United States Department of the Interior

FISH AND WILDLIFE SERVICE

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In Reply Refer To:
AFWO

November 6, 2014

Memorandum

To: Trinity River Adaptive Management Working Group

From: Joe Polos, TAMWG Designated Federal Official

Subject: Presentations from the Joint TMC/TAMWG Phase I workshop, October 30-31, 2014

The attached file is a compilation of the presentations from the Trinity River Restoration Program programmatic workshop held on October 30-31, 2014, in Weaverville, CA. A companion document is being prepared that will summarize the information presented during the workshop. When the summary document is completed it will be distributed to TAMWG members. This compilation of presentations, along with the summary document when it is available, will serve as the summary/minutes of the October 30-31 TAMWG meeting. We did record the meeting and that recording is available for review.

TRRP Programmatic Workshop
Draft Agenda
Meeting Room, Weaverville Public Library
351 Main St.
Weaverville, CA 96093

October 30-31, 2014

Purpose: This workshop series is intended to build a common understanding among TRRP policy makers, stakeholders, and staff about (1) what has been learned during the past nearly 10 years of Program implementation and (2) how that information will influence future mngt. and restoration actions. *The emphasis of this specific workshop will be the evolution of channel rehabilitation efforts.*

Topics: Central tenets of the Trinity River Mainstem Fishery Record of Decision (ROD)
Evolution in channel rehabilitation strategy
SAB review and recommendations

Note: There will be an opportunity for public questions / comments during each discussion period.

Agenda

Thursday, October 30, 2014

Meeting no. / Access code: 578 615 730 Password: Abc@123! Audio: 1-408-792-6300
Link: https://trrp.webex.com/trrp/j.php?MTID=m8e0de9584869efa059cfa3c0570c4df2

Time	**Topic**	**Discussion Leader**
	Opening Session	
9:00	Introduction 1. *Purpose of workshop series* 2. *Purpose of this event* 3. *Future topics / events* 4. *Agenda review*	Schrock
9:30	ROD tenets	Franklin
10:00	BREAK	
	Channel Rehabilitation Evolution Session	
10:30	Overview of channel rehab evolution/timeline	Bandrowski
10:45	Habitat Lessons Learned 1. *How the habitat assessment has helped change the way we design projects.* 2. *Is a single mainstem channel sufficient for habitat?* 3. *Discussion*	 Martin Chamberlain Facilitator: Ledwin
NOON	LUNCH (on your own)	
1:00	Physical Processes Lessons Learned 1. *Why have the projects gotten so big? What happened to the "Feathered Edge" and "Berm Notching" approach?* 2. *Why are we pushing the river the around so much?* 3. *Why are we using so much large wood on the projects?* 4. *Discussion*	 Krause Gaeuman Bandrowski / Smith Facilitator: Stewart

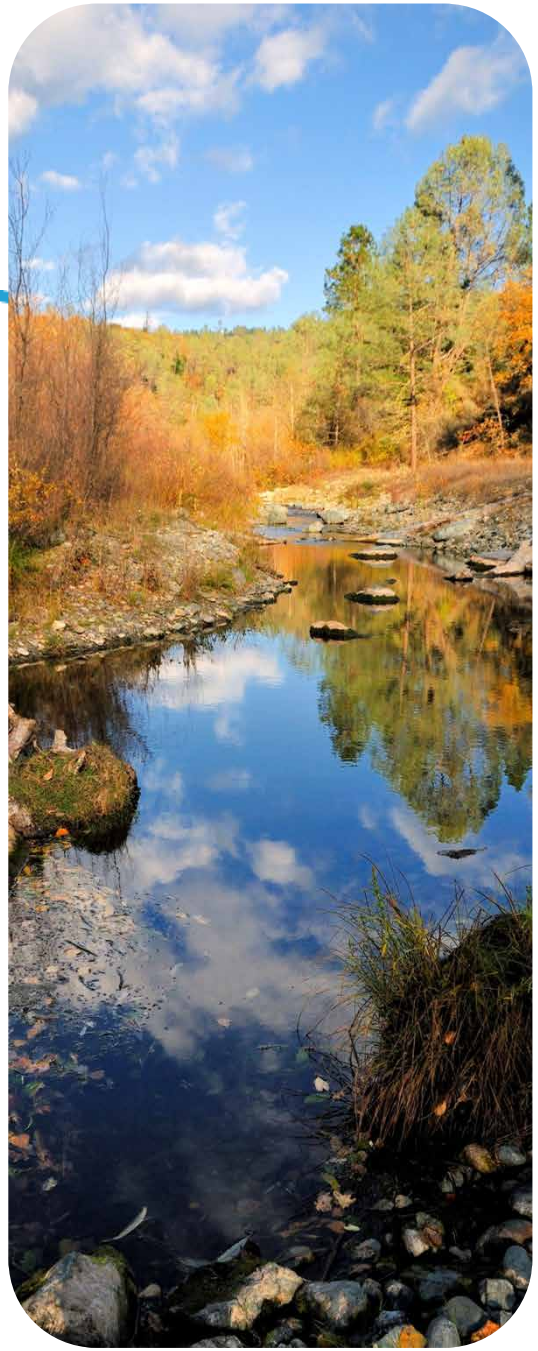
Time	**Topic**	**Discussion Leader**
2:15	Riparian Lessons Learned 1. *Is the riparian revegetation working?* 2. *Are constructed surfaces working to restore natural riparian recruitment processes?* 3. *Discussion*	 Lee and Bair Lee and Bair Facilitator: TBD
3:30	BREAK	
3:45	Conclusion (Session 1 of 2; looking back): – *What has been learned during the past nearly 10 years of Program implementation?* – *What is it that we don't understand but want to learn?*	Presenters Facilitator: TBD
4:45	Outline day 2 agenda	Schrock
5:00	ADJOURN	

Friday, October 31, 2014

Meeting no. / Acess code: 574 616 222 Password: Abc@123! Audio: 1-408-792-6300
Link: https://trrp.webex.com/trrp/j.php?MTID=m50a3b5e1de2da2c8988a29769977a097

Time	**Topic**	**Discussion Leader**
	Channel Rehabilitation Evolution Session *Continued*	
9:00	Conclusion (Session 2 of 2; looking forward): – *What are priority Phase 2 design challenges and proposed revisions to the Phase 2 design process based on lessons learned?* – *What can we do to foster organizational learning?*	Panel Facilitator: TBD
10:15	BREAK	
	SAB review and recommendations	
10:30	Introduction	Schrock
10:45	TRRP DSS Introduction	DeWeber
11:00	DSS Component Update	Clarke
11:15	DSS next steps Discussion based on Appendix H	Schrock
12:15	How could channel rehabilitation decisions be informed in the future?	Schrock, Bandrowski Clarke, DeWeber
12:45	Conclusion	Schrock
1:00	ADJOURN	

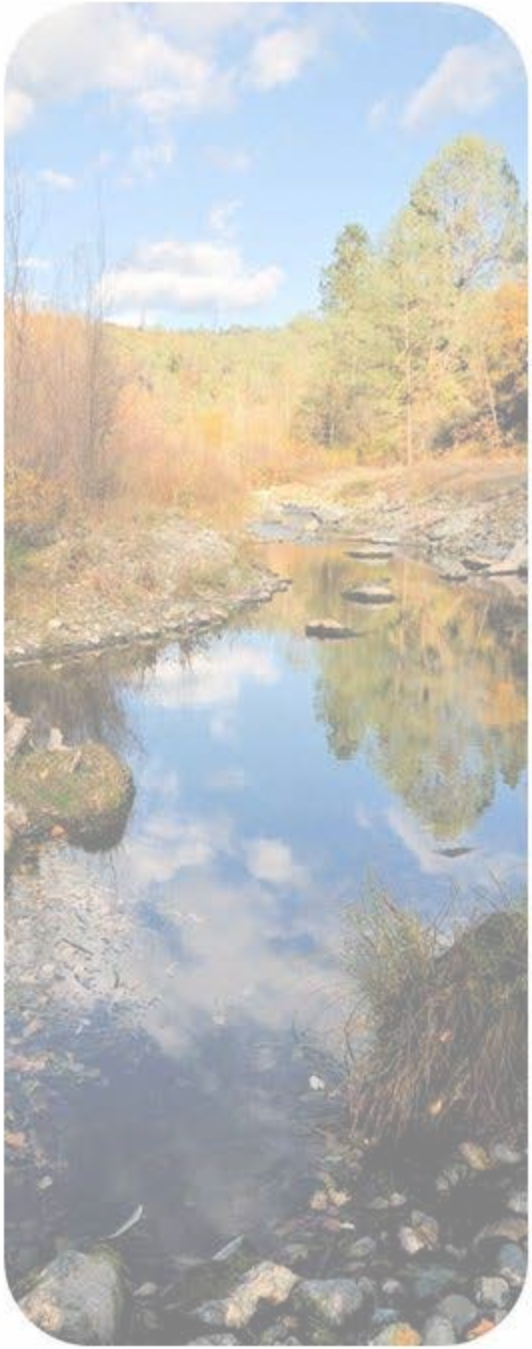
Channel Rehabilitation Workshop



Robin Schrock
Trinity River Restoration Program

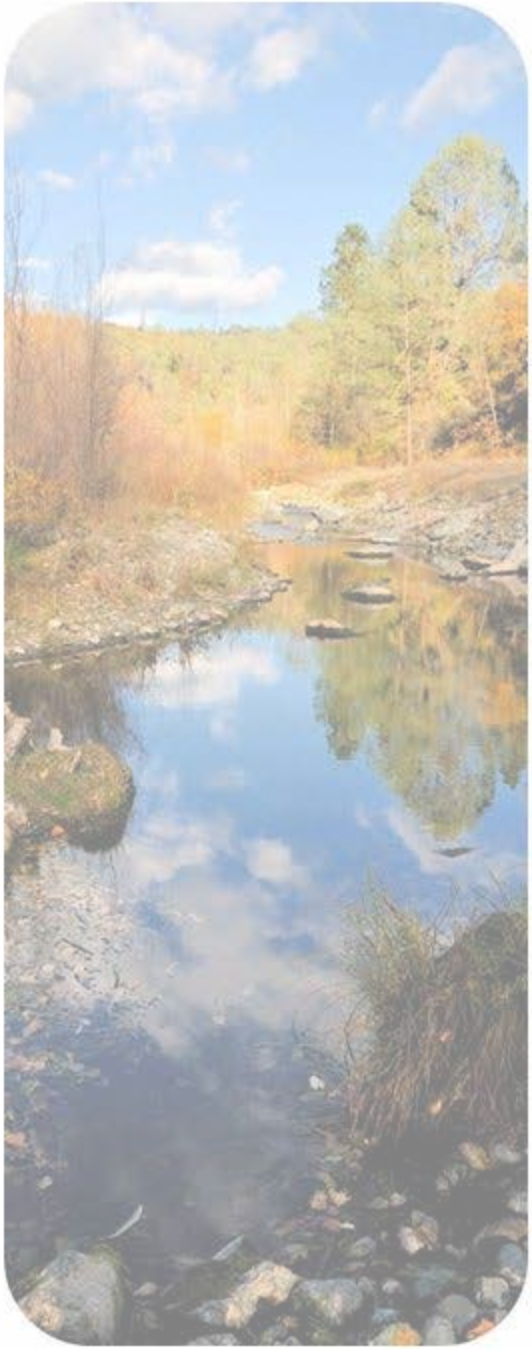
Purpose of the Workshop Series

- Provide the public, decision makers and advisory group with a common knowledge of the program's science base
  - § Tenets of the Record of Decision
  - § Advances over the past ten years
  - § Advances since the Phase 1 review
- Learn about advances in monitoring and assessment
- Describe how new information has informed changes in program management action



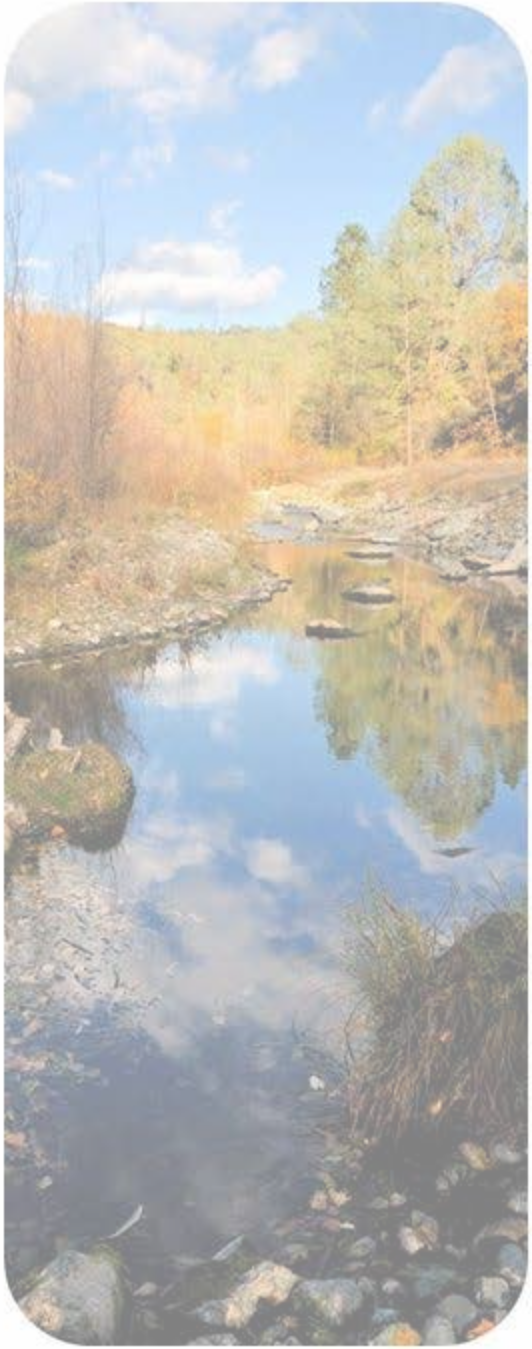
Purpose of this Event

- Focus on habitat assessments
- Describe how they inform design
- Learn how physical processes respond to design
- Appreciate the role of riparian vegetation



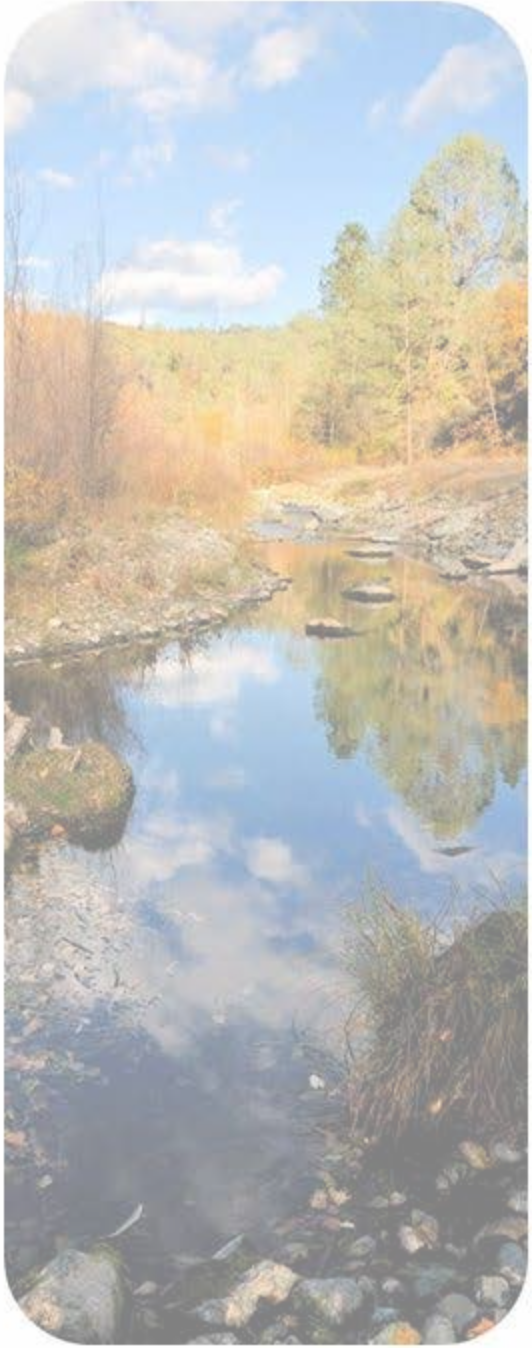
Purpose of this Event

- Review ten years of learning
- Discuss assumptions
  - what we think we know
- Prioritize design challenges
- Explore Decision Support Systems
- Updates for TRRP DSS



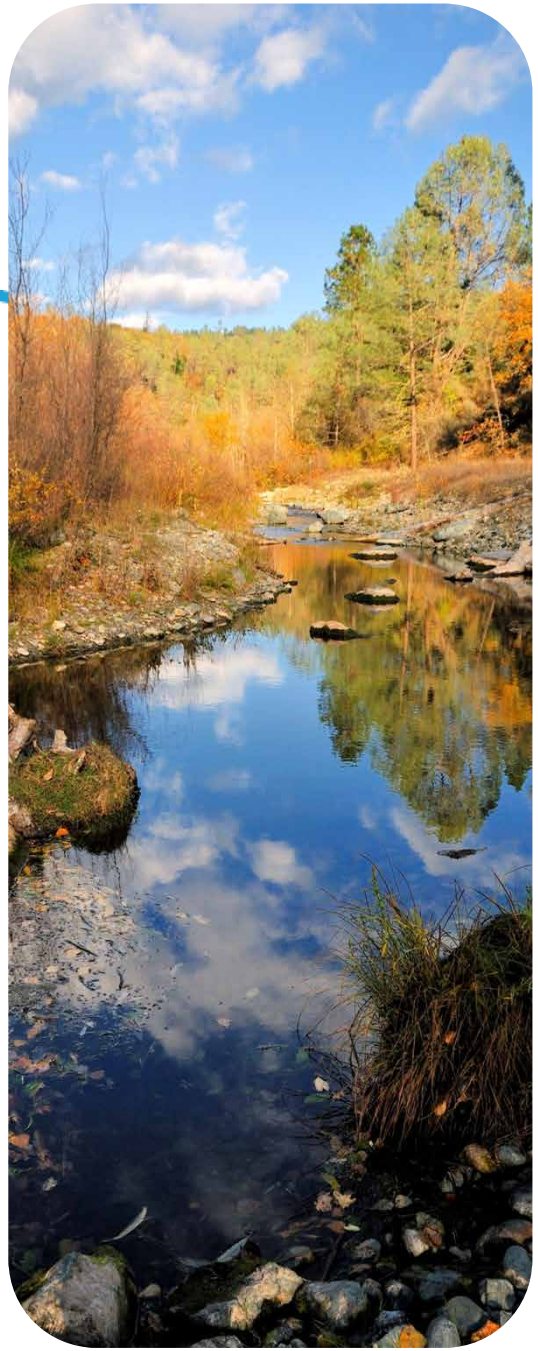
Purpose of this Event

Learning	Assumptions	Uncertainty



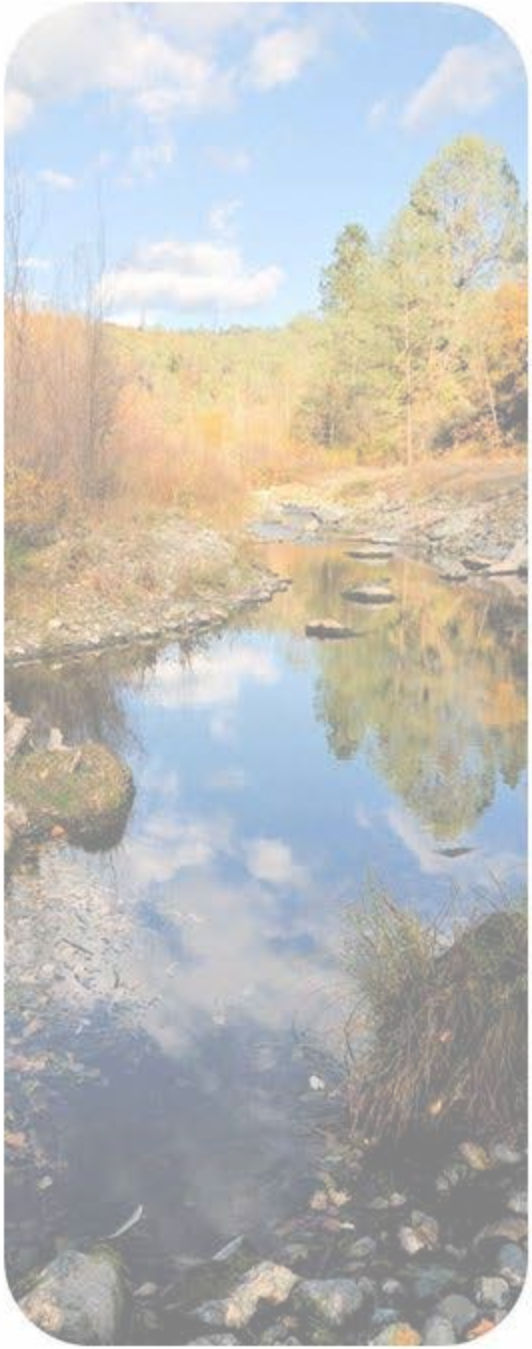
Lessons Learned

- Lesson one – It takes people
- Lesson two – It takes time
- Lesson three – It takes patience



Future Topics

- Fish Population Dynamics
- Flow & Temperature
- Watershed Synopsis
- Program Adaptive Management



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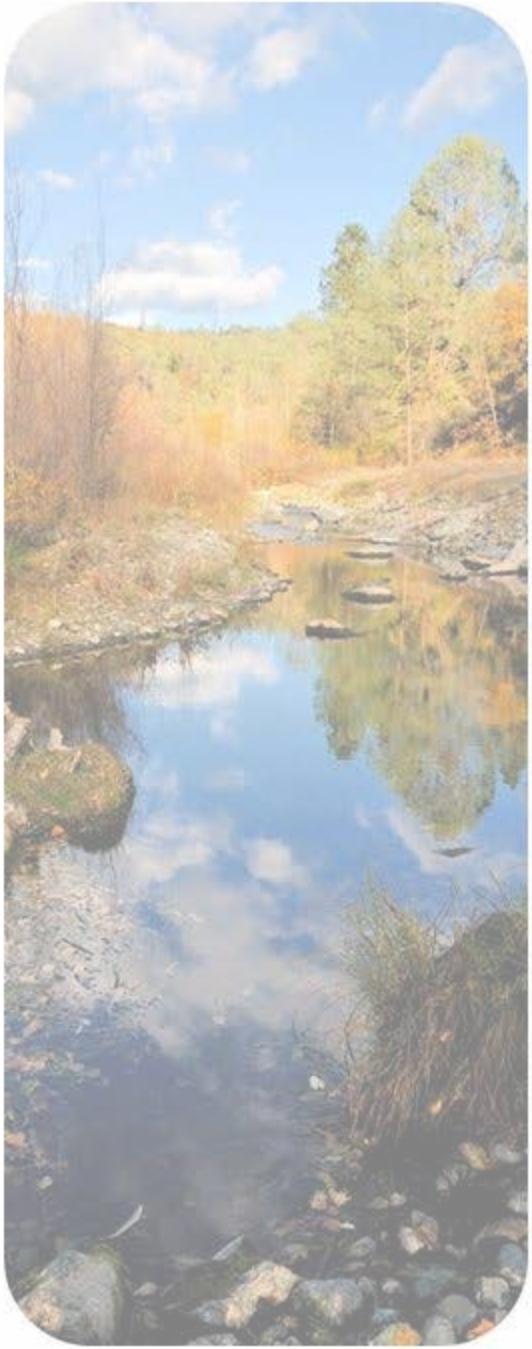

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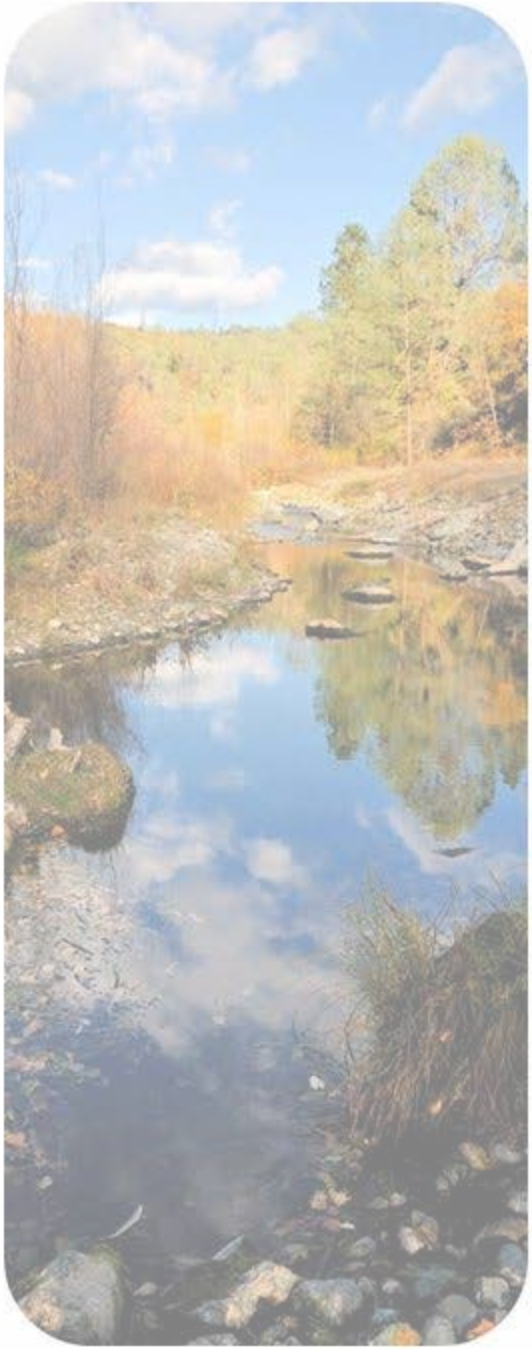
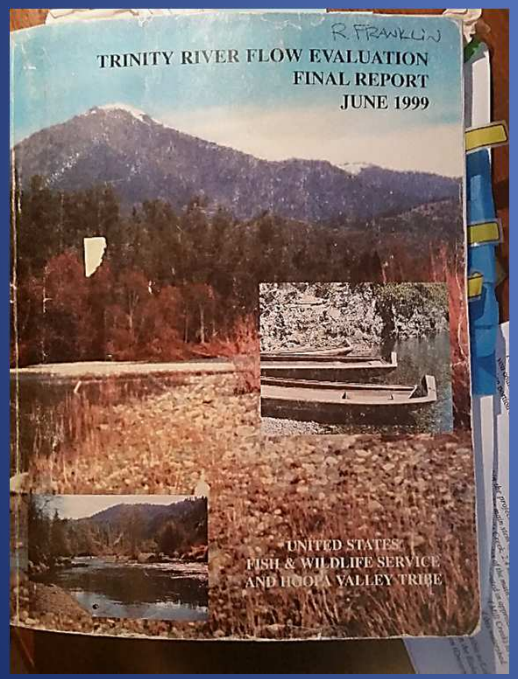


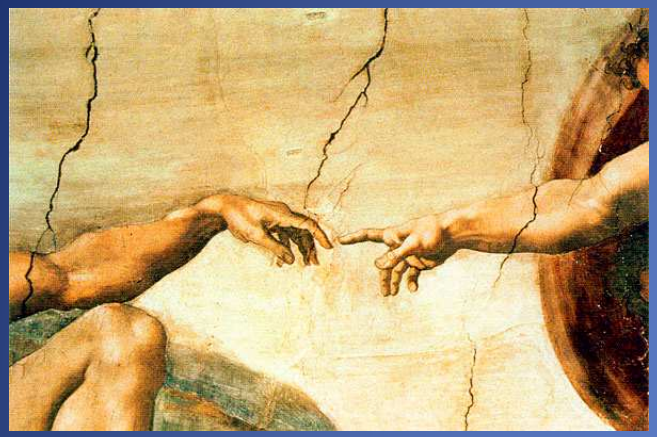
Basics of the Flow Study and ROD

- **What** did the ROD authorize that instructs Phase Two?



… And **Why** did the Flow Study recommend this approach?

In the Beginning…



Engineers Ruled the Earth…

Trinity River Restoration Strategy

Premise: Native life (including salmonids) adapted to the unimpaired ecosystem and the habitats provided. If naturally produced salmonid populations are to be restored, habitats on which they depend must be restored.

Restoration Strategy: Integration of riverine processes and instream flow-dependent needs.

What does “Alluvial” mean?

A river with bed and banks made up of mobile sediment. Alluvial rivers are self-formed, meaning that their channels are shaped by the flows that they experience, and the ability of flows to erode, deposit, and transport sediment

Healthy River Concept

- A New Direction
  - **away from single species management**
  - **away from engineered habitat**
- Developed “attributes of alluvial river integrity” from historical analysis, literature, and field observations.
- Used attributes to develop restoration objectives in the Flow Study.

Integrated Studies of Ecosystem Components

1985-1997

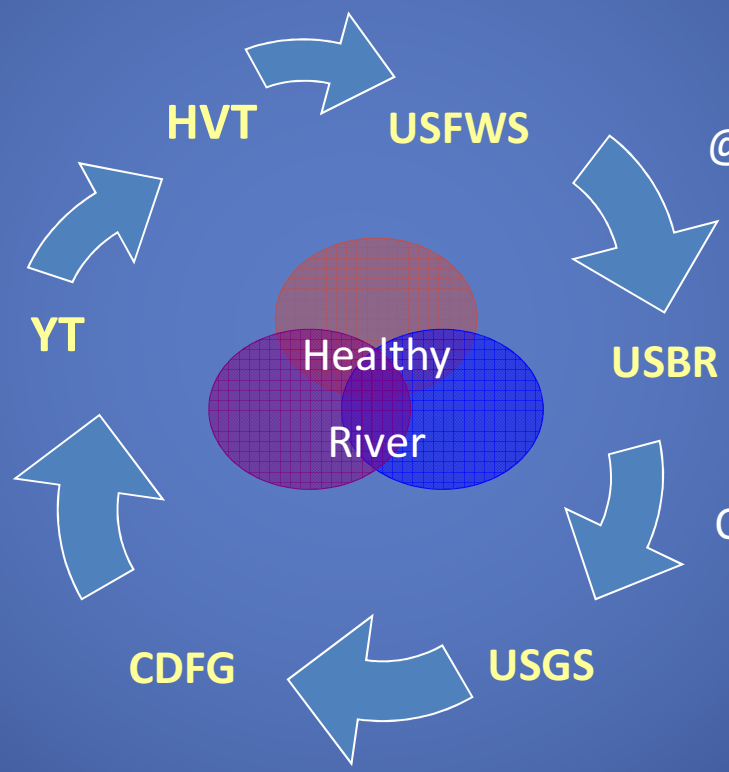
Salmonid

Microhabitat Studies

1988-1997

Habitat

@ Rehabilitation Sites



1977-1997

Flow-Temperature Studies

1993-1997

Chinook Production Model

(SALMOD)

1990-1995

Sediment Transport Studies

1990-1997

Fluvial Geomorphology

Integration of Studies

- Peer Review of Each Independent Study
- Inter-Agency Team Integrates Studies
- Resolution of Policy with Science
- Development of a Joint Recommendation
  - Federal, Tribal, State concurrence

Flow Study Recommendations

1. Increased release volumes to the river
2. Mechanical channel rehabilitation
3. Coarse and fine sediment management
4. Adaptive management

#1 - Increased Flow Releases

- To meet habitat and temperature needs of anadromous fish
  - Temperatures at levels near optimal
  - Habitat flows tuned to winter/spring needs
- To restore fluvial processes within infrastructure constraints
  - Peak release from Trinity Dam approx. 11,000cfs

#2 - Channel Rehabilitation Projects

- Delta management
- Construction Projects
  - Building gravel bars
  - Building side channels
  - Lowering floodplains
  - Adding gravel
- Riparian planting/mitigation
- Missing – Large Wood

Channel Rehabilitation Recommendations

(TRFES Chapter 8.3)

- Varied by reach of river due to changes in tributary flow accretion, sediment supply…

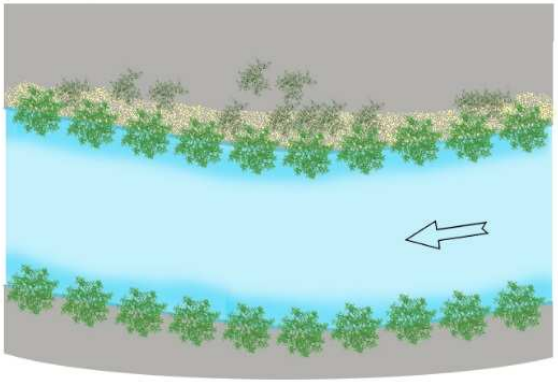
- General prescriptions to be considered within site specific characteristics and constraints:
  - "construct bank rehabilitation sites and alternate bar rehabilitation projects that include building skeletal point bars after riparian berms are removed to encourage development of alternate bars…"
  - "re-vegetate reconstructed floodplains …"
  - "removing riparian berm at key locations may induce alternate bars to form during high flows " below Indian Creek due to flow accretion and coarse sediment input from tributaries.
    - If bar formation does not occur construct skeletal bar and floodplain features
  - Maintain existing side channels and evaluate high-flow hydraulics of side channel sites to ensure that they are self-maintaining

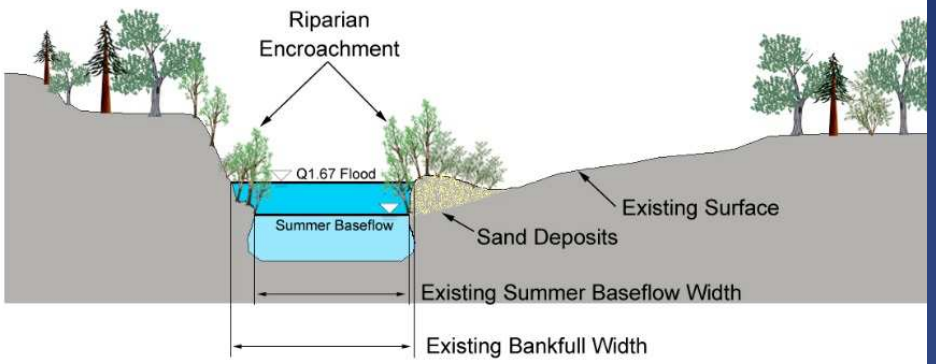
PROPOSED DESIGN APPROACH

Flow Study Proposed Design Approach

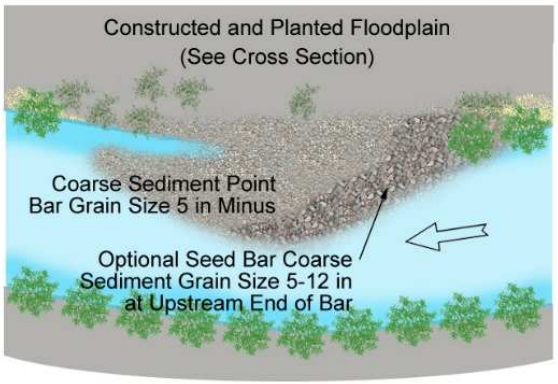
PLANFORM | **CROSS SECTION**

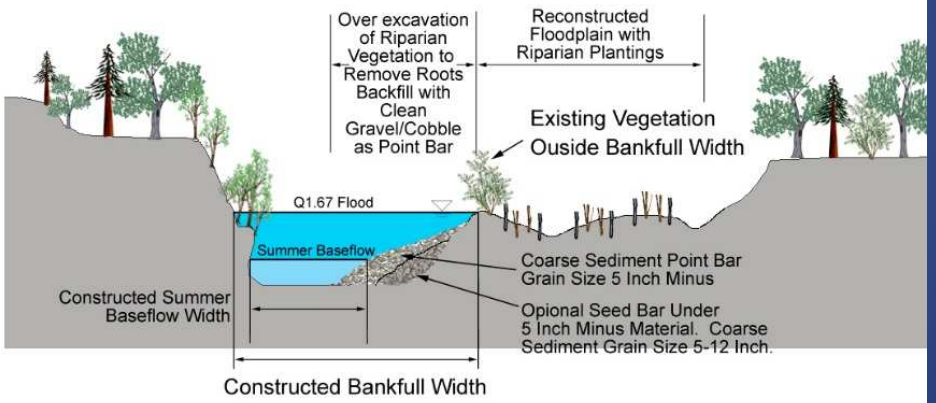
EXISTING CHANNEL



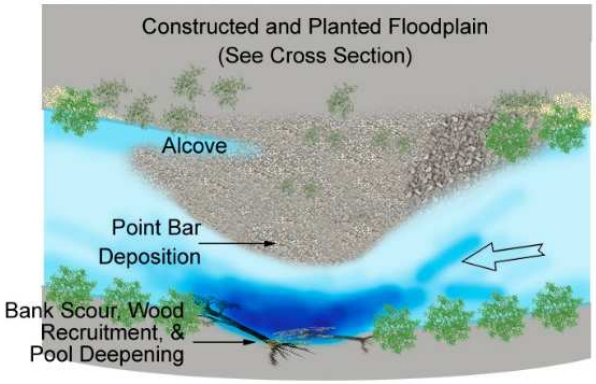


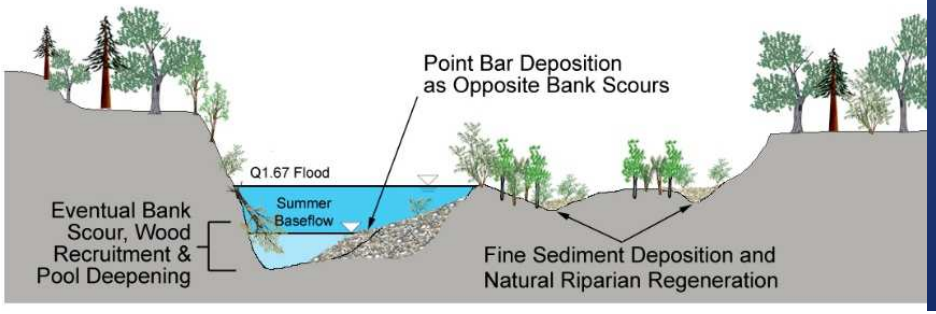
CONSTRUCTED POINT BAR AND FLOODPLAIN





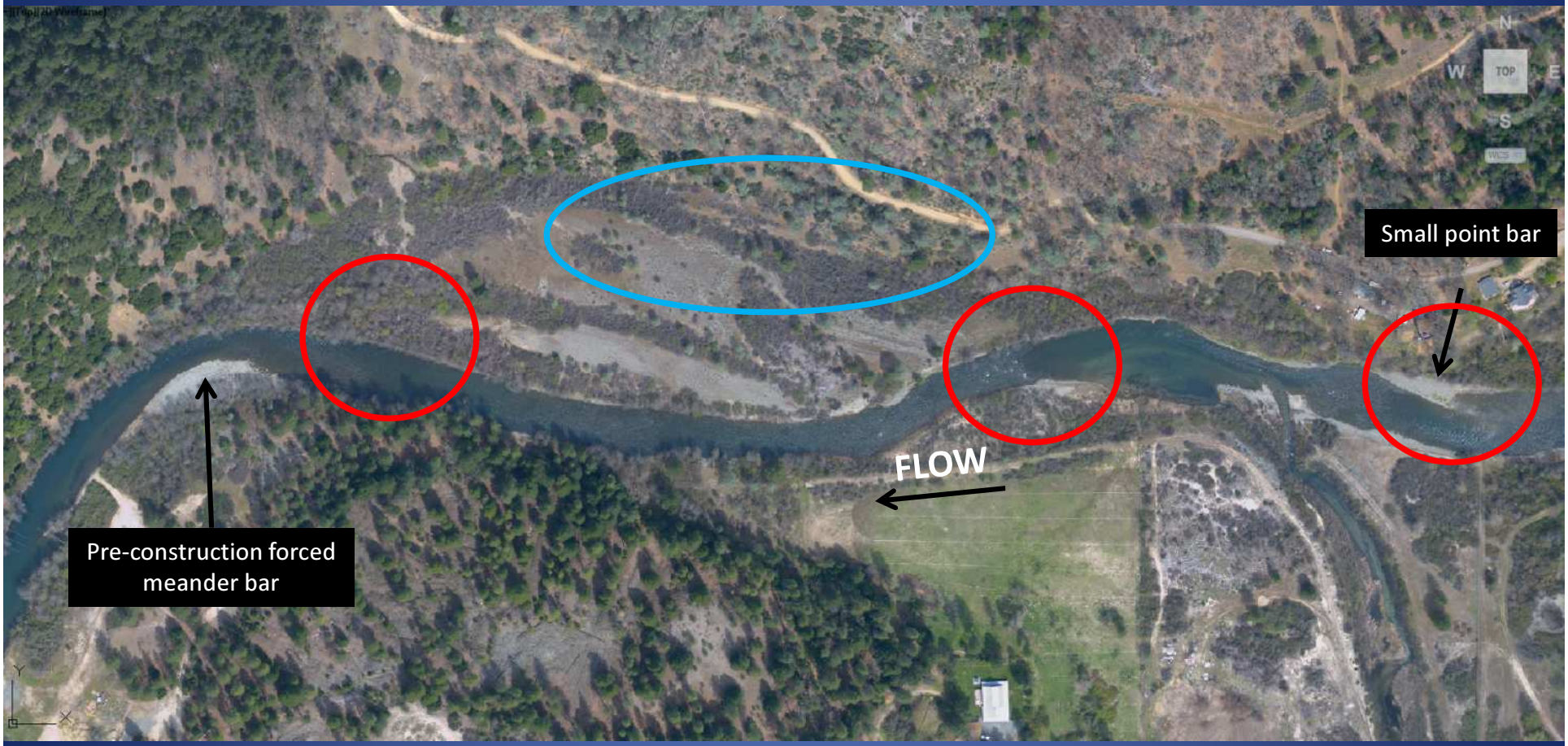
ANTICIPATED POINT BAR EVOLUTION





GRASS VALLEY CREEK AND TRINITY HOUSE GULCH

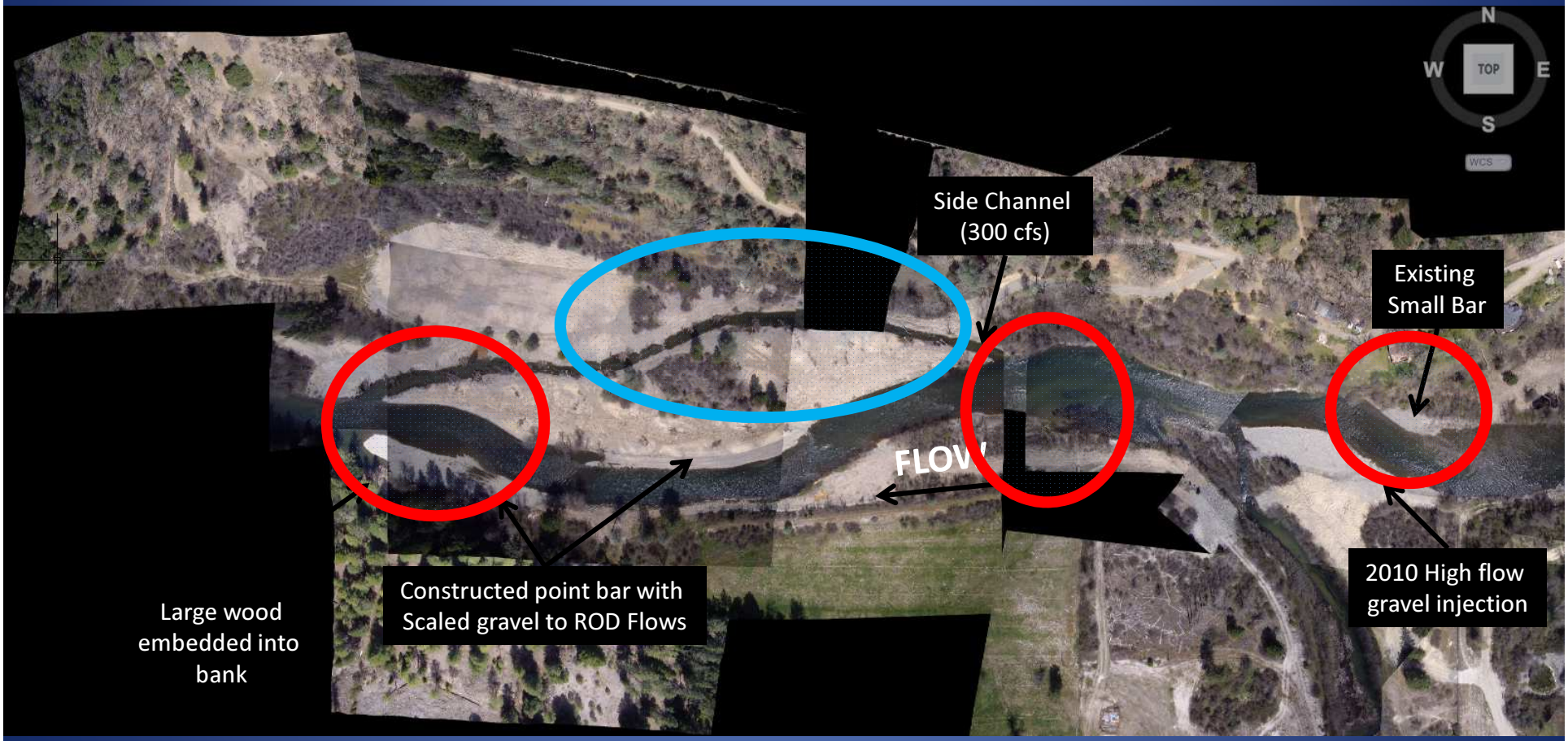
Pre-Construction Fall 2009 (450 cfs)



Typical riparian encroached channel.

GRASS VALLEY CREEK AND TRINITY HOUSE GULCH

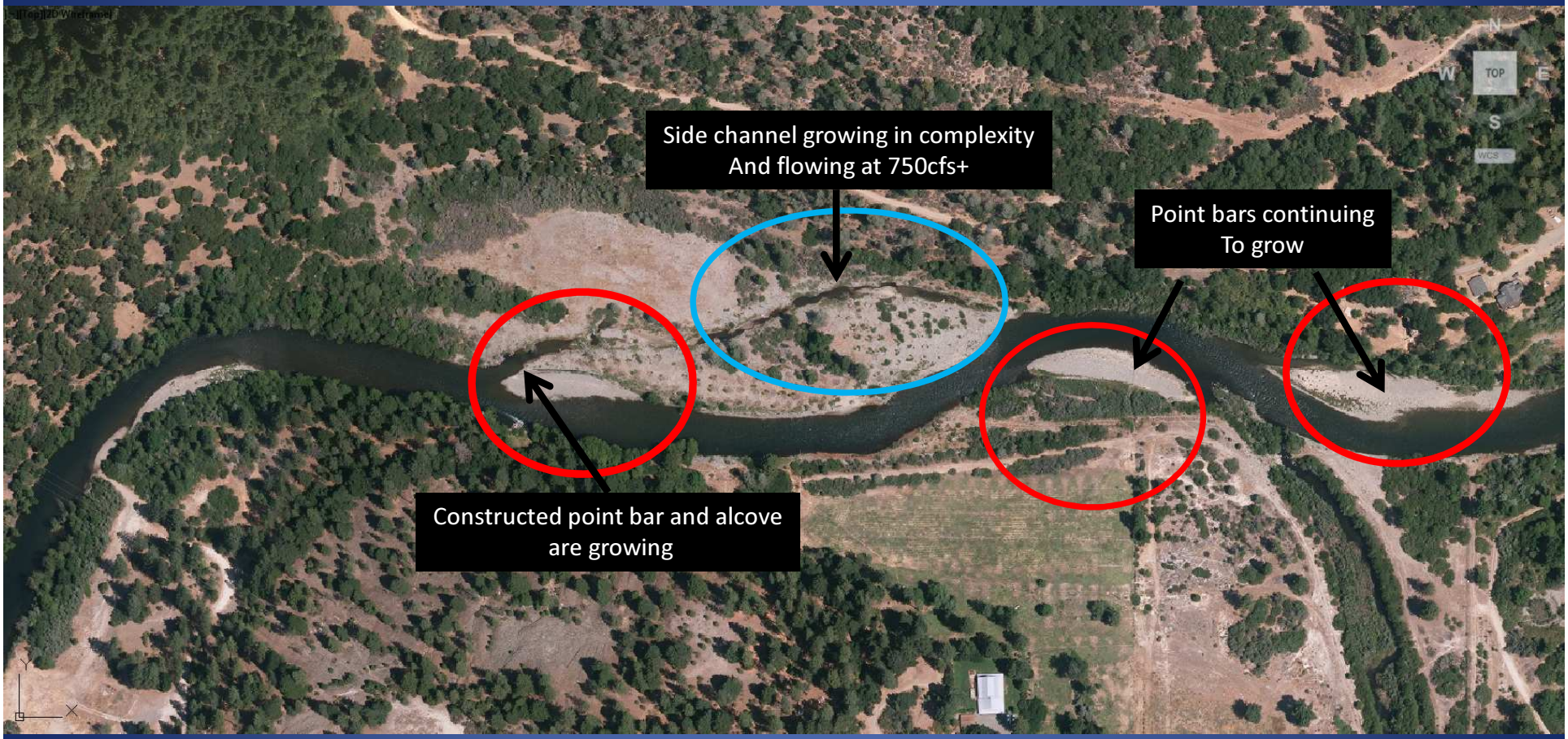
As-Built Fall 2011 (300 cfs)



Constructed side channel and bars. Floodplain terrace lowered.

GRASS VALLEY CREEK AND TRINITY HOUSE GULCH

Summer 2014 (450 cfs)



Three Years After Construction

GRASS VALLEY CREEK AND TRINITY HOUSE GULCH

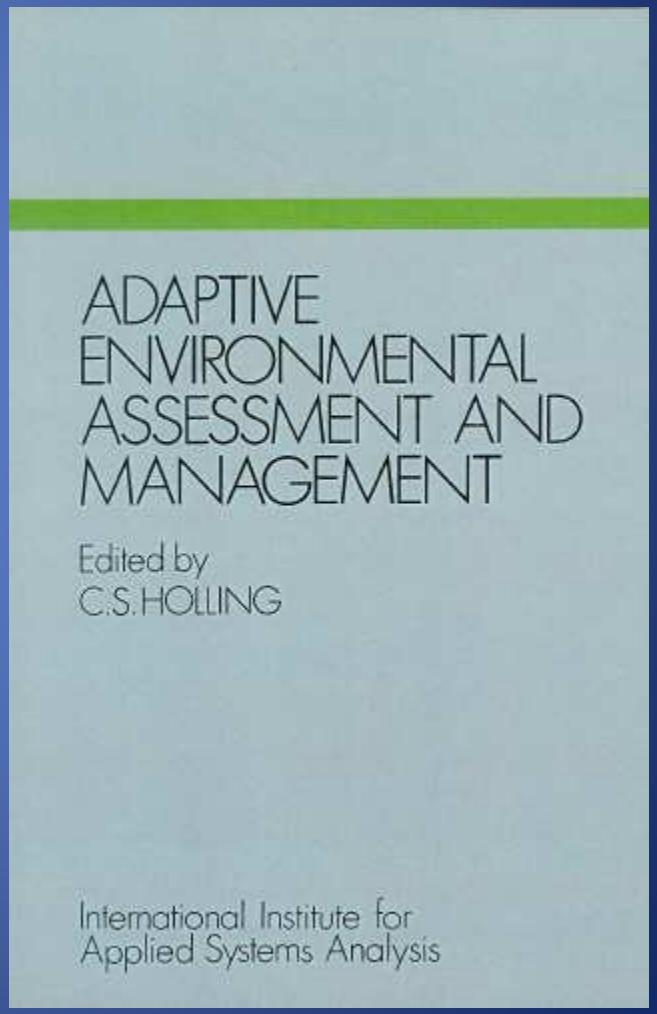
Pre-Construction Fall 2009 (450 cfs)

#3 - Sediment Management

- Add gravel above Indian Creek to mitgate blocked recruitment from above dams.
- Annual augmentation to replace gravel transported downstream.
- Add gravel – sized to new flow regime - during channel rehabilitation activities.
- Reduce sand in mainstem (Hamilton Ponds).

#4 - Adaptive Environmental Assessment and Management

- Formal scientific process applying models of ecosystem components
- Explicitly incorporates learning as part of the objective, and hence, decisions which improve learning are valued over those which do not
- As new knowledge is gained, models are updated and optimal strategies are derived accordingly



AEAM…the path ahead

- Implement fully-structured AEAM process.
- Develop DSS component
  - out of synch with Phase Two design work
- Reconcile scientific disputes over the Big Questions.

Example uncertainties

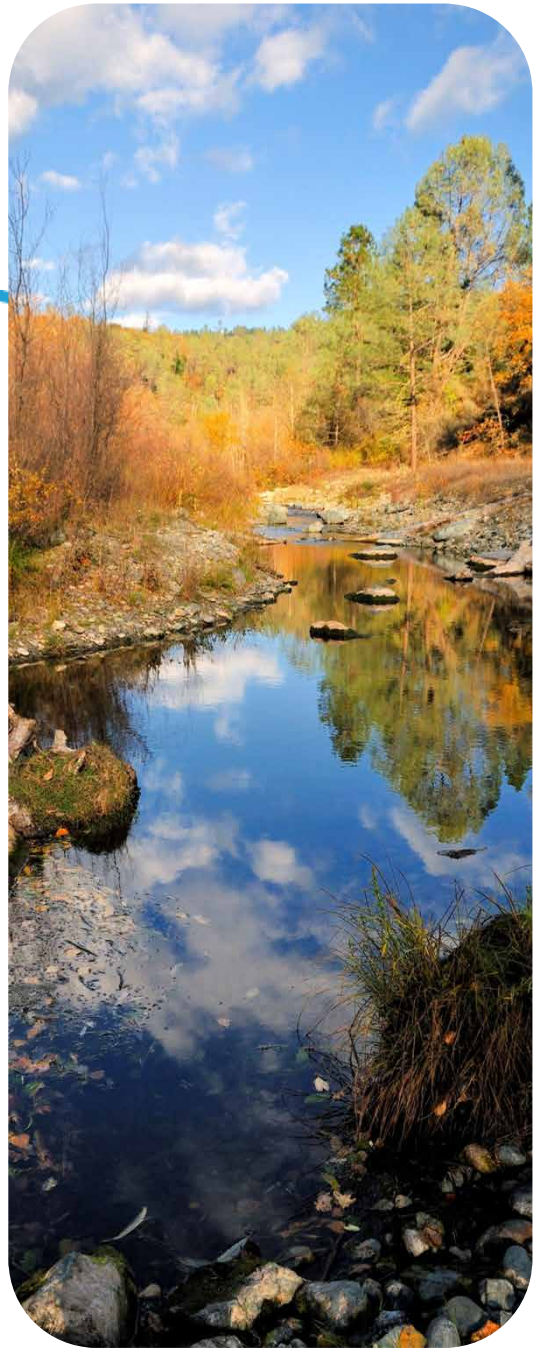
to be evaluated through AEAM

- Can a more dynamic and complex channel support restoration?
- Are flows sufficient to prevent encroachment - especially during drought?
- How to add gravel and wood?
- Can we mitigate climate change (warming)?

Channel Rehabilitation Workshop

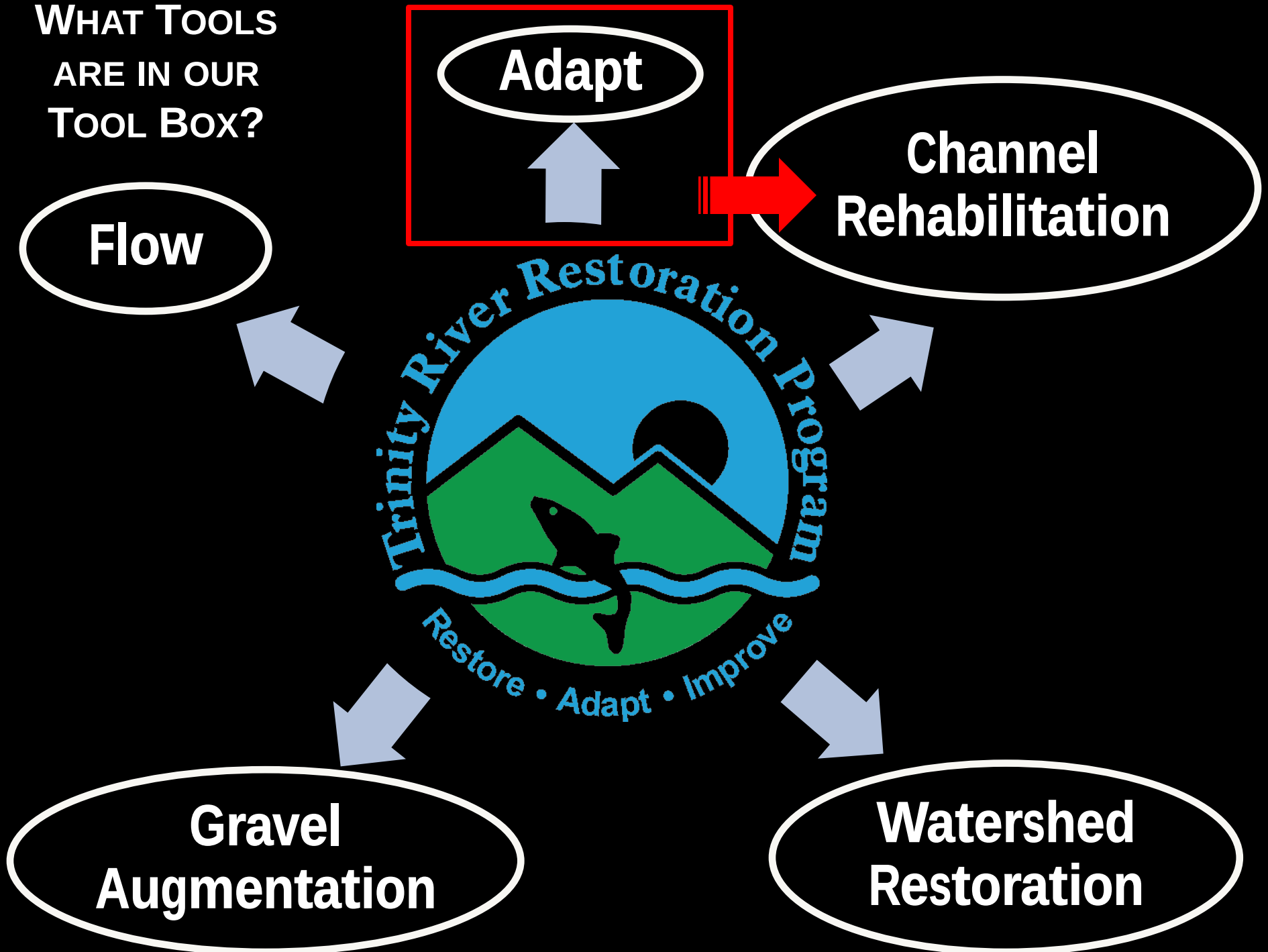
Channel Rehabilitation Evolution Timeline Ten Years of Lessons Learned (2005-2015)

David (DJ) Bandrowski
Bureau of Reclamation (TRRP)

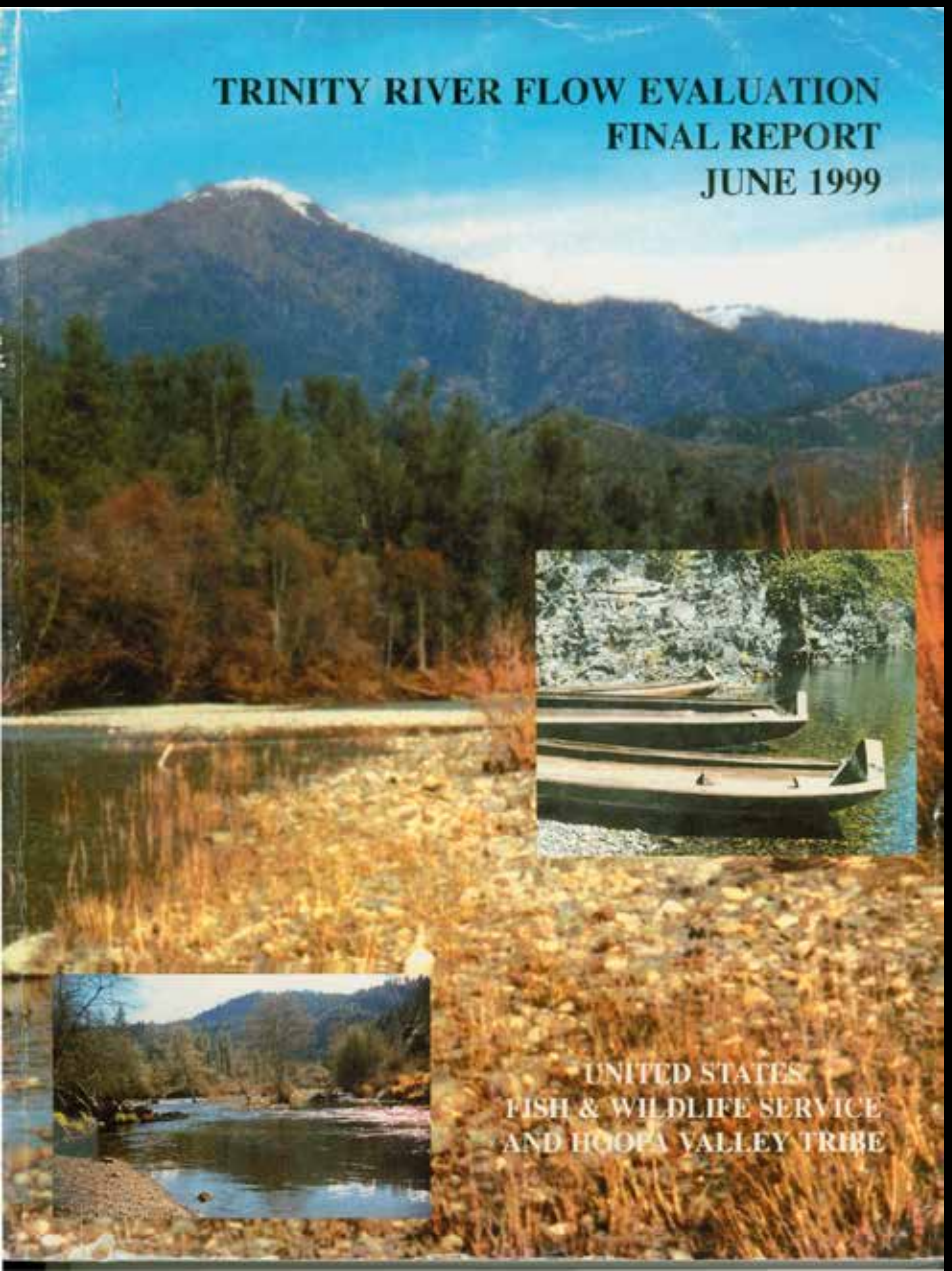


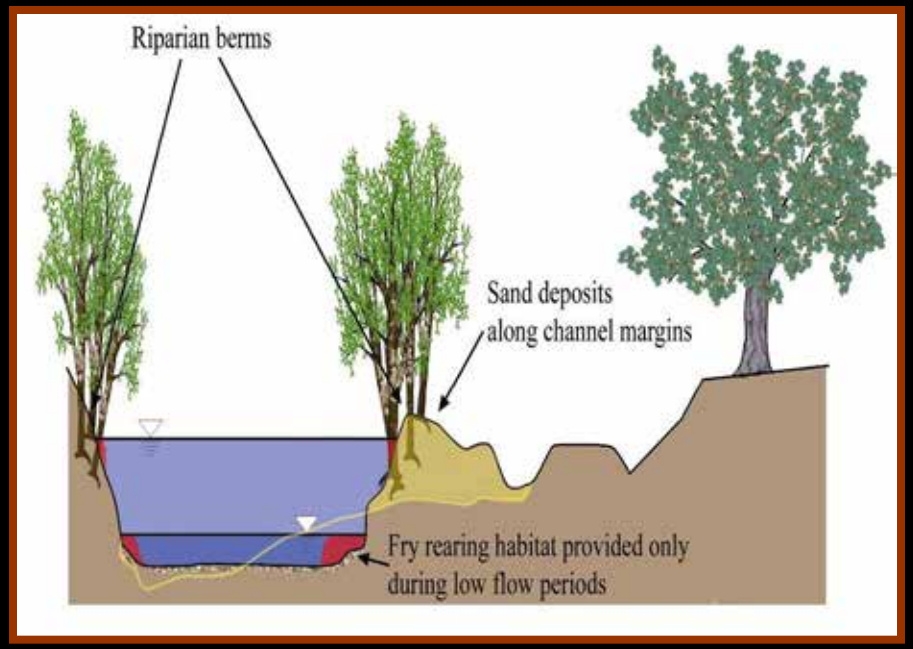
"Restore – Adapt – Improve"
Coordination – Collaboration – Commitment

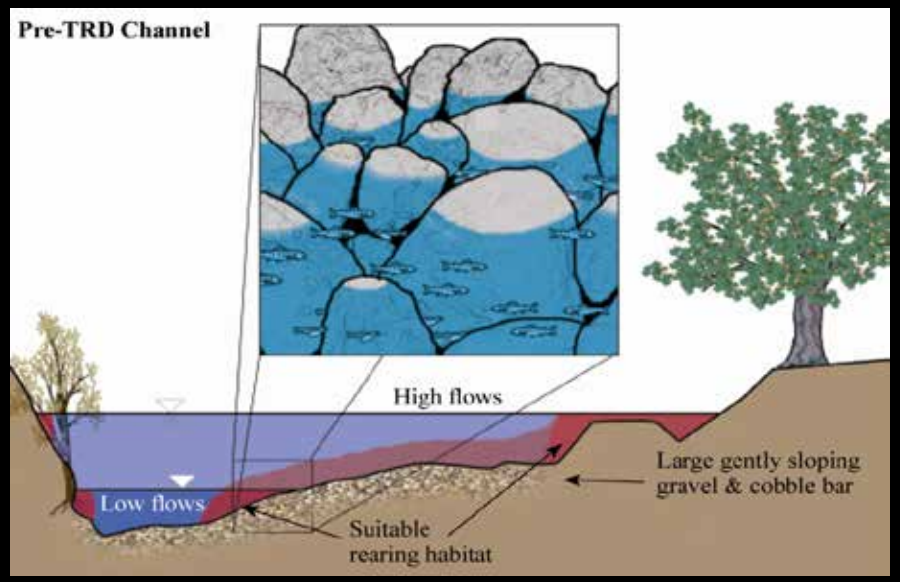
What Tools are in our Tool Box?



