FY2018-20 Synthesis Reports
-
A 2025 Perspective

Eric Peterson

TRRP Science Coordinator

Synthesis Report Funding Approval

- For many years, Science had mostly focused on improving individual monitoring projects
- Program was ready to really engage cross-topic evaluation to support Adaptive Environmental Assessment and Management (AEAM, or simply AM)

- FY2018
  - 13 projects

- FY2020
  - 1 additional project

Note: numerous other studies have been proposed in FY2018 and afterward that are not tracked here as "synthesis reports" although some may provide similar topical reviews.

E.g. the redd scour report

Synthesis Reports

Project No.	Brief Title	Involved Entities	Proposed Due*	Status
TRRP-2018-002	Tributary Delta	*Program Office (POC: Todd Buxton, TRRP)*	March 2019	**Published in *Ecohydrology* 2022;e2463**
TRRP-2018-003	Fish Habitat	*HVT, USFWS, YT, USBR TSC (POC: Damon Goodman, USFWS)*	2nd Q 2019	**USFWS portion Posted; YT portion Posted**
TRRP-2018-007	Juvenile Chinook Production	*USFWS, YT, HVT (POC: Bill Pinnix, USFWS)*	July 2017	**YT Portion Posted** **USFWS portion in final edits**
TRRP-2018-009	Cohort Reconstruction	*HVT, USFWS, CDFW (POC: Ken Lindke, CDFW)*	2nd Q 2019 Cur.ETA mid-2024	In progress
TRRP-2018-011	Adult Salmon Spawning	*USFWS, HVT, YT, CDFW (POC: Steve Gough, USFWS)*	2nd Q 2019 Cur.ETA fall 2023	In final edits
TRRP-2018-018	Bed Mobility and Scour	*HVT, USFWS (POC: Geoff Hales & Scott McBain, McBain Associates)*	2nd Q 2018	**FINAL POSTED**
TRRP-2018-019	Cottonwood Seed Dispersal	*HVT (POC: John Bair, McBain Associates)*	3rd Q 2018	**FINAL POSTED**
TRRP-2018-021	Riparian Encroachment	*HVT (POC: John Bair, McBain Associates)*	4th Q 2018	**FINAL POSTED**
TRRP-2018-022	Sediment Storage	*HVT, USFWS (POC: Geoff Hales & Scott McBain, McBain Associates)*	4th Q 2018	**FINAL Posted**
TRRP-2018-025	Channel Complexity	*HVT, USFWS (POC: Smokey Pittman & Scott McBain, McBain Associates)*	August 2019 Cur ETA ?	Delayed- uncertain timeline
TRRP-2018-027	Fine Sediment	*Program Office, NMFS, HVT (POC: Todd Buxton, TRRP)*	July 2020	**FINAL POSTED**
TRRP-2018-032	Water Temperature	*YT, USFWS, HVT, USBR, NMFS (POC: Eli Asarian, Riverbend Sciences)*	May 2019	**FINAL POSTED**
TRRP-2018-033	Large Wood Management	*NMFS, YT, HVT (POC: Scott McBain)*	April 2018 Cur.ETA 2024	Recently reorganized team, in progress,
TRRP-2020	Flow Synthesis	*HVT et al. (POC: Justin Alvarez)*	Mid FY 22 Cur.ETA: July 2024	In Progress

TRRP-2018-002
Tributary Deltas

Gaeuman and Stewart (USBR) ***became*** Buxton and Bradley

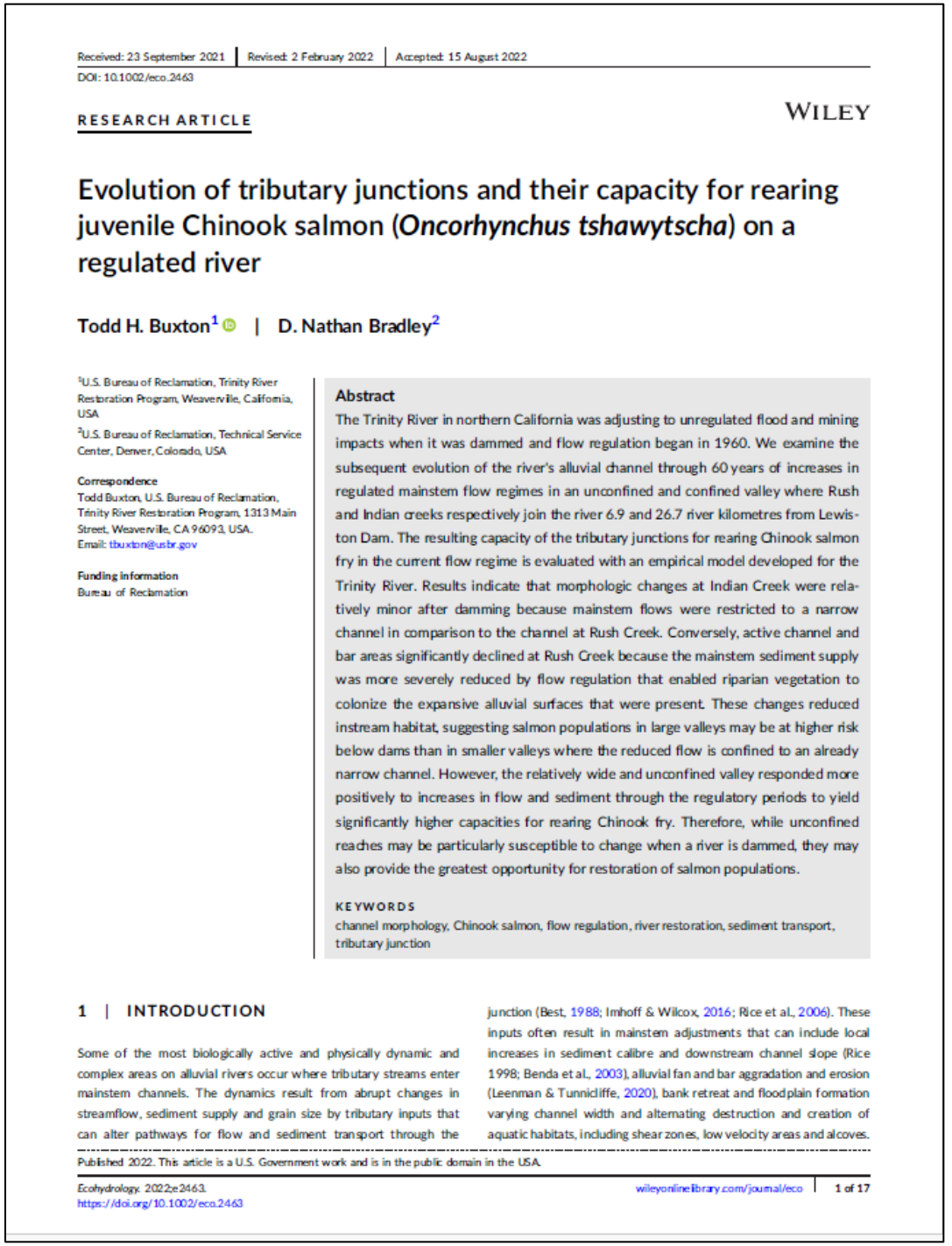
Buxton, T. H. and D. N. Bradley. 2022. Evolution of tributary junctions and their capacity for rearing juvenile Chinook salmon (Oncorhynchus tshawytscha) on a regulated river. Ecohydrology.

