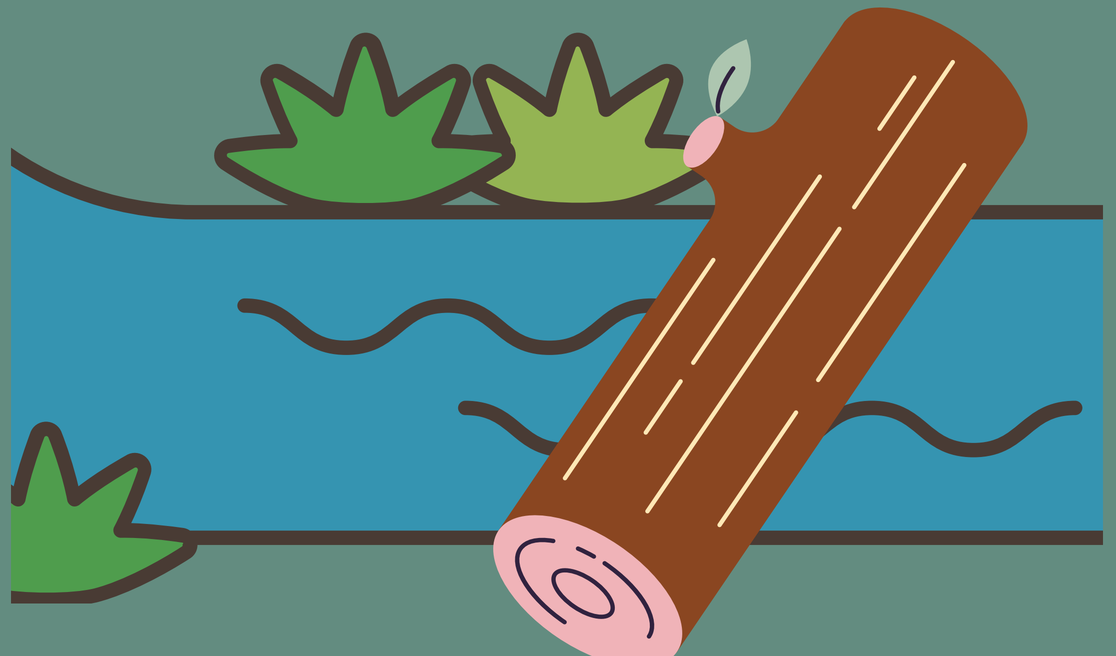

RESULTS

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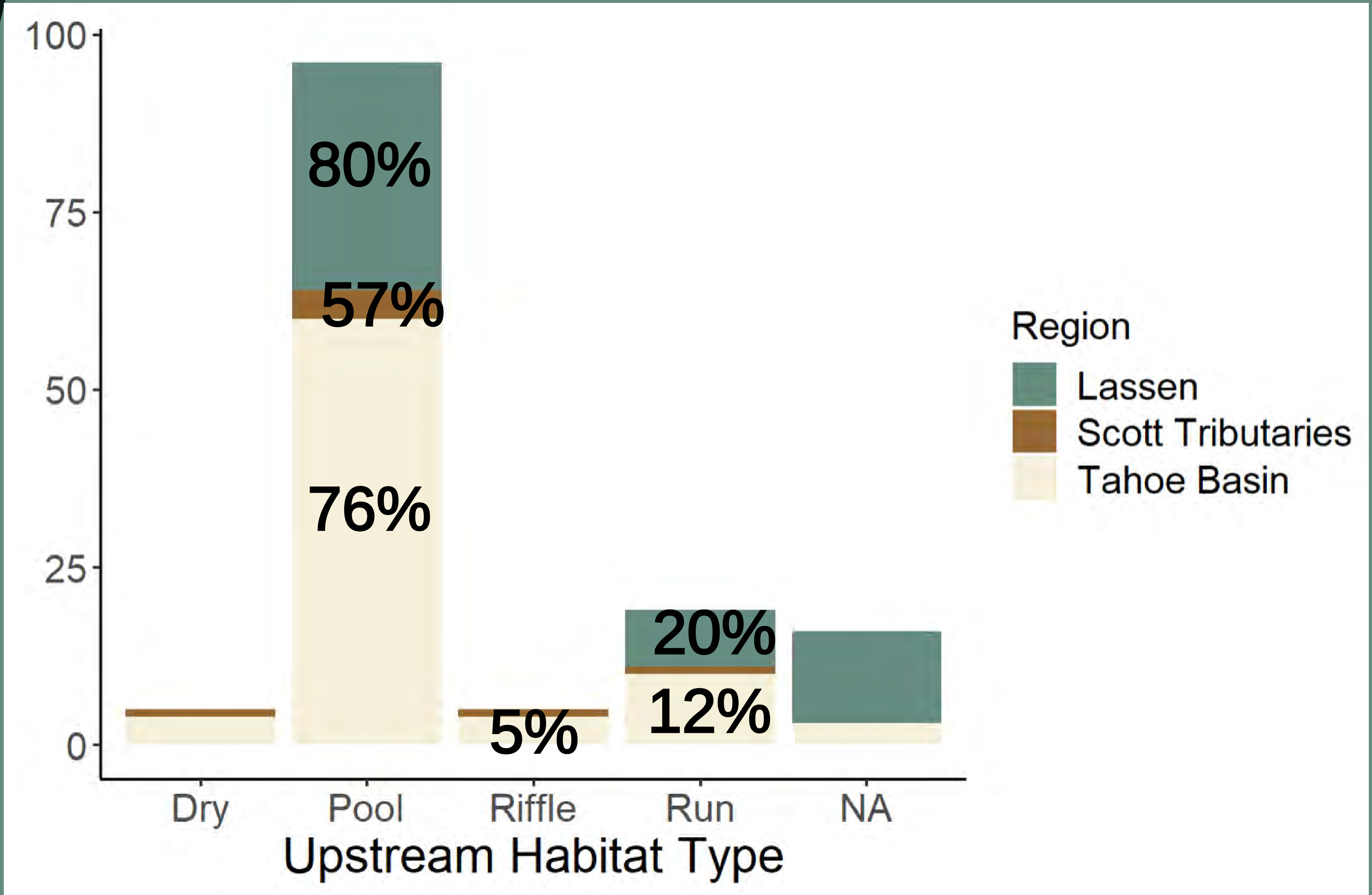

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RESULTS

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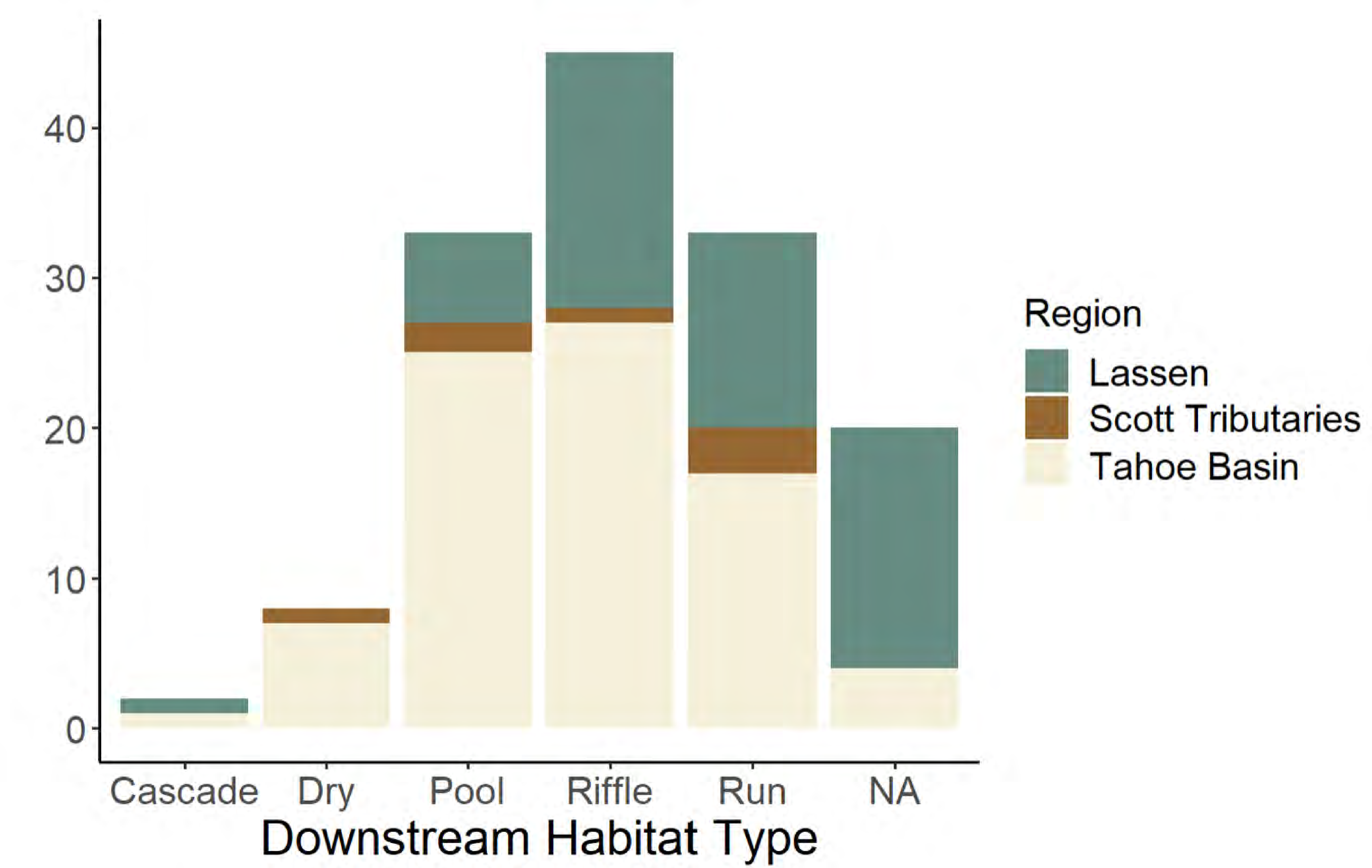

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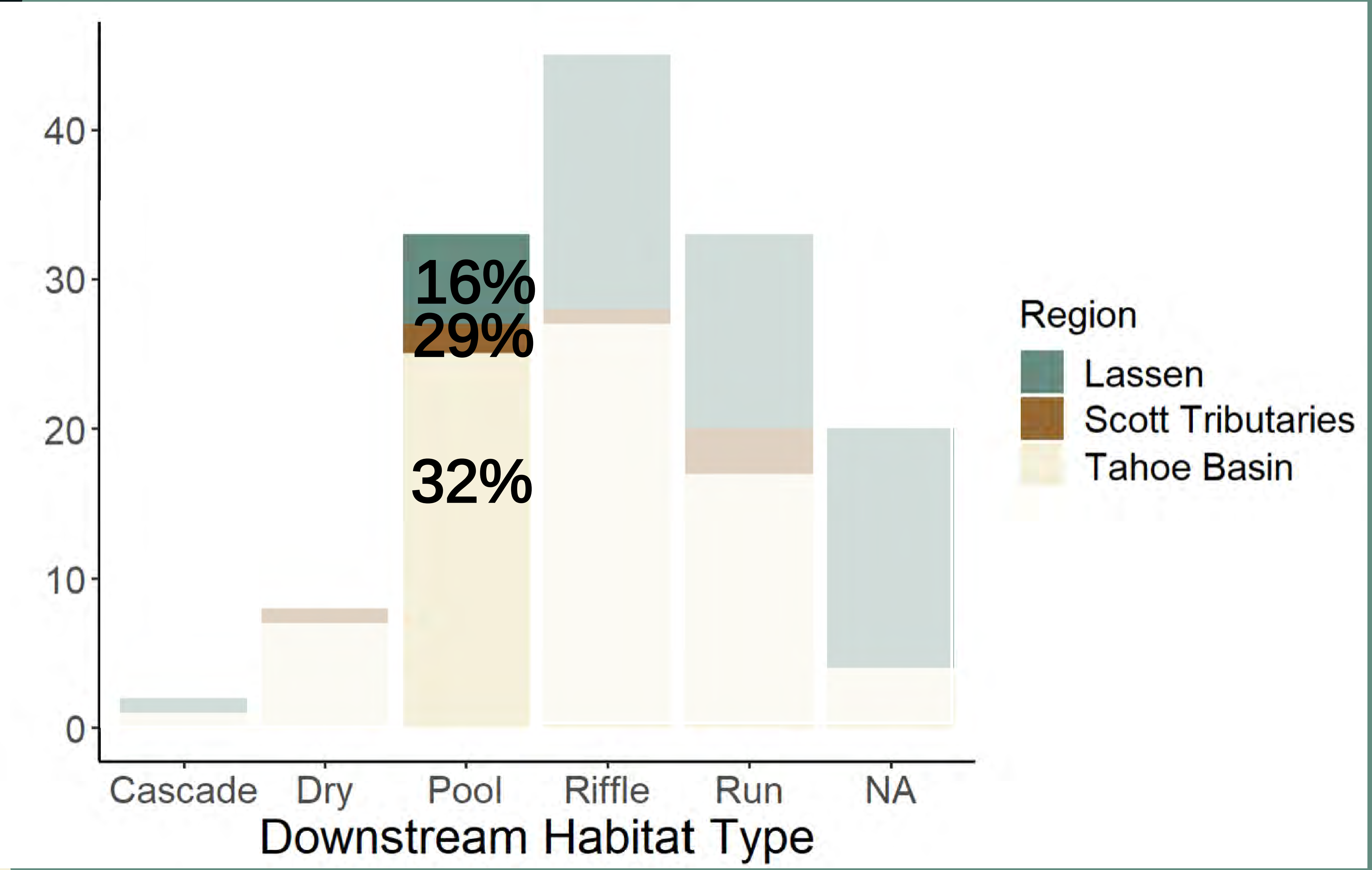

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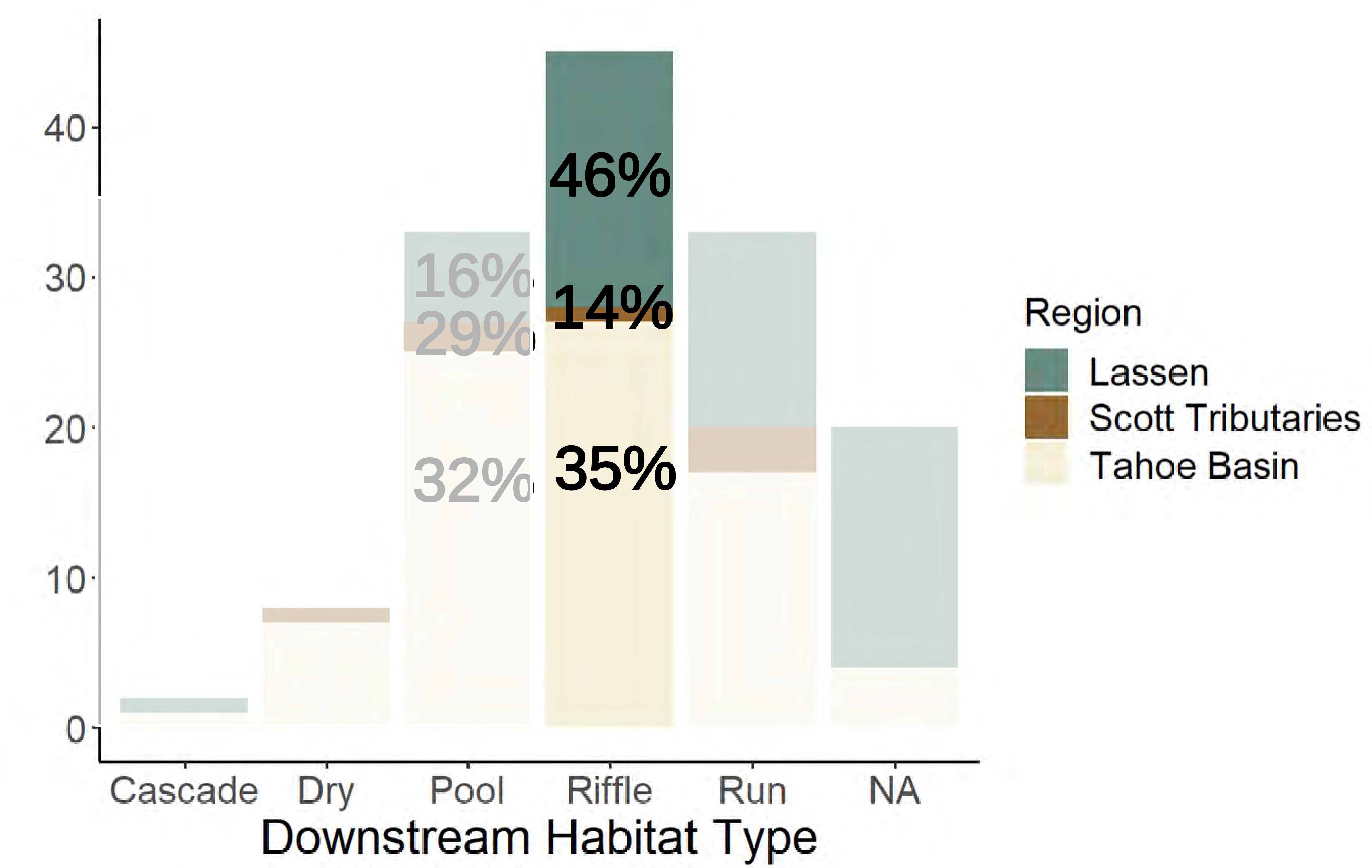

