

# Erosion and Best Management Practices after Forest Fire: How Water Quality Monitoring and Bioassessment Studies Reveal Impacts of the Ponderosa, Rim, and King Fires

California State Water Resources Control Board's Annual Watershed Health Indicator and  
Data Science Symposium, Sacramento, California, June 20, 2018

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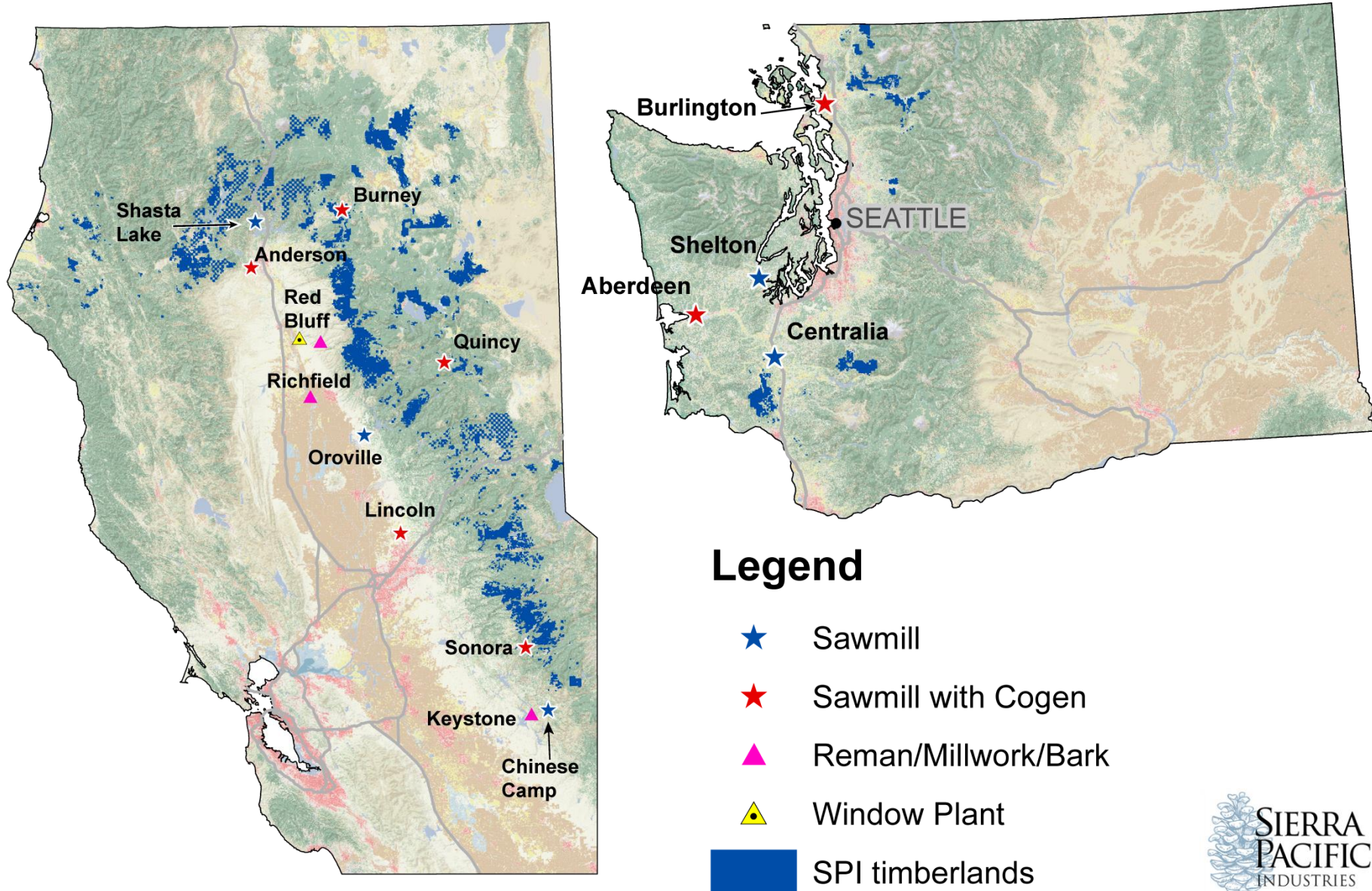
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# Sierra Pacific Industries Timberlands and Production Facilities

