Effects of the 2013 Rim Fire on Fine Sediment Storage, Large Wood Storage, and Vegetation Establishment in the Hetch Hetchy Reach of the Tuolumne River.

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The San Francisco Public Utilities Commission
Upper Tuolumne River Ecosystem Program
Collaborative, science-based river management

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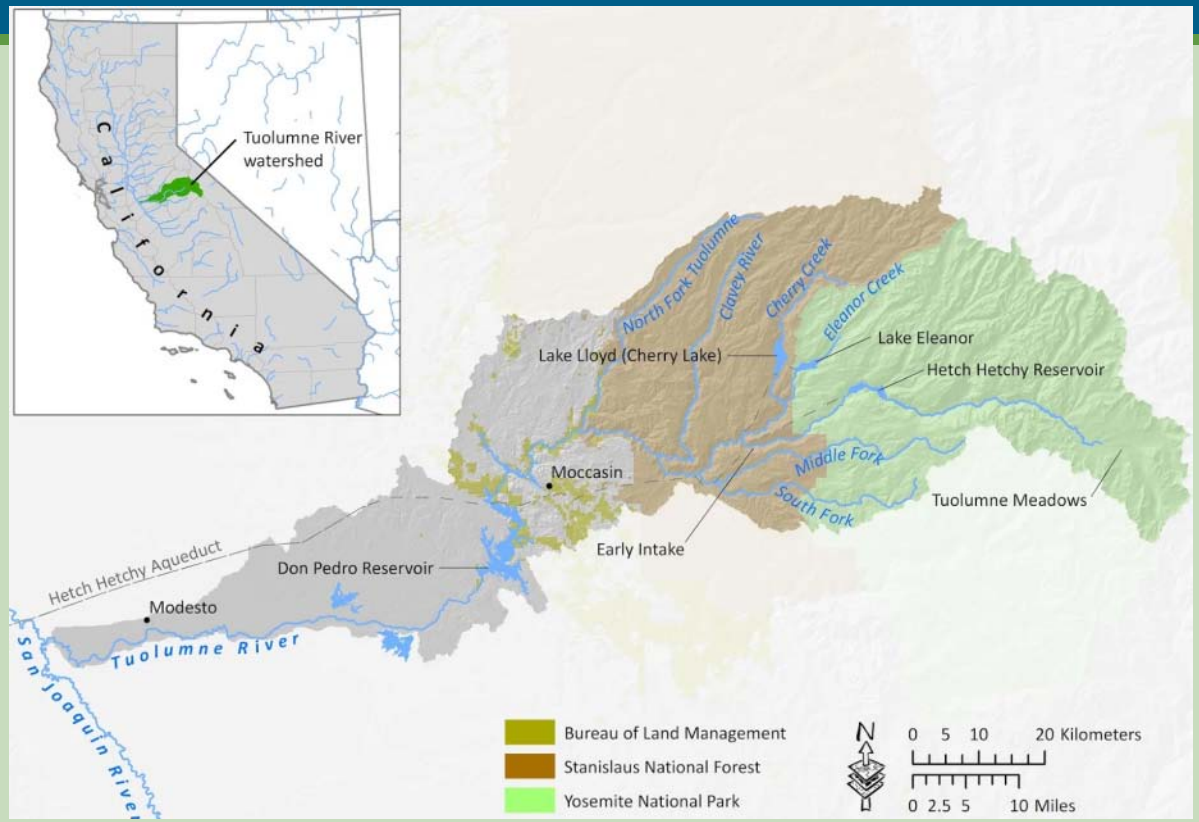
Upper Tuolumne River Ecosystem Program



Watershed inputs
(water, sediment, large wood)

↓

Processes
(sediment transport, bed scour)

↓

Physical Attributes
(point bars, pools)

↓

Habitat

↓

Biology
(plants, fish, frogs)

Overview:

- Drought and O'Shaughnessy Dam operations affect <u>water inputs</u>
- Fire effects change <u>sediment, large wood inputs</u>
- These inputs affect habitat and biology, though those changes may be difficult to quantify
- In our work presented here, we illustrate changes in <u>sediment, vegetation, and large wood</u>

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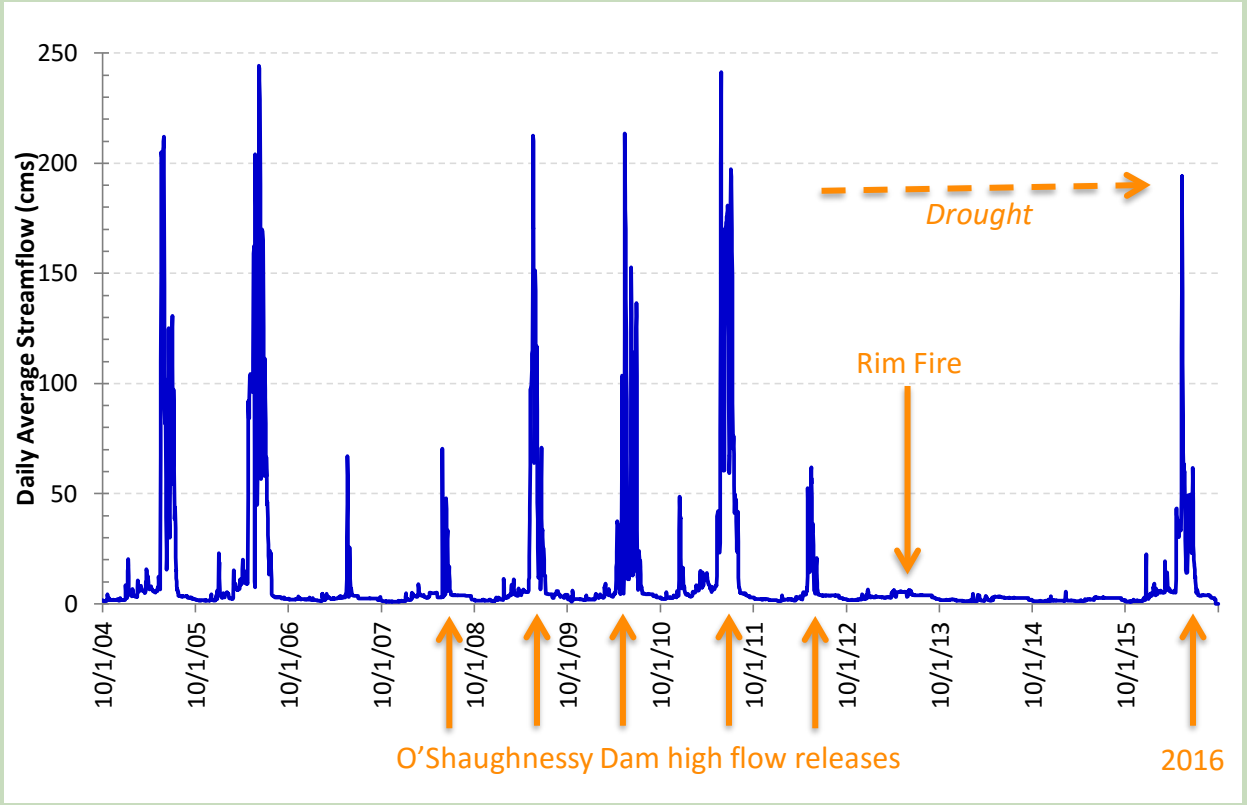
Tuolumne River above Early Intake near Mather (USGS Gage#11-276600)