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RESULTS

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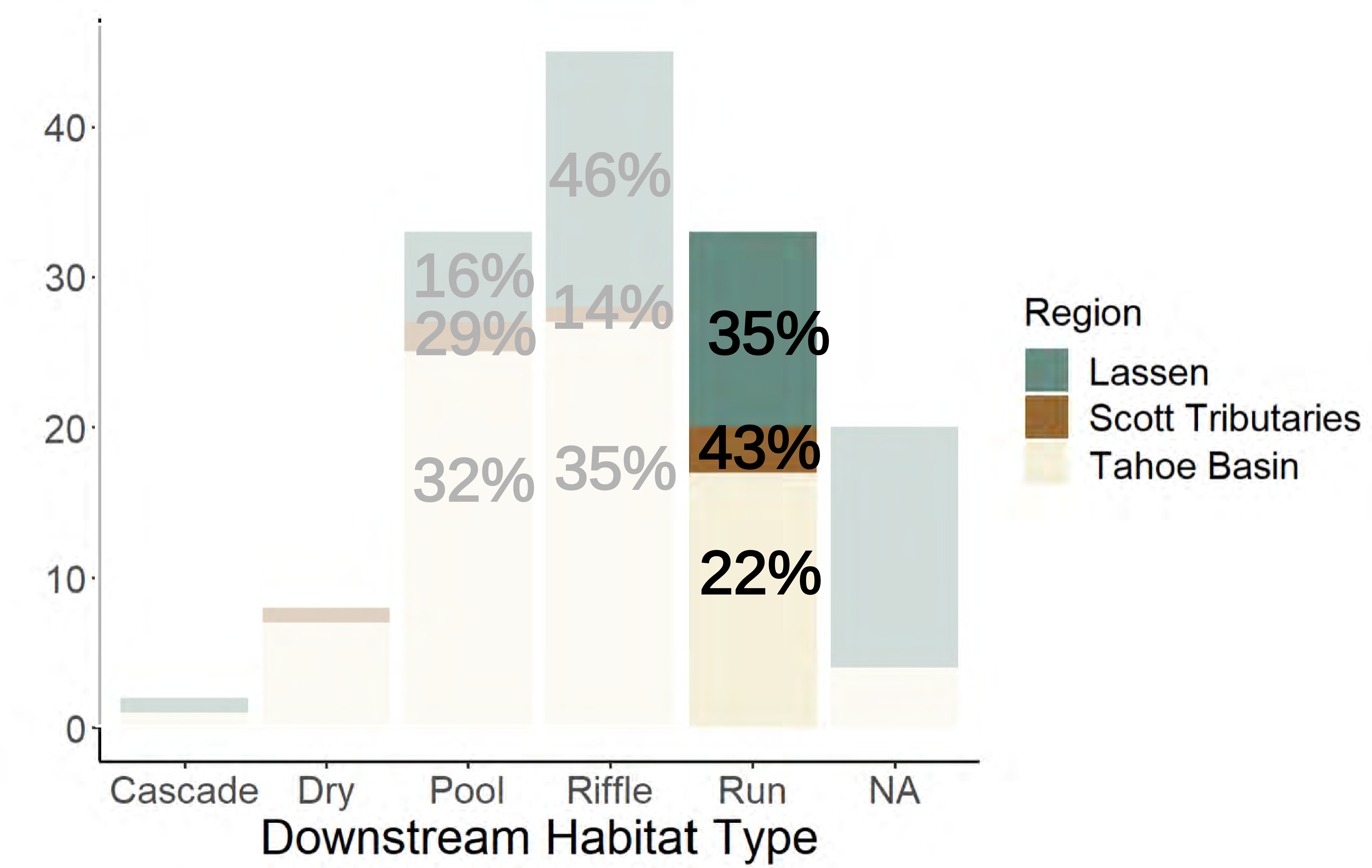
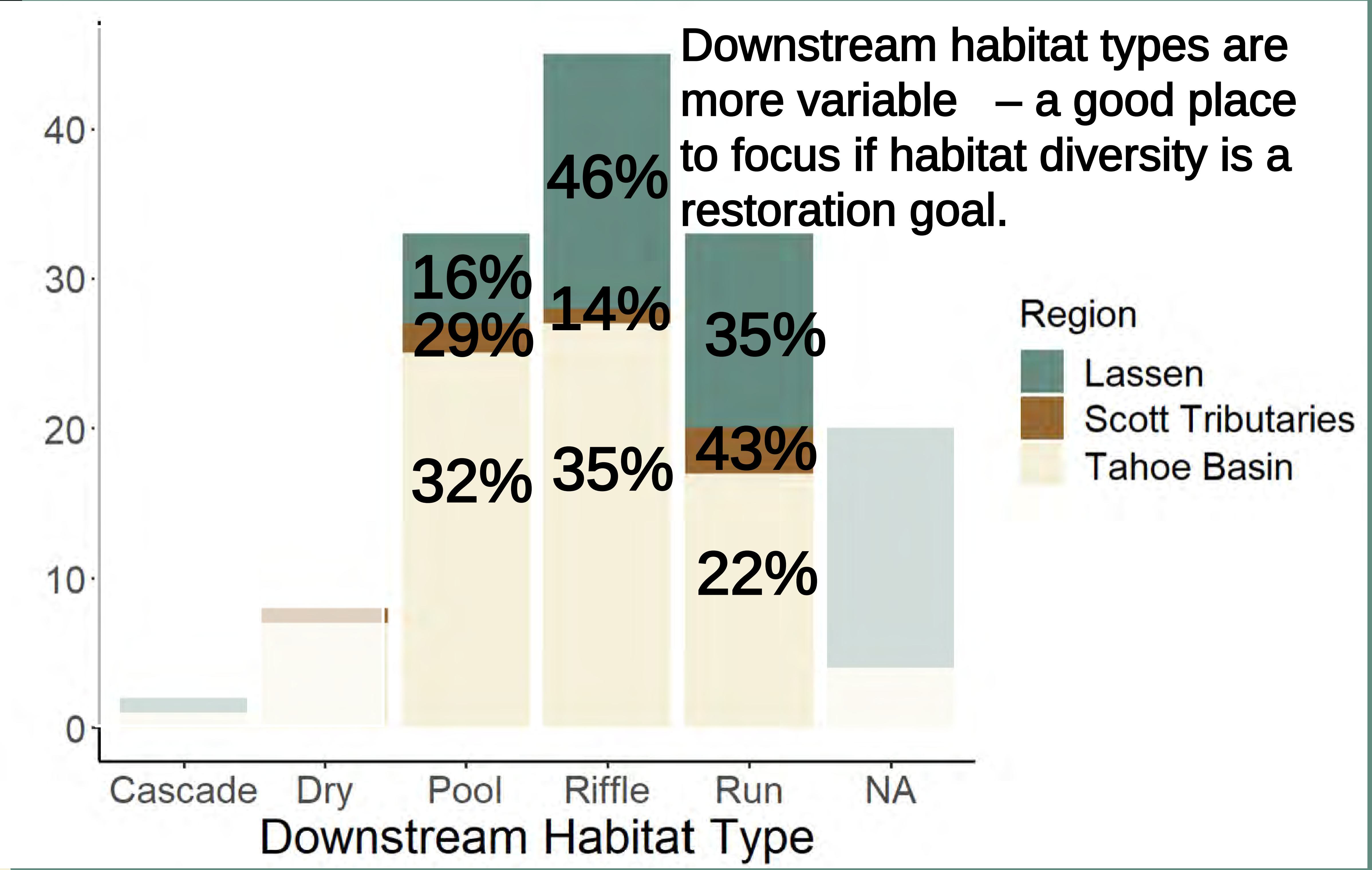


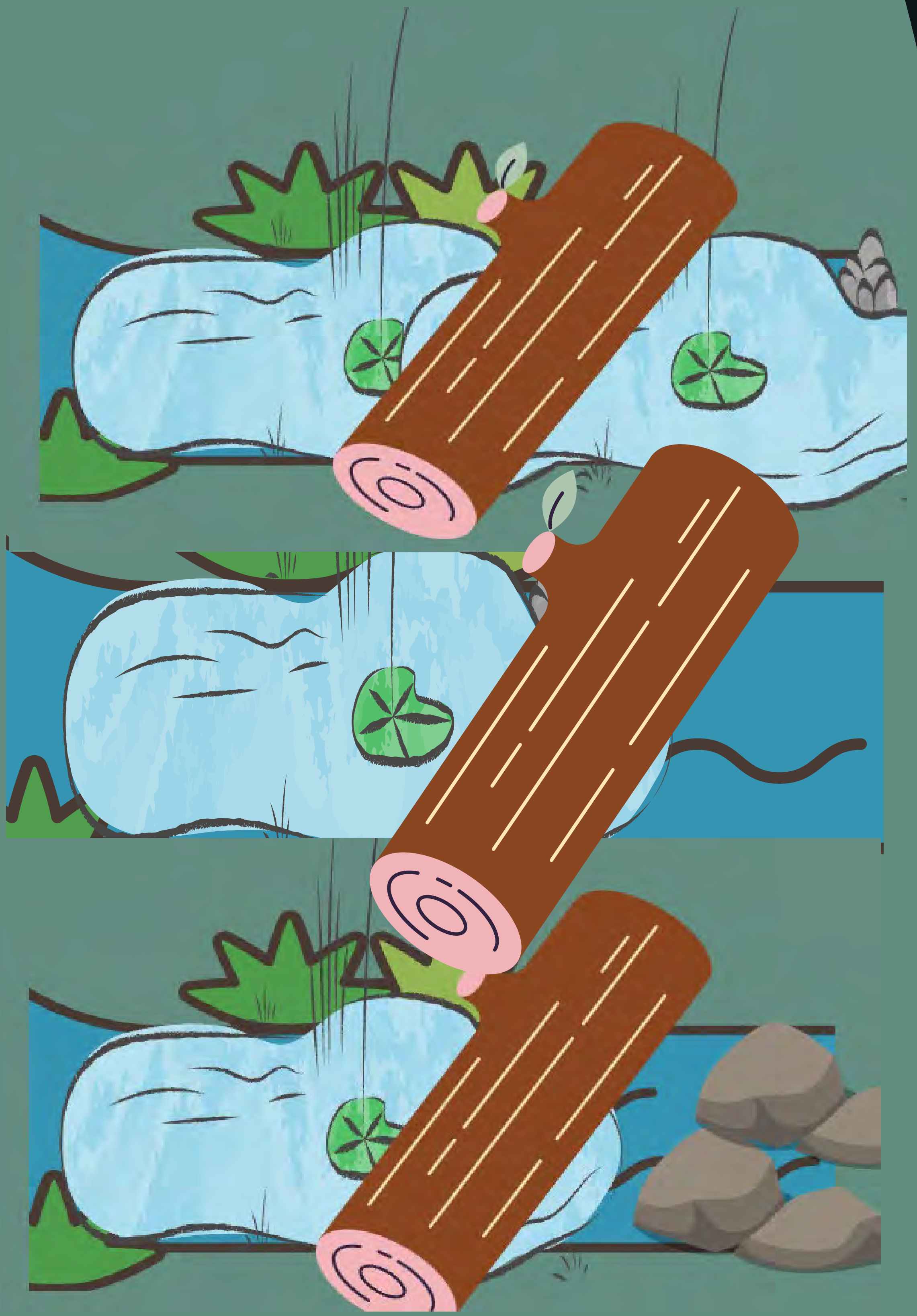
How does the dam spacing and structural characteristics of beaver-maintained systems relate to observed **in-stream habitat characteristics** ?

RESULTS

01 02 03

Downstream habitat types are more variable – a good place to focus if habitat diversity is a restoration goal.





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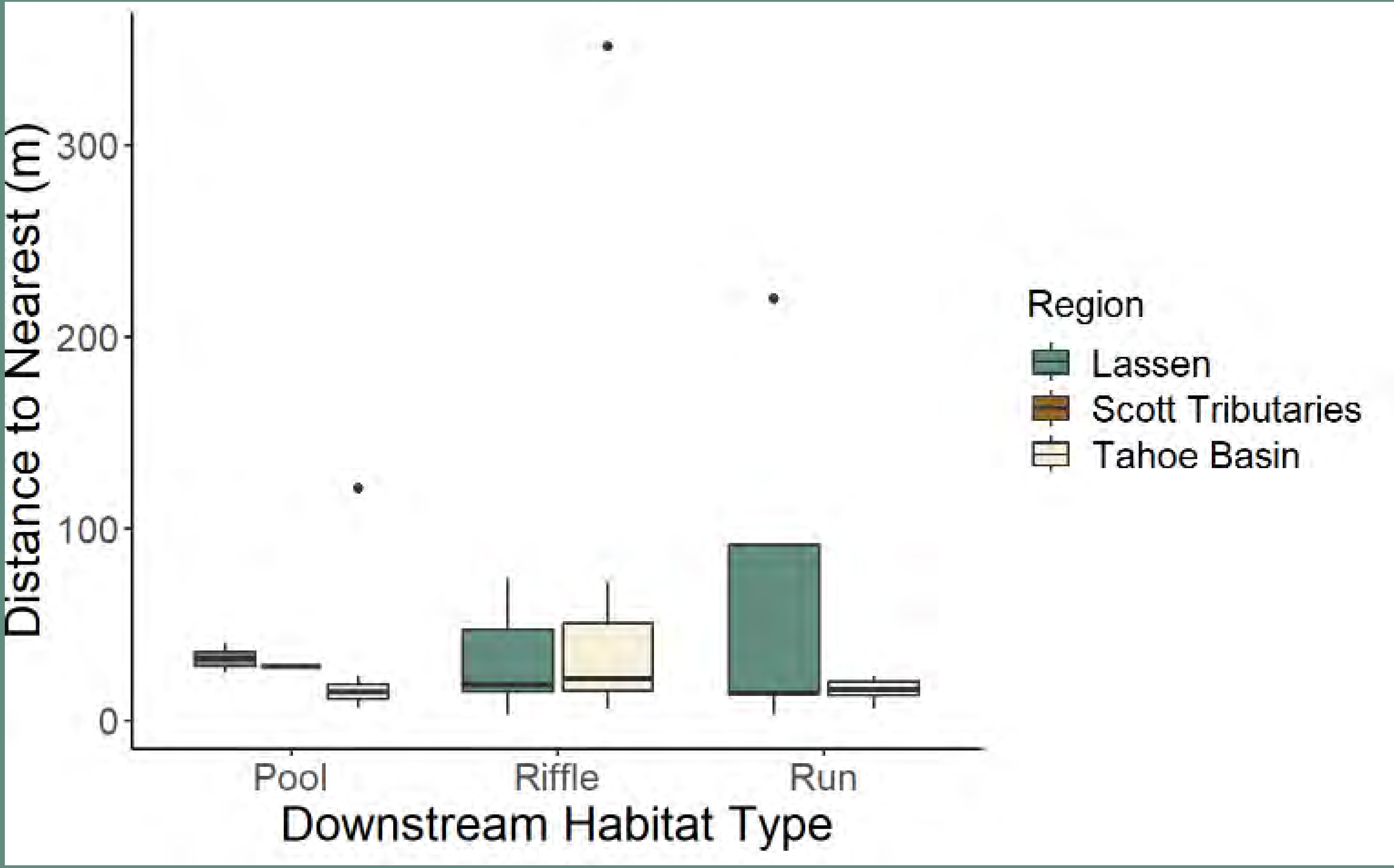

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RESULTS

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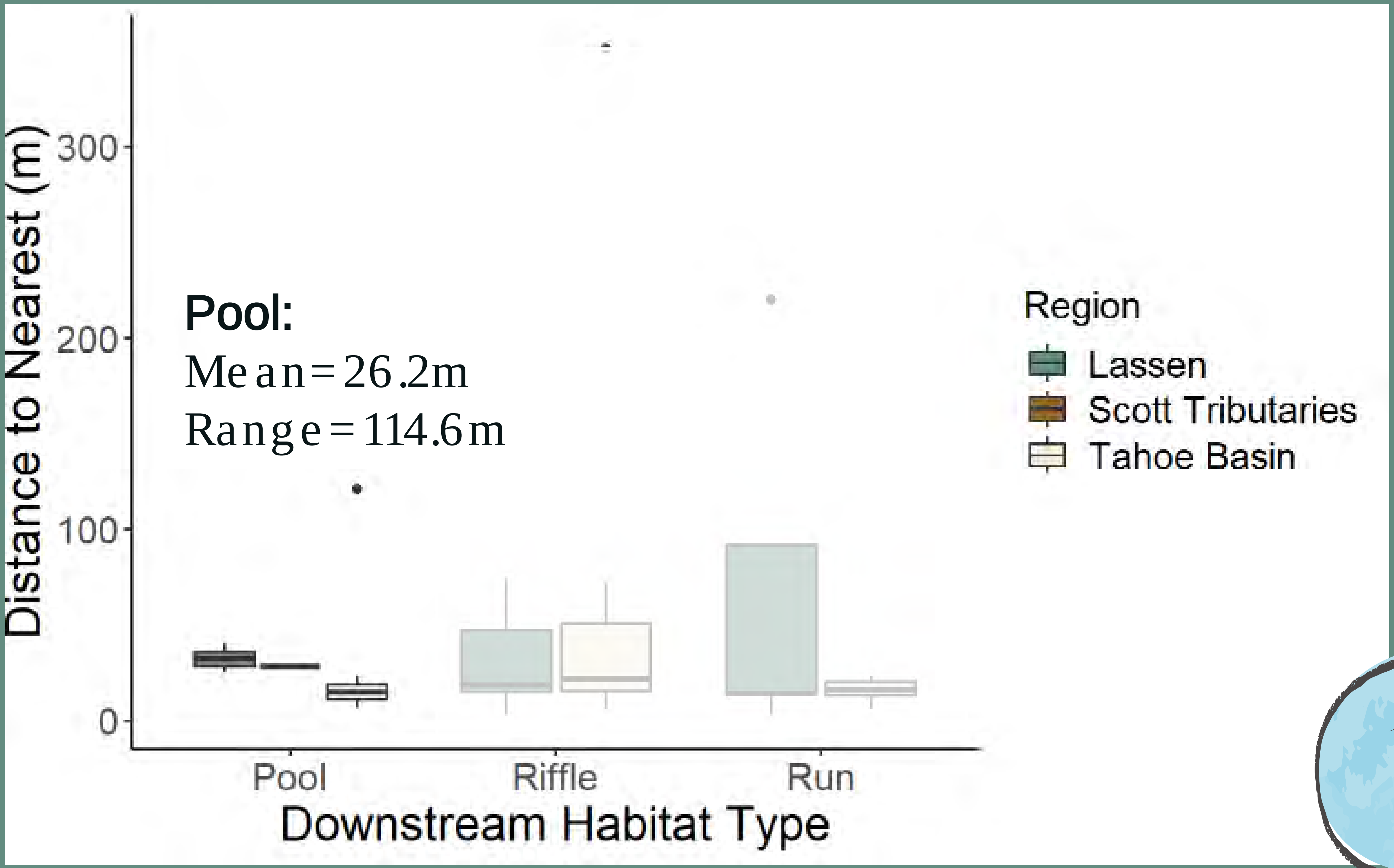