Purpose: assess sediment inputs from tributaries (quantities and routing) using high resolution terrain models.

Largely contrasted Rush and Indian Creek deltas.

Results:

- Unconfined reaches both
  - more sensitive to effects from dams and
  - more responsive to changes in flow management (greater potential to improve)
- Sensitivity to dam effects included
  - channel simplification
  - Reduced juvenile chinook capacity
- No specific recommendations



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RESEARCH ARTICLE

WILEY

Evolution of tributary junctions and their capacity for rearing juvenile Chinook salmon (*Oncorhynchus tshawytscha*) on a regulated river

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Funding information
Bureau of Reclamation

Abstract

The Trinity River in northern California was adjusting to unregulated flood and mining impacts when it was dammed and flow regulation began in 1960. We examine the subsequent evolution of the river's alluvial channel through 60 years of increases in regulated mainstem flow regimes in an unconfined and confined valley where Rush and Indian creeks respectively join the river 6.9 and 26.7 river kilometres from Lewiston Dam. The resulting capacity of the tributary junctions for rearing Chinook salmon fry in the current flow regime is evaluated with an empirical model developed for the Trinity River. Results indicate that morphologic changes at Indian Creek were relatively minor after damming because mainstem flows were restricted to a narrow channel in comparison to the channel at Rush Creek. Conversely, active channel and bar areas significantly declined at Rush Creek because the mainstem sediment supply was more severely reduced by flow regulation that enabled riparian vegetation to colonize the expansive alluvial surfaces that were present. These changes reduced instream habitat, suggesting salmon populations in large valleys may be at higher risk below dams than in smaller valleys where the reduced flow is confined to an already narrow channel. However, the relatively wide and unconfined valley responded more positively to increases in flow and sediment through the regulatory periods to yield significantly higher capacities for rearing Chinook fry. Therefore, while unconfined reaches may be particularly susceptible to change when a river is dammed, they may also provide the greatest opportunity for restoration of salmon populations.

KEYWORDS
channel morphology, Chinook salmon, flow regulation, river restoration, sediment transport, tributary junction

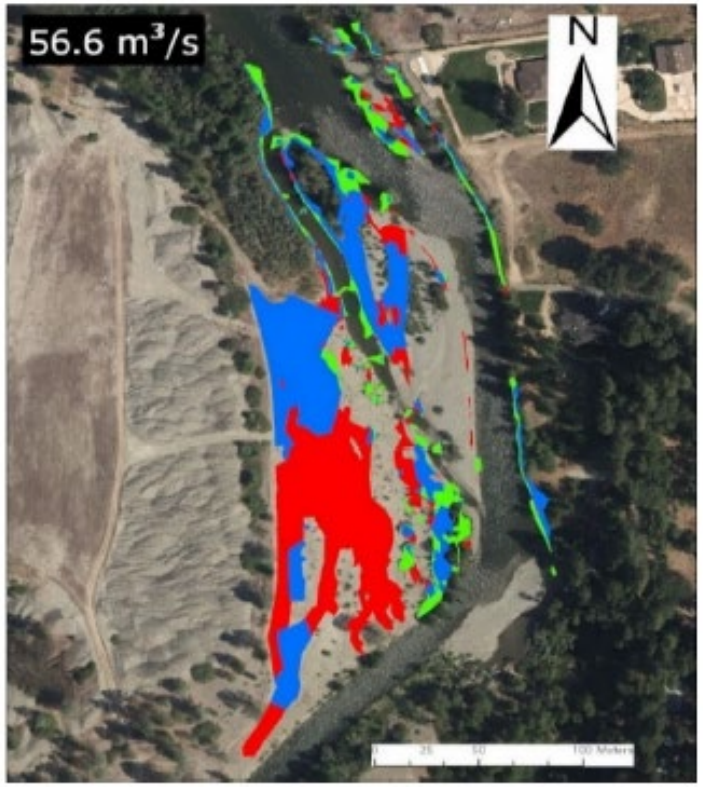
1 | INTRODUCTION

Some of the most biologically active and physically dynamic and complex areas on alluvial rivers occur where tributary streams enter mainstem channels. The dynamics result from abrupt changes in streamflow, sediment supply and grain size by tributary inputs that can alter pathways for flow and sediment transport through the junction (Best, 1988; Imhoff & Wilcox, 2016; Rice et al., 2006). These inputs often result in mainstem adjustments that can include local increases in sediment calibre and downstream channel slope (Rice 1998; Benda et al., 2003), alluvial fan and bar aggradation and erosion (Leenman & Tunnicliffe, 2020), bank retreat and floodplain formation varying channel width and alternating destruction and creation of aquatic habitats, including shear zones, low velocity areas and alcoves.