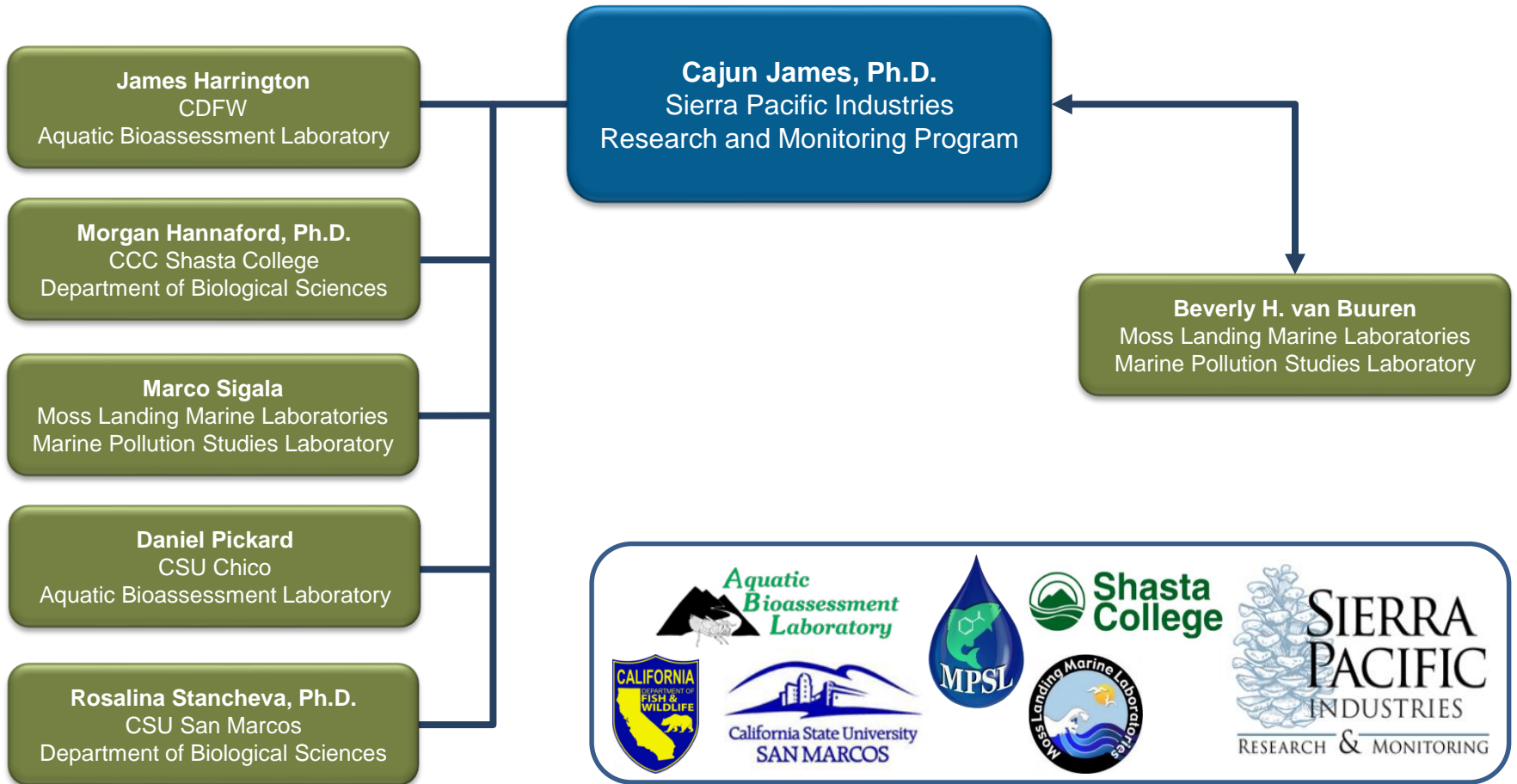


# Background

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- Sierra Pacific Industries (SPI) manages 1.66 million acres of forestlands in California.
- Since 2000, SPI's Research and Monitoring Program has studied timber operations and fire as they relate to water quality, sedimentation, erosion, aquatic life, and habitat.
- Research has been facilitated by a growing network of stations collecting continuous water quality and weather data. Twenty-two continuous water quality monitoring stations collect data for 10 parameters.
- Over 90 weather stations (32 permanent) collect data for 13 critical fire-related parameters pertaining to air, wind, and soil.
- SPI's monitoring data is supplemented by field and laboratory bioassessment studies focused on algae, benthic macroinvertebrates, and physical habitat assessment.

# Collaboration - Partners





# Quality Assurance

## Quality Assurance Project Plan

- US EPA 24-element format
- SWAMP-comparable
- Data upload to CEDEN
- Projects audited annually



## Research and Monitoring Program Quality Assurance Project Plan

Version 1.0  
August 4, 2017

**Prepared by:**  
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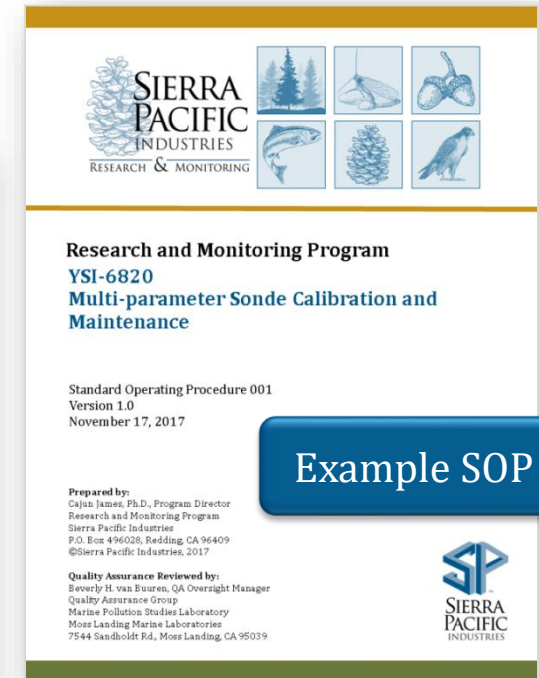
**In collaboration with:**  
Quality Assurance Group  
Marine Pollution Studies Laboratory  
Moss Landing Marine Laboratories  
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Third-party Oversight  
QA Services

Marine Pollution Studies Laboratory  
Moss Landing Marine Laboratories



# The Need for Water Quality Data



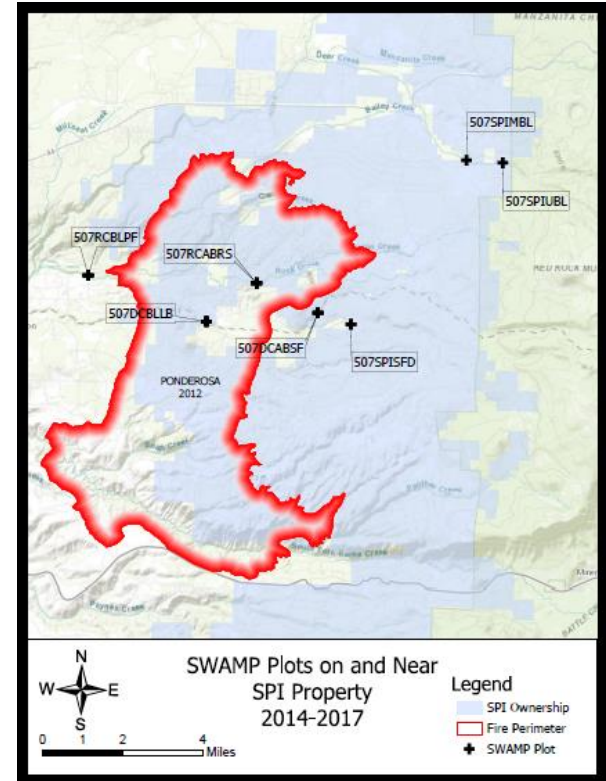
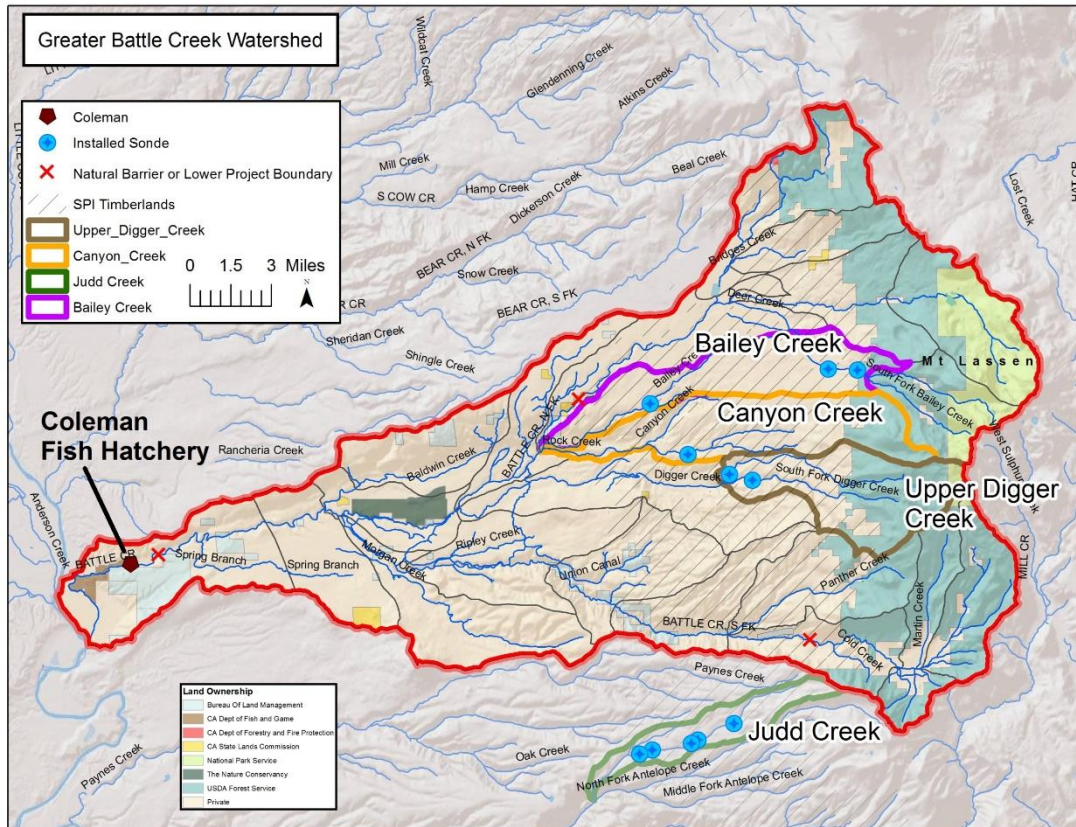
Fires burned a combined >380,000 acres with almost 58,000 of those acres on SPI forestlands