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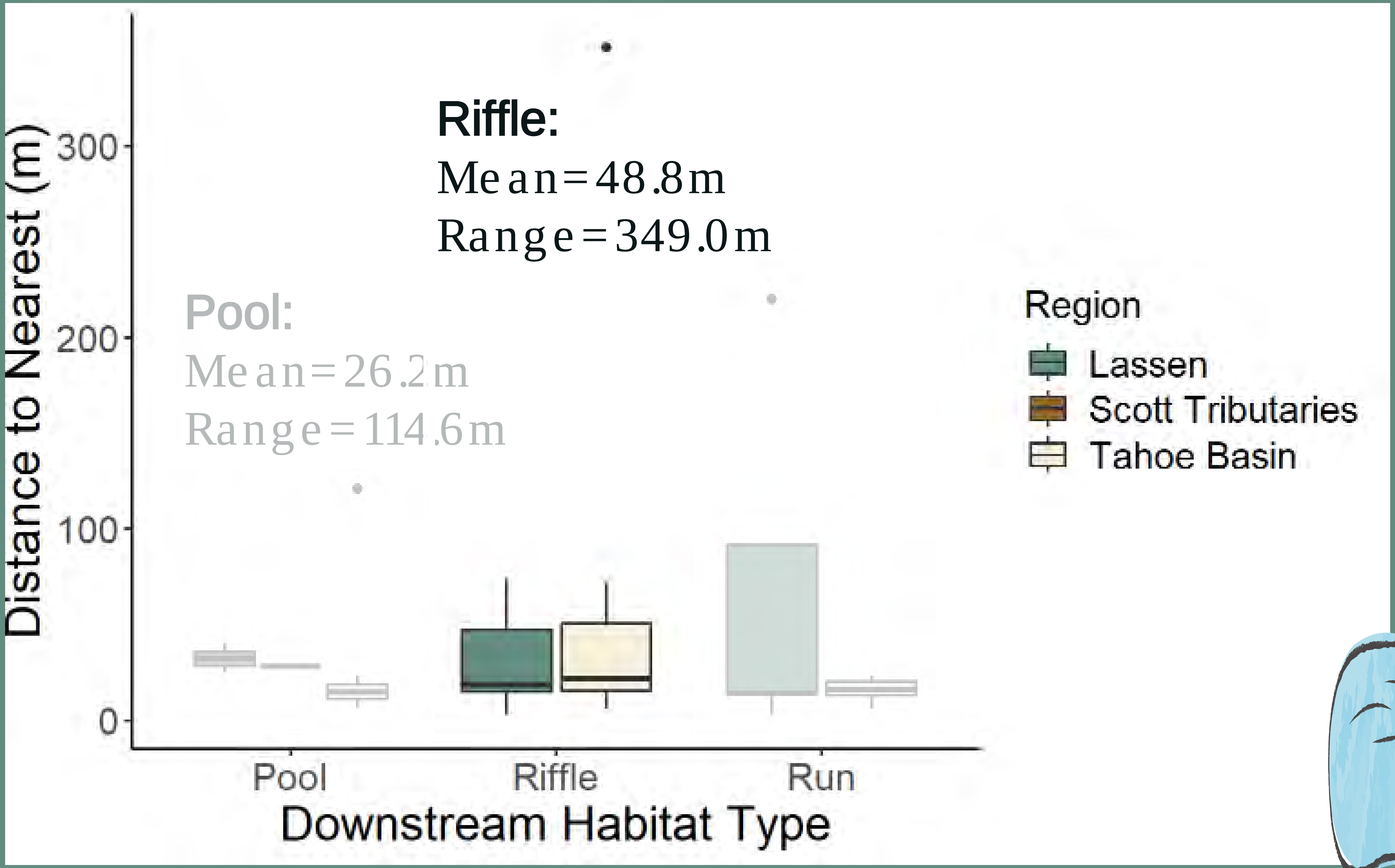

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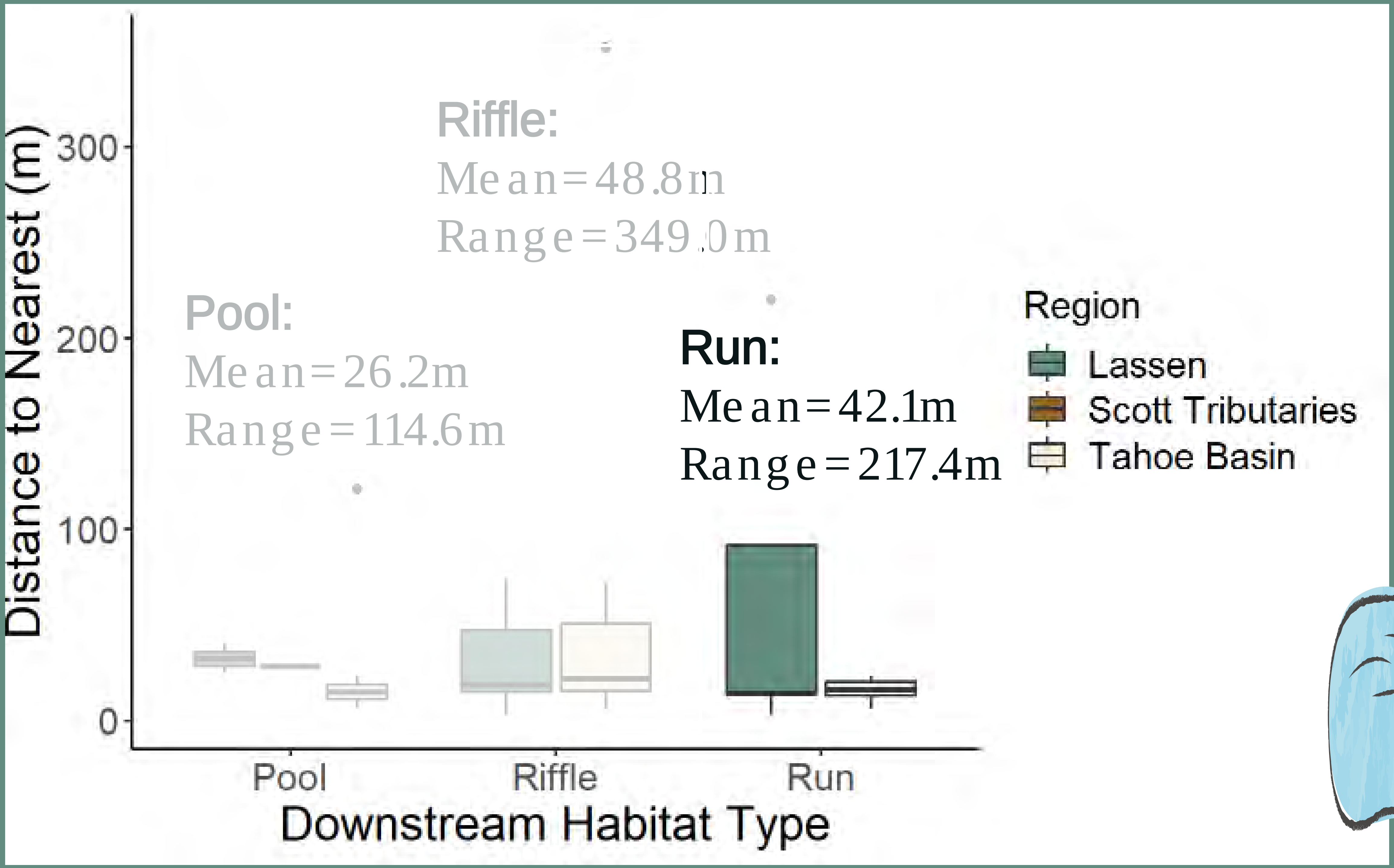

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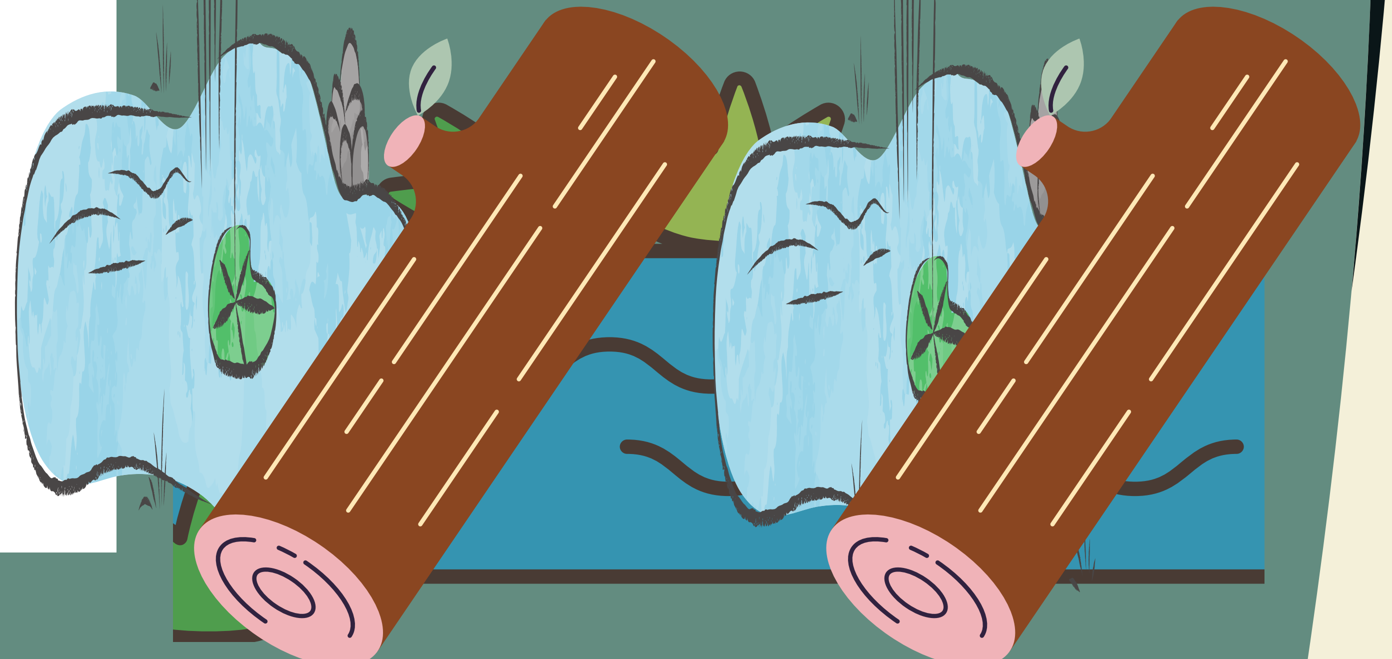

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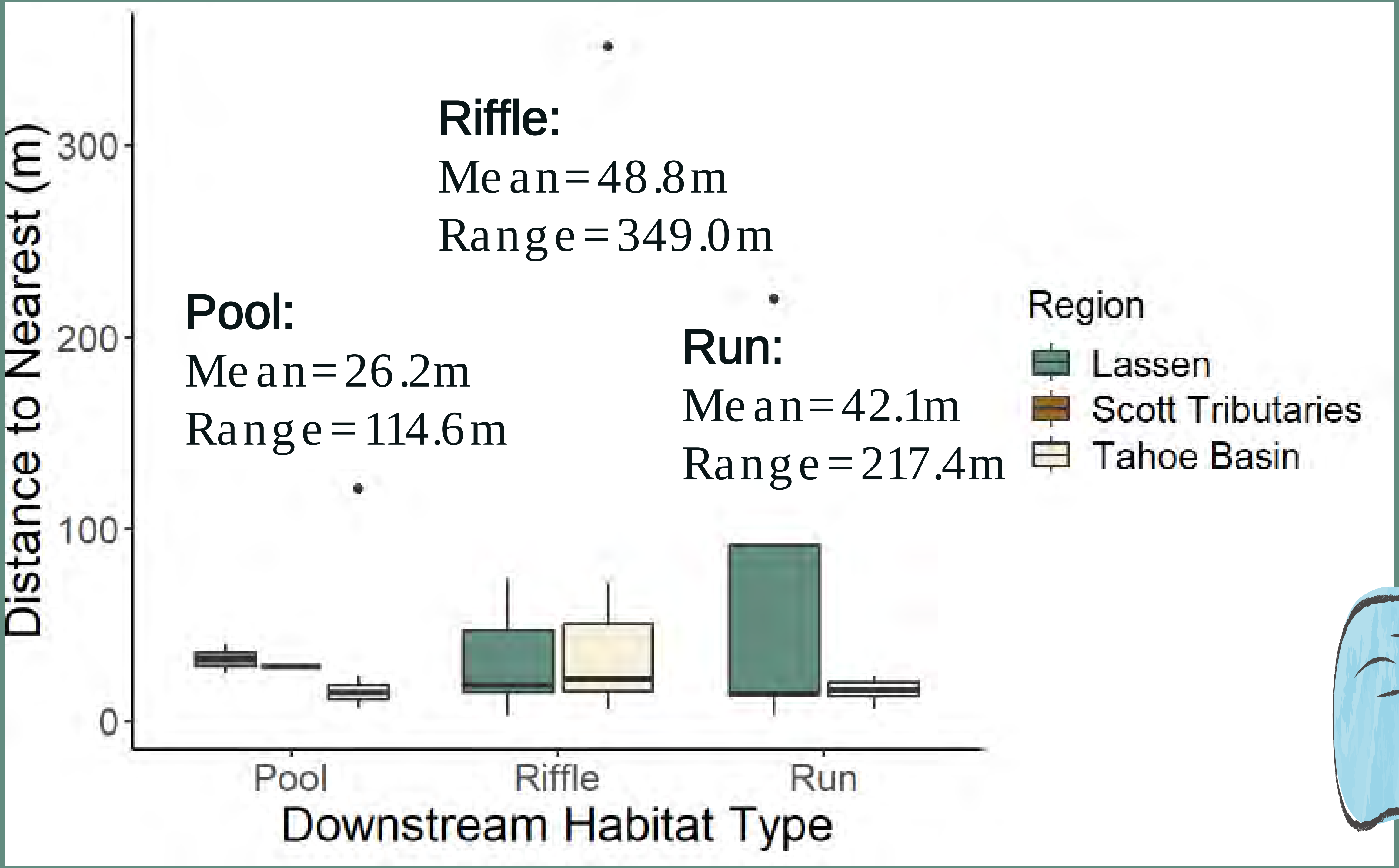

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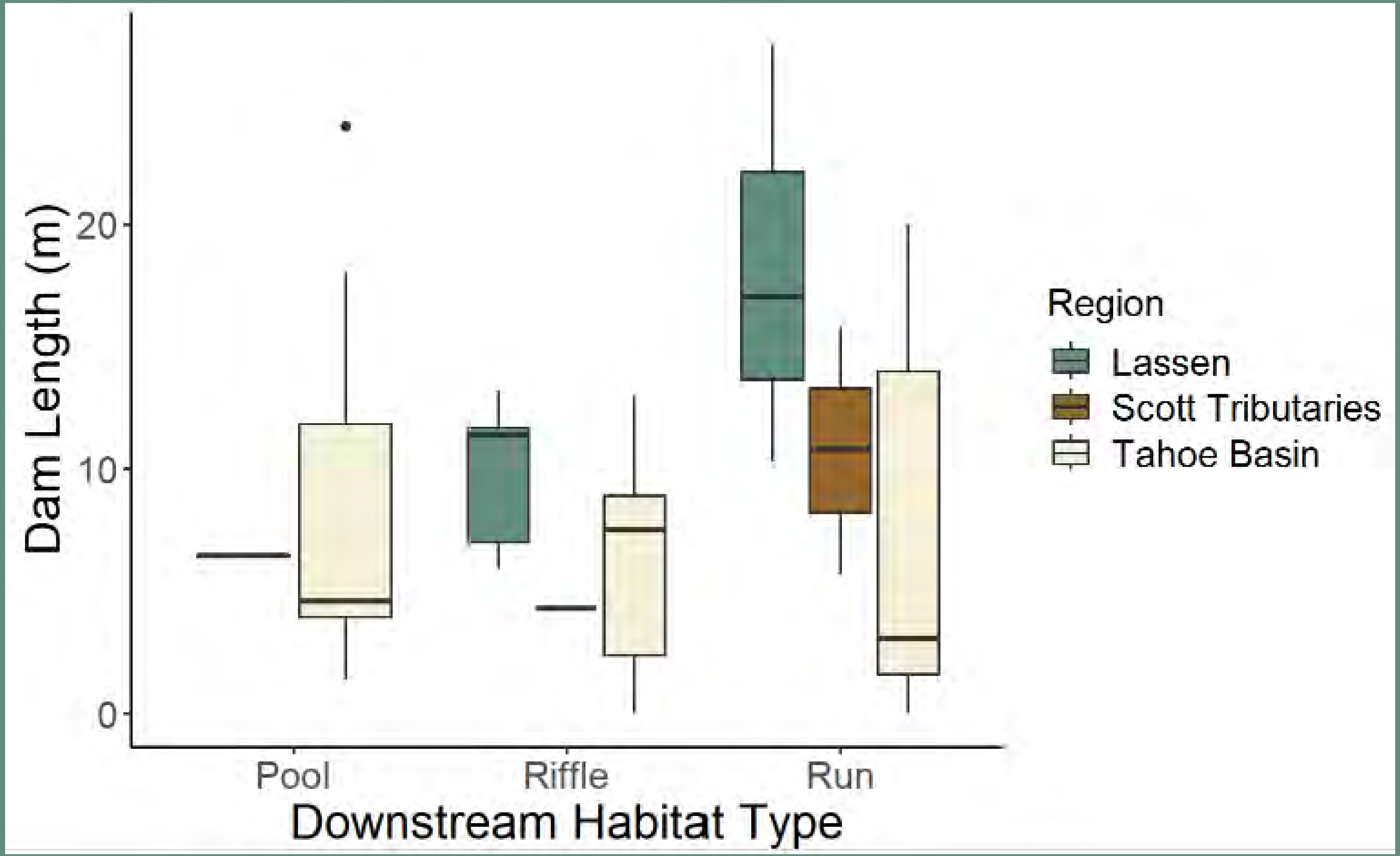