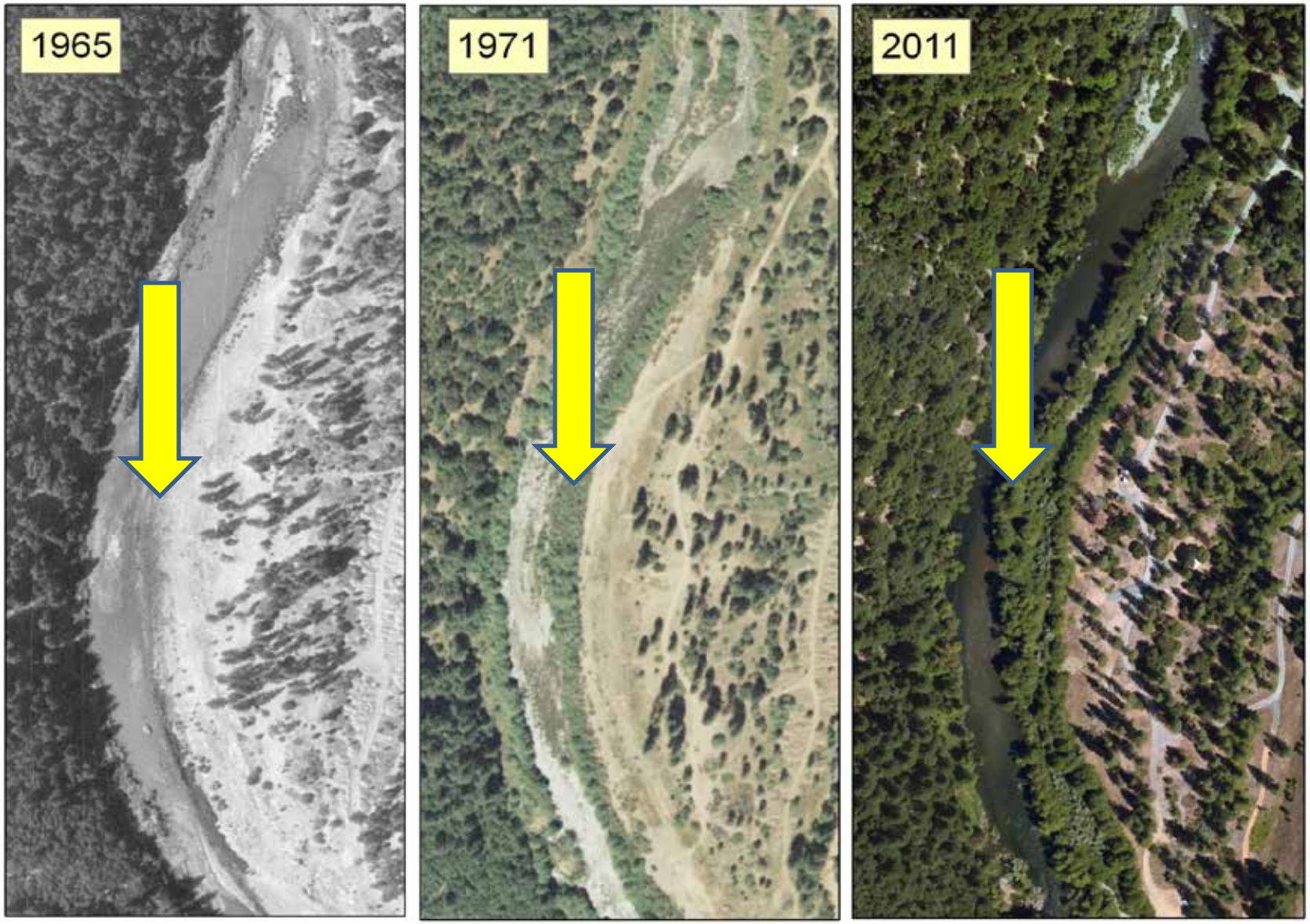
THE DECLINE OF THE TRINITY RIVER – THE "SIMPLIFIED CHANNEL"
- THE RIPARIAN BERM HYPOTHESIS -







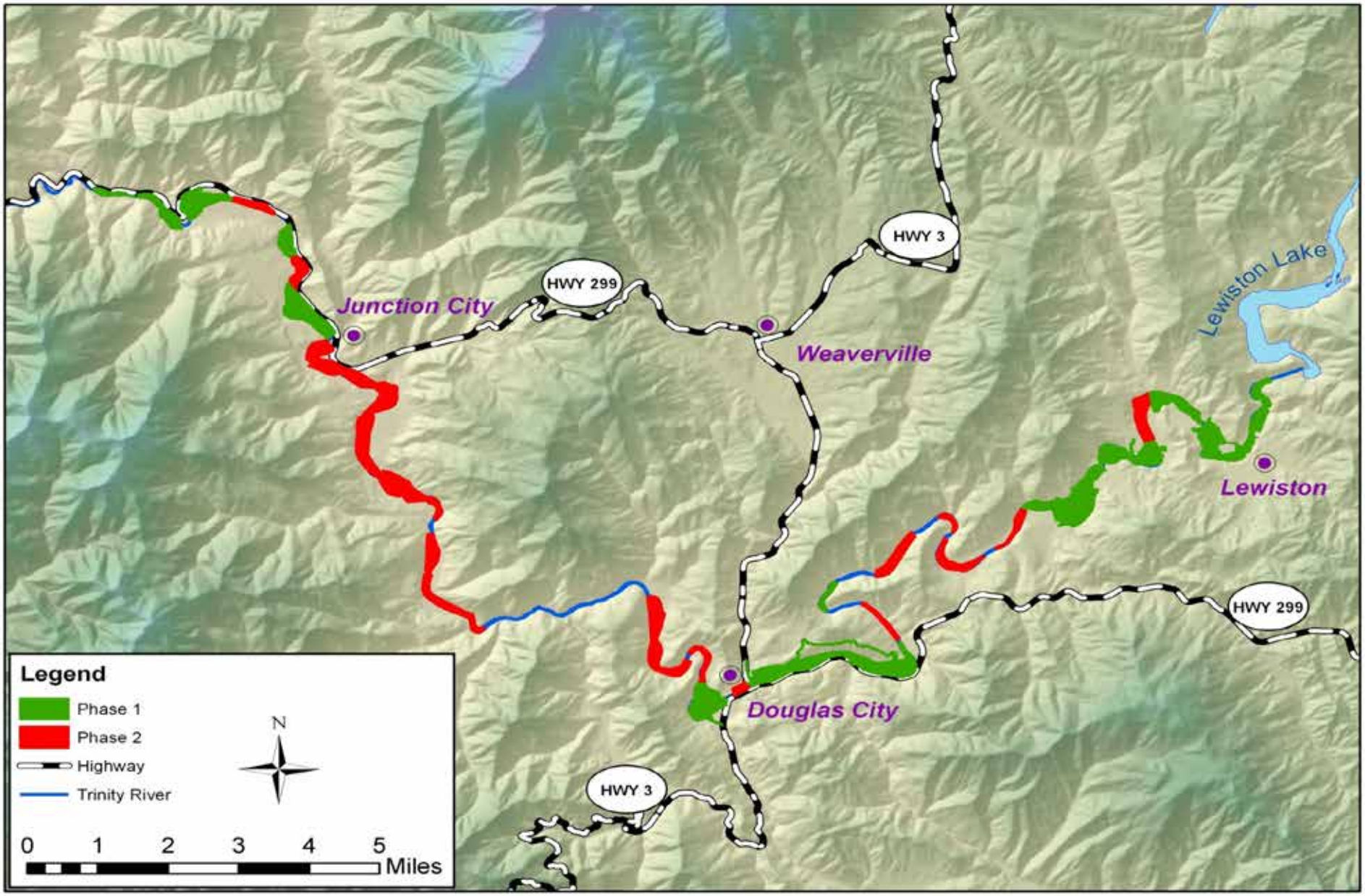
From Complex to Simple - The Encroached Channel "The Riparian Berm Example"



The Challenges of Channel Rehabilitation Implementation on the Trinity is Not Just One Dimensional

Vegetation isn't the only Thing That Has Encroached into the Floodplain - Dealing with Practicality

40 Mile Restoration Reach – Phase I and Phase II Sites



Channel Rehab Evolution – Timeline of Projects
Continued Progress – Continued Learning

Phase I Begins (2005)

Phase II Begins (2011)

2005 – Hocker Flat

2006 – Canyon Creek

2007 – Indian Creek

2008 – Lewiston/ Dark Gulch

2009 – Sawmill

2010 – Lowden, THG, Reading

2011 – Wheel Gulch

2012 – Upper JC, LSF

2013 – Lorenz Gulch/ DC

2014 – Lower JC

Terraces/Berm Removal- Large Floodplain Development (Constraints)

1st Side Channel Development

Aggressive Wood Integration

1st forced Meander/Log Jam

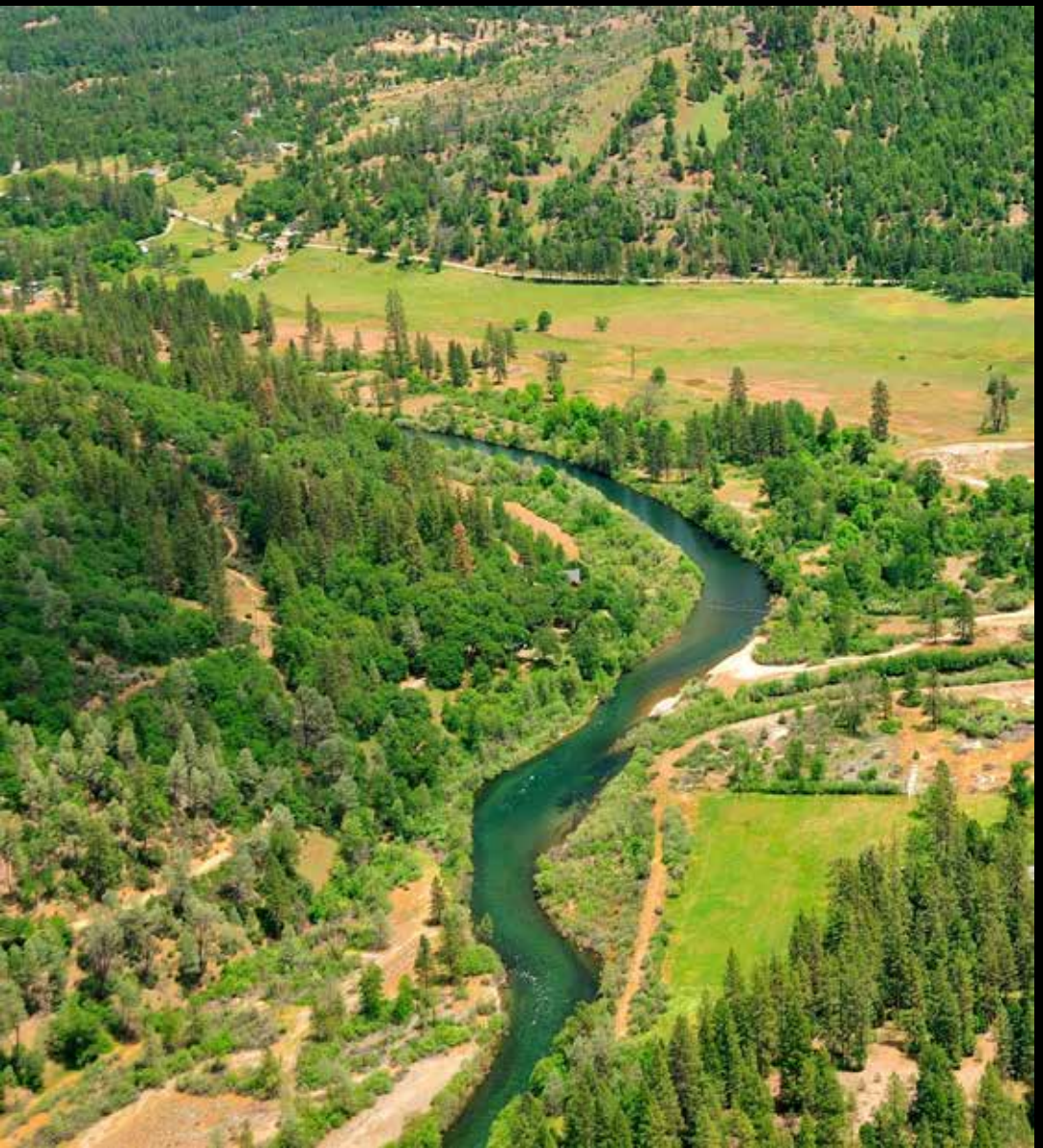
1st -Off-Channel Rearing Pond and Split Flows

1st Mid-Channel Island

Complexity and Diversity in Approach of Design Features Continues….

Fiscal Year	Rehabilitation Site Name	Number of (ROD) Sites	Earth-work (CY)	Large Wood – Approximate (Pieces)	River Miles	Acres Treated
2005	Hocker Flat	1	83,000	0	1.0	26
2006	Canyon Creek Sites	4	91,000	100	1.7	40
2007	Indian Creek Sites	3	77,800	200	2.8	31
2008	Lewiston and Dark Gulch Sites	8	56,900	200	3.7	42
2009	Sawmill and Steel Bridge Day Use	2	87,750	260	0.8	25
2010	Lowden Ranch, Trinity House Gulch, and Reading Creek	5	202,600	300	2.4	36
2011	Wheel Gulch	1	48,000	200	0.3	7
2012	Upper Junction City Lower Steiner Flat	4	63,900	400	1.2	45
2013	Lorenz Gulch and Lower Douglas City	2	56,400	600	1.4	52
2014	Lower Junction City	1	34,580	250	0.5	52
Total		**31**	**801,930**	**2,435**	**15.8**	**356**

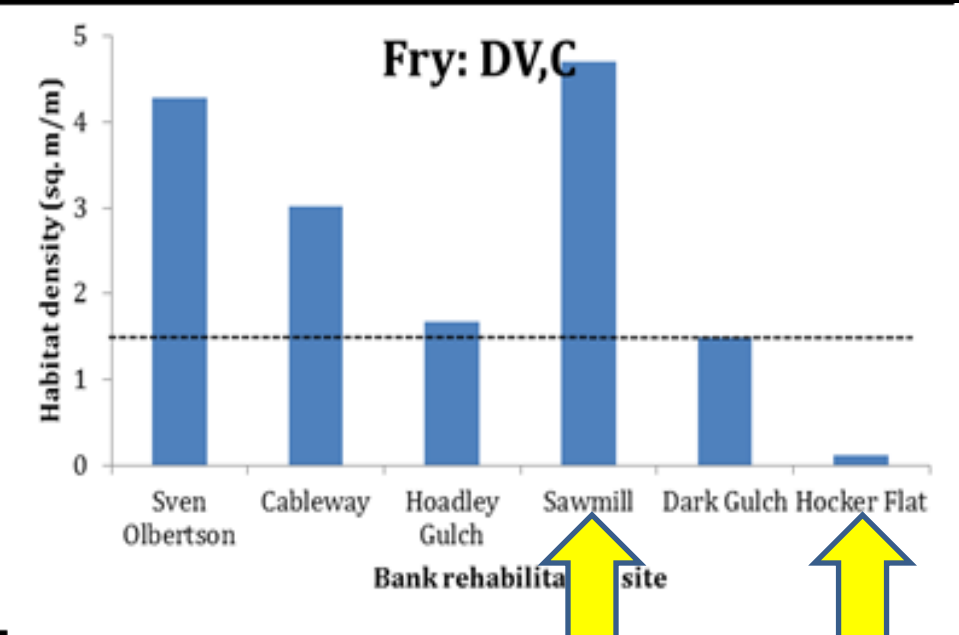
"Process Based Restoration - Promoting System-Wide Change"
A Strategic Combination of Flow – Gravel – Channel Reahb

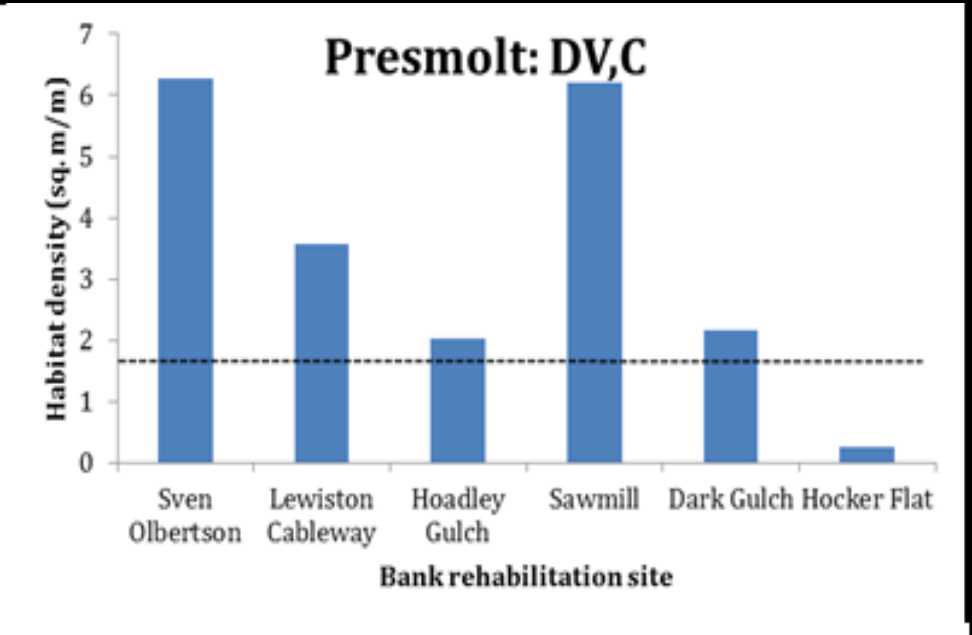


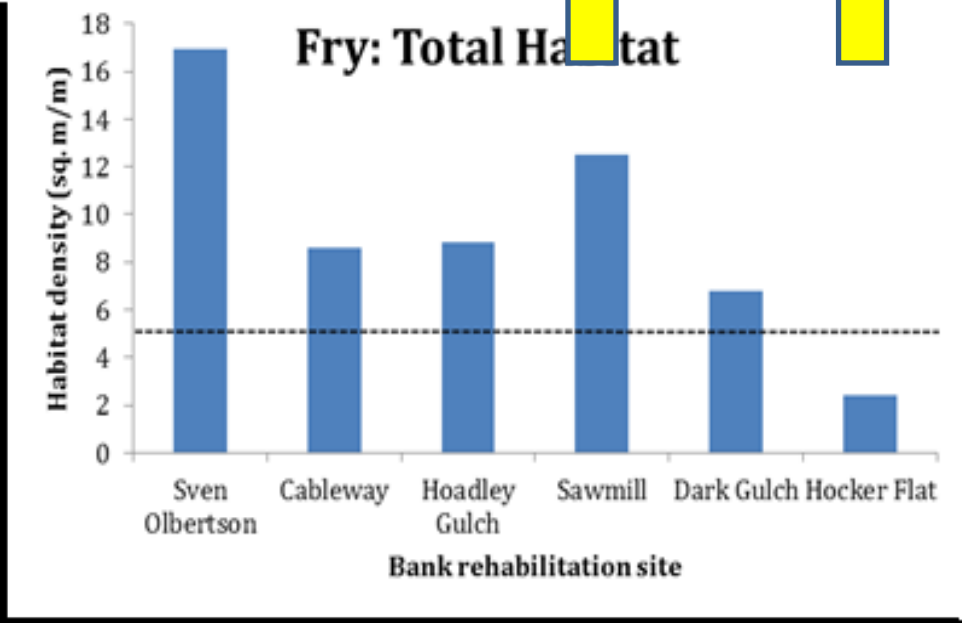
"Design Evolution" – Hocker Flat Rehab Site 2005

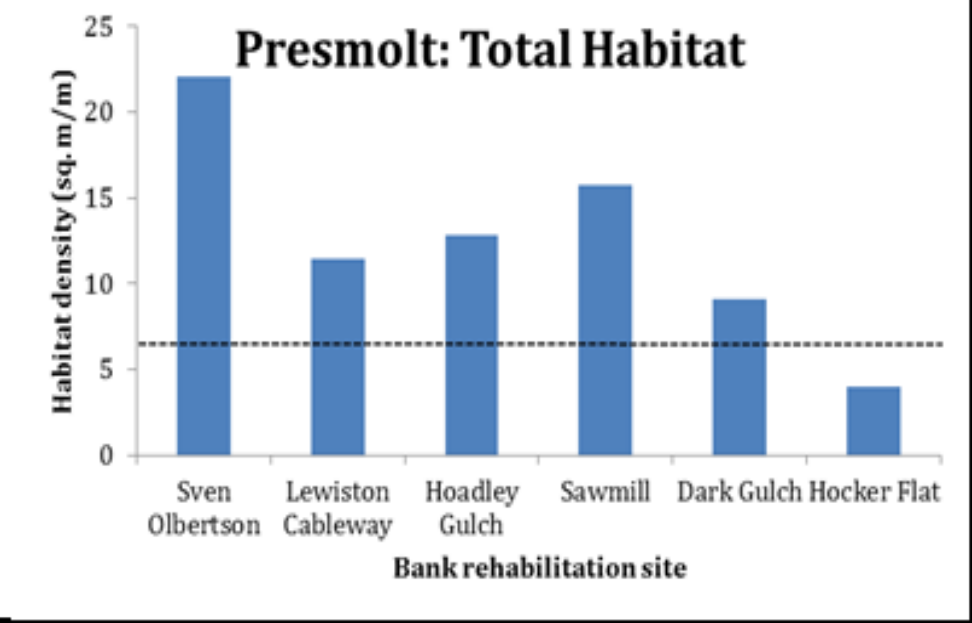
"Design Evolution" – Sawmill Rehab Site 2009

Monitoring and Assessment - What Does the Data Say? How Does the Project Sites Compare?



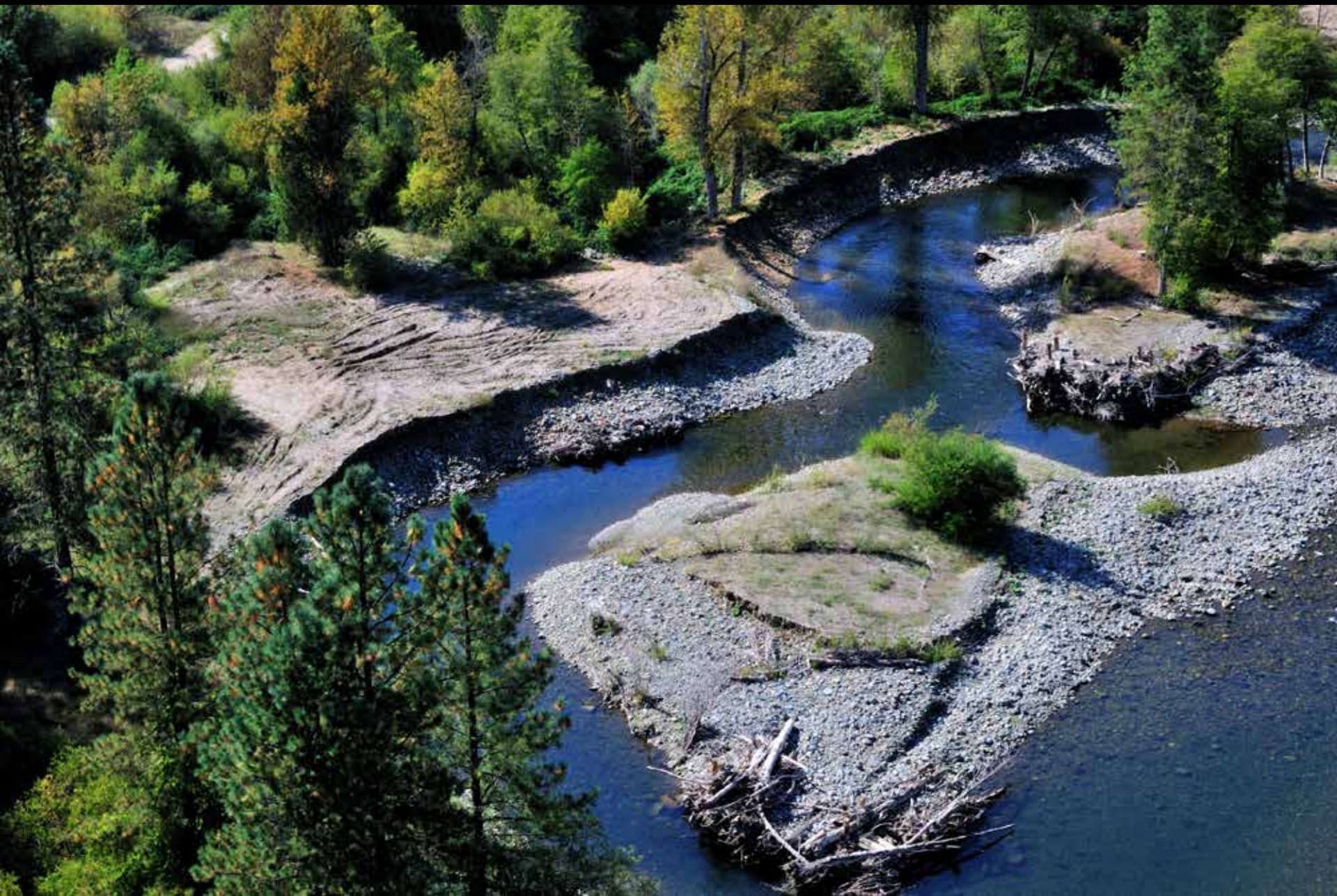






"Applying the Data to Design" – Lowden Ranch Rehab Site 2010
Building Complexity and Channel Dynamism

"Physical and Biological Diversity – Flows/Gravel/Rehb"
Lowden Ranch Rehab Site 2010



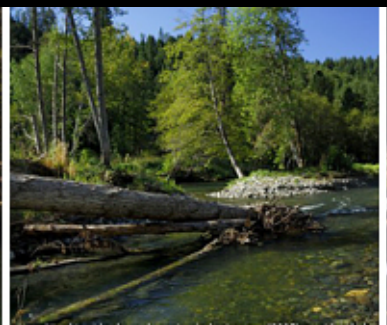
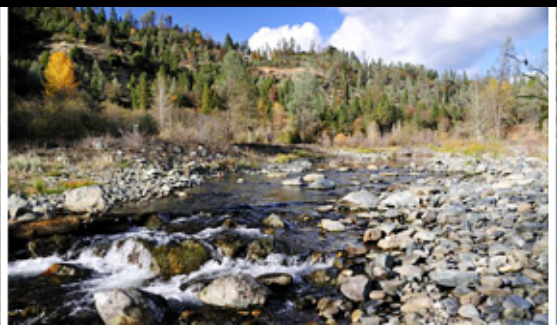
"Build it and They Will Come - Full Life History Utilization"
Wheel Gulch 2011

"Integration of Science Monitoring and Predictive Modeling"
Upper Junction City - 2012

Tell me and I'll forget. Show me, and I may not remember. Involve me, and I'll understand.

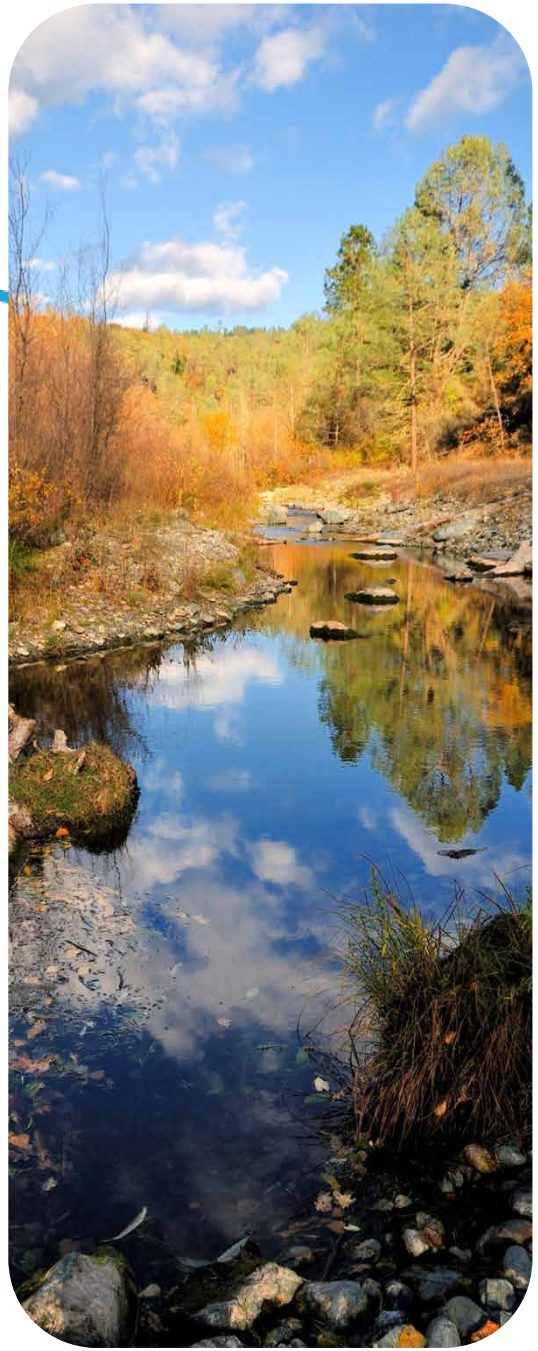
- Native American Saying -

DJ Bandrowski P.E.
Implementation Branch Chief
530-623-1811 / www.trrp.net

Lessons Learned

1. Complexity and Diversity of Design Features are Important
2. Engaging and Involving Stakeholders Early in the Process is Key
3. Large Wood Introductions are Important for Physical Process and Habitat Creation/Cover
4. Balancing Streampower with Floodplain Shallow Water Habitats

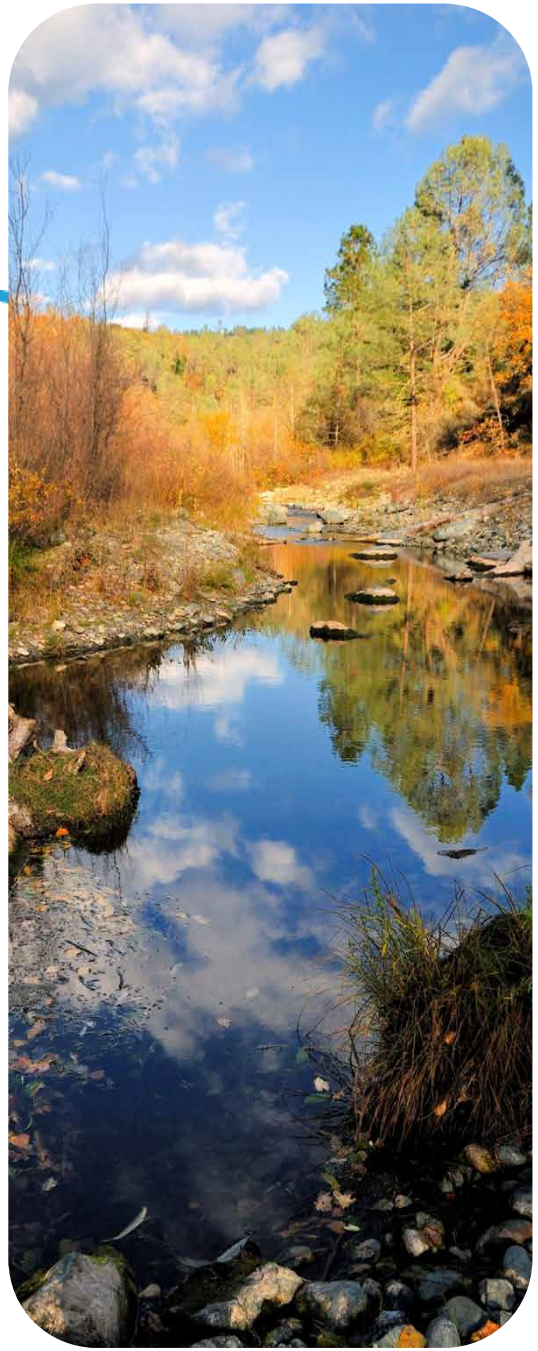


Trinity River Restoration Program

Restore • Adapt • Improve

Channel Rehabilitation Workshop

How the habitat assessment has helped change the way we design projects



Aaron Martin

Yurok Tribal Fisheries Program

Willow Ck, CA

Two Objectives:

- Explain why cover and wood is such an important component to the rehabilitation strategy
- Explain how the habitat assessment has helped inform and change rehabilitation designs on the Trinity

Rearing habitat limited

Map based approach

What is rearing habitat?

- Velocity, Cover, Depth – Key elements that define fry and juvenile rearing habitat
- Velocity- Small fish (1.5-3” long) can not swim very fast
- Cover- Small wood/sticks provide escape cover for fish from predators, but it also creates a velocity break!

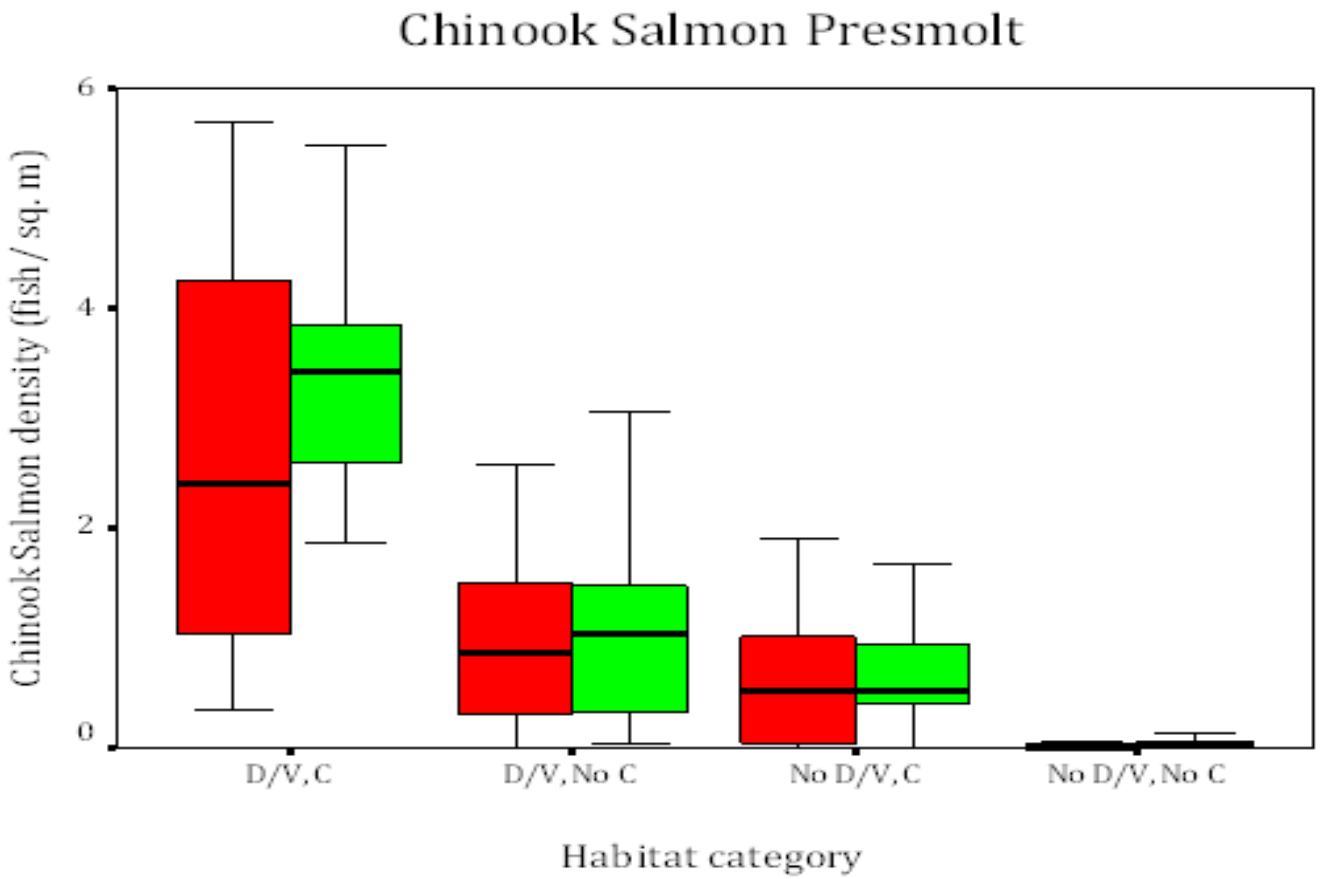
Habitat Categories

We define 3 kinds of habitat:

Optimal-Slow/shallow and in-cover

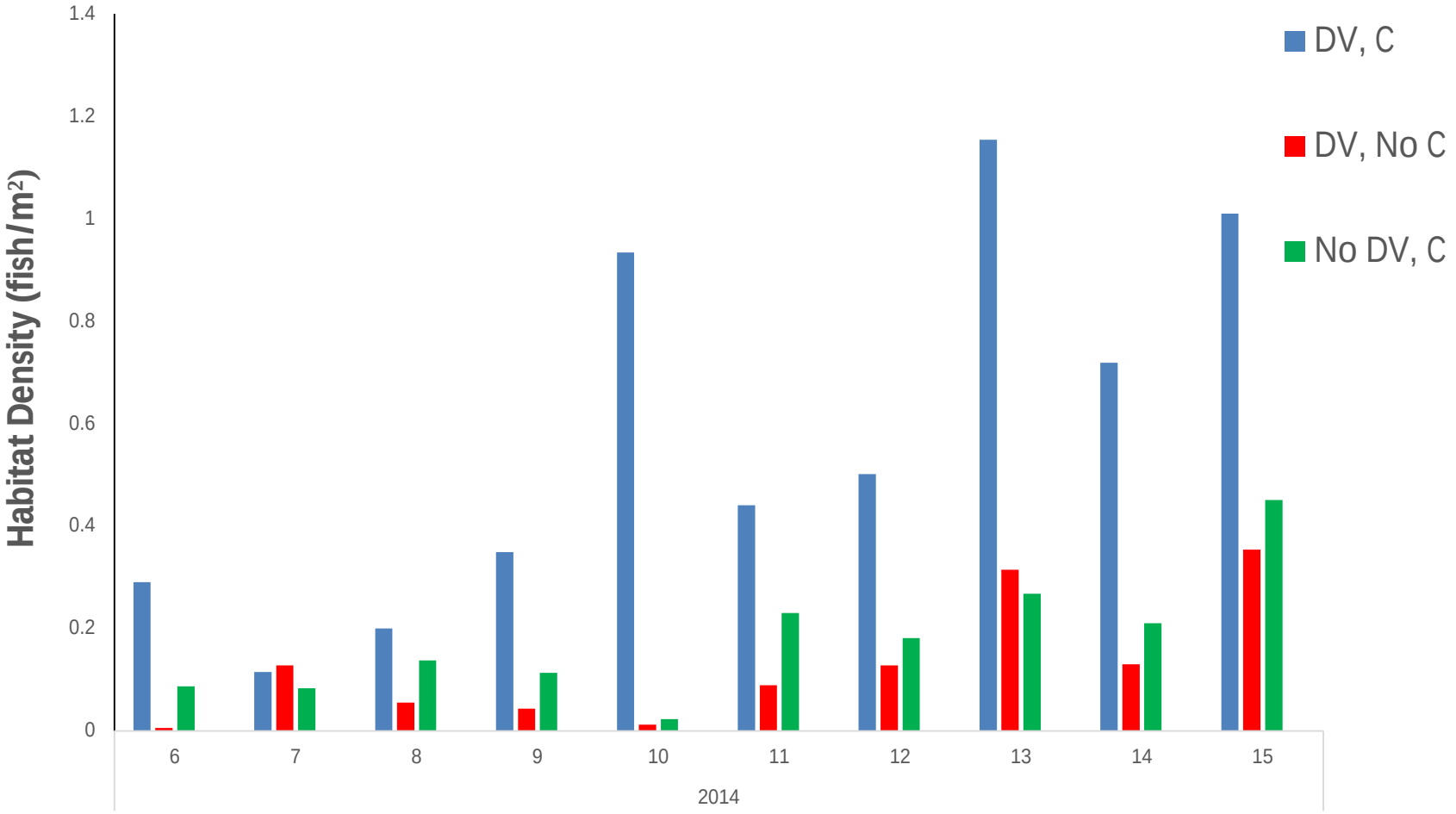
Suitable-Slow/shallow or in cover

Unsuitable-Too fast or deep and not in cover

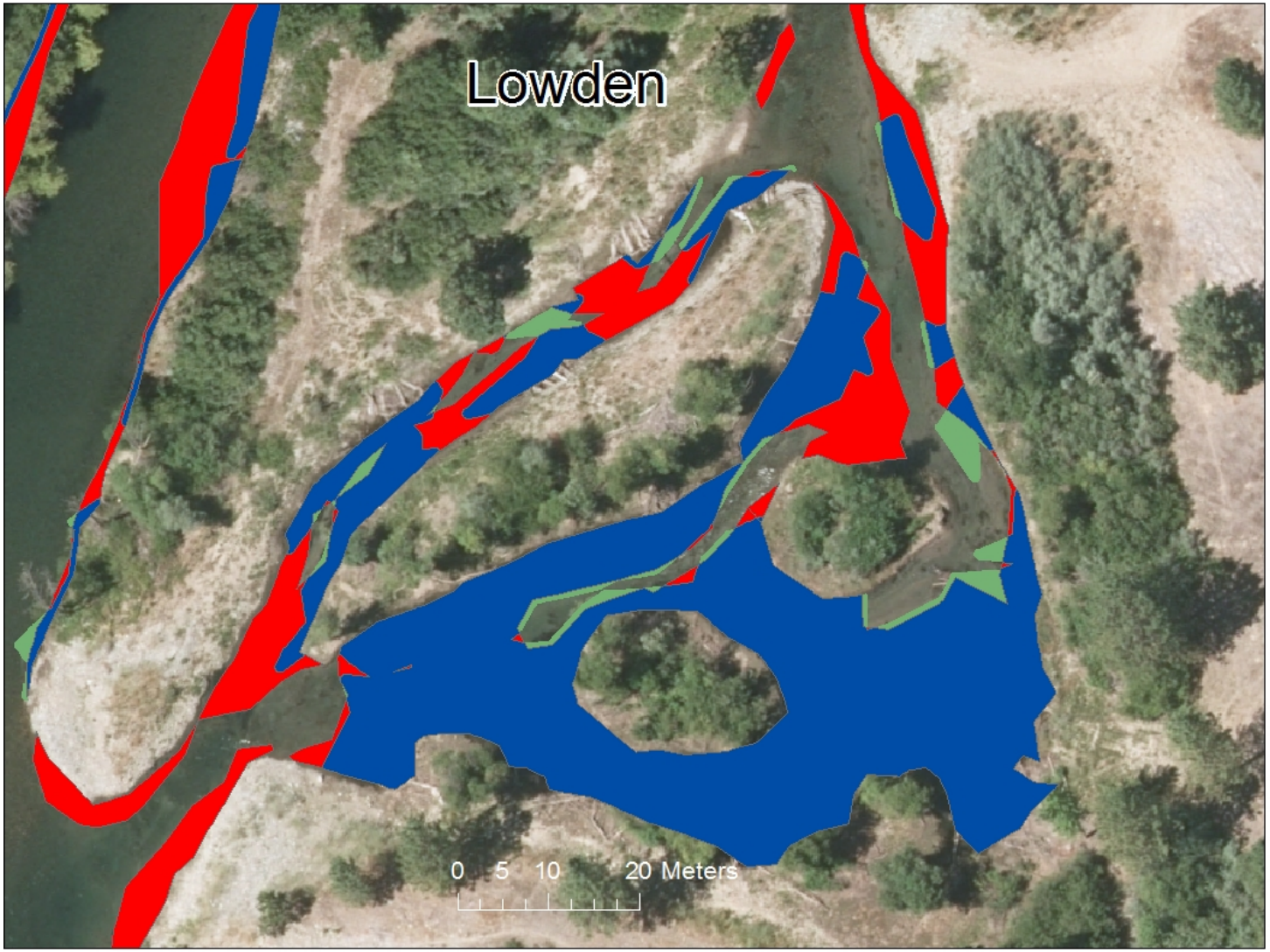


Snorkeling via two different methods prove that our definitions of habitat quality and mapping criteria are correct.

Independent Validation



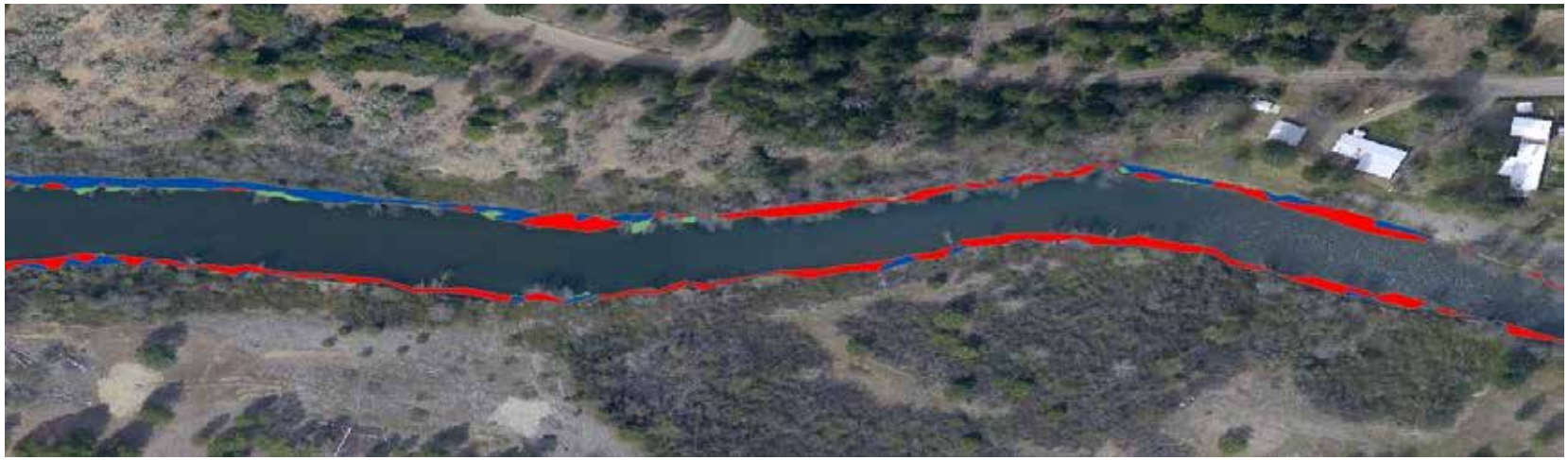
Wood is good!



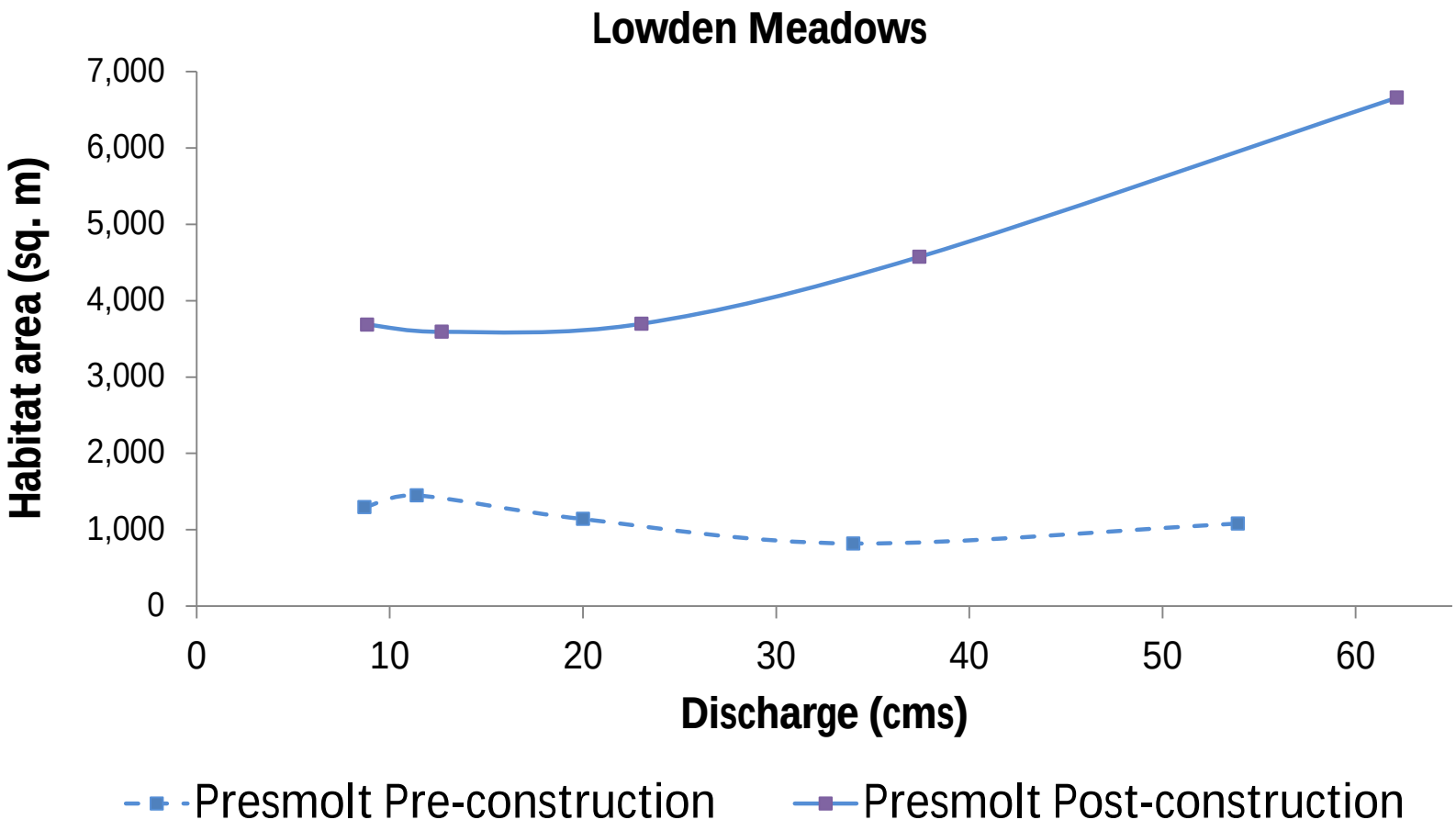
Pre/post-construction and revisit assessments

- Conducted 15 pre/post construction assessments since 2007, 7 of which are multi-flow.
- Revisited Hocker, Indian Ck, Vitzhum Gulch, Upper Dark Gulck, Cableway, Sawmill, Sven Olberston and more.
- Can compare the entire suite of treatment types. ie-feathered edges, side channels, forced meanders, split channels, alluvial bars.

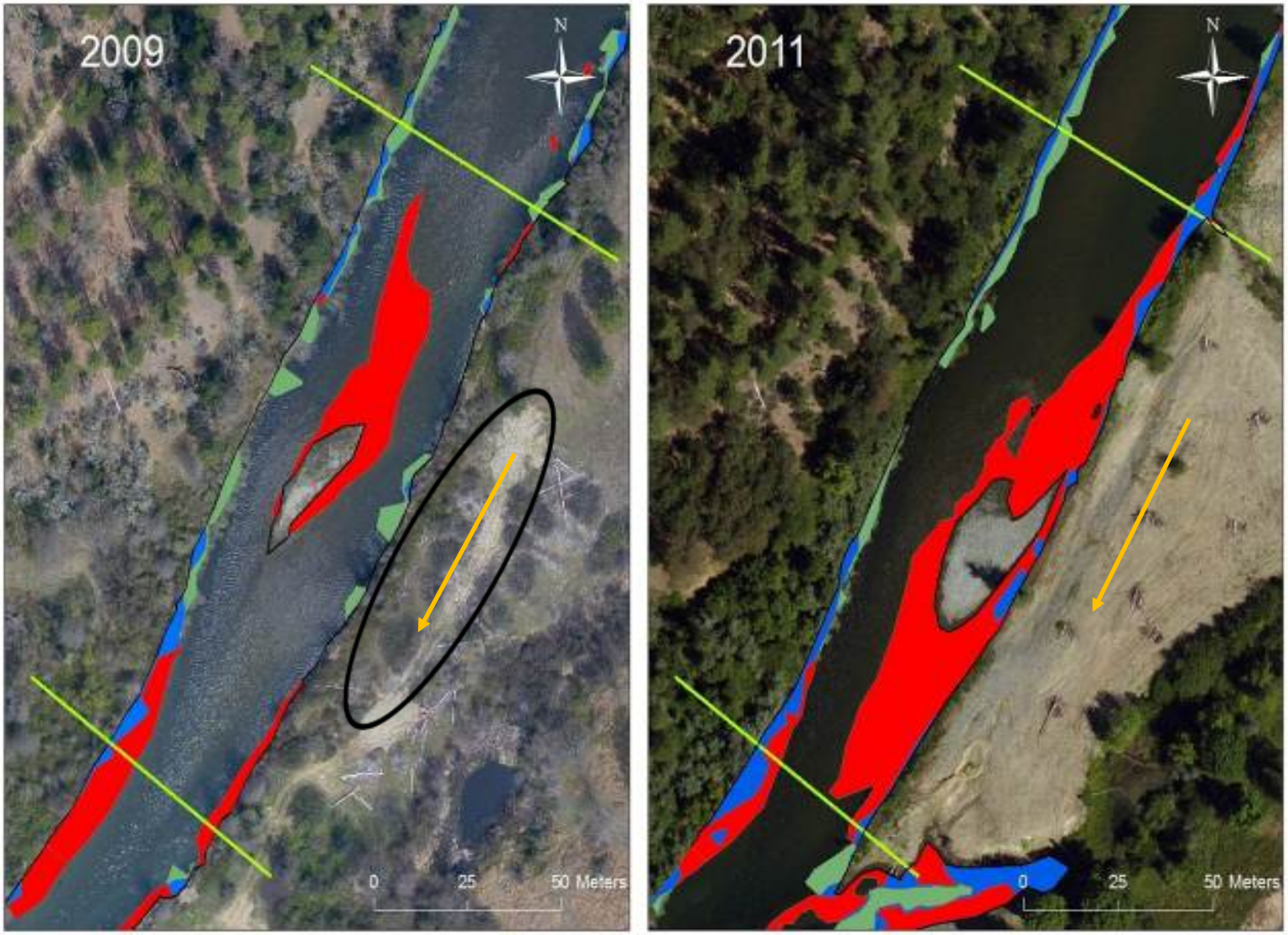
Example: Lowden Meadows



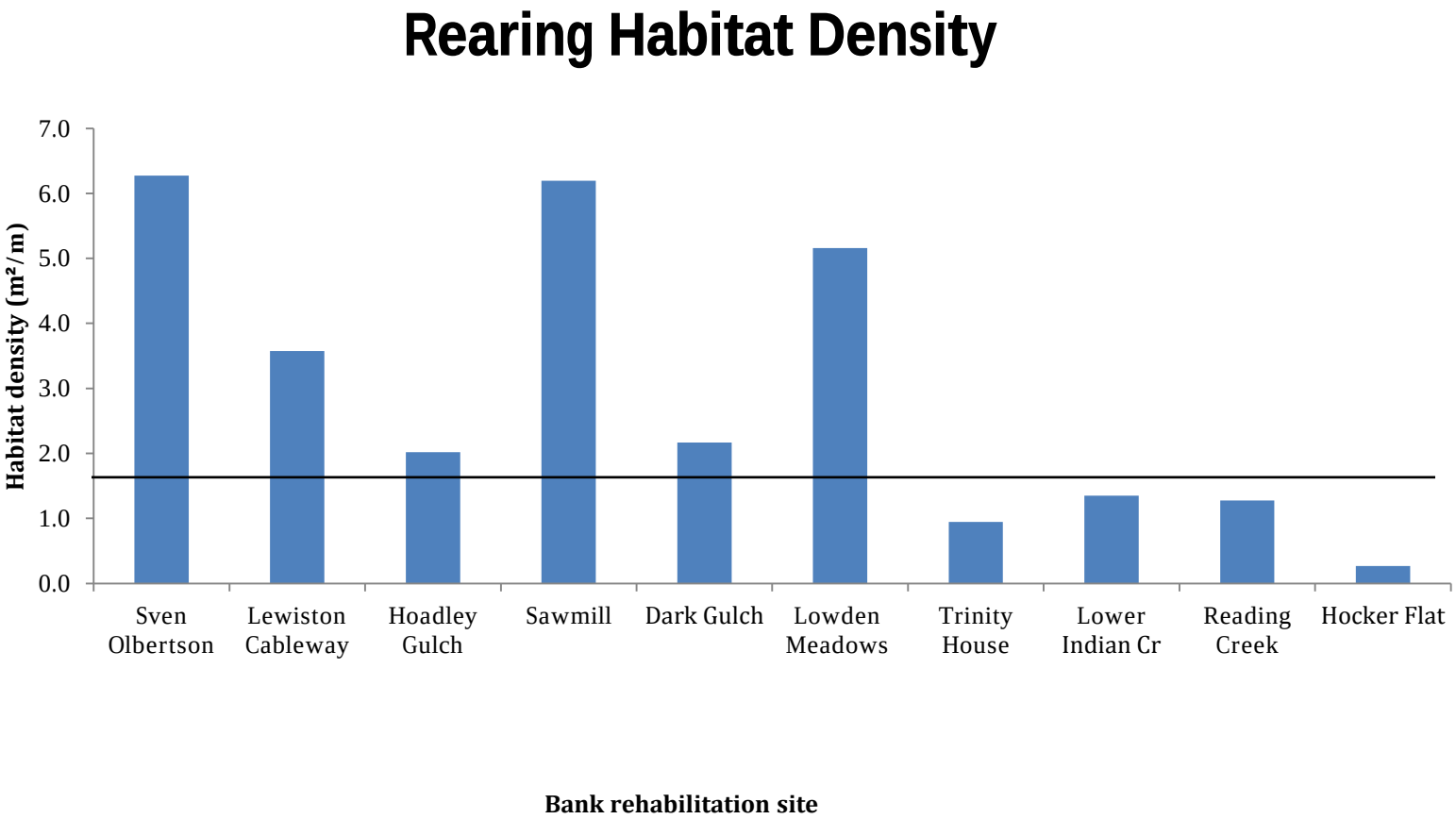
Pre/post construction- multi flows

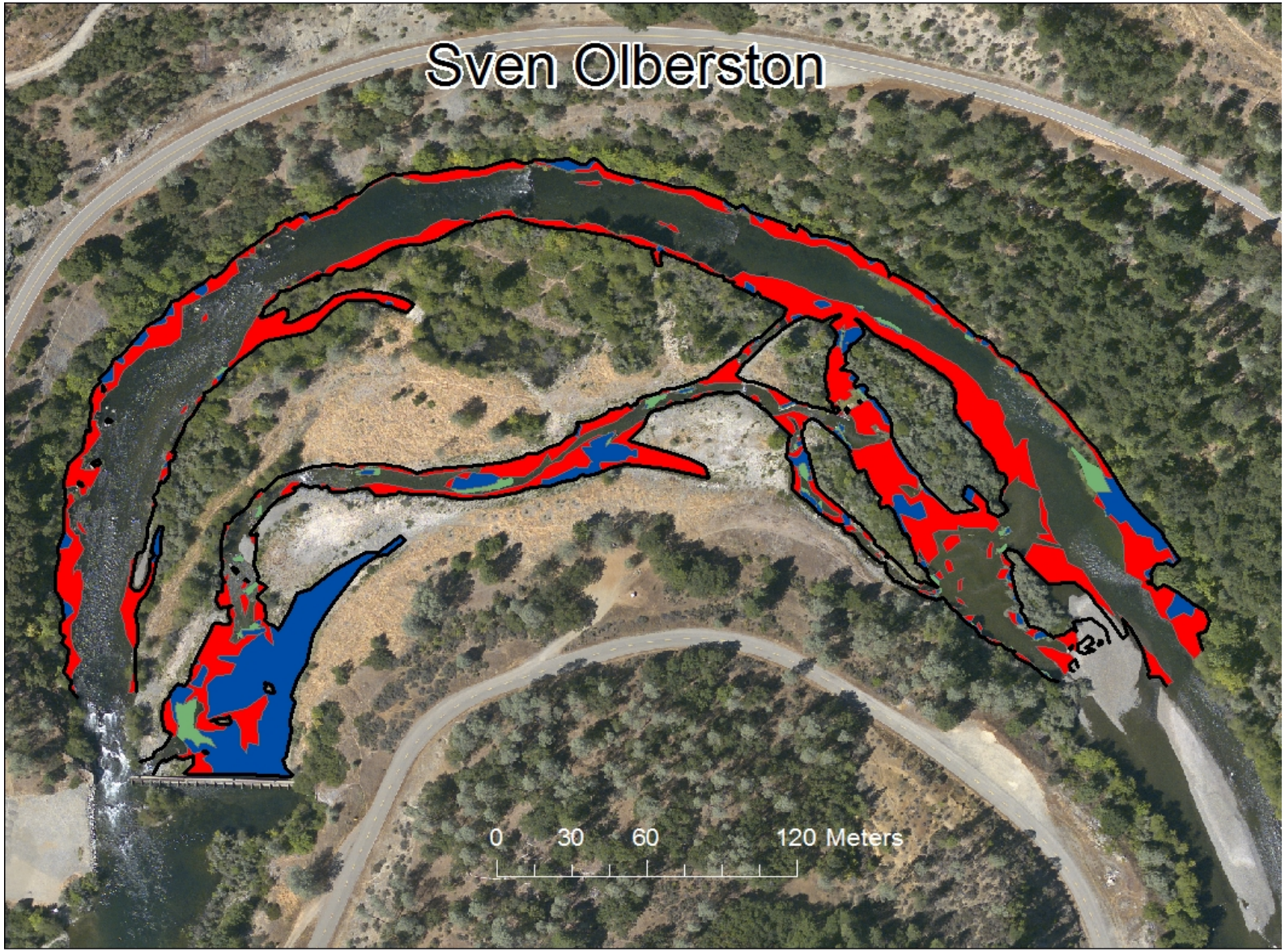


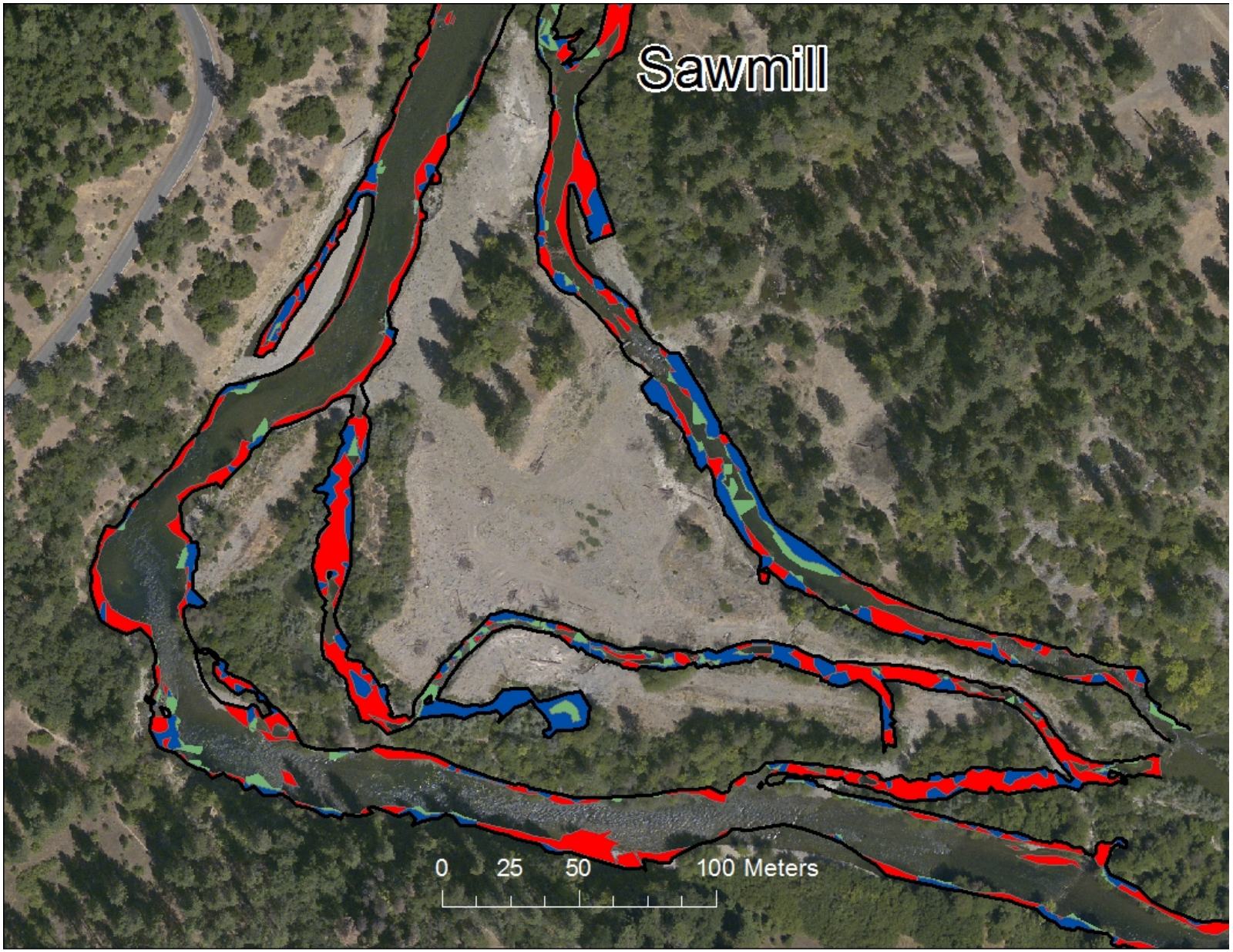
Treatment specific



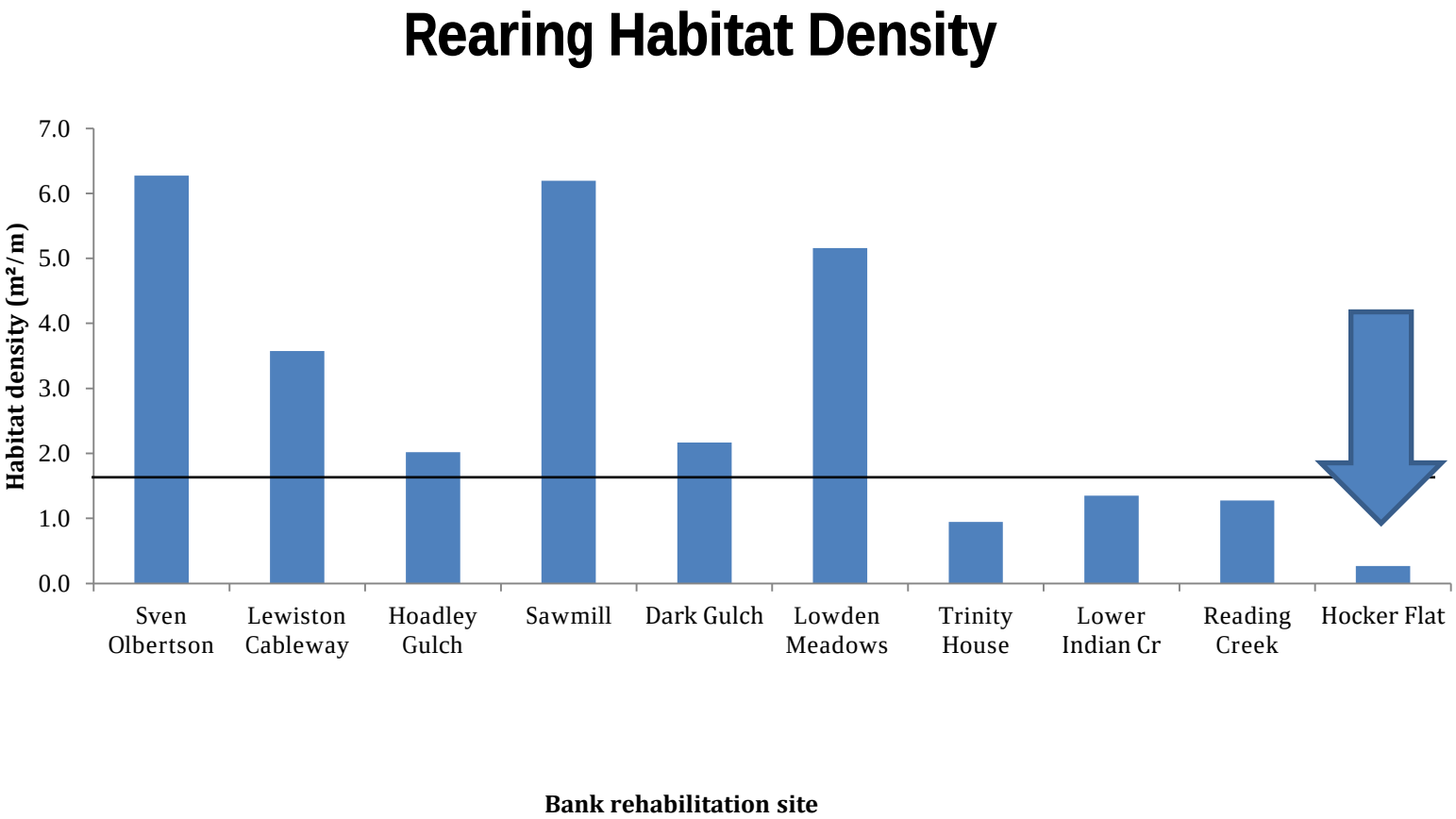
Cross Site Comparisons




Sven Olberston
0
30
60
120 Meters


Sawmill
0 25 50 100 Meters

Cross Site Comparisons



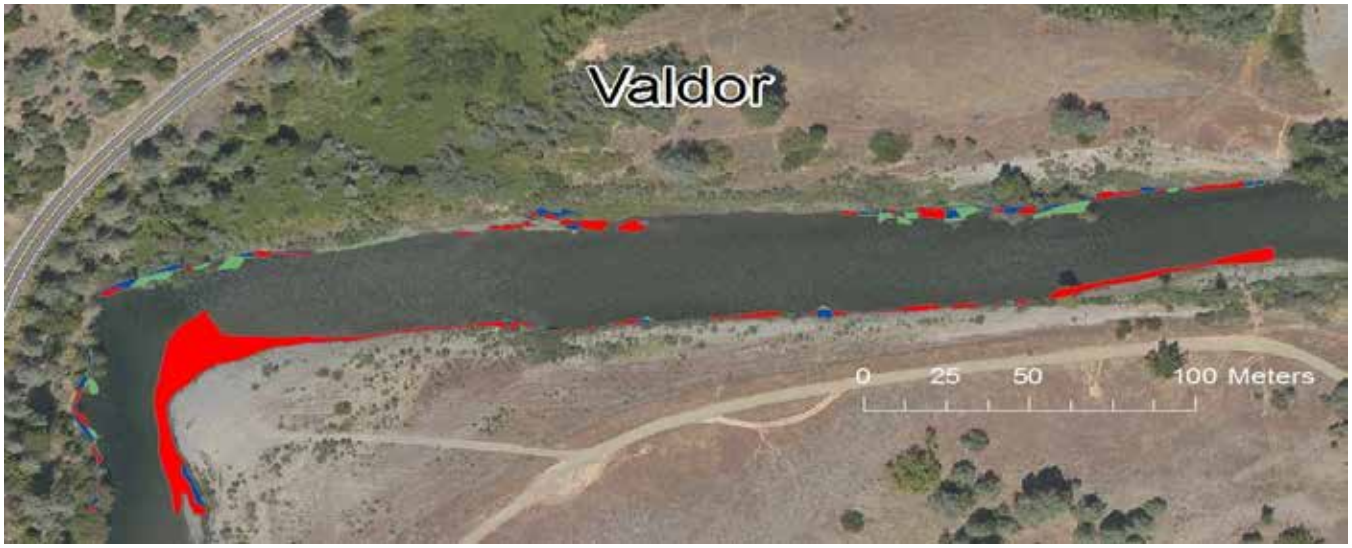
Hocker Flat-2013 (8 years after construction)

- 8 years after construction, habitat density at Hocker Flat is still less than half the reach average

What’s the difference?