- Ponderosa (2012)
- Rim (2013)
- King (2014)



# Sites

- North Fork Digger Creek
- Rock Creek



# Water Quality Data

- 22 continuous water quality monitoring stations collect data for 10 parameters
- A dataset of over 2 million relevant results has allowed SPI's Research and Monitoring Program to study a variety of aspects of the pre-and post-fire environment.



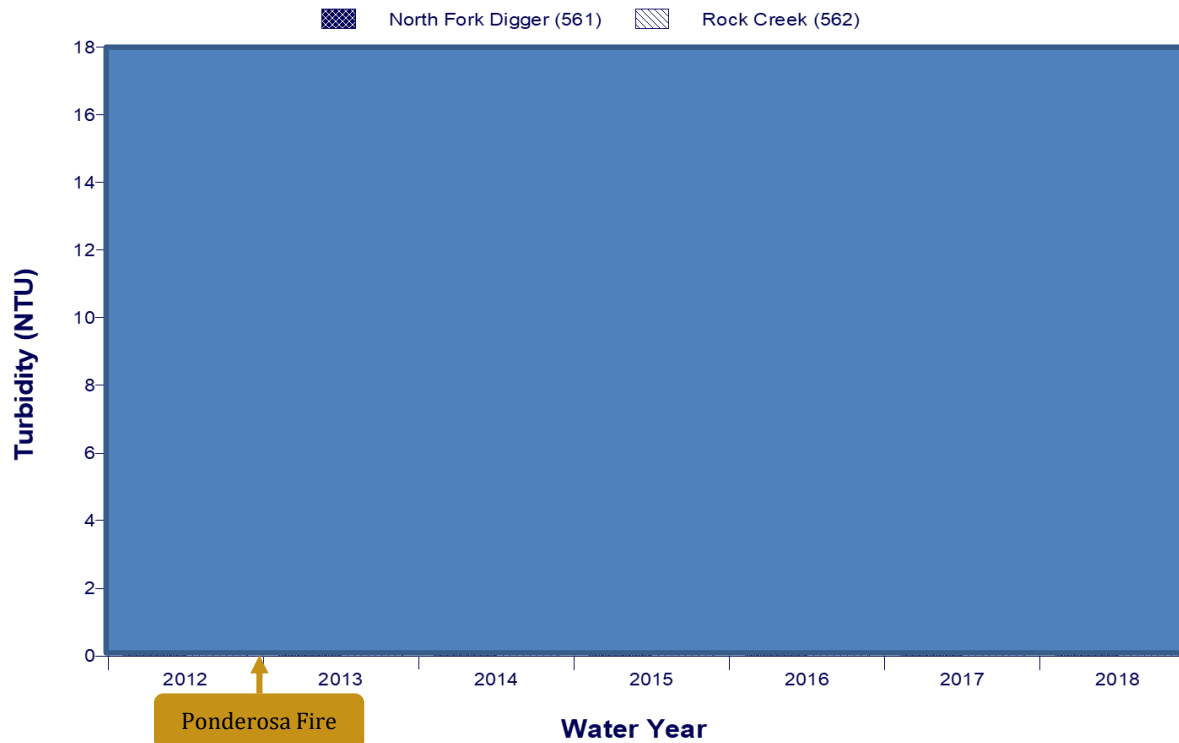


# Weather Data



Over 90 weather stations (32 permanent) collect data for 13 critical fire-related parameters pertaining to air, wind, and soil.