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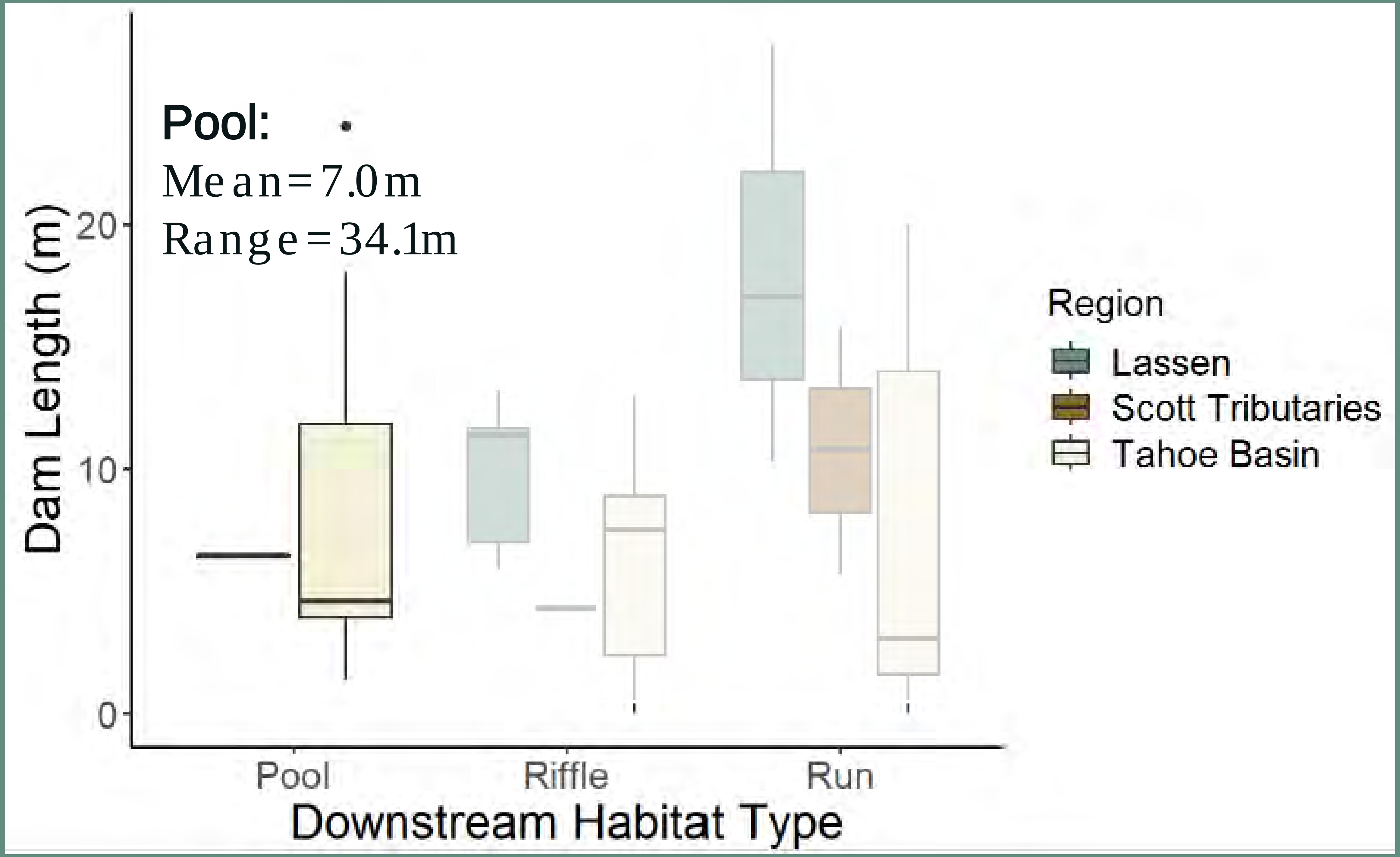

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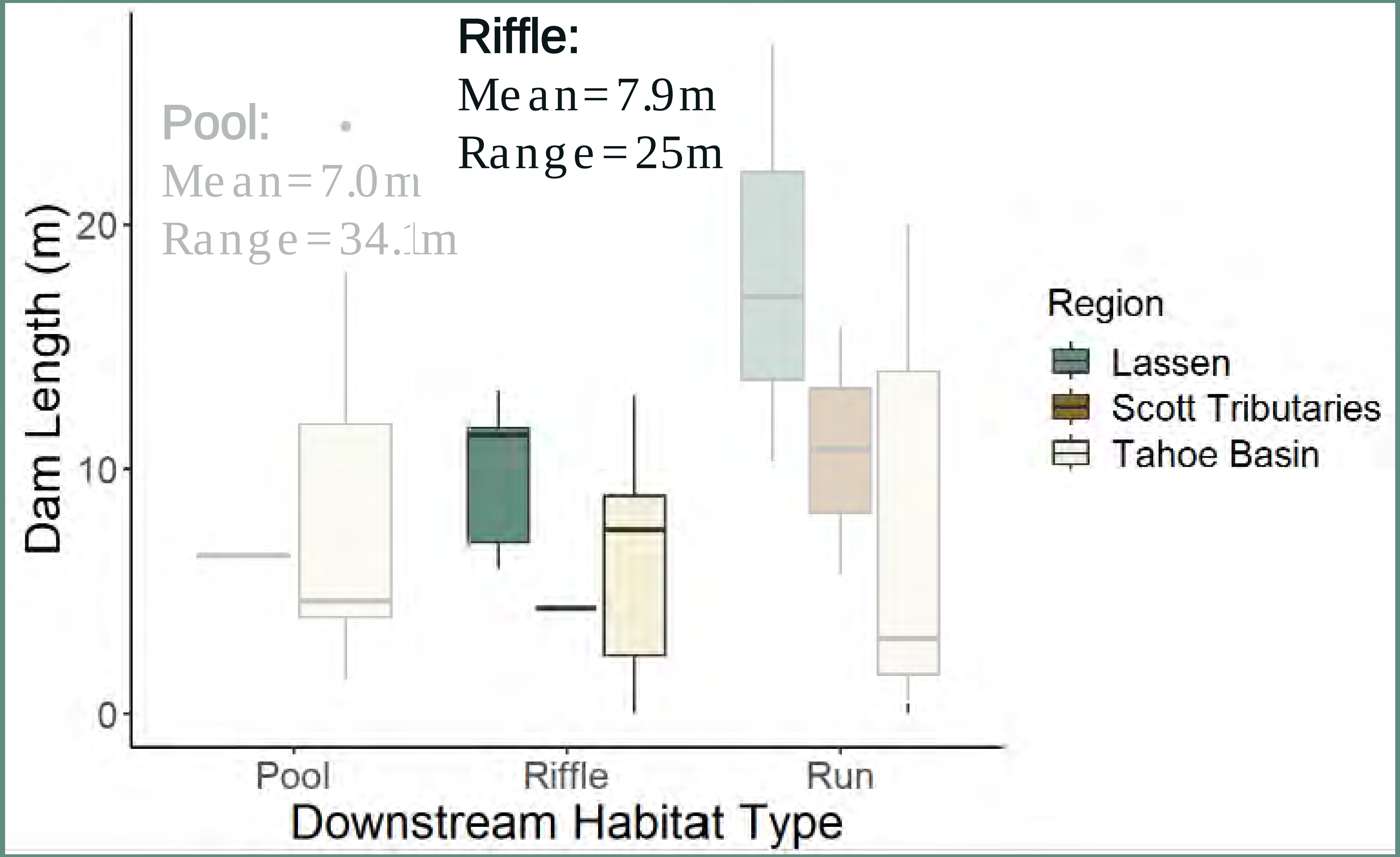

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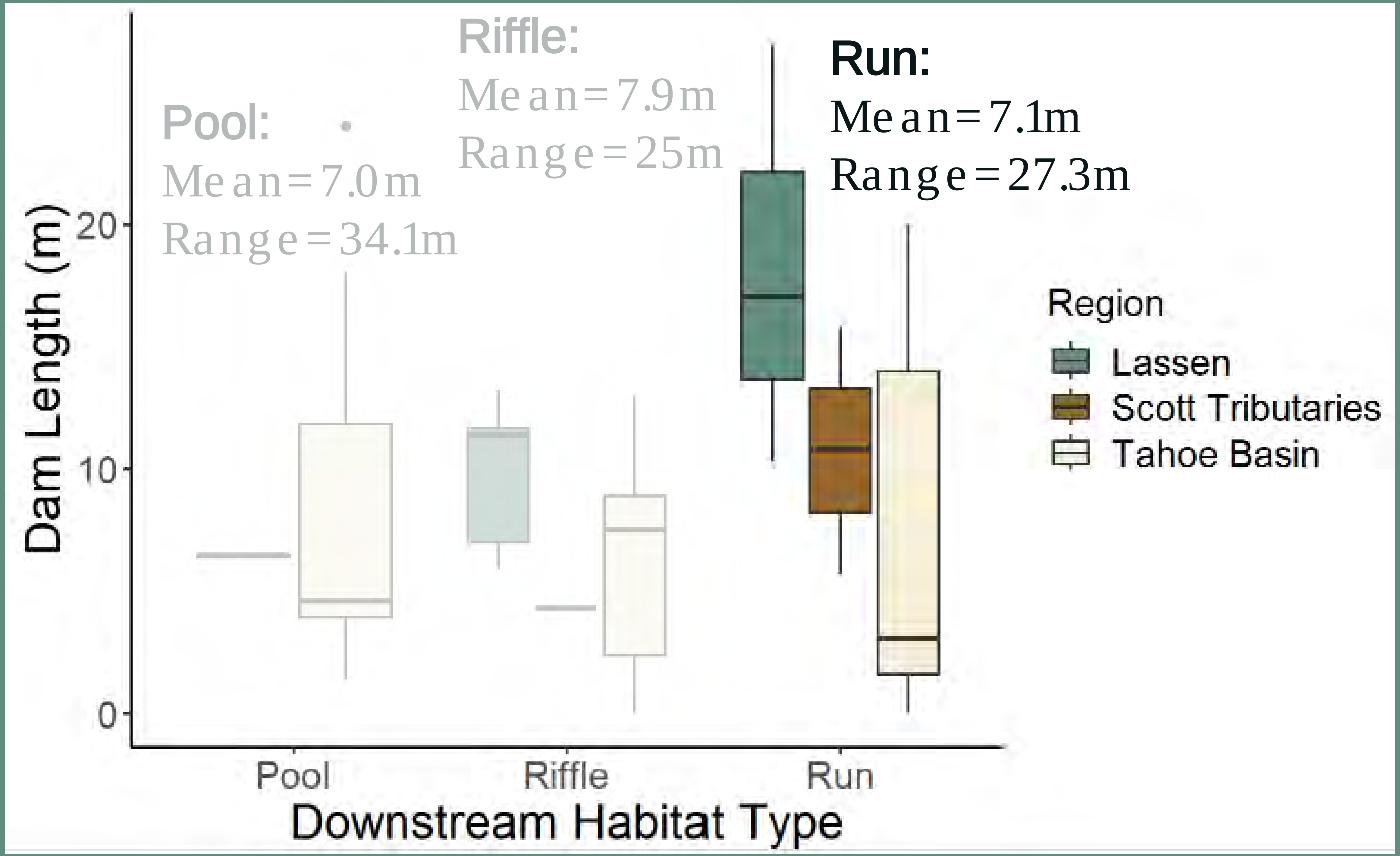

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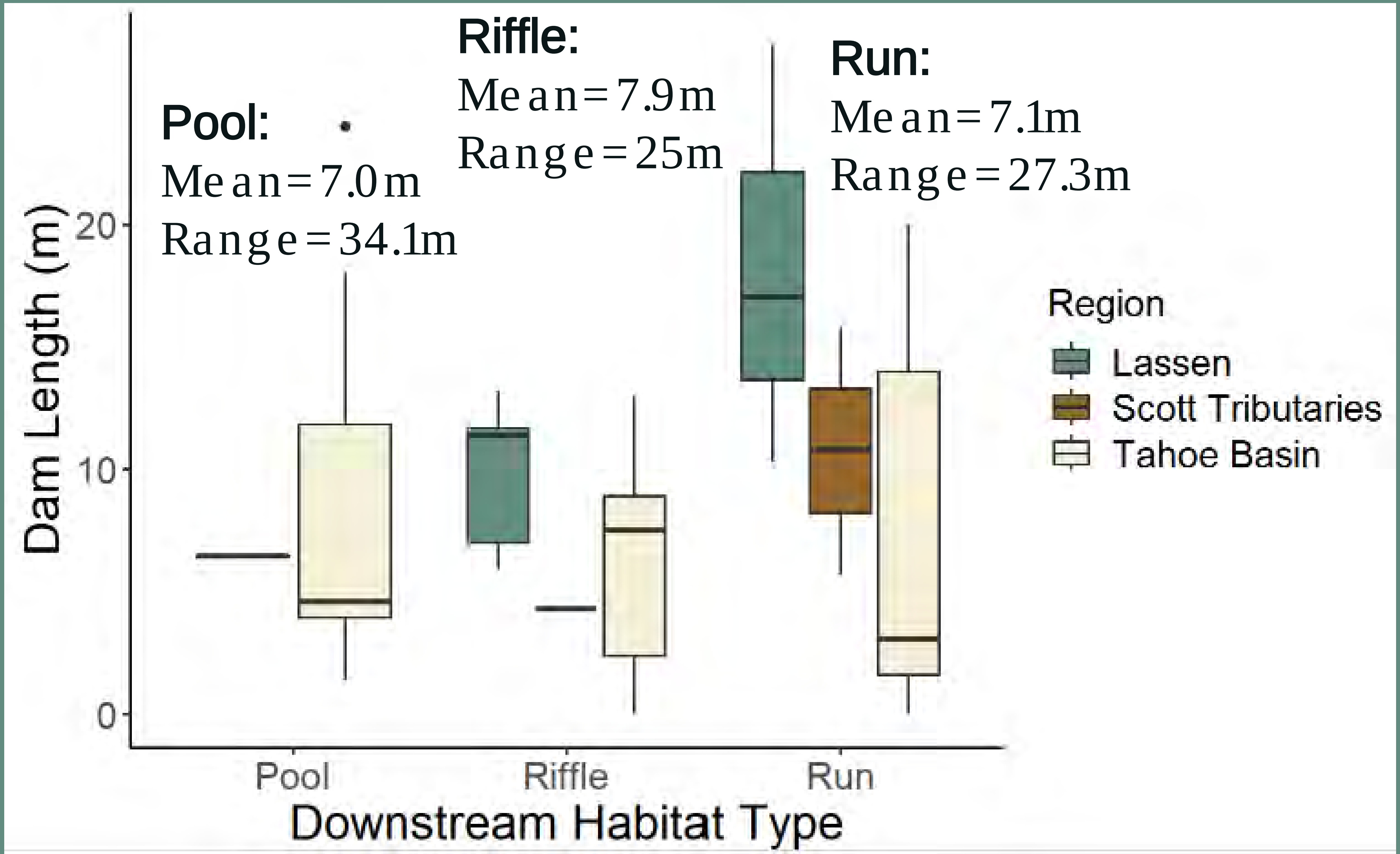


How does the dam spacing and structural characteristics of beaver-maintained systems relate to observed **in-stream habitat characteristics** ?

QUESTIONS

01

What **spacing** do we see between dams in beaver-maintained systems?

- ➢ 58.5 m mean
- ➢ 688 m range

02

What common **structural characteristics** do we see in beaver dams?

- ➢ 7.3m mean length, 35m range
- ➢ 0.5m mean height, 1.5m range

03

How does the dam spacing and structural characteristics of beaver-maintained systems relate to observed **in-stream habitat characteristics** ?

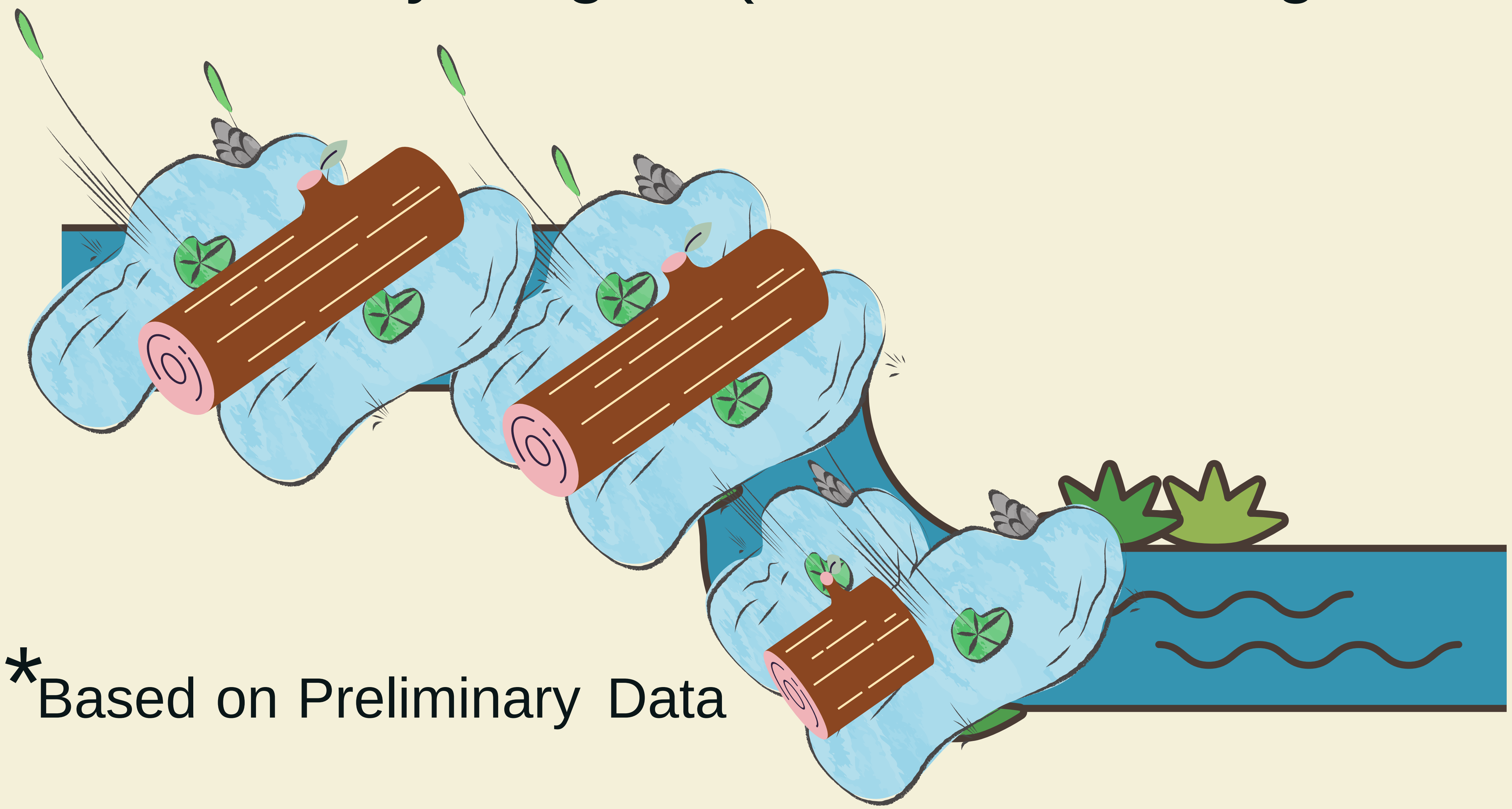
- ➢ Structure spacing impacts DS habitat types
- ➢ Length was less impactful

