

Effects of Logging Near Streams to Restore Riparian Aspen

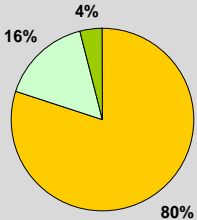
Collaborative Project

USFS – Lassen NF
 USFS – Region 5
 University of California



Decline of Aspen

- Lassen NF – ELRD.
- >600 stands inventoried.
- ~3,700 stand acres.
- <1% of district area.



Risk Factor	%
Conifer encroachment	96
Excessive browse	54

Risk of Stand Extinction
 ■ High ■ Moderate ■ Low

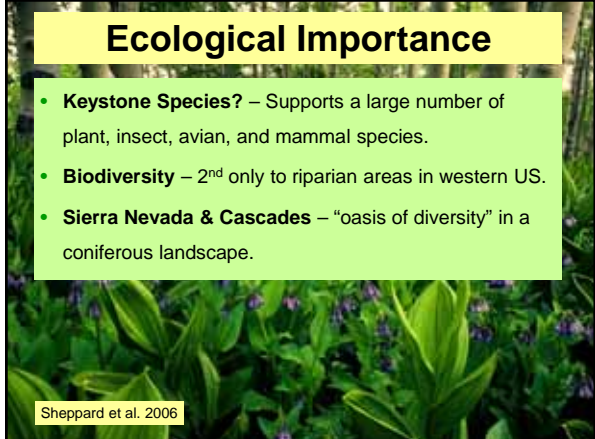
Conifer encroachment reduces recruitment, leads to stand decay



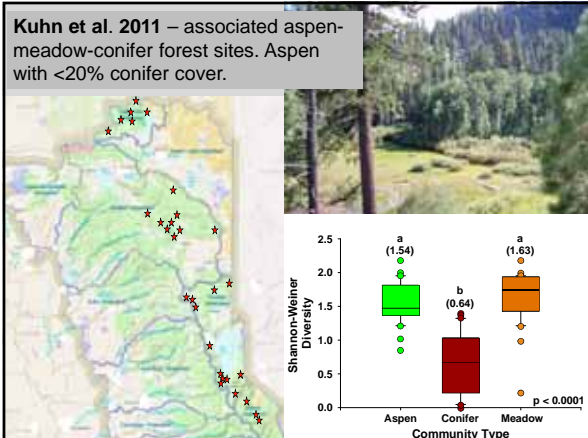
Ecological Importance

- Keystone Species?** – Supports a large number of plant, insect, avian, and mammal species.
- Biodiversity** – 2nd only to riparian areas in western US.
- Sierra Nevada & Cascades** – “oasis of diversity” in a coniferous landscape.

Sheppard et al. 2006



Kuhn et al. 2011 – associated aspen-meadow-conifer forest sites. Aspen with <20% conifer cover.

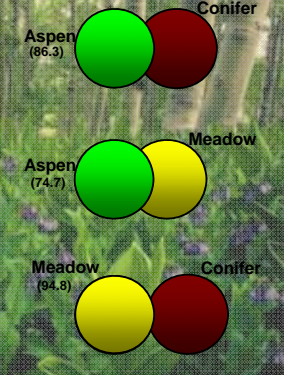


Shannex-Wilcher Diversity

Community Type	Mean Diversity	Significance
Aspen	1.54	a
Conifer	0.64	b
Meadow	1.63	a

p < 0.0001

Dissimilarity Among Community Types



% Dissimilarity = (1 - Jaccard's)

Many riparian aspen stands are encroached by conifers.
Conifer removal is an effective release strategy.

Jones et al. 2005
Restoration Ecology

Some Concerns

- Reduce stream canopy cover?
- Increase stream temperature?
- Degrade water quality and aquatic habitat?
- Compact soils?

Test Concerns

- Lassen NF.
- Significant conifer encroachment.
- Active aspen restoration program.
- Collaborative study to evaluate possible water-riparian impacts.