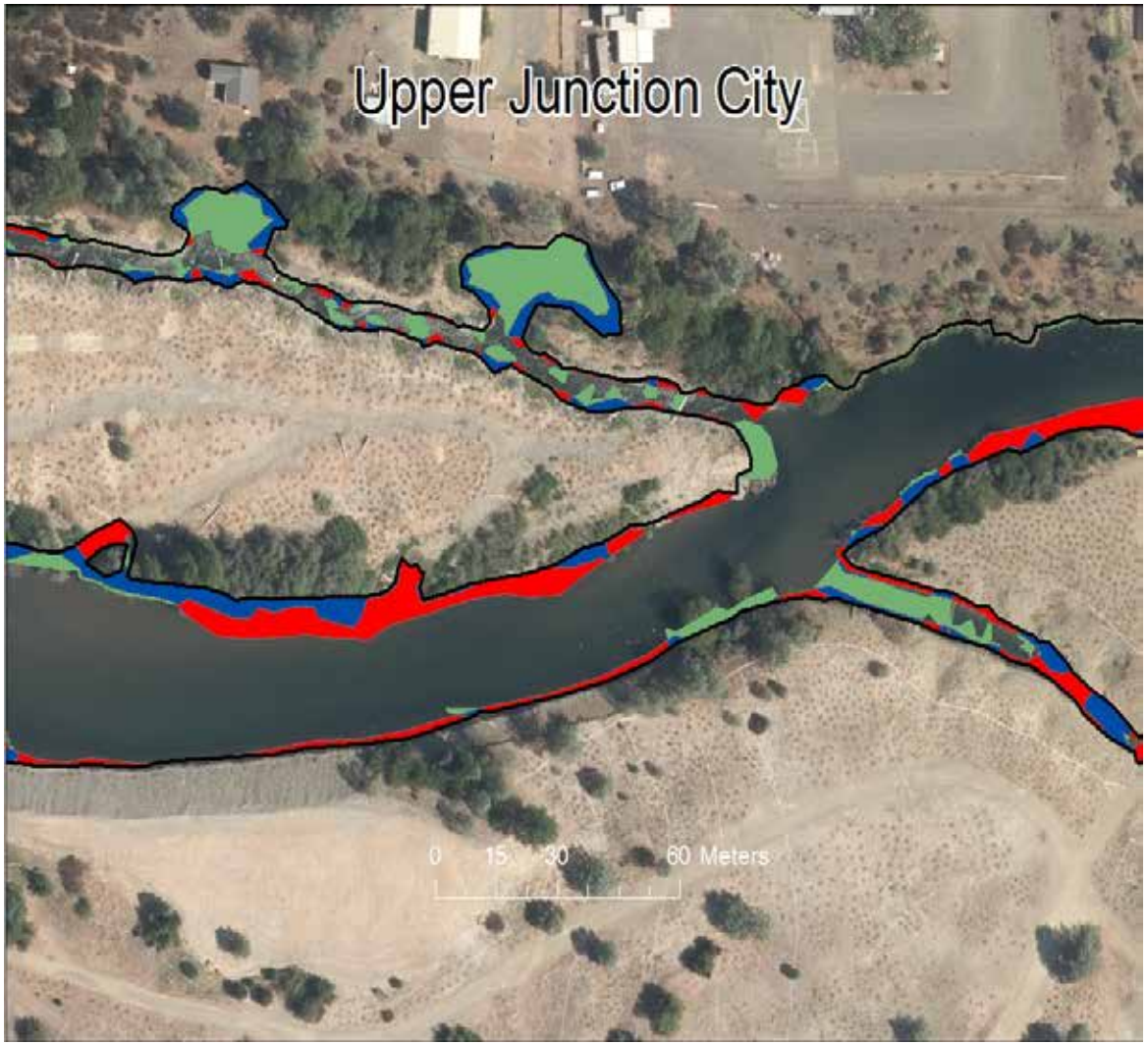
- Edge habitat
  - Rearing habitat is directly related to the length of wetted edge
  - More edge length in a section of river = more habitat
- Cover Additions
  - Early sites removed all vegetation/wood and did not add any back in
  - Since 2007, we’ve been adding more and more wood to the rehabilitation sites

More edge = More habitat

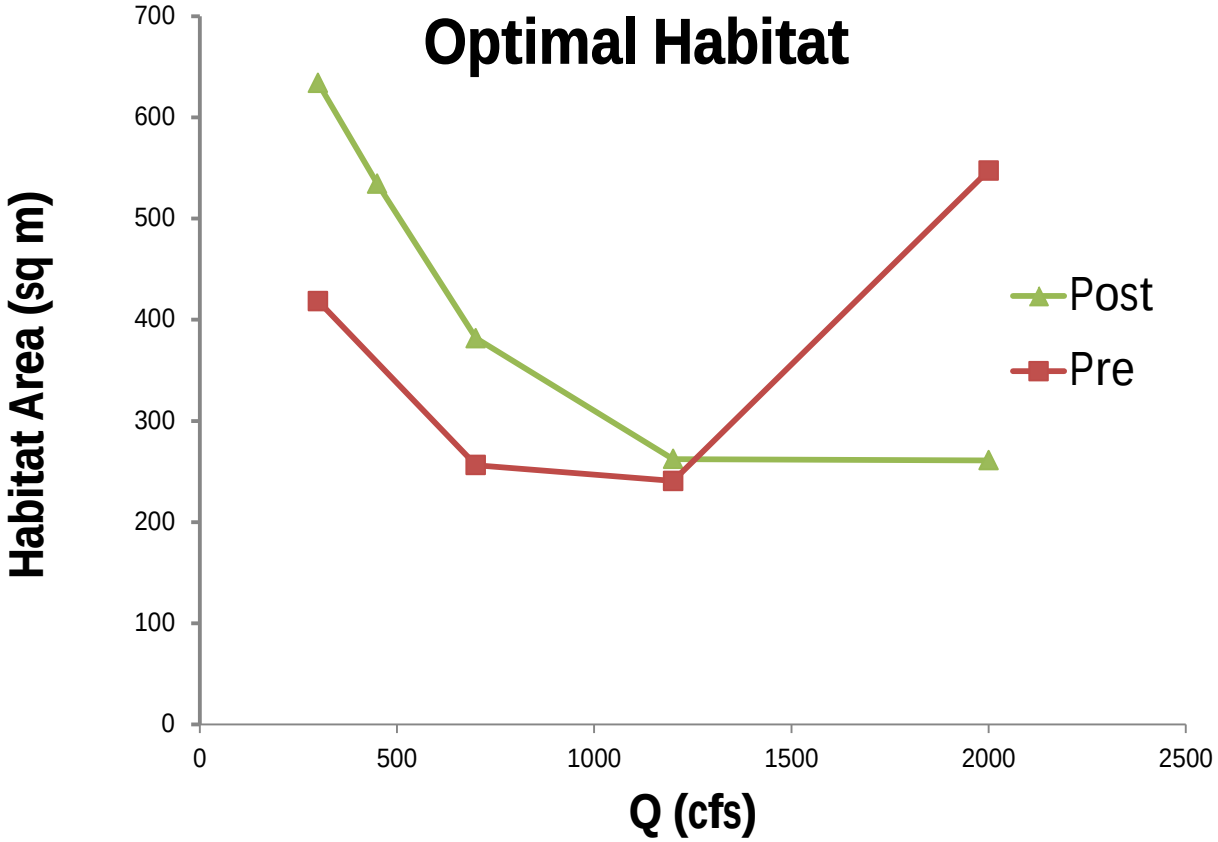


Side channels – Refuge from predators?

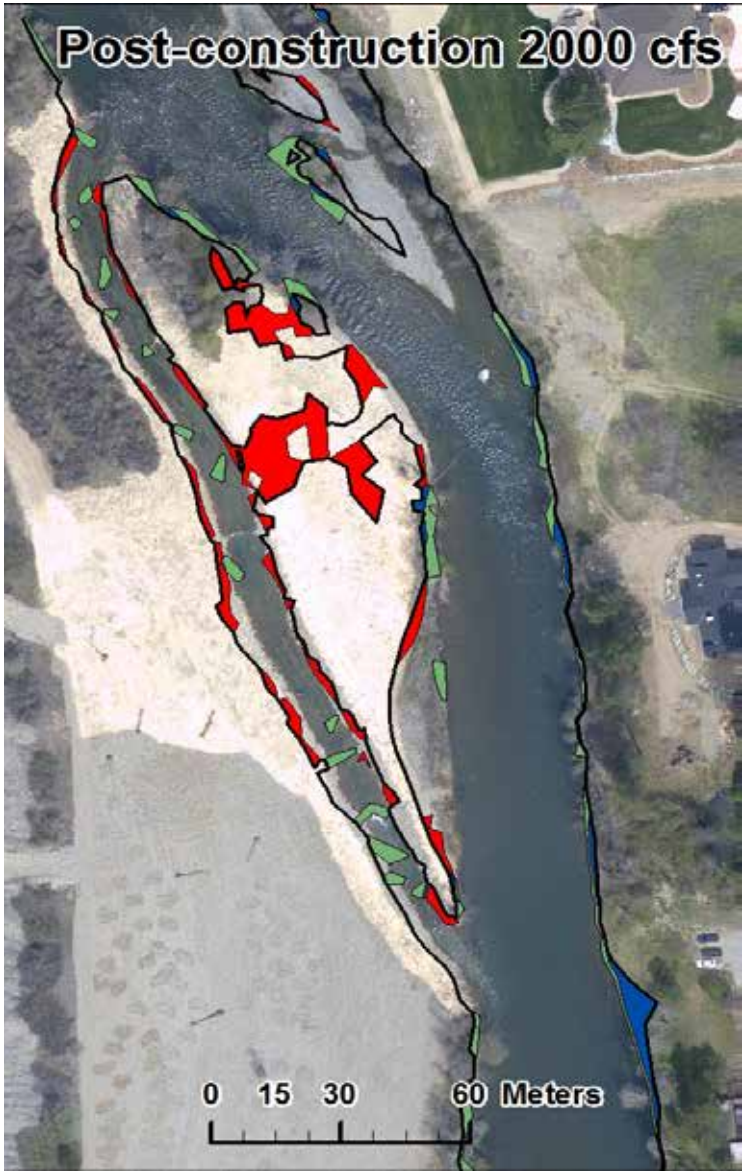
- The smaller the fish, the more vulnerable they are.
- Mainstem vs side channel
- Little fish in a big pond



Upper Dark Gulch

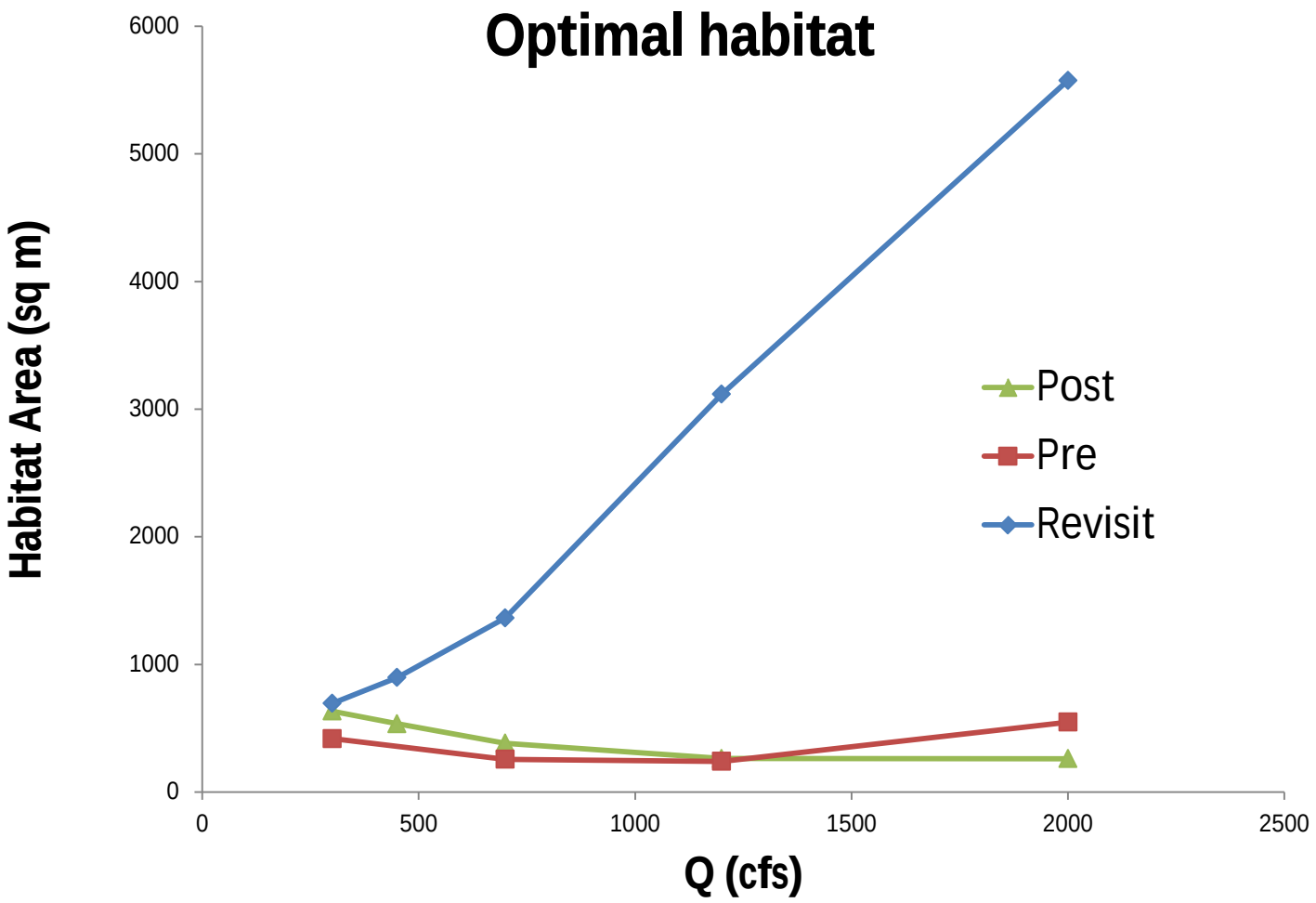


Pre-construction 2000 cfs
0 15 30 60 Meters


Post-construction 2000 cfs
0 15 30 60 Meters

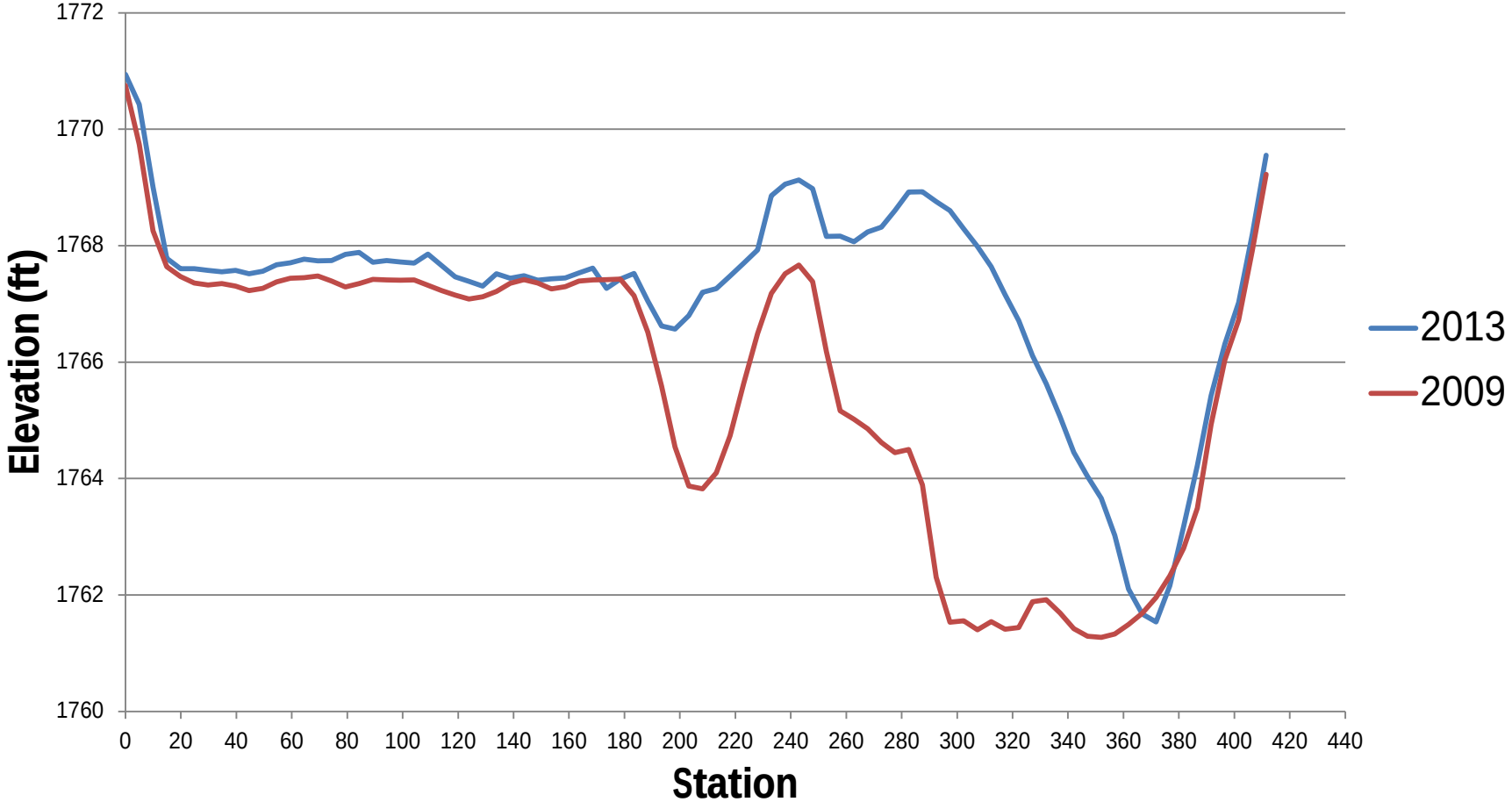
2011 High Flow

Revisit (post high flow)

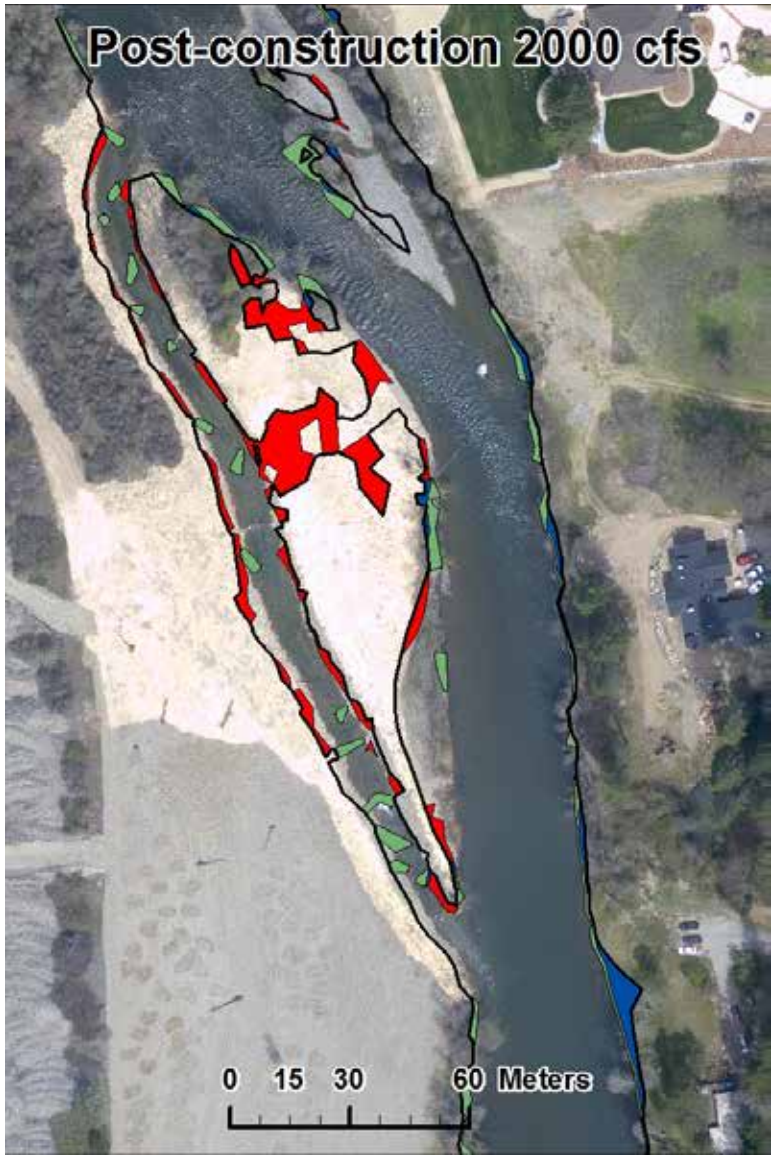


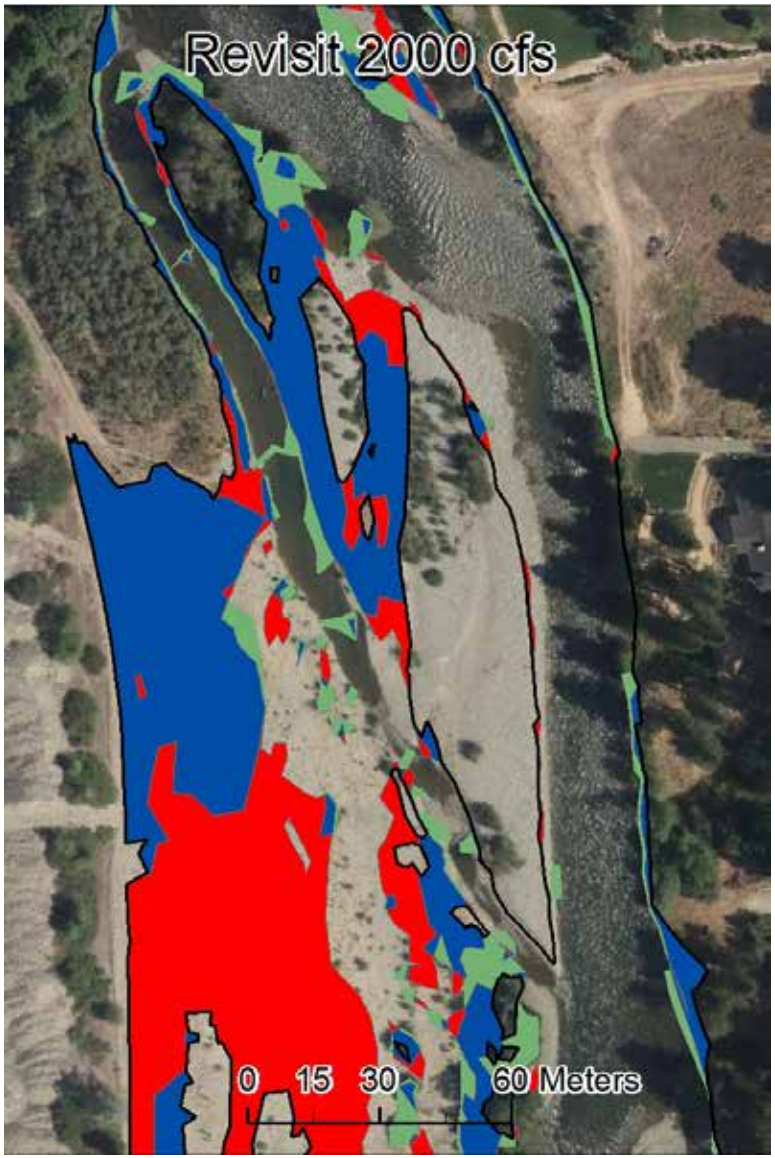
What Happened?!?

Cross section profile



Process!!


Post-construction 2000 cfs
0 15 30 60 Meters


Revisit 2000 cfs
0 15 30 60 Meters

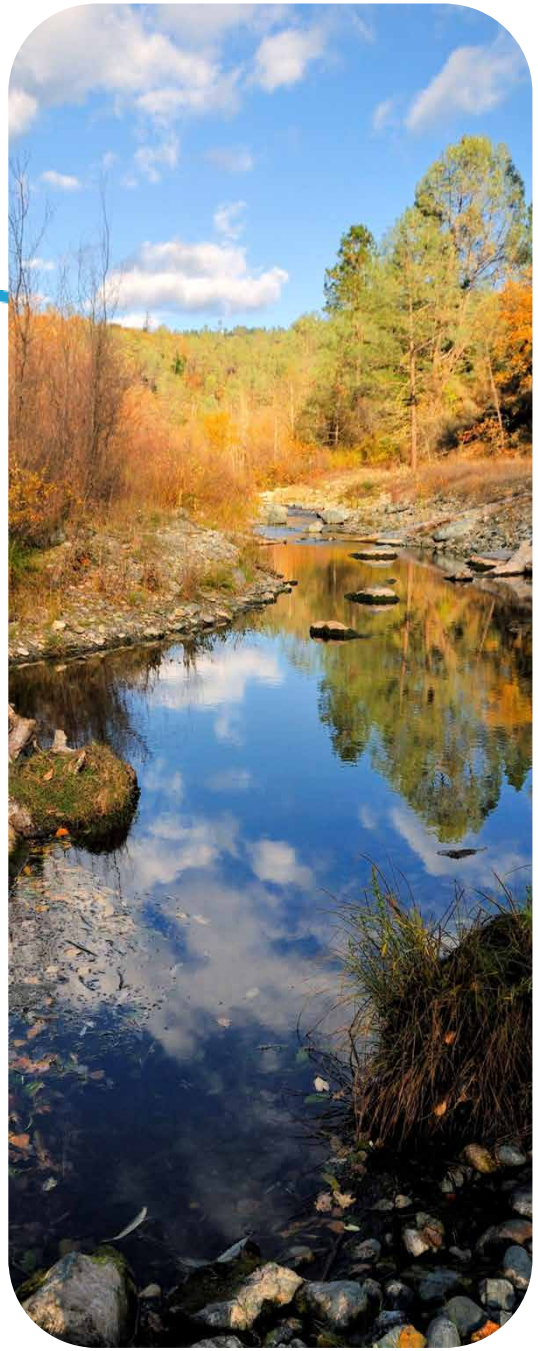
Riparian Development

Wrapping up

- 7 years of habitat data
- Present the data each year to the design team
- Improving turnaround time of the information

Lessons Learned

1. More edge = more habitat
2. Side channels/Split channels provide large habitat gains
3. Wood is good



Acknowledgements

- Trinity Habitat Team
  - Damon Goodman, Dan Menton, Matt Smith-Caggiano , Mike Sundman, Nick Van Vleet & Arcata Fisheries Staff (USFWS)
  - Kyle DeJuilio, Hank, Jeremy & Larry Alameda, Axel Erickson, Timothy Ulrich (YTFP)
  - Justin Alvarez, Rocky Jones ,Thomas Masten, Seth Brenten, Keith Hostler (HVTFP)
- Andreas Krause
- David “DJ” Bandrowski & TRRP Staff
- My family!

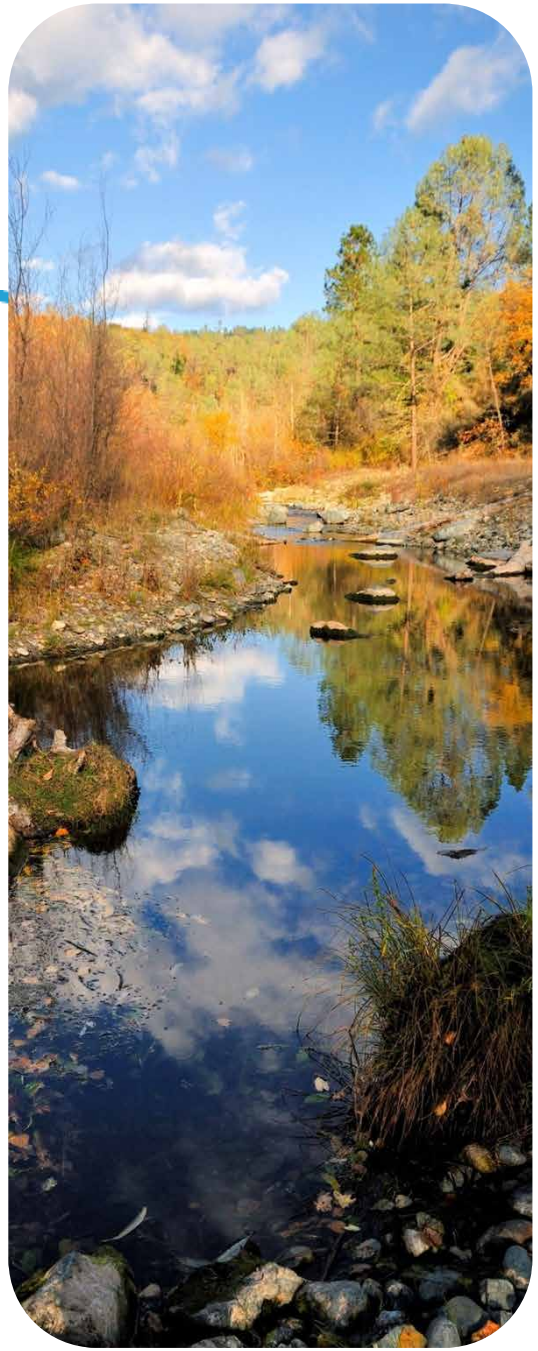
Trinity River Restoration Program

Restore • Adapt • Improve

Questions?

Channel Rehabilitation Workshop

Is a single mainstem channel sufficient for habitat?



Charles Chamberlain
U.S. Fish and Wildlife Service

Is a single mainstem channel sufficient for habitat?

1. Context for the question
2. Review recent analysis
   a) Beechie et al 2014
   b) Phase I review
3. Flow to habitat relationships
4. Lessons learned

Is a single mainstem channel sufficient for habitat?

Sufficient for what?

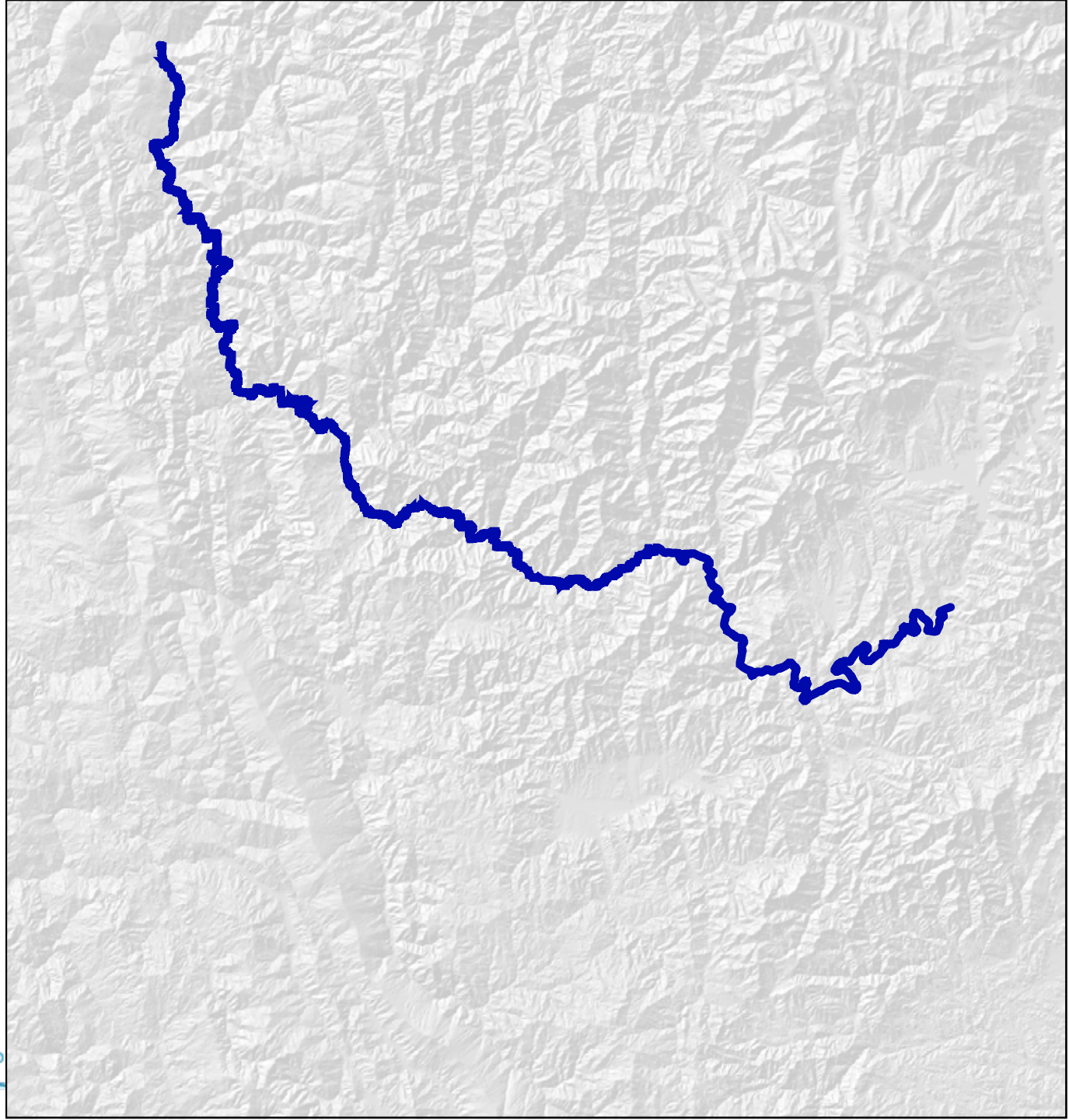
Natural origin escapement goals:

- 62,000 fall run Chinook Salmon
- 6,000 spring run Chinook Salmon
- 1,400 Coho Salmon
- 40,000 steelhead

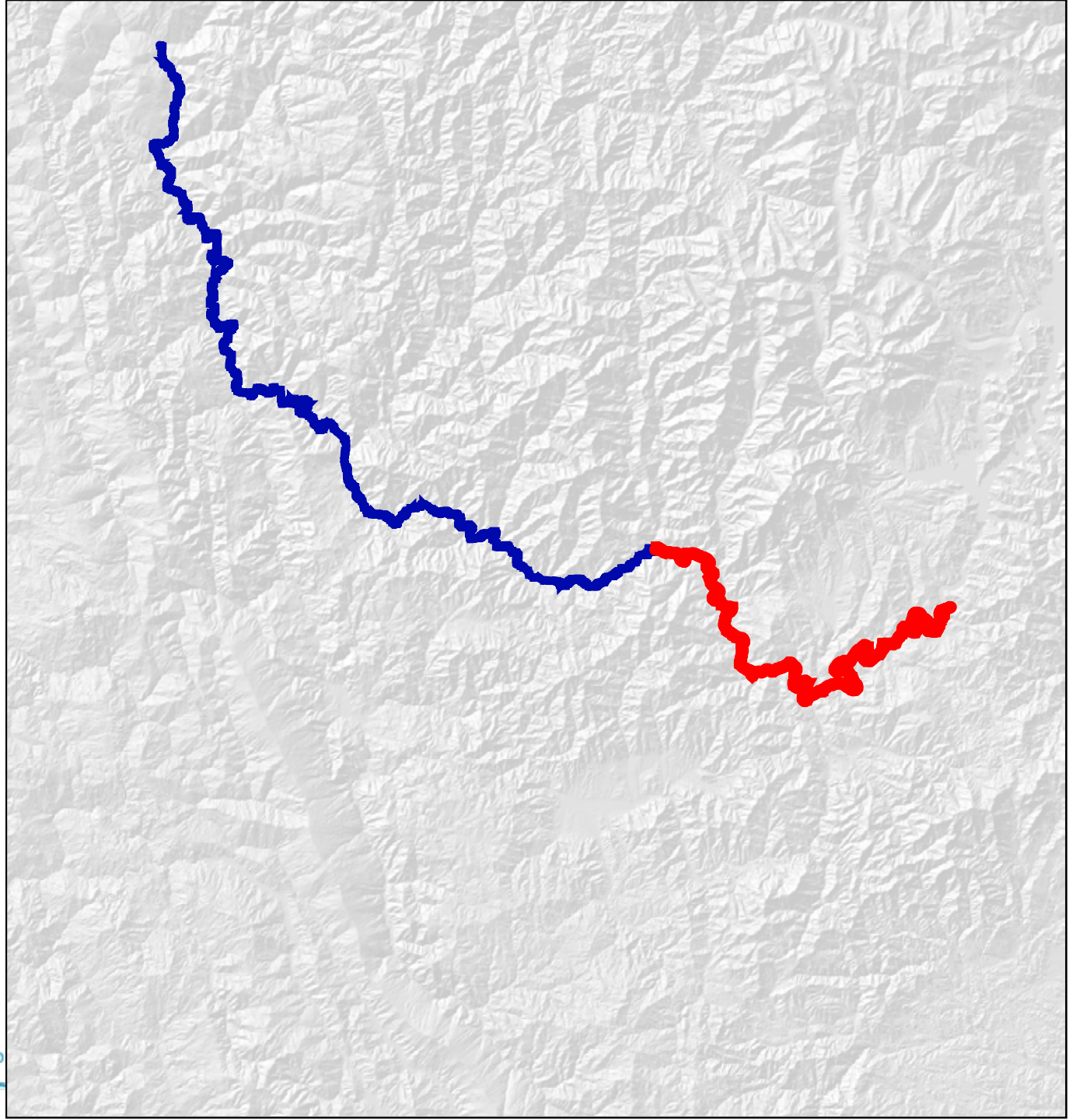
Need habitat to return 62,000 natural origin **fall Chinook Salmon** to the Trinity Basin

... *plus*

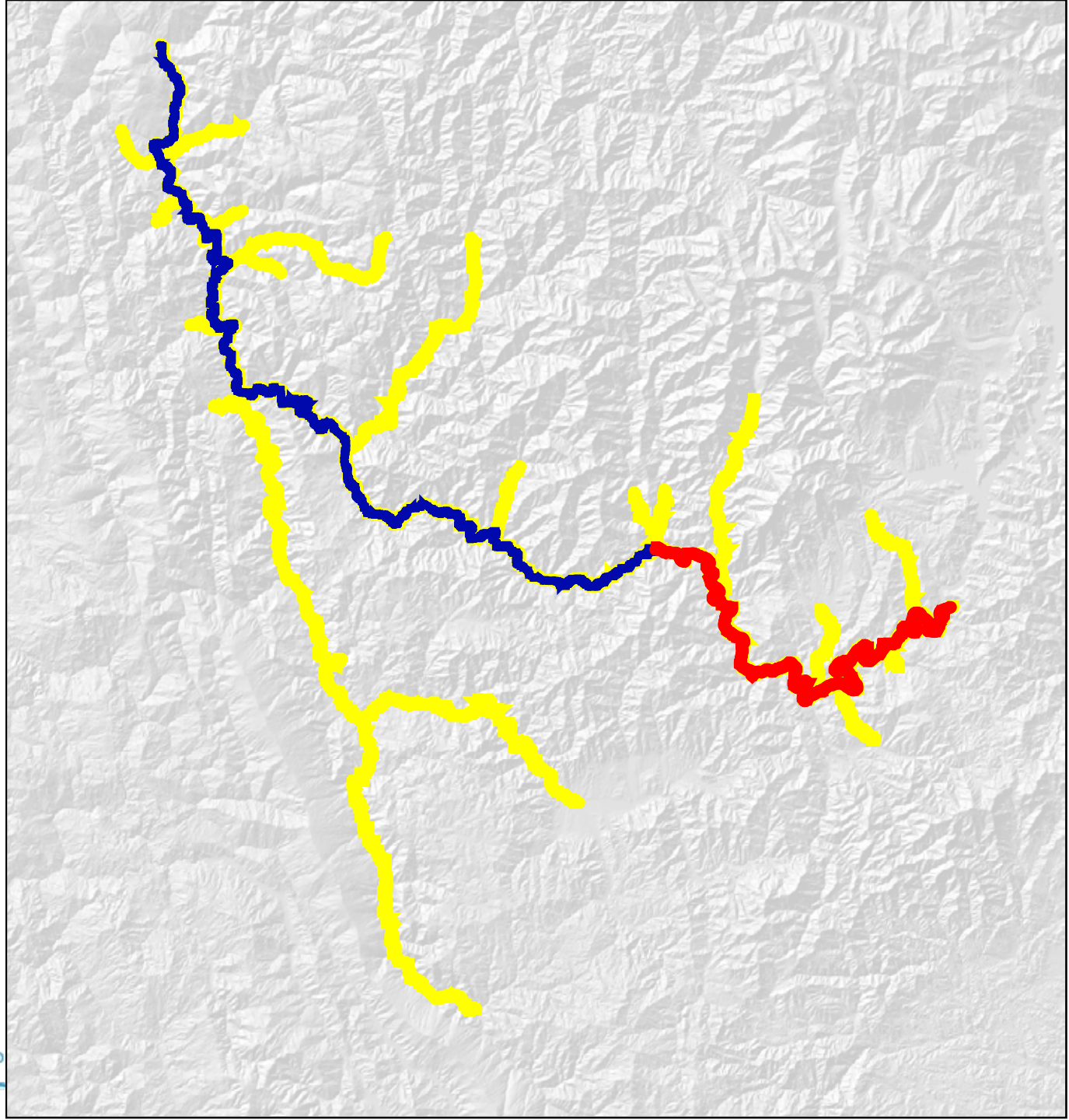
... expanded harvest opportunities to commercial, recreational, and tribal fisheries



Channel Rehabilitation Worksho



Channel Rehabilitation Worksho



Restoration Ecology
THE JOURNAL OF THE SOCIETY FOR ECOLOGICAL RESTORATION

RESEARCH ARTICLE

Comparison of Potential Increases in Juvenile Salmonid Rearing Habitat Capacity among Alternative Restoration Scenarios, Trinity River, California

Timothy J. Beechie,[1,2] George R. Pess,[1] Hiroo Imaki,[1] Aaron Martin,[3] Justin Alvarez,[4] and Damon H. Goodman[5]

Abstract

River restoration plans often propose multiple rehabilitation actions to address key habitat impairments, but they rarely attempt to quantify the potential benefits of alternative sets of actions for targeted biota. We use geomorphic and biological analyses to estimate restoration potential under three alternative scenarios for a 64-km section of the Trinity River, California, between the North Fork Trinity River and Lewiston Dam, which is the focus of habitat rehabilitation efforts under the Trinity River Restoration Program. The three scenarios are (1) increasing habitat quality by wood additions and alcove construction, (2) increasing habitat quantity by increasing sinuosity and side-channel length, and (3) increasing both habitat quality and quantity. For each scenario, we used existing stream habitat and juvenile salmonid data from previous studies to estimate potential improvements in fry or pre-smolt production. The potential increase in *Oncorhynchus tshawytscha* (Chinook salmon) and *O. mykiss* (steelhead) fry rearing capacity was 62 and 67%, respectively, for Scenario 1 (increasing habitat quality), and 36 and 44% for Scenario 2 (increasing habitat quantity). Only the most optimistic Scenario 3 (increasing both habitat quality and quantity) more than doubles potential juvenile salmonid production (112% increase in Chinook fry capacity and 107% increase in steelhead fry capacity). These quantitative predictions are useful in developing realistic restoration targets and evaluating whether proposed restoration actions can achieve the aims of a restoration program.

Key words: alternatives analysis, habitat capacity, river restoration, salmonids.

Beechie et al 2014

- Baseflow habitat from systemic survey
- Scenario 1 – applied 12% gain of optimal cover

ASSESSING TRINITY RIVER SALMONID HABITAT AT CHANNEL REHABILITATION SITES, 2007-2008.

Damon H. Goodman[1], Aaron Martin[2], Justin Alvarez[3], Andrea Davis[3] and Joe Polos[1]

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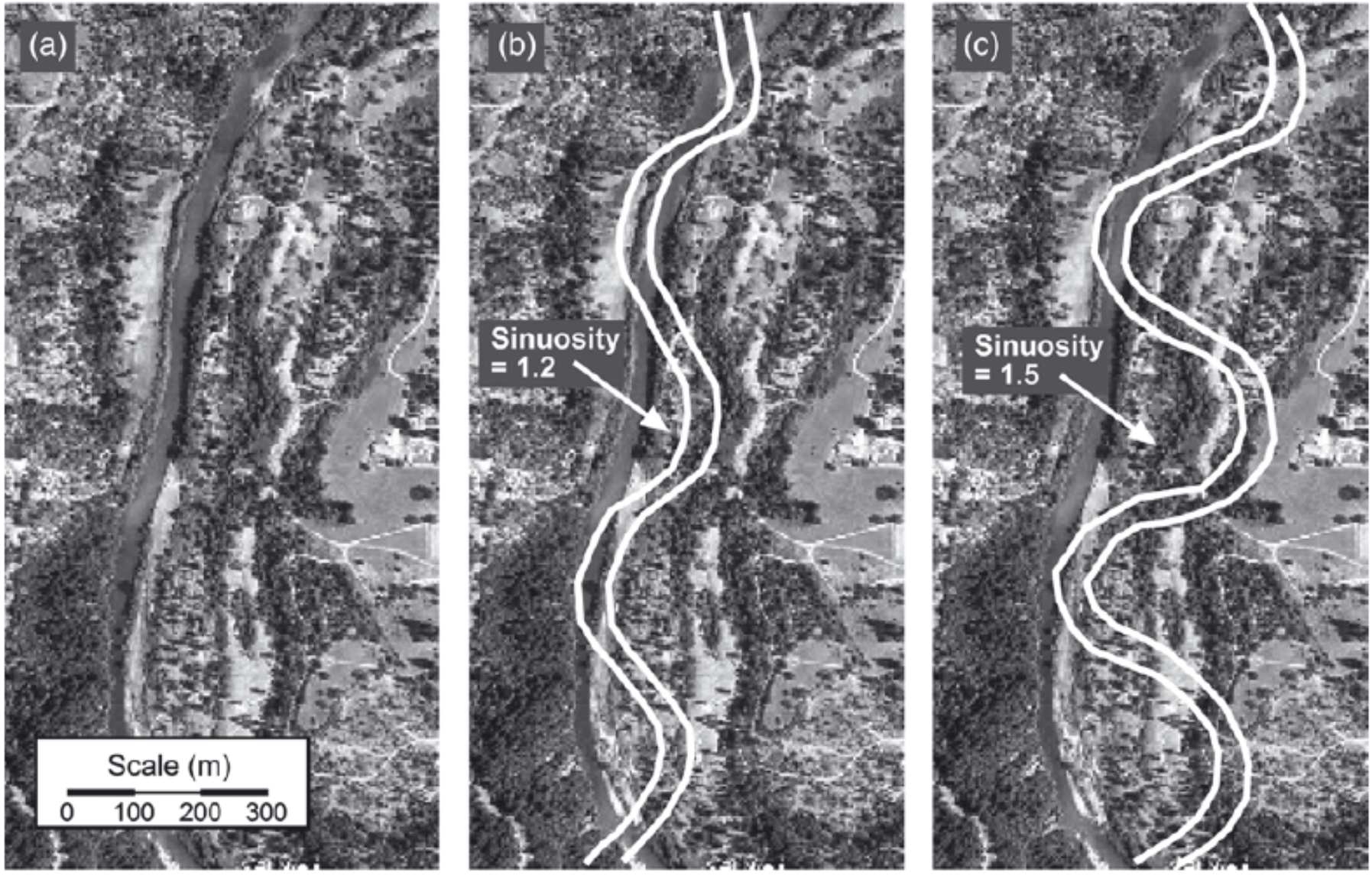
2500 Hwy. 96
Weitchpec, CA, 95525

Hoopa Valley Tribe[3]
PO Box 417
Hoopa, CA 95546

Beechie et al 2014

- Scenario 2 – increased channel length based on assumed sinuosity and side channel potential


(a)
Scale (m)
0 100 200 300
(b)
Sinuosity = 1.2
(c)
Sinuosity = 1.5

Beechie et al 2014

- Scenario 3 – Combination of 1&2

Beechie et al 2014

Scenario	Estimated potential gain in Chinook Salmon fry habitat
I	62%
II	36%
II	112%

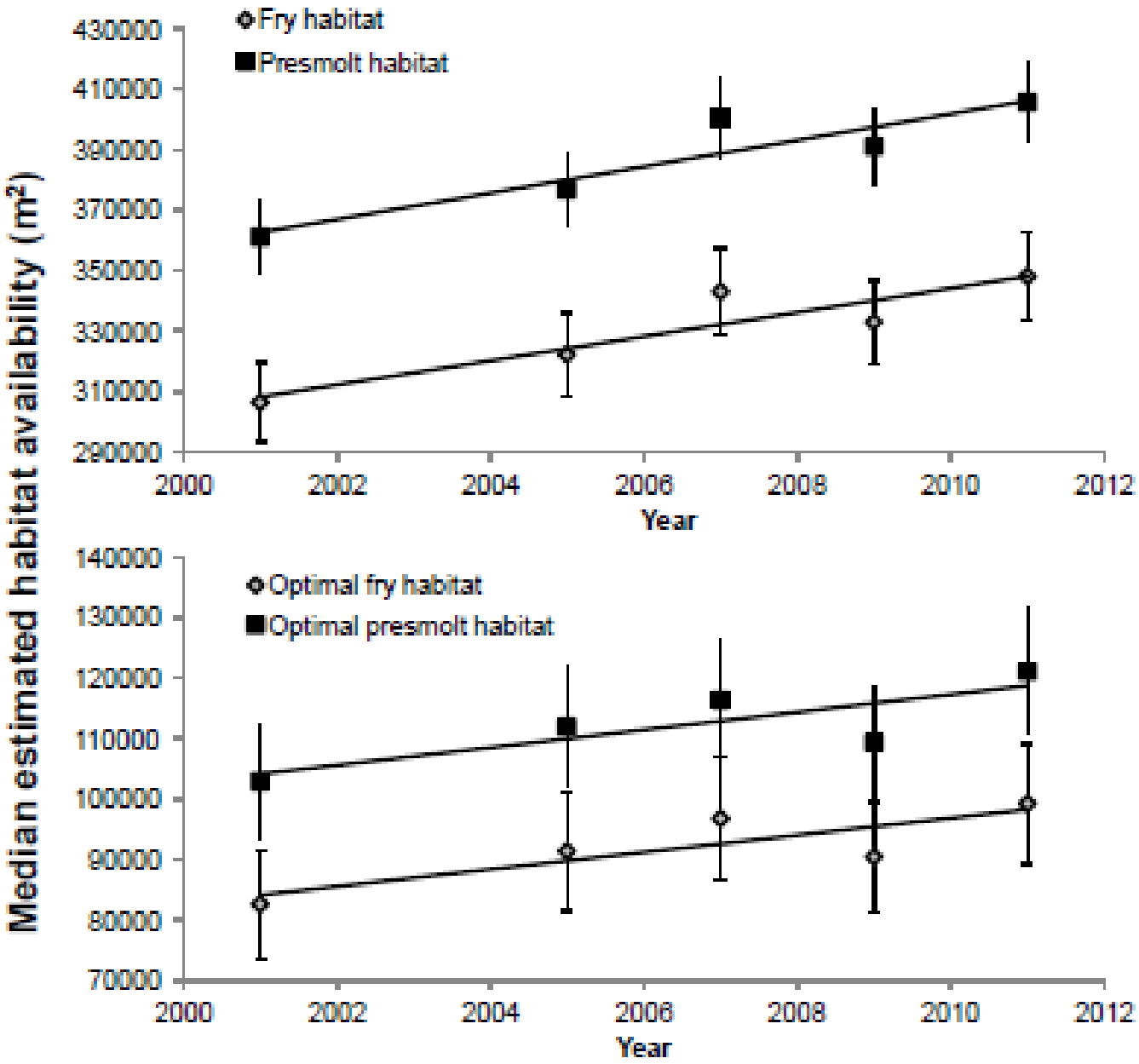
Phase I SAB review

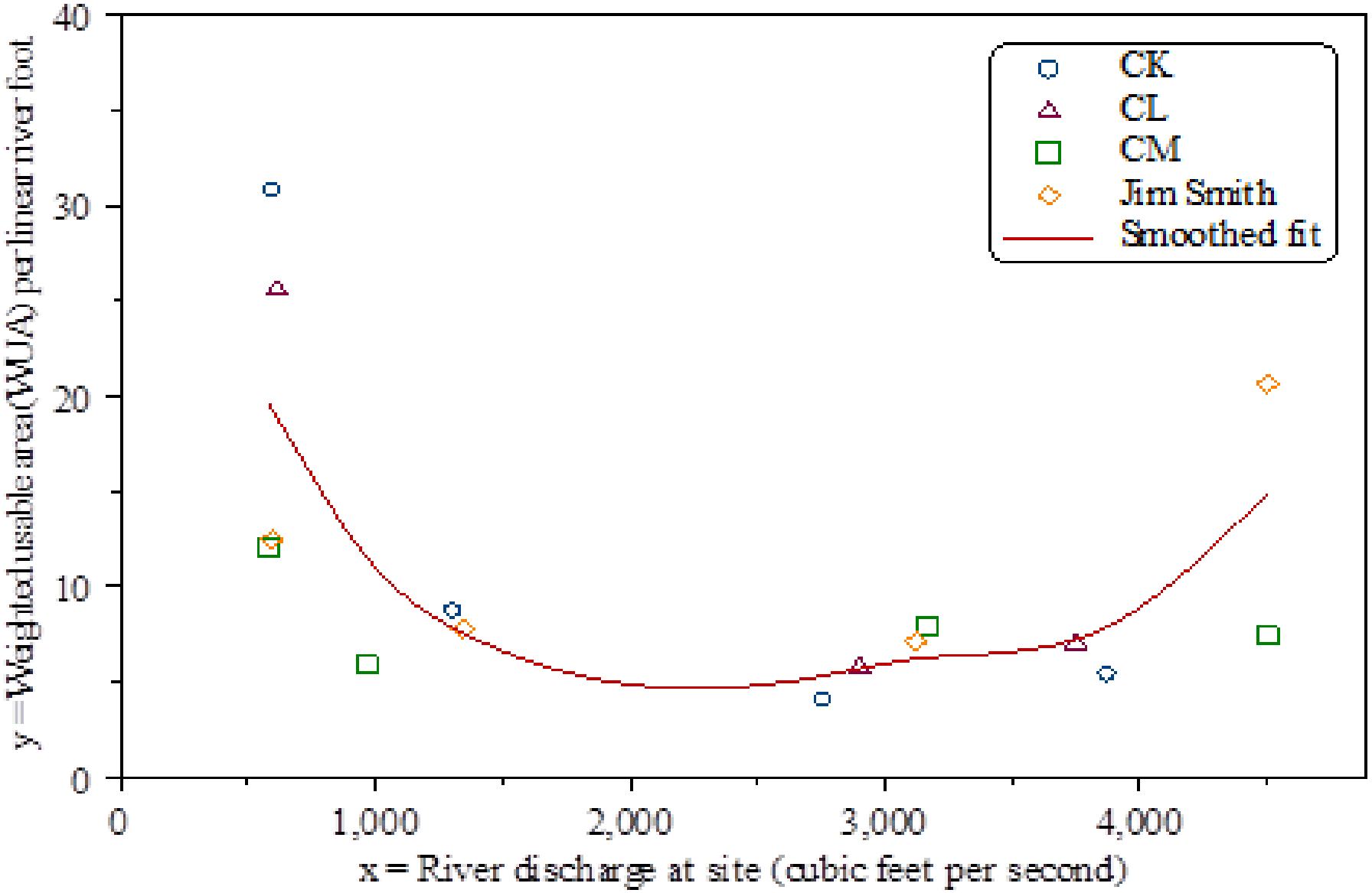
Review of the Trinity River Restoration Program Following Phase 1, with Emphasis on the Program's Channel Rehabilitation Strategy

Prepared for Trinity River Restoration Program

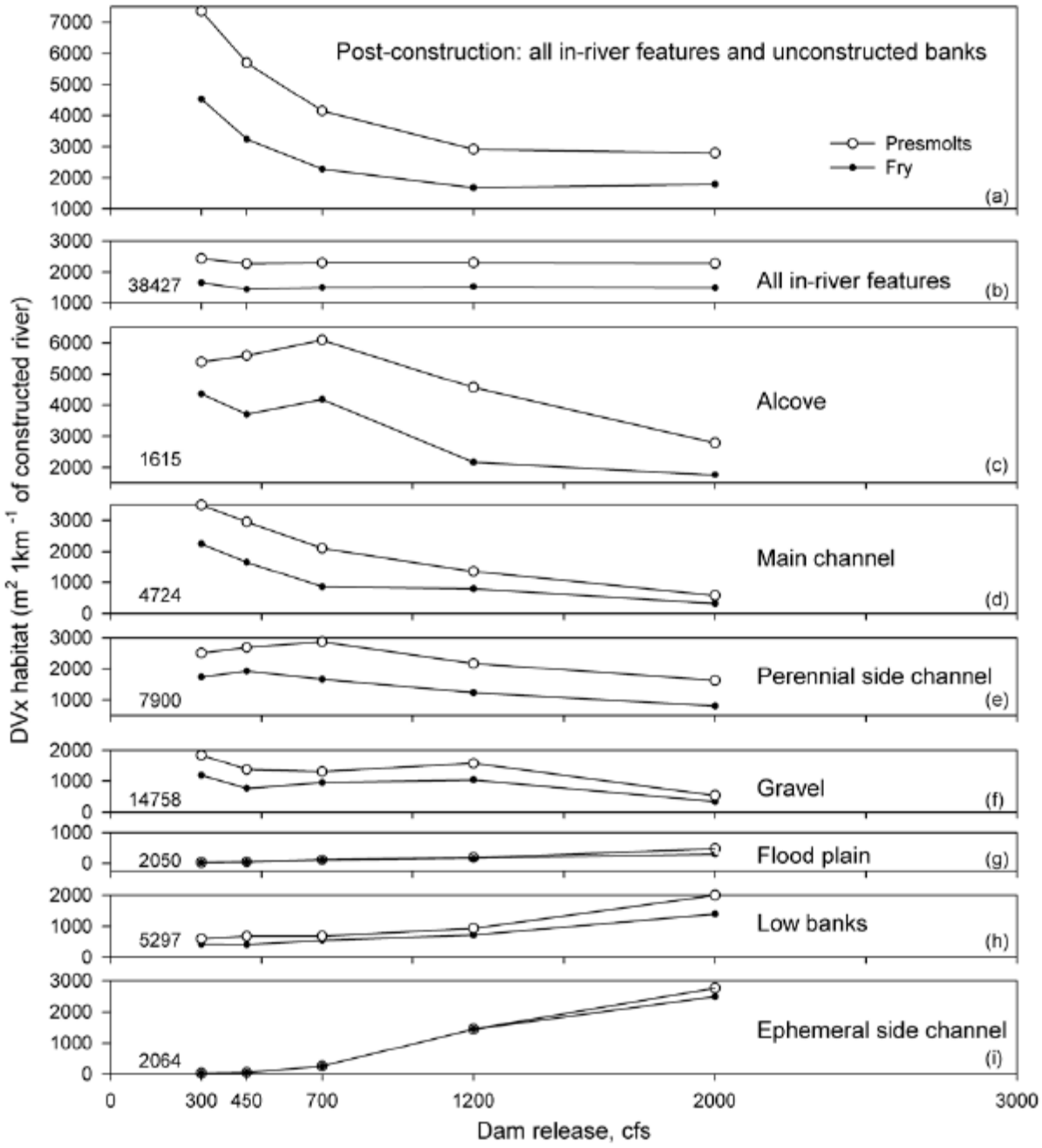
April 2014

Phase I SAB review

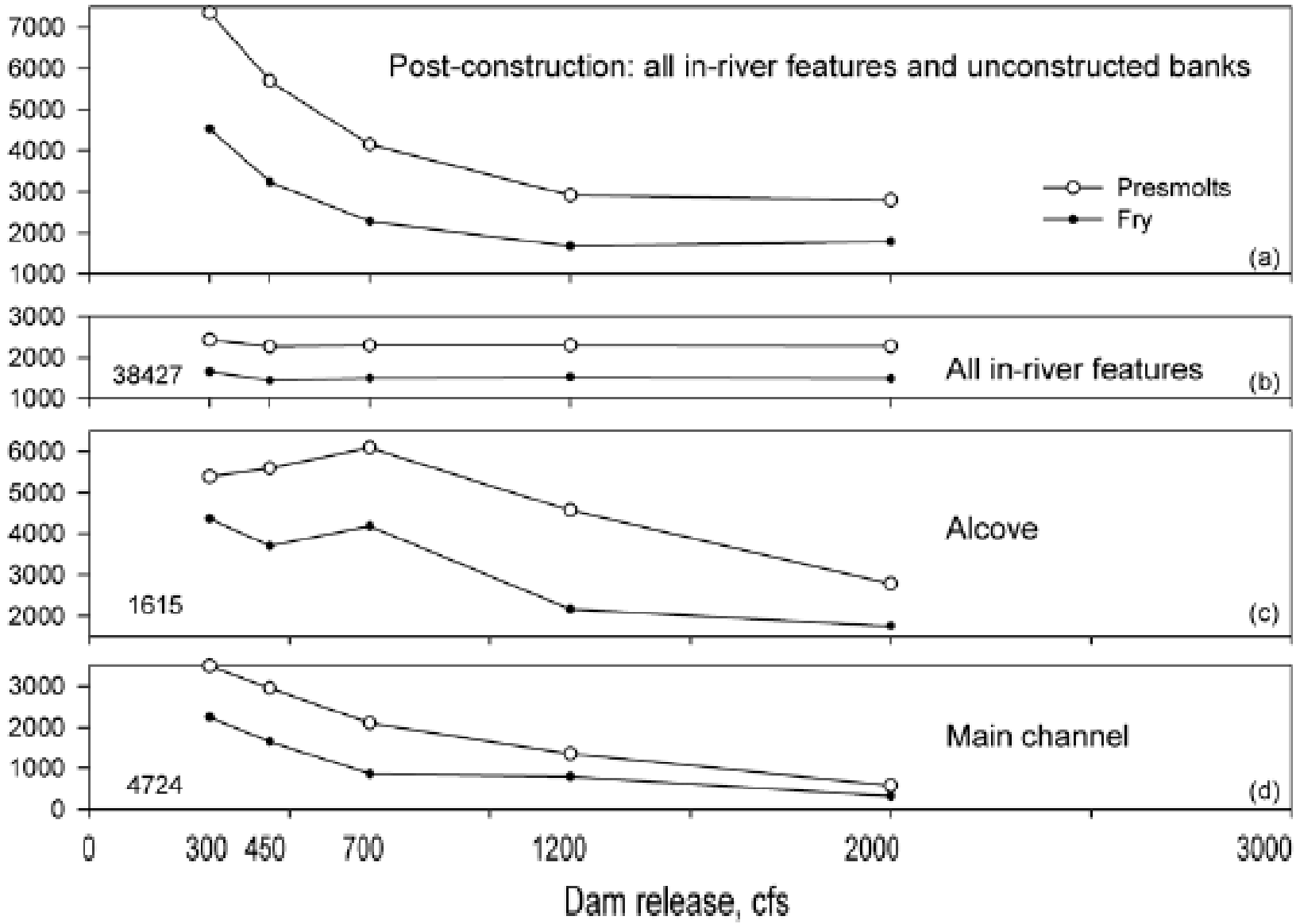



CK
CL
CM
Jim Smith
Smoothed fit
y = Weighted usable area (WUA) per linear river foot
x = River discharge at site (cubic feet per second)
0
10
20
30
40
0
1,000
2,000
3,000
4,000

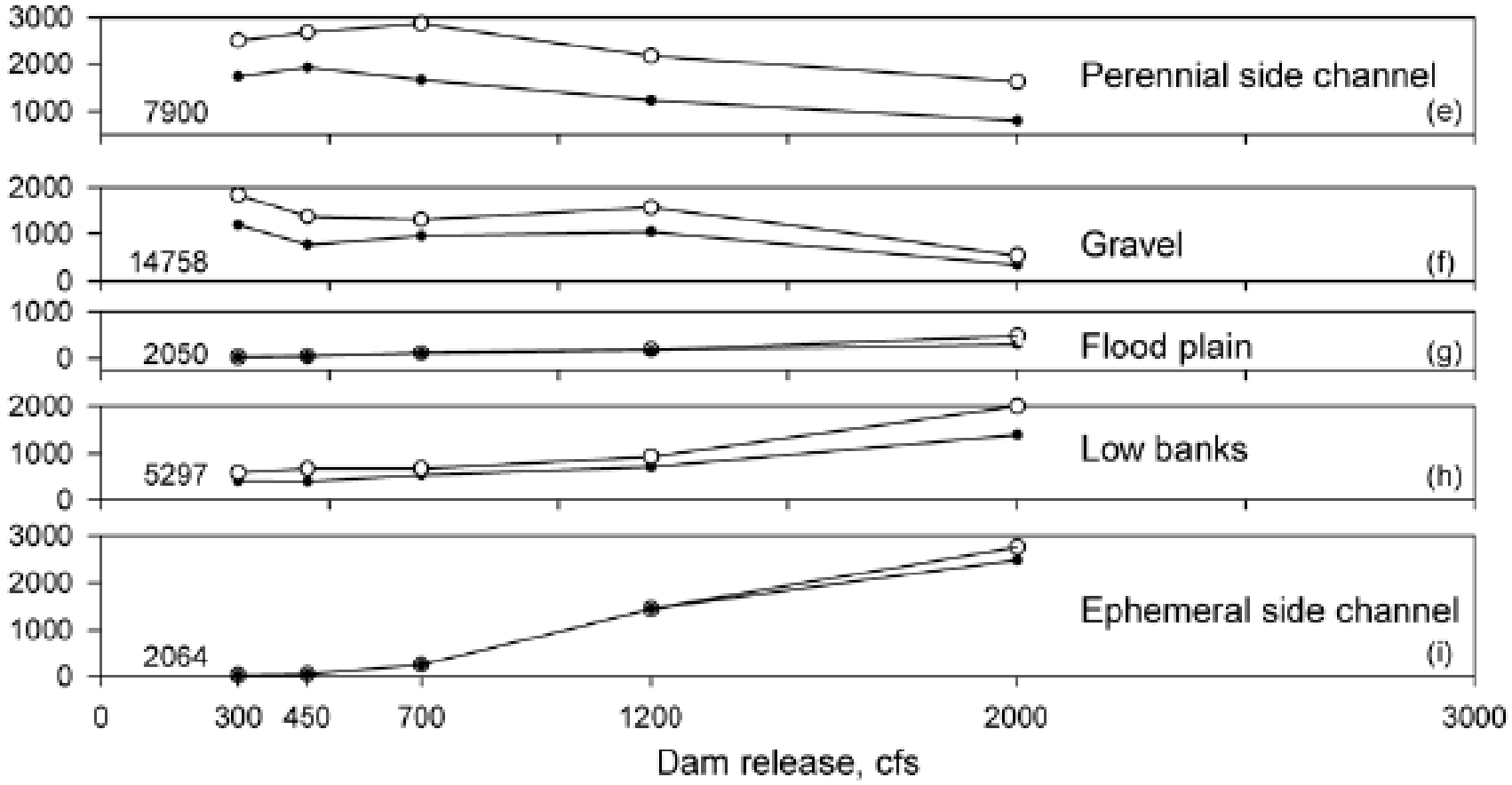
Phase I SAB review

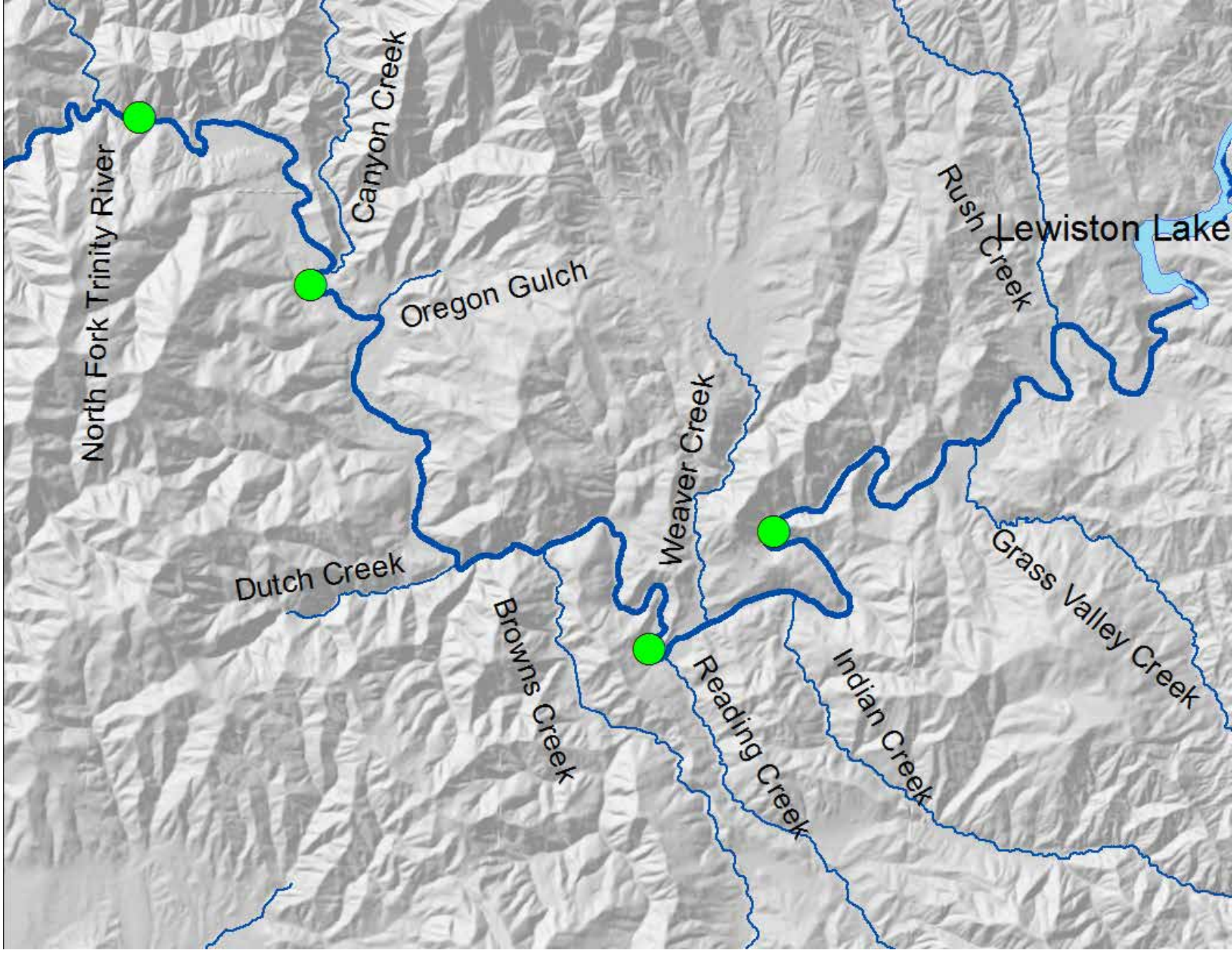


Phase I SAB review

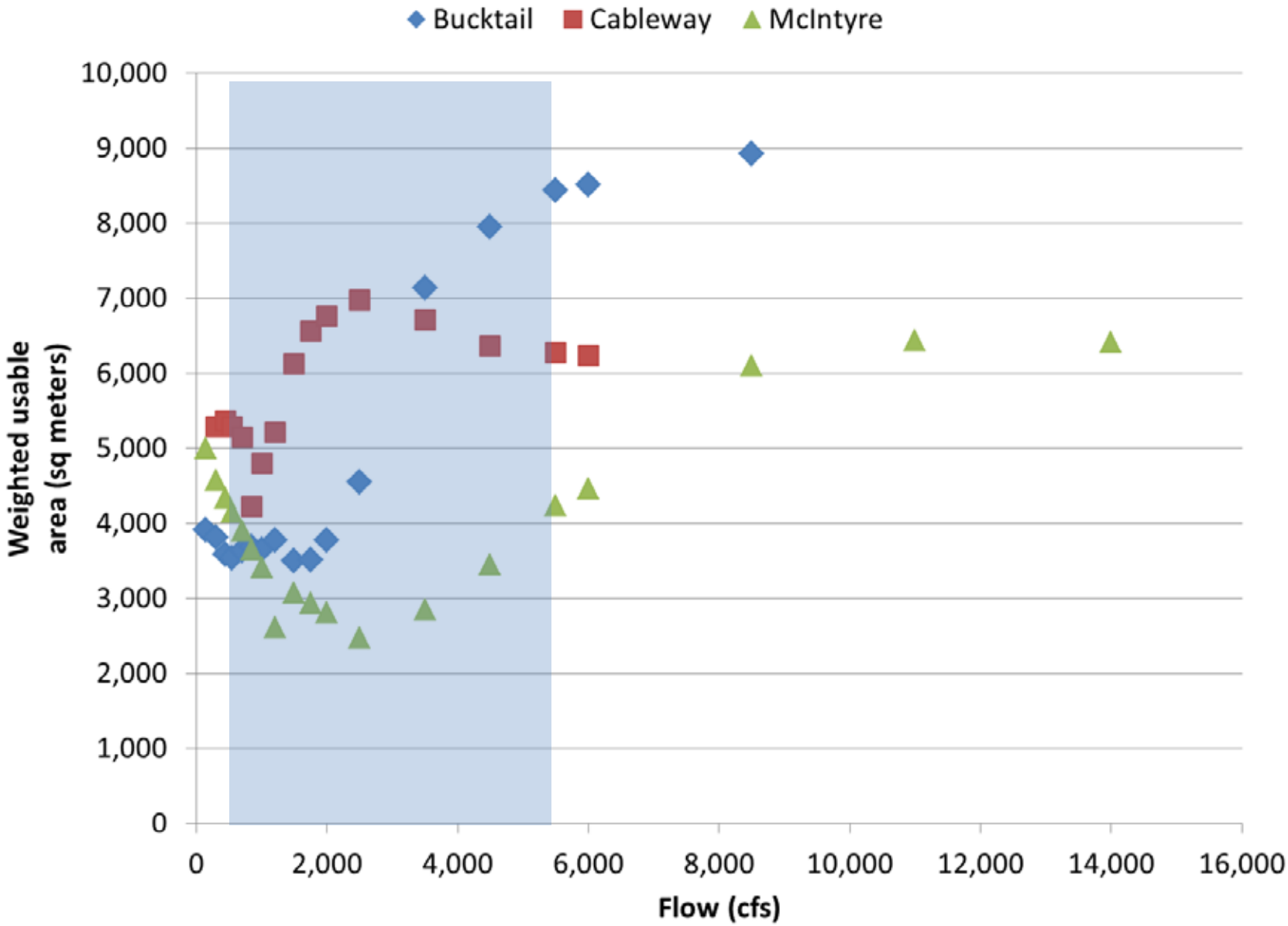


Phase I SAB review

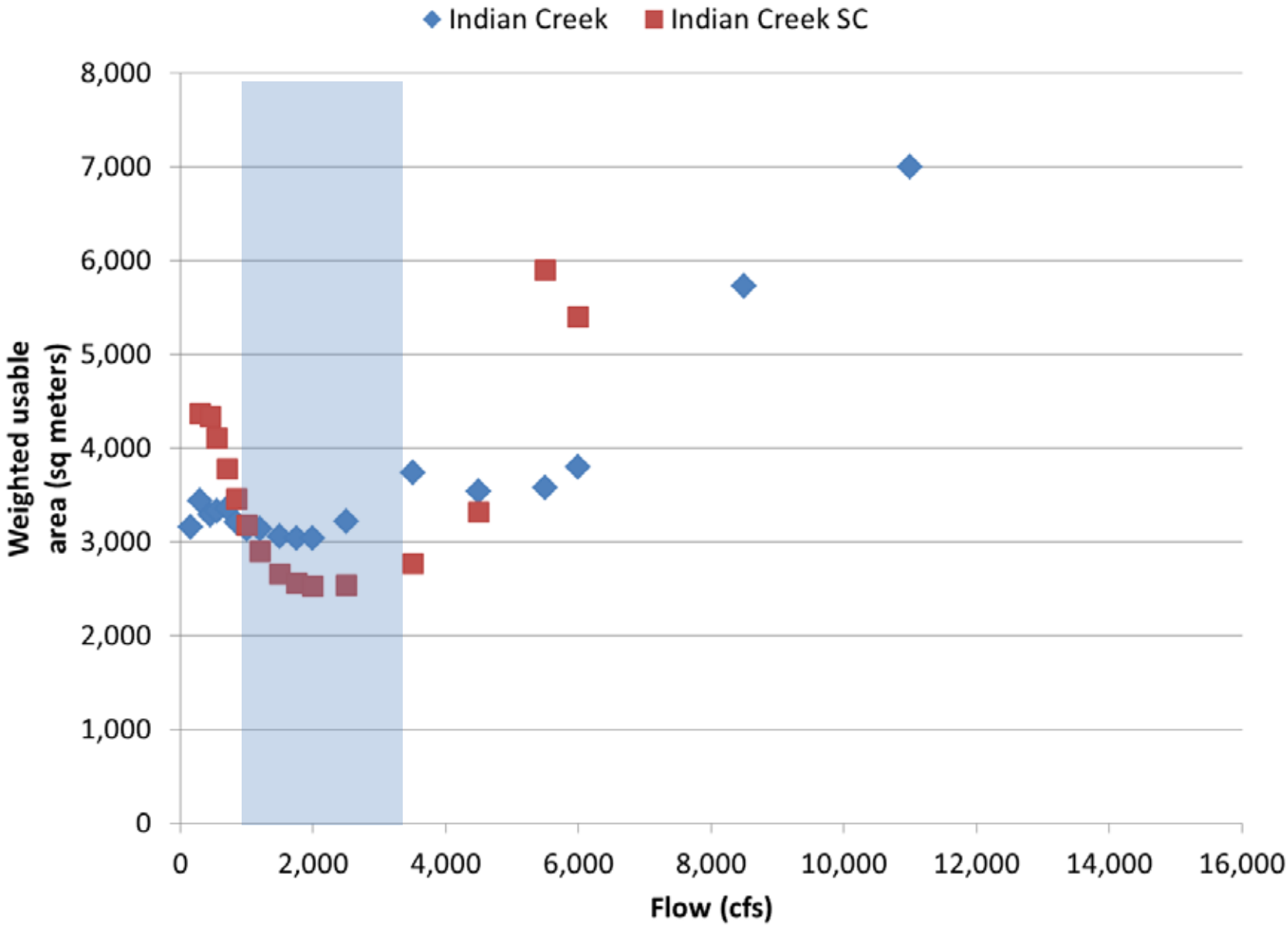



North Fork Trinity River
Canyon Creek
Oregon Gulch
Rush Creek
Lewiston Lake
Weaver Creek
Dutch Creek
Browns Creek
Reading Creek
Indian Creek
Grass Valley Creek