CONCLUSIONS *

Restoration Goal: Increase Pool Habitat

Space dams close together (mean 26m apart at our sites)

Vary lengths (mean 7.3 m long at our sites)



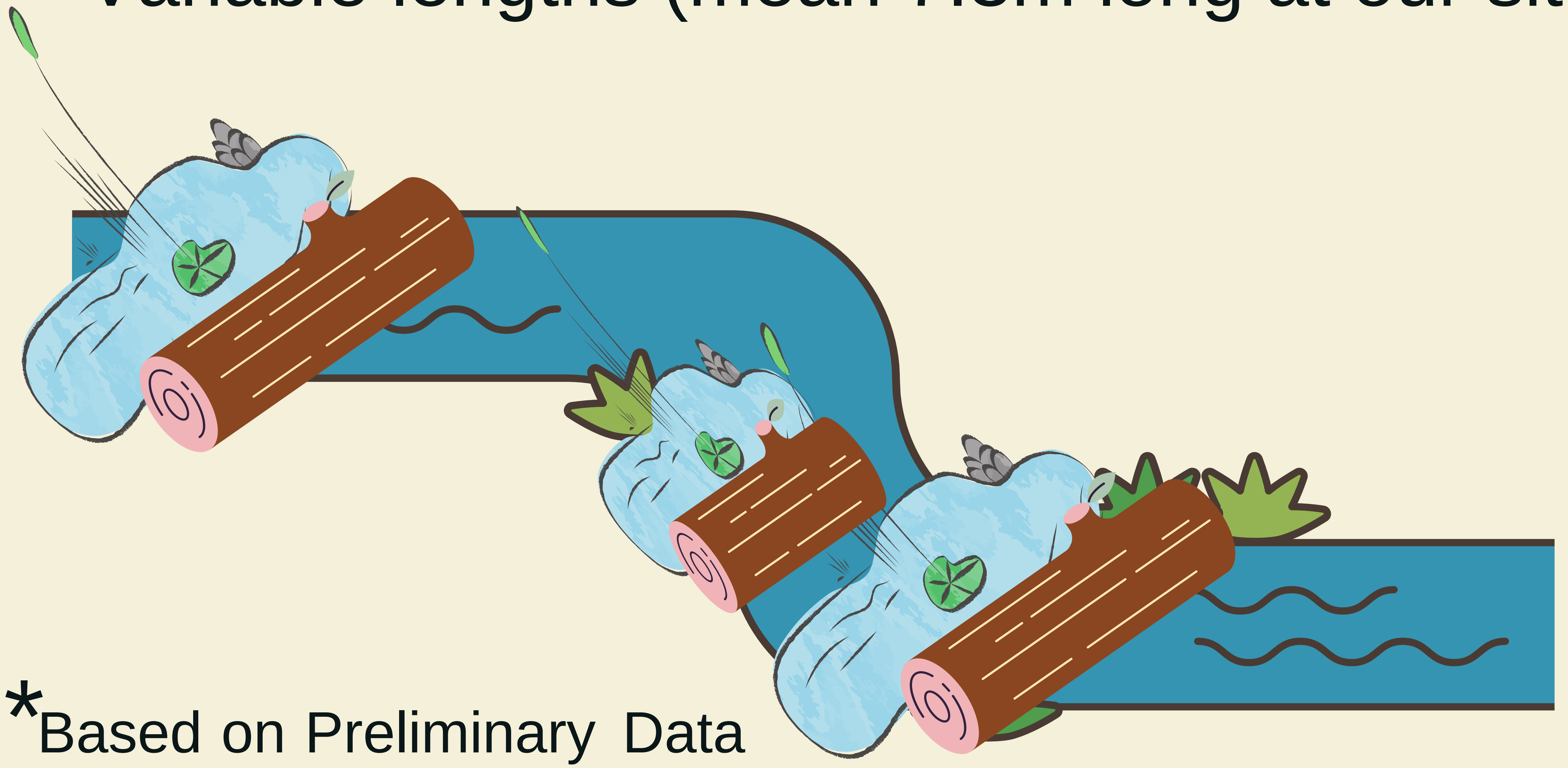
*Based on Preliminary Data

CONCLUSIONS*

Restoration Goal: Increase Habitat Diversity

Space more variably (42 -48 m apart mean for runs/riffles at our sites)

Variable lengths (mean 7.3m long at our sites)



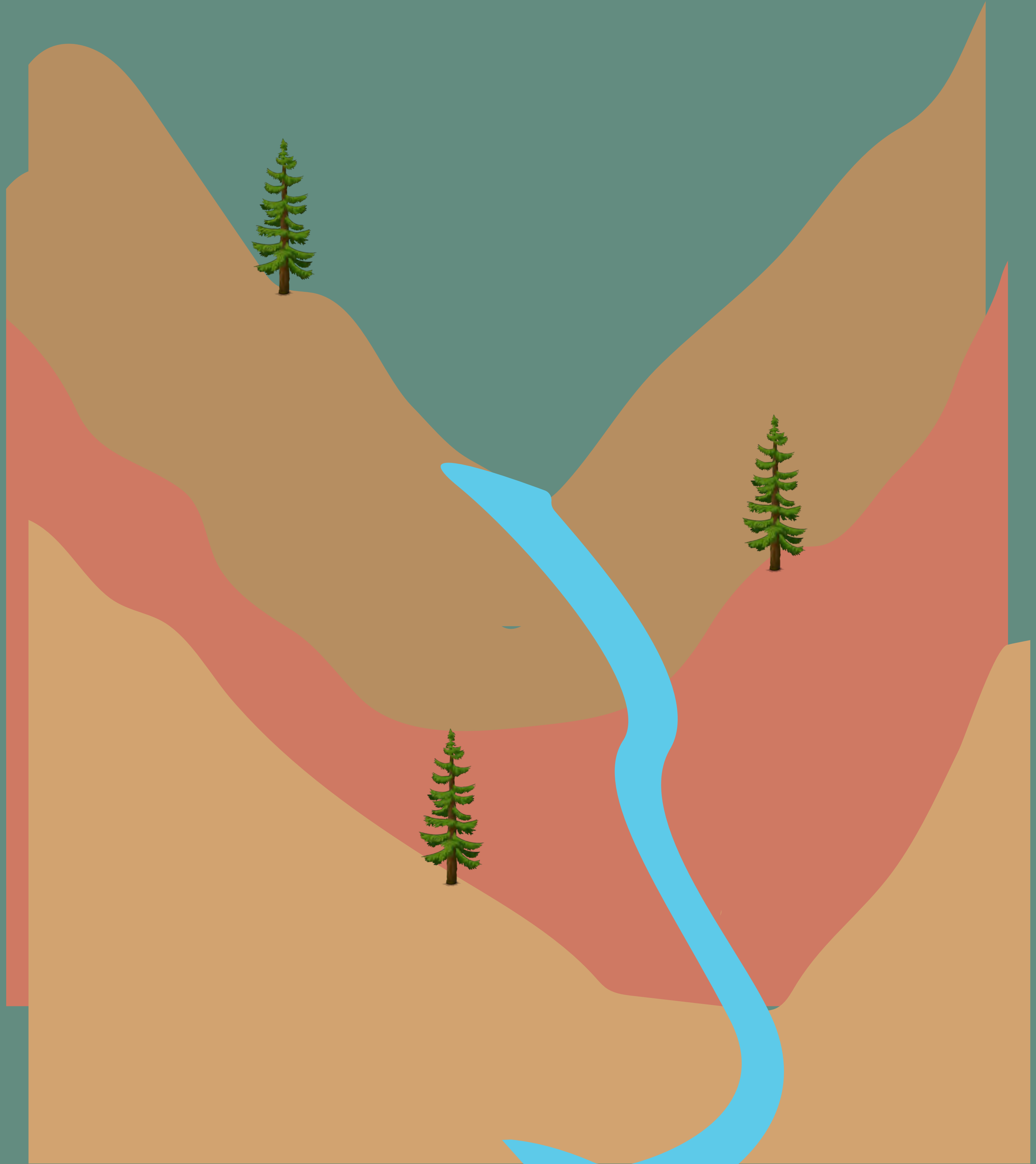
*Based on Preliminary Data

MOVING FORWARD

More sites!

New questions like:

How does large scale geomorphic context impact the habitat response to beaver dams and beaver mimicry restoration?




SRF | 2025
Thank You
Presented by Caroline Gengo
Co-authors: Sarah Yarnell, Doug Kelt, Rob Lusardi
Funding from The Nature Conservancy and CDFW

Hydraulic Modeling for Restoration Potential In Waddell Creek

Zan Rubin & Brigid Lynch
SRF May 2, 2025

Balance Hydrologics

CALIFORNIA STATE PARKS SINCE 1864

PARKS CALIFORNIA

Presentation Outline

01 Motivation

02 Methods

03 BBRSP Results

01 Motivation

Landscape Fire and Sediment

- Increasing fire frequency and intensity
- Fires commonly lead to increases in hillslope erosion and sediment delivery to channel network

Landscape Fire and Sediment

- This increase in sediment transport can be harmful to:
  - Aquatic ecosystems
  - Downstream infrastructure (e.g. sedimentation induced flooding)
  - Downstream water users

Paonia Reservoir, Colorado
Jeffrey Beall, Flickr

Landscape Fire and Sediment

- ❑ Sediment management often focused on hillsides



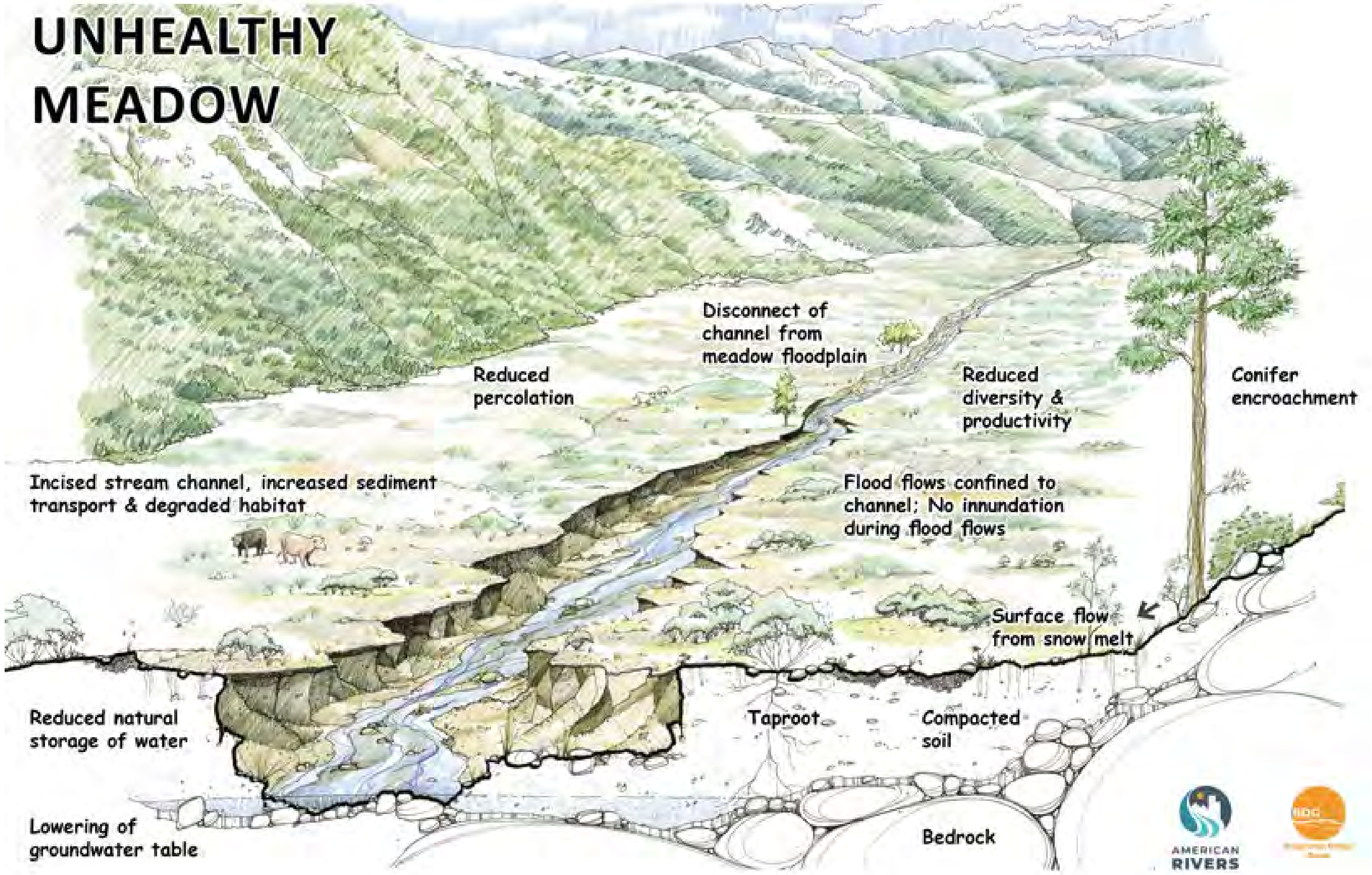

Landscape Fire and Sediment

- ❑ Fires also present opportunities with the increase of sediment and wood delivery.

Where in the landscape can wood and sediment best be used for restoration?

Example: Incised Meadow Restoration

- Restoration approaches include filling channels and other approaches to aggrading streambeads and raising water tables



Example: Meadow Restoration

Example: Meadow Restoration

Perazzo Meadows

Example: Meadow Restoration

- Use wood and sediment to aggrade incised channels- in floodplain reaches
- Mountain meadows are a great example and very visible.

What about subtler features?

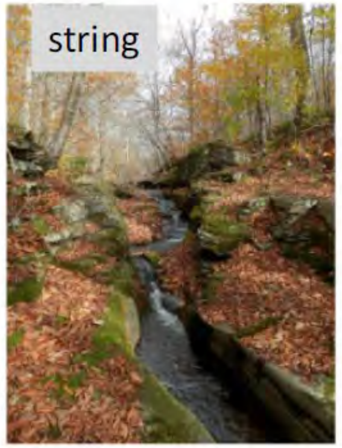
Bruneau River

Beads on a String…

- River networks can be described as a series of beads and strings
- Beads
  - Wider, lower gradient
  - Lateral channel migration
  - Habitat heterogeneity
  - Infiltration and water retention
  - Nutrient and carbon cycling/storage
  - Fire breaks
- Strings
  - Confined, steep, often bedrock

A

Biscuit Brook, New York
drainage area 10.5 km^2



Stanford et al. 1996
Wohl, et al. 2018

An Example from the Waddell Creek Watershed

- ❑ Aggrade incised channels
- ❑ Increase floodplain connectivity
- ❑ **Restore alluvial cover on streambed**

Sediment and wood trapped upstream of bridge

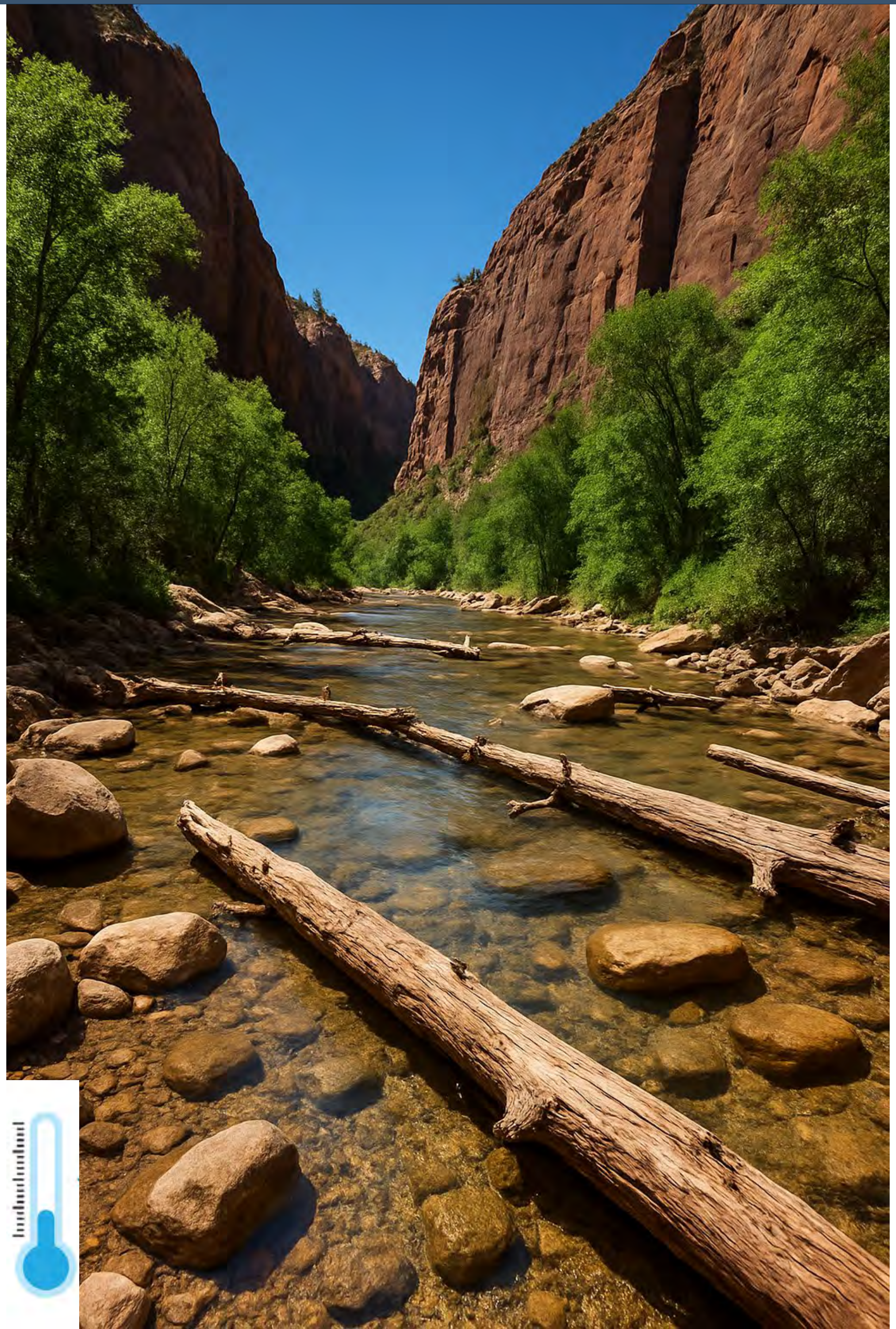
Exposed bedrock channel downstream of bridge