- Experimental spring releases have supported development of San Francisco's draft O'Shaughnessy Dam Instream Flow Mangement Plan
- 2016 releases were designed to reduce uncertainties & provide interim ecological benefits



Year	Cumulative Precipitation through May (cm)	Water Year Class
93 year Average	85.1	Normal
2012	54.3	Extremely Dry
2013	65.5	Dry
2014	52.0	Extremely Dry
2015	47.5	Extremely Dry
2016	96.3	Normal

PPT 1469+50 above Early Intake woody plant encroachment

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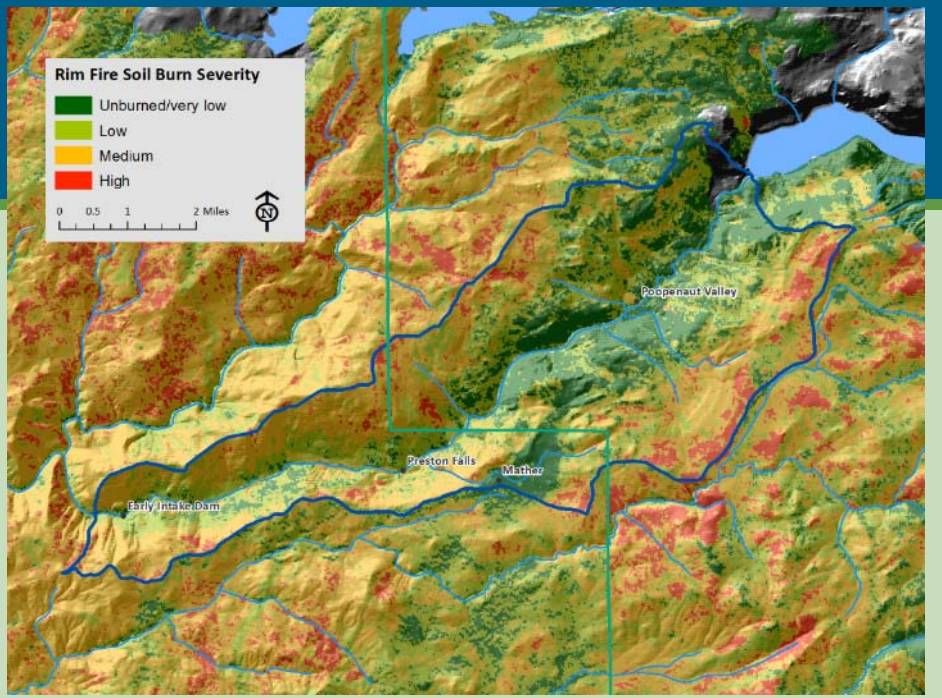
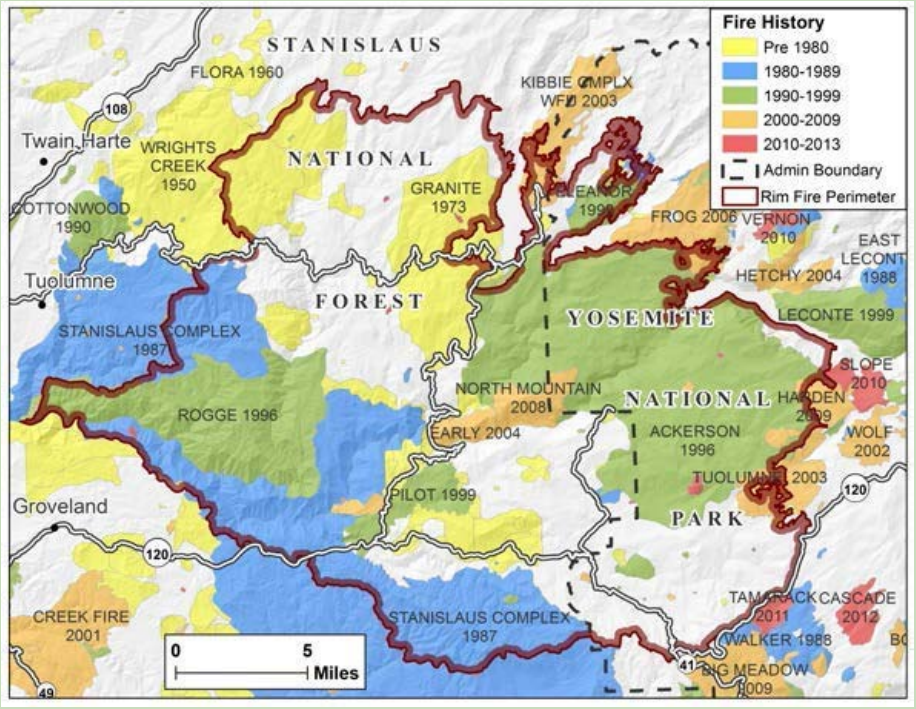
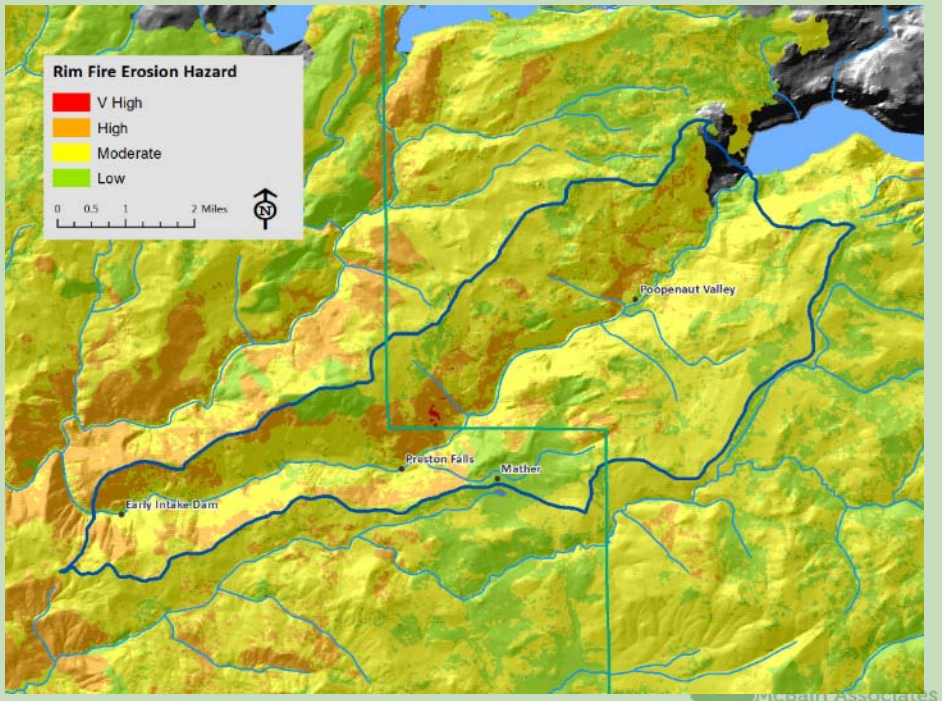
Rim Fire