# Average Daily Maximum Turbidity

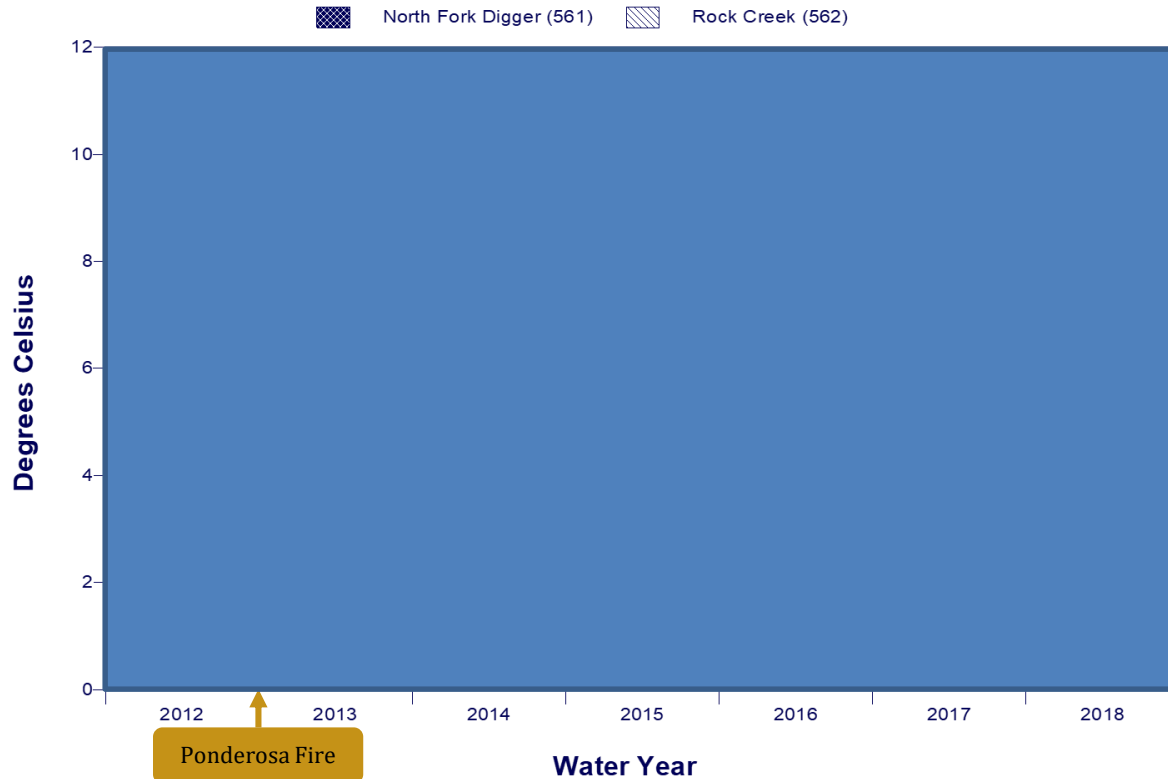


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Each day of monitoring has four data values measured and stored each hour (i.e., at 0, 15, 30, and 45 minutes), resulting in 96 collected measurements each day. Therefore, each year has 35,040 total turbidity measurements.



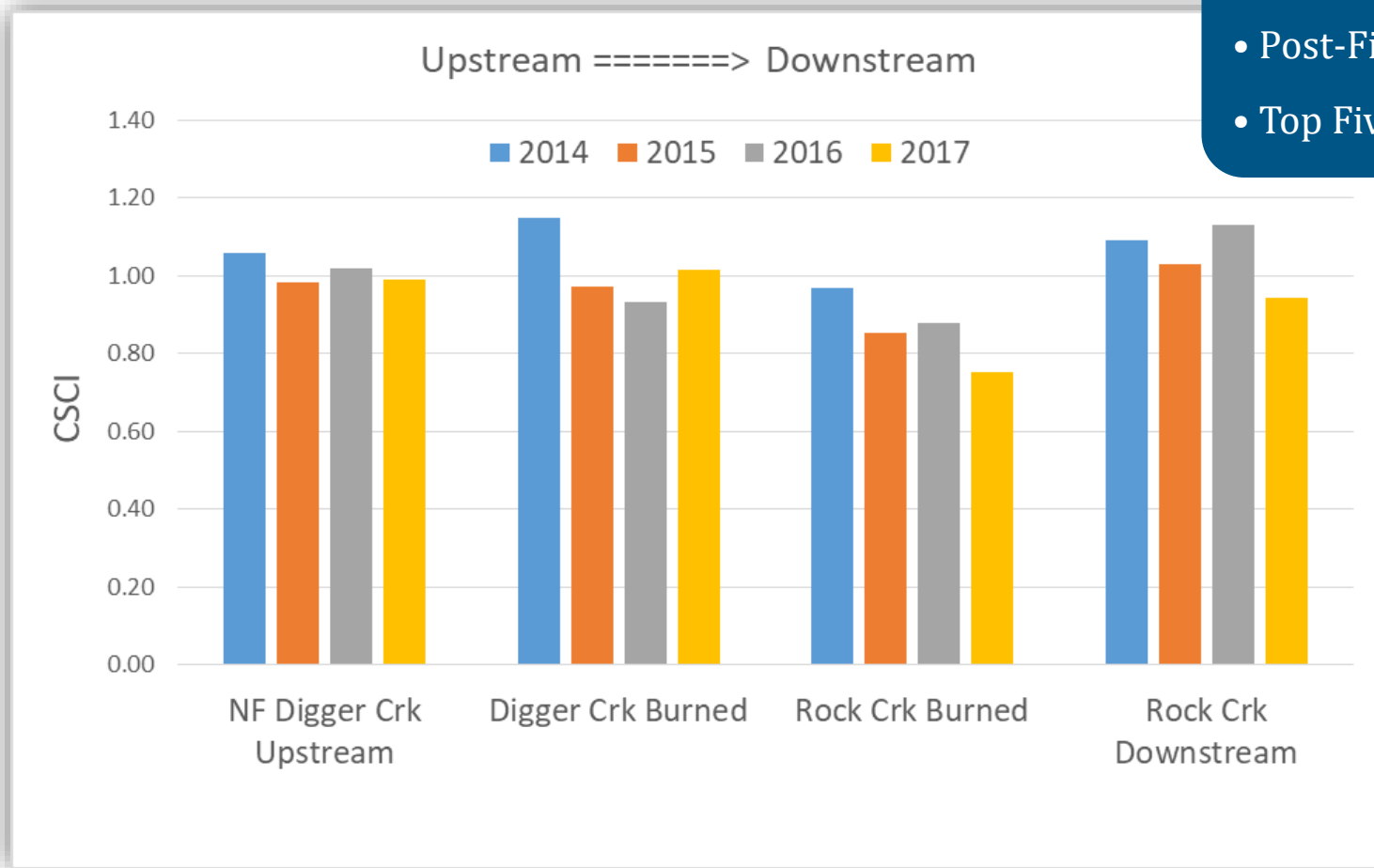
# Average Daily Maximum Water Temperature



Each day of monitoring has four data values measured and stored each hour (i.e., at 0, 15, 30, and 45 minutes), resulting in 96 collected measurements each day. Therefore, each year has 35,040 temperature measurements.