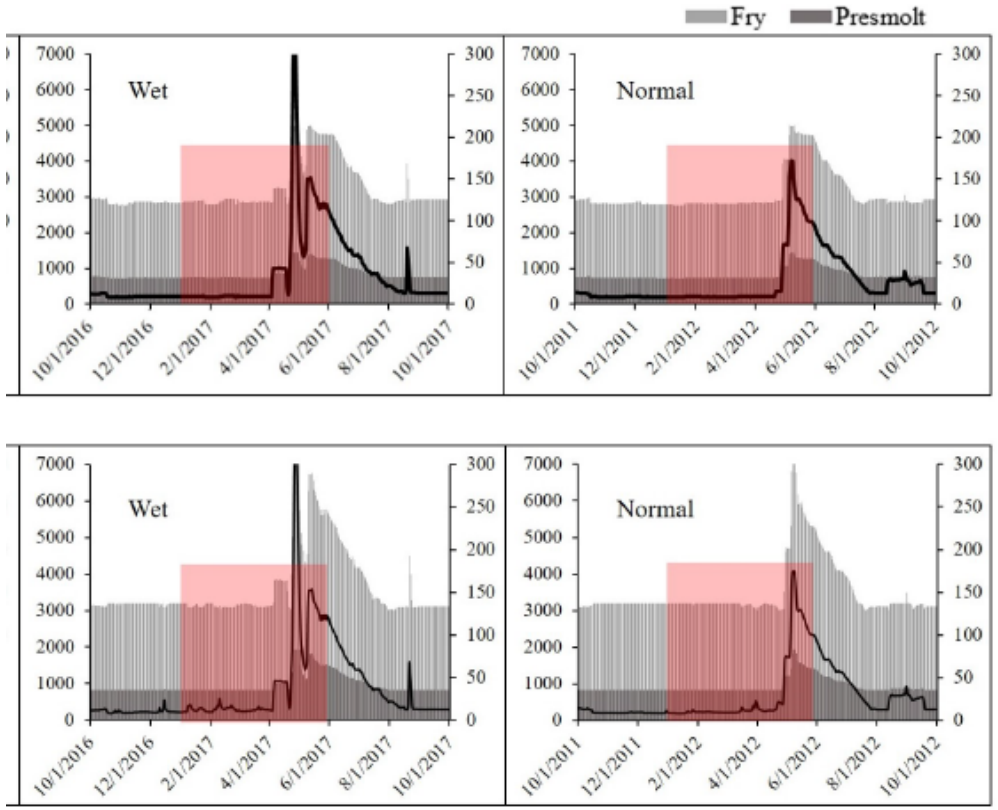
TRRP-2018-003 Fish Habitat

Purpose: To inform the TRRP about the performance and evolution of constructed rehabilitation sites relative to rearing habitat at multiple streamflows to assist the adaptive management process of the program.

Boyce, J., D. H Goodman, N. A Som, J. Alvarez, K. Hopkins, and A. Martin. 2020. Streamflow and Juvenile Salmonid Habitat Availability at Six Rehabilitation Sites on The Trinity River, California 2008-2017.



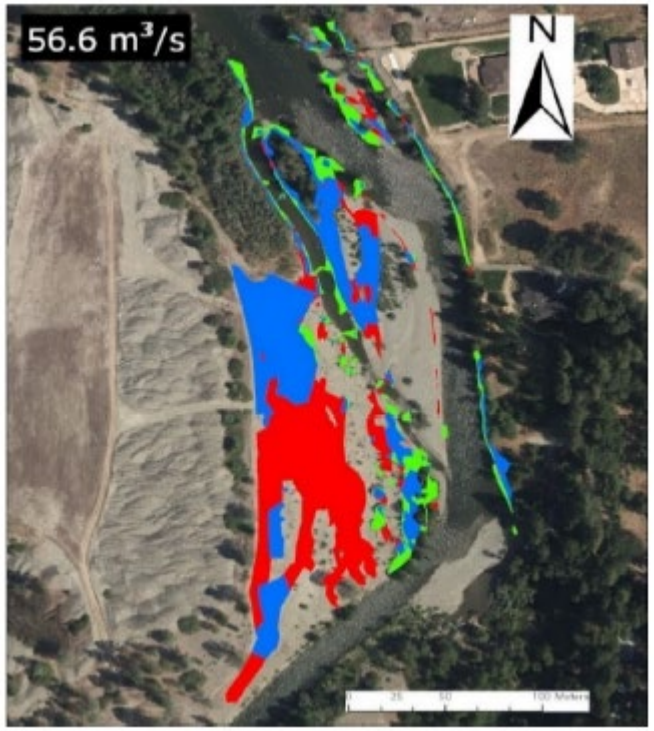
Cooper-Hertel, E., D. Gaeuman, K. De Juilio, A. Martin, J. Boyce, D. H. Goodman, N. Som, and J. Alvarez. 2022. Trinity River Juvenile Salmonid Habitat Synthesis: Physical Habitat Capacity at the Restoration Site and Reach Scale.



TRRP-2018-003 (a) Fish Habitat

Boyce, J., D. H Goodman, N. A Som, J. Alvarez, K. Hopkins, and A. Martin. 2020. Streamflow and Juvenile Salmonid Habitat Availability at Six Rehabilitation Sites on The Trinity River, California 2008-2017.

- Purpose:
  - To inform the TRRP about the performance and evolution of constructed rehabilitation sites relative to rearing habitat at multiple streamflows to assist the adaptive management process of the program.
- Results:
  - Channel Rehabilitation does create habitat
  - As sites evolve, that created habitat reduces
  - However, all sites studied retained greater habitat than prior to rehab