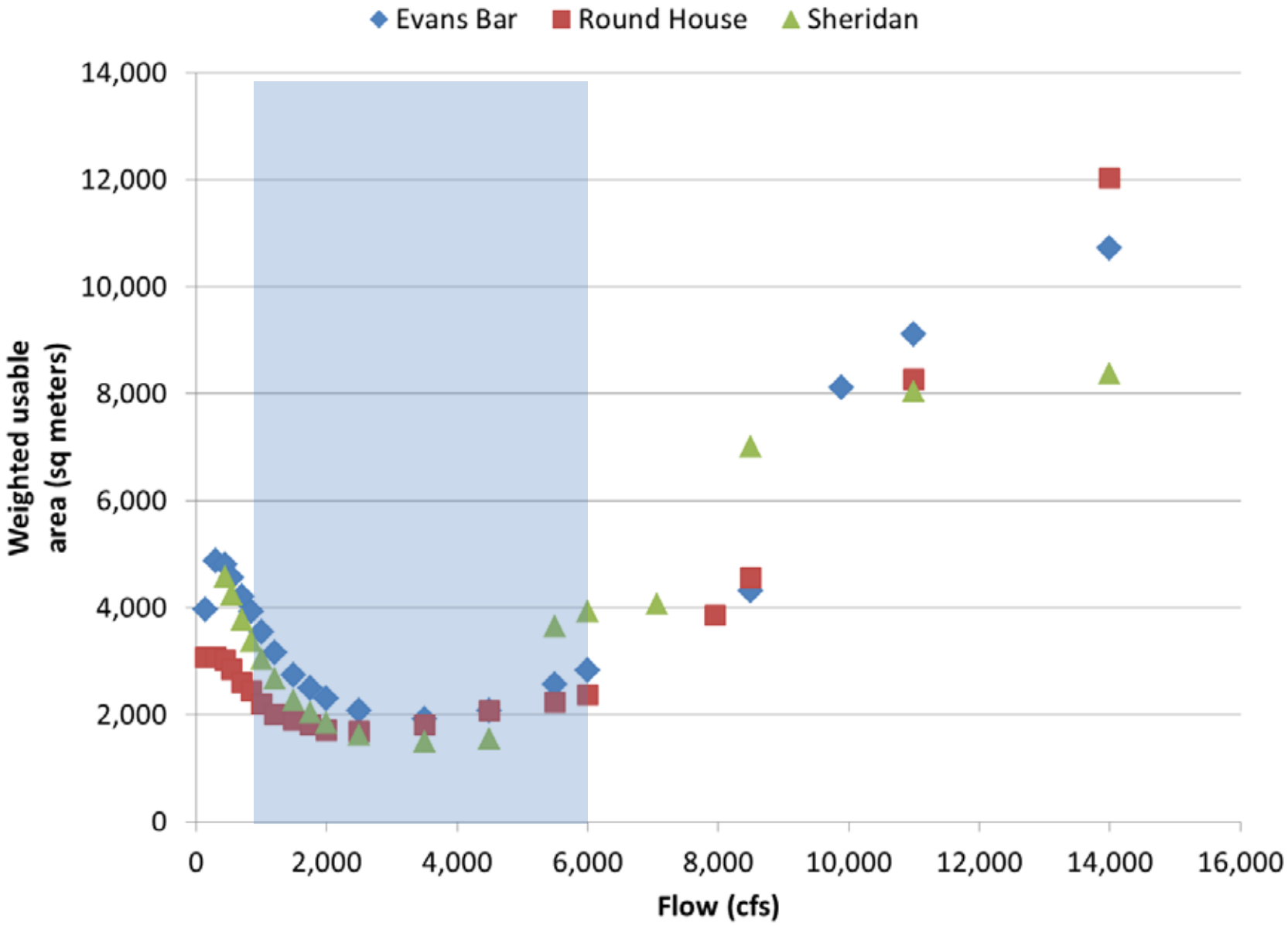
Lewiston to Limekiln



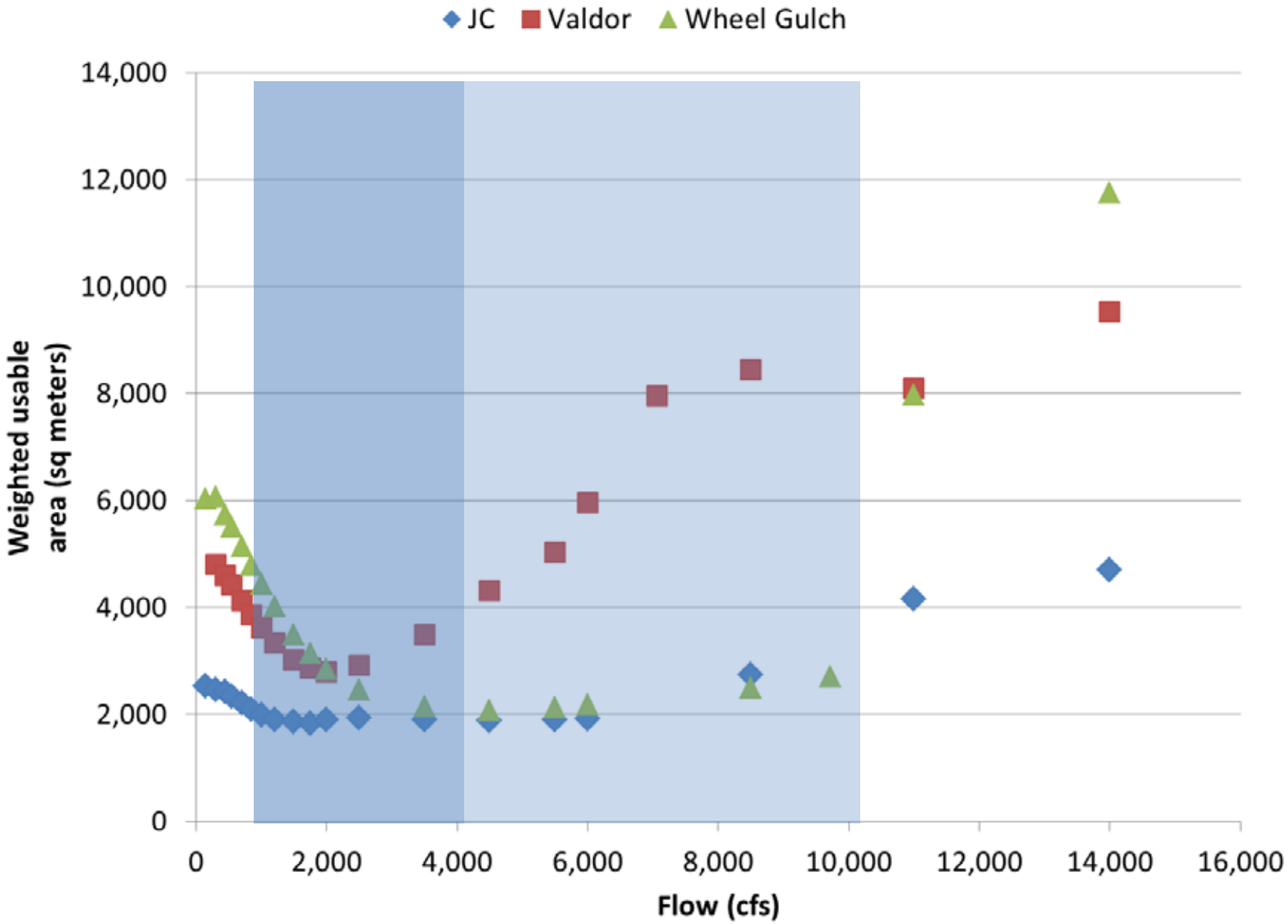
Limekiln to Douglas City



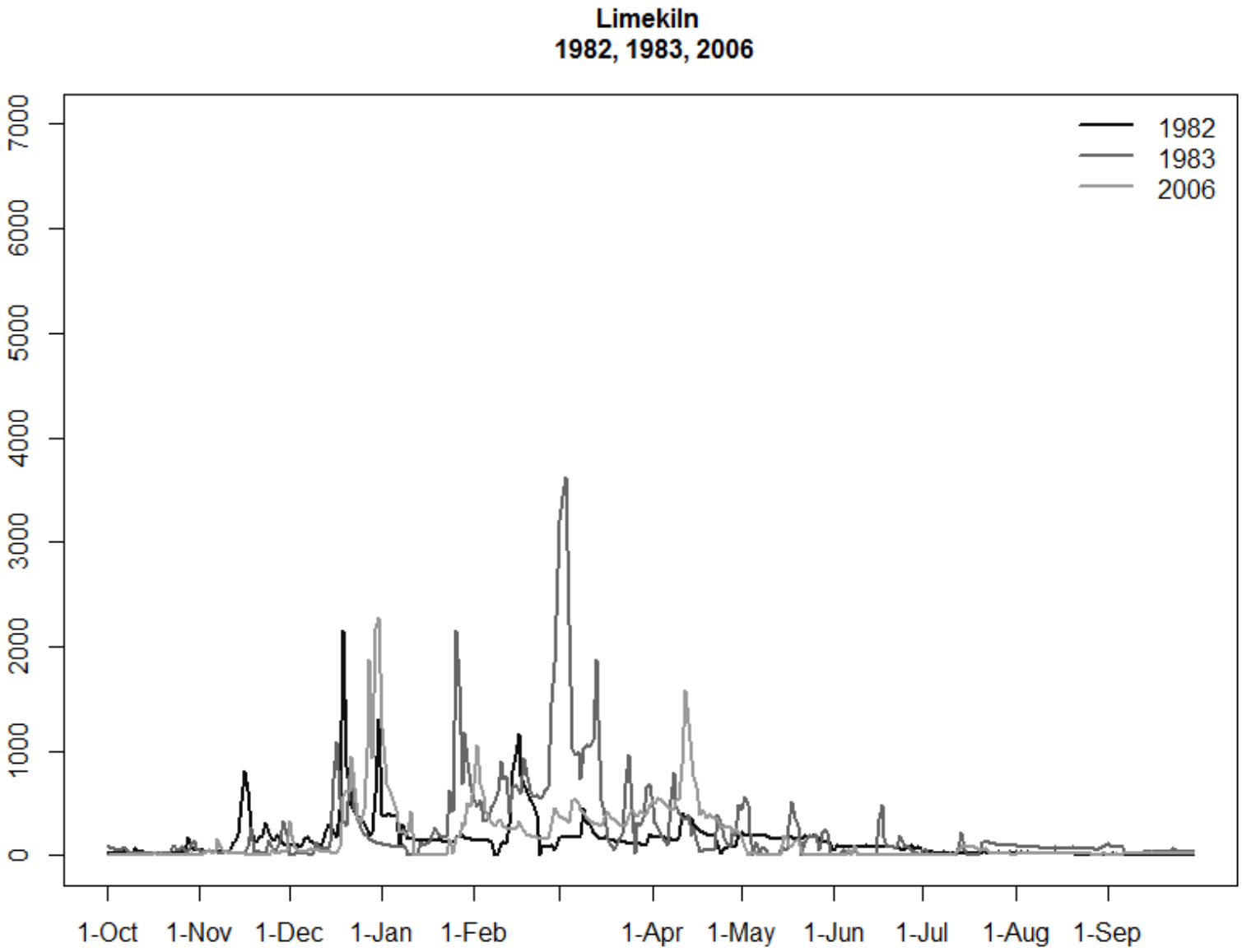
Douglas City to Junction City



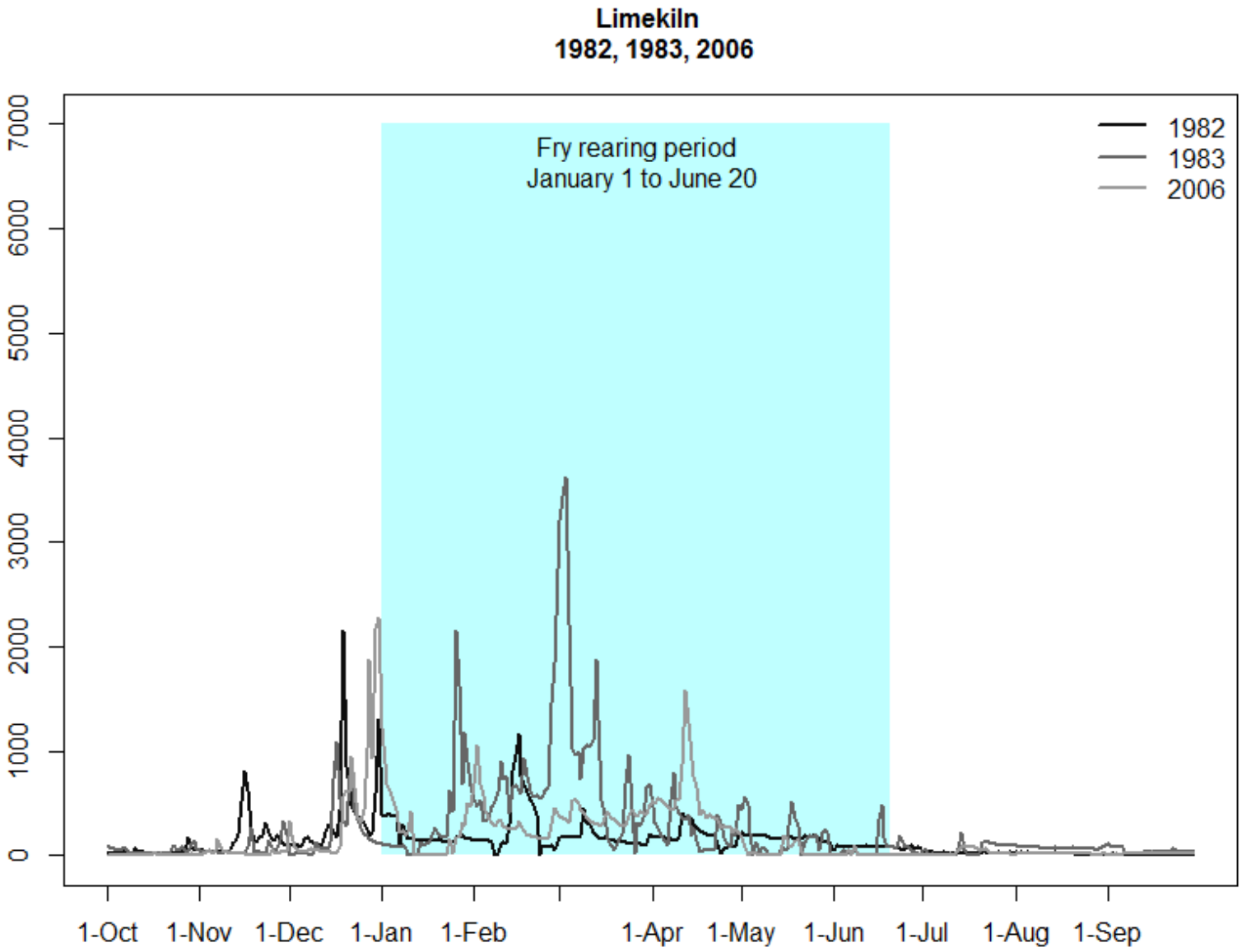
Junction City to North Fork



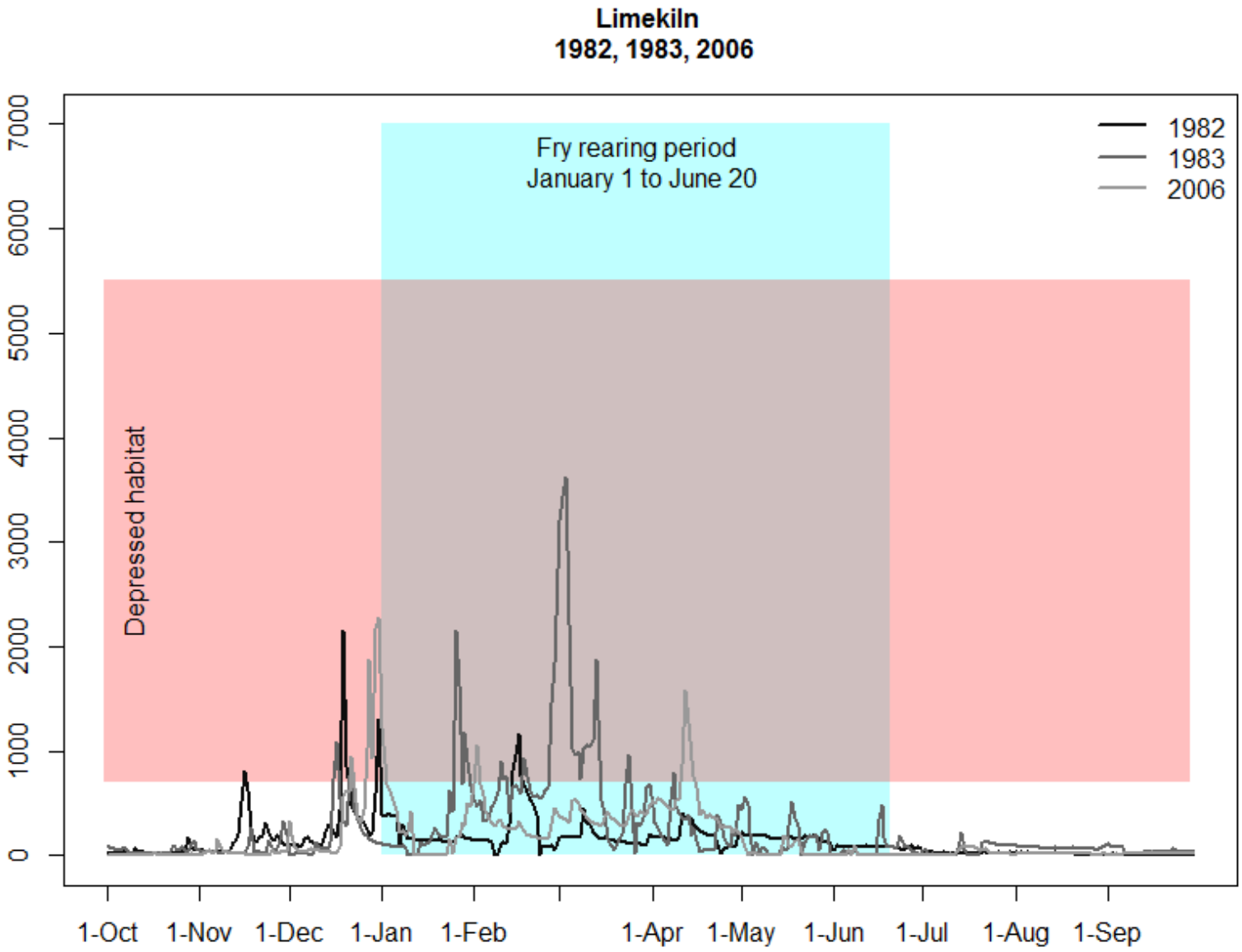
Extremely wet



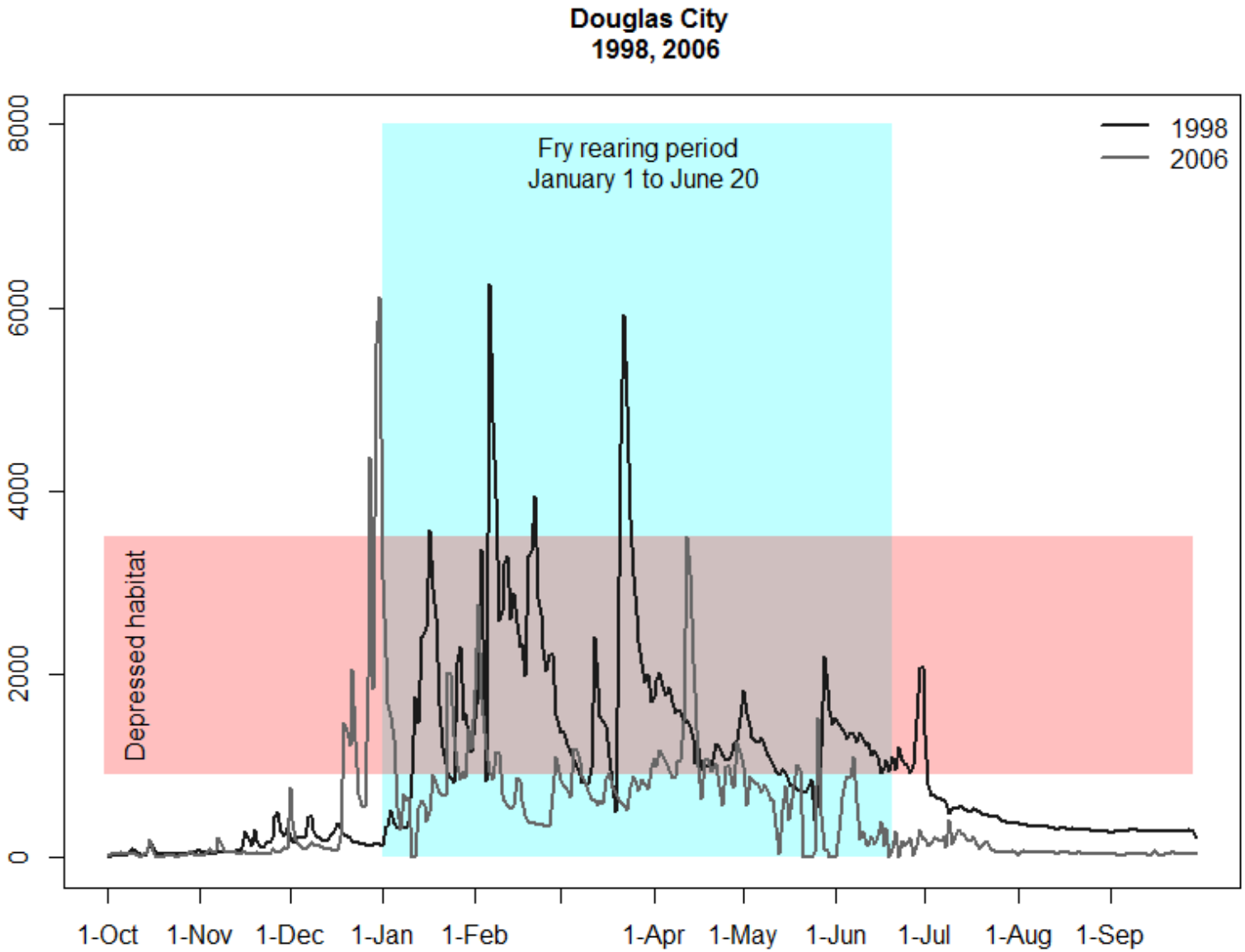
Extremely wet



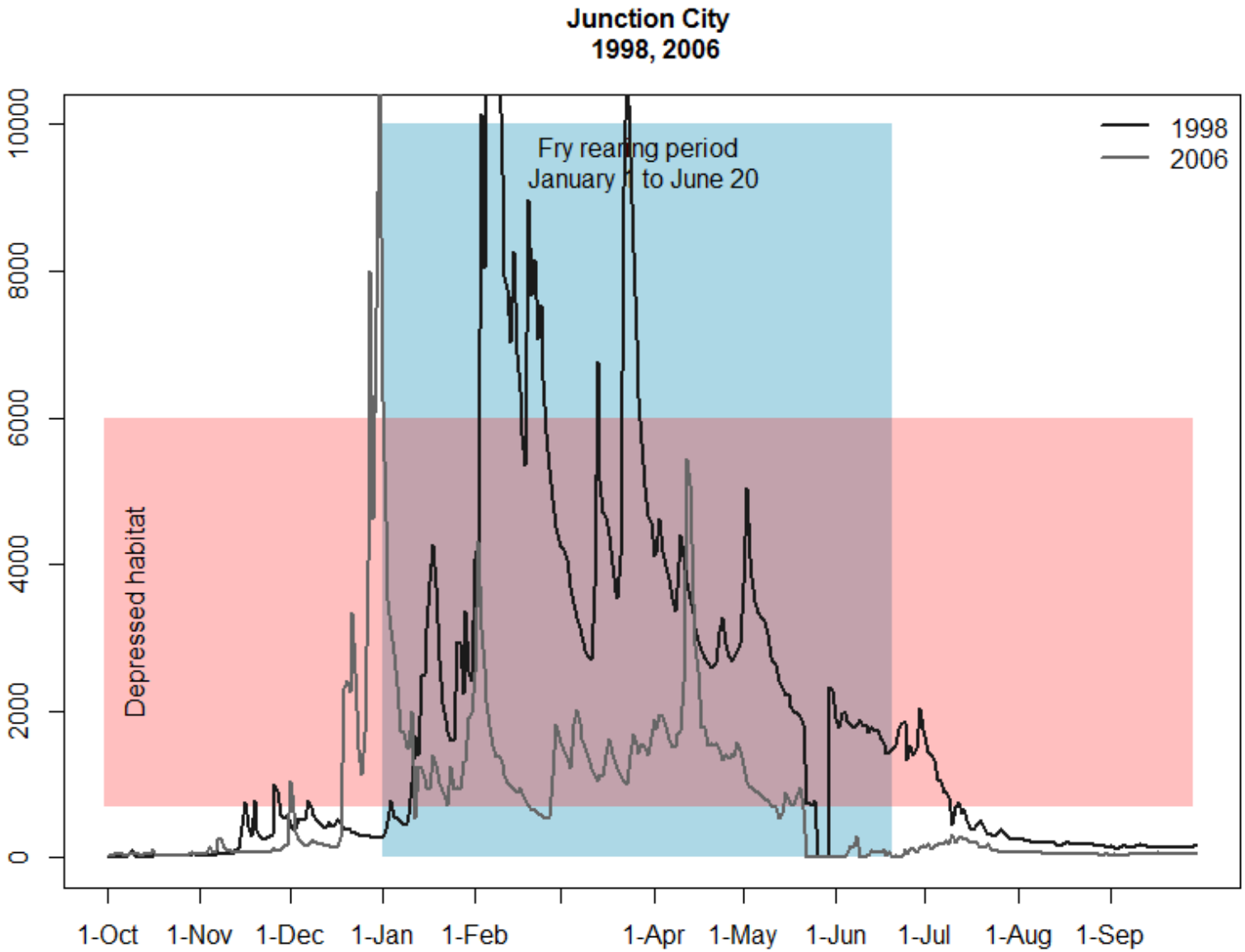
Extremely wet



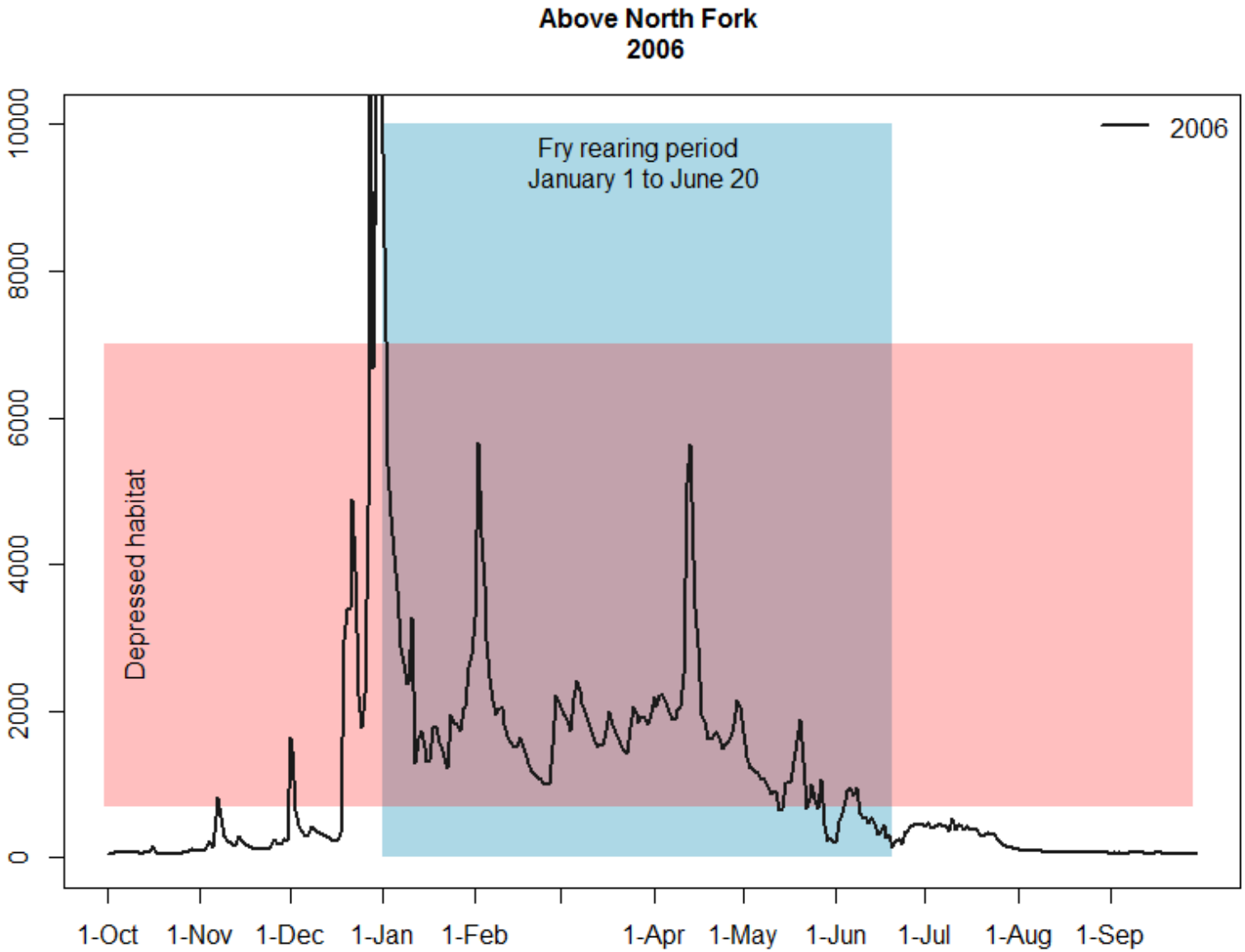
Extremely wet



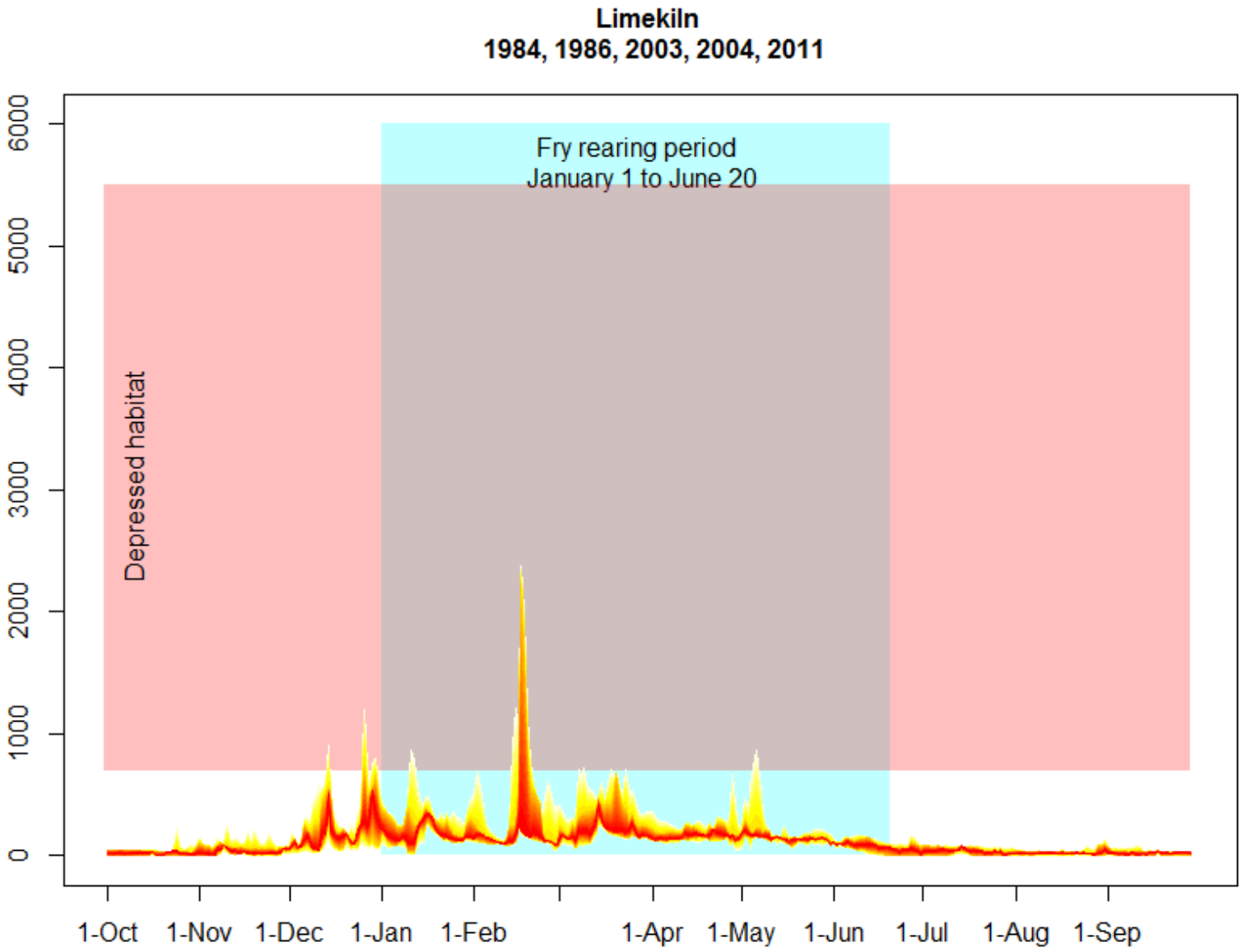
Extremely wet



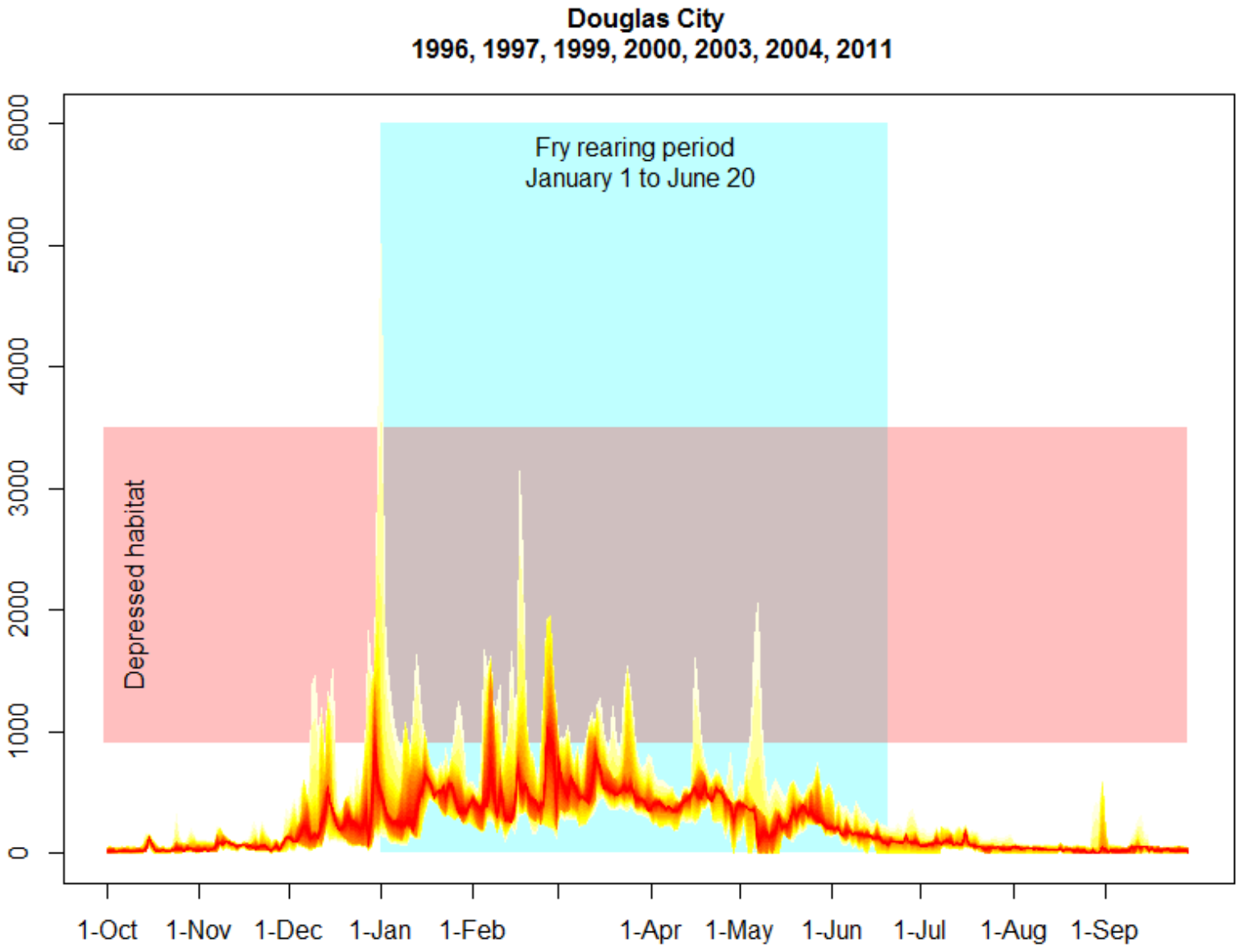
Extremely wet



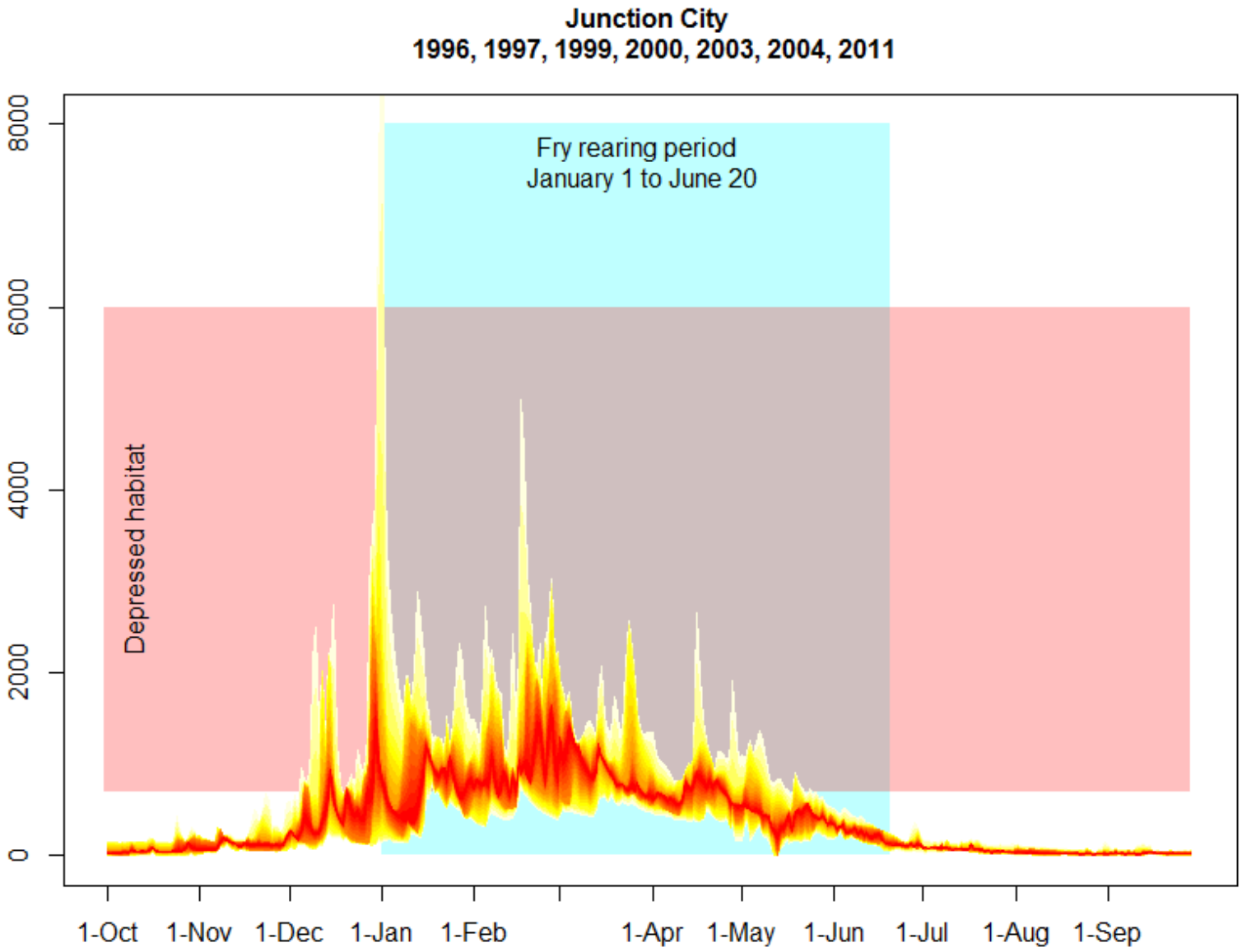
Wet


Limekiln
1984, 1986, 2003, 2004, 2011
Fry rearing period
January 1 to June 20
Depressed habitat
0
1000
2000
3000
4000
5000
6000
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep

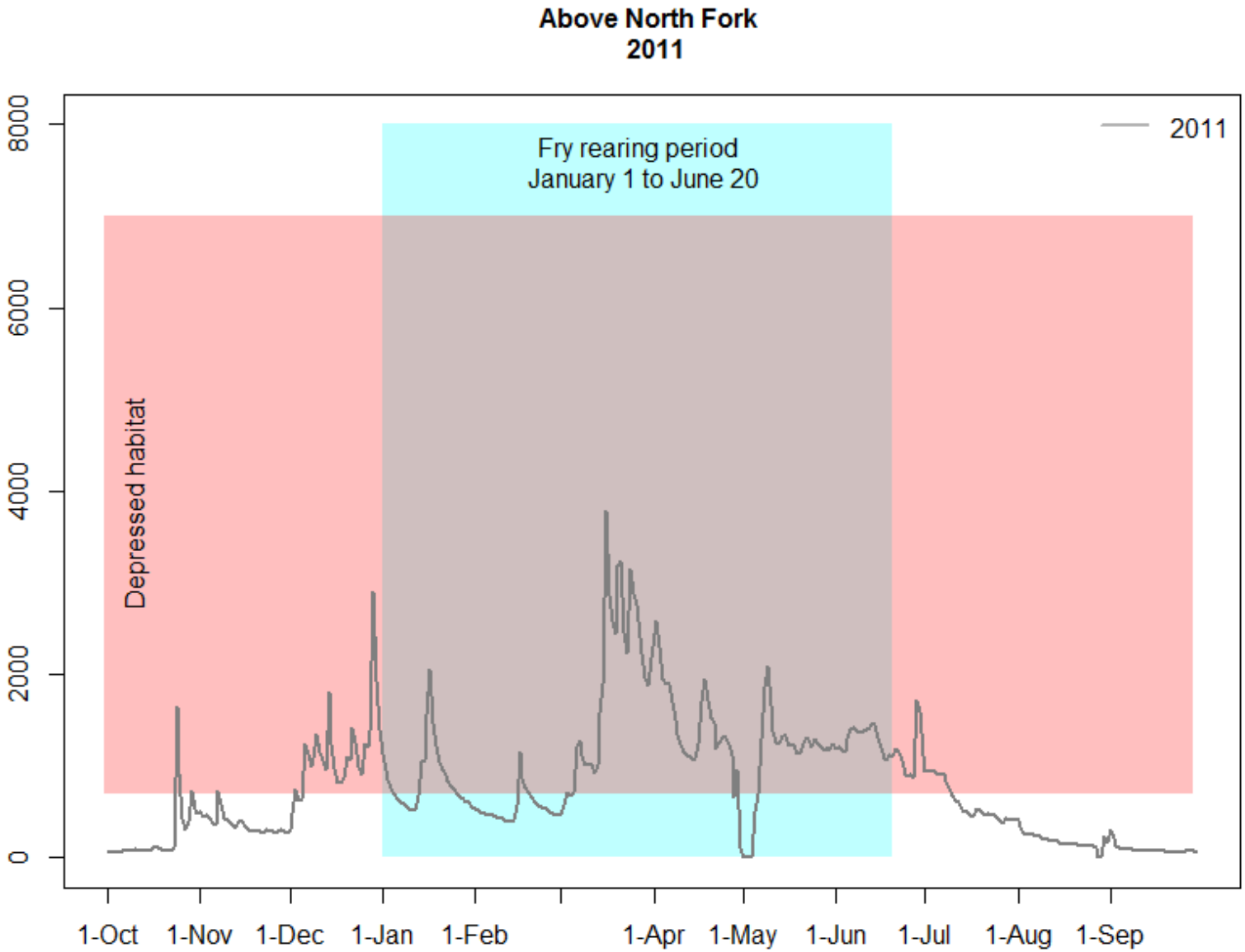
Wet


Douglas City
1996, 1997, 1999, 2000, 2003, 2004, 2011
Fry rearing period
January 1 to June 20
Depressed habitat
0
1000
2000
3000
4000
5000
6000
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep

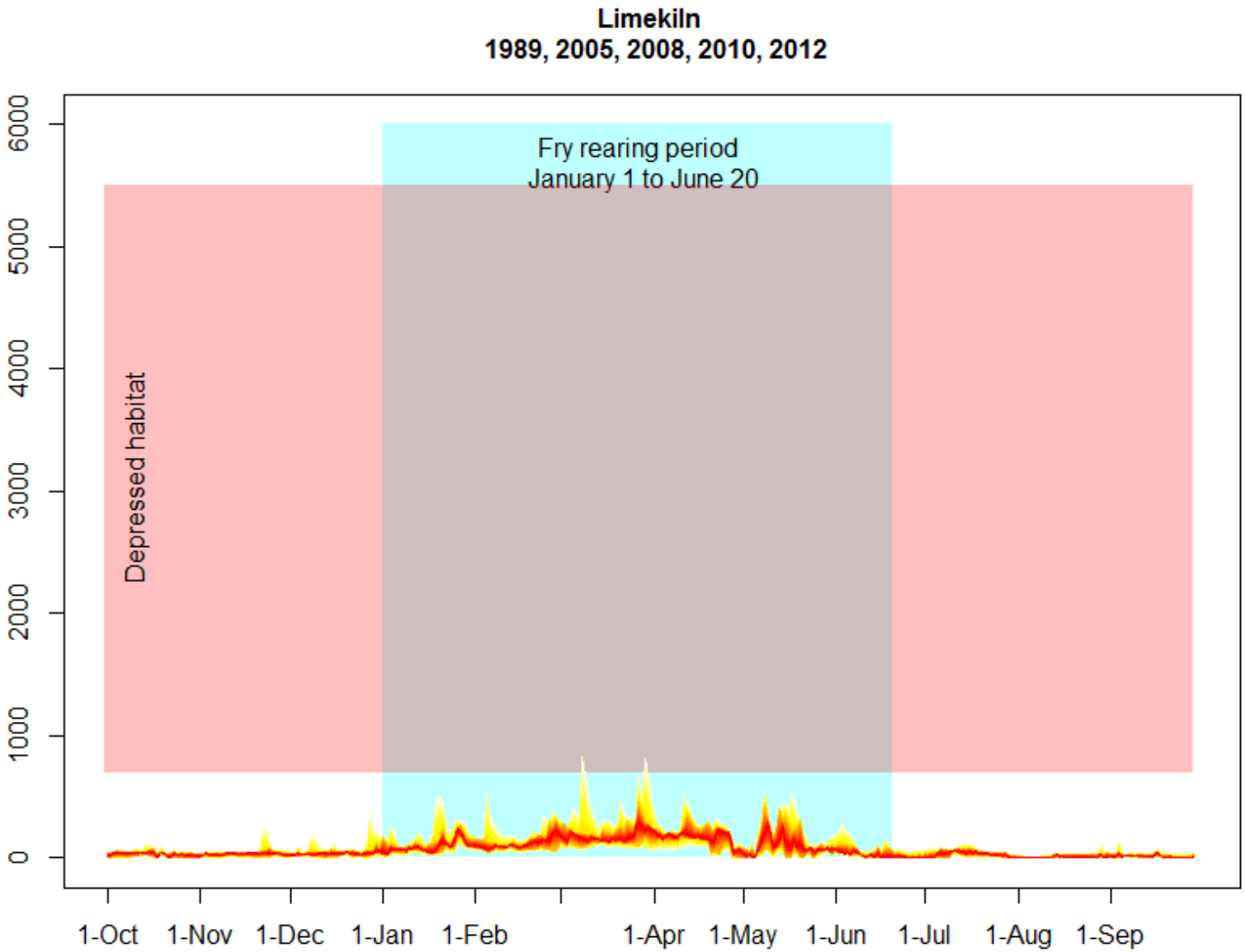
Wet


Junction City
1996, 1997, 1999, 2000, 2003, 2004, 2011
Fry rearing period
January 1 to June 20
Depressed habitat
0
2000
4000
6000
8000
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep

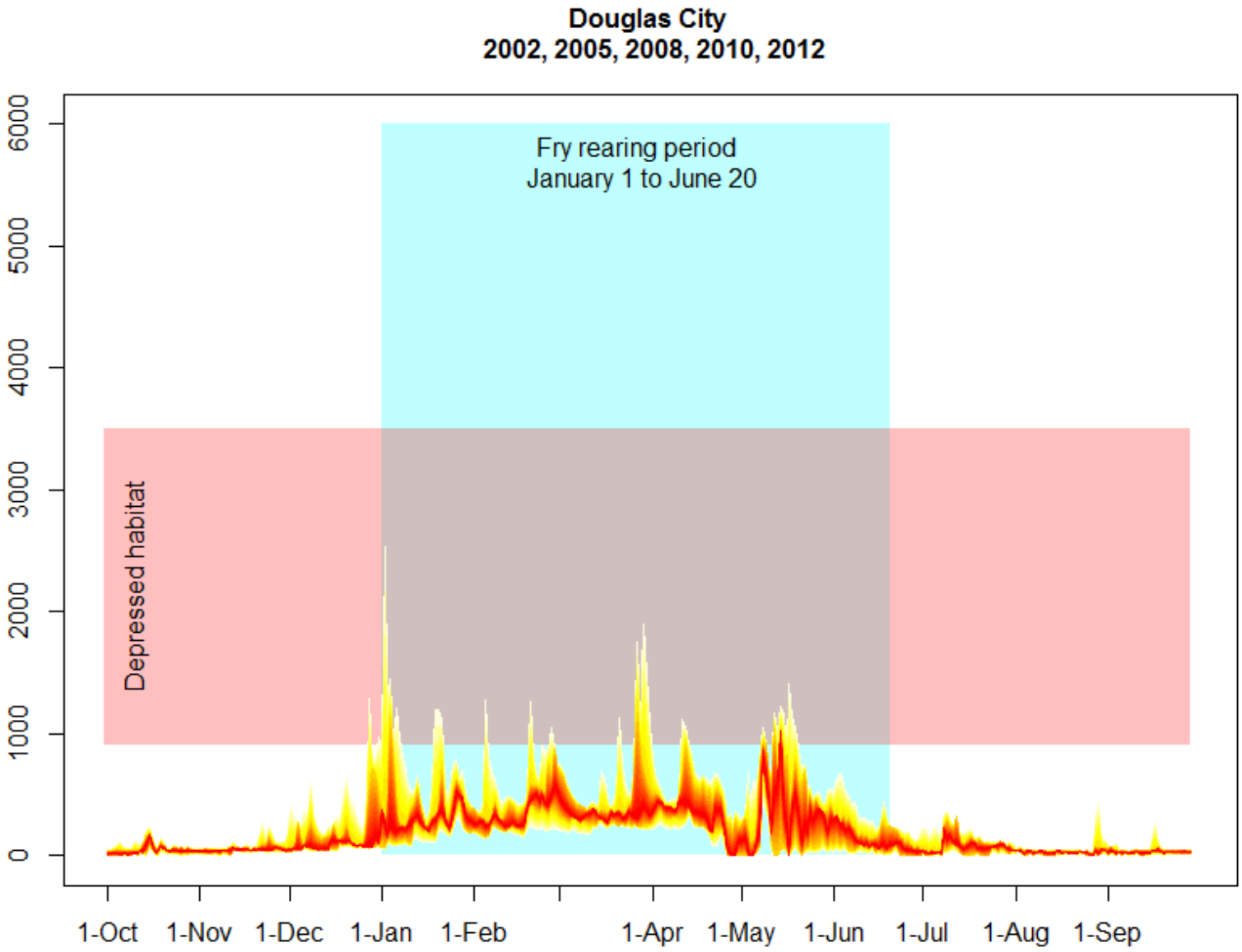
Wet


Above North Fork
2011
2011
Fry rearing period
January 1 to June 20
Depressed habitat
8000
6000
4000
2000
0
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep

Normal


Limekiln
1989, 2005, 2008, 2010, 2012
Fry rearing period
January 1 to June 20
Depressed habitat
0
1000
2000
3000
4000
5000
6000
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep

Normal


Douglas City
2002, 2005, 2008, 2010, 2012
Fry rearing period
January 1 to June 20
Depressed habitat
0
1000
2000
3000
4000
5000
6000
1-Oct
1-Nov
1-Dec
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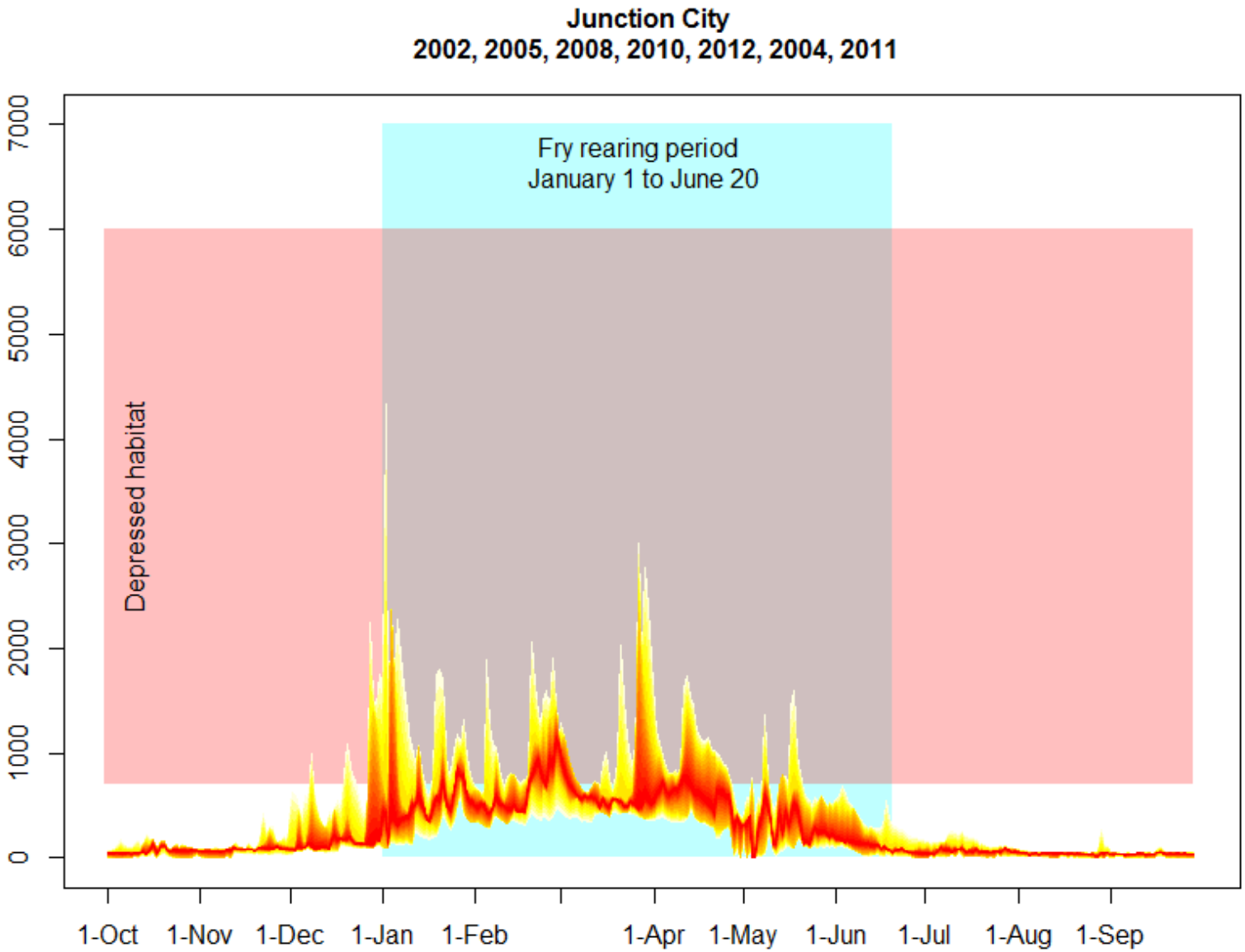
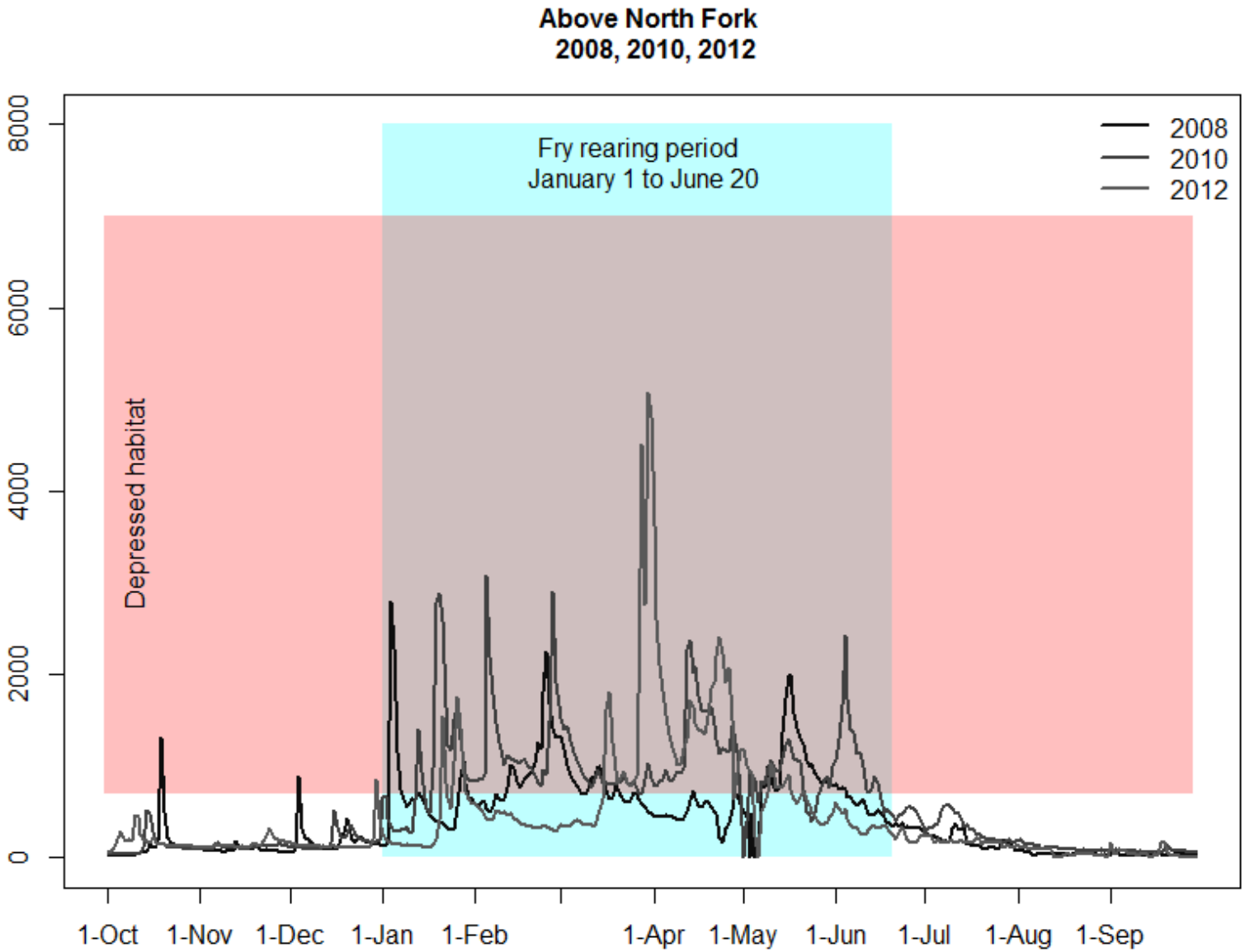
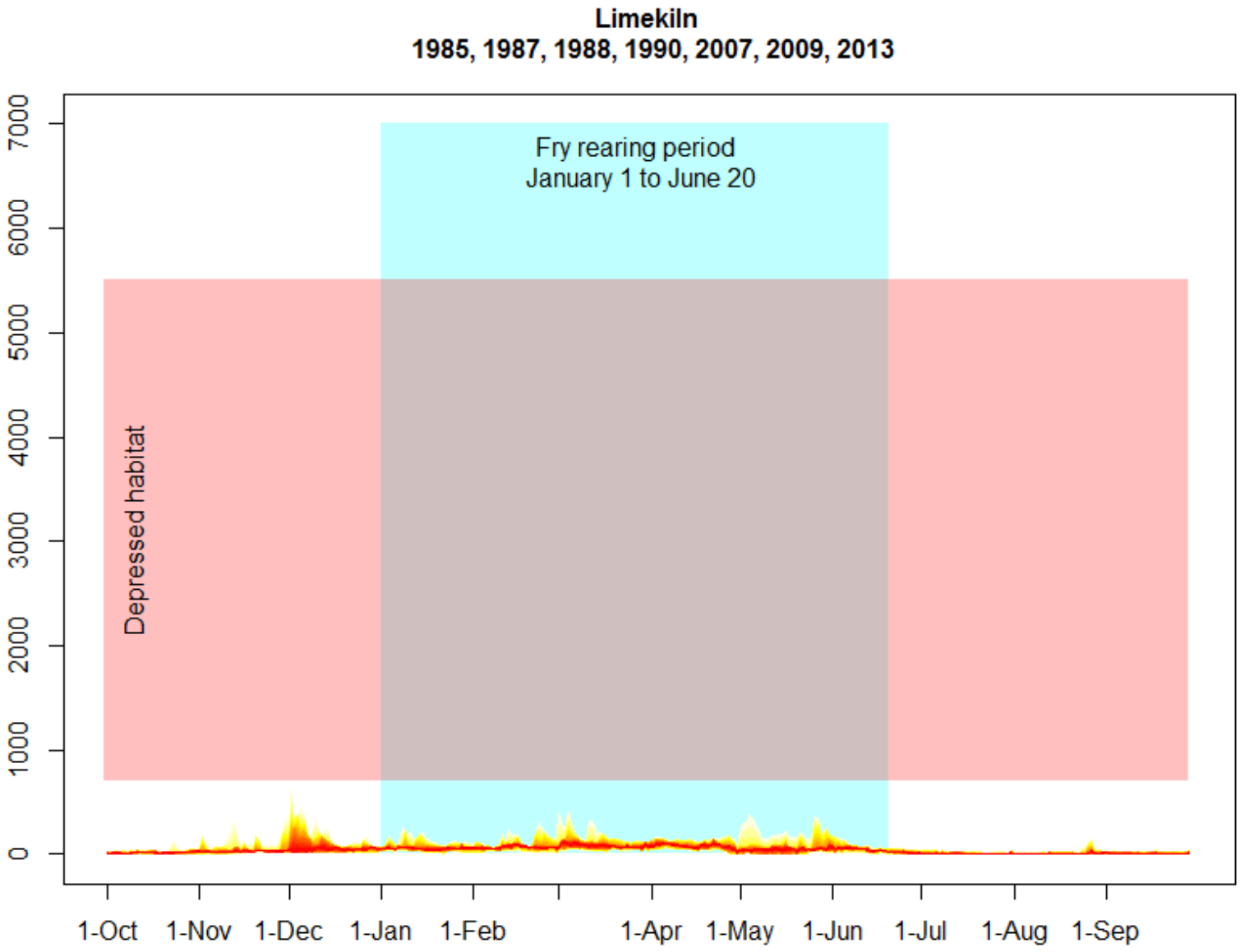
Normal