- Begins August 17, 2013
- Burns over 104,000 hectares
- Is the third largest wildfire to date in California.







Upper Tuolumne River Ecosystem Program
Post Rim Fire Monitoring

SEDIMENT

- REDUCED SOIL RETENTION AND FLOOD PEAK ATTENUATION
- INCREASE IN SEDIMENT DELIVERED VIA TRIBUTARIES
- CHANGE IN GRAVEL QUALITY
  - Proportion of each size fraction in lee deposits and pool tails
  - Change in gravel permeability
- CHANGE IN HABITAT
  - Spawning
  - Benthic invertebrate
  - Herpetofauna

NUTRIENTS

- INCREASE IN CARBONIZED MATERIALS
- CHANGE IN ALLOCHTHONOUS MATERIAL TYPE AND ABUNDANCE
  - Deciduous detrital matter
  - Coniferous detrital matter
- INCREASE IN FREQUENCY AND ABUNDANCE OF LARGE WOOD
- CHANGE IN HABITAT
  - Rearing and Adult holding
  - Benthic invertebrate
  - Herpetofauna

COVER

- DECREASE IN WOODY VEGETATION AREA
  - Reduction in shaded area
- TEMPERATURE EFFECTS
  - Water and air
  - Riparian microclimate
- INCREASE IN FREQUENCY AND ABUNDANCE OF LARGE WOOD
- CHANGE IN HABITAT
  - Rearing and Adult holding
  - Birds
  - Herpetofauna

Monitoring included Photopoints, Topographic Surveys, Large Wood Mapping; Plant Sampling

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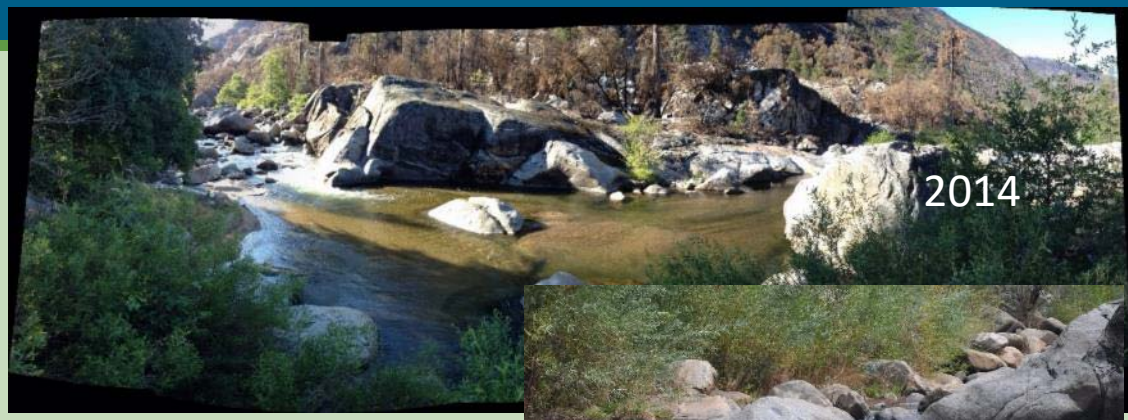
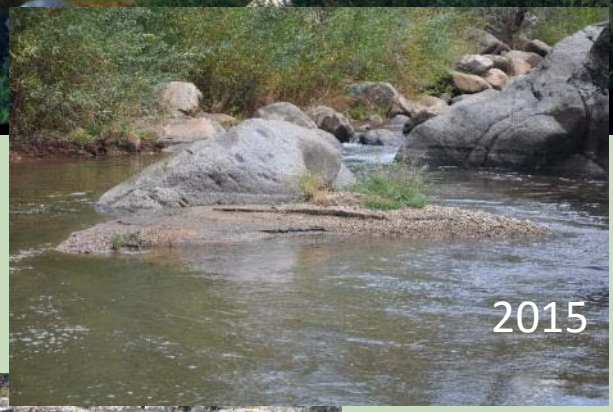
Sand filled pools