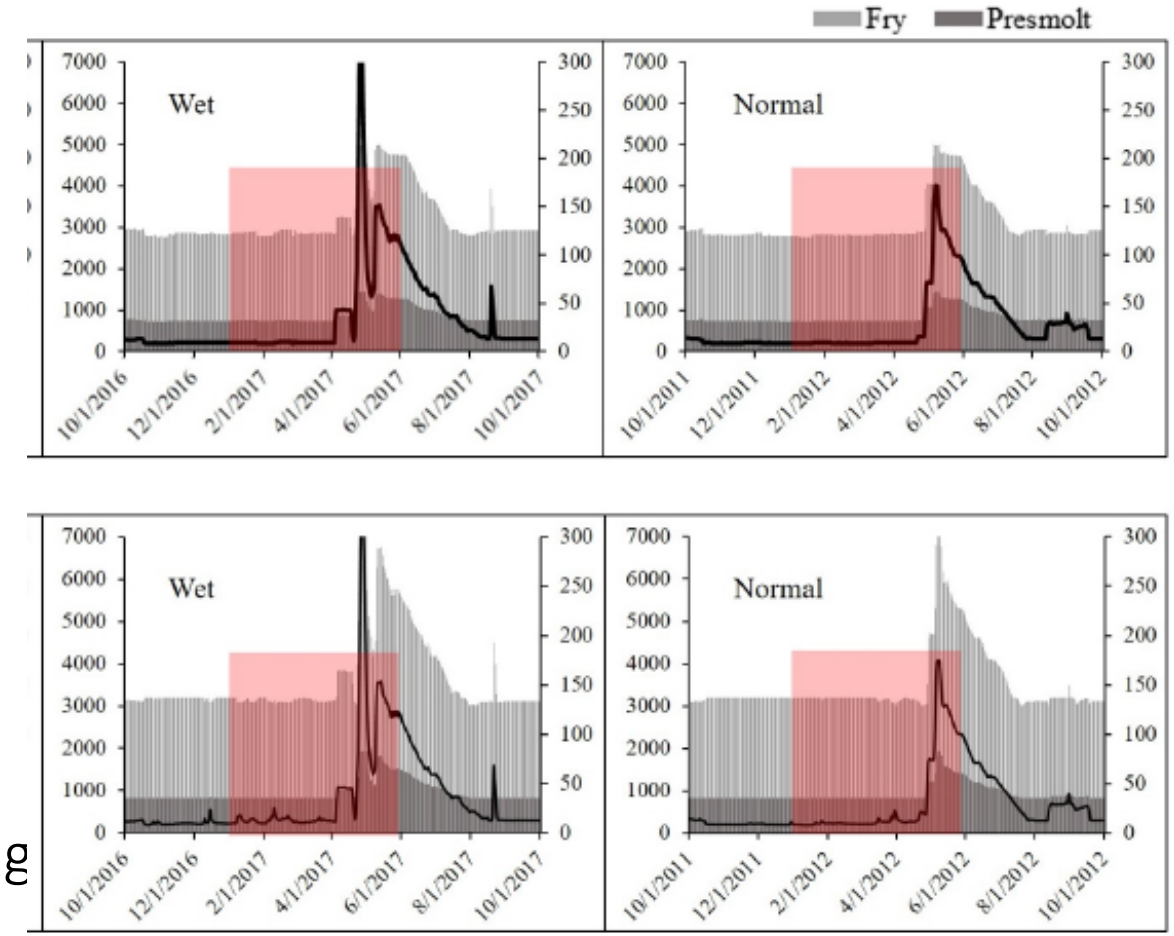


- No specific recommendations

TRRP-2018-003 (b) Fish Habitat

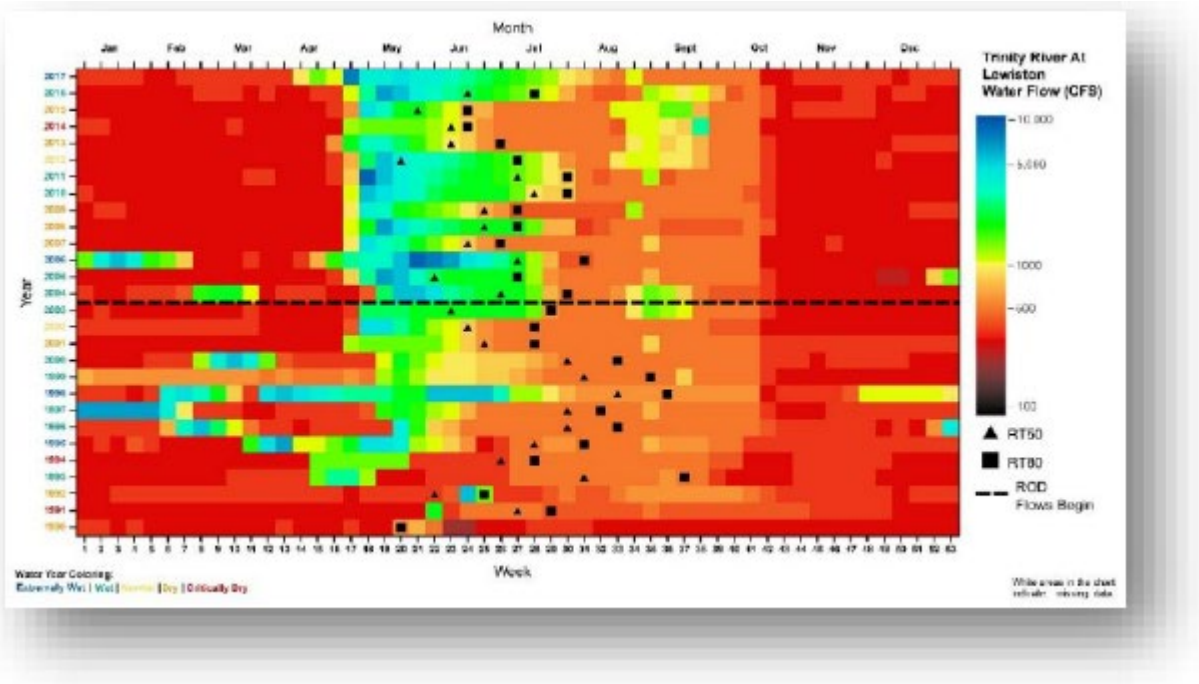
Cooper-Hertel, E., D. Gaeuman, K. De Juilio, A. Martin, J. Boyce, D. H. Goodman, N. Som, and J. Alvarez. 2022. Trinity River Juvenile Salmonid Habitat Synthesis: Physical Habitat Capacity at the Restoration Site and Reach Scale.

- Purpose:
  - -same-
- Results:
  - Advanced upon prior report
  - Developed capacity-flow relationships (reaches and rehab sites)
  - “winter baseflow limits capacity during 70% of the rearing period,”
- Recommendations:
  - Rehab: Increase wetted width at discharges available for much of rearing period
  - Flow: Alternative management during rearing

