

Effects of prescribed fire on riparian and hydrological function in riparian areas of southwest Oregon mixed-conifer forests

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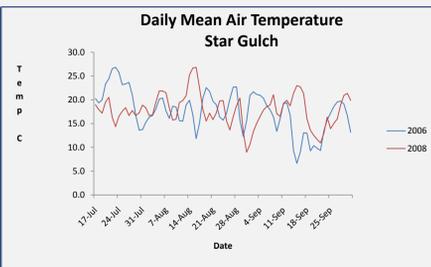
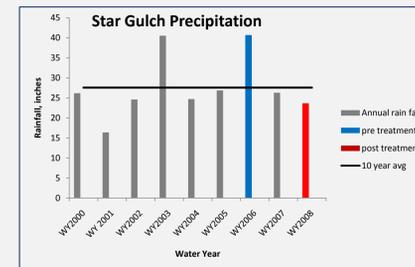
Abstract

Riparian areas are important ecological transition zones between aquatic and terrestrial habitats. Many riparian zones have been altered by past management practices, resulting in unnaturally dense even-aged stands that are potentially more vulnerable to wildfire and would benefit from fuel reduction treatments. However, federal land managers, required to protect these sensitive environments, have been reluctant to apply treatments to these areas in the face of uncertain ecological affects. This study, one component of a broader ecological study funded by the Joint Fire Science Program, measured several riparian and hydrological parameters, including summer stream flow, water quality, channel shade, summer water temperature, and substrate in eight small headwater catchments. Hydrological years varied substantially between calibration and post treatment seasons, complicating interpretation of results, but overall the study indicated that treatments did not measurably affect summer flow or water quality. Channel shade was reduced in one of the riparian treatment basins, but was maintained or improved in all other study basins. Stream temperature appears to have been affected by the treatments in most of the basins, including buffered upland treatment basins, as warming rates and 7-day maximum temperatures were increased in most study basins, while these same metrics were decreased in the control basins. Substrate remained unchanged post treatment, but the study basins have not experienced a post treatment flushing flow to date.

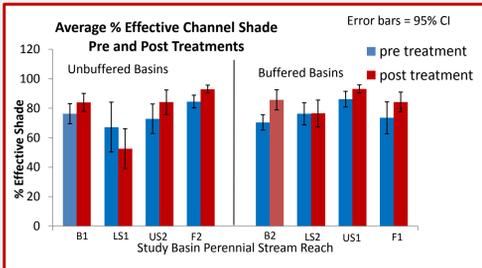
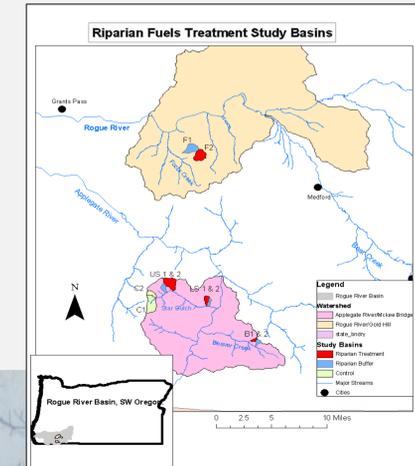
Shade Study – Percent effective shade was measured via solar pathfinder equipment at 20 points along each perennial reach in the study basins pre and post treatment. Mean shade values were then tested for significant differences. Shade was lost in one of the riparian treated basins, but was maintained or improved in all other basins. Shade loss in the one basin was a result of dominant vegetation type; young resprouted hardwoods that once cut left the channel exposed, as there was no mature overstory vegetation.

Study Design

This study design reflects the complexity of a multi-party interdisciplinary venture as the broad JFSP funded study included wildlife, botanical, fire effects, and riparian/hydrologic parameters. After exhaustive efforts, the needs of the lead agency and private interests ultimately determined the final criteria for study basin selection. The eight selected basins adhere to aspects of the original selection criteria developed by the interdisciplinary team. Paired study basins are adjacent and include perennial and intermittent stream reaches. Slope, aspect, elevation, geology, annual precipitation and vegetative qualities are similar between adjacent basins, but differ throughout the study area. Vegetation ranges from mixed-conifer forest, to a mixed-conifer/hardwood forest with patches of oak woodland and shrub within upland and riparian areas. The history of fire, placer mining and timber activity also varies between basins. All study basins are in the Rogue River Basin of SW Oregon. Fuels treatments (buffered vs. unbuffered riparian zone) were randomly assigned to basins. The initial year of treatment (2006) began immediately after the collection of baseline data and included manual fuels reduction (cutting and hand piling) during the winter and spring months. This treatment prescription removed brushy species and small diameter (<6") conifers. In 2007 and 2008 winter and spring pile and broadcast burning occurred in basins where conditions favored these management applications. Post treatment data collection occurred following the spring broadcast burns.