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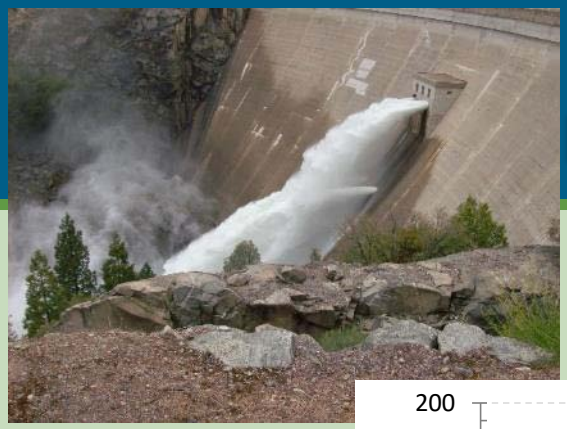
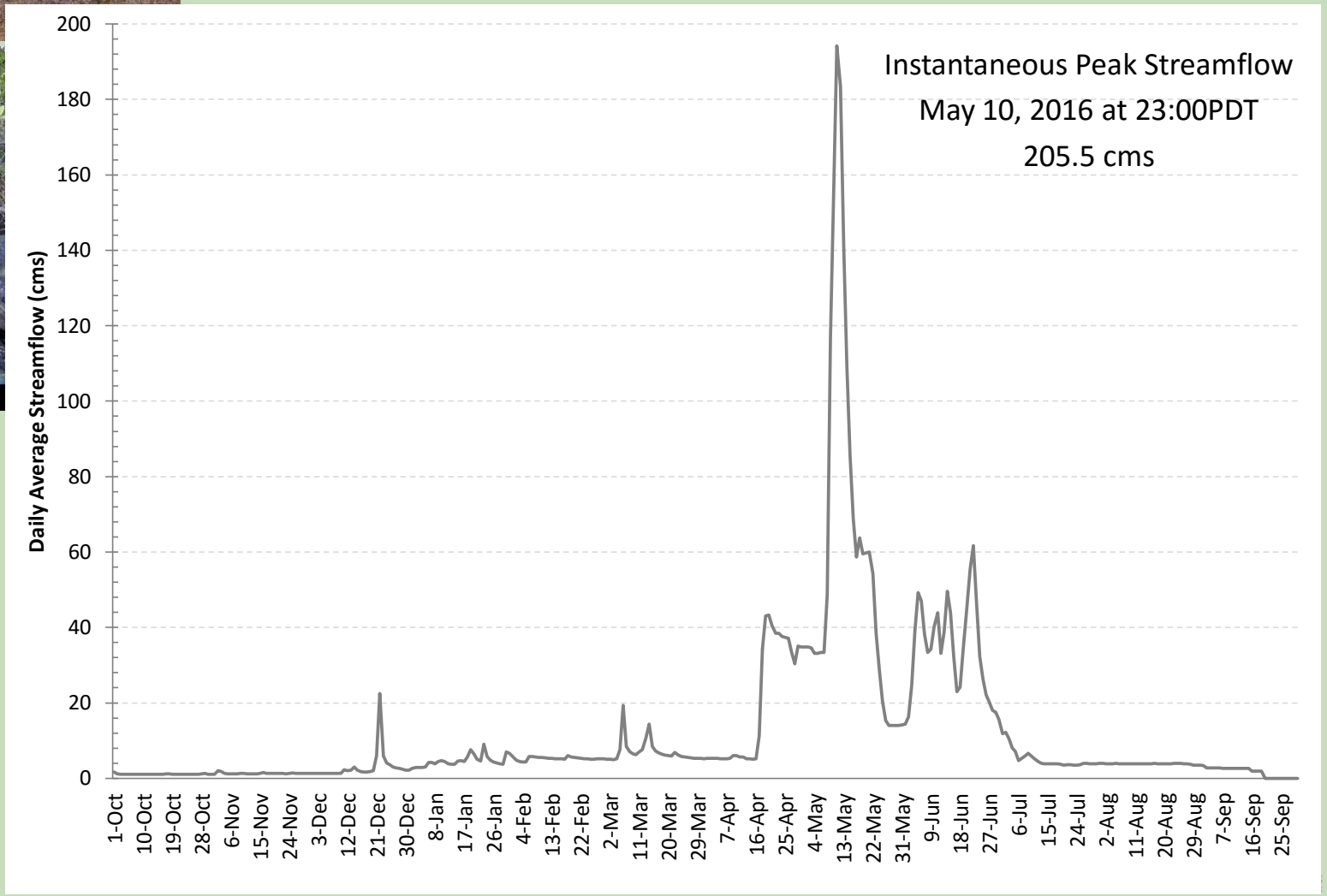
Tuolumne River streamflows above Early Intake near Mather (USGS Gage#11-276600)