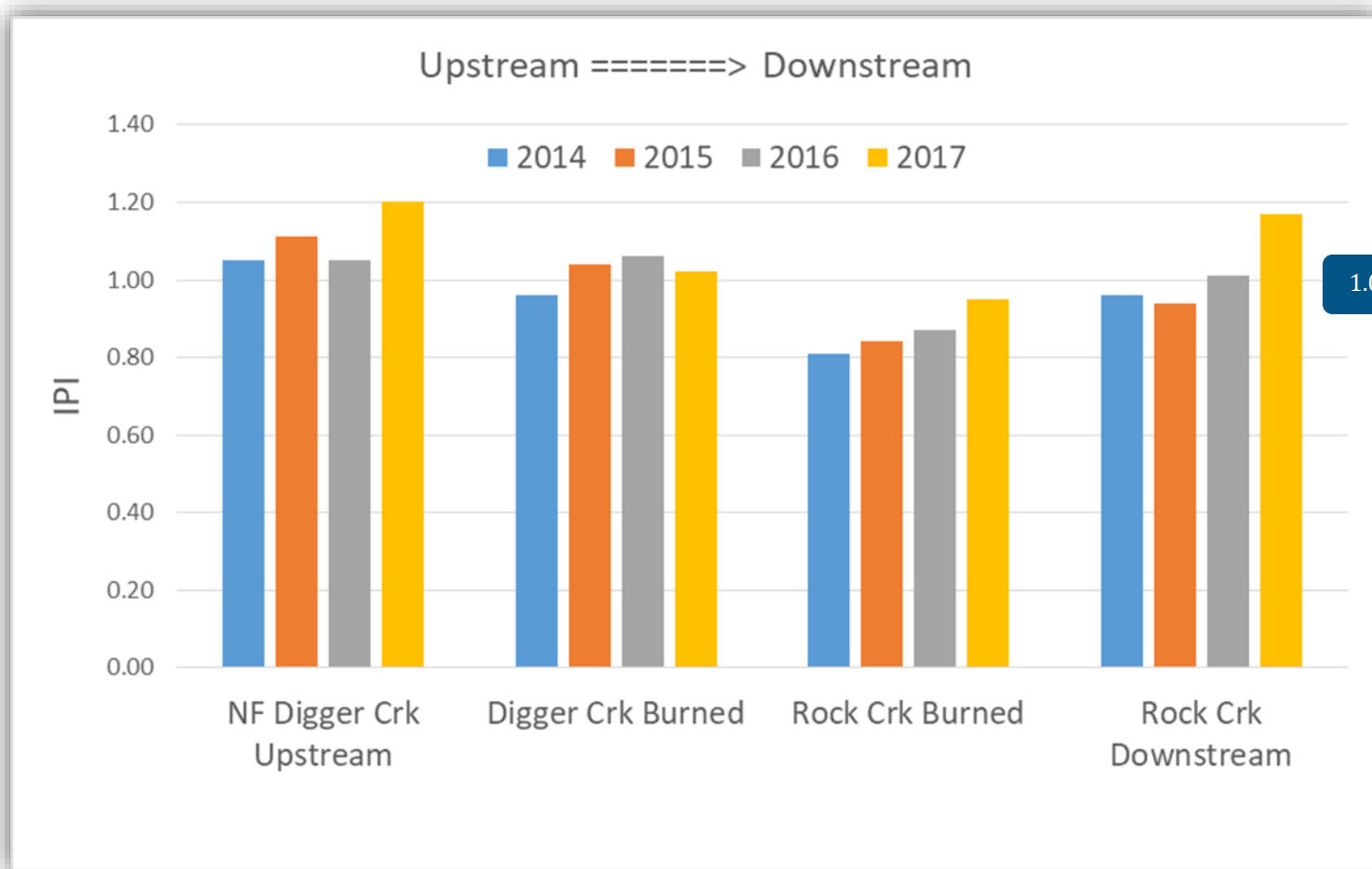
# California Stream Condition Index

- Ponderosa Fire 2012
- Post-Fire Results
- Top Five Species





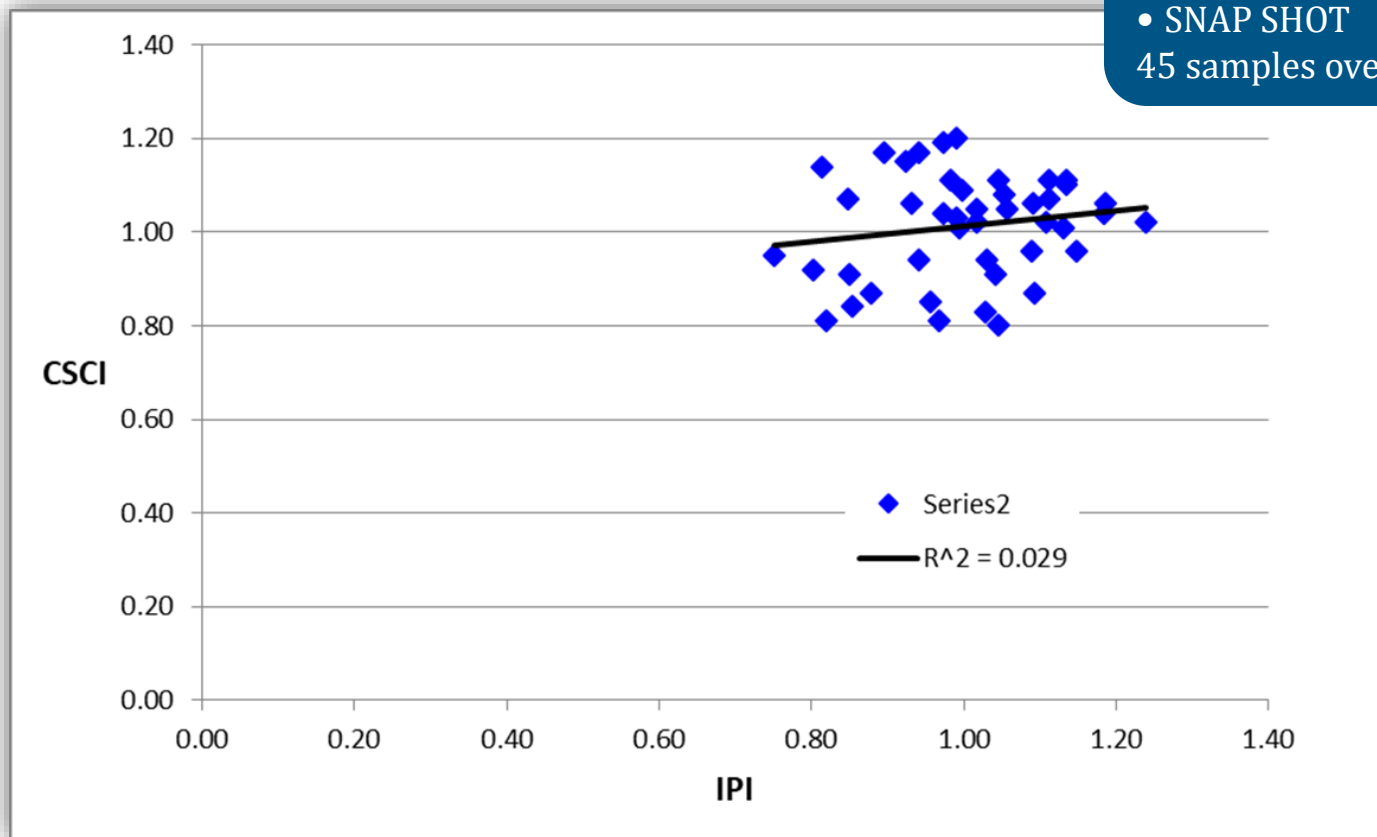
# Index of Physical Habitat Integrity



1.0 Average Good Conditions

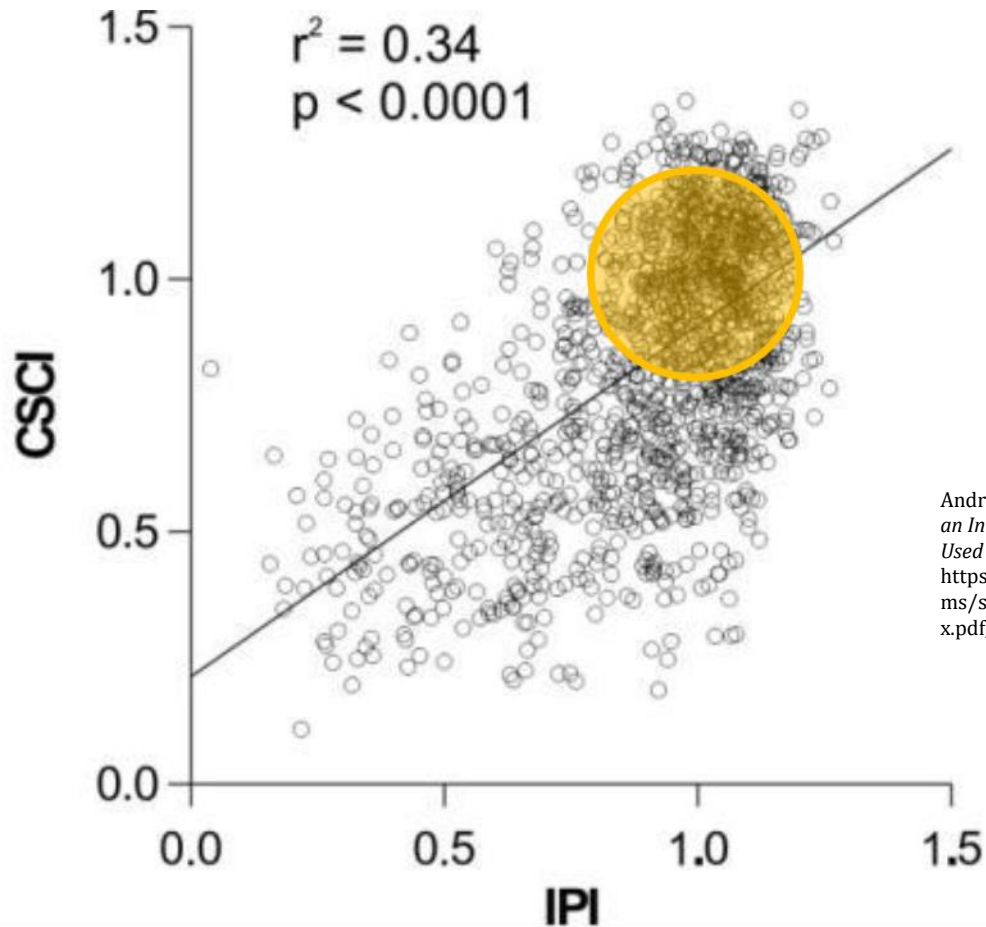
# Forest Land CSCI / PHAB correlation

- No significant correlation. Samples are in Upper Quartile of Statewide data
- SNAP SHOT  
45 samples over four-year period





# Statewide CSCI / PHAB correlation



Andrew Rehn, Peter Ode, and Raphael Mazor, *Developing an Index of Physical Habitat Integrity And How It Might Be Used In Water Resource Programs*, Slide 