Junction City
2002, 2005, 2008, 2010, 2012, 2004, 2011
Fry rearing period
January 1 to June 20
Depressed habitat
0
1000
2000
3000
4000
5000
6000
7000
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep

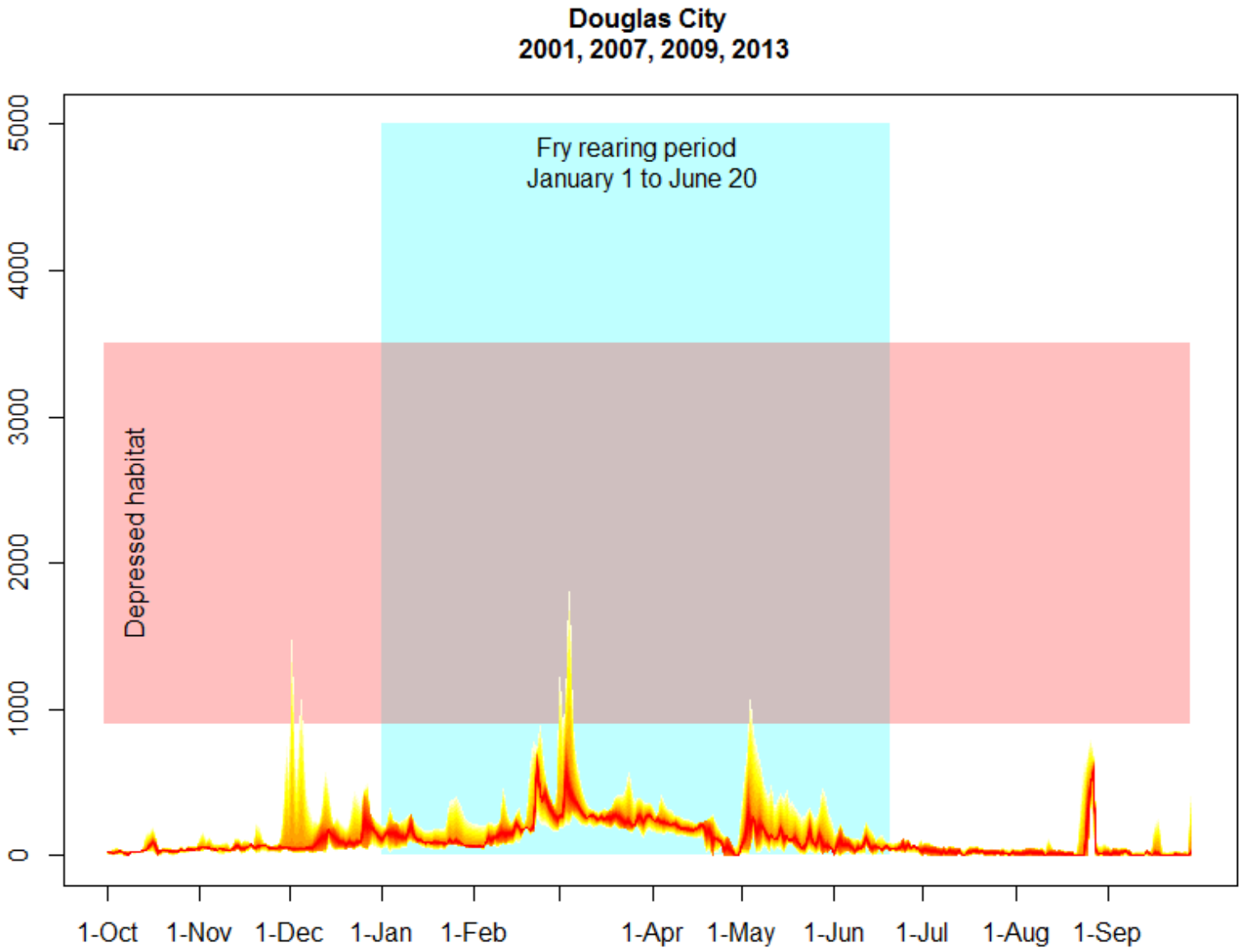
Normal


Above North Fork
2008, 2010, 2012
Fry rearing period
January 1 to June 20
Depressed habitat
2008
2010
2012
0
2000
4000
6000
8000
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep

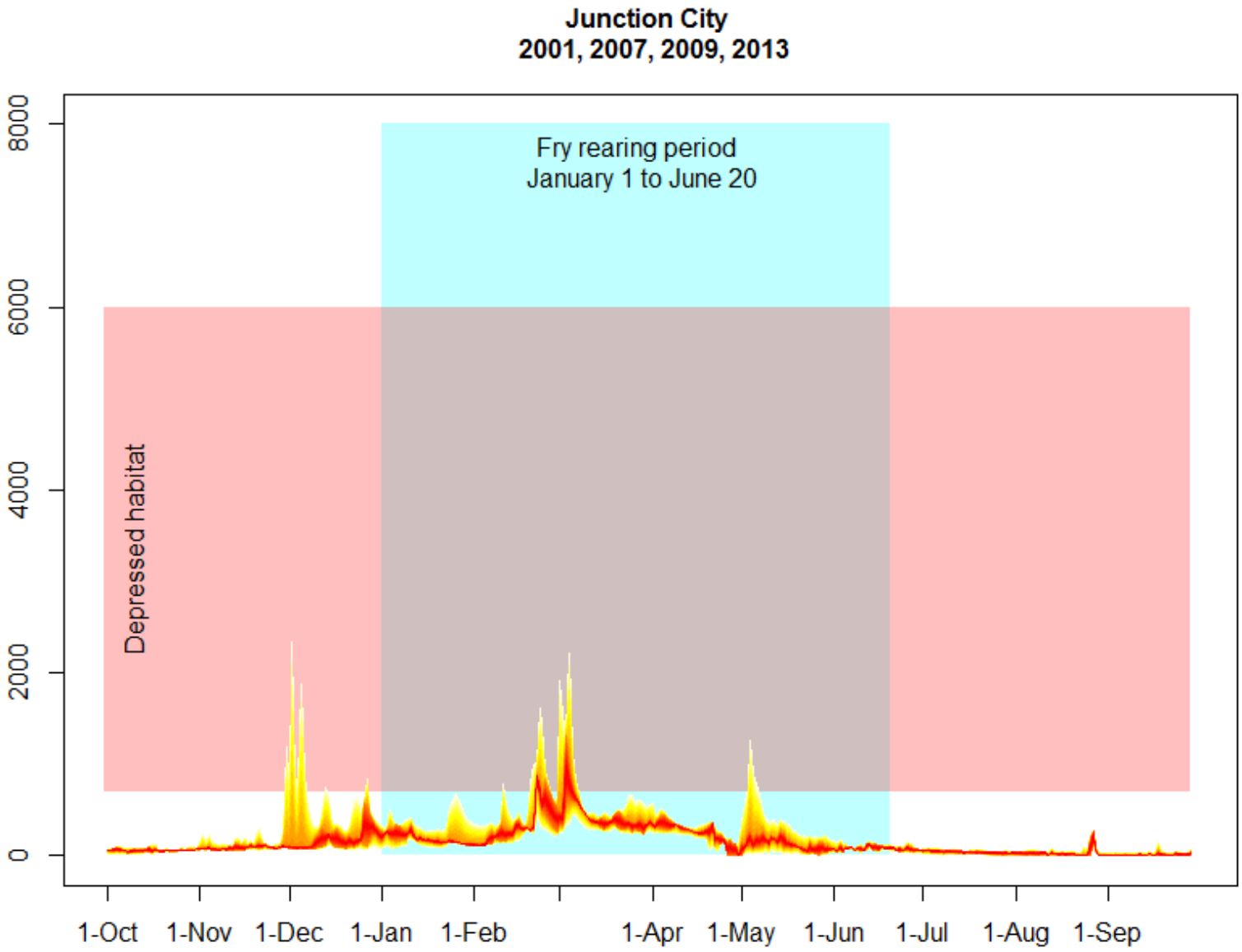
Dry


Limekiln
1985, 1987, 1988, 1990, 2007, 2009, 2013
Fry rearing period
January 1 to June 20
Depressed habitat
0
1000
2000
3000
4000
5000
6000
7000
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep

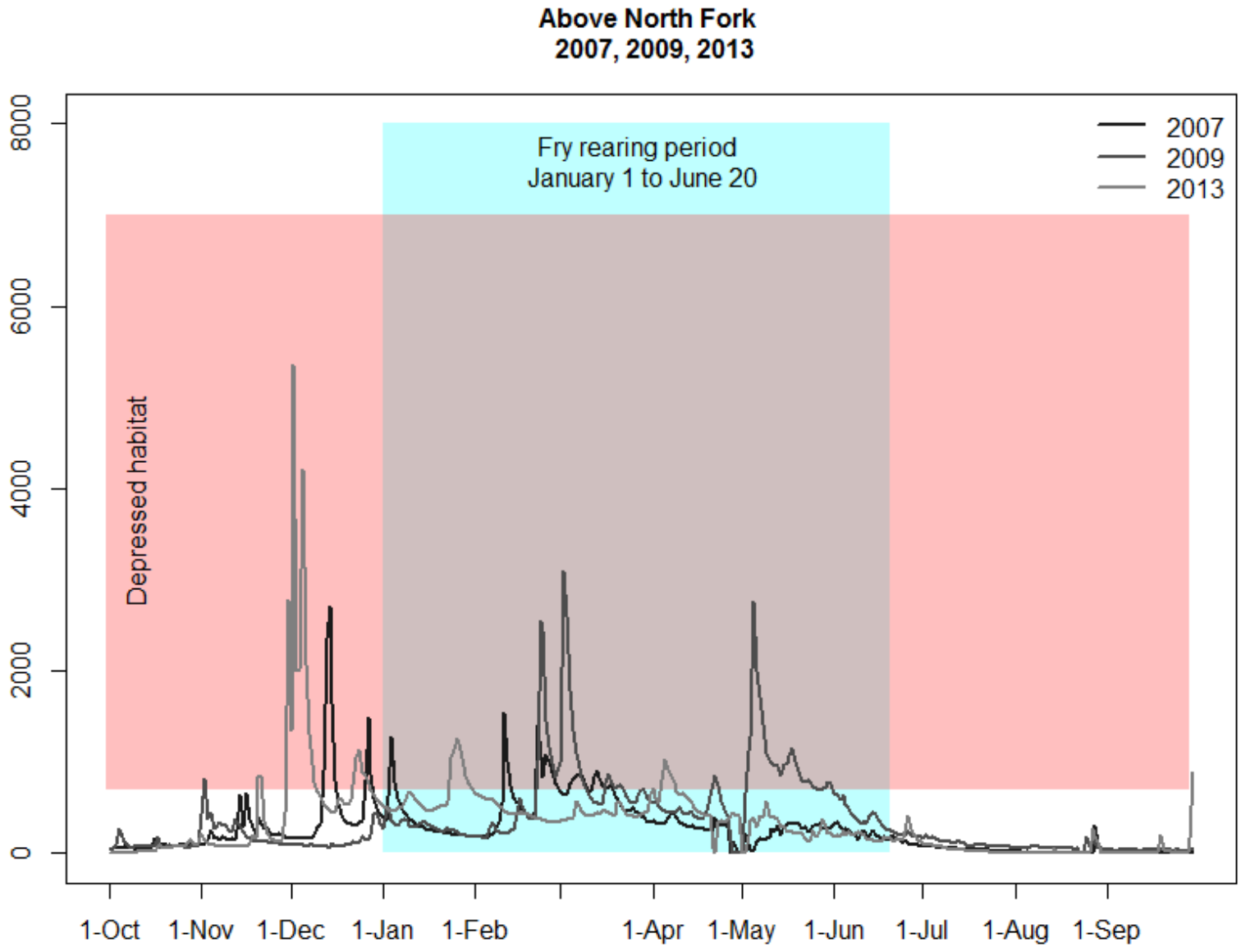
Dry


Douglas City
2001, 2007, 2009, 2013
Fry rearing period
January 1 to June 20
Depressed habitat
0
1000
2000
3000
4000
5000
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep

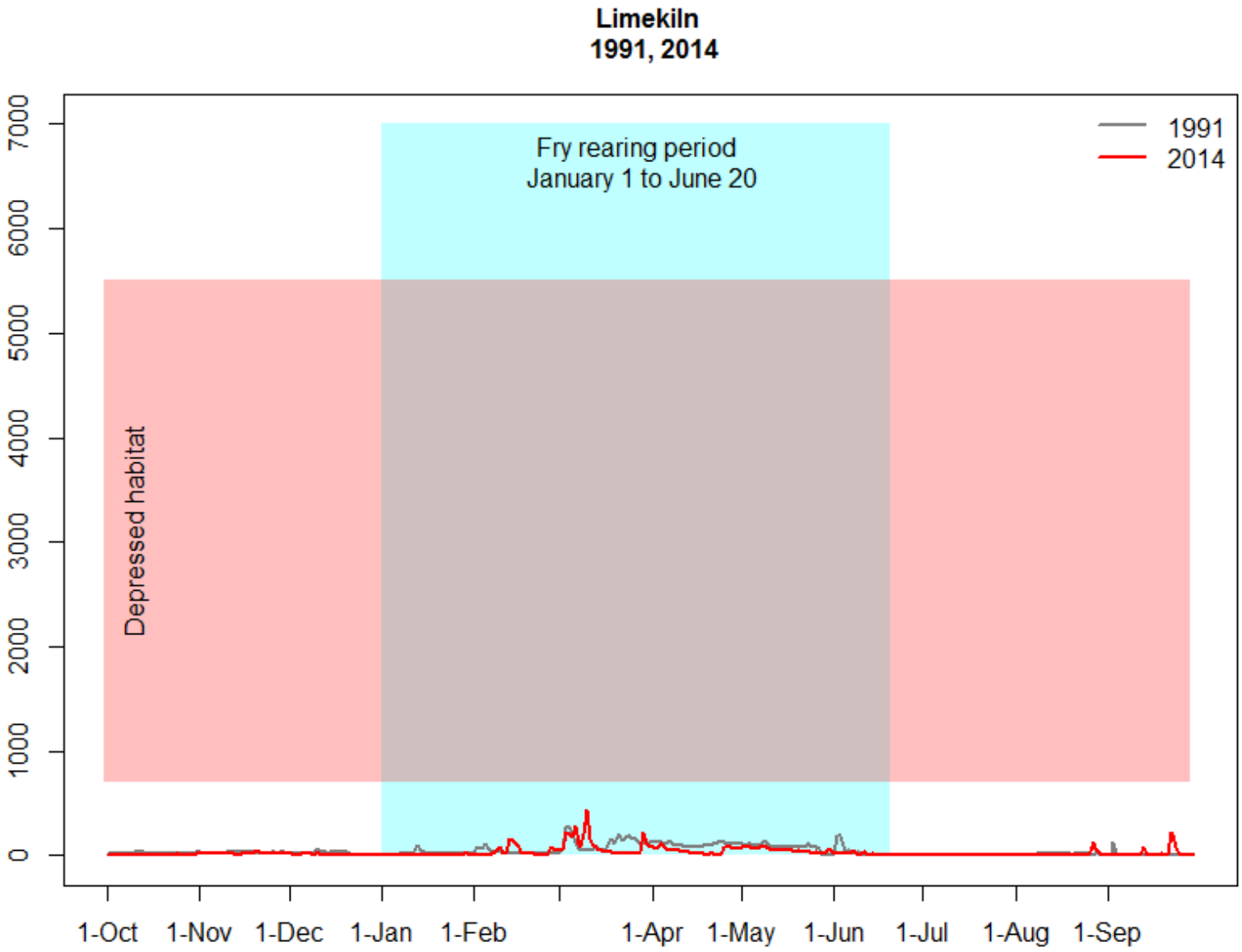
Dry


Junction City
2001, 2007, 2009, 2013
Fry rearing period
January 1 to June 20
Depressed habitat
0
2000
4000
6000
8000
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep

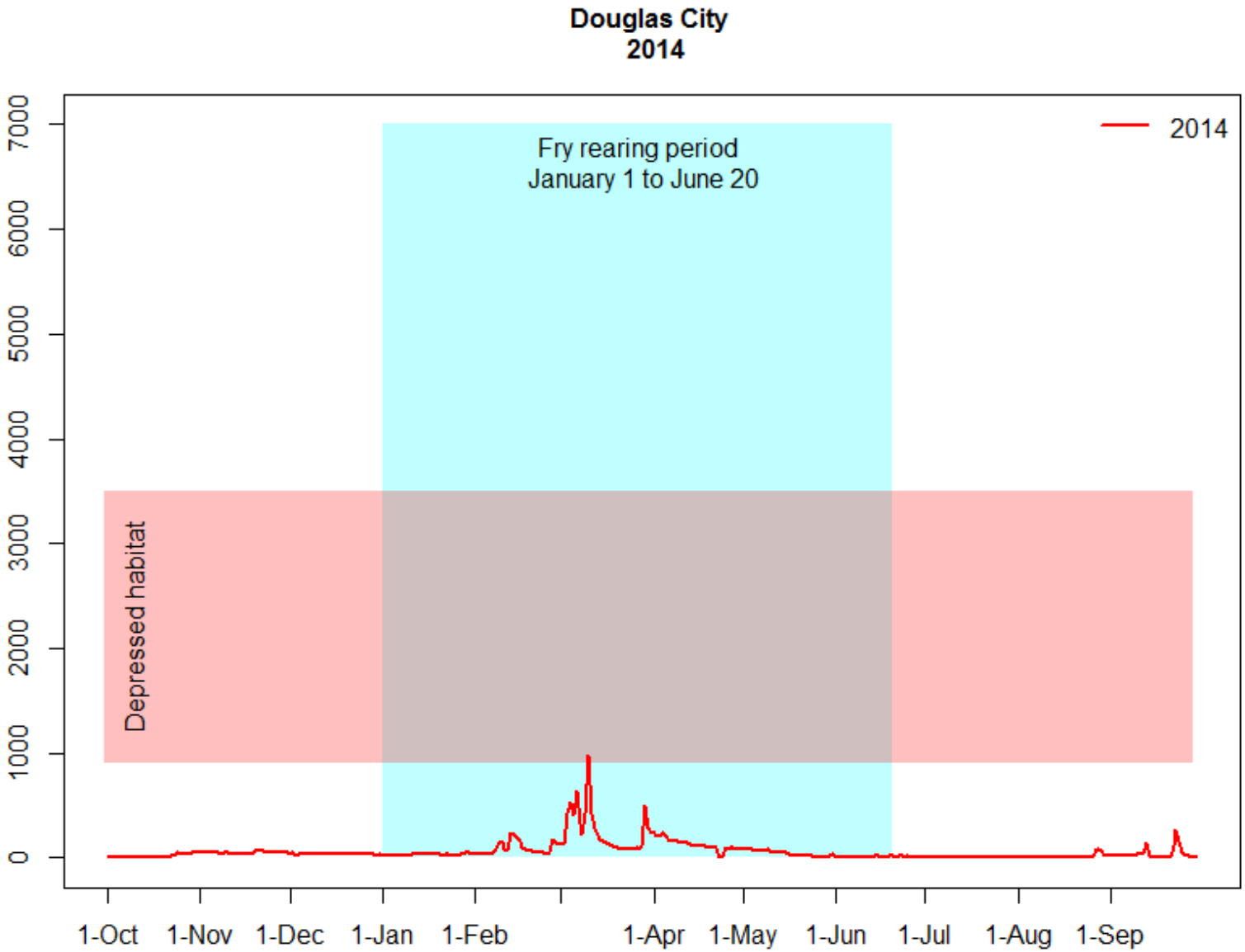
Dry


Above North Fork
2007, 2009, 2013
Fry rearing period
January 1 to June 20
Depressed habitat
2007
2009
2013
0
2000
4000
6000
8000
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep

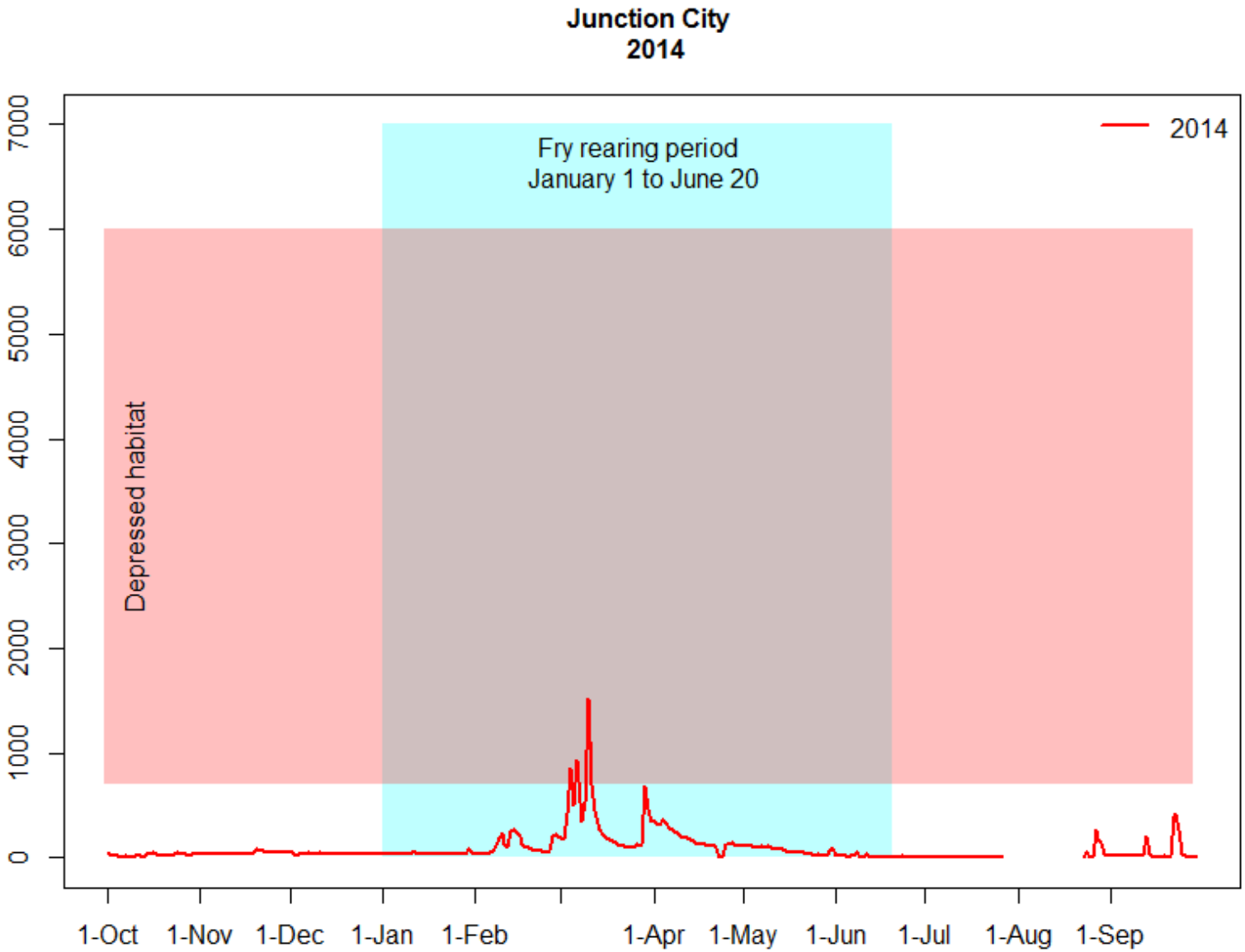
Critically dry



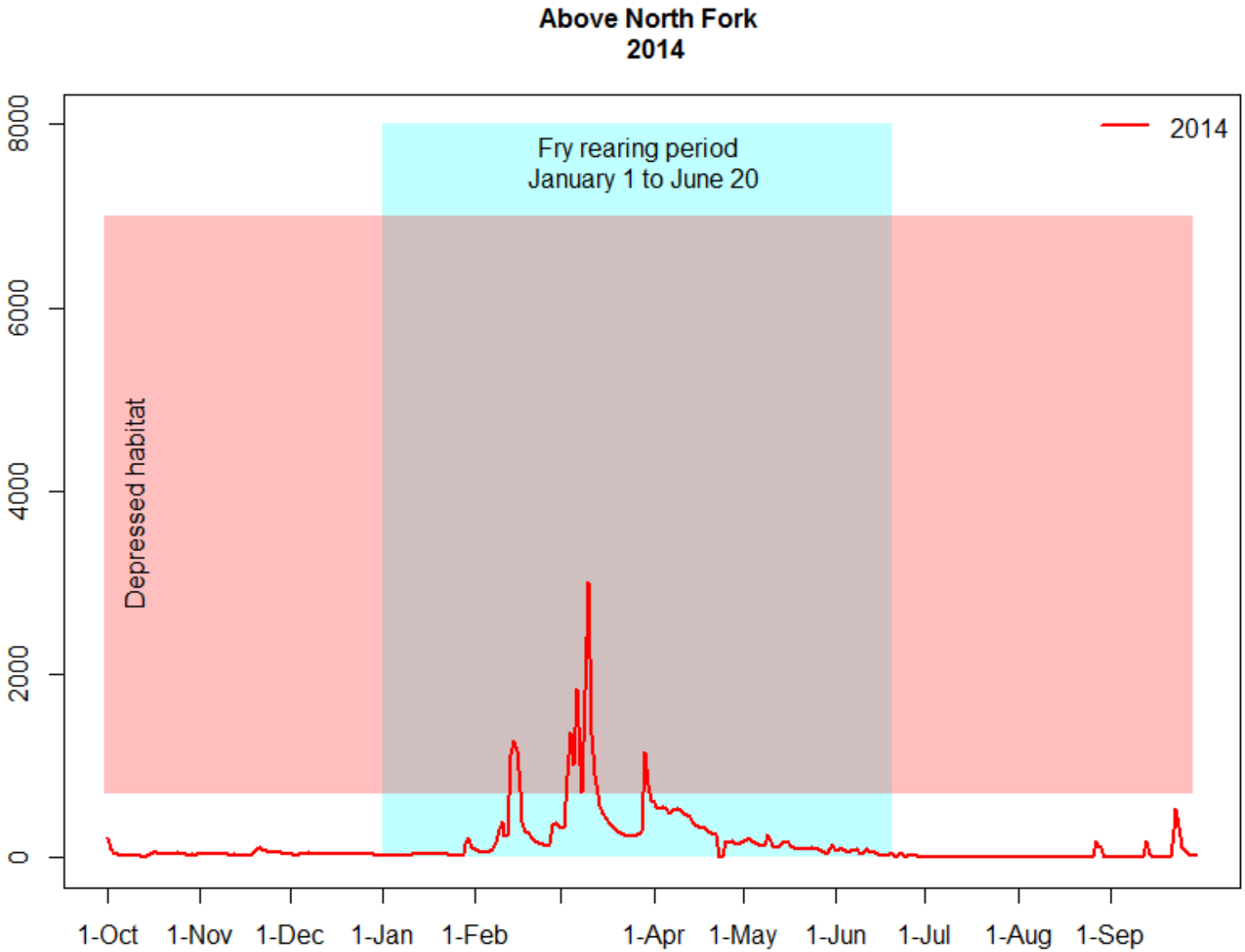
Critically dry

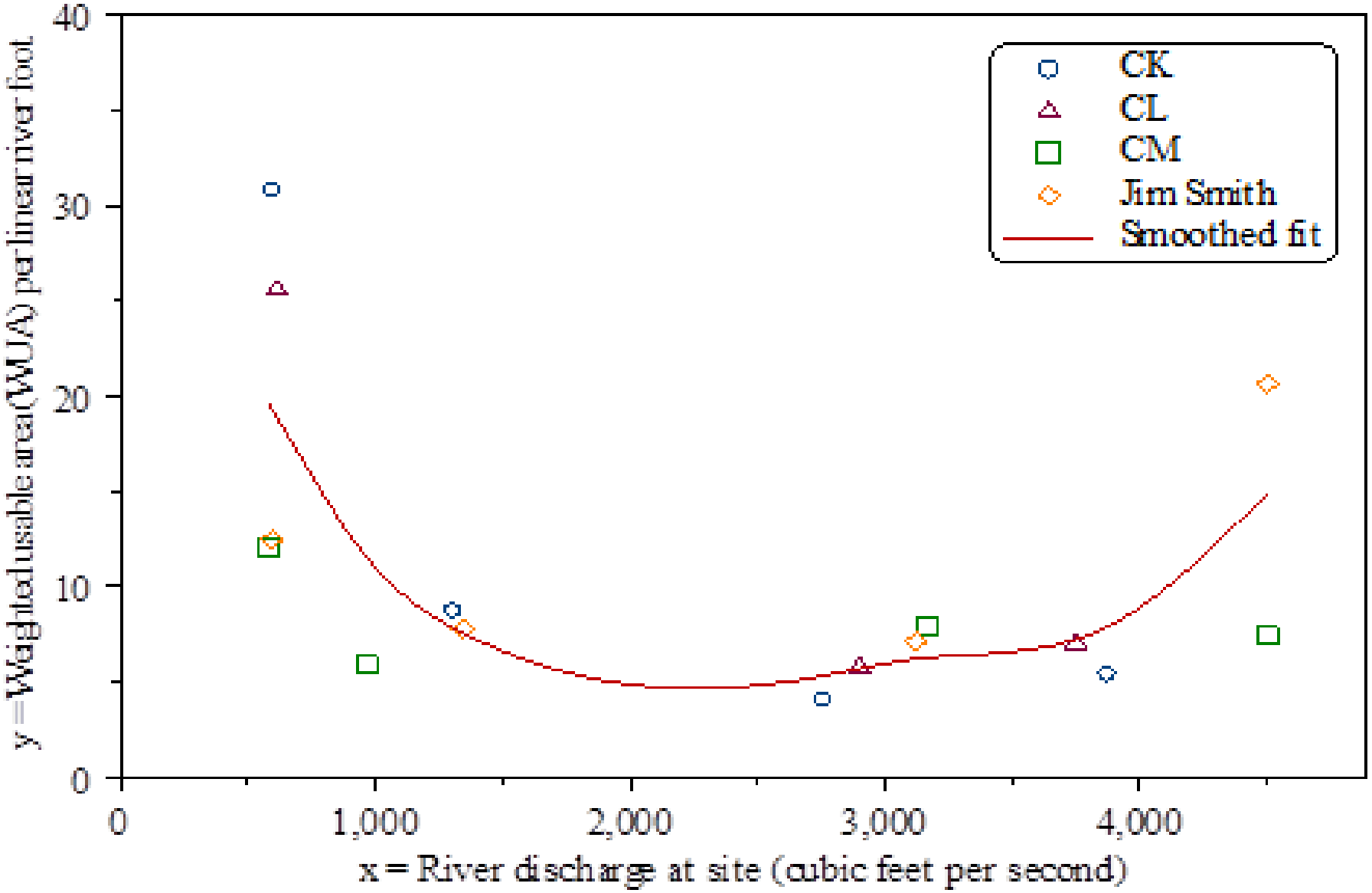


Critically dry

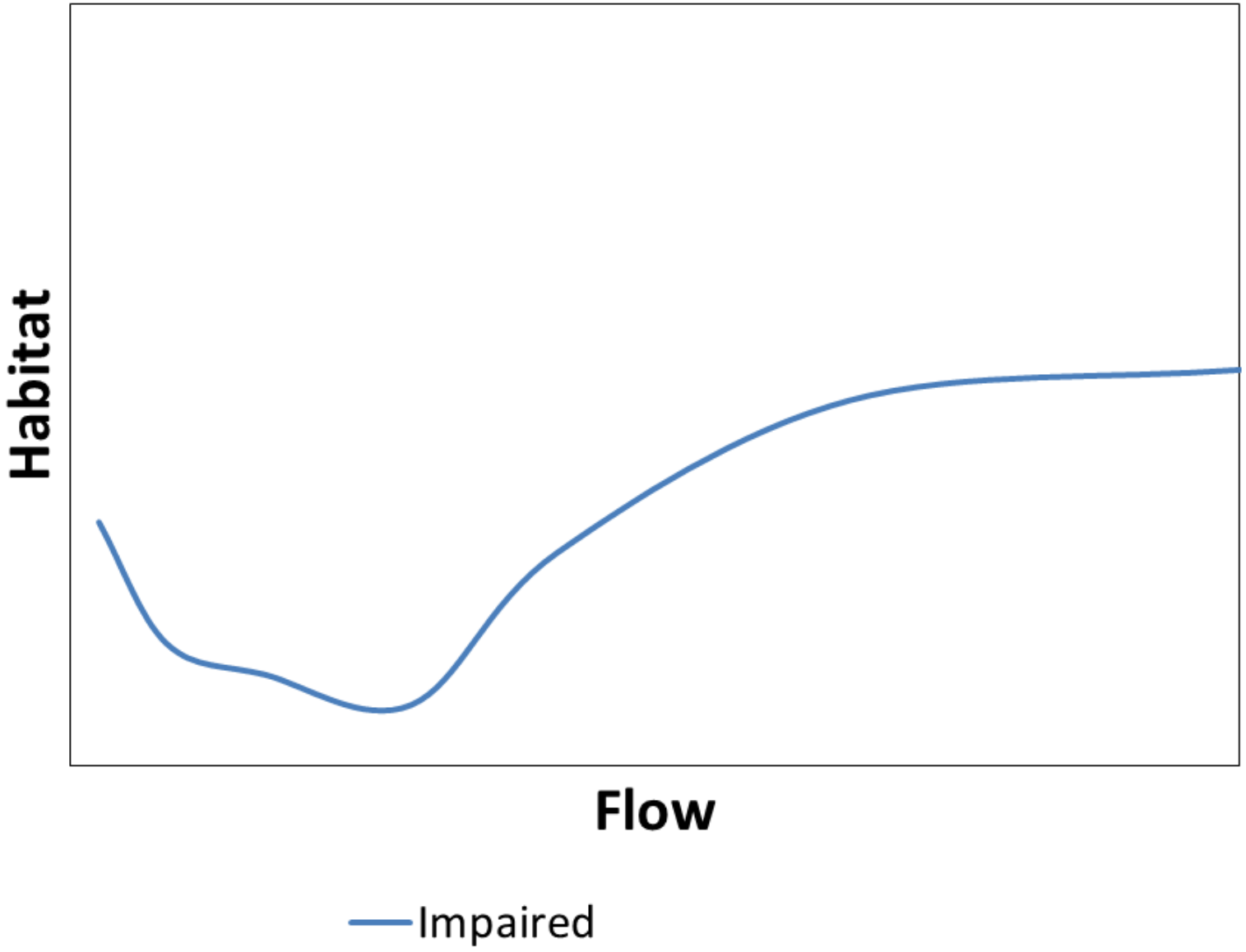


Critically dry

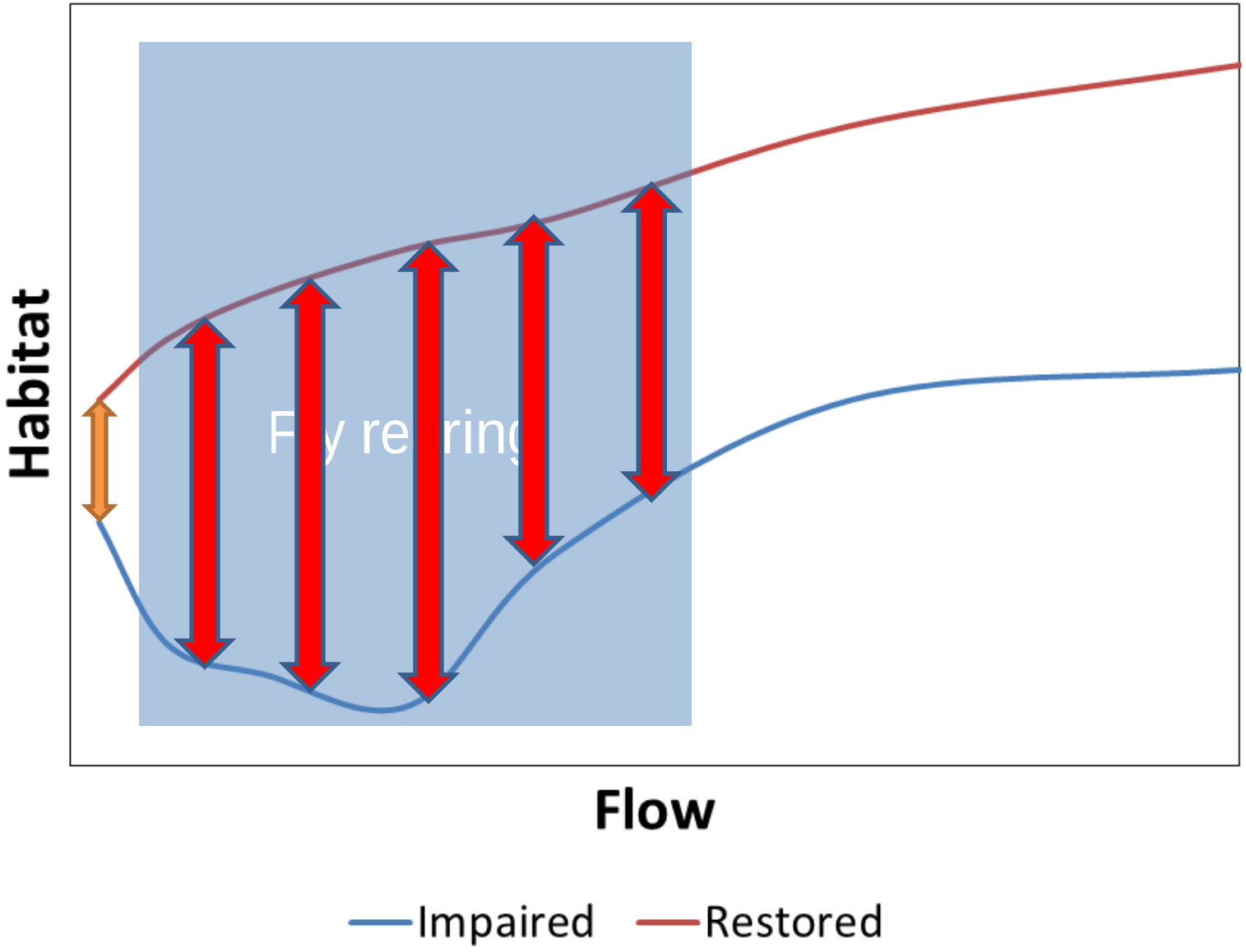



CK
CL
CM
Jim Smith
Smoothed fit
y = Weighted usable area (WUA) per linear river foot
x = River discharge at site (cubic feet per second)
0
10
20
30
40
0
1,000
2,000
3,000
4,000

Flow to habitat relationship



Flow to habitat relationship

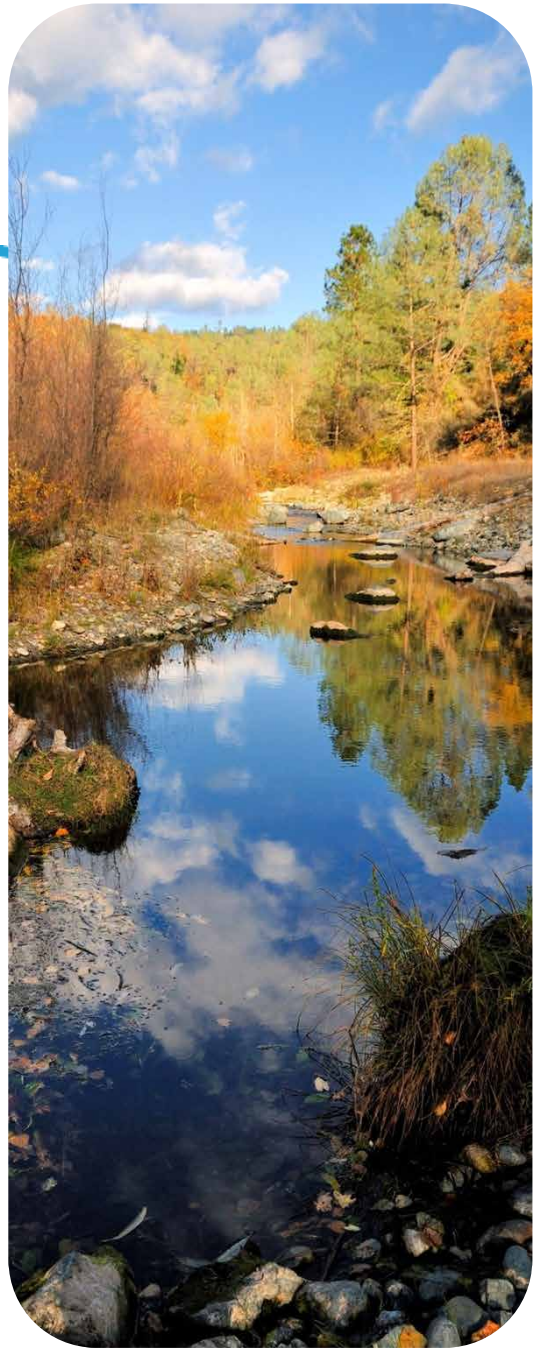


Trinity River near Trinity Center at the confluence of Swift Creek
(Photo date ca. 1910-1930)

Trinity River in the Minersville area (Photo date ca. 1910-1930)

Lessons Learned

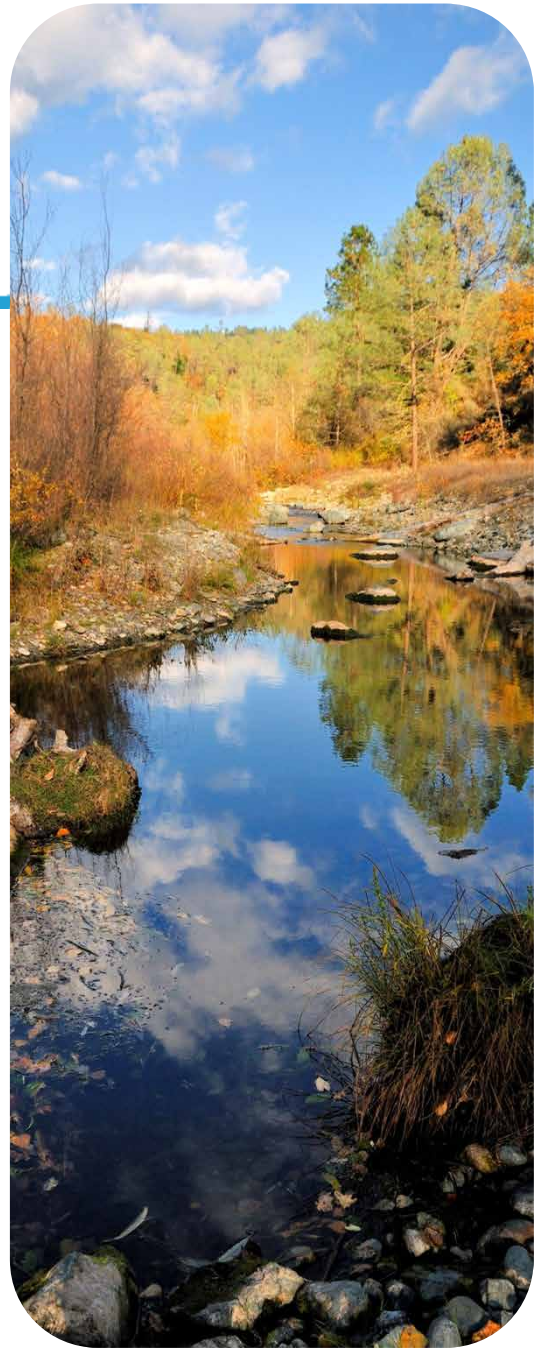
1. Total production needed from Trinity Basin yet to be defined
   a. A single thread low-flow channel is unlikely to be “sufficient”
2. Summer baseflow habitat is a weak metric for program success
   a. A multiple thread low-flow channel is also unlikely to be “sufficient”
3. Habitats that are engaged at intermediate flows are critical for improving mainstem salmon production



Channel Rehabilitation Workshop

What Happened to Berm Removal?
and
Why have the projects gotten so big?

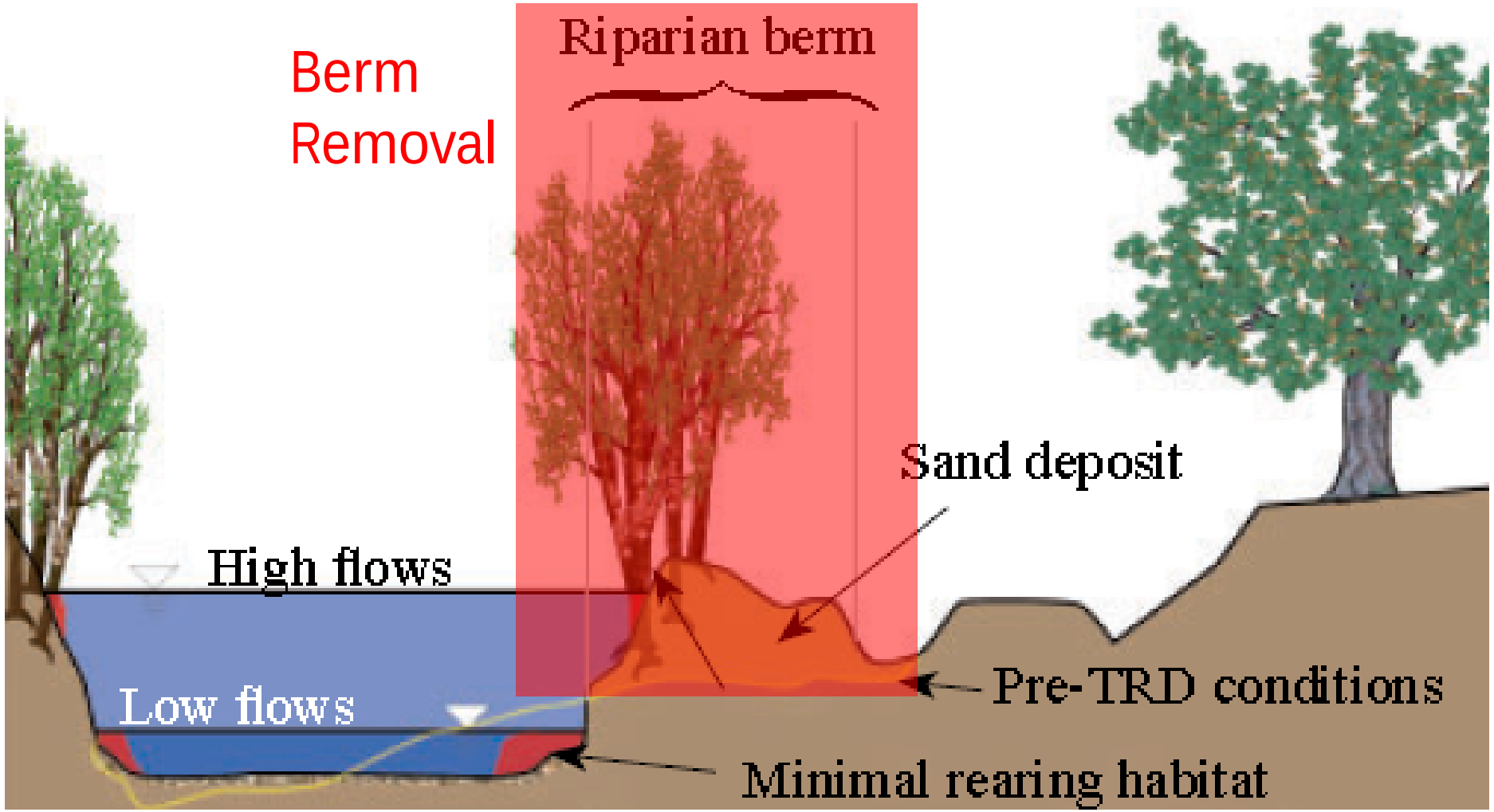
Andreas Krause
Yurok Tribe



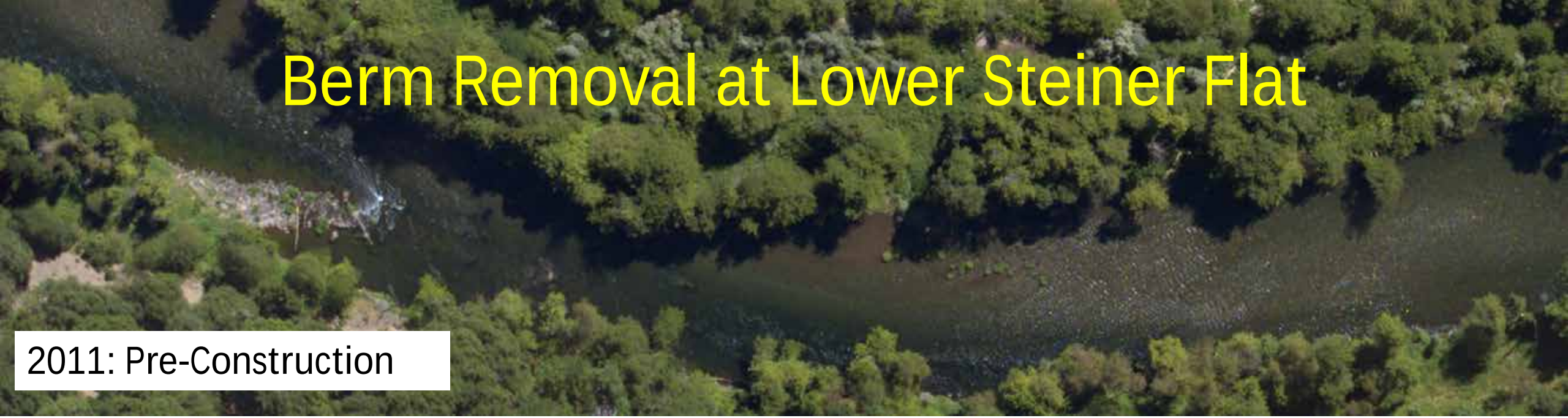
Channel Rehabilitation Intent

Increase alluvial nature of the river

What is a Riparian Berm?



Berm Removal at Lower Steiner Flat



2011: Pre-Construction

2013: Post Construction + 1 Flow Release

Why aren’t you completely removing all the vegetation?

<u>1999 Flow Study</u>

“Channel rehabilitation is not intended to remove all riparian vegetation, but remove vegetation in strategic locations to promote alluvial processes necessary for the restoration and maintenance of salmonid populations.”

Why don’t you do berm removal everywhere?

1999 Flow Study:

“Trinity River is a mix of alluvial and bedrock morphologies”

Bank Types

- Berms
- Bedrock
- Terraces
- Other

Recommended Channel Rehab Techniques

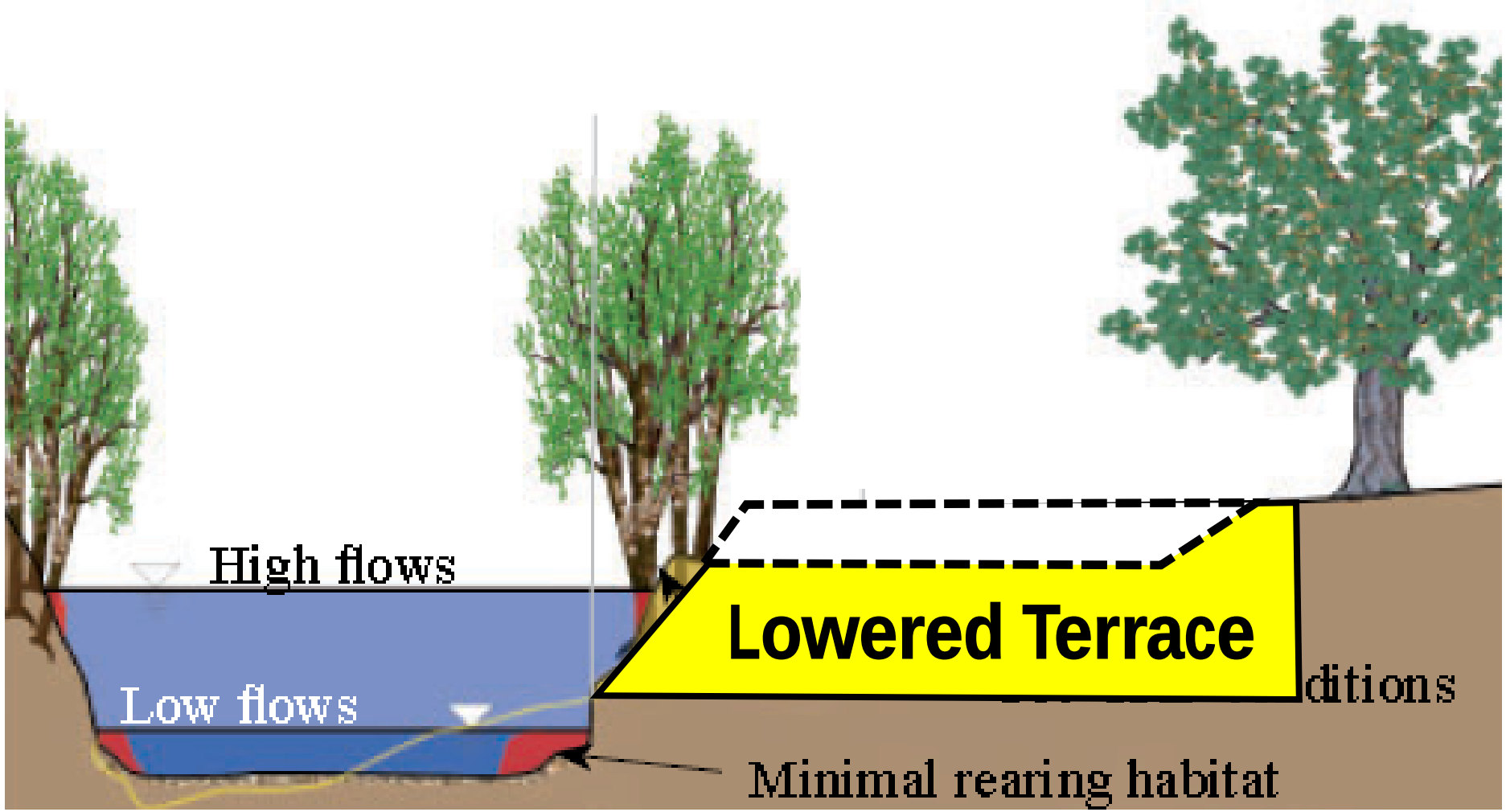
- Riparian berm removal
- Bar construction
- Reshape the channel
- Reshape floodplains and low terraces
- Construct functional floodplains
- Construct off-channel habitat and wetlands
- Build side channels
- If alluvial response not observed, more aggressive options should be pursued

What happened to Berm Removal?

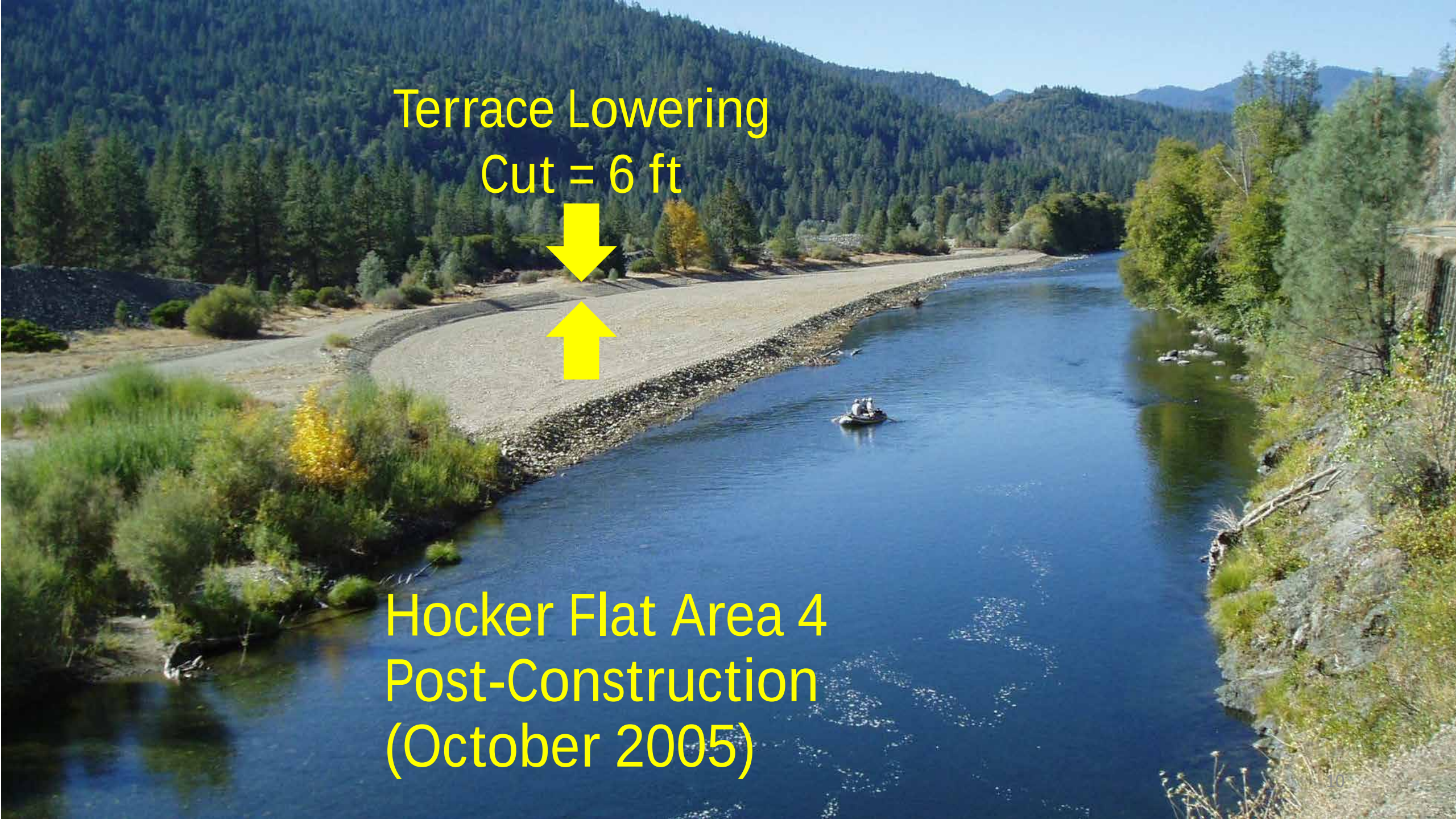
Berm removal is:

- One tool among many
- Still utilized where appropriate

Berms, Terraces, and “Big” Projects



Hocker Flat Area 4
Pre-Construction (March 2005)


Terrace Lowering
Cut = 6 ft
Hocker Flat Area 4
Post-Construction
(October 2005)

Winter Storm Dec. 2005
Photo at 14,000 cfs
Peak = 28,800 cfs

Hocker Flat Area 4
March 2006
2,000 cfs

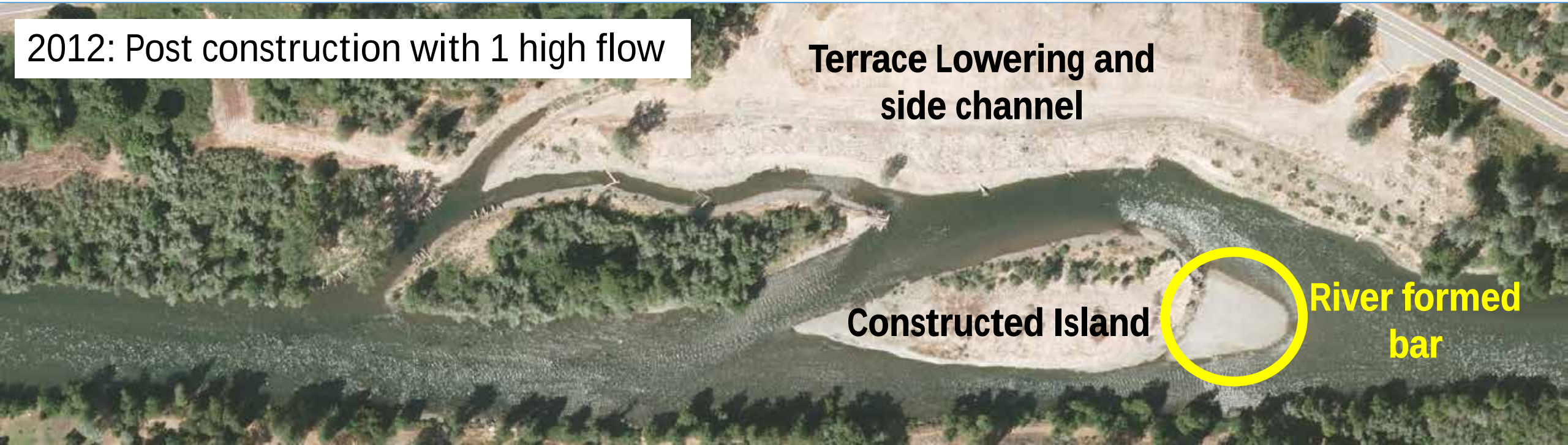
River formed bar
Hocker Flat Area 4
2013
300 cfs

Response Time

- Not directly addressed in 1999 Flow Study or 2000 ROD

Wheel Gulch

2010: Pre-Construction


2012: Post construction with 1 high flow
Terrace Lowering and side channel
Constructed Island
River formed bar

Response Time

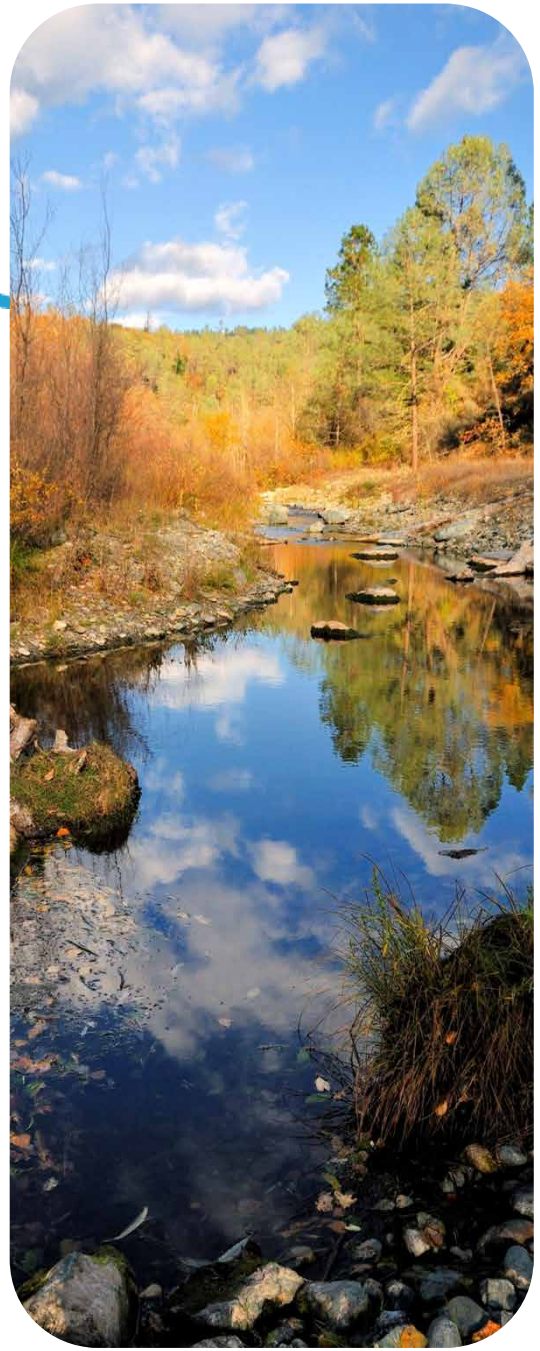
	Hocker Flat	Wheel Gulch
# Years to Form Bar	6	1
# Years with Flows > 7,500 cfs	5	0
Peak Flow (cfs)	28,800	6,990
Sediment Supply	Very High	Very High

Project Size and Complexity vs. Response Time

Larger, more complex projects implemented to speed up:

- Channel evolution
- Habitat creation
  - Post construction
  - Over time
- Fish response
- Adaptive Management Learning Cycle to inform future designs

Lessons Learned

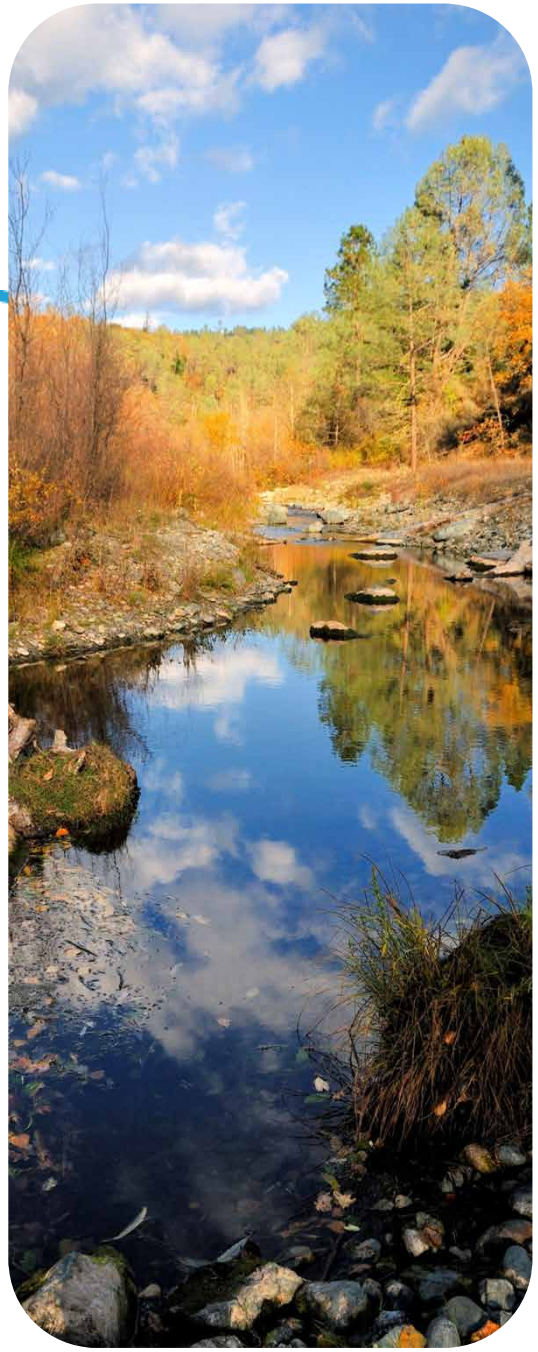


From SAB Phase 1 Review (page 32, 39)

1. The river is much less alluvial than originally envisioned
2. River terraces may require extensive cutting
3. Large-scale channel features may be needed to interact with flood flows and drive more rapid changes
4. The desired response time greatly influences the type and size of management actions

Channel Rehabilitation Workshop

Why are we pushing the river around so much?



David Gaeuman
Bureau of Reclamation

Rehabilitation Objectives
(Trinity River Record of Decision)

"The Preferred Alternative will restore the diverse fish habitat necessary to restore the anadromous fishery of the Trinity River."

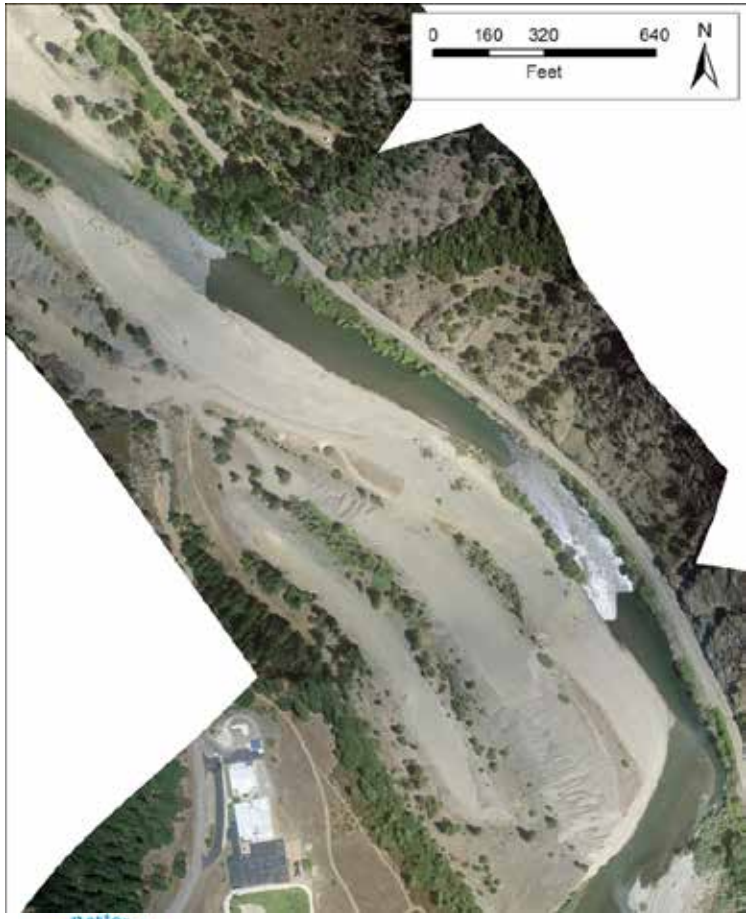
"…provide physical fish habitat (i.e., appropriate depths and velocities, and suitable temperature regimes for anadromous salmonids."