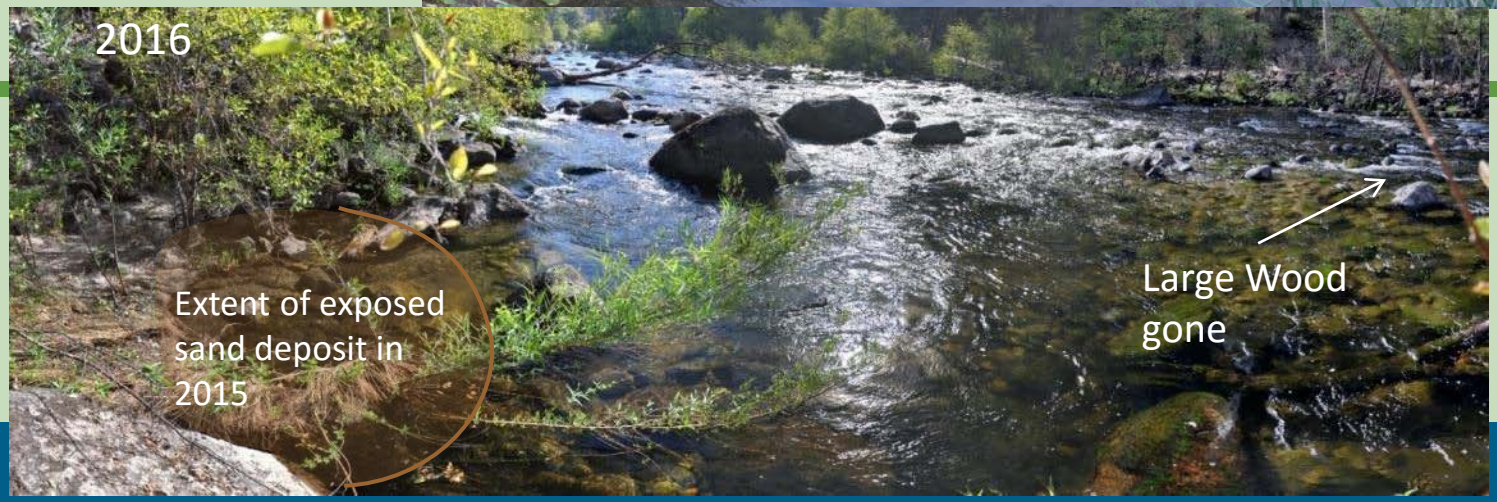


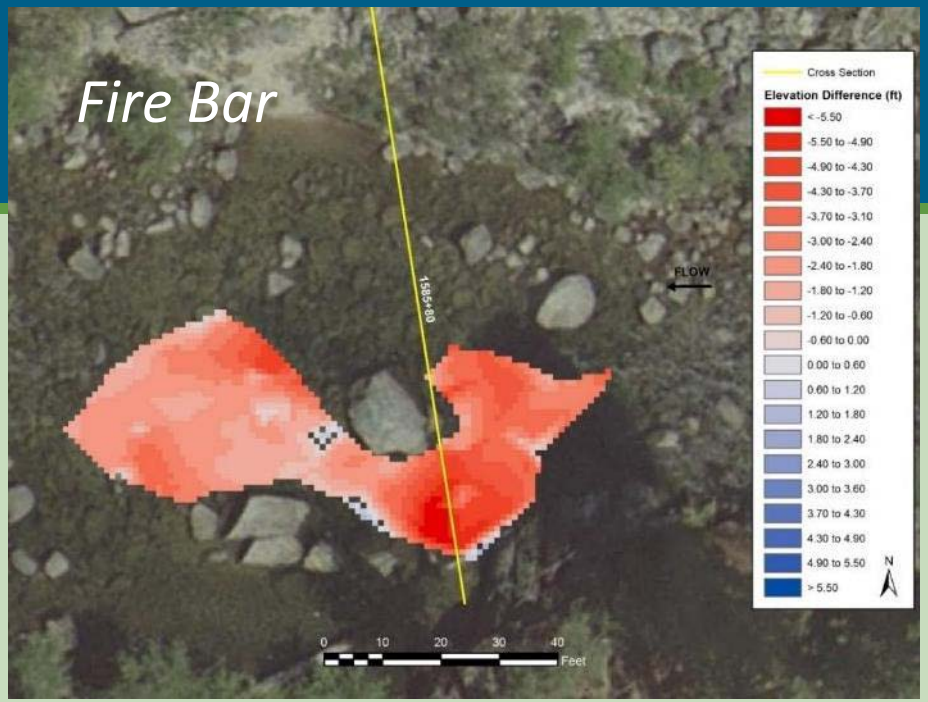


PPT 1529+30

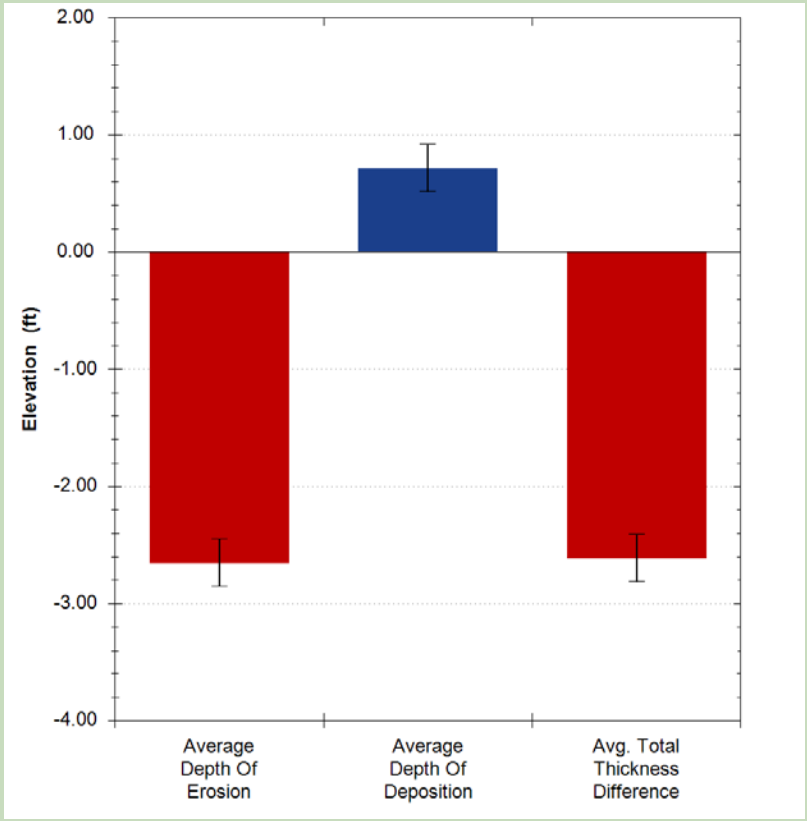

2014
Sand Bar
Large Wood

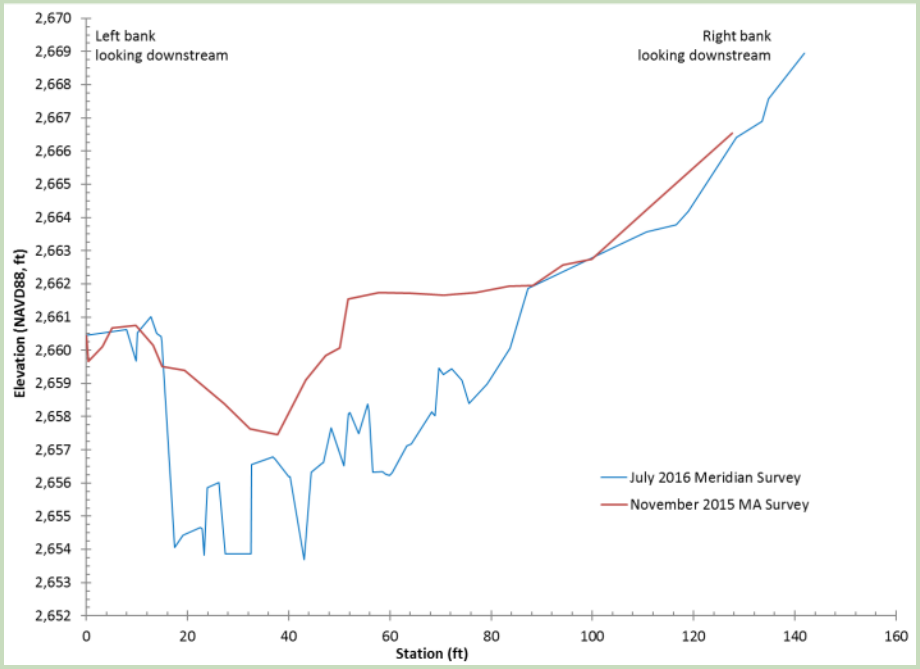

2015
Establishing willows
Large Wood
Cattails


2016
Extent of exposed sand deposit in 2015
Large Wood gone



	Raw	Thresholded MinLOD 0.2 ft		± Error Volume	% Error
Total Net Volume Difference (ft^3)	-4823.3	-4823.4	±	364.6	-7.6