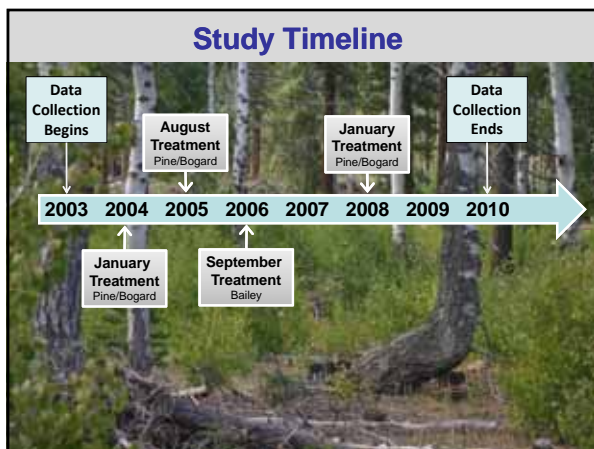
2 Projects, 4 Treatments

Eagle Lake Ranger District
Pine-Bogard Project

- Phase 1
Jan 2004 Treatment
- Phase 2
Aug 2005 Treatment
- Phase 3
Jan 2008 Treatment

Hat Creek Ranger District
Bailey Project

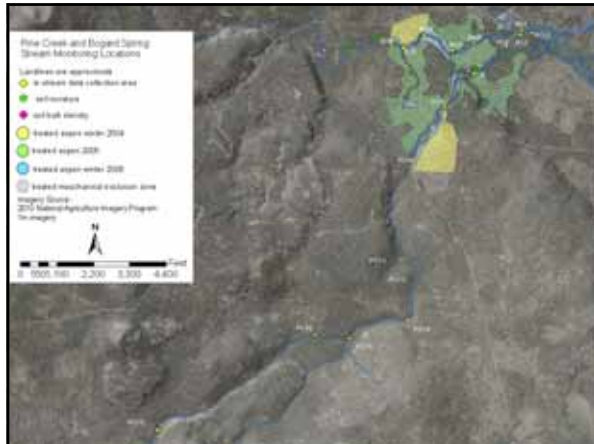
- Sep 2006 Treatment



Data for this presentation:

Pine, Bogard, Bailey Creeks
Data from 2003 to 2010

- Water Quality
- Stream Canopy Cover and Solar Radiation
- Stream Temperature
- Aquatic Macroinvertebrates
- Soil Bulk Density
- Soil Moisture



Phase 1: Jan 2004 (yellow)

~60 Acres, Pine Cr. ~2,360',
Bogard Cr. ~1,420'

Over snow – protect soil

Whole tree – reduce slash

End-line to within 75 ft of stream
– to protect riparian areas.

Track-laying harvester, rubber tire skidders.



Phase 2: Aug 2005 (green)

200 Acres, Pine Cr. ~5,910',
Bogard Cr. ~3,590'

Late harvest – dry soils,
further reduce slash

Whole tree – reduce slash

Variable distance from stream
based on slope, ground cover,
etc.– 15 to 125 ft.

Track-laying harvester, rubber
tire skidders.



Phase 3: Jan 2008 (blue)

200 Acres, Pine Cr. ~5,910',
Bogard Cr. ~3,590'

Late harvest – dry soils,
further reduce slash

Whole tree – reduce slash

Variable distance from stream
based on slope, ground cover,
etc.– 15 to 125 ft.

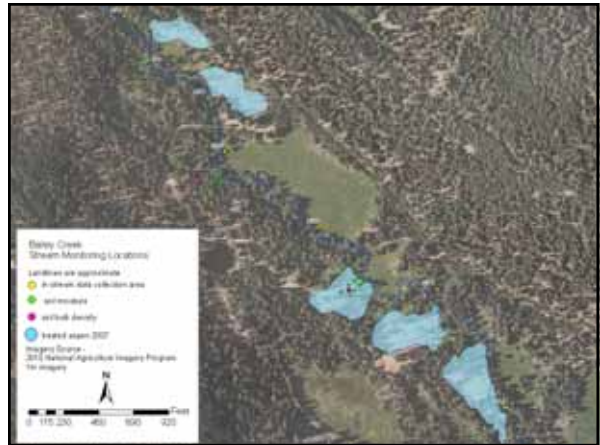
Track-laying harvester, rubber
tire skidders.



Snow depth during Jan 2008 treatment



**Bogard Creek following Jan 2008 treatment
(photo taken spring 2008)**



Bailey Project Sep 2006

~11 Acres, ~1,830' of the
total BR1 to BR6 reach
length (6,460')

Late harvest – dry soils,
further reduce slash

Whole tree – reduce slash

Variable distance from
stream based on slope,
ground cover, etc.– 5 to
100 ft.

Track-laying harvester,
rubber tire skidders.