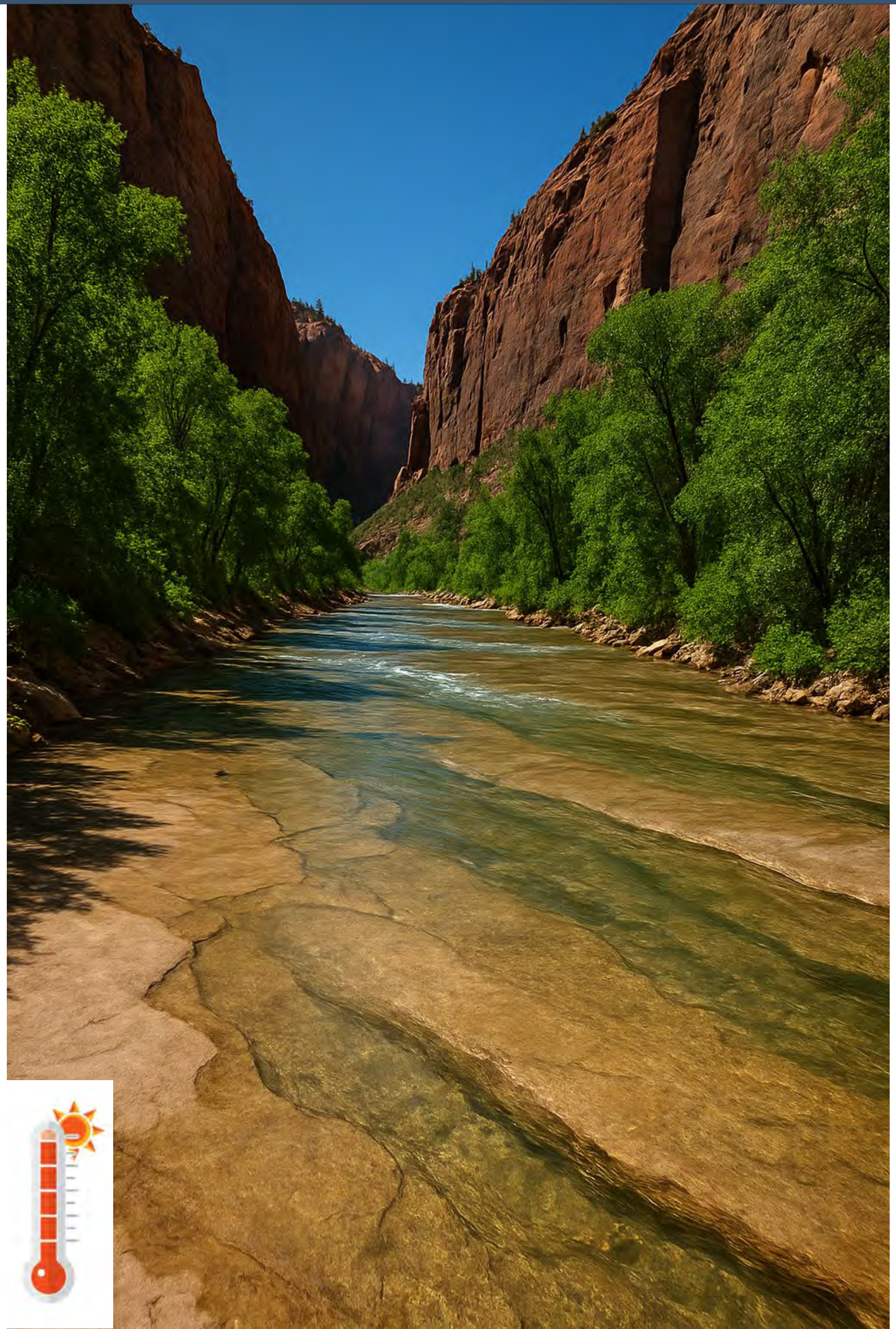
Bedrock/Alluvial Stream Temperature

Toyohira River, Hokkaido, Japan

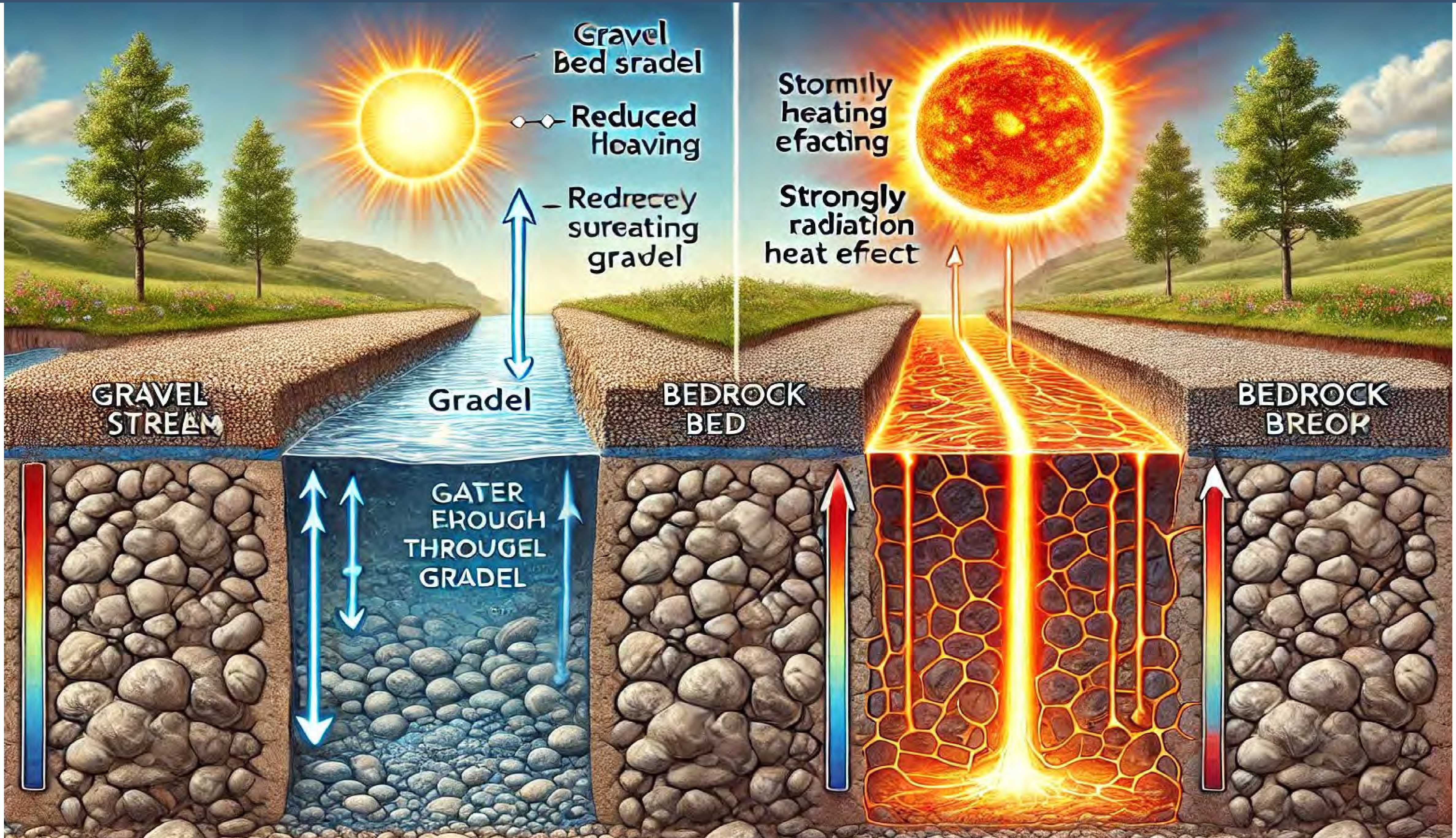
Cabled cobbles and boulders to try and recover alluvial bed

Alluvial Cover and Stream Temperature

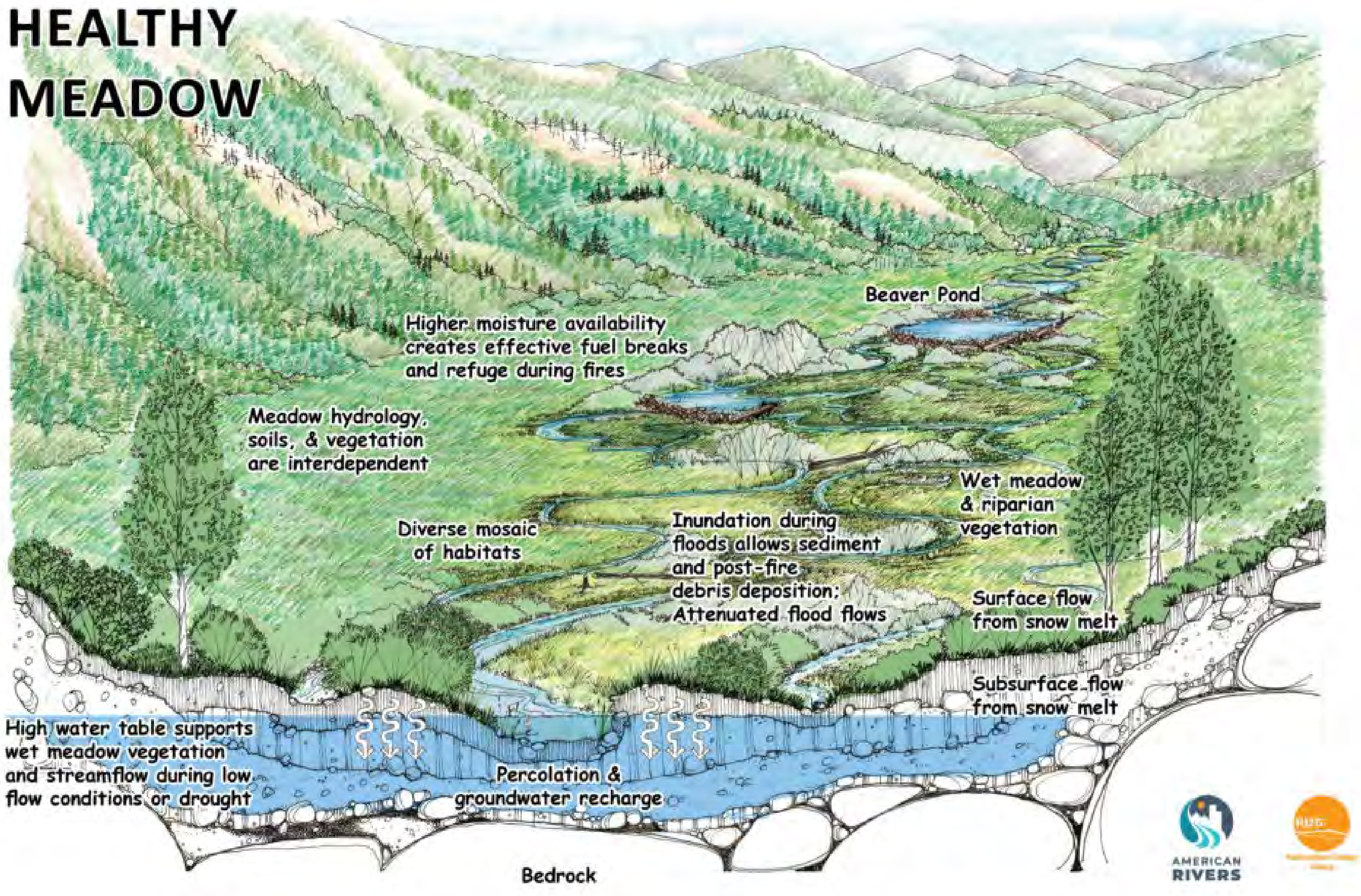




Alluvial Cover and Stream Temperature



Be Brave and Be Bold- Kellyx



Causes of Loss of Bead Function

Willamette River

"It would be impossible to confine its waters in one main and permanent bed"

-Reports of the Secretary of War 1875

550 trees per km removed from 1870 to 1950

2 to 3 logs per km present in 1984

J. R. Sedell & J. L. Froggatt, Importance of streamside forests 1831

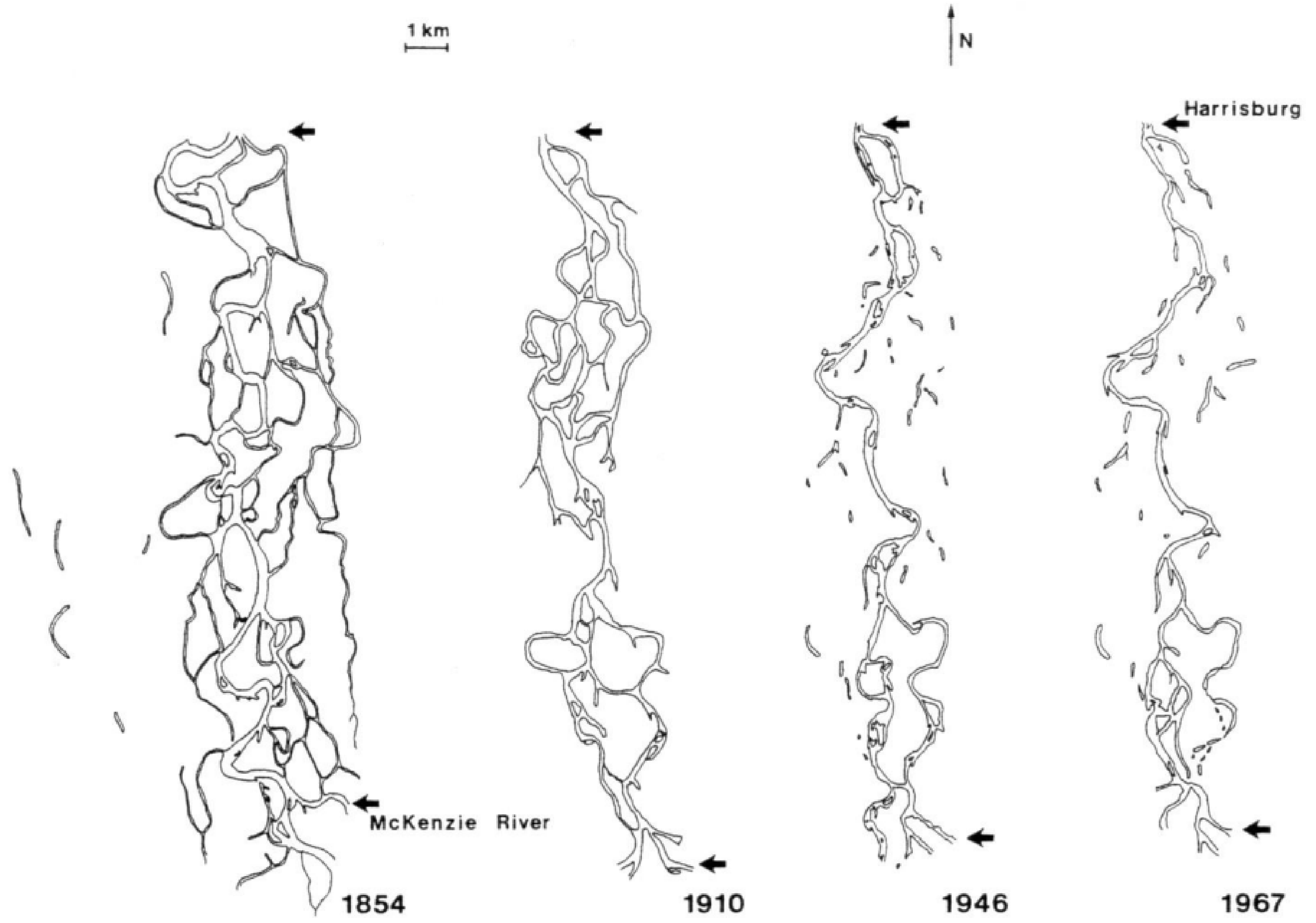


Fig. 2. The Willamette River from the McKenzie River confluence to Harrisburg, showing reduction of multiple channels and loss of shoreline 1854—1967.