Total Net Volume Difference (yds^3)	-178.6	-178.6	±	13.5	-7.6





Fire Bar: larger geomorphic features where the channel was confined

PPT 1469+50 fine sediment deposits nested in boulders

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PPT 1592+25 fine sediment deposition at Mystery Bar

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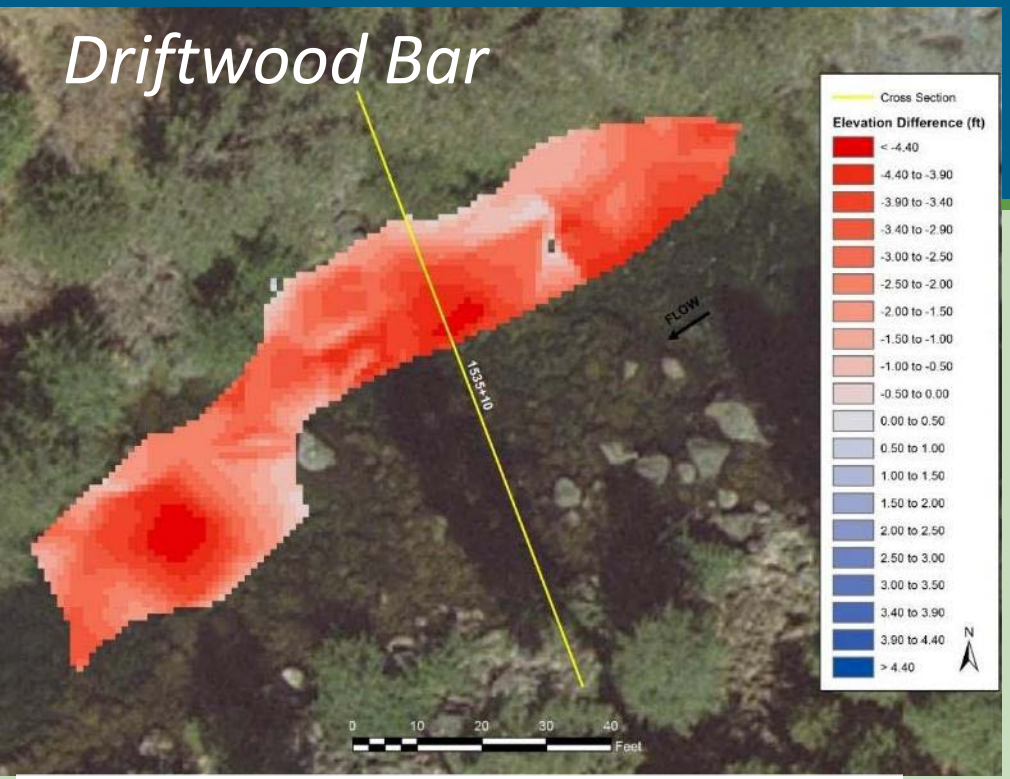
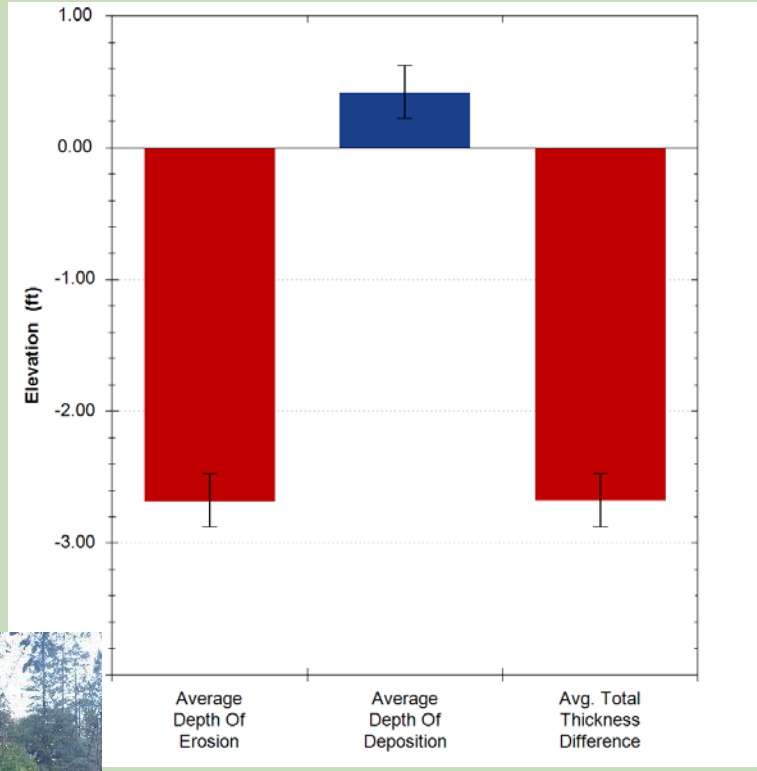
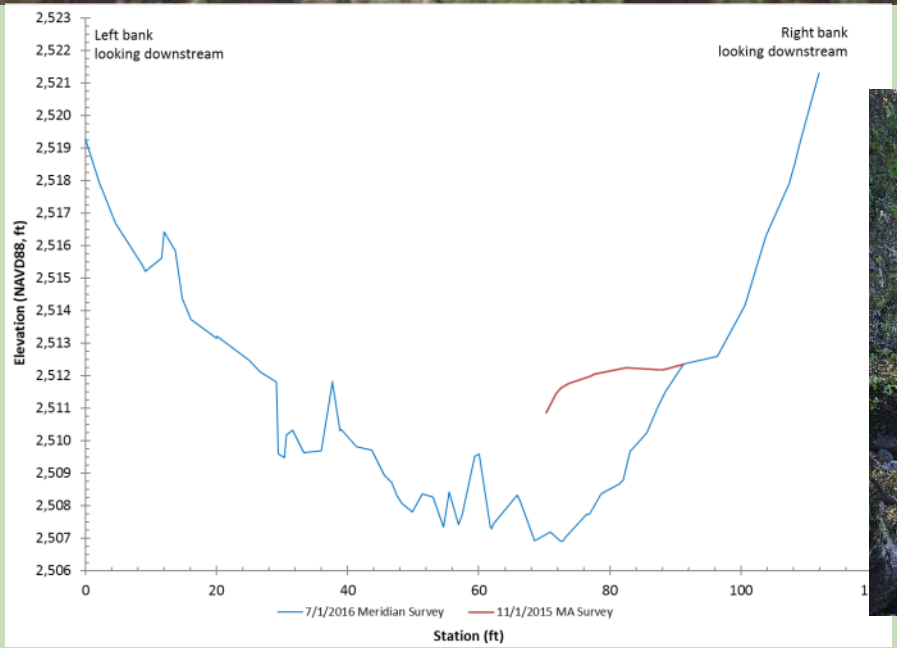
Driftwood Bar