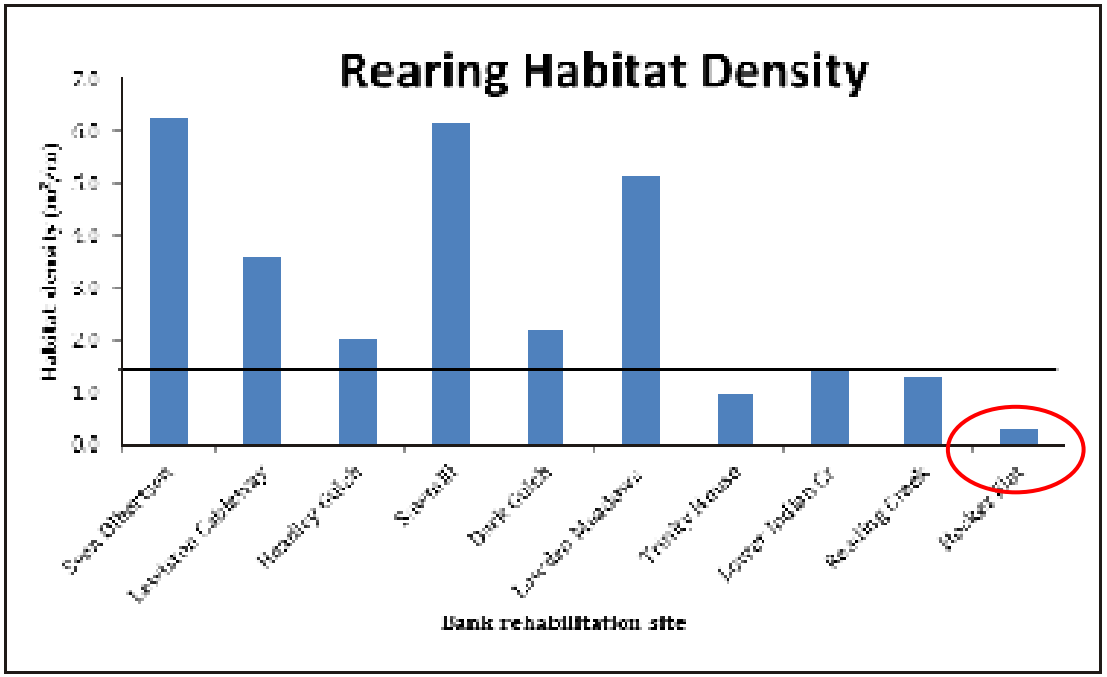
"..restore the riverine processes that create and maintain the structural integrity and spatial complexity of the fish habitats."

The ROD emphasizes physical habitat diversity and spatial complexity.

Feather Edges and Early TRRP Projects = Channel Widening

Produced neither process or much habitat





What is Physical Complexity?

This isn't it.

But maybe this is.

Planform curvature
Variable channel width
Variable depth
Shoreline rugosity
Bars and islands
Side channels
Alcoves
Riffles and pools
Deep scoured holes
Backwaters and eddys
Bedrock outcrops
Woody cover

Complexity Comes from Forcing Elements that "*push the river around*"

Johnson Point

Alcatraz

- Bedrock outcrops
- Valley curvature

- Boulders and colluvium
- Alluvial fans and deltas

Complexity Comes from Forcing Elements that "*push the river around*"

Sheridan Hole and Bar

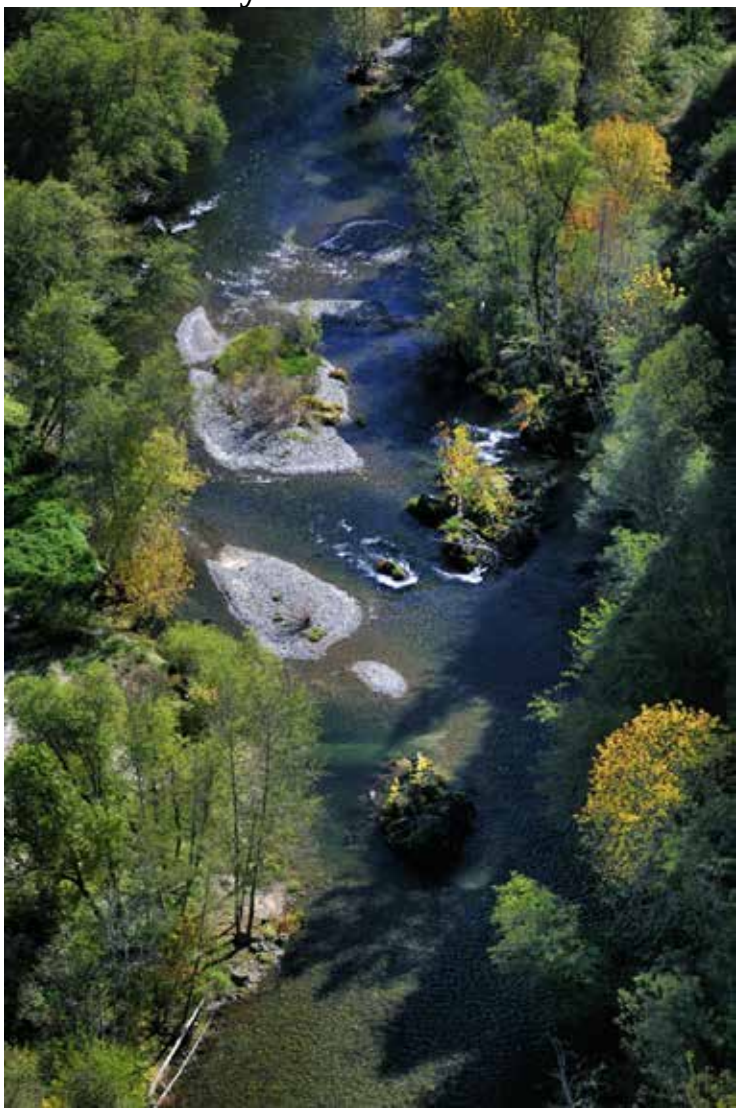
Hidden Bar

Goat Farm

- Bedrock outcrops
- Valley curvature
- Boulders and colluvium
- Alluvial fans and deltas

Complexity Comes from Forcing Elements that "*push the river around*"

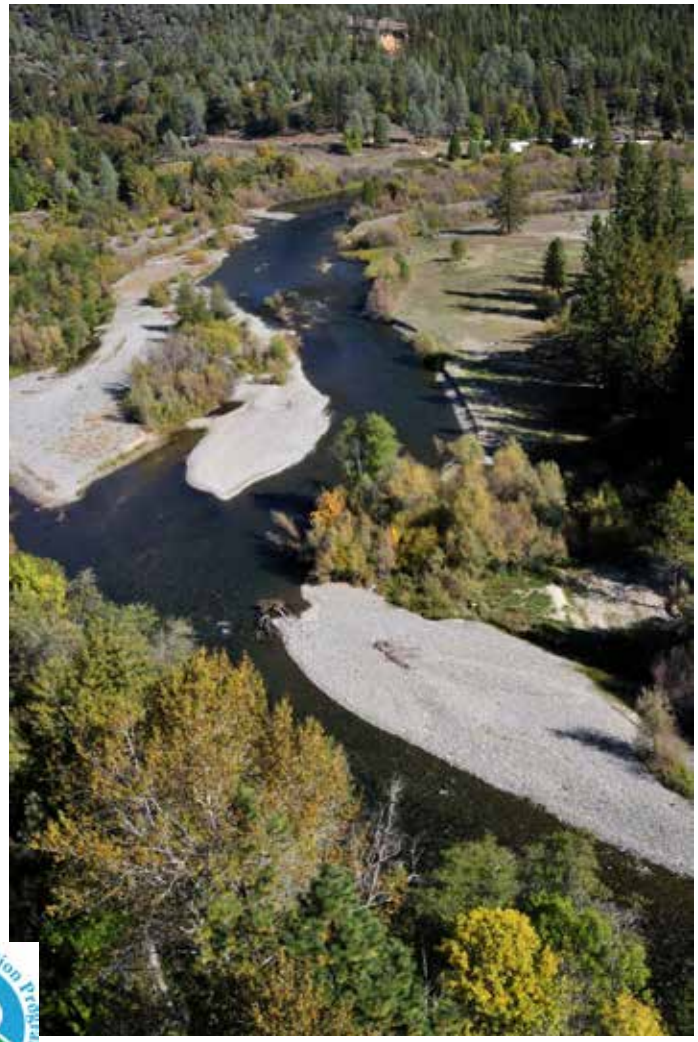
Near MacIntyre Gulch



Steiner Flat Road

Complexity Comes from Forcing Elements that "*push the river around*"

Rush Creek delta



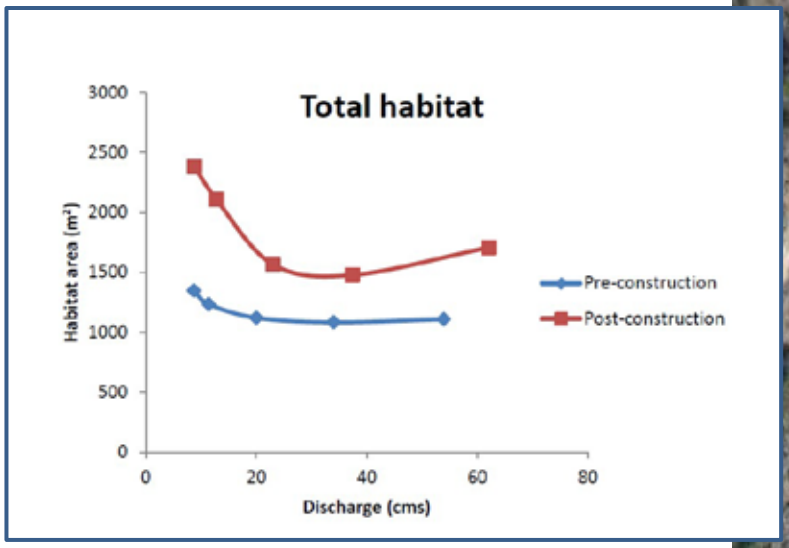
Oregon Gulch delta

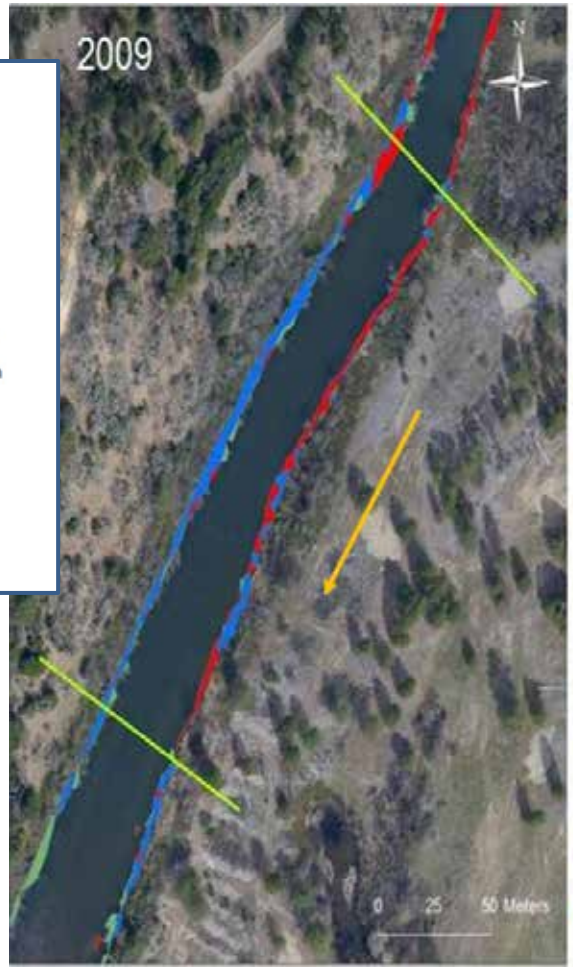
- Alluvial fans and deltas

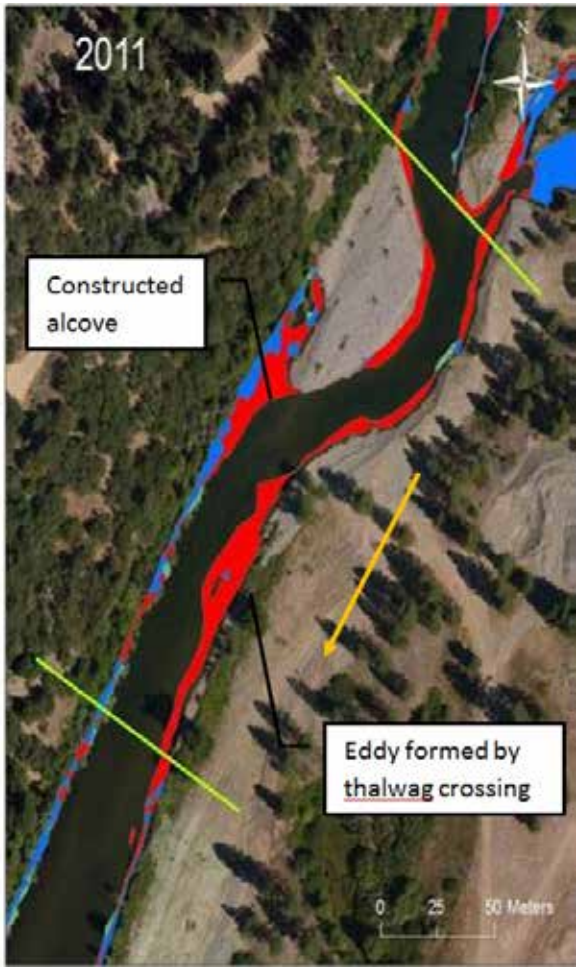
The Role of Large Wood

Lowden Ranch, 2010
The first large-scale forced meander

Lowden Ranch, 2010
The first large-scale forced meander







124% more fry habitat and 84% more presmolt habitat in the main channel.

231% more fry habitat and 252% more presmolt habitat overall.

Wheel Gulch, 2011

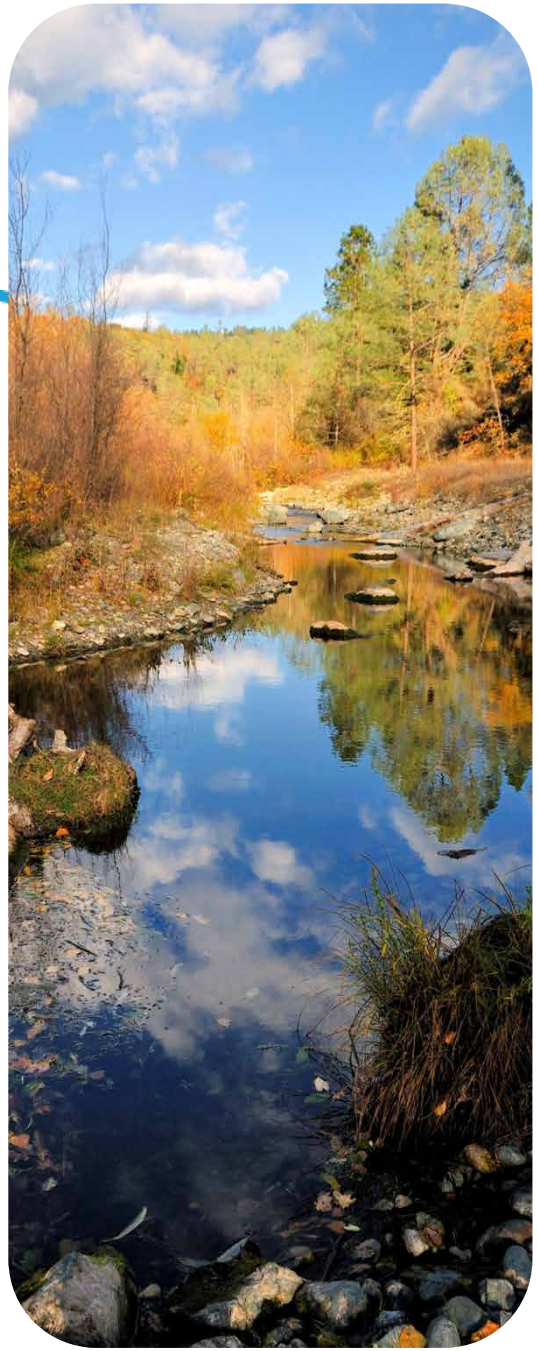
Upper Junction City, 2012

Lorenz Gulch, 2013

Lower Junction City, 2014

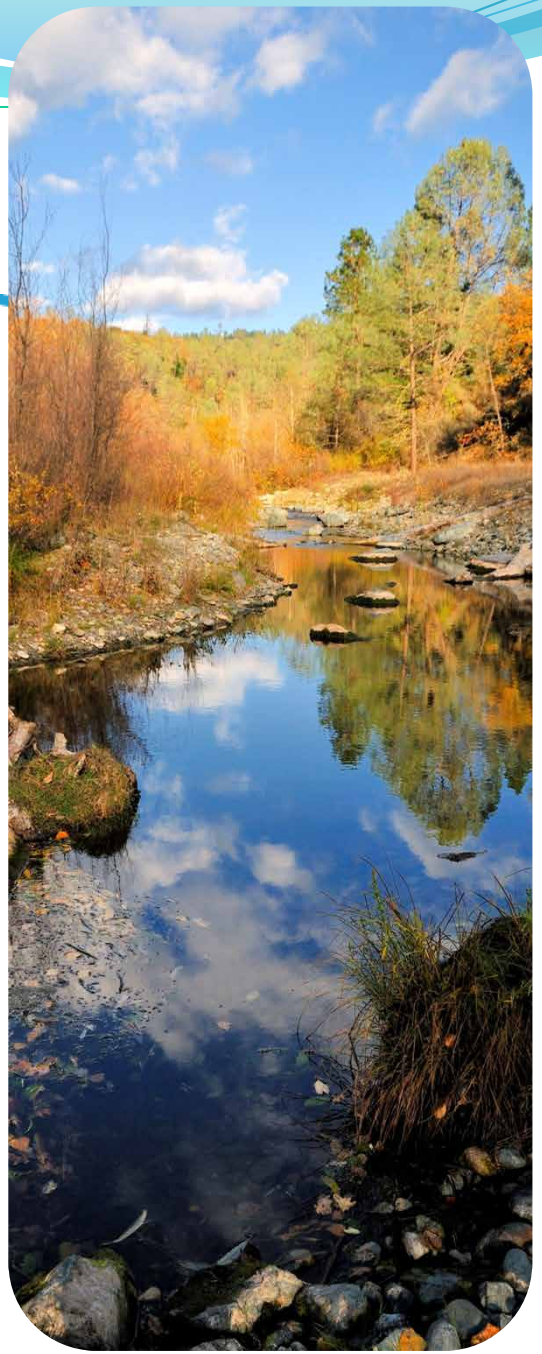
Lessons Learned

1. Complex channel morphology is associated with forcing elements, such as bedrock outcrops and valley curvature.
2. Forcing elements that concentrate flow stimulate a geomorphic response.

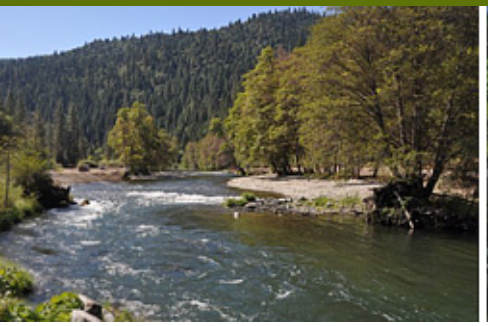
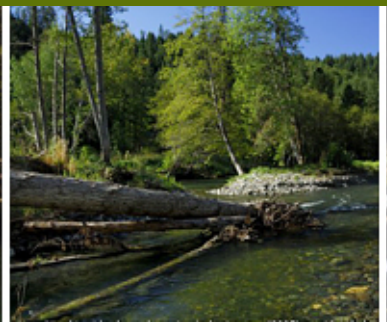
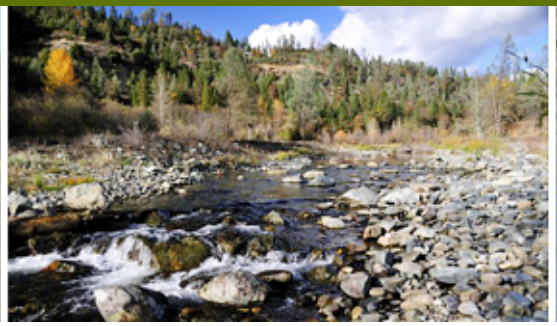
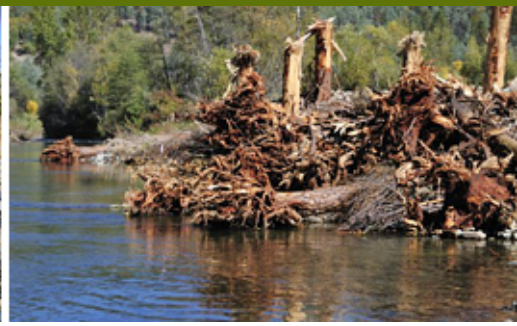


Channel Rehabilitation Workshop

Why are we using so much large wood in the channel rehabilitation projects?



DJ Bandrowski
Bureau of Reclamation, Trinity River Restoration Program
Wes Smith
Ocean Assoc Inc, NOAA Fisheries Contractor

Part A – DJ Bandrowski

- Existing Conditions
- Evolution of Wood Implementation on the Trinity
- How did we get here? – What does the Scientific Literature and Similar Restoration Projects Recommending?

- Part B – Wes Smith
- Applying the Science and Data to the Trinity
  - Historic Reference Condition on the Trinity
  - Approaches to Estimating Large Wood Additions
- Future Large Wood Management on the Trinity

Part A – DJ Bandrowski

- Existing Conditions
- Evolution of Wood Implementation on the Trinity River
- How did we get here? – What does the Scientific Literature and Similar Restoration Projects Recommending?

Why don't you see more wood currently in the Trinity River (Existing Conditions):

- Mining removed valley bottom tree stands and stored wood
- Dams block large wood transport and flow releases limit transport
- Logging depleted hillslope wood and limits future recruitment
- Limited re-growth in river corridor
- Primarily alder and willow lining the channel
- Record of Decision – Didn't prescribe wood…

IT'S LIMITED BUT THERE IS EXISTING WOOD IN THE TRINITY SYSTEM

Limekiln

McIntyre Gulch

LARGE WOOD EVOLUTION – THE EARLY YEARS

LARGE WOOD EVOLUTION – THE LATER YEARS

What is the Science Telling us About Wood:

- Large wood creates and maintains complex and diverse channel morphology and aquatic habitat
  - Increases Aquatic and Terr. Habitat (Juvenile/Adults, Wildlife)
  - Increases Hydraulic Complexity (Low Flow and High Flow)
  - Increases Physical Process (Bed Texture, Sed. Supply, Pools)
  - Increases Biological Utilization (Fish, Macros, Wildlife, etc.)
  - Increases Food Web and Nutrients
  - Floodplain Dynamics

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Geomorphology

journal homepage: www.elsevier.com/locate/geomorph

The floodplain large-wood cycle hypothesis: A mechanism for the physical and biotic structuring of temperate forested alluvial valleys in the North Pacific coastal ecoregion

Brian D. Collins [a,*], David R. Montgomery [a], Kevin L. Fetherston [b], Tim B. Abbe [c]

[a] Department of Earth and Space Sciences and Quaternary Research Center, University of Washington, Seattle, WA 98195, USA
[b] R2 Resource Consultants, Redmond, WA 98052, USA
[c] Geoline ENTRIX Inc., Seattle, WA 98119, USA

RIVER RESEARCH AND APPLICATIONS

River Res. Applic. (2011)

Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/rra.1481

JUVENILE SALMON RESPONSE TO THE PLACEMENT OF ENGINEERED LOG JAMS (ELJS) IN THE ELWHA RIVER, WASHINGTON STATE, USA

G. R. PESS,[a*] M. C. LIERMANN,[a] M. L. MCHENRY,[b] R. J. PETERS[c] and T. R. BENNETT[a]

[a] *NOAA Fisheries, Northwest Fisheries Science Center, Seattle, Washington, USA*
[b] *Lower Elwha Klallam Tribe, Port Angeles, Washington, USA*
[c] *United States Fish and Wildlife Service (USFWS), Suite 102, Lacey, Washington, USA*

LARGE WOOD EVOLUTION AND FLOODPLAIN DYNAMICS

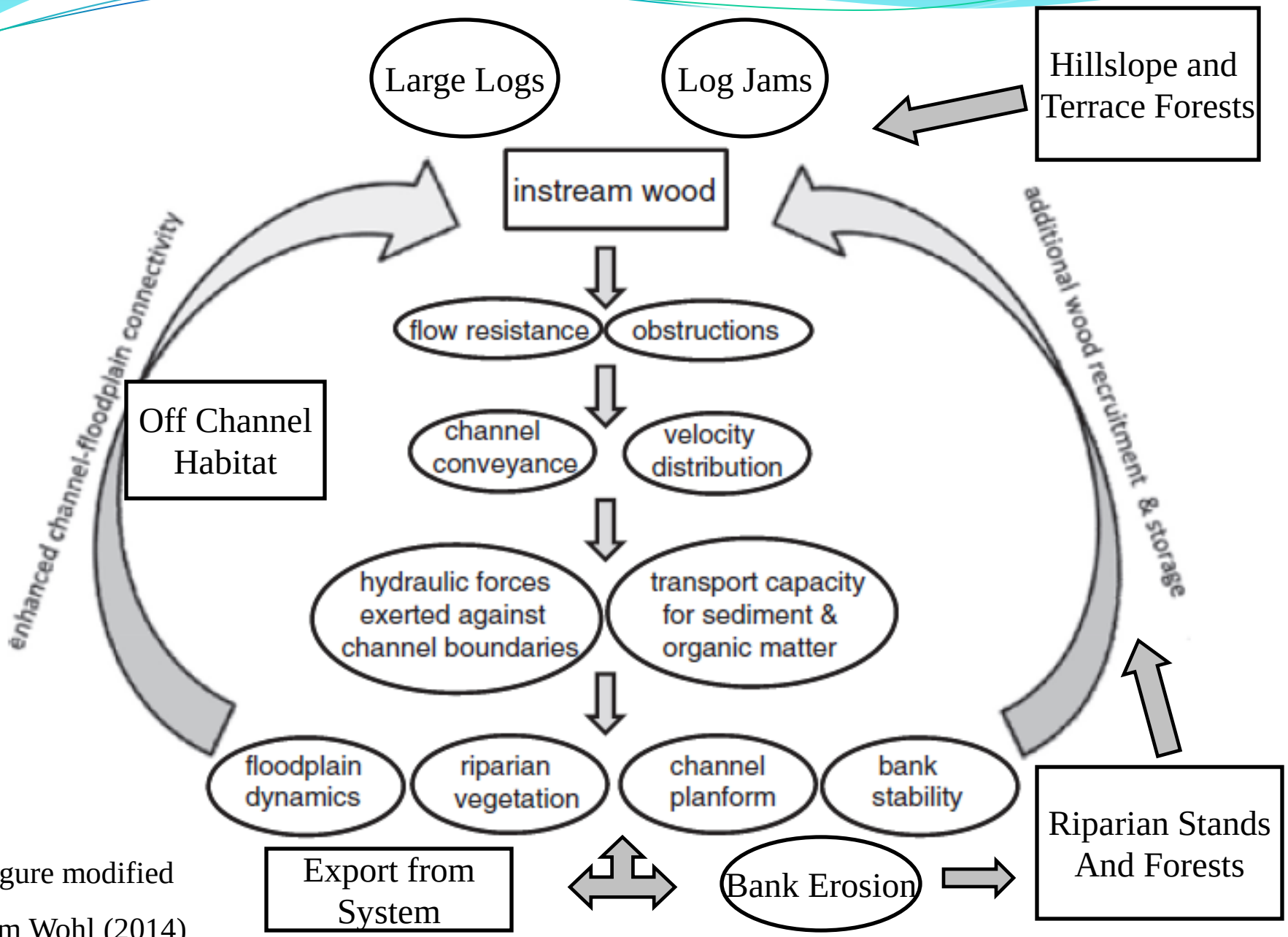
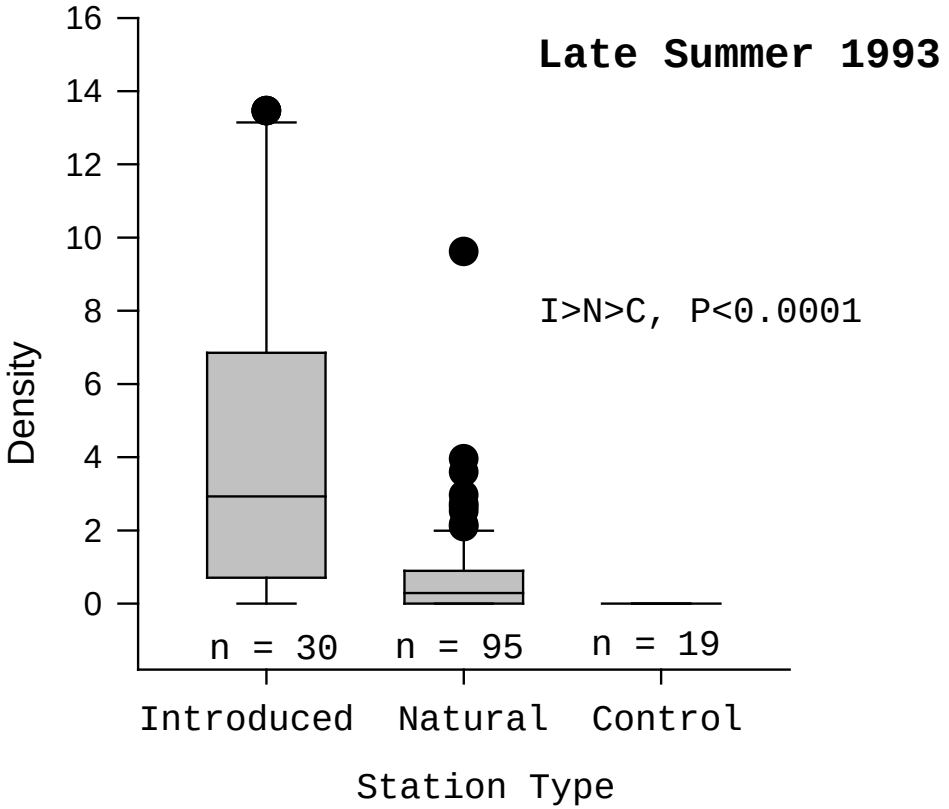


Figure modified from Wohl (2014)

HABITAT RELATIONSHIPS WITH LARGE WOOD

•Juvenile coho salmon distribution and abundance influenced by wood in a large river channel



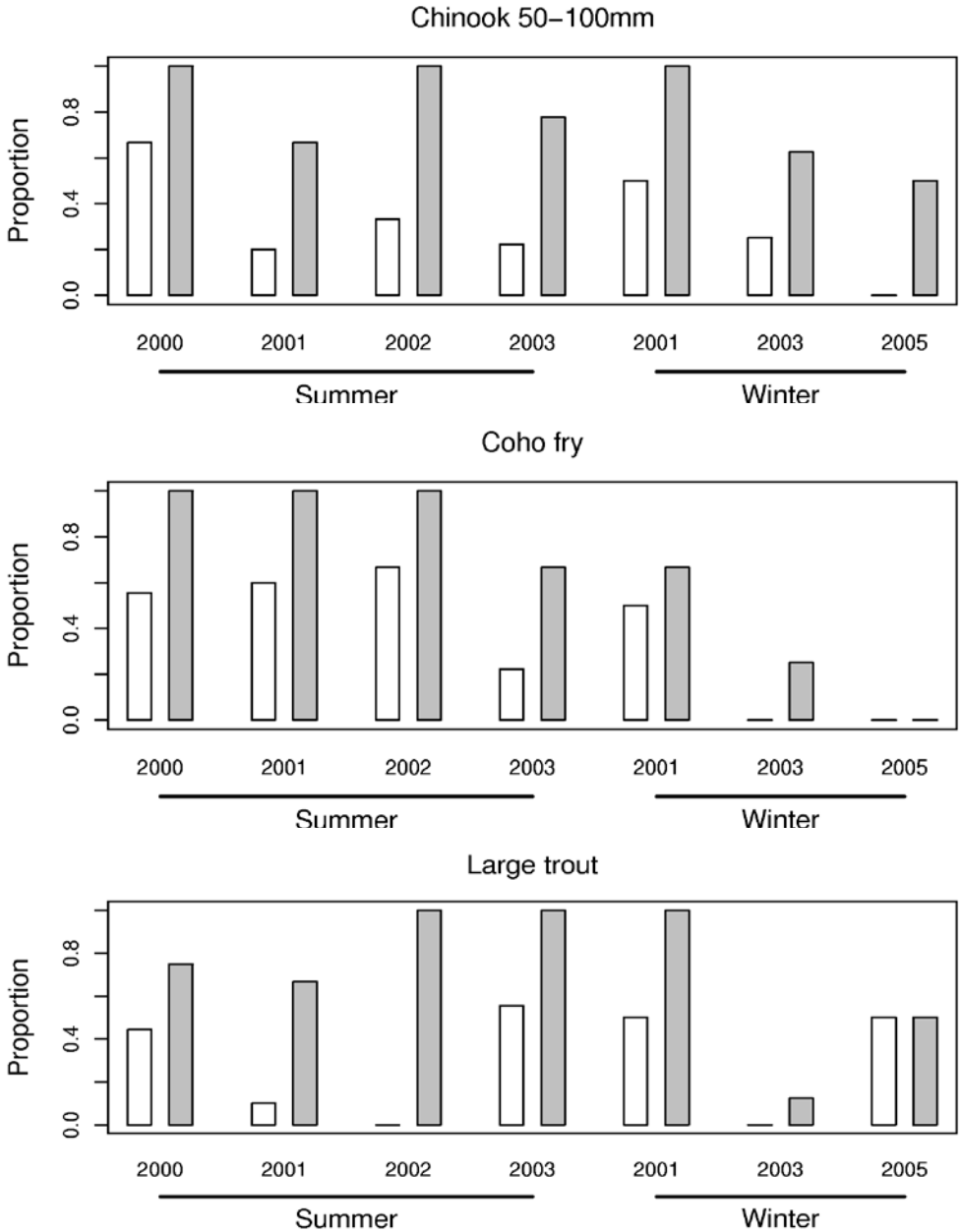
Peters 1996

Ph.D. Diss., UW

HABITAT RELATIONSHIPS WITH LARGE WOOD

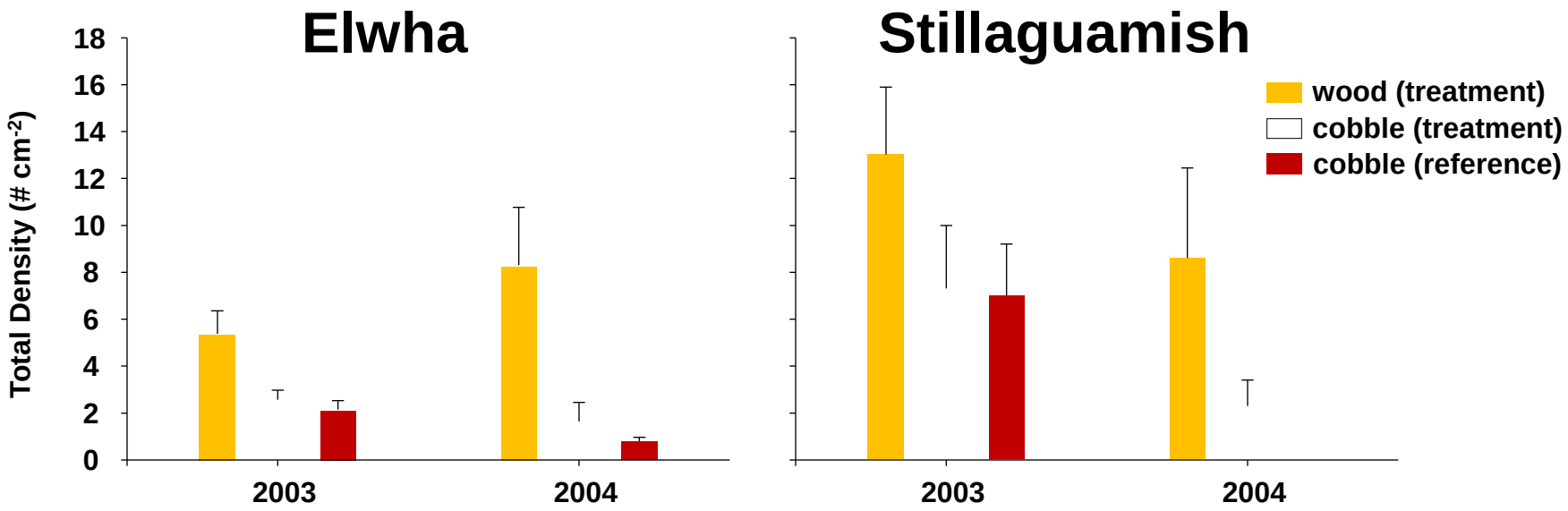
Elwha River

- **2001-2001 (7 survey events)**
- **<u>Seasonal Analysis</u>**
  - **The proportion of juvenile salmonids was > in ELJ than non-ELJ habitats in 75% species/size categories.**

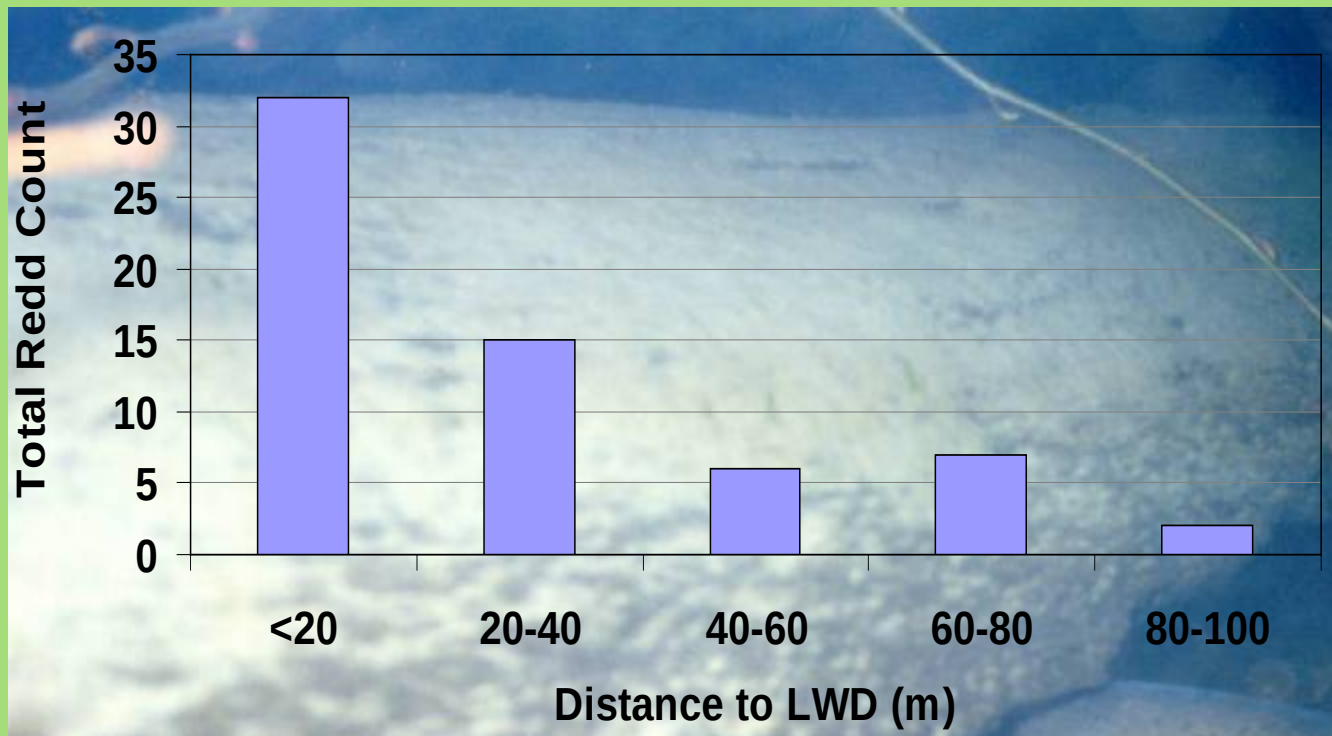


Invertebrate Results

- Invertebrate densities greater on wood than cobble
- No apparent reach affect



Coe et al. 2009, River Res. App.



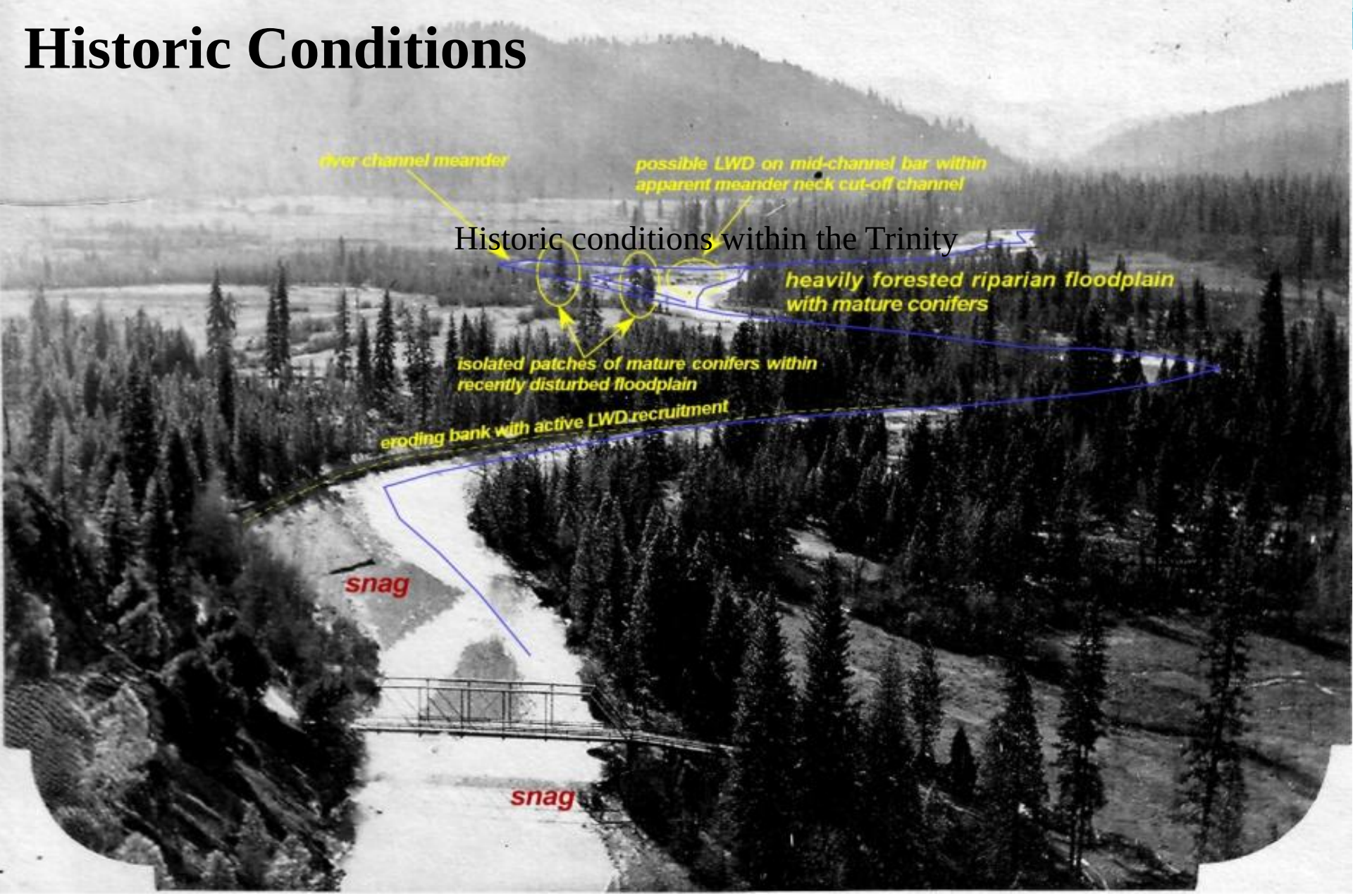
Redd density decreases with distance from logjams
Lower Elwha River

Hundreds of juvenile salmon have been counted under a single engineered logjam

Part B – Wes Smith

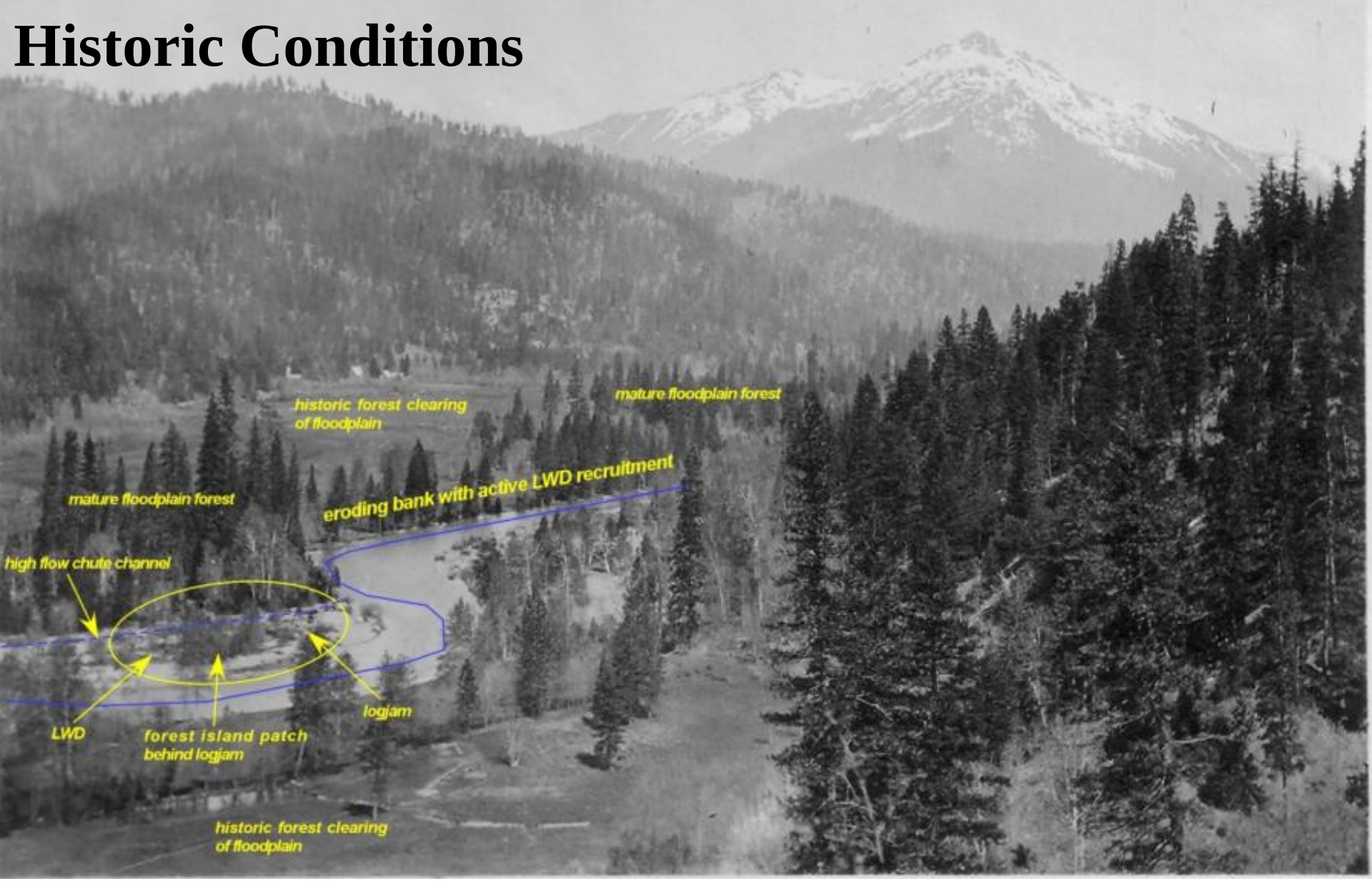
- Applying the Science and Data to the Trinity
  - Historic Conditions on the Trinity River
  - Approaches to Estimating Wood Additions
- Future Wood Management on the Trinity

Historic Conditions



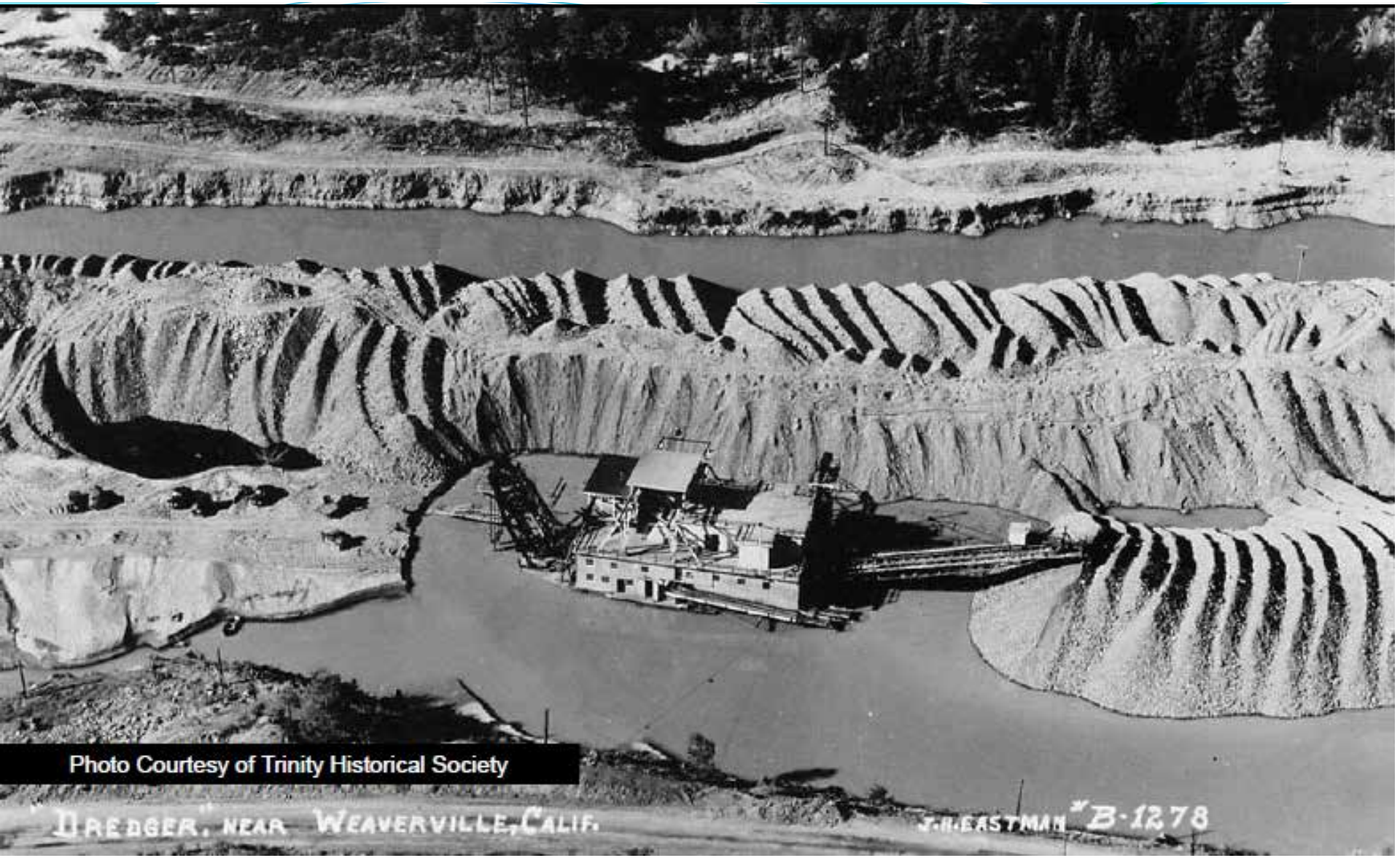
Trinity River circa 1910-1930 near Trinity Center near Swift Creek confluence.
Photo Courtesy of Trinity County Historical Society. Interpretations by Tim Abbe.

Historic Conditions



Trinity River in the Minersville area circa 1910-1930.
Photo courtesy of Trinity County Historical Society. Interpretations by Tim Abbe.

Trinity River Corridor Alterations



Dredger Operations on the Trinity River circa 1940s.
Photo courtesy of Trinity County Historical Society.

Approaches to Estimating Wood Additions

- Ecologic and Geomorphic Functions
- Reference Loading
- Wood Budgets ($I-O=\Delta S$)

Lisle (2002)

Initial Wood Loading Estimates

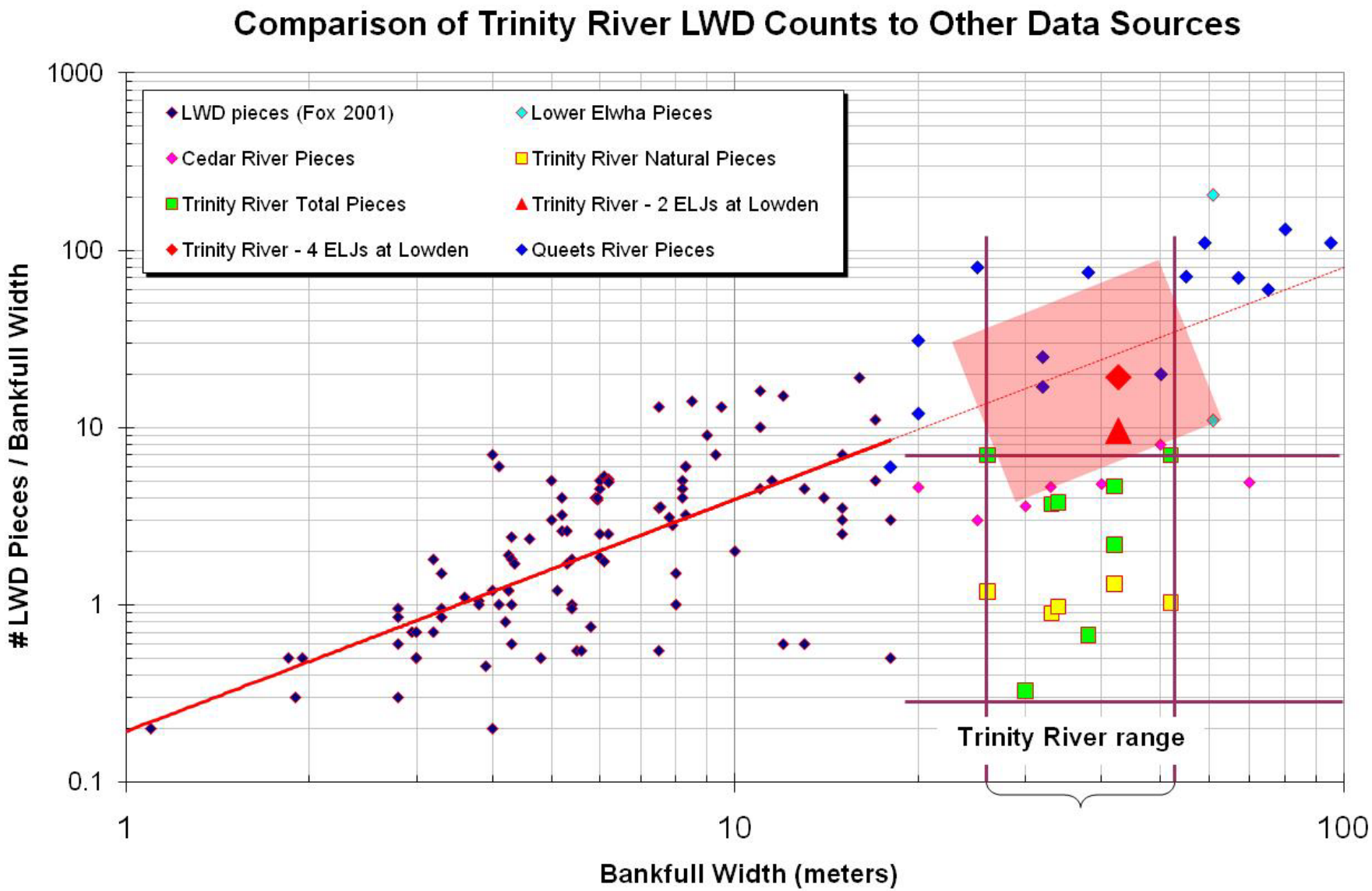


Figure modified from Cardno ENTRIX and CH2MHill (2011).

Initial Large Wood Recommendations

- Cardo ENTRIX (2011) recommended 50 to 60 wood pieces per 100 meter of river
- Recommended 4 to 5 engineered log jams (ELJs) per 1,000 meter of river

Large Wood Additions

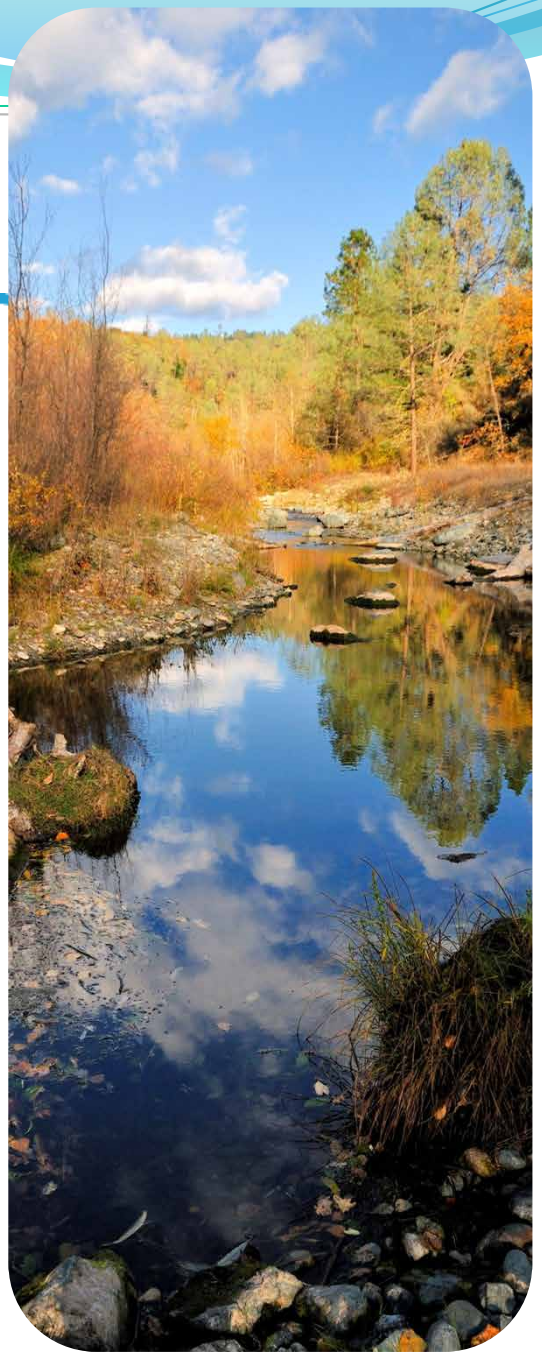
Project Year	Rehabilitation Site Name	Large Wood – Approximate (Pieces)
2005	Hocker Flat	0
2006	Canyon Creek Sites	100
2007	Indian Creek Sites	200
2008	Lewiston and Dark Gulch Sites	200
2009	Sawmill and Steel Bridge Day Use	260
2010	Lowden Ranch, Trinity House Gulch, and Reading Creek	300
2011	Wheel Gulch	200
2012	Upper Junction City Lower Steiner Flat	400
2013	Lorenz Gulch and Lower Douglas City	600
2014	Lower Junction City	250
Total		**2,435**

Wood Management Strategy

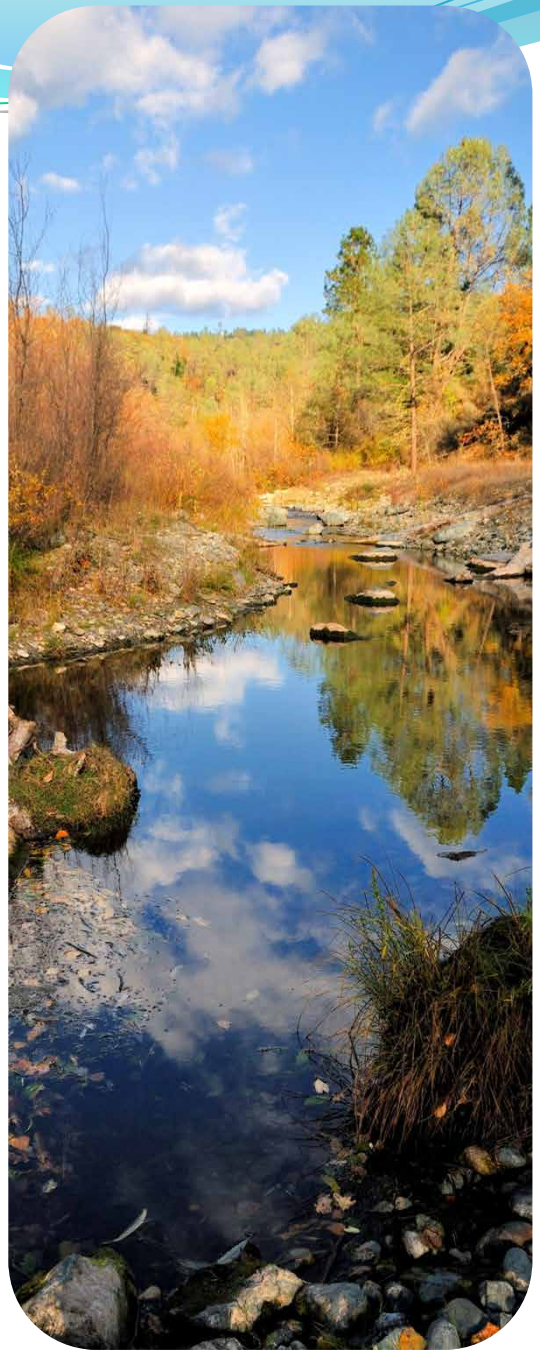
- Context and Vision
  - Current and Desired Conditions
- Short-term augmentation to increase storage/habitat
- Long-term augmentation to maintain storage/habitat
  - Injections and/or placements
  - Riparian and upland plantings
  - Encourage channel migration/erosion
  - Tributary and hillslope wood management
- Expected benefits/outcomes
- Risk management
- Adaptive management and monitoring

Lessons Learned

1. The Program and the greater scientific community have recently come to understand the significant importance of wood in rivers
2. Large quantities of wood are needed
3. Riparian forests take a long time to grow



TAMWG Role



Questions?

Riparian Lessons Learned

October 30th, 2014

James Lee
Hoopa Valley Tribe and TRRP

John Bair
McBain Associates

Riparian Habitat Management

- Alter instream changes caused by riparian encroachment associated with regulated streamflows
- Compensate for riparian habitat losses associated with channel rehabilitation projects

Maintain and Create Riparian Habitat that Benefits Fish and Wildlife

- Increase species and age class diversity
- Restore a spatially variable vegetated fringe along the summer and winter water edge
- Increase riparian vegetation that can supply large wood
- Revegetate with native riparian plants emphasizing cottonwoods to increase seed source for natural regeneration

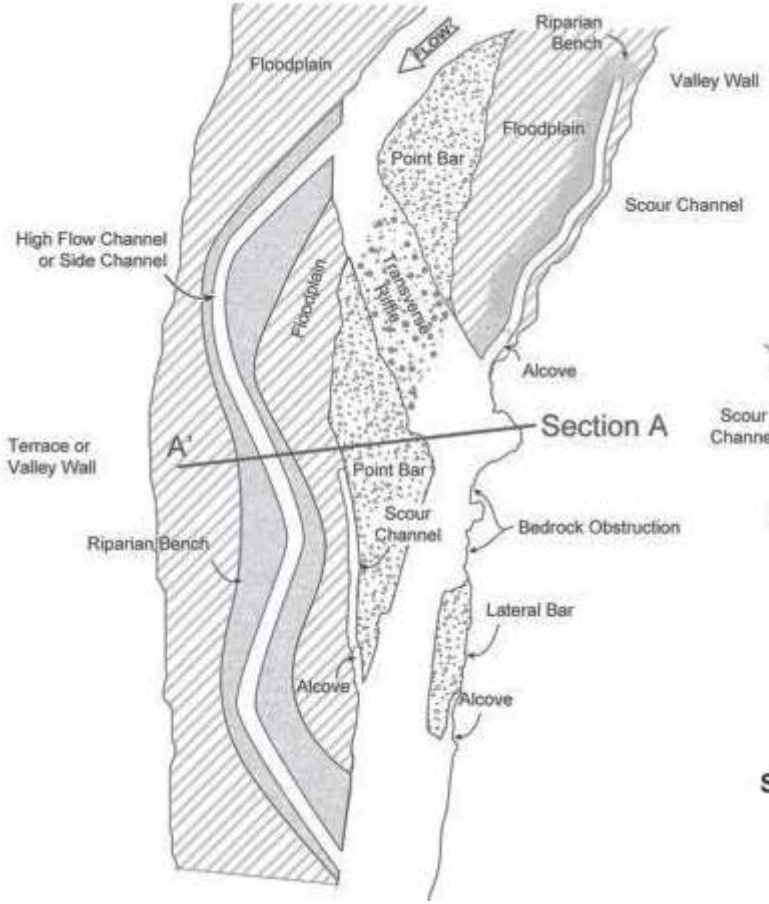
Revegetation + Woody Plant Recruitment

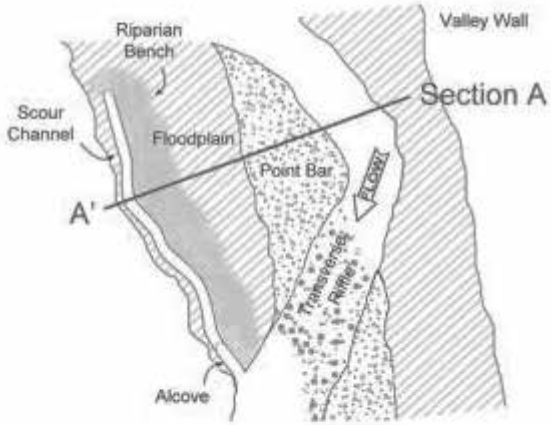
= No Net Loss

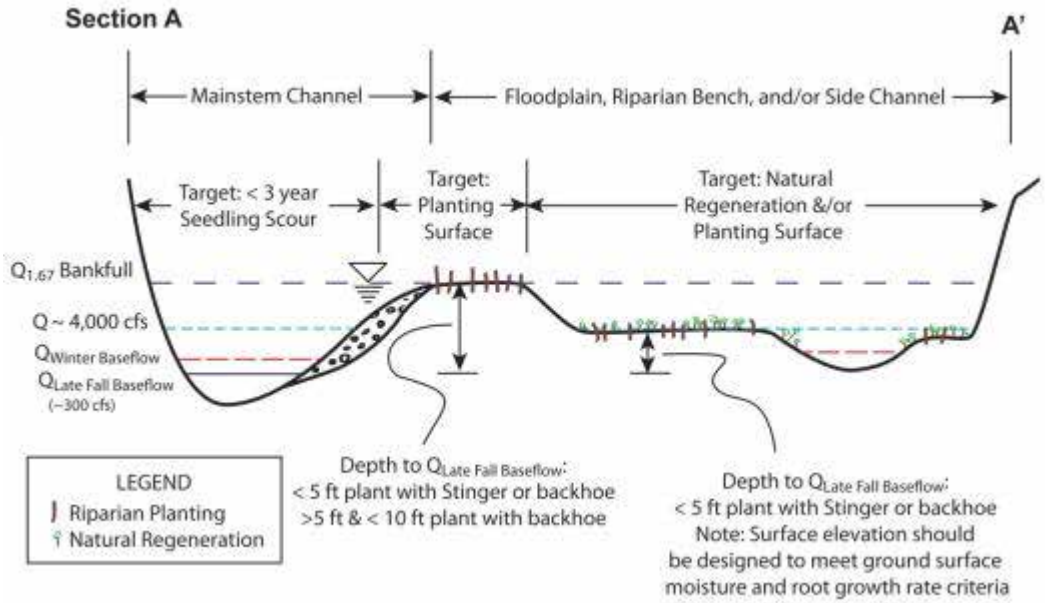
Short Term Habitat Recovery + Long Term Sustainability

= Compensation

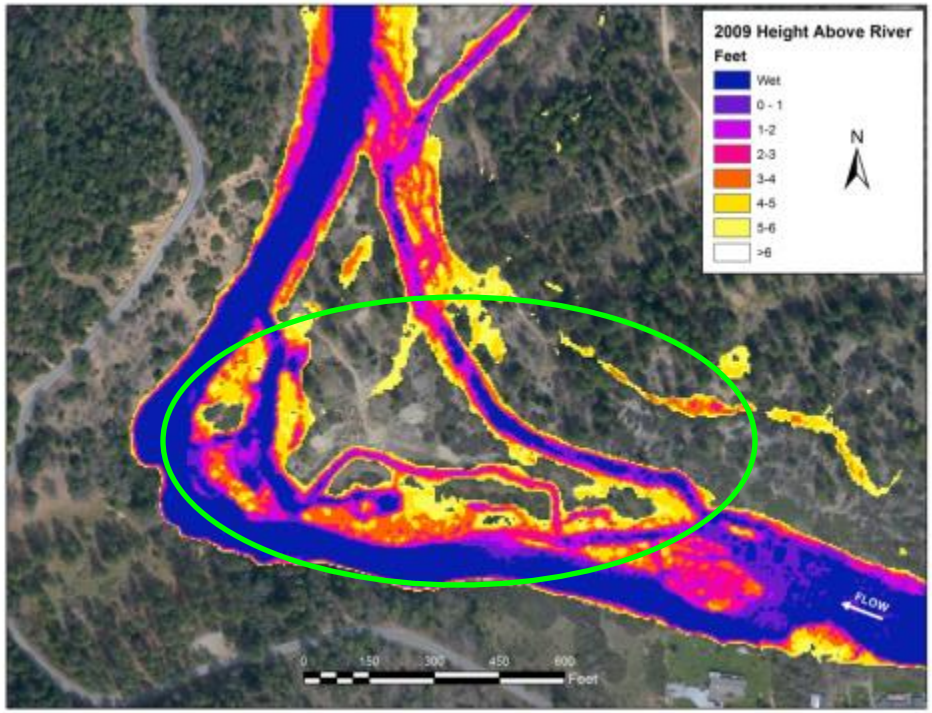
2010 Channel Design Guide

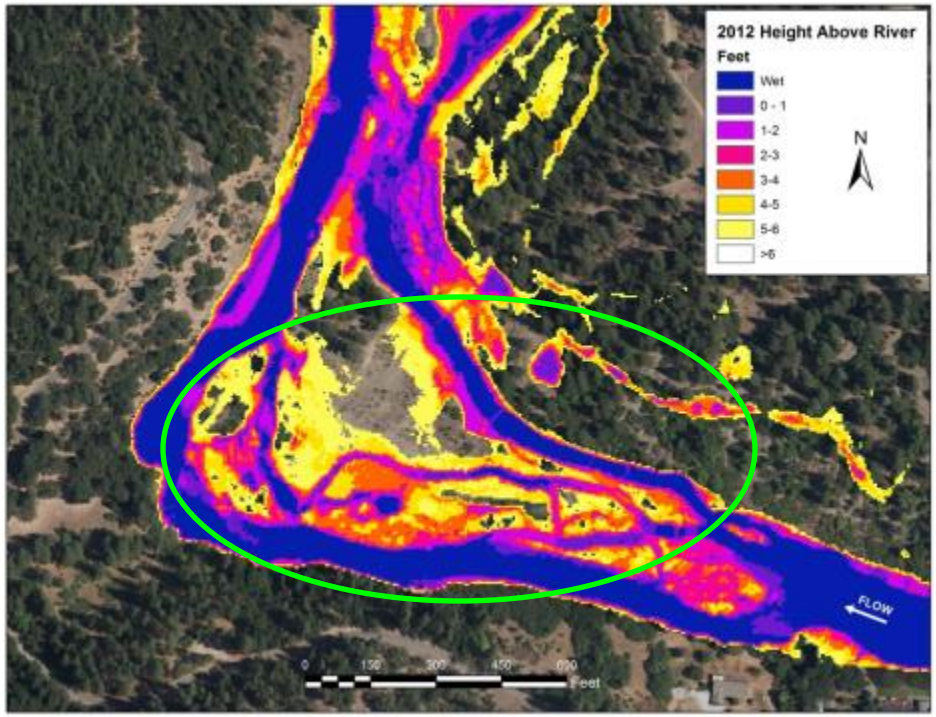






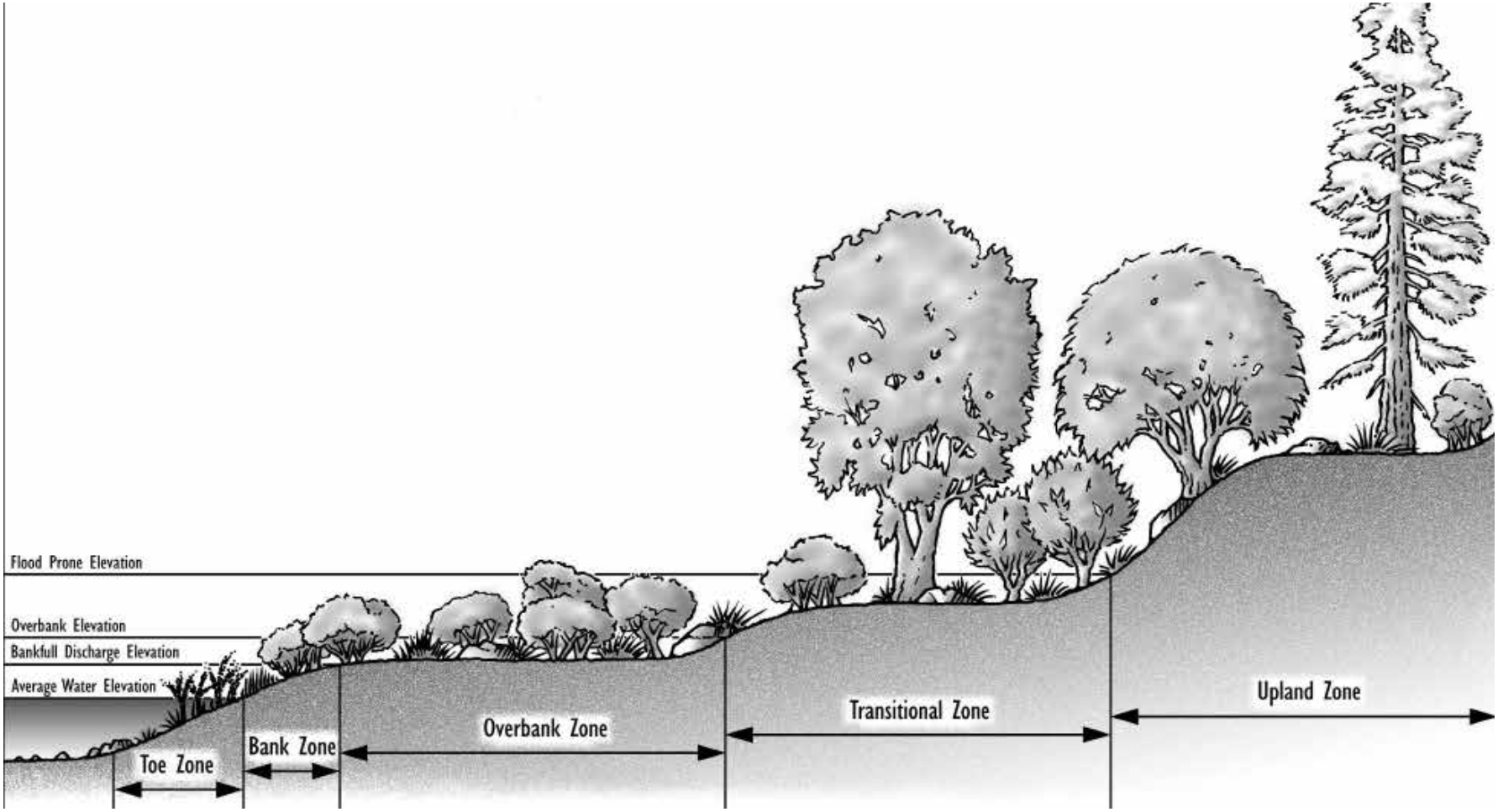
Ground Height Above River





- Pre-construction
- Post -construction

Changes in Ground Elevation = Riparian Zonation



What should our efforts look like in 50 years?