Wood Loading

- Trees need to be moved somewhere after a fire…

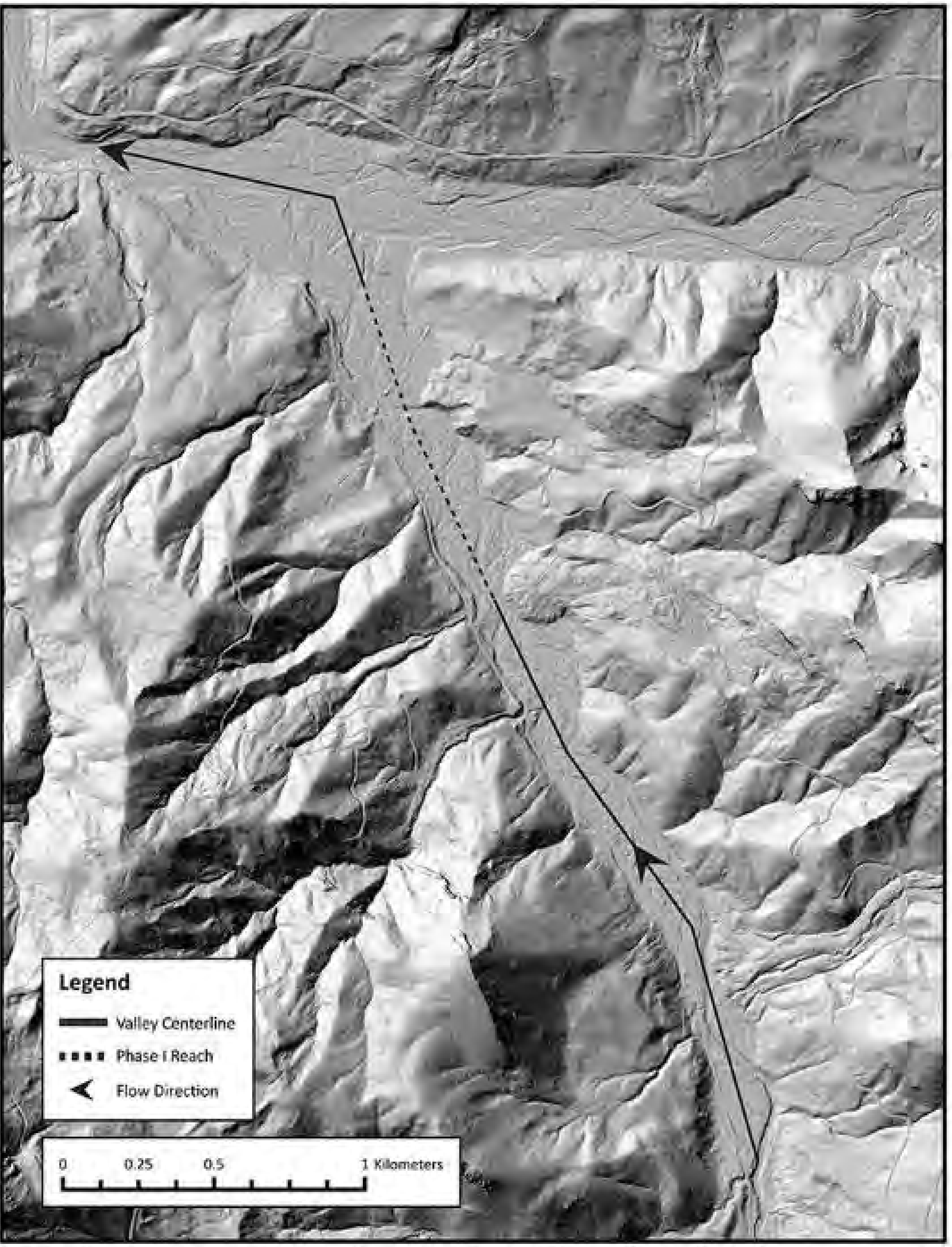
Breitenbush River, OR

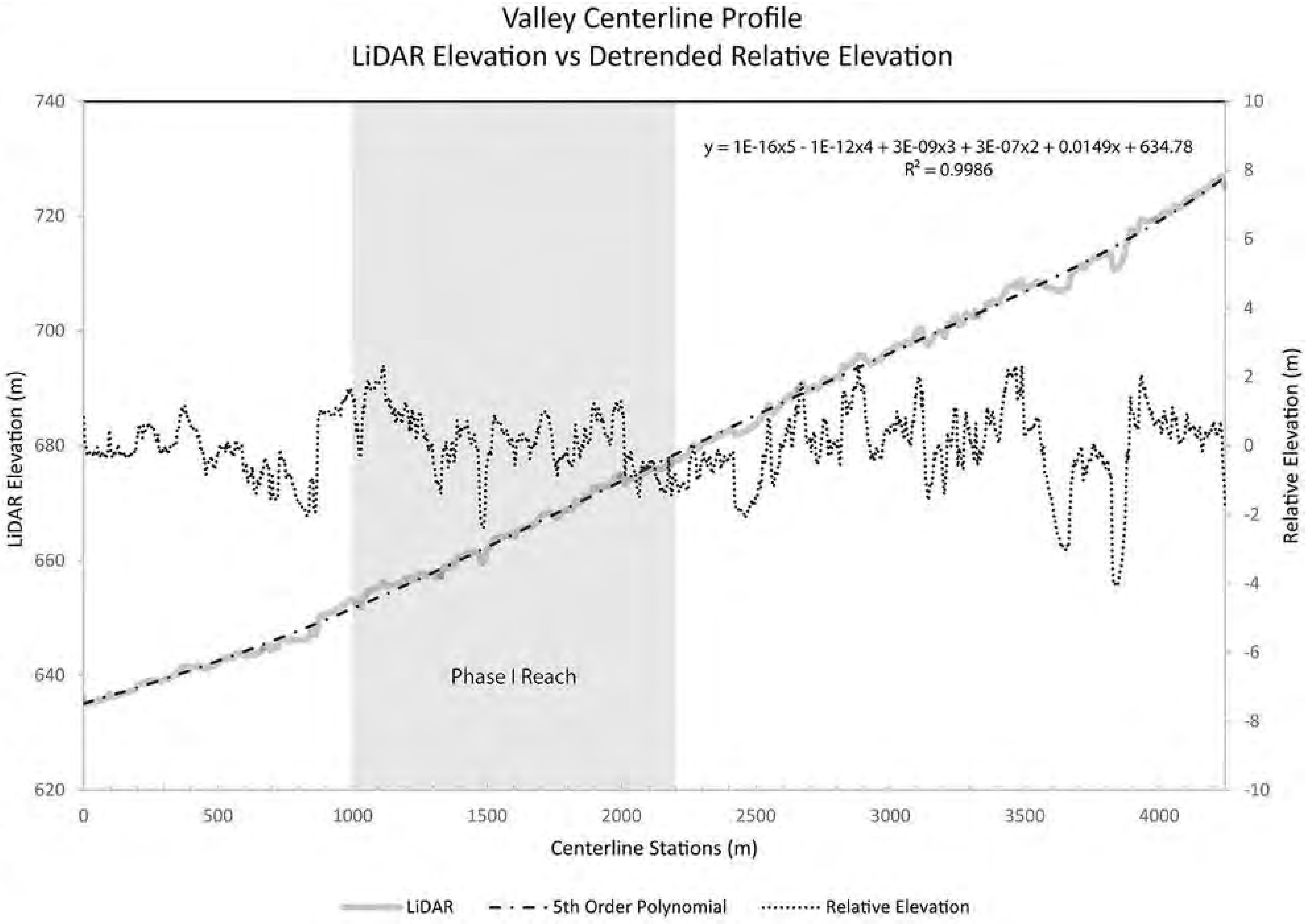
02

Methods

How to identify incised beads

Reach-scale Approach- Geomorphic Grade Line

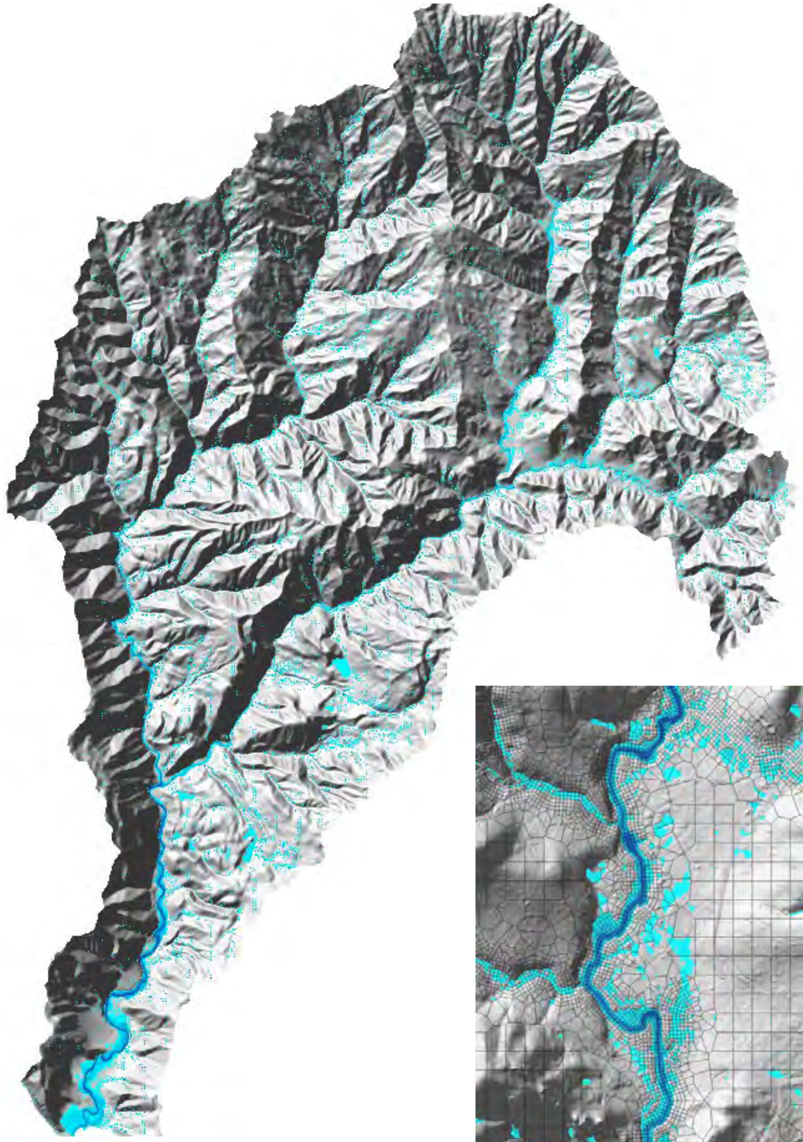


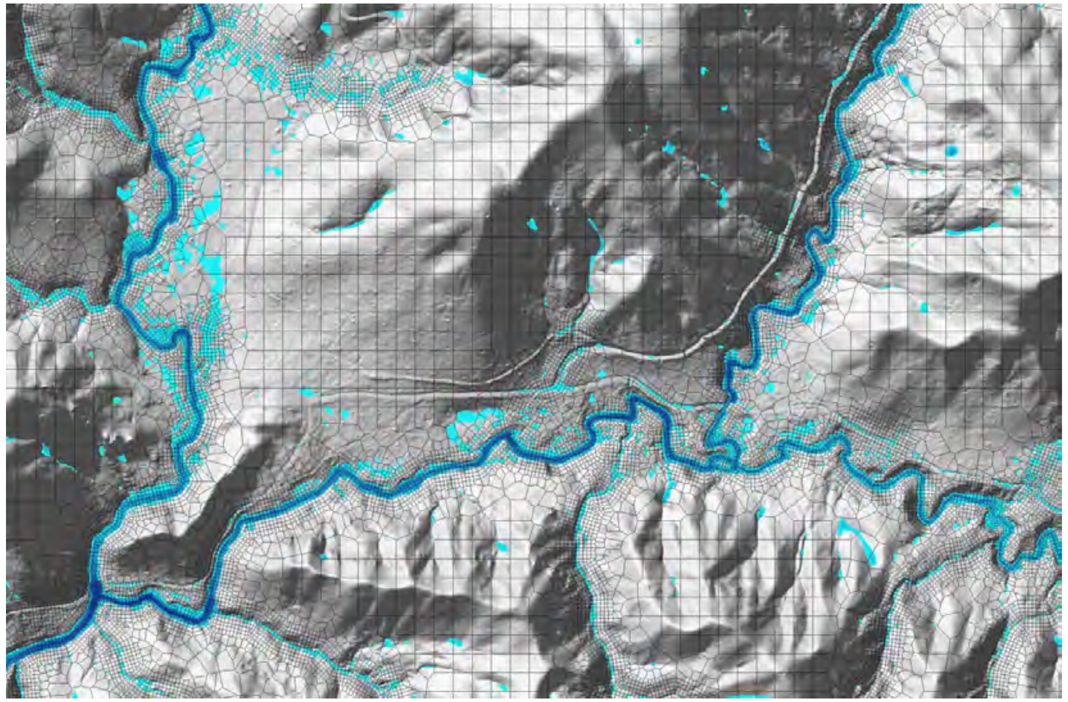


Powers, et al. 2018

Watershed-scale Hydraulic Modeling

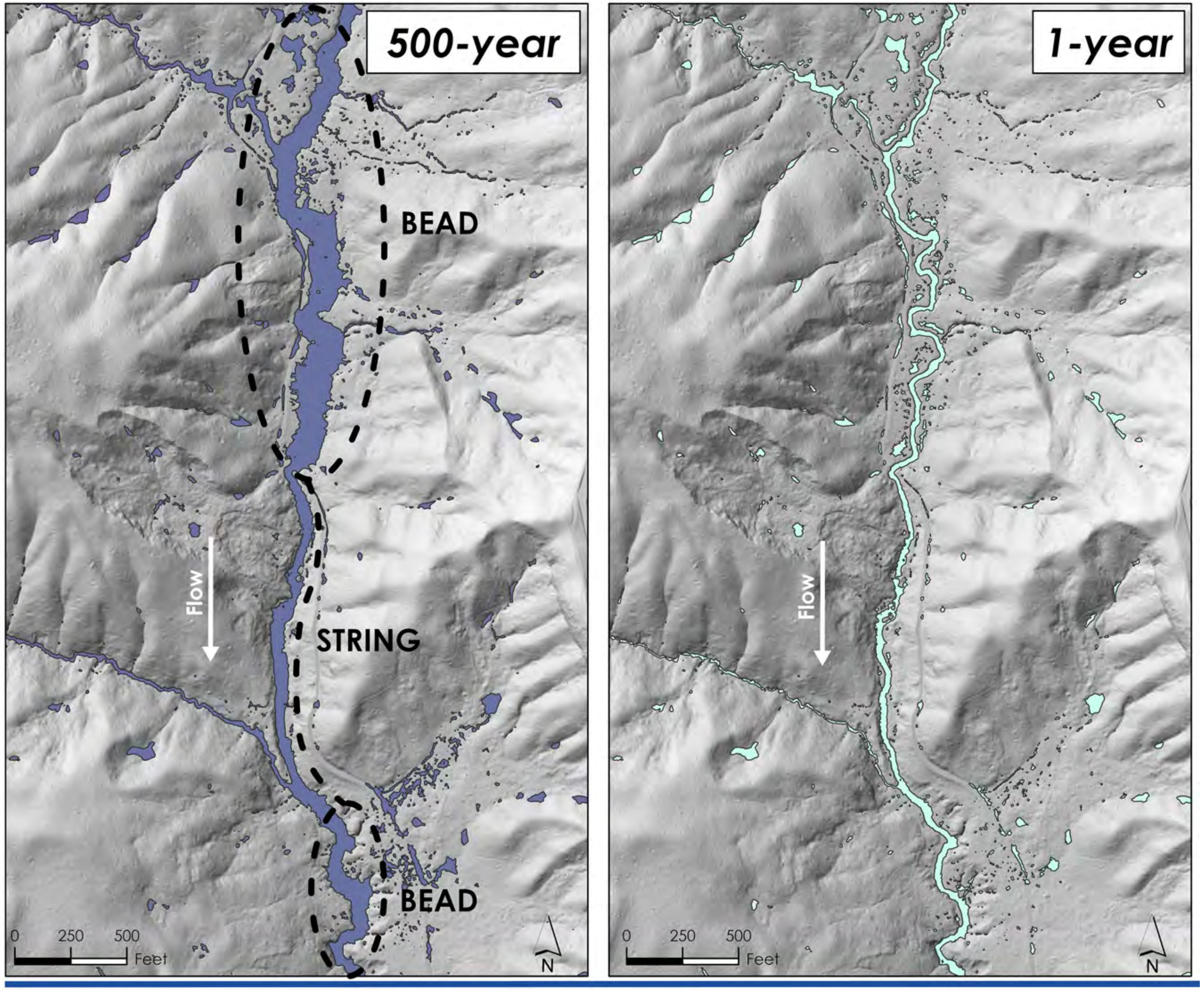
- Rain-on-grid HEC-RAS model
  - Model creates gridded rainfall across the watershed from NOAA Atlas 14-point precipitation estimates
  - Used flowlines to create breaklines to refine model resolution along channels
  - Create inundation extents for an entire watershed! …
    - With many simplifications for roughness, ET, infiltration, % impervious, etc.