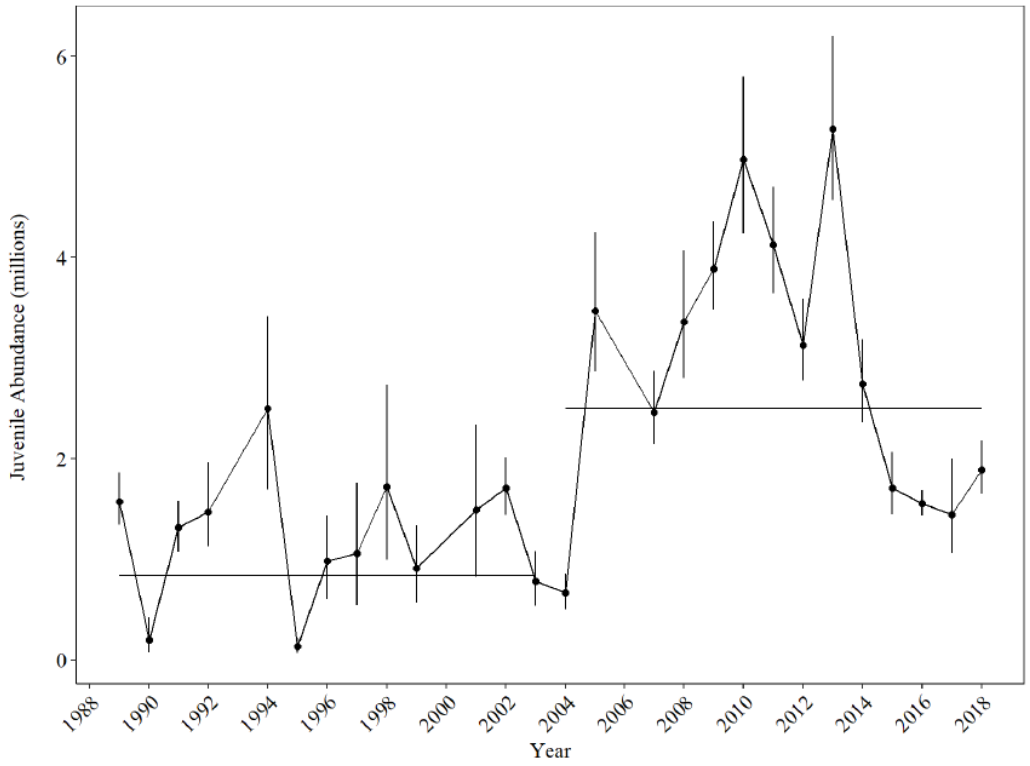


TRRP-2018-007 Juvenile Chinook Production

Thomas Gast & Associates. 2021. Analysis and model evaluation of long-term data collected at the Willow Creek outmigrant trap.

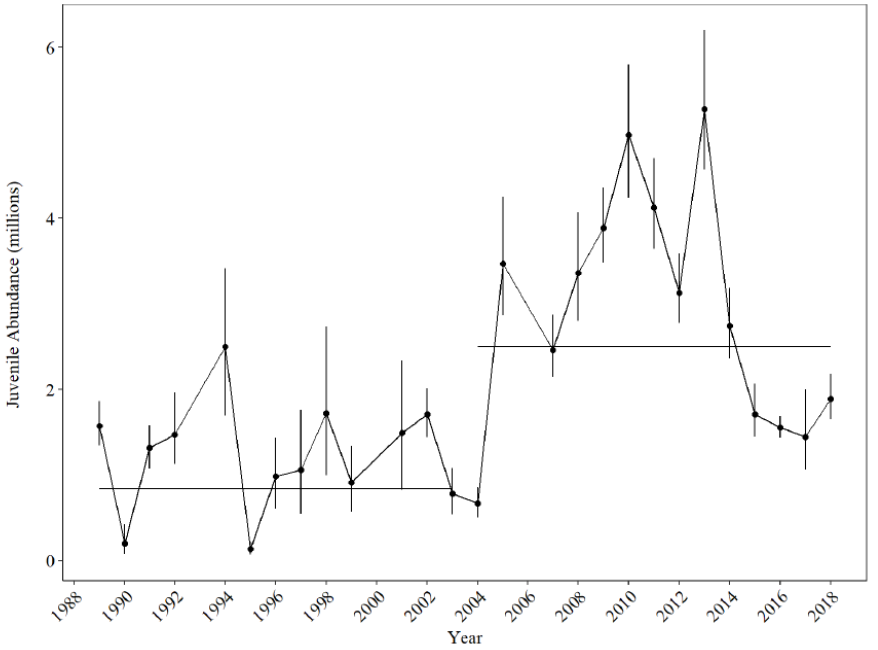


Pinnix, W. D., S. P. Boyle, T. Wallin, T. Daley, and N. A. Som. 2022. Long-Term Analyses of Estimates of Abundance of Juvenile Chinook Salmon on the Trinity River, 1989-2018.



TRRP-2018-007 (b) Juvenile Chinook Production

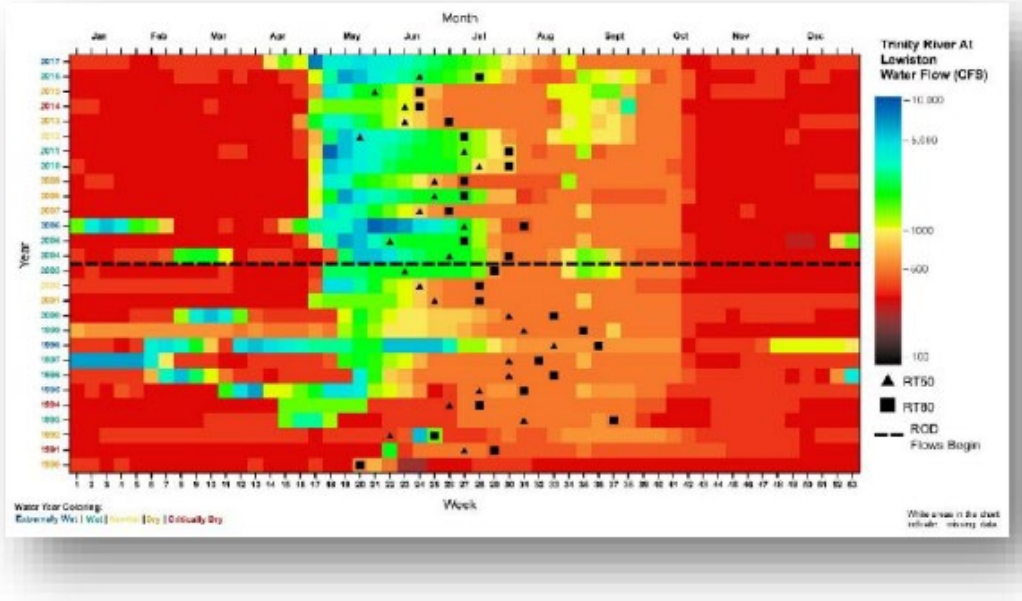
Pinnix, W. D., S. P. Boyle, T. Wallin, T. Daley, and N. A. Som. 2022. Long-Term Analyses of Estimates of Abundance of Juvenile Chinook Salmon on the Trinity River, 1989-2018



- Purpose
  - **Eval of production, condition**
  - ~~Eval of timing relative to temperature~~
- Analyzed full period of record for juvenile Chinook outmigration (Willow Creek: 1989 to 2018)
- Results
  - WC statistically strong step-change in outmigrant population (doubled) commencing with full ROD flows
  - Similar when viewed as Smolts-per-Spawner
  - But also indications of smaller fish, noting growth appears muted after ROD flows rise, perhaps due to low water temperature in critical growth periods (May-June).
- Recommendations
  - Reanalyze Pear Tree data when more years are available
  - Use either total biomass, or biomass per spawner as juvenile Chinook response metric

TRRP-2018-007 (a) Juvenile Chinook Production

Thomas Gast & Associates. 2021. Analysis and model evaluation of long-term data collected at the Willow Creek outmigrant trap. Report 20190910YTFP for the Trinity River Restoration Program (TRRP).