29, [https://www.waterboards.ca.gov/water\\_issues/programs/swamp/bioassessment/docs/10\\_ode\\_et\\_al\\_phab\\_index.pdf](https://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/docs/10_ode_et_al_phab_index.pdf), accessed on May 29, 2018.

# Top Five Species – Digger Creek Above

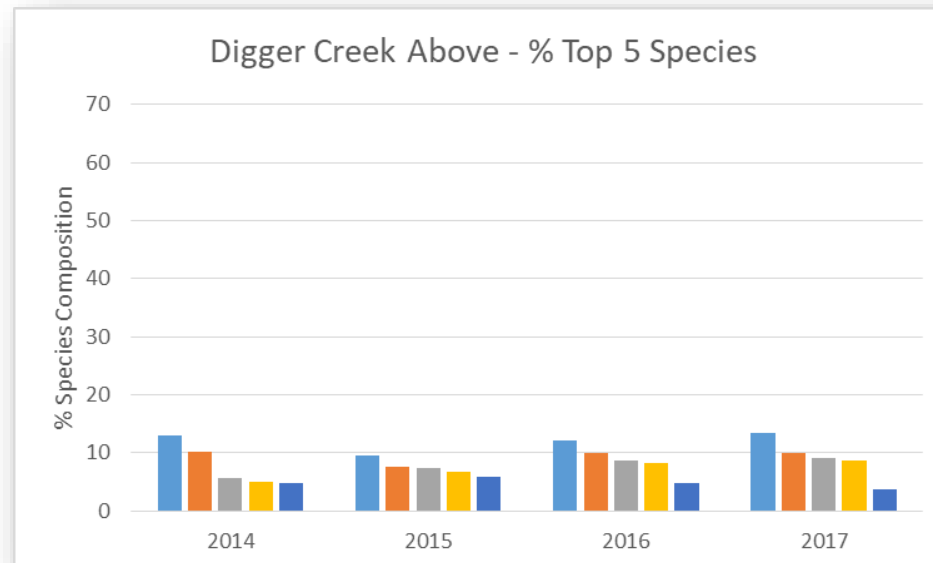
- Collector gatherers consistent
- Species composition even 2014-2017
- Some shredders



*Heterlimnius* (riffle beetle)



*Lepidostoma* (caddisfly)



# Top Five Species – Digger Creek Burned Reach

- Collector gatherers and filter feeders
- Consistently in Top Five over four years
- These species generally indicate organic matter is available within the stream (open area).



*Simulium* (black fly)



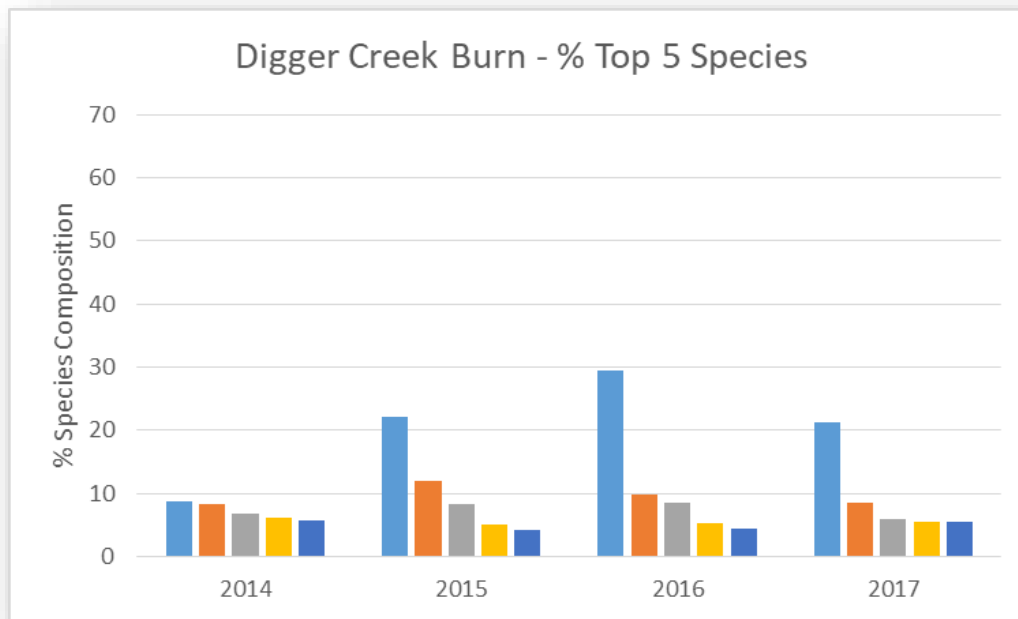
*Hydropsyche* (caddisfly)