Bailey Before versus After Treatment

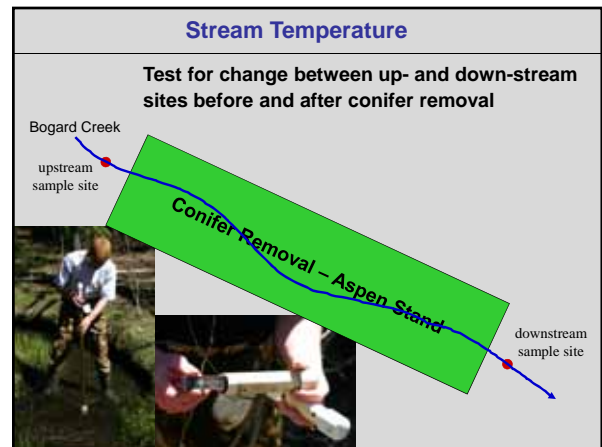
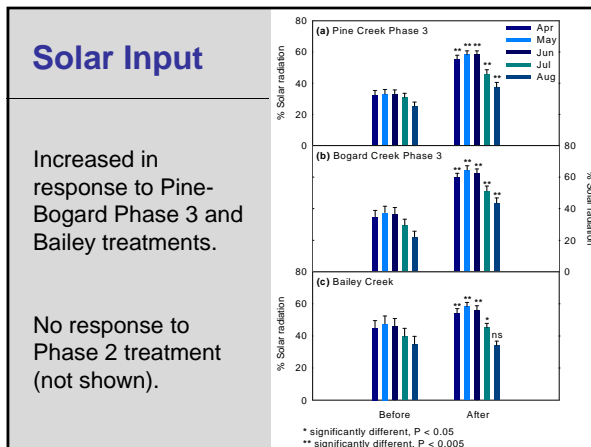
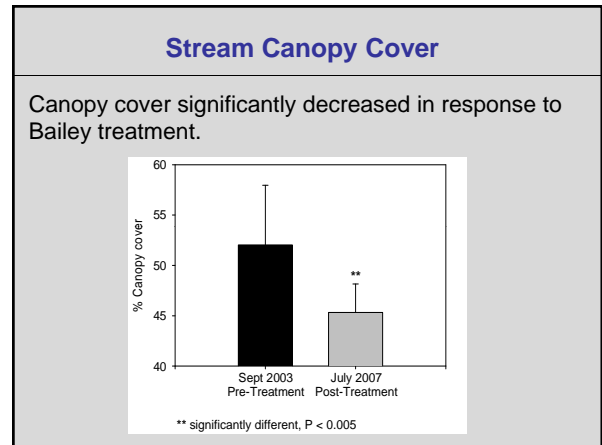
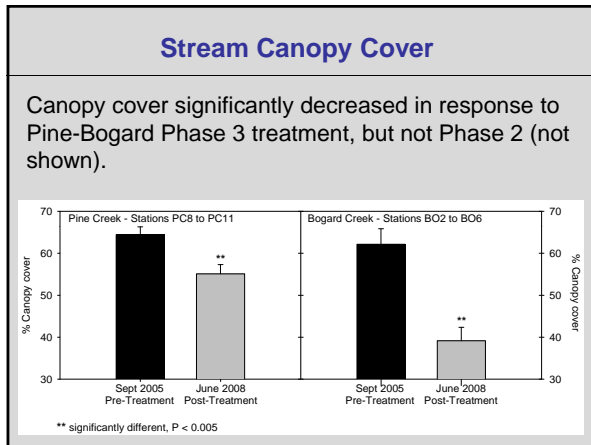
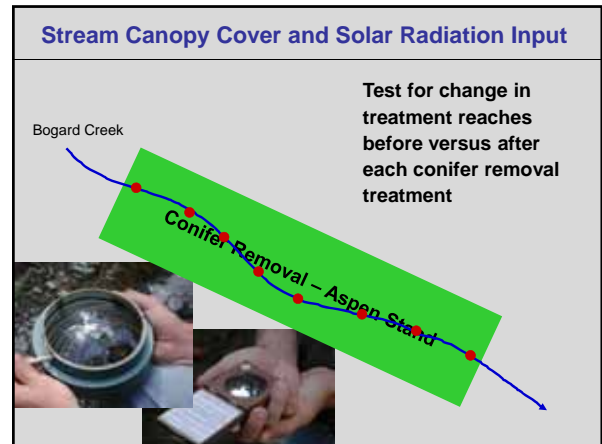