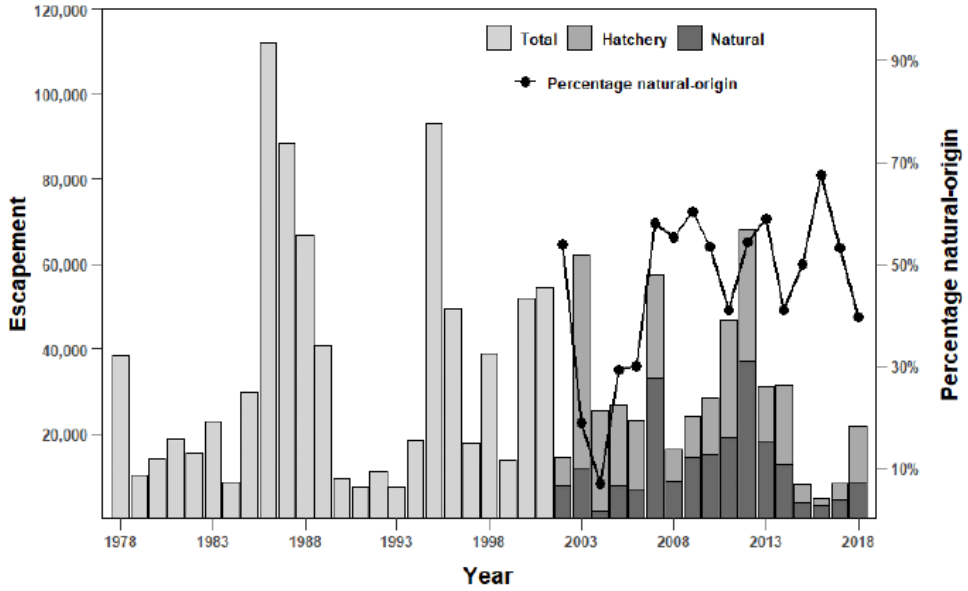
- Purpose:
  - ~~Eval of production, condition~~
  - **Eval of timing relative to temperature**
- Massive report
  - 50 pages primary content
  - Numerous appendices
  - Hundreds of pages of data
- Results:
  - Affirms basic results of Pinnix et al.
  - RT50 and RT80 as function of cumulative T, emergence date, redd counts, discharge, plus
  - RT50 more variable so may be better response metric
  - T during initial timing of ROD-flows (April and May) corresponds to consumption rates and outmigration timing
- Recommend flow management for warmer T (April and May), including selective withdrawal

TRRP-2018-011 Adult Salmon Spawning

Gough, S. A., R. Smit, K. Lindke, K. De Juilio, C. Laskodi, G. Kautsky, and B. C. Matilton. 2024. Assessment of adult salmonid spawning in the Trinity River.

- Purpose
  - Analysis of Adult Returns (all Salmonids, natural and hatchery)

- Results
  - Total Escapement:
    - Fall-run Chinook: Since 2002, natural-origin was above 40% in most years, but median return has **reduced** after ROD (25,471 -> 23,049)
    - Spring-run Chinook: lowest runs prior to ROD, but median return has **reduced** (12,622 -> 7,404)
    - Coho: median return has **reduced** (8,836 -> 5,994)
    - Steelhead: median return has **increased** (7,563 -> 15,263)
  - Natural spawning escapement:
    - Fall-run Chinook 13,168 -> 15956
    - Spring-run Chinook 7,371 -> 4,437
    - Coho 6,004 -> 2,918
    - Steelhead 6,546 -> 11,579
  - Affirmed
    - Tributary surveys showing fewer fish
    - Mainstem spawning has spread out (less concentrated in hatchery area, more in downstream reaches)
    - Superimposition disproportionally affects spring-run Chinook
    - Prespawn mortality is low

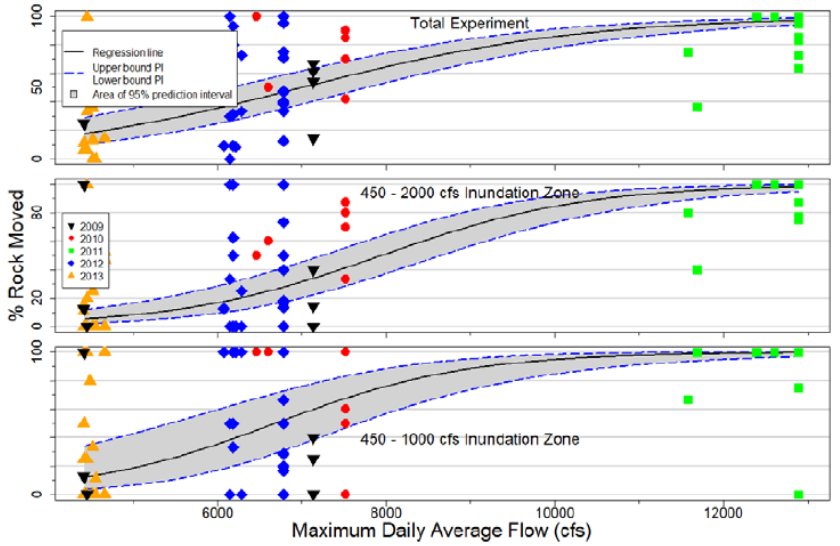


- Recommendations
  - Reevaluate natural-origin escapement targets
  - Determine effect of ocean conditions on adult returns
  - Evaluate holding habitat for spring-run (stratification?)
  - Increase spawning habitat
  - Further evaluate temperature targets
  - Review redd/carcass survey design

TRRP-2018-018 Bed Mobility and Scour

Hales, G., A. Hilton, S. McBain, and S. Howlin. 2020. Statistical evaluation of Trinity River point bar bed mobility and bed scour during annual spring ROD releases for WY 2009 - 2013.