Revegetation

Functionally our Goal is to Revegetate Surfaces That Did Not Support Riparian Vegetation

2000 2006 2010 2011

- Channel Rehabilitation
- Sediment Management
- Increased Streamflows

- Lowered floodplain inundated roughly every other year
- No planting below the floodplain elevation

Constructed Floodplains

Pole Cutting Collection and Handling

Photos Courtesy of the Trinity County Resource Conservation District

Planting Constructed Floodplains with Mini-excavator

Photos Courtesy of the Trinity County Resource Conservation District

2000

- Channel Rehabilitation
- Sediment Management
- Increased Streamflows

2006

- Lowered floodplain inundated roughly every other year

2010

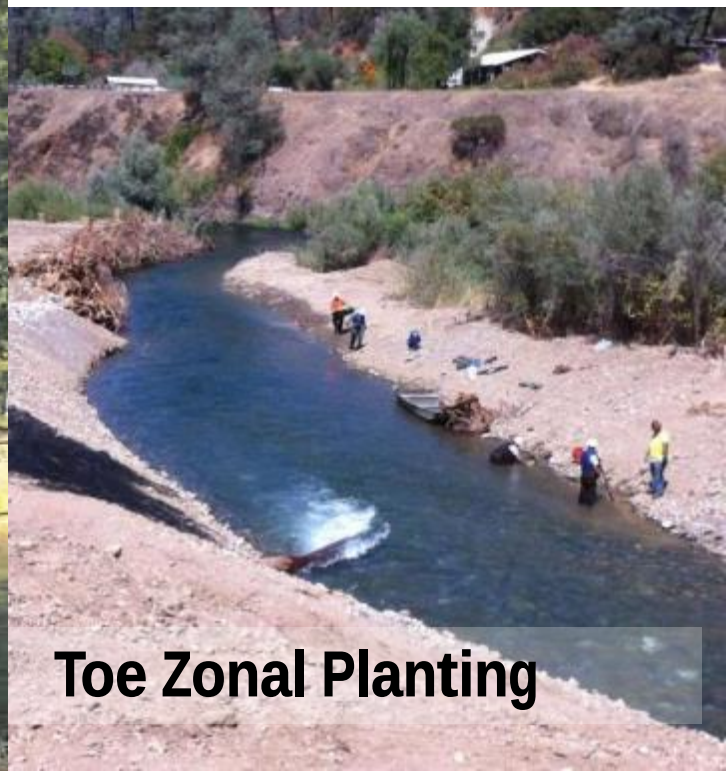
- Constructed Side Channels
- Forced Meanders
- Gravel Bars
- Large wood augmentation
- Fish habitat structures

2011

- Off channel ponds
- Split Flow Channels

Side Channels

Slope and Toe Zonal Plantings



Sedge Swales

Wood Structures and Medial Bars

Nursery Material Collection and Handling

Willow Clump Salvage and Installation

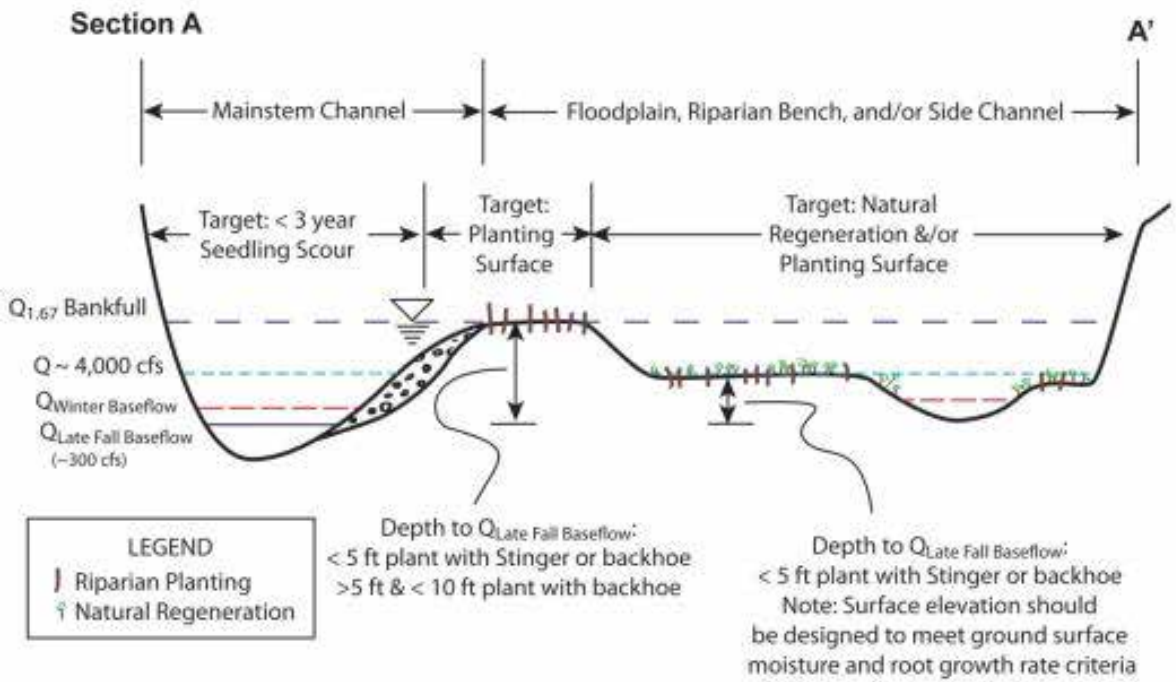
Willow Trenches

- **Mulch**
- **Browse Protection**
- **Irrigation**

What we have learned :

- These are exceptionally difficult places to get riparian plants to grow
- Pole cuttings and Nursery Container Stock can both be used effectively to recover short term habitat losses
- Plant protection is necessary to get plants above the browse level
- Mulch reduces weed competition and reduces local soil moisture loss
- Irrigation promotes survival and rapid growth

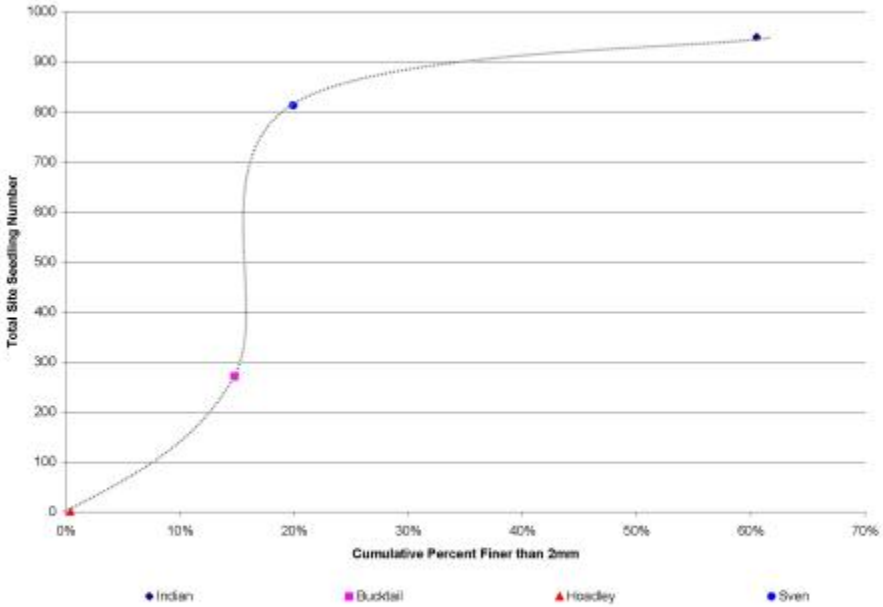
Are constructed surfaces working to restore natural riparian recruitment processes?


Section A
A'
Mainstem Channel
Floodplain, Riparian Bench, and/or Side Channel
Target: < 3 year Seedling Scour
Target: Planting Surface
Target: Natural Regeneration &/or Planting Surface
Q1.67 Bankfull
Q ~ 4,000 cfs
QWinter Baseflow
QLate Fall Baseflow (~300 cfs)
LEGEND
Riparian Planting
Natural Regeneration
Depth to QLate Fall Baseflow:
< 5 ft plant with Stinger or backhoe
>5 ft & < 10 ft plant with backhoe
Depth to QLate Fall Baseflow:
< 5 ft plant with Stinger or backhoe
Note: Surface elevation should be designed to meet ground surface moisture and root growth rate criteria

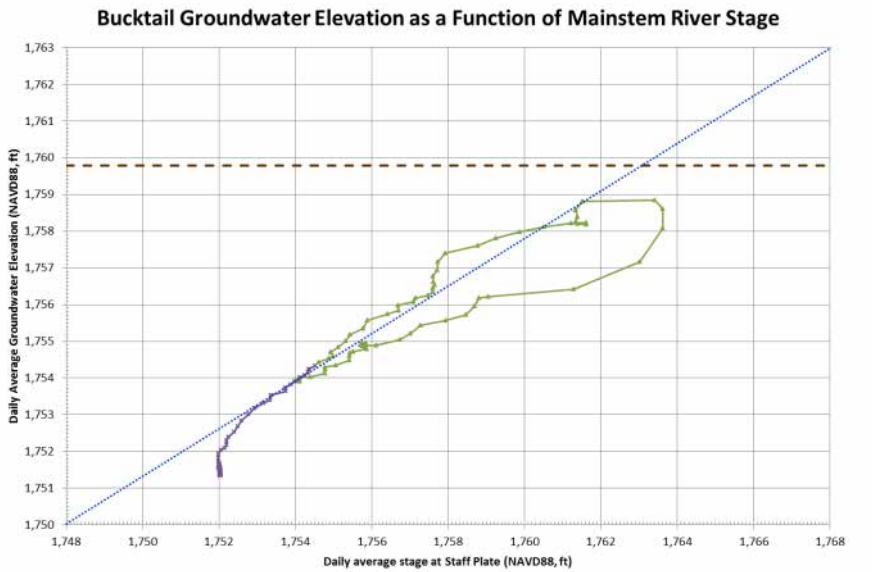
What are environmental conditions are needed?

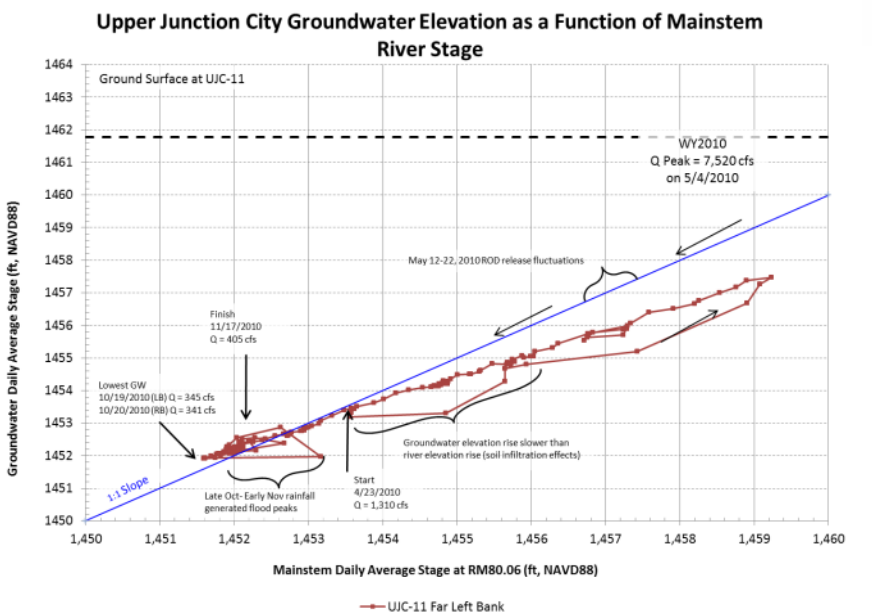
- Streamflow connection to groundwater
- Fine sediment
- Shallow groundwater during and after seed dispersal of target species to promote moist soils at the ground surface

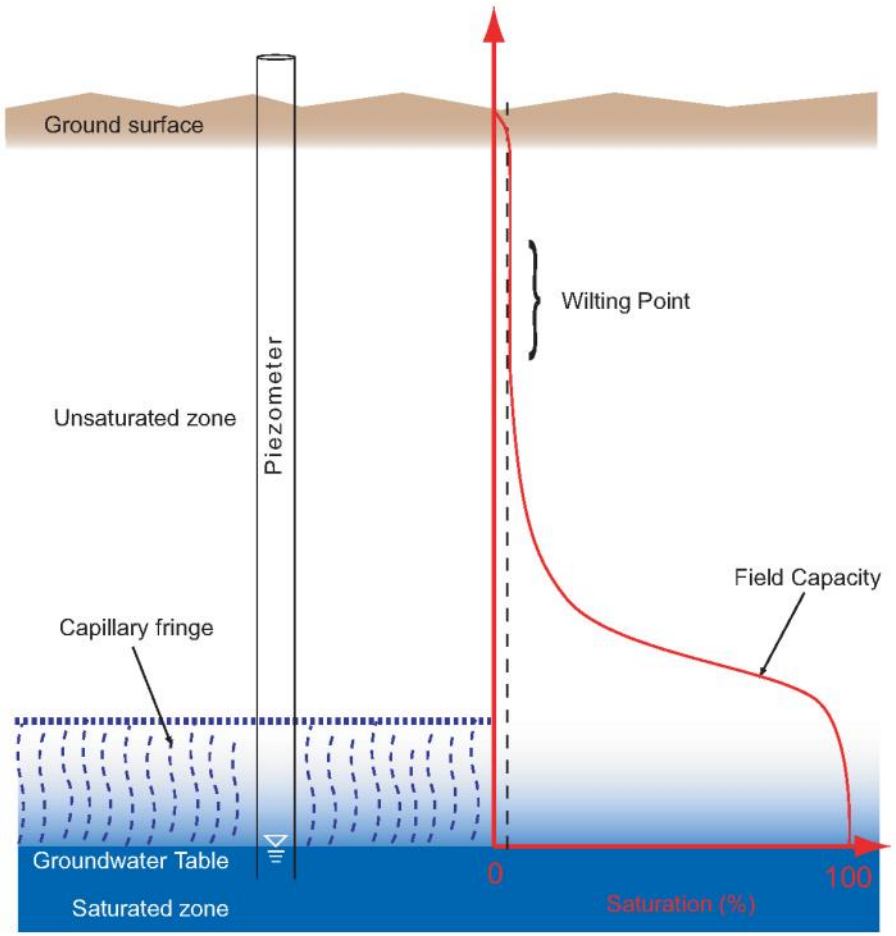
Substrate Composition and Soil Moisture



Groundwater Response at Channel Rehabilitation Sites to Managed Streamflows







2000

- Channel Rehabilitation
- Sediment Management
- Increased Streamflows

- Streamflows that recede a rate that will not strand fish

2006

- Lowered floodplain inundated roughly every other year

- Streamflows that recede at the rate of root growth at Hocker Flat

2010

- Constructed Side Channels
- Forced Meanders
- Gravel Bars
- Large wood augmentation
- Fish habitat structures

- Streamflows that recede at the rate of root growth at Lewiston
- 5 day benches

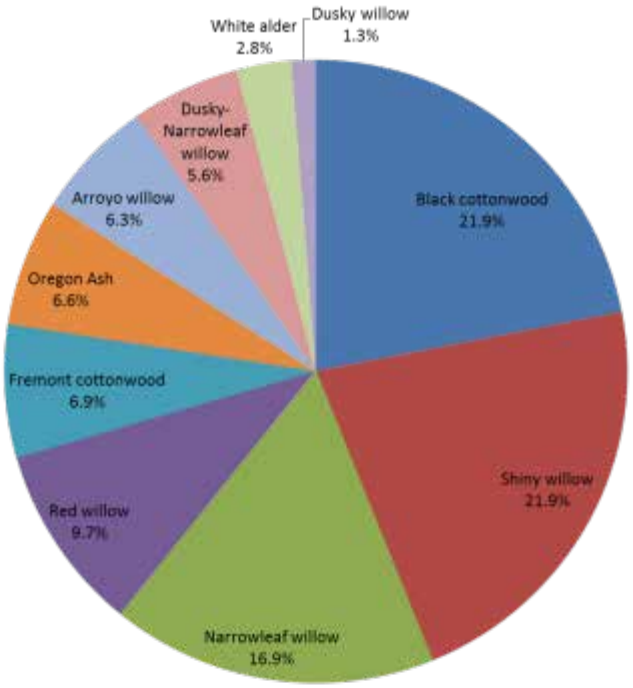
2011

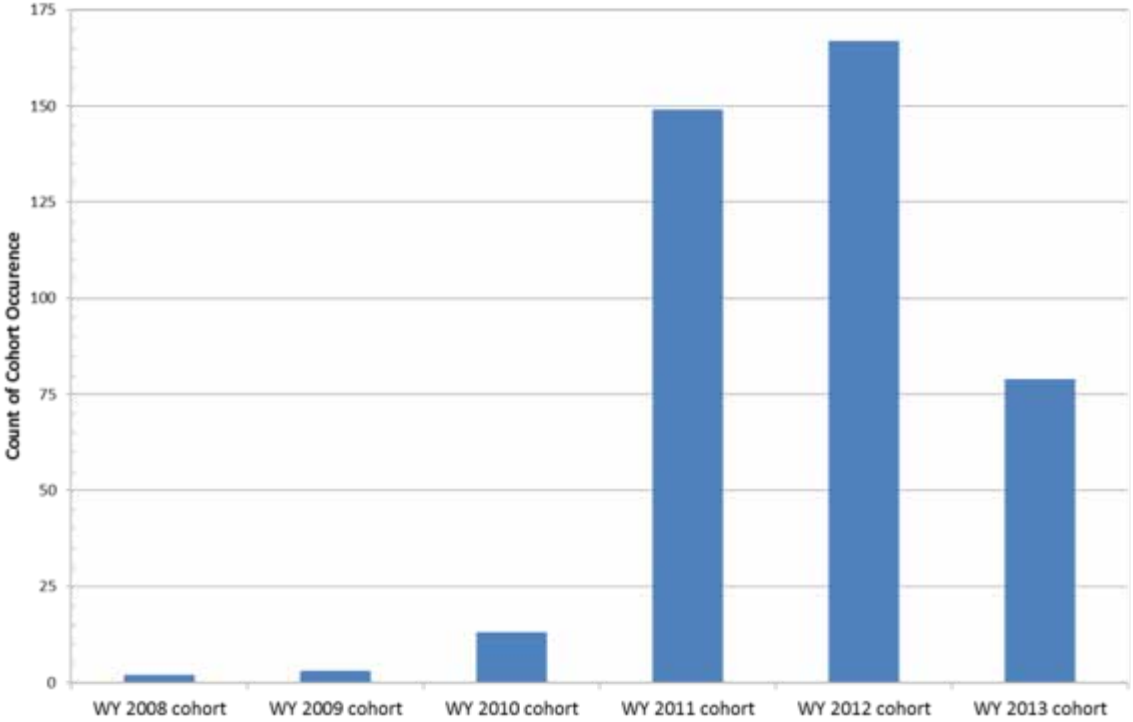
- Off channel ponds
- Split Flow Channels

- Streamflows that recede at the rate of root growth at the confluence of the North Fork
- Multiple 5 day benches

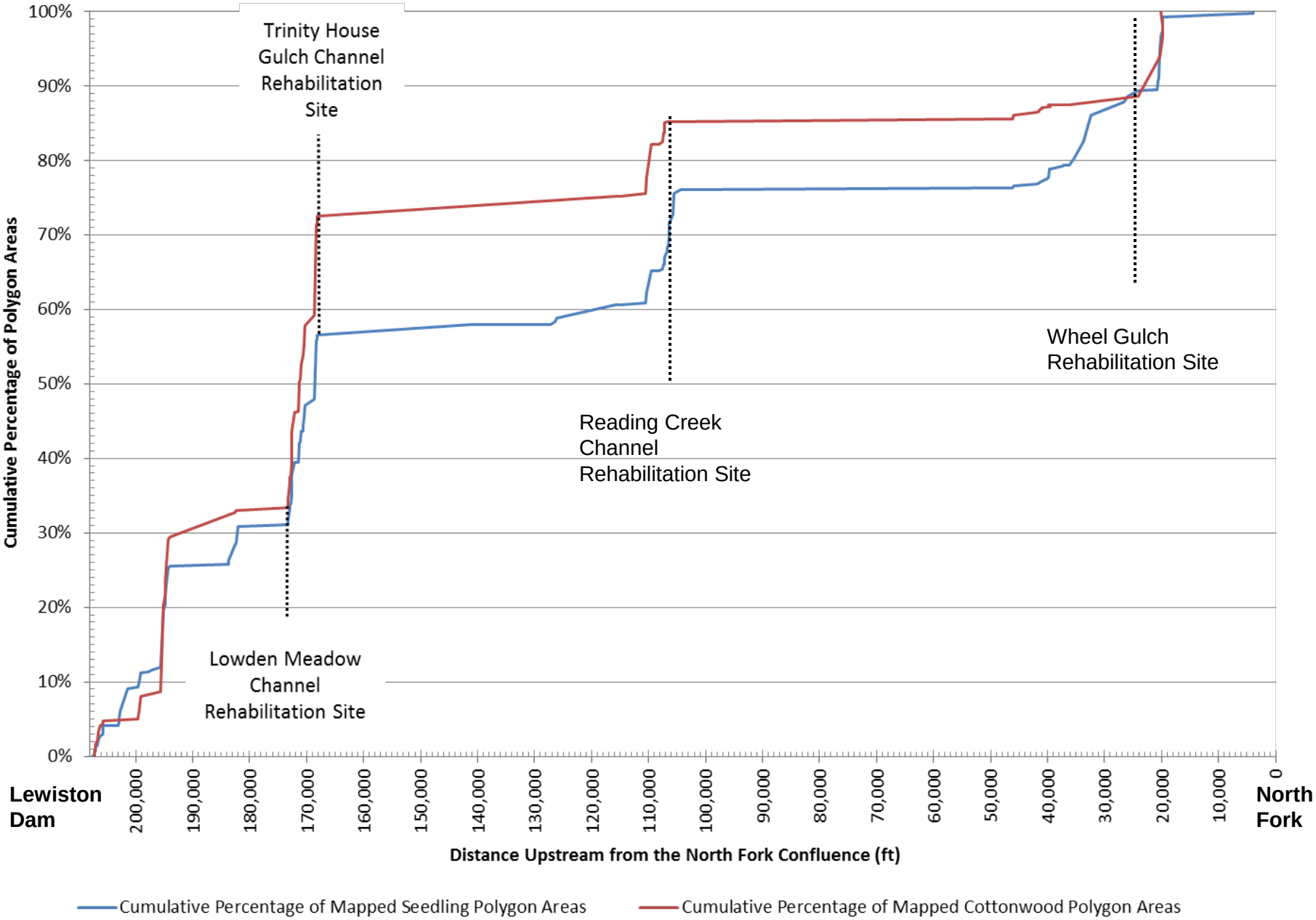
Riparian Woody Plant Floodplain Colonization

Mixture of Riparian Hardwoods with 2011 and 2012 Hydrographs Achieving the Greatest Recruitment Success

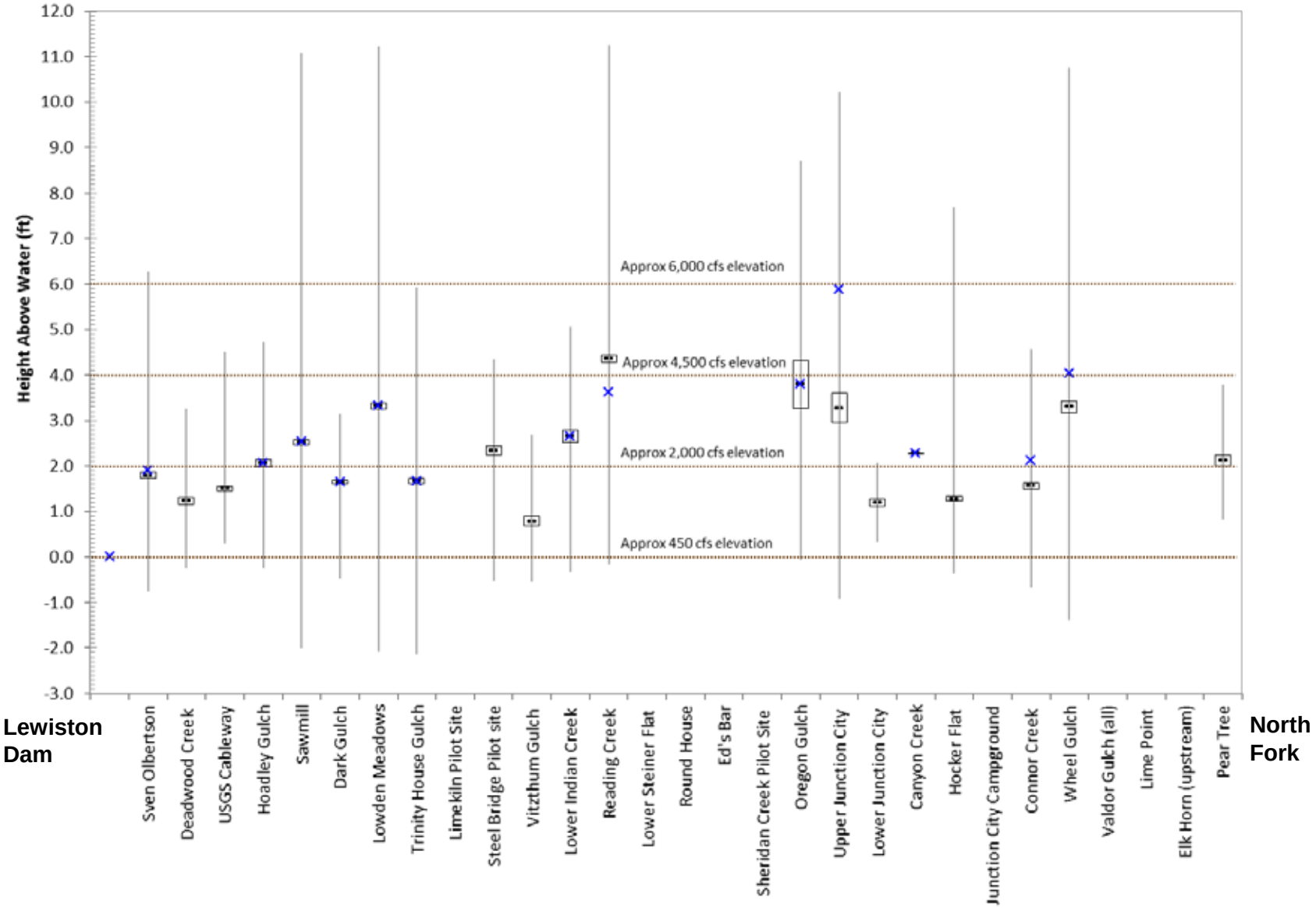




More Initiation was Observed Closer to the Dam



Most Mapped Seedling Locations at Channel Rehabilitation Sites Occurred within 4 ft of the Summer Baseflow

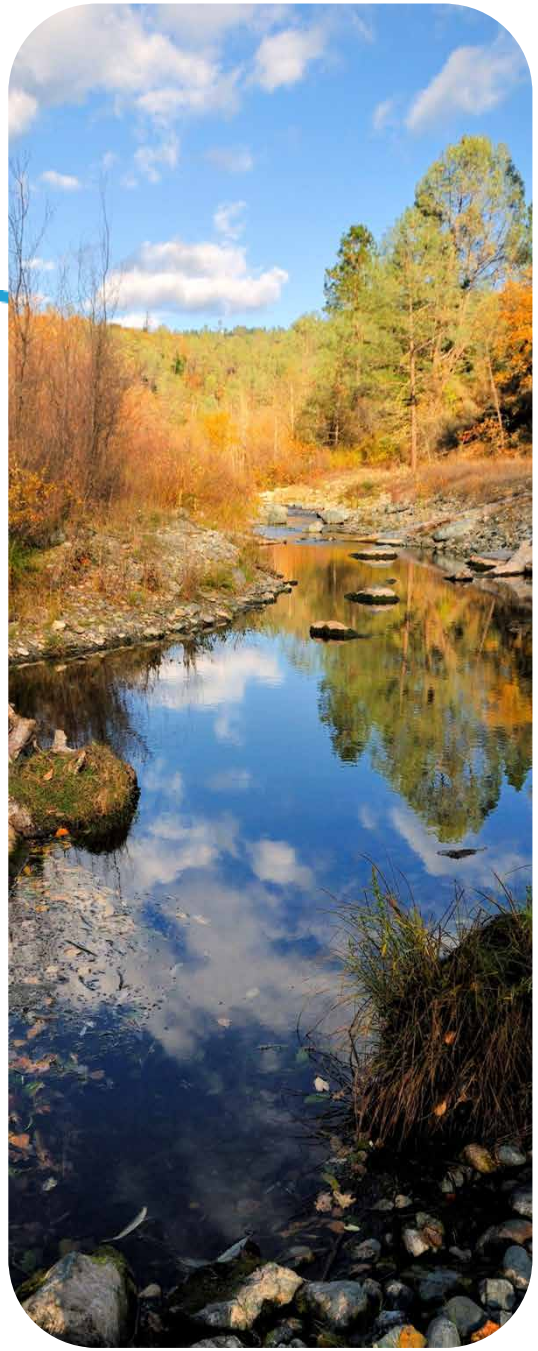


What We Have Learned :

- Substrate must be more than 20% fine sand and silt to support seed germination
- Near channel groundwater can be managed using streamflows
- Constructed ground surfaces within 4 vertical feet of the of the summer water surface support cottonwood seedling germination and growth through the first year

Channel Rehabilitation Workshop

A Brief Introduction to Decision Support Systems

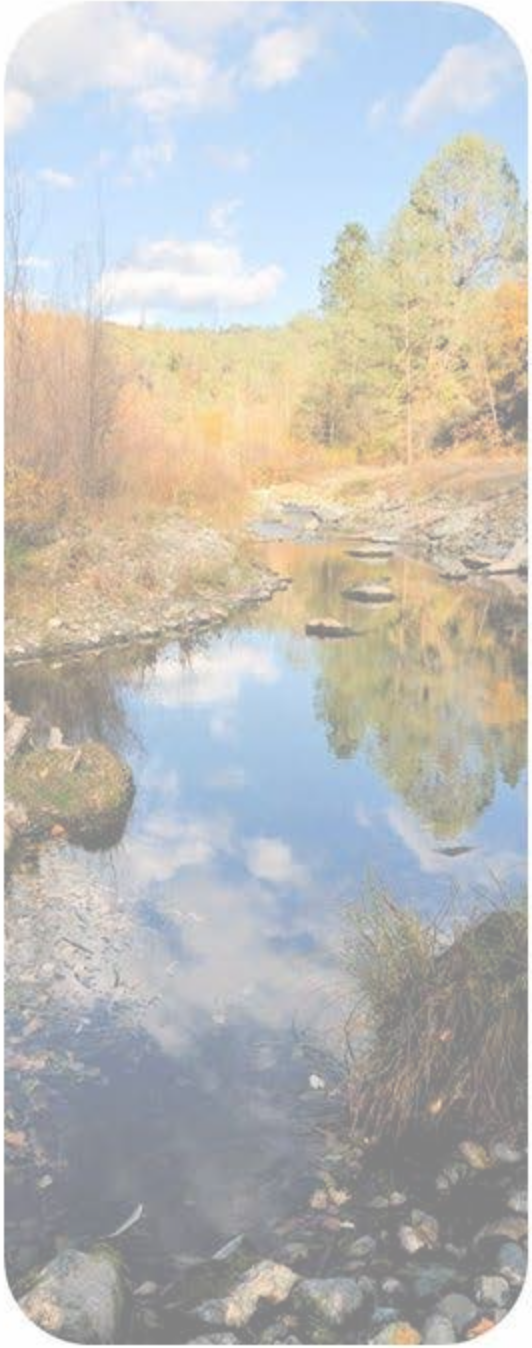


J. Tyrell DeWeber

Oregon Cooperative Fish & Wildlife Research Unit

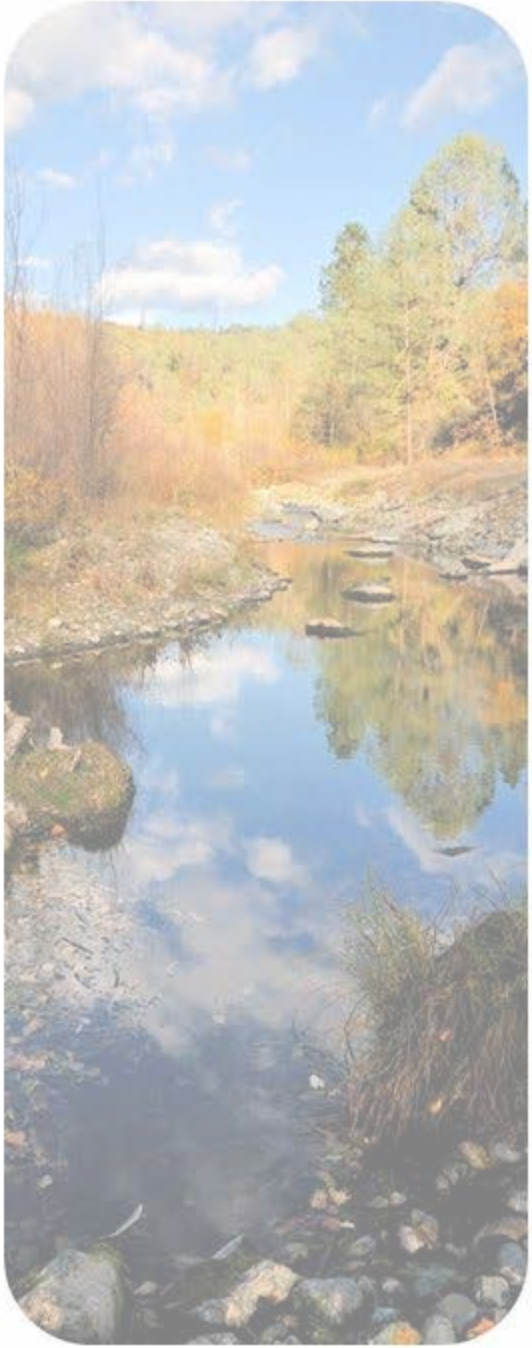
Decisions, Decisions

- Decisions can be complex
- Informed decision making is important
- Decision Support System:
  - a system that presents the potential outcomes of different actions so that managers can make a decision more easily and objectively



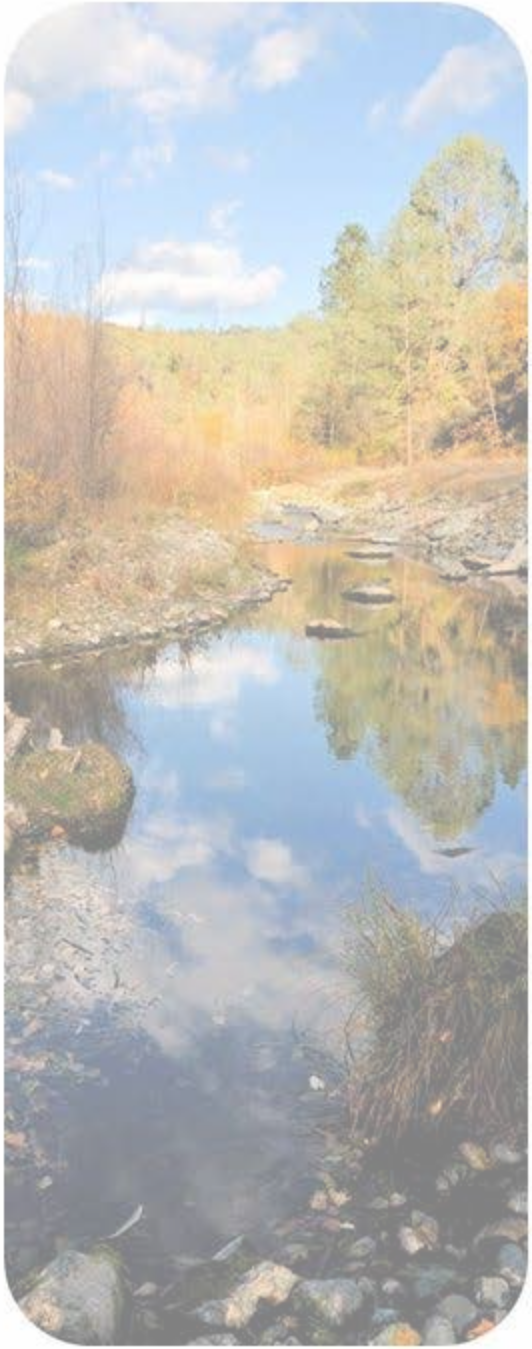
Key Parts of a DSS

- Measurable Objectives
  - What do we want to achieve?
- Available management actions
  - What can we do? (could do nothing)
- Some knowledge of system
- Predictions of response
  - Actions linked to objectives
  - Probability of each outcome given

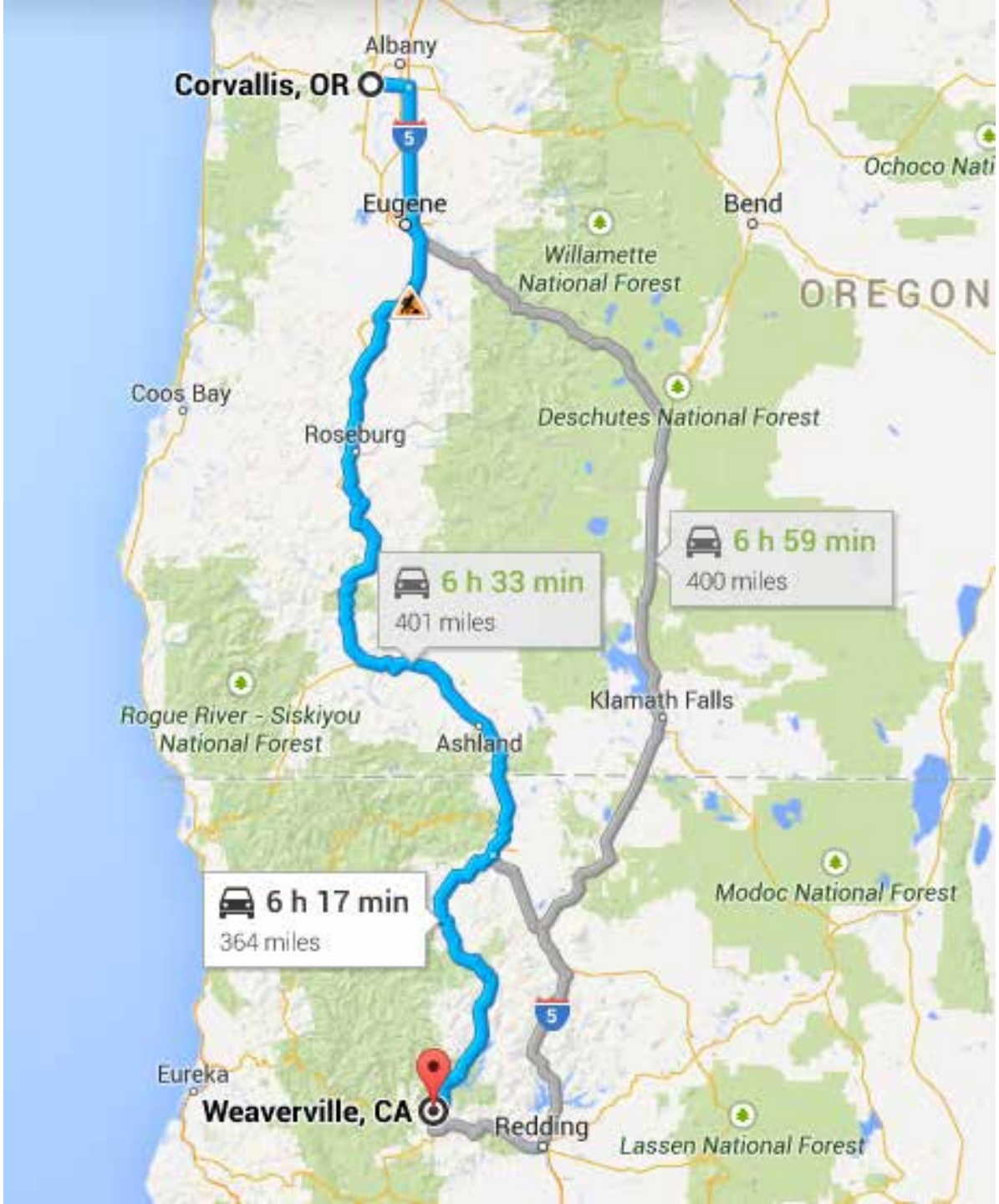


A Familiar DSS: Google Maps

- Objectives:
  - Get to a destination
  - Minimize driving time
  - Minimize cost (distance, tolls, etc.)
- Actions: Alternate routes
- Predictions:
  - Use complicated route models
- Output:
  - Distance and time for different routes

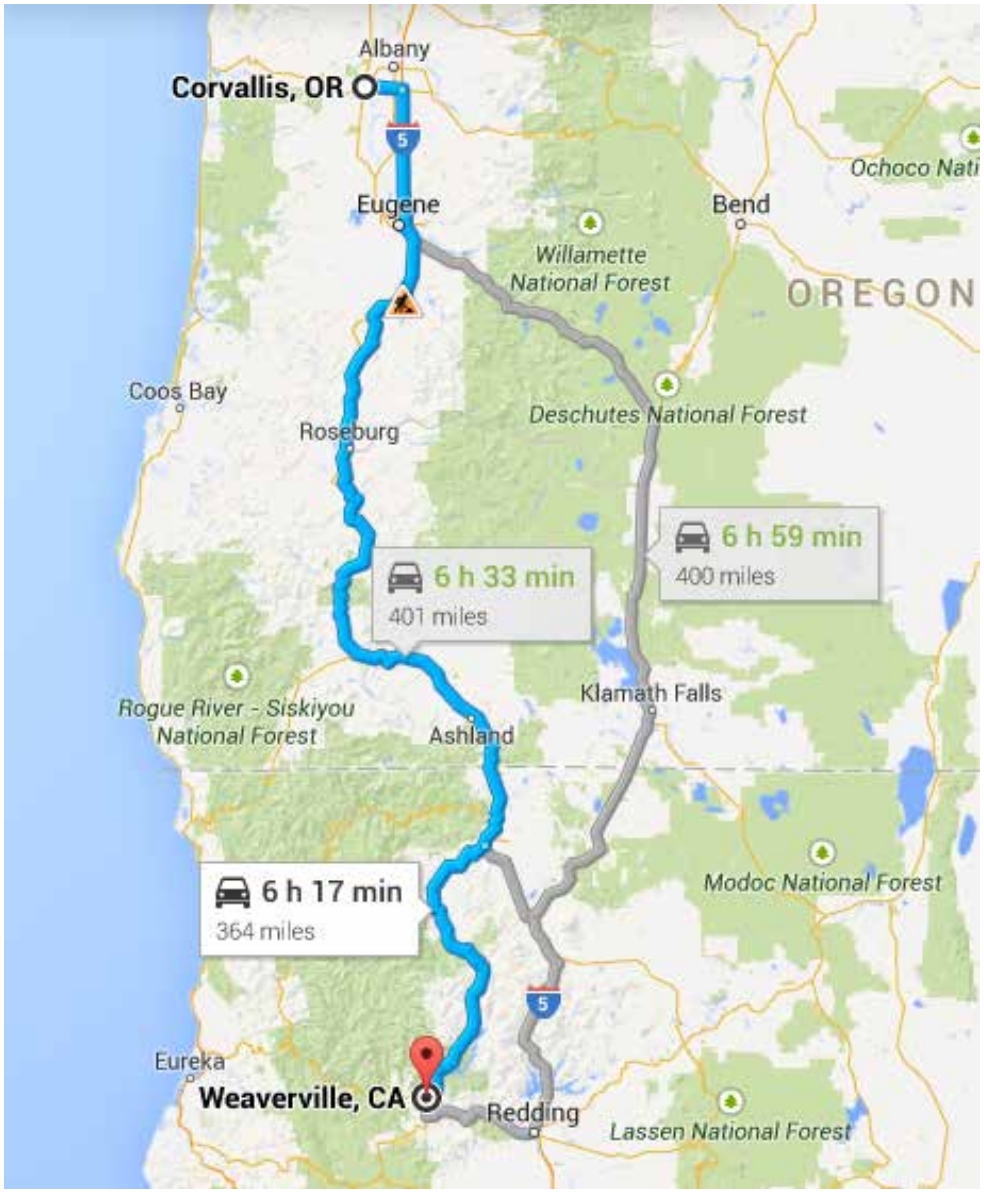


- Very useful information for decisions
- Choice depends on objectives
  - Time?
  - Cost?
  - Safety?



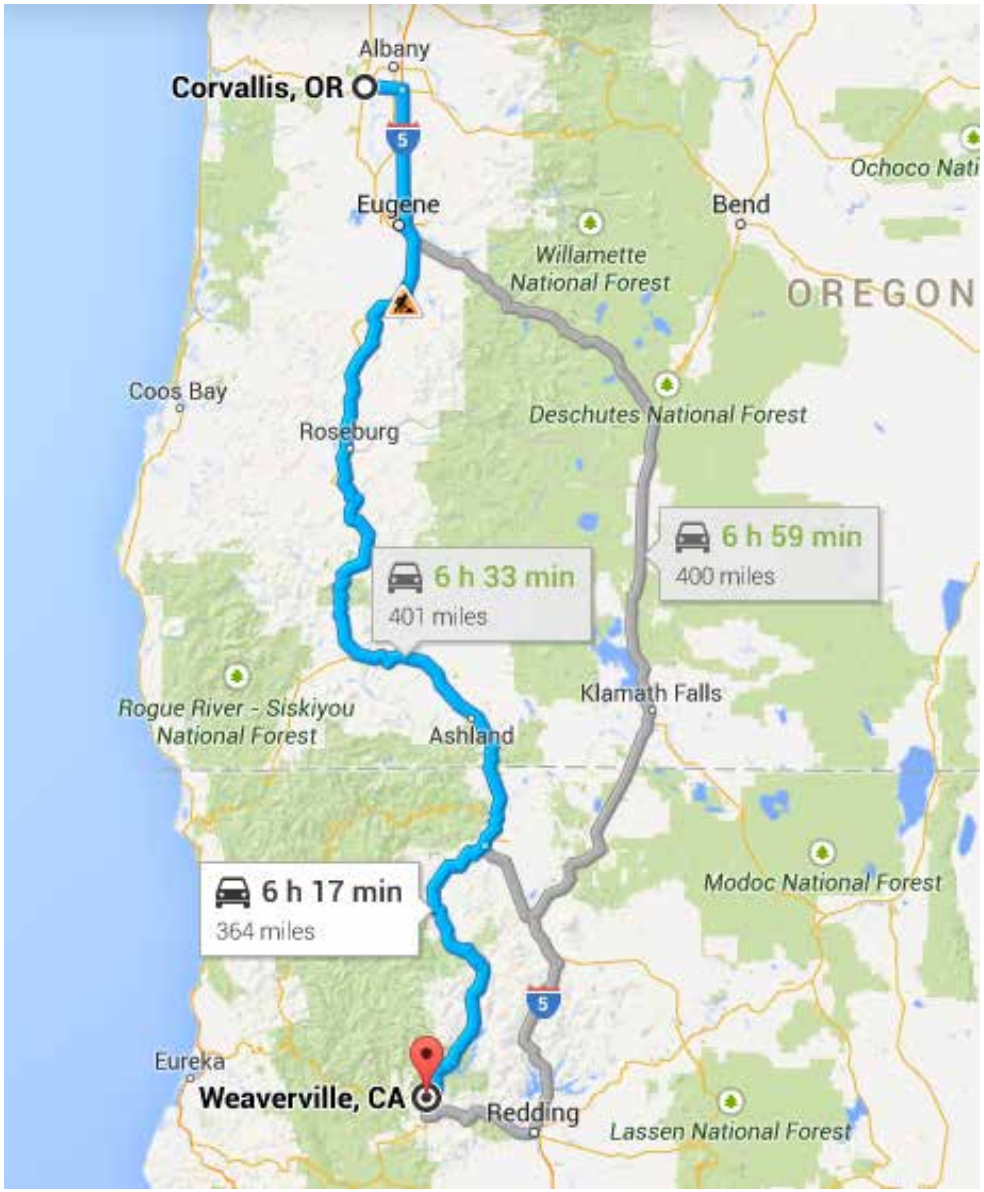
Lessons from Google Maps

- Must monitor the right thing
- Poor metrics:
  - Average speed
  - Elevation gain
  - Number of curves
- Irrelevant for most people's decisions



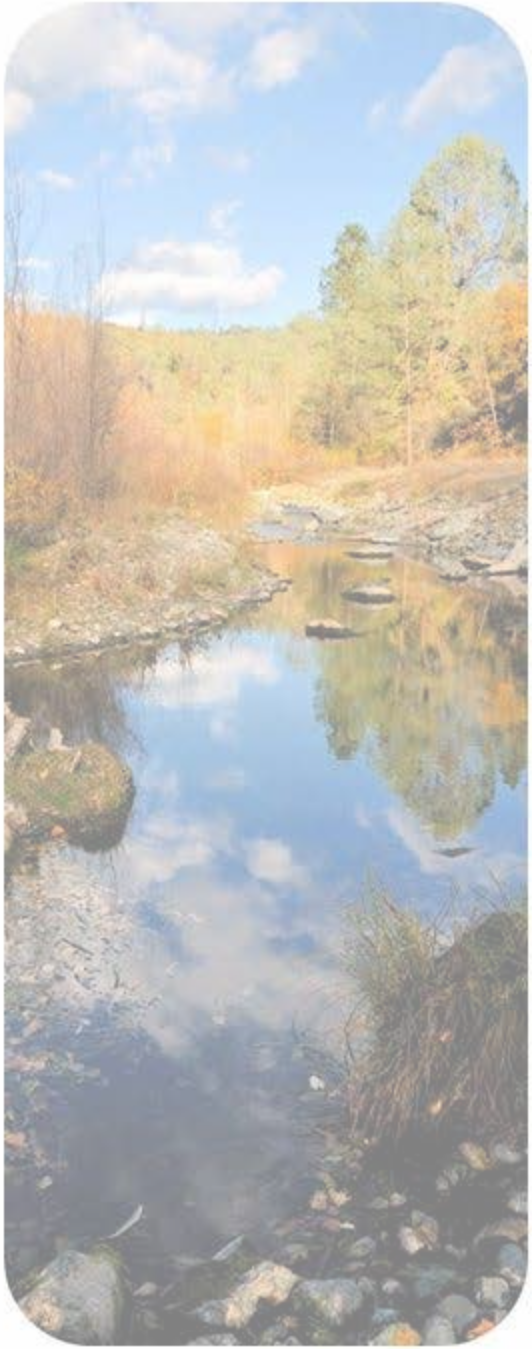
Lessons from Google Maps

- DSS must include all criteria for decision
- Imagine a freight company
  - Maximize profit!!
  - Many trucks, shifts, deliveries, etc.
  - More complicated than a simple route choice
- Google Maps one part of larger DSS



Benefits of a DSS

- Maintain focus
  - Decisions linked to objectives
- Transparency in decisions
- Can balance multiple objectives
  - Ex: salmon restoration, safety, recreation, etc.
- Improved learning
  - Compare alternative models
  - Find out what works!

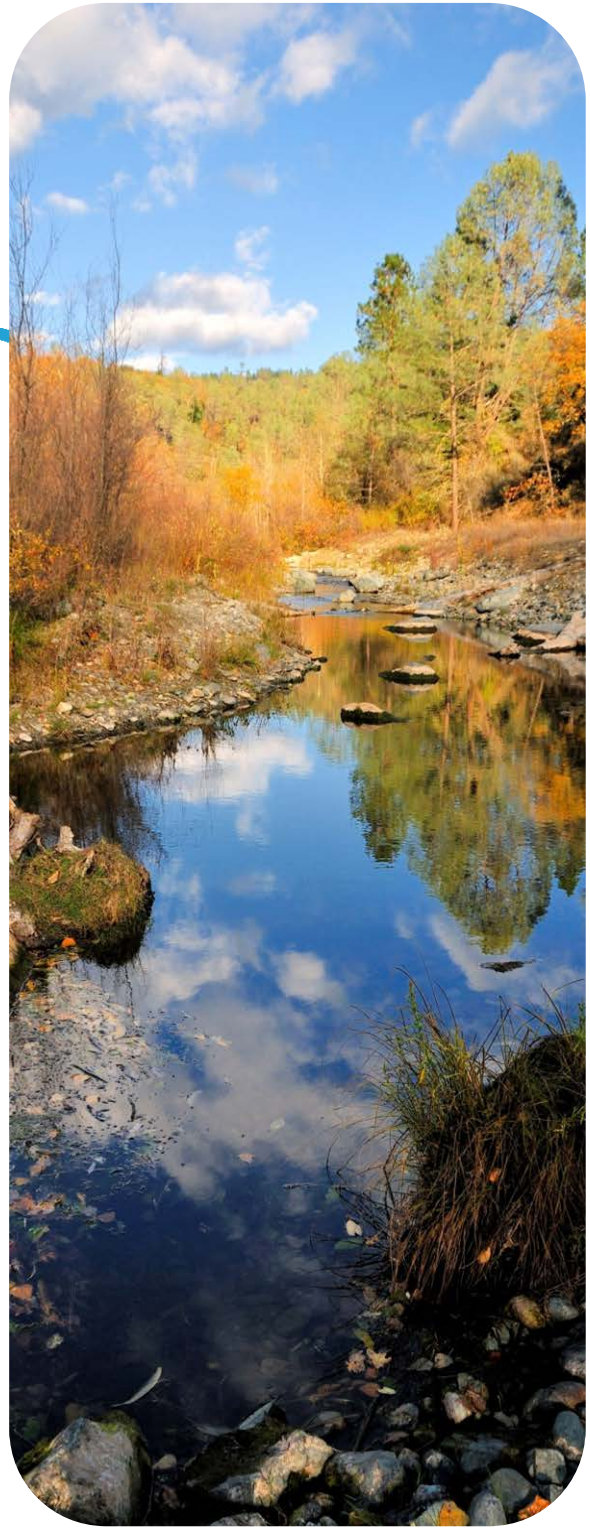


Channel Rehabilitation Workshop

Decision Support Systems

Component Update

Ernie Clarke
US Fish and Wildlife Service



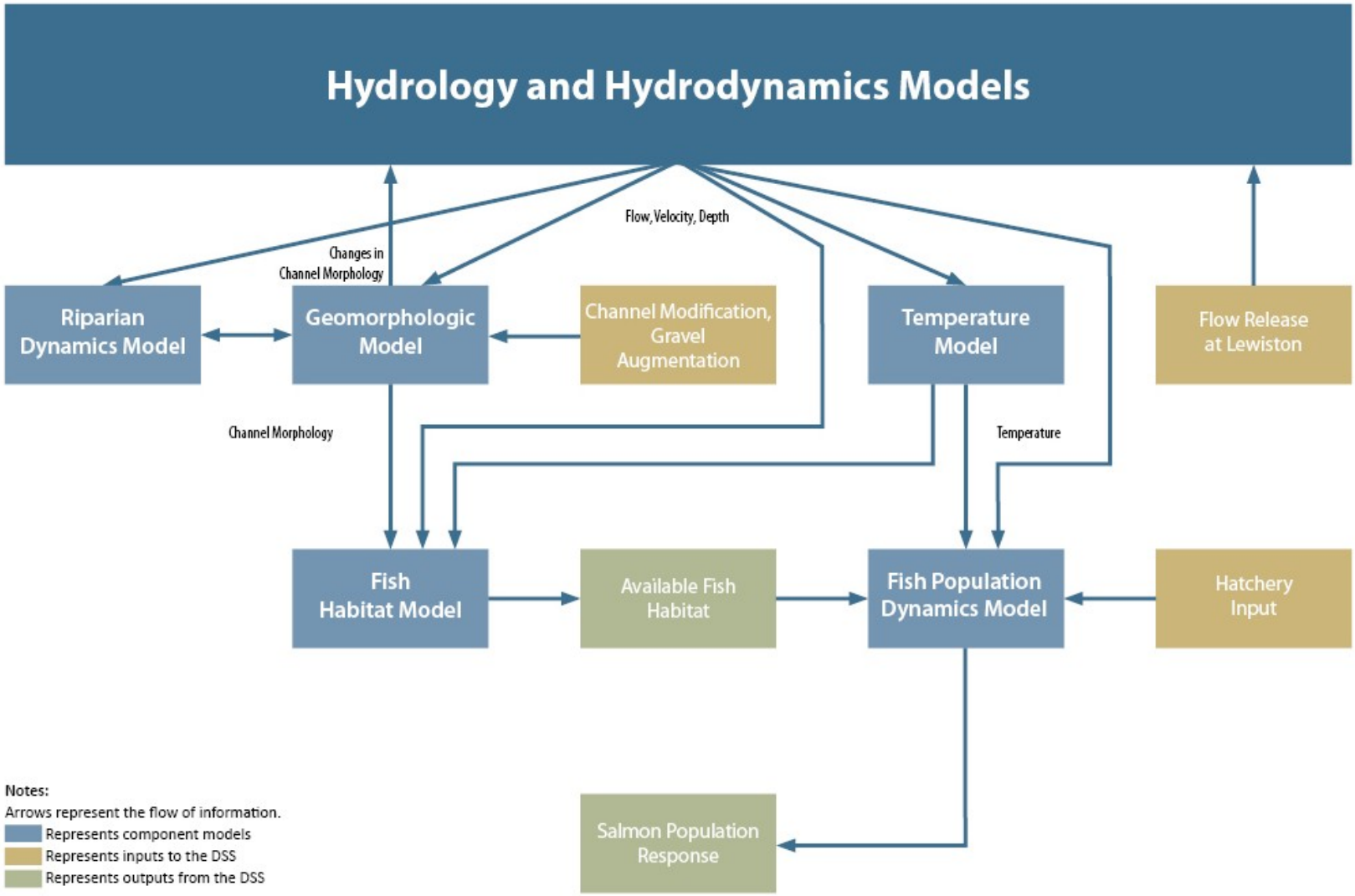
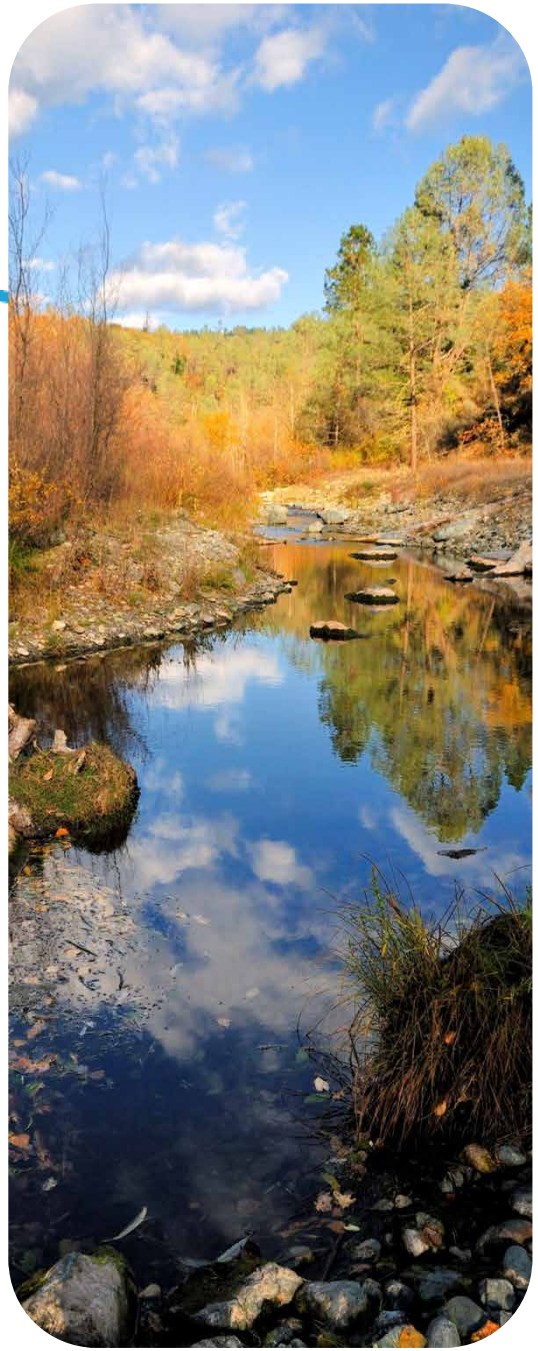


Figure 14

Model components of a Decision Support System for the Program. See Appendix H, Section 3.1 for further discussion.