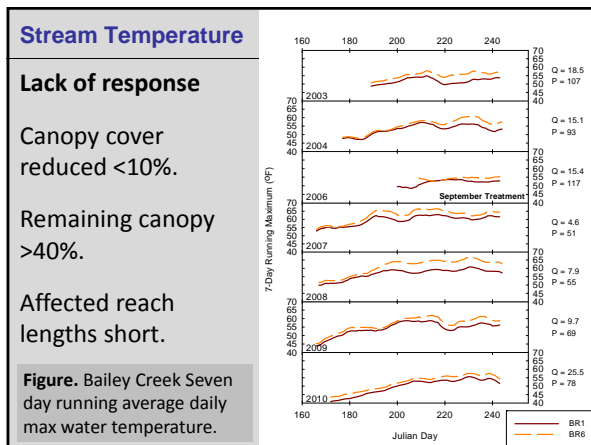
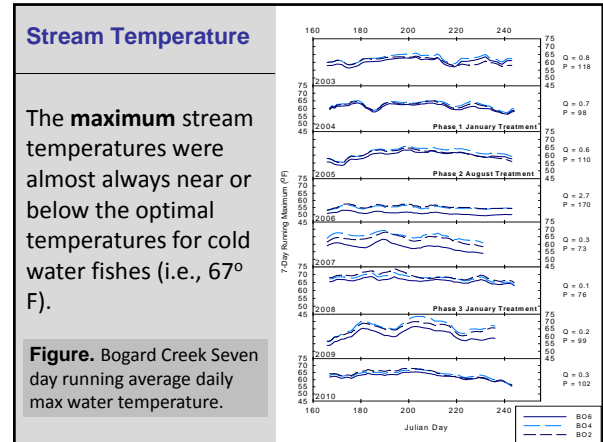
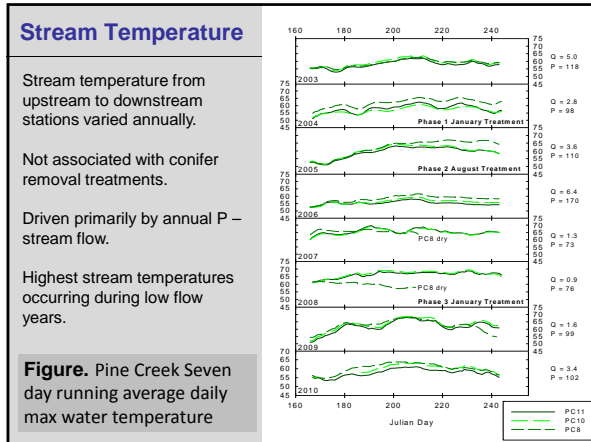
No water chemistry changes were detected

Table The mean results for all samples collected across stations PC17 to PC7 at Pine Creek (2003 – 2010), across stations BO6 to BO1 at Bogard Creek (2003 – 2010), and across stations BR1 to BR6 at Bailey Creek (2003-4004, and 2006-2010).

Creek	Nutrient	No. Samples Collected	No. Samples < DL *	% Samples < DL *	Mean of all Samples	Mean of all Samples > DL *
Pine	NO ₃ -N	758	636	84	0.007	0.03
	NH ₄ -N	761	753	99	0.027	0.26
	PO ₄ -P	758	651	86	0.01	0.04
Bogard	NO ₃ -N	430	348	81	0.008	0.03
	NH ₄ -N	433	432	99	0.026	0.47
	PO ₄ -P	430	63	15	0.04	0.04
Bailey	NO ₃ -N	315	272	86	0.005	0.02
	NH ₄ -N	316	293	93	0.030	0.09
	PO ₄ -P	315	311	99	0.005	0.04

* DL = Detection Limit





Aquatic Macroinvertebrates

% tolerant to pollution was zero in 86 % of samples collected.

The highest % tolerant of pollution was 0.6 %, at upstream station PC13.

Diversity, richness and % intolerant of pollution varied from year to year at each station