*Orthocladus sp* (midge)

# Top Five Species – Digger Creek Burned Reach

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*Orthocladius sp* (midge)



# Top Five Species – Rock Creek Burn

- Collector gatherers and filter feeders
- *Heterlimnius* dominated 2016-2017



*Baetis* (mayfly)



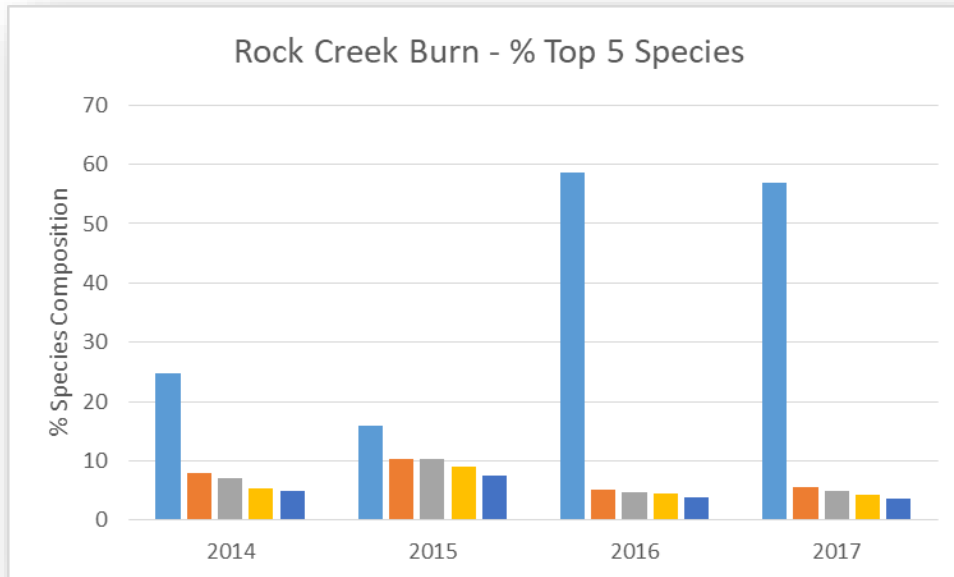
*Hydropsyche* (caddisfly)



*Heterlimnius* (riffle beetle)

# Top Five Species – Rock Creek Burn

- Collector gatherers and filter feeders
- *Heterlimnius* dominated 2016-2017
- The biotic score likely decreased because it was dominated by a more tolerant species.



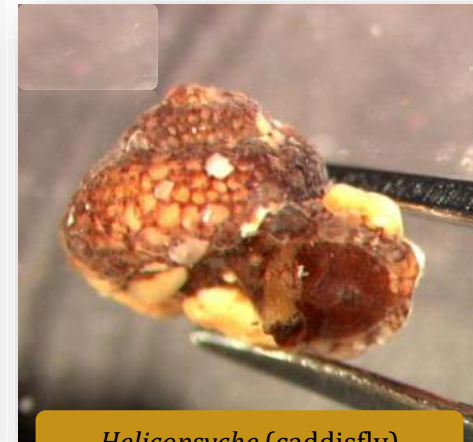
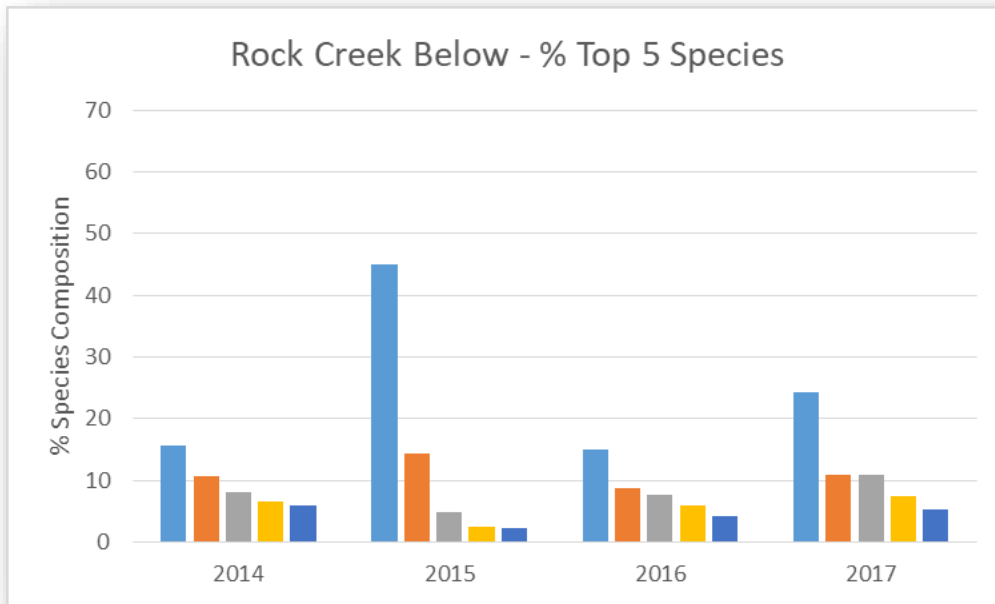
*Heterlimnius* (riffle beetle)