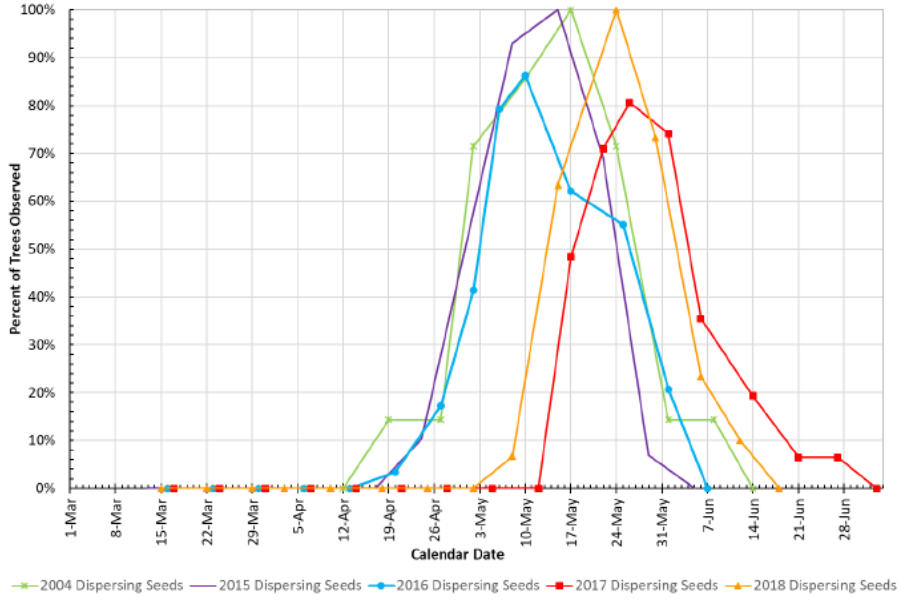
- Purpose
  - Develop a statistical model of bed mobility and scour based on flow to support DSS
  - Using field data: tracer rocks at cross sections and scour chains
- Results
  - Predicting exact proportion of bed mobilized shows “considerable variability”
  - Analysis simplified to predict probabilities of
    - 80%+ mobility,
    - 1+ D84 scour
  - Models are available for use in DSS
- Recommendations
  - More monitoring between existing sites
  - Comparison to 2D hydraulic models (SRH2D)



TRRP-2018-019 Cottonwood Seed Dispersal

Bair, J. H., A. Hamilton, J. Lee, and S. Loya. 2020. Cottonwood Seed Dispersal on the Trinity River.

- Purpose: Quantify cottonwood seed dispersal period for improved annual hydrograph schedules
- Results
  - Dispersal varies by at least 1 month between years,
  - function of degree-hours
- Recommendations
  - Mid- to late-May had highest median seed dispersal and was reliable in dispersal
  - Based on limited years of regular sampling, so more monitoring to fine tune understanding



TRRP-2018-021 Riparian Encroachment

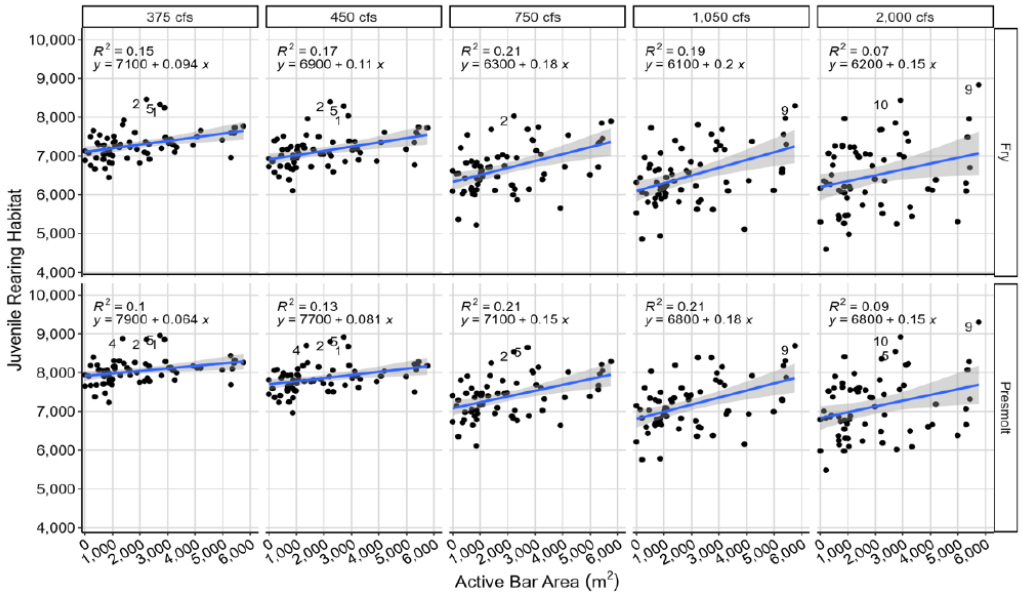
HVTFD (Hoopa Valley Tribal Fisheries Department) and MA (McBain Associates). 2021. Vegetation encroachment synthesis for the Trinity River.

- Purpose
  - Assess status of riparian encroachment and success of ROD flows in reducing encroachment
- Results
  - Flow study hypotheses were evaluated and additional hypotheses advance
  - ROD flows have managed riparian encroachment – from 2005 to 2017 just one cohort (2006) survived to establishment beyond the ability of ROD flows to scour.
- Recommendations
  - Review achievable channel patterns including encroachment at higher elevations
  - More rigorous evaluation of berms
  - Evaluate linkage between gravel augmentation and riparian encroachment
  - Repeat exposed gravel bar census [has been done once more: Buxton & McSloy 2024]
  - Continue use of riparian encroachment risk in flow DSS
  - Evaluate variable summer baseflows… “Constant 450 cfs streamflow, regardless of water year type, is a primary contributing factor that leads to encroachment. Summer baseflow variability would promote greater low water fringe complexity […].“

TRRP-2018-022 Sediment Storage

Hoopa Valley Tribal Fisheries Department (HVTFD) and McBain Associates. 2023. Coarse sediment storage on the Trinity River: recommendations and correlations to juvenile Chinook Salmon rearing habitat.