	Raw	Thresholded MinLOD 0.2 ft		± Error Volume	% Error
Total Net Volume Difference (ft^3)	-6766.8	-6765.7	±	505.0	-7.5
Total Net Volume Difference (yds^3)	-250.6	-250.6	±	18.7	-7.5





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PPT 1534+75 at Driftwood Bar

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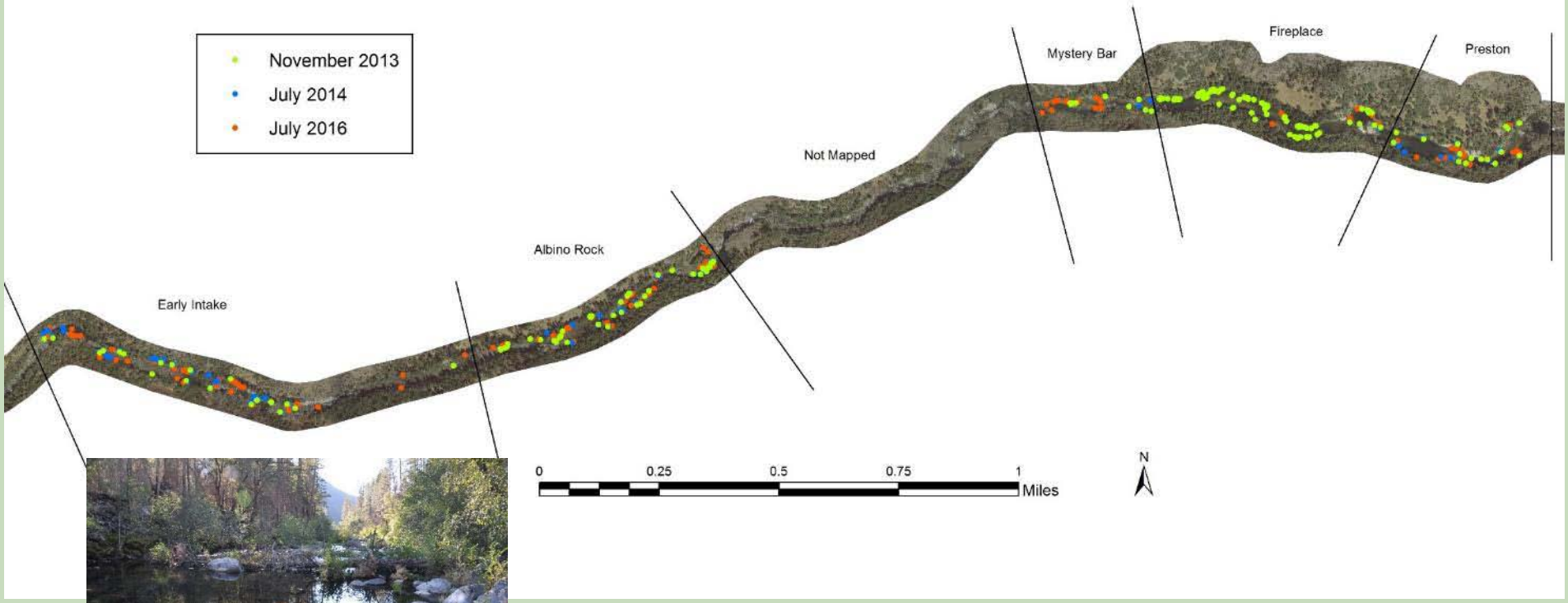
2013 – 2016 Post Rim Fire large wood loading