# Top Five Species – Rock Creek Below

- Algae scrapers dominate
- *Helicopsyche* abundant



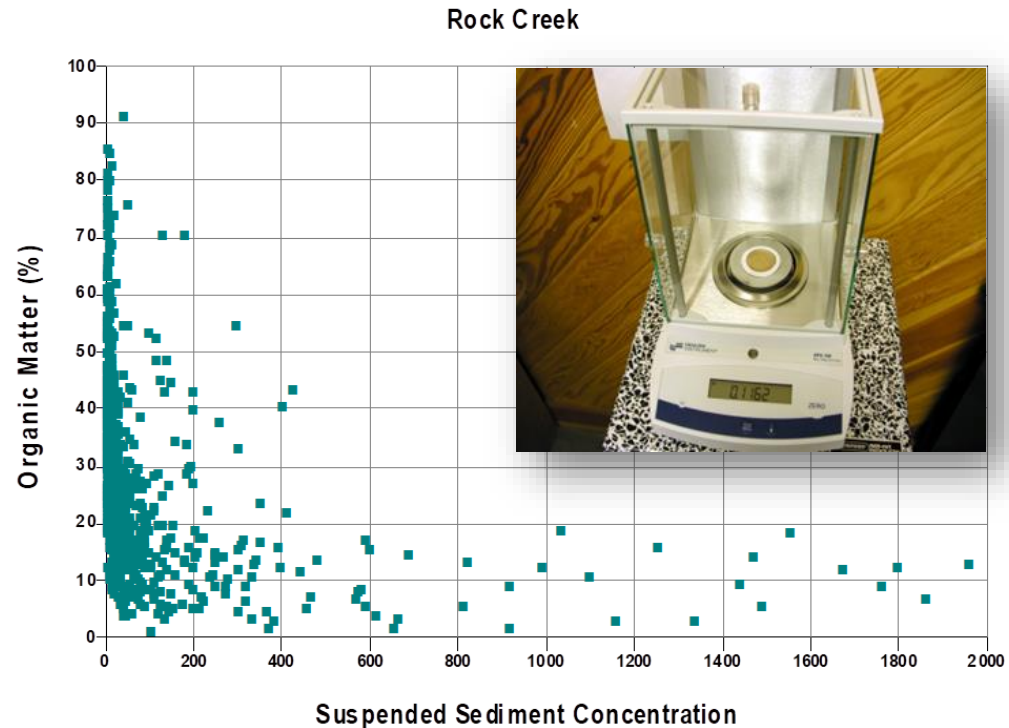
*Epeorus* (mayfly)



*Helicopsyche* (caddisfly)

# Particulate Organic Matter

- For a given turbidity, POM may vary greatly ( $\bar{x} = 40\%$ /filter)
- Increased turbidity decreases the proportion of POM
- More research needed (Madej 2005)







# Best Management Practices

## Goal

- Keep soil on the hillslope
- Reduce sediment delivery to streams

## Application

- Historically applied far from streamside buffer zones first, but reversed following Ponderosa fire
- Also implemented immediately following the Rim and King fires

## Considerations

- Immediate post-fire access required
- Implementation cost
- Timing of fire prior to rain/snow

Central Valley Regional Water Quality Control Board

**Waiver Addendum**  
(Attach to Waiver Certification Notice)

Description of Emergency Notice Conditions and Plan:

- Habitat Retention Islands shall be retained throughout the emergency area; covering 2% of the region. Existing habitat retention islands within previously harvested regions burned by the fire will be left in place.
- Harvest operations will be prioritized near watercourse zone buffers to facilitate timely on-trail rip-rap to dismount hillslope and upslope areas from the watercourses. Utilizing on-trail rip-rap to reduce erosion near watercourses.
- Equipment Limitation Zones (ELZs) shall be established for all Class II and Class IV watercourses of a minimum of 25 feet where slope steepness is less than 30%, and 50 feet where slope steepness is greater than 30%.
- Watercourse and Lake Protection Zones (WLPZs) shall be established for all Class I and Class II watercourses, springs and meadows.
- Trees to be harvested within ELZ & WLPZ buffer zones shall be identified by an RPF or supervised employee with a painted blue stripe at 60 inches from the butt mark below the outside of the tree. All watercourse buffer zones shall be established using a combination of blue- & blue/white striped flagging.
- Large trees retained within WLPZs shall be those not conducive to recruitment to provide for the beneficial functions of riparian zones (e.g., trees at least 100 feet from the stream, trees with roots that provide direct stream bank stability, trees in advanced stages of decay). Trees closest to the stream bank will be given the highest preference for retention.
- No bridging of trees across watercourses or skidding of trees down ditches shall be allowed.
- Tractor road crossings of Class II ELZs will be dry at the time of use. All Class II watercourse tractor road crossings utilized in the emergency operations will be restored to their natural orientation or grade and mulched with slash or straw mulch.
- Seasonal watercourse temperatures in Class I and Class II watercourses are not a limiting factor.
- No aquatic or wetland habitat for salmon or steelhead or endangered species exists in the emergency area.
- No soils with high or extreme erosion hazard rating (EHR) are present in the emergency area.
- No known slides, unstable areas, or changeable conditions exist in the emergency area.
- Known domestic water use within, or within one mile down stream of the harvest area includes: Miles Thompson Ditch TSON ROSE Sections 7-18; Rock Creek Ditch TSON ROSE Section 15 & 14; Lutzee Ditch TSON ROSE Sections 17 & 18; Young Property TSON ROSE Section 18. These Class IV watercourses shall receive ELZ protection as described above.
- Winter Period Operations applies in the time period November 1<sup>st</sup> to April 1<sup>st</sup>. All timber operations, including mechanical site preparation, may be conducted during the winter period. The intent of this winter operating plan is to provide flexibility for operations within the winter period during extended periods of dry weather with little to moderate antecedent soil wetness. Timber operations may be conducted during these "Extended Dry Periods" or during other periods when "Wet Frozen Conditions" as defined under 140CR § 886.1 are present. Operations shall not be conducted in areas that meet the definition of "Saturated Soil Conditions" as defined under 140CR § 886.1.
- The burned area has been covered by individual timber harvest planning documents for more than a decade where numerous road and watercourse crossing upgrades were proposed, implemented and monitored for effectiveness.
- SFI shall notify Water Board staff prior to the installation of any new or upgraded watercourse crossing proposed during operations (e.g., projects requiring notification pursuant to Section 1802 of the Fish and Game Code).
- SFI will continue all monitoring and reporting requirements associated with CRWQCB, Central Valley Region No. 05-010-002.
- A Regional Board Waiver Termination request shall be filed upon completion of timber harvest activities.

Registered Professional Forester Name <b>Henry T. James</b>	Registered Professional Forester Number <b>#2689</b>
Address <b>P.O. Box 488014</b>	
County <b>Redding</b>	State <b>CA</b>
Phone <b>(530) 378-8124</b>	Job Code <b>88048-8014</b>
	RPF Signature

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# Best Management Practices: Roads

## Goals

- Enable immediate post-fire access
- Reduce sediment delivery



## Examples

- Decommissioning
- Repairs/upgrades
- Rocking/chipping



# Best Management Practices: Harvest Units

## Goals

- Break up hydrophobic soil layer
- Increase water infiltration
- Increase soil roughness
- Decrease hillslope length



## Examples

- Slash packing
- Mastication
- Salvage logging
- Contour tilling

Contour tilling (left) and salvage logging (right) were subsequently adopted by SPI and applied to 9,875 acres following the Ponderosa Fire.



# Take Home Points



Ponderosa Fire ( August 2012)



Ponderosa Fire (May 2018)

- Funding collaboration with other scientists and organizations is key
- Comparability with other projects and having a quality assurance system (QAPP, SOPs) facilitates data sharing
- Post-fire sedimentation lessons may be applied post-harvest as well
- Internal communication between research and forestry staff lead to innovation and efficient implementation of BMPs
- Pre-fire continuous instream water quality monitoring allows for tracking of recovery of water quality and effectiveness of BMPs