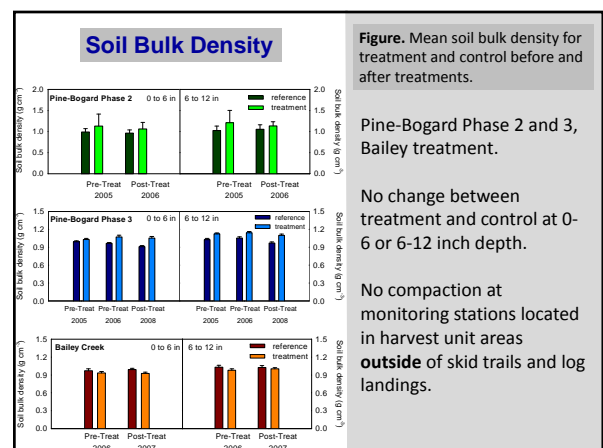
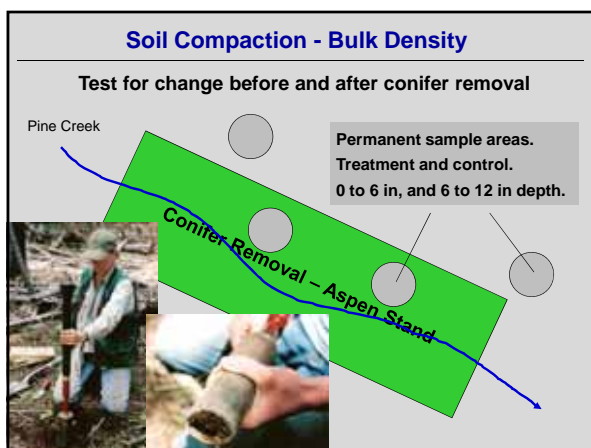
No correlation with treatments.

Table Aquatic macroinvertebrate metrics for Pine, Bogard, and Bailey Creek samples collected June-July 2003-04, 2007-08, 2010.

Metric	PC10				PC11				PC13						
	2003	2004	2007	2008	2003	2004	2007	2008	2003	2004	2007	2008			
No. Families	16.5	17.0	19.0	23.0	15.5	11.0	21.0	25.0	21.0	15.0	21.5	4.0	22.0	24.0	
Shannon D.I.	2.34	2.62	1.13	1.40	1.84	2.37	1.68	1.02	1.50	1.81	1.95	2.81	0.85	2.62	2.86
% Tolerant	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.2
% Intolerant	15.8	24.7	6.6	8.1	10.3	15.5	14.2	4.4	7.3	8.4	10.1	31.8	64.0	23.9	22.3

Metric	BO1				BO4				BO6						
	2003	2004	2007	2008	2003	2004	2007	2008	2003	2004	2007	2008			
No. Families	15.0	13.0	15.0	17.0	17.0	16.5	15.0	31.0	22.0	11.5	20.0	21.0	20.0	23.0	
Shannon D.I.	2.47	2.26	1.48	2.24	2.54	2.83	2.09	2.76	2.69	2.67	2.00	2.22	2.23	1.91	2.25
% Tolerant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% Intolerant	28.0	44.7	29.2	40.6	23.3	24.3	12.9	20.6	17.8	21.7	28.9	11.0	16.7	7.4	11.0


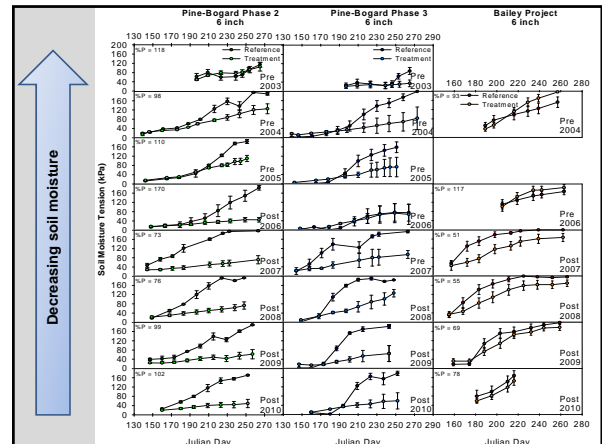
Metric	BR1				BR4				BR6						
	2003	2004	2007	2008	2003	2004	2007	2008	2003	2004	2007	2008			
No. Families	12.5	10	12	18	17	10.5	12	15	21	--	--	14	23	16	
Shannon D.I.	2.31	2.01	2.08	2.59	2.92	2.03	2.19	1.96	2.49	2.78	--	--	2.19	3.17	2.82
% Tolerant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	0.3	0.3	0.0
% Intolerant	23.4	52.2	32.5	43.3	37.8	50.0	32.3	26.7	30.3	35.6	--	--	33.7	65.4	29.7



Soil Moisture

Soil moisture at both depths increased compared to reference site following Pine-Bogard Phase 2 and 3 and Bailey treatment ($P < 0.001$).

Increased soil moisture following treatment result of reduced evapotranspiration.

Conifer removal to restore riparian aspen:

- i. had no effect on water quality (chemical, physical) or aquatic macroinvertebrates (biological)
- ii. decreased canopy cover and increased solar radiation following the Bailey Project and following Phase 3 of the Pine-Bogard Project, but did not influence stream temperature.
- iii. had no effect on soil bulk density but did cause a significant increase in soil moisture
- iv. Submitting paper to for peer-review, publication.