Channel Rehabilitation Workshop

An Example Decision Support System For Flow Management

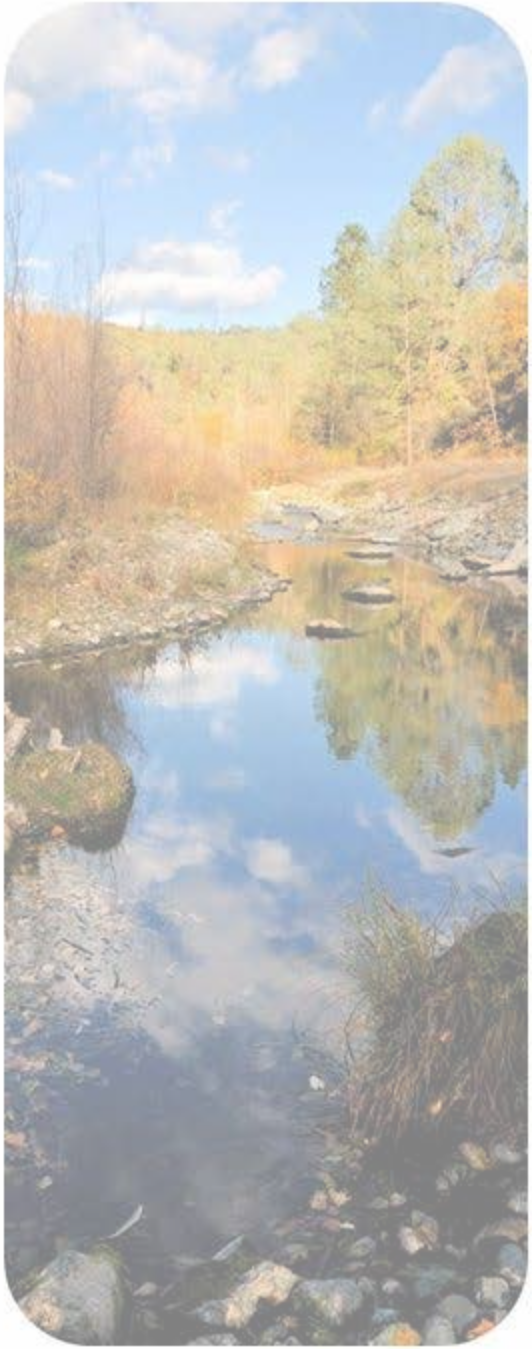


Jefferson Tyrell DeWeber

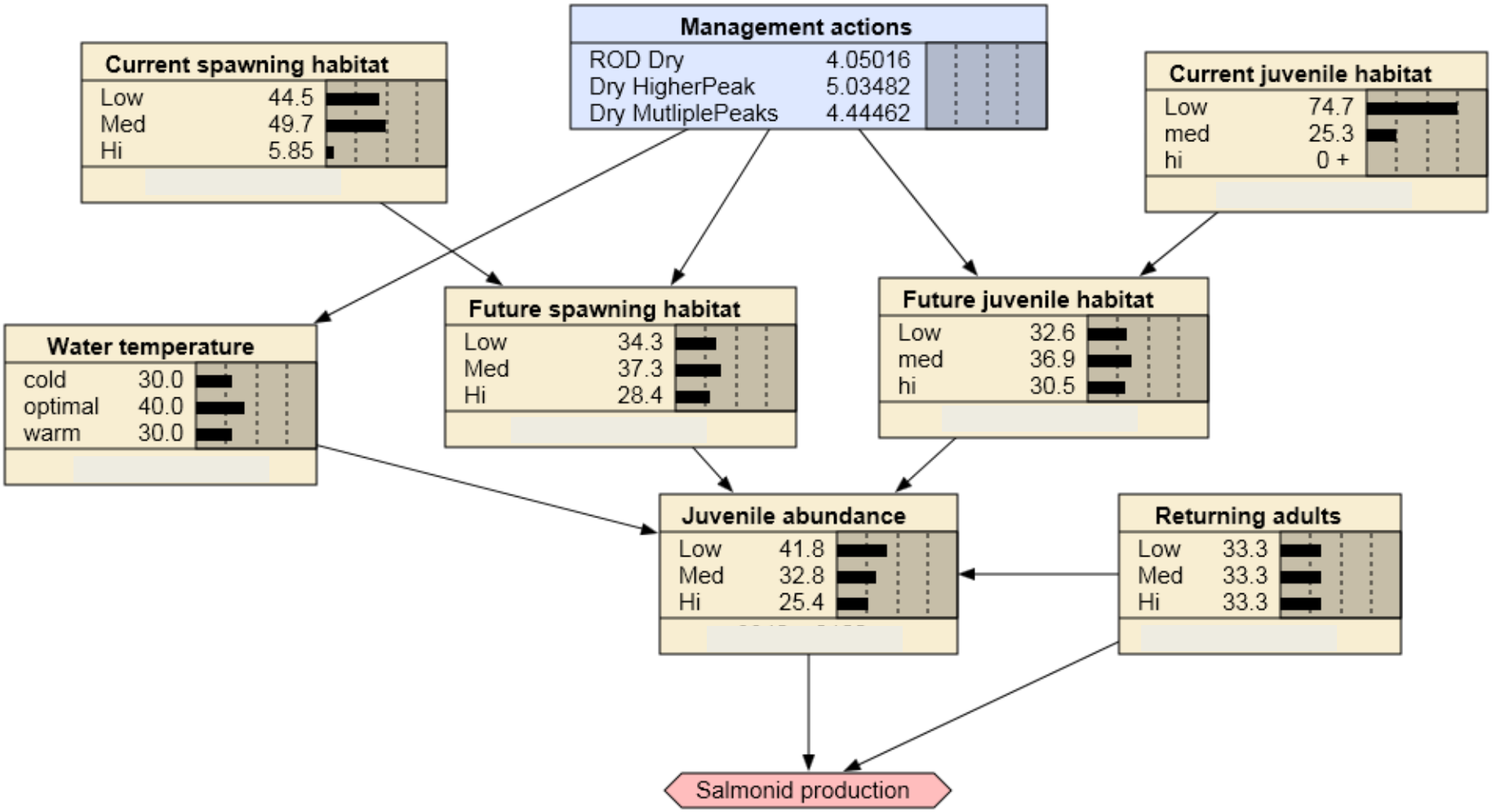
Oregon Cooperative Fish & Wildlife Research Unit

Key Parts of a DSS

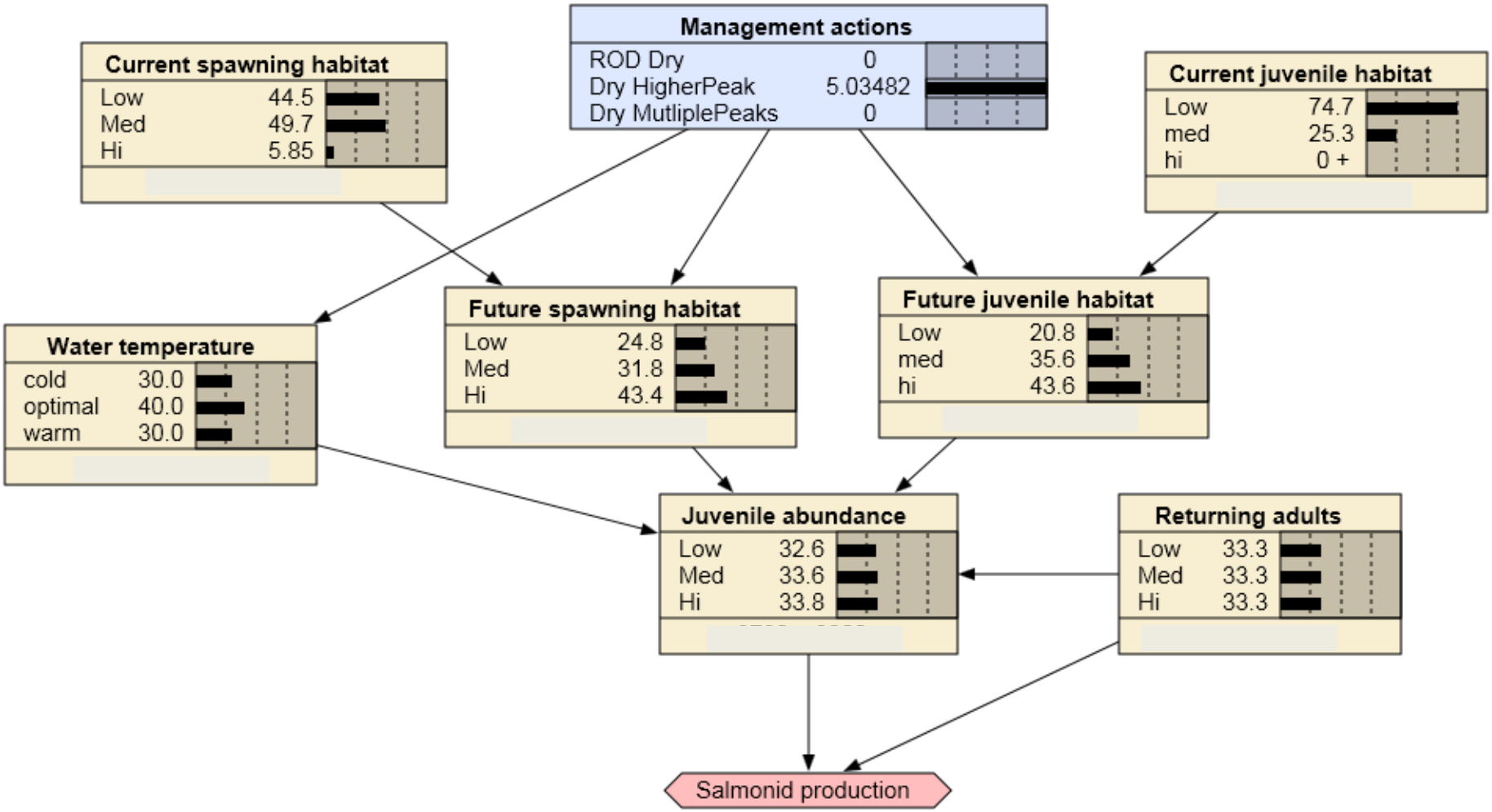
- Measurable Objectives
  - Salmon production
- Management actions
  - Different hydrographs
- Information about the system
  - Data and models
- Predicted response to actions
  - Models linking flow, habitat and production



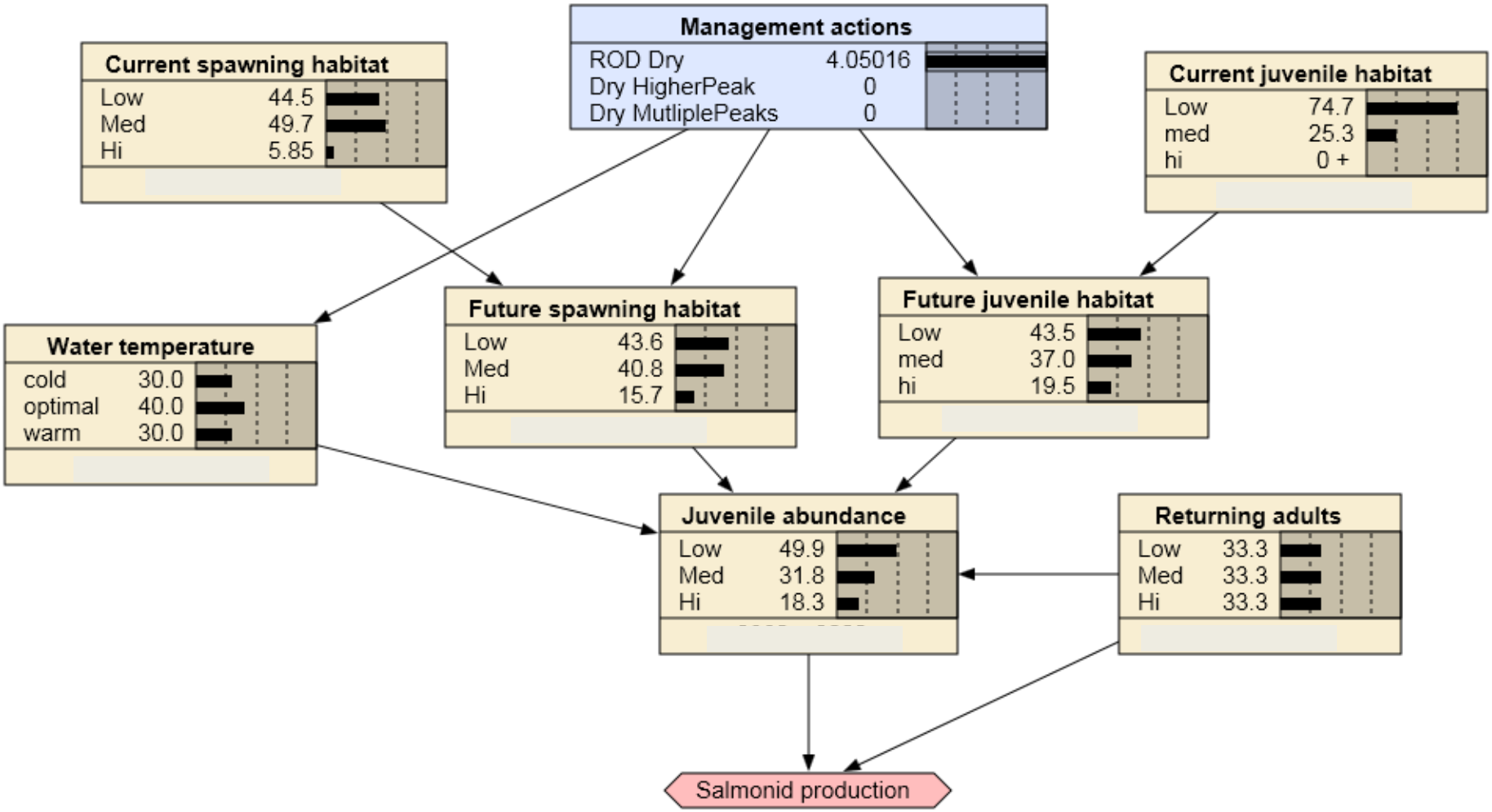
Example DSS (Demo Only)



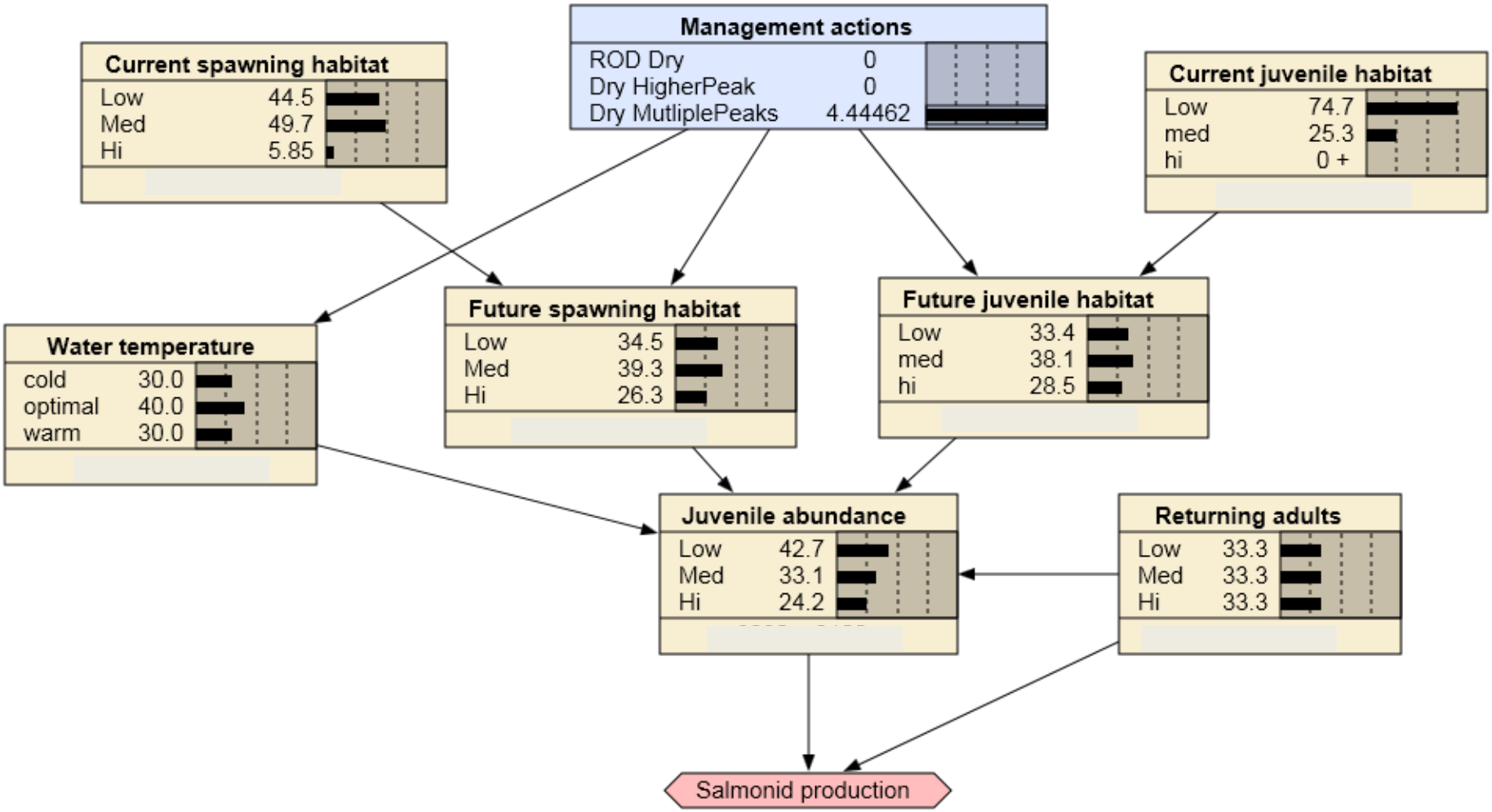
Example DSS (Demo Only)



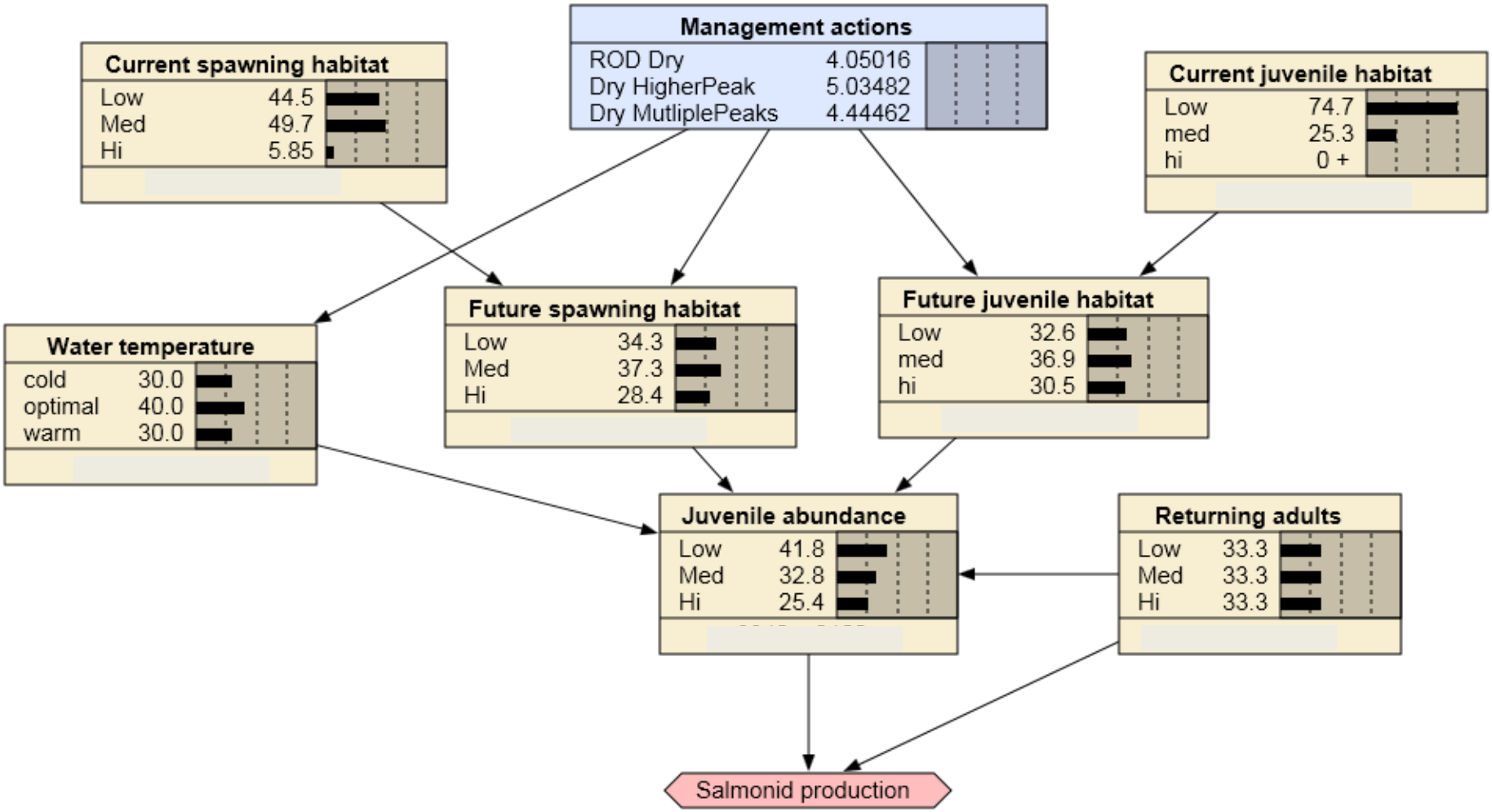
Example DSS (Demo Only)



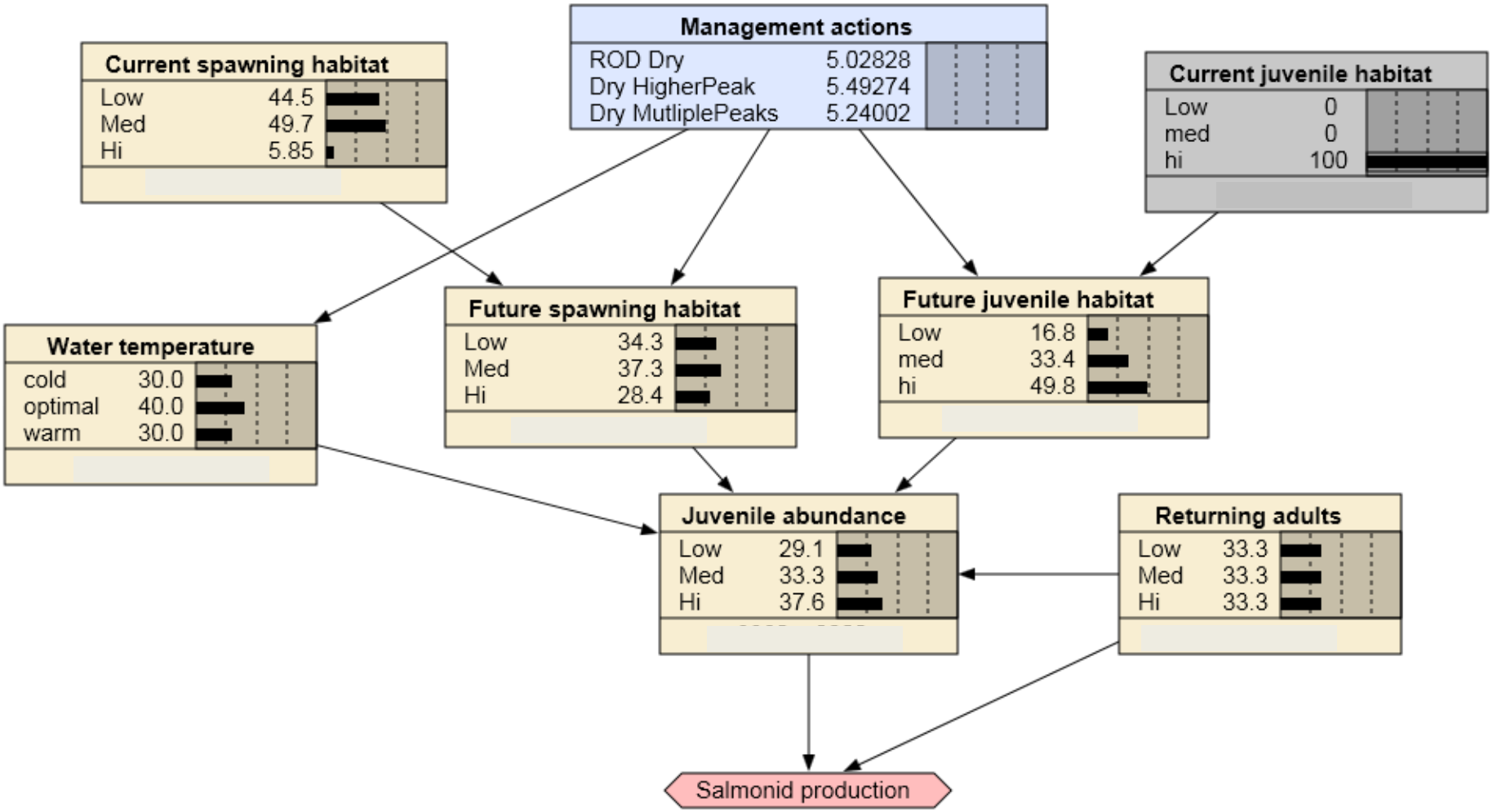
Example DSS (Demo Only)



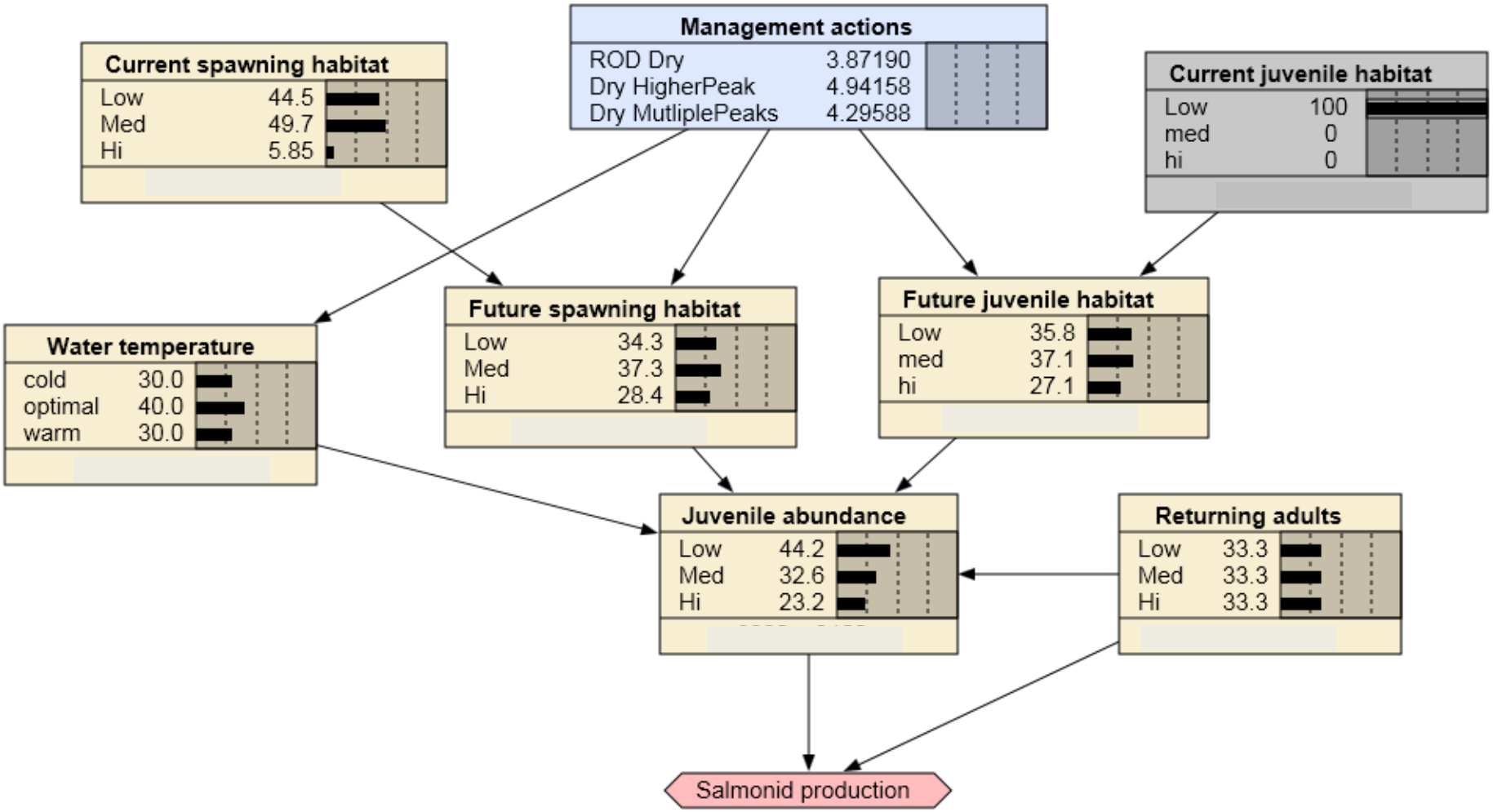
Example DSS (Demo Only)



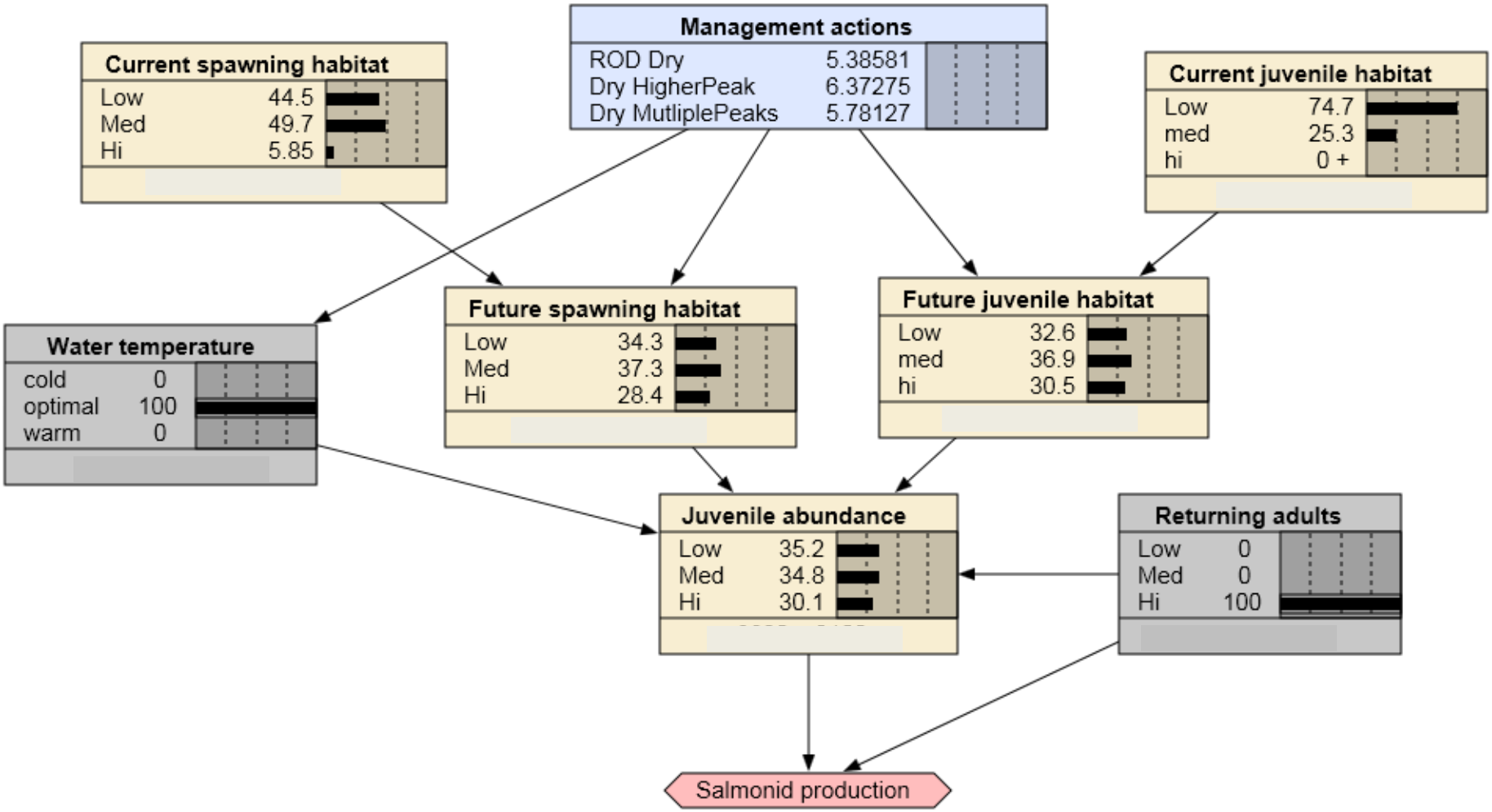
Example DSS (Demo Only)



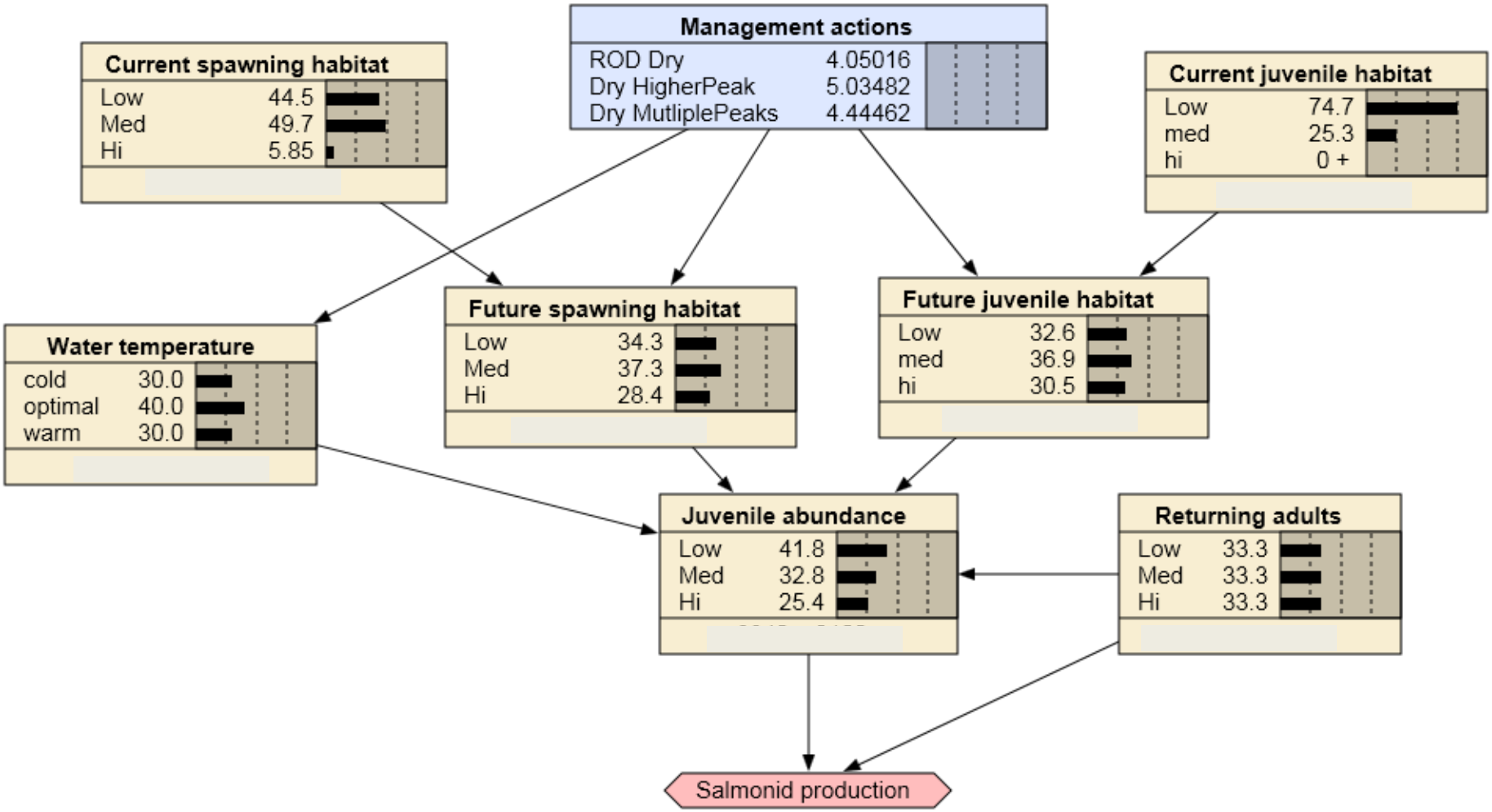
Example DSS (Demo Only)



Example DSS (Demo Only)



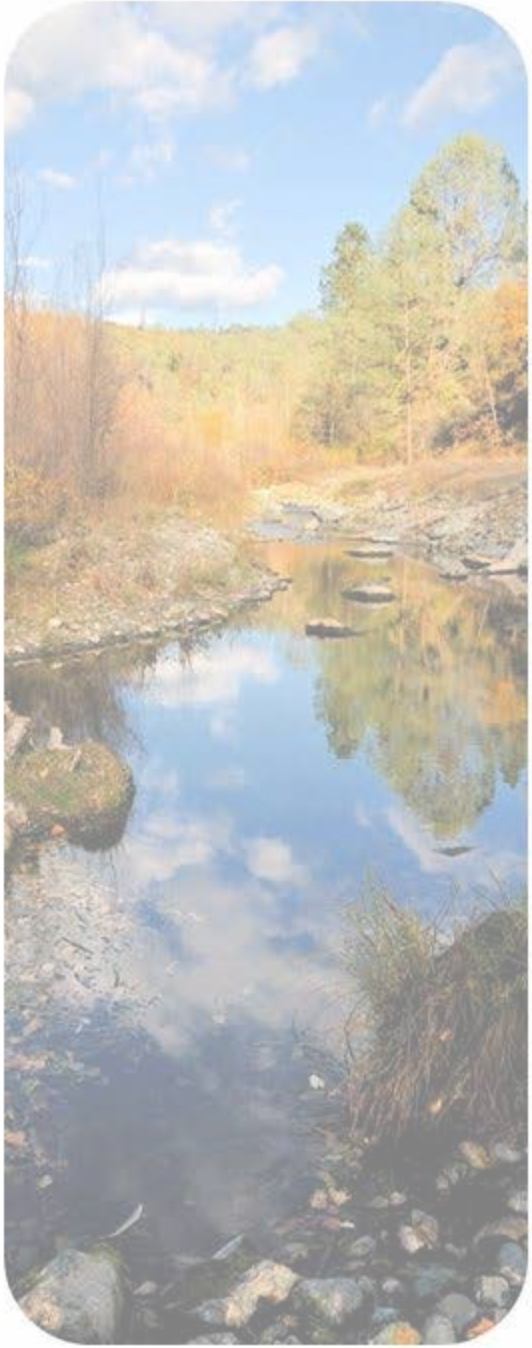
Example DSS (Demo Only)



But wait …

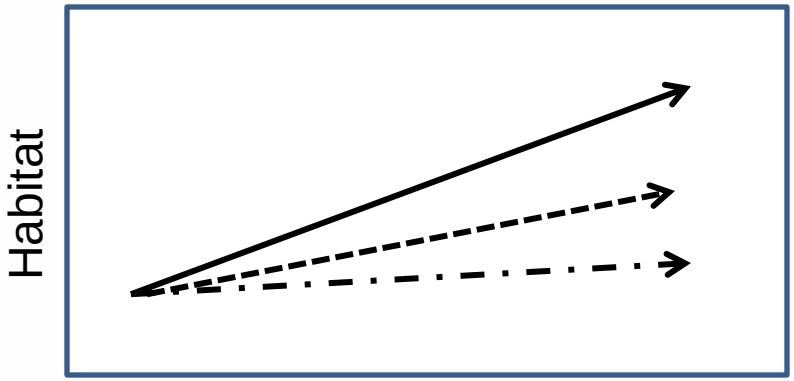
- I thought we could compare two models!
- Yes, we can
- As a reminder:

  Model = How we think the system works

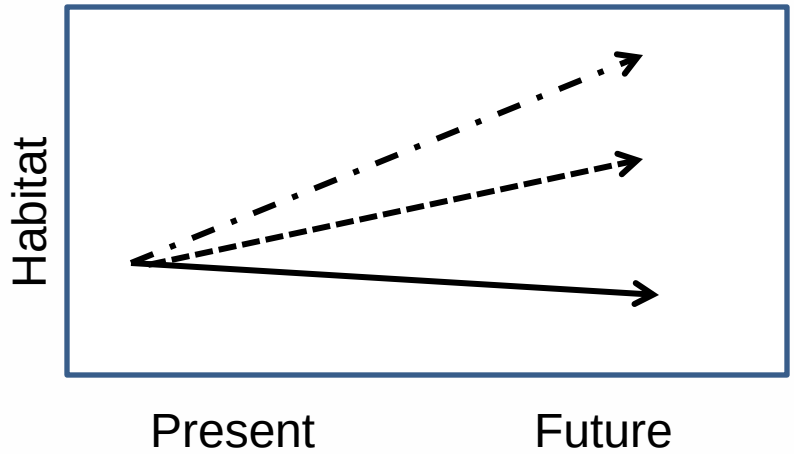


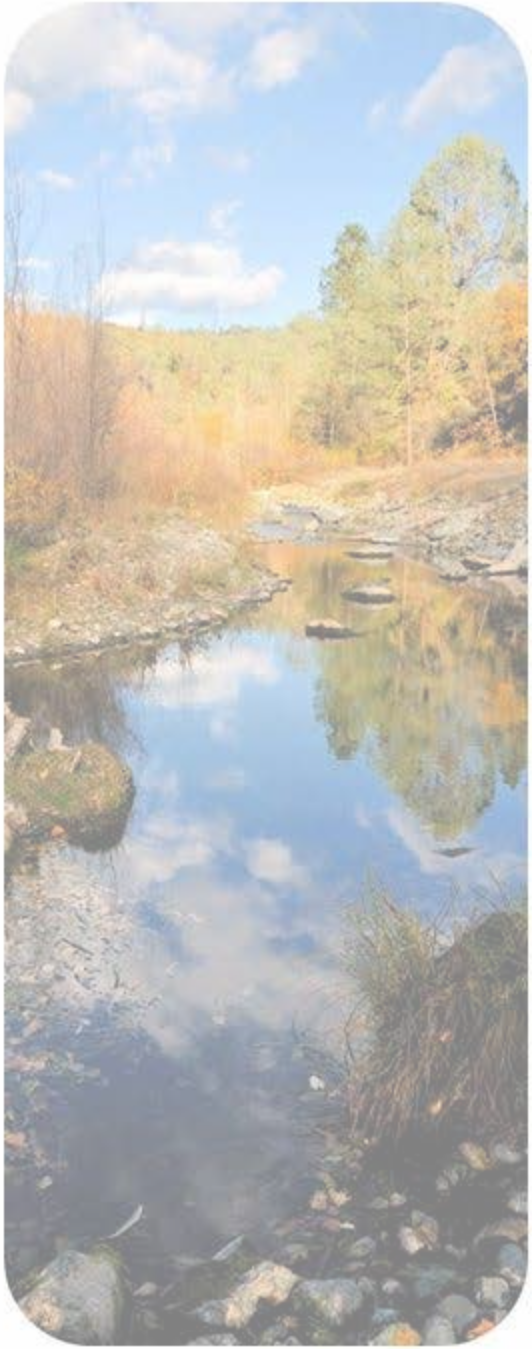
Alternative Models

Model 1:

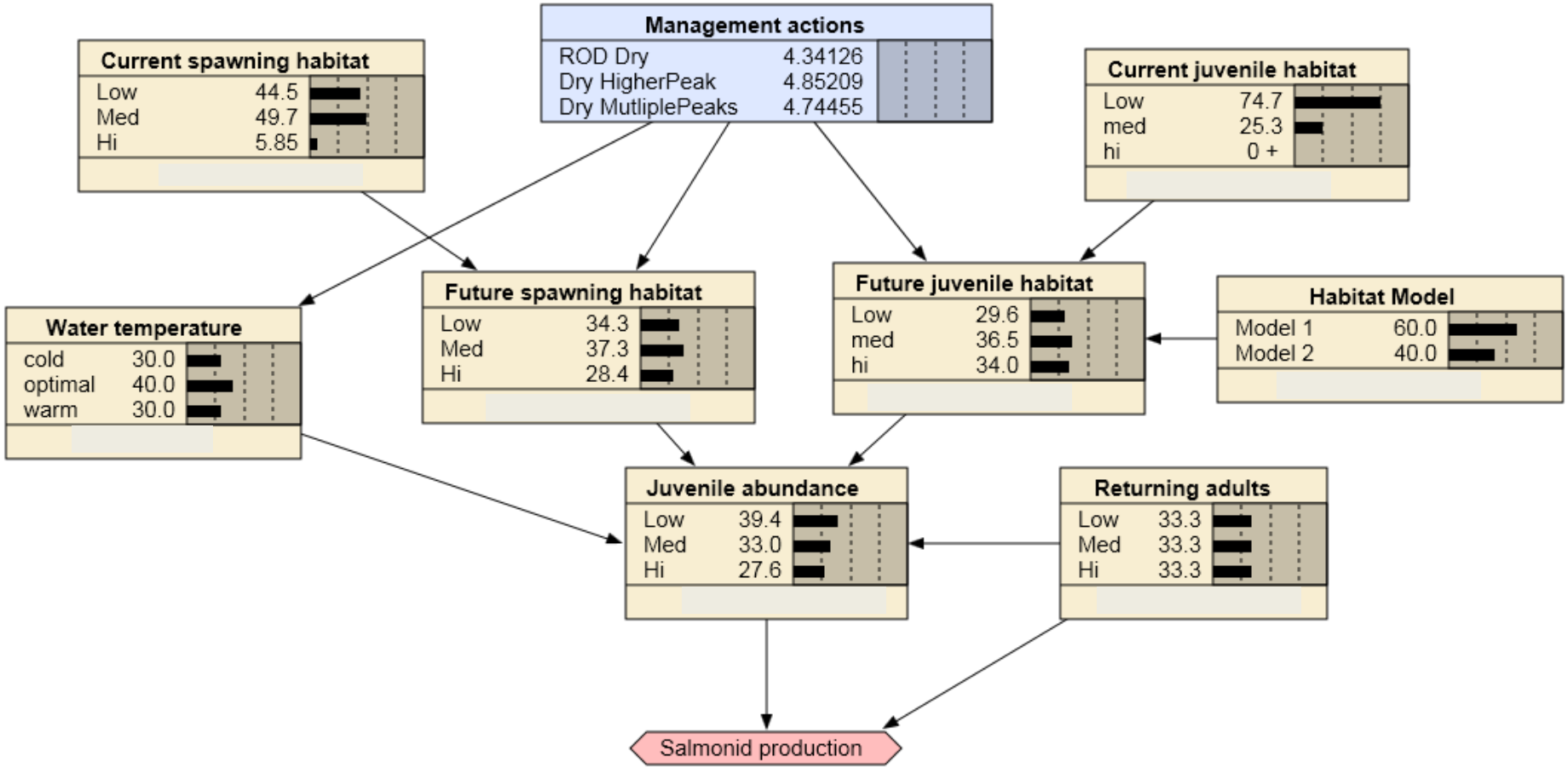


Model 2:

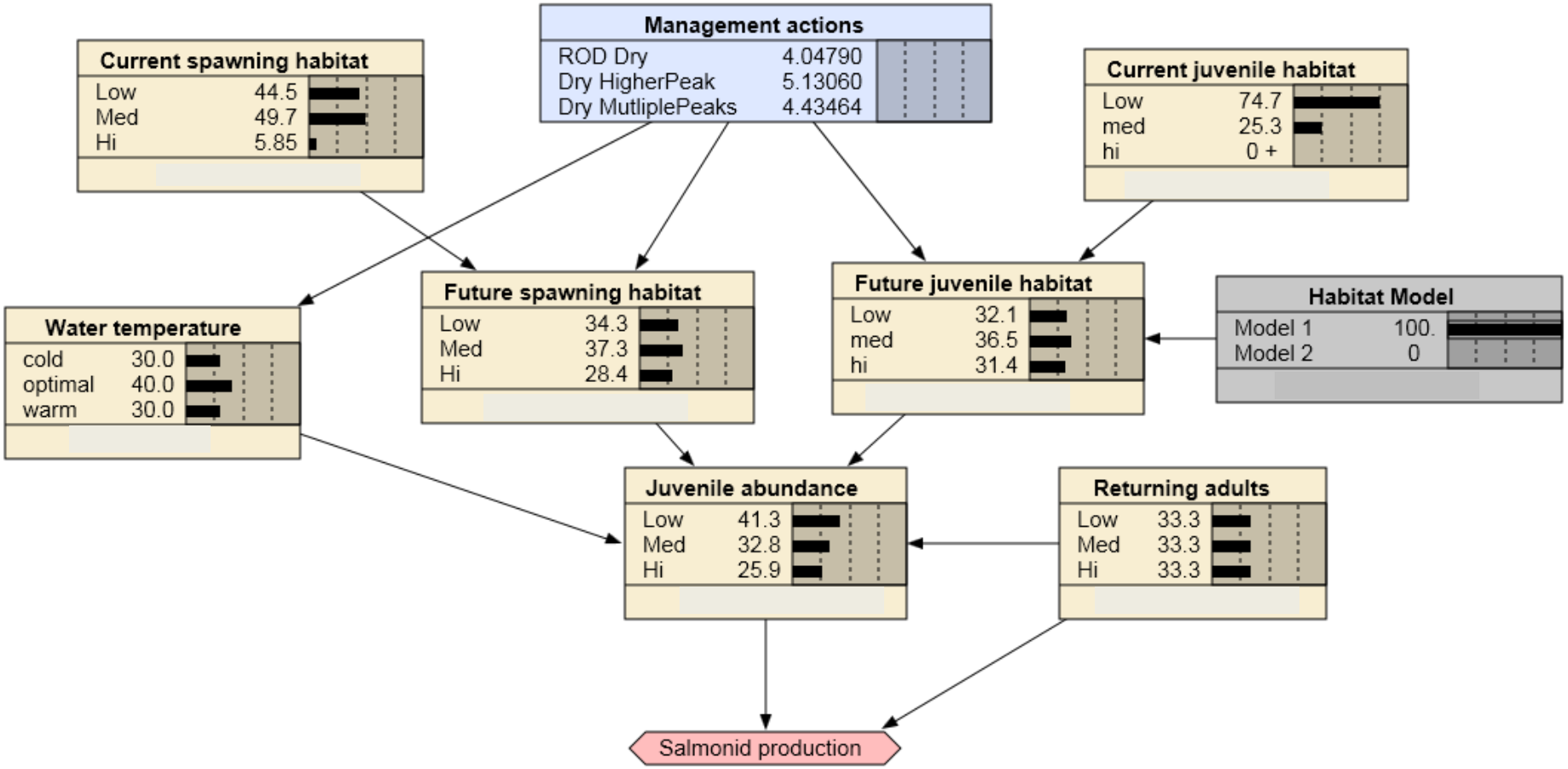




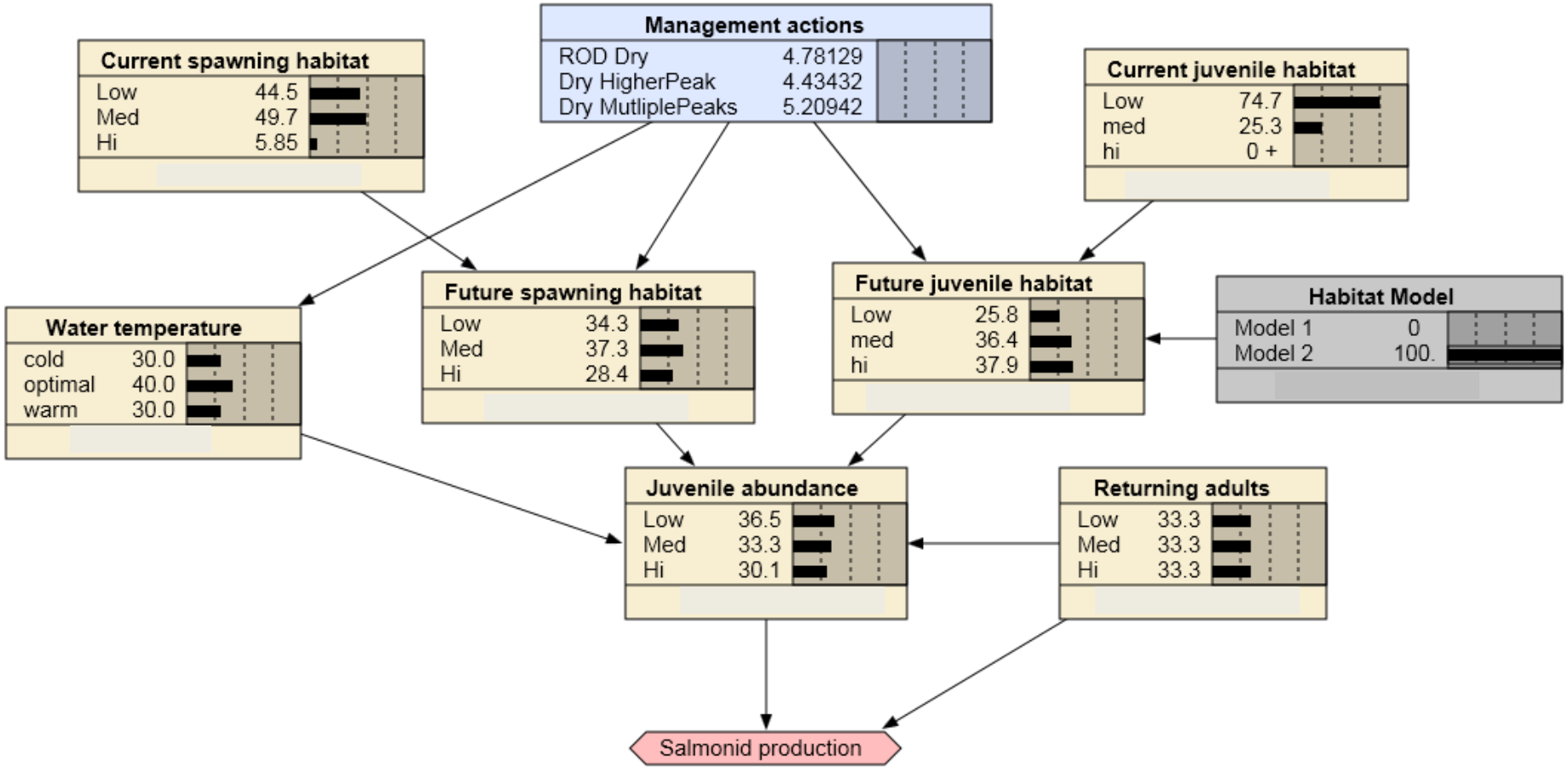
With Alternative Models



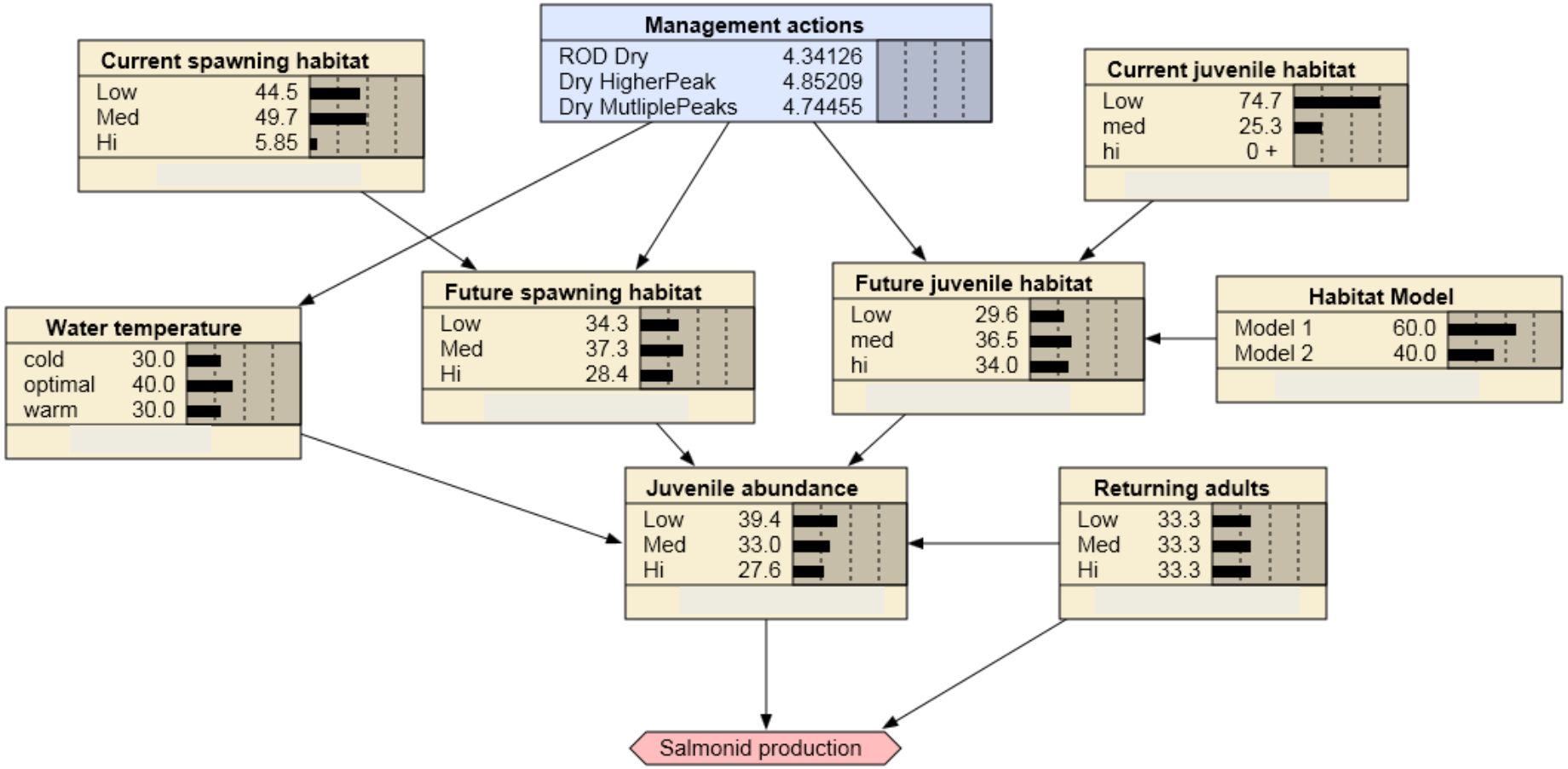
With Alternative Models



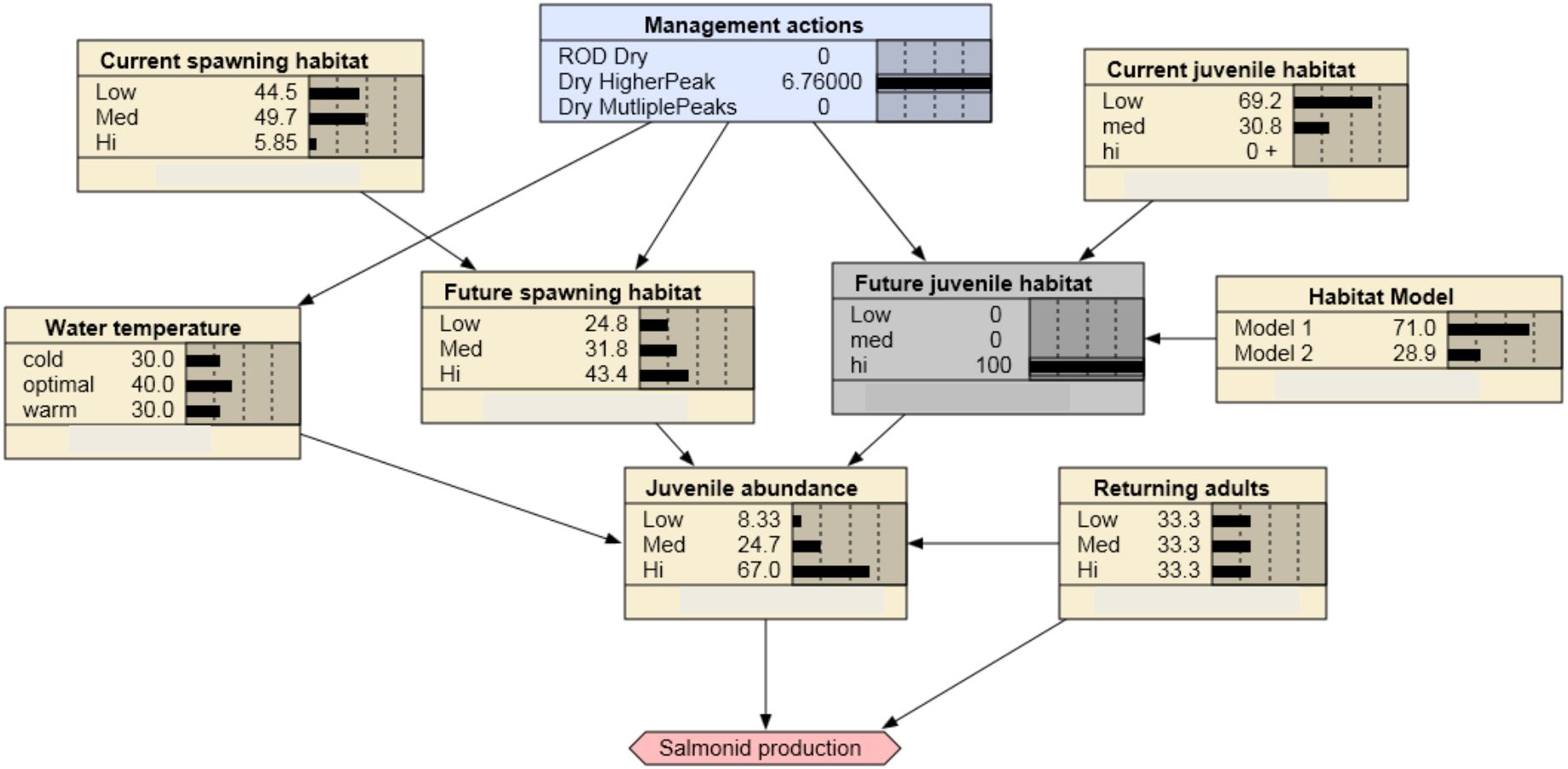
With Alternative Models



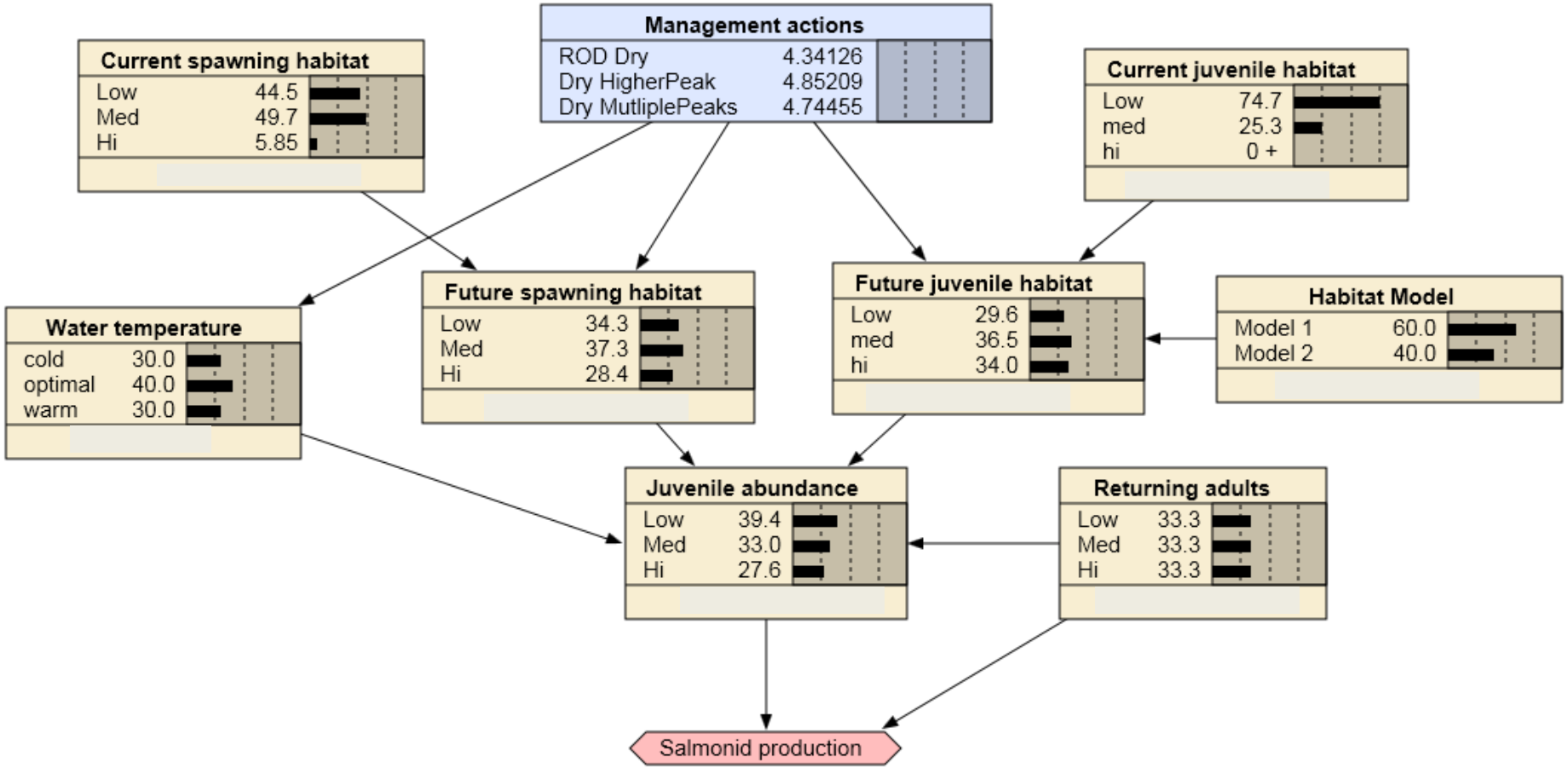
With Alternative Models



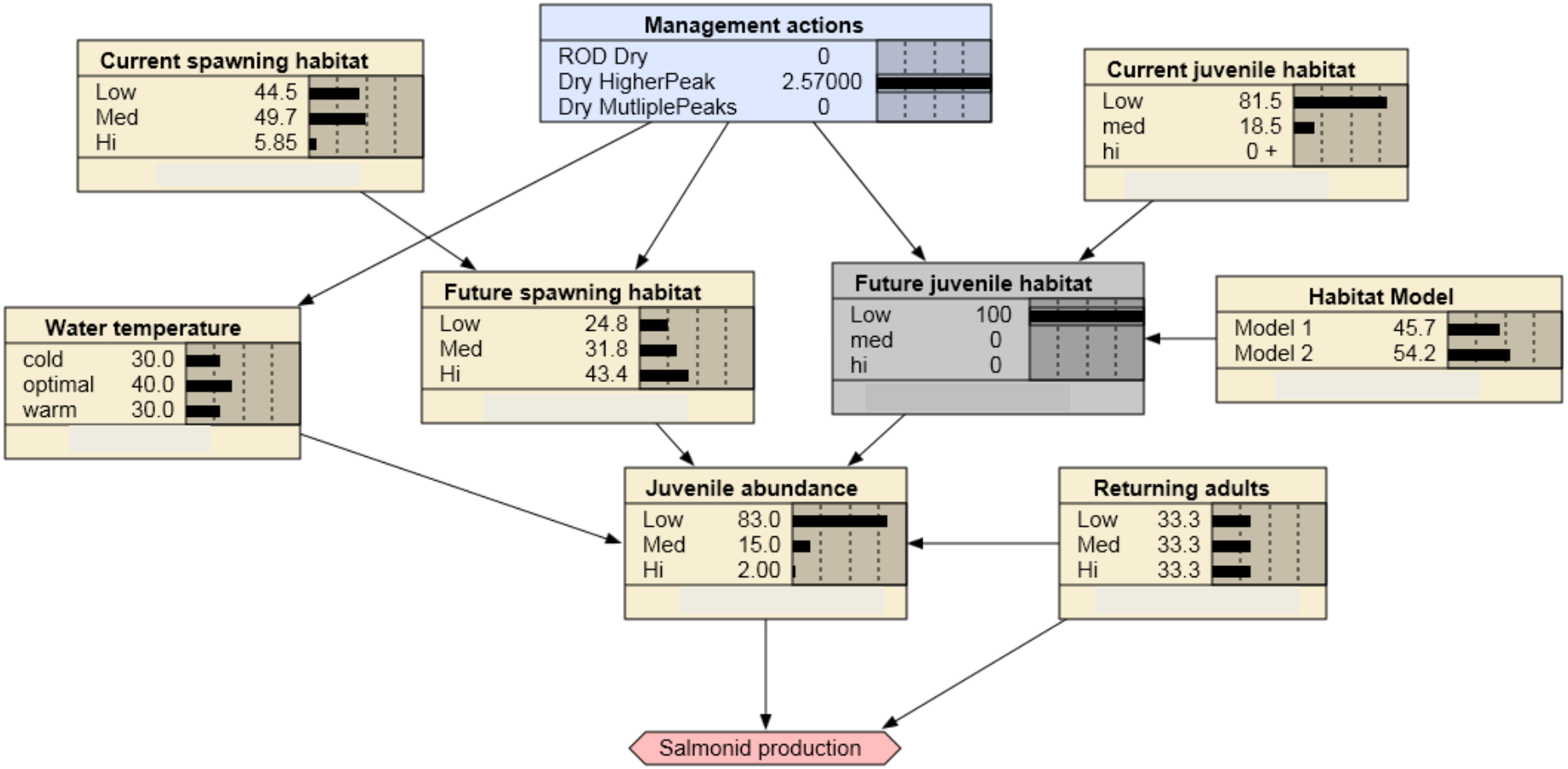
With Alternative Models

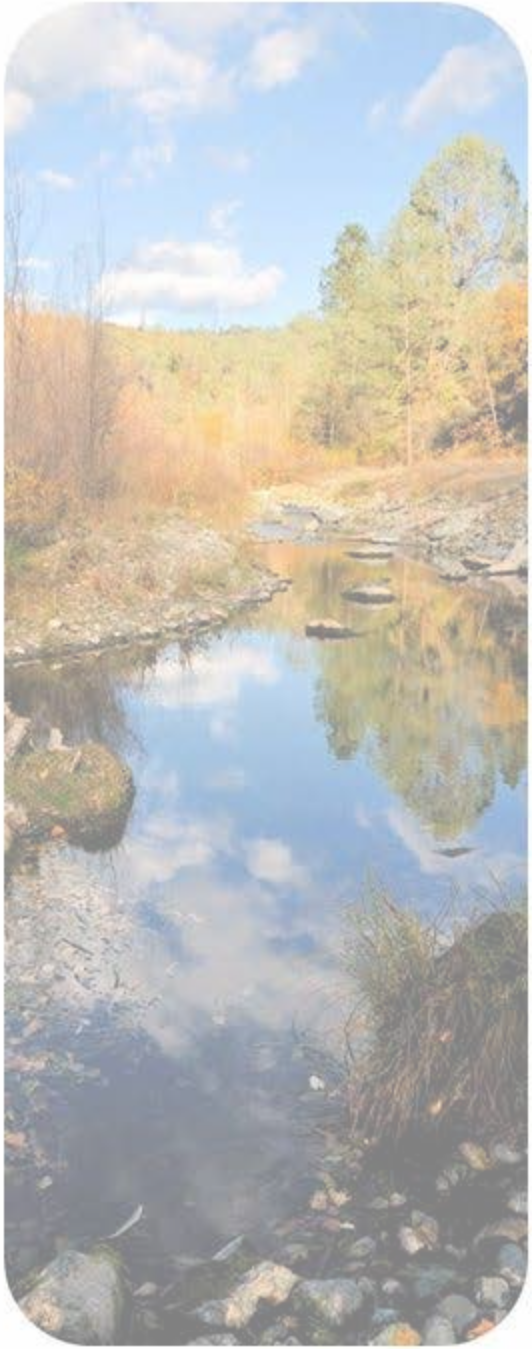


With Alternative Models



With Alternative Models



Next Steps

- Clarify objectives
  - What should we consider when making decisions?
  - Are objectives equally important?
- Link Models Together
  - Output from one must be input for another
  - Identify alternative models
- Decision Sensitivity Analysis
  - What factors lead to altered decisions?
  - This can simplify the DSS