- Purpose
  - Correspondence of fish habitat to bar area and gravel storage to provide basis of future coarse sediment management
- Results
  - Linked 2015 active bar mapping report to juvenile habitat (GRTS), channel complexity, plus to Foothill Yellow-legged Frog egg mass data.
- Recommendations
  - Prioritized reaches for gravel augmentation (esp. Pokerbar to Steelbridge, JC areas)
  - Multi-site augmentation per reach
  - Use channel enhancements (wood, meanders) to increase gravel storage (bars)



TRRP-2018-027 Fine Sediment

Buxton, T. H. 2021. History of fine sediment and its impacts on physical processes and biological populations in the restoration reach of the Trinity River, CA.

- Purpose
  - Assess current status of fine sediments in the mainstem Trinity River
- Results
  - Reviewed history of river with regards to fine sediments
  - Reviewed ecological function of fine sediments
  - Evaluated flushing effect of ROD flows
  - Recognized a ***deficit*** now exists for fine sediments from Lewiston Dam to at least Rush Creek (subsequent work has extended this toward Douglas City)
  - Deltas temporarily have excess sediment due to timing of flows
- Recommendations
  - Winter flows to route fines from tributary deltas
  - Augment fines above Rush Creek
  - Remove listing as sediment impaired
  - Stop dredging Hamilton Ponds

Figure 14. Nearly three feet of fine sediment accumulation near Poker Bar (RM 103.0) in August 1975.

TRRP-2018-032 Water Temperature

Asarian, J. E., K. De Juilio, S. Naman, D. Gaeuman, and T. Buxton. 2023. Synthesizing 87 years of scientific inquiry into Trinity River water temperatures. Report for the Trinity River Restoration Program (TRRP).

- Purpose
  - Major evaluation of water temperature in river and tributaries to understand natural and flow-managed thermal regimes
- Results
  - River temperature below Lewiston Dam does not follow natural patterns (warmer in fall/winter, colder in spring/summer)
  - "April in Dry years and May in Normal and wetter years are the only time periods in spring when it is possible for temperatures in the entire Lewiston to Weitchpec reach of the Trinity River to approximate unimpaired (i.e., pre-dam) patterns"
  - "In May of Dry years and June of Normal and wetter years, elevated releases suppress growth of cold-blooded aquatic species."
  - Reservoir storage < 750taf in Sept-Nov risks salmonid egg mortality due to high temperatures

- Recommendations
  - Monitor T upstream of Trinity Reservoir
  - Spring flows should generally recede sooner
  - T targets should emphasize growth and timely outmigration
  - Install a temperature control device for Trinity dam and revise Lewiston lake
  - 750 taf minimum pool for Trinity Lake
  - Assess multi-year drought effects
  - Develop tool for modeling Trinity River temp at lower flow levels (recently done)

TRRP-2018-009 Cohort Reconstruction

- Collaborators:
  - HVT
  - CDFW (in kind)
  - USFWS (in kind)
- $18,325 (+ USBR added support from TSC $40,928)
- Purpose:
  - Gather requisite data, build modeling methods and code.
  - Fall-run Chinook
- Objectives:
  - Connects adult run populations to originating brood years and associated conditions, restoration actions.
  - Provide this information for use in other analyses / synthesis reporting
  - Update Bradford & Hankin (review of adult monitoring projects)
- Status:
  - Nearly complete…
  - Model redevelopment into R is complete
  - Going to PFMC (could get updates)
  - Ken running model
  - To be used in a life cycle model for the Limiting Factors Analysis

TRRP_2018_025 Channel Complexity

- Collaborators
  - HVT
  - USGS
  - Thom Lisle
  - McBain Associates
  - USFWS (in kind; reviews only)
- $126,852
- Purpose: analysis on how to attain fish habitat through physical dynamics
- Objectives:
  - Recommend changes to conceptual models
  - Recommend refinement of management objectives and actions
  - Recommend changes in science workplans
- Status:
  - Near complete draft (from Robert Franklin)
  - ARS working to bring across finish
  - If not, will be HVT priority after Flow Synthesis

TRRP_2018_009 Large Wood Management Strategy

- Collaborators
  - NMFS ($4,800 + in-kind)
  - HVT/McBain ($15,708 + $33,600 in FY22)
  - YT ($22,771) - diverted to other projects (SC/DG Effectiveness Monitoring + 7 other topics)
  - Subsequently added TC, USFWS (in kind)
- Total $76,879
- Purpose:
  - Enable targeting wood supply and storage that will foster natural fluvial processes, geomorphic elements, riparian vegetation patches, aquatic habitat features, and ROD restoration objectives.
- Objectives:
  - Technical basis of how large wood interacts with river corridor geomorphology
  - Conceptual wood-floodplain (corridor) models
  - Estimation of short and long-term wood target levels
  - Develop monitoring plan
  - Guidelines on implementation
  - Living document to be updated in future
- Status:
  - Numerous staffing changes among NMFS, HVT, and YT.
  - 2023-24 Fred Meyer (ARS / McBain Assoc) and Veronica Yates rejuvenated
  - 2025 Simone Groves now taking significant roll
  - Riparian Aquatic Ecology Workgroup has helped and is providing some degree of oversight

TRRP-2020 Flow Synthesis

- Collaborators:
  - HVT
  - YT
  - NMFS (in kind)
  - McBain Associates (sub)
- $108,617
- Purposes:
  - Synthesize information learned about flow releases since the ROD
  - Recommendations toward better temperatures and food production
- Objectives:
  - History of flow releases
  - Evaluate effectiveness toward program objectives/targets
  - Recommend changes to flow management
- Status
  - HVT and YT have recently established contract support to complete (McBain, Pickard).
  - Intend completion by end of calendar year.

Summary

- Cross-topic analyses involves complex interactions among monitoring projects
  - This was a growth period for TRRP Science
  - Annual Science proposals have subsequently advanced due to this growth
- Origins of current TRRP AEAM Trends:
  - Frequent questioning of timing of traditional ROD flows with impacts to temperature and fish growth
  - Some questioning toward geomorphology and riparian too
  - Disparity of juvenile and adult population trends led to the ongoing Limiting Factors Analysis
  - Beginnings of questions on summer baseflows (toward riparian, spring chinook holding)
- Lots of work has been completed – something to be proud of.
  - Some still needs completion