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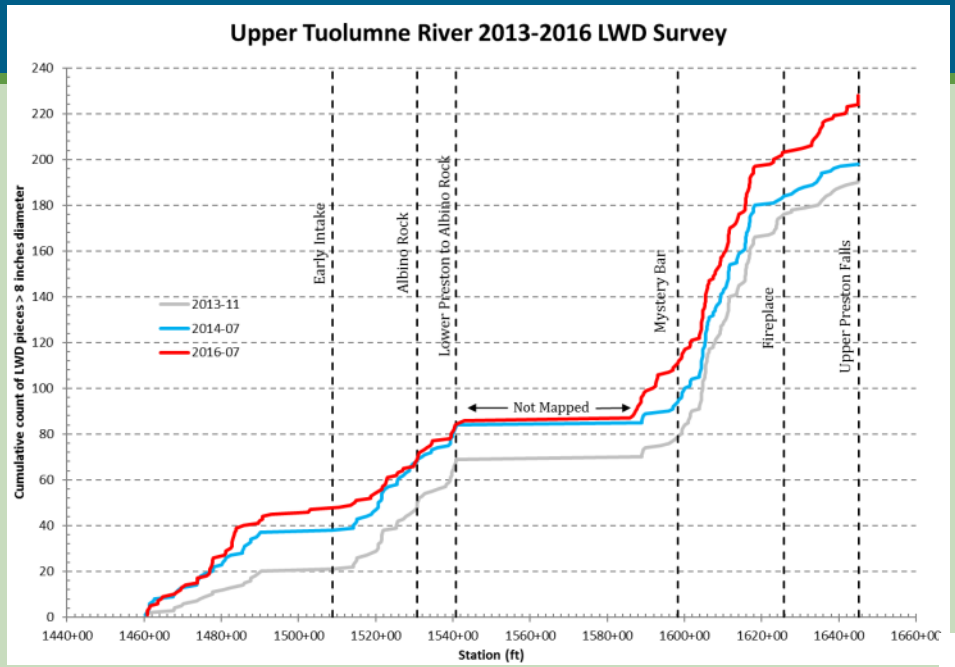
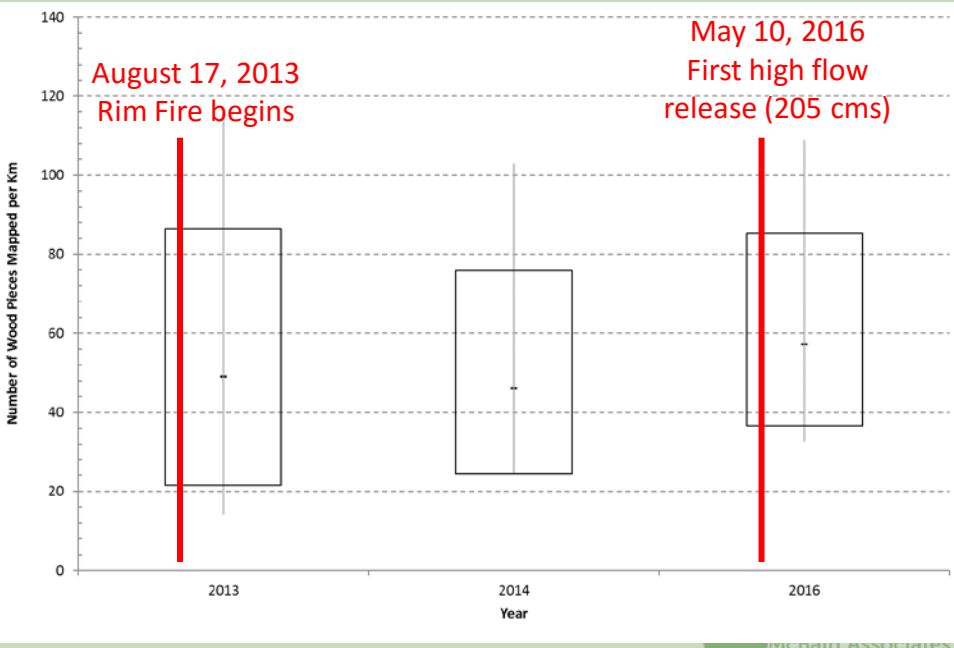
Post Rim Fire large wood loading





Summary of Rim Fire, 2013-2015 drought, and 2016 high flow release (205 cms)

Sediment

- In-channel sand accumulation after Rim Fire and during drought
- 205 cms did not mobilize large cobble and boulder deposits
- 205 cms flushed large quantities of sand and removed accumulated in-channel fine sediment at various scales (surficial storage, lee deposits, bars, deltas)
- Short-duration high magnitude releases can be effective tools for "resetting" the channel after fine sediment accumulation (series of drier years)

Riparian Vegetation

- Riparian plant colonization of fine sediment deposits after Rim Fire and drought (lee deposits➔bars and deltas)
- 205 cms removed established vegetation on larger sandy surfaces (new sand bars and deltas that were scoured)
- 205 cms did not remove riparian vegetation rooted in interstitial spaces of larger grain sizes (large cobbles and boulders)
- Short-duration high magnitude releases can be an effective tool for "resetting" riparian vegetation established on fine sediment deposits (after a series of drier water years), but less so on deposits of larger grain sizes (cobbles and boulders)

Large Wood

- Rim Fire and subsequent wind-throw and wood routing has increased the number of wood pieces (192 up to 228) and an increased in wood density (44.8 up to 53.1 p/Km) from 2013 to 2016

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