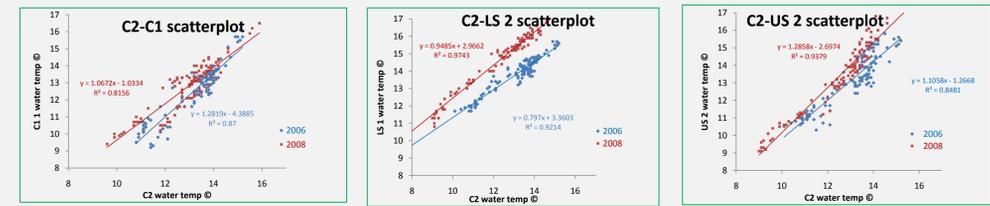
The study seasons were similar with regards to temperature, but very different water years preceded the calibration and treatment seasons.



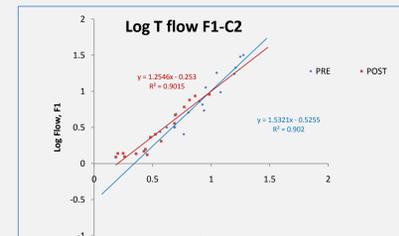
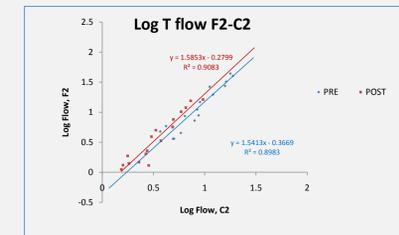
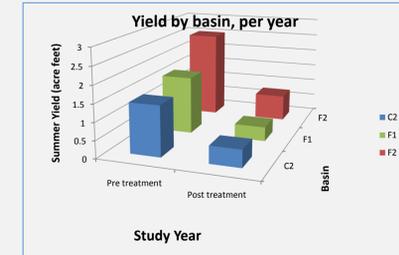
Temperature Study- Water temperature was monitored pre and post treatment with HOBO data loggers. Stream temperature relationships were established between control and study basins during the calibration season, and change in the relationship post treatment was tested for significance via regression. Results indicate that although treatments did not measurably affect mean summer water temperatures, both the 7 day maximum temperatures and rates of warming were increased in most of the study basins, while these same two metrics decreased in the controls.

BASIN	ODEQ Standard criteria	2006		2008	
		7 day max	Days over criteria	7 day max	Days over criteria
Controls					
C1	16	16.67	5	16.06	3
C2	16	15.41	0	15.28	0
Riparians					
US 2	16	17.24	36	19.19	56
LS 1	16	20.47	69	17.47*	9*
F2	18	14.56	0	18.07	2
B1	16	14.93	0	18.66	49
Uplands					
US 1	16	12.97*	0	10*	*
LS 2	16	16.21	3	18.06	70
F1	18	15.21	0	14.01	0
B2	16	14.93	0	11.8*	*

Relationship of summer temperature between Control Two and select basins pre/post treatment. Lines depict rate at which water warmed in the study basins relative to Control Two.



Summer Stream Flow: Check dams with outlet pipes were constructed near each basin outlet. Pre and post treatment flow measurements were taken weekly during summer months by placing a container of known volume below the outflow and measuring the time to fill the container. A relationship between flow in the study basins and the control basins was established during the calibration season, and change post treatment was tested for significance via linear regression. A dry water year preceding the post treatment season resulted in many study streams going dry at their outlets before the summer ended, hence the flow study became a case study using the paired Foothills study basins (F1 and F2) and Control 2 (C2). Yield post treatment was roughly one third of volumes observed pre treatment due to the large difference in water years. Fuels treatments had no detectable affect to summer base flow in either of the treatment basins.



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* = incomplete data sets as stream went dry before end of summer