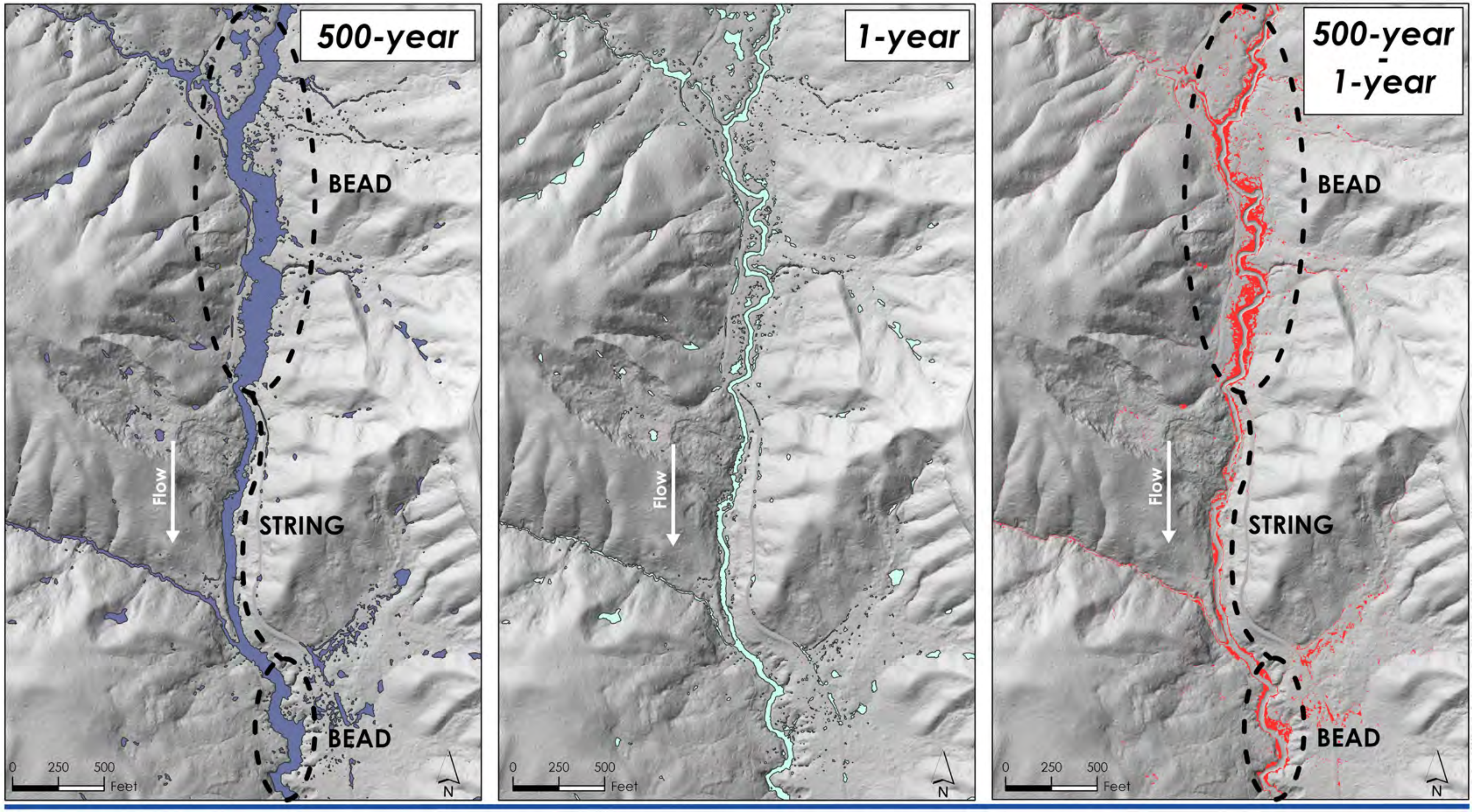
Landscape-scale Hydraulic Modeling

- Model two events:
  1. The event that would fill wide valley bottoms (500-year)
  2. The event that would be contained within an incised reach (1-year)



Site Selection - Degraded Bead Screening Tool

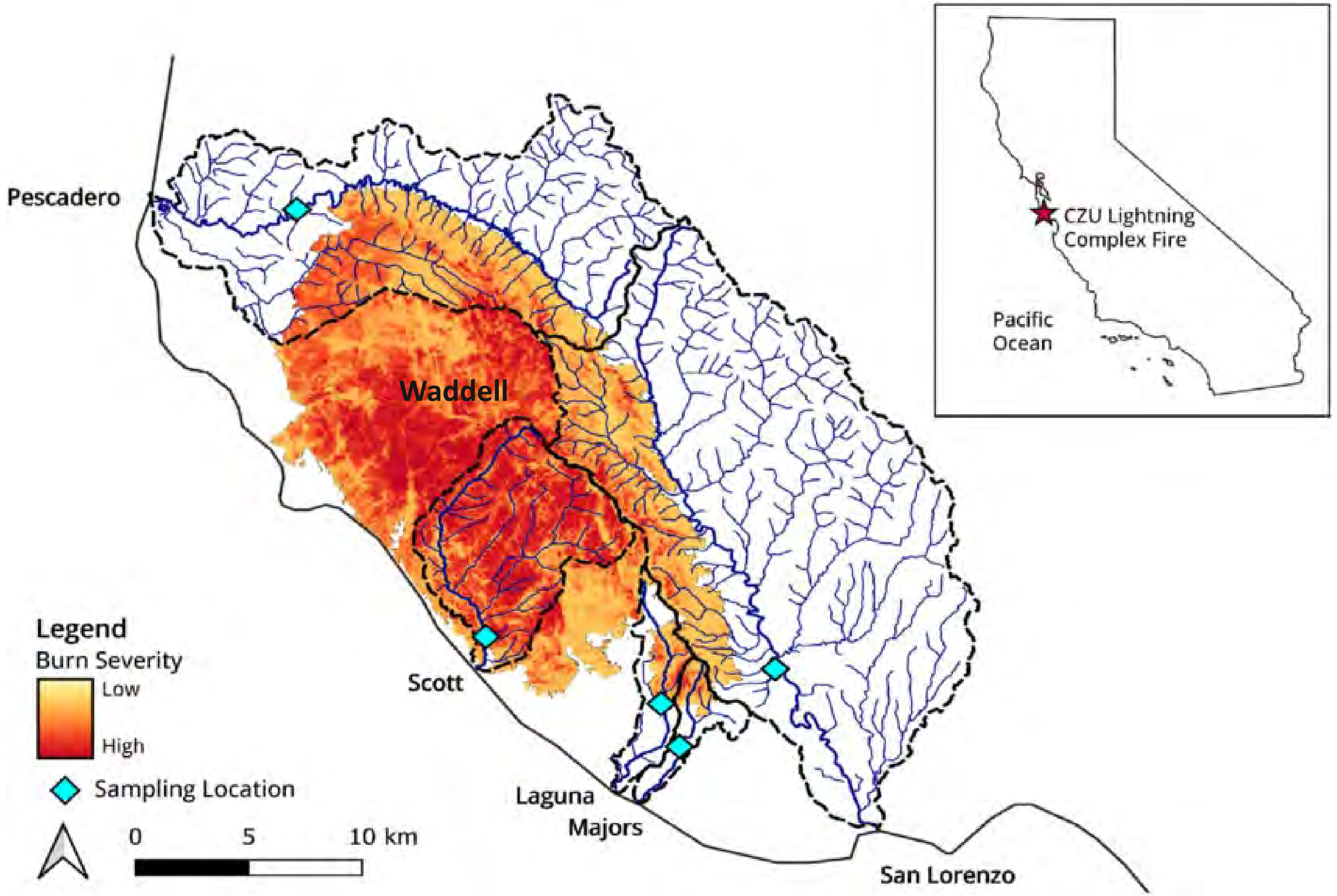
- ❑ Clipped the ~500-year inundation extent by the 1-year
- ❑ Locations where the 500-year extent is wide and the 1-year extent is narrow are our ideal reaches
- ❑ Flows are currently confined to a narrow reach but there is space to connect to nearby floodplain.
- ❑ Visual inspection of the clipped output to identify candidate reaches



03 Waddell Creek Results

Waddell Creek / CZU Lightening Fire

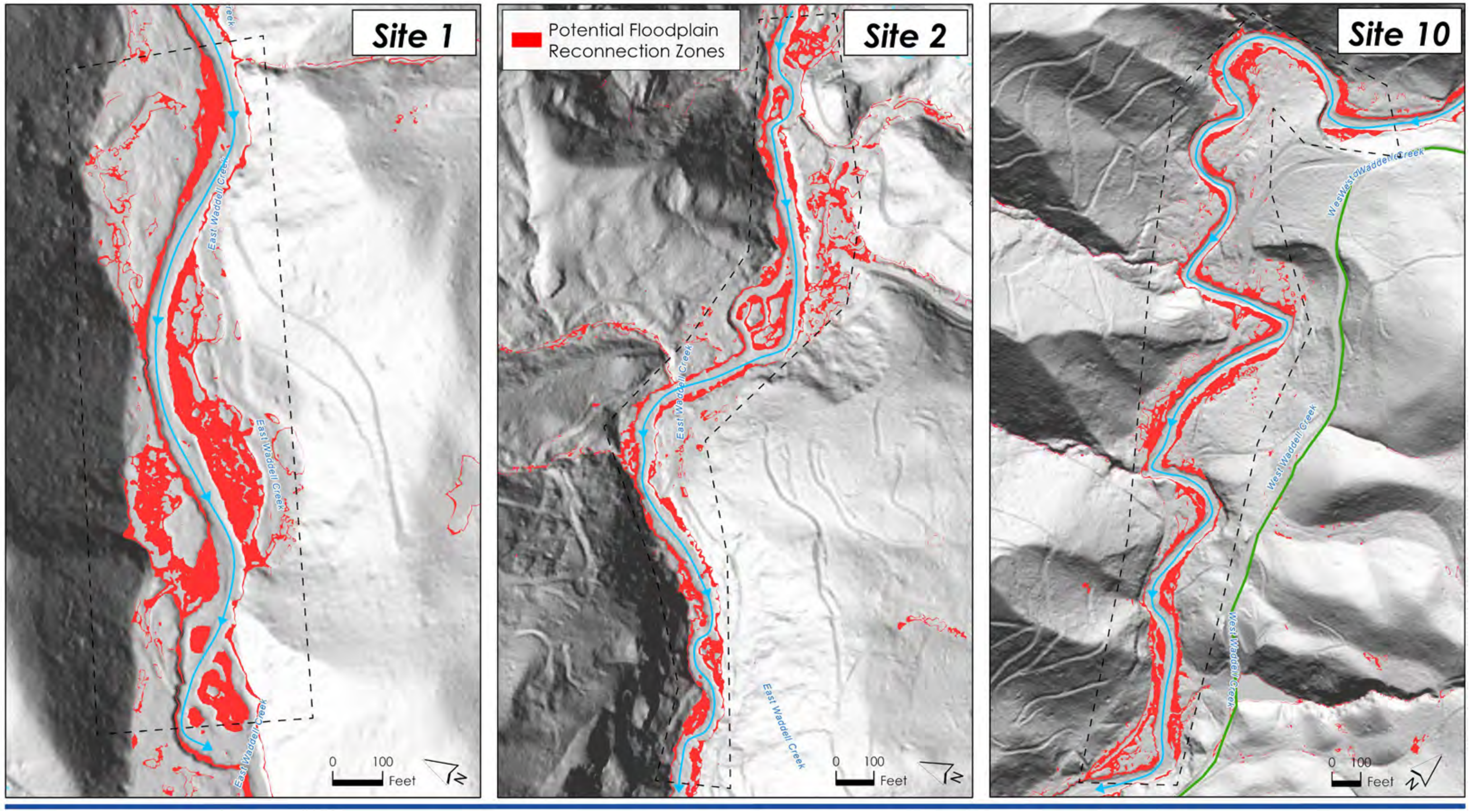
- 2020 CZU Lightning Complex Fire burned 86,509 total acres
- Most of the BBRSP burned in the fire
- Waddell Creek Watershed: 15,300 acres
    - 23.5% high burn severity
    - 54.5% moderate burn severity
    - Post-fire erosion rates estimated to be more than 10 tons per acre



Barton, et al. 2023

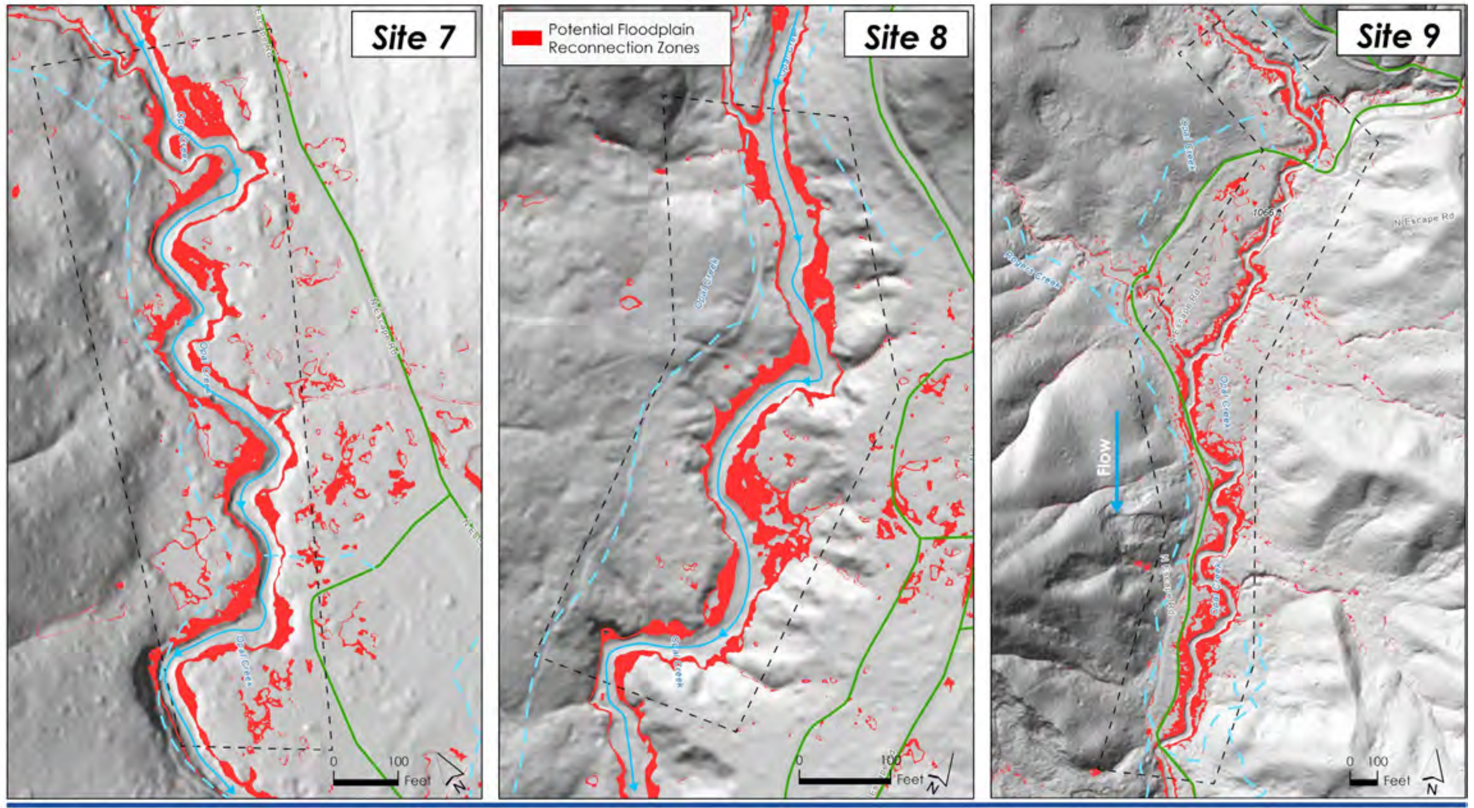
Results

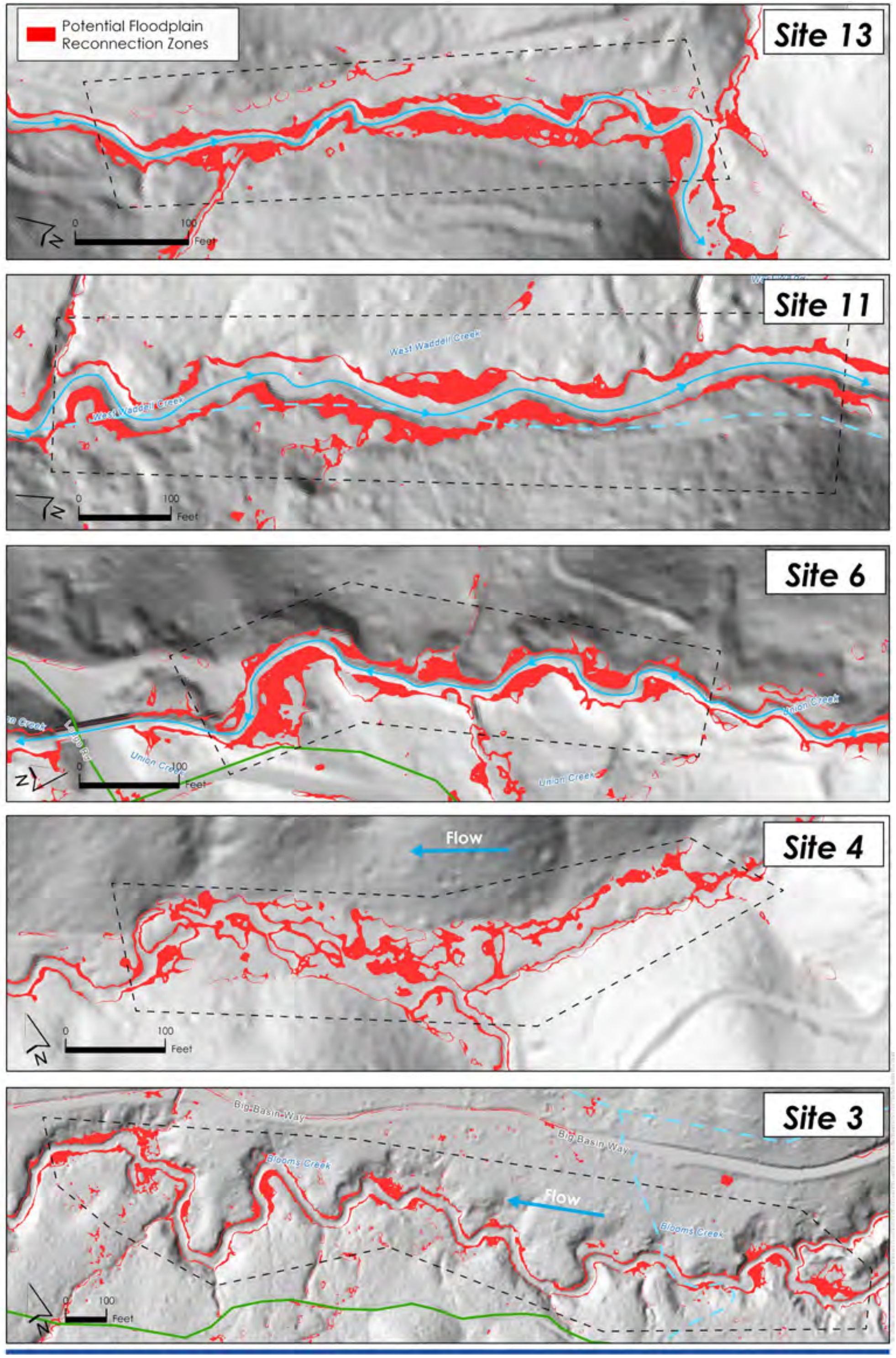
- Sites 1, 2, 10
  - Along mainstem of East and West Waddell Creek
  - Larger watershed area may need bigger material/equipment to persist
  - Considerations: fish passage, access, bridges and infrastructure



Results

- Sites 3, 4, 6, 7, 8, 9, 11, 13
  - Along tributaries to Waddell Creek
  - Smaller watershed area
  - Restoration approach: wood or rock structures
  - Considerations: fish passage, may only require hand tools, rapid deployment following fire





Fire, Sediment, Wood- Recap

This screening tool can help with rapid identification of degraded beads.

Think about beads in post-fire restoration!