Genetic diversity and population structure in the rare, endemic Baker cypress (*Cupressus bakeri*)

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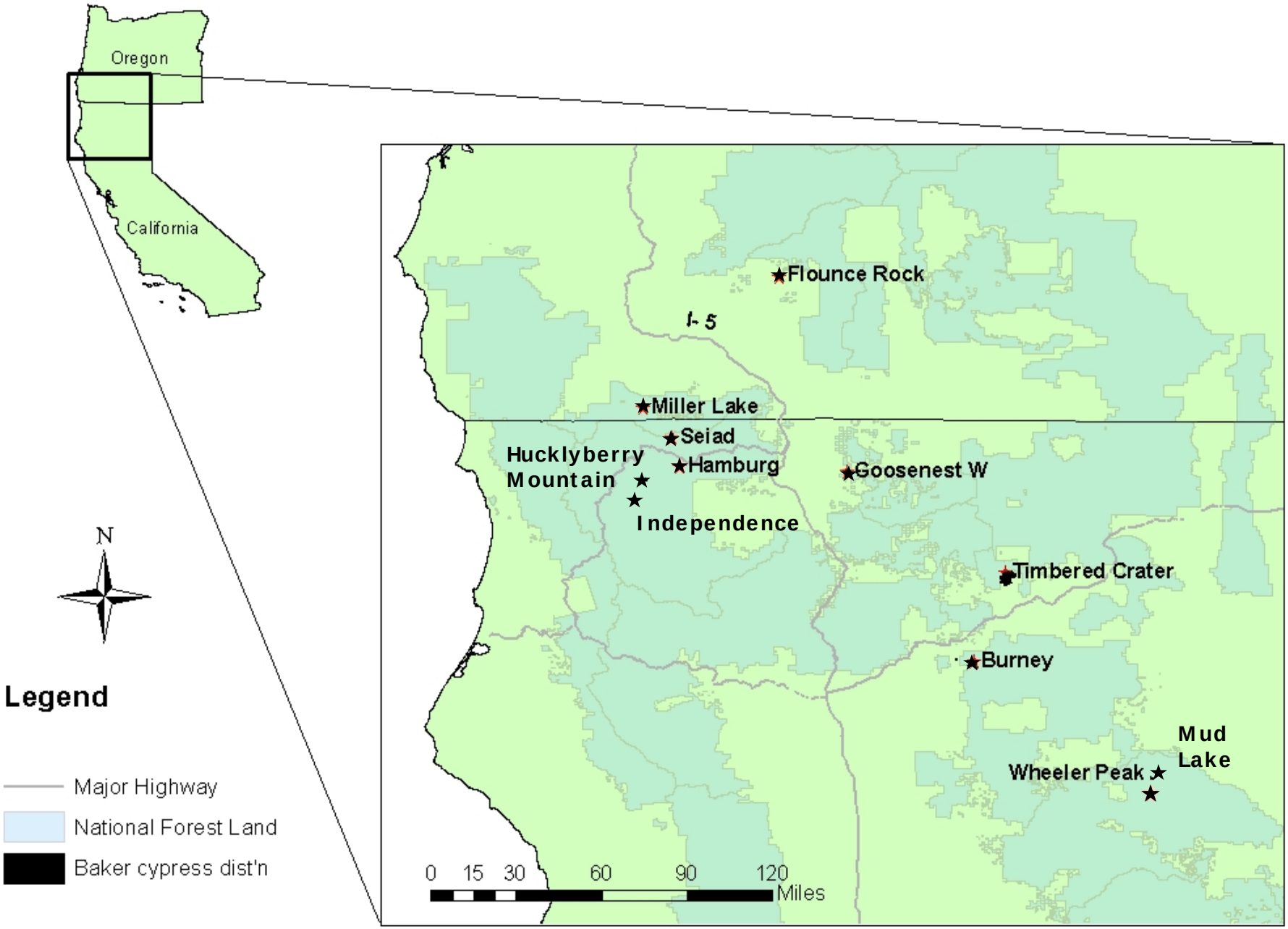
Introduction

- Baker cypress (*Cupressus bakeri*) is 1 of 10 species of cypress on the west coast
- Highly fragmented
- 11 known populations
- Northernmost cypress (Flounce Rock SW OR)
- Highest elevation cypress (Wheeler peak CA)
- Furthest inland (Wheeler peak CA)


Oregon
California
Flounce Rock
I- 5
Miller Lake
Seiad
Hucklyberry
Mountain
Hamburg
Goosenest W
Independence
Timbered Crater
Burney
Mud
Lake
Wheeler Peak
N
Legend
Major Highway
National Forest Land
Baker cypress dist'n
0 15 30 60 90 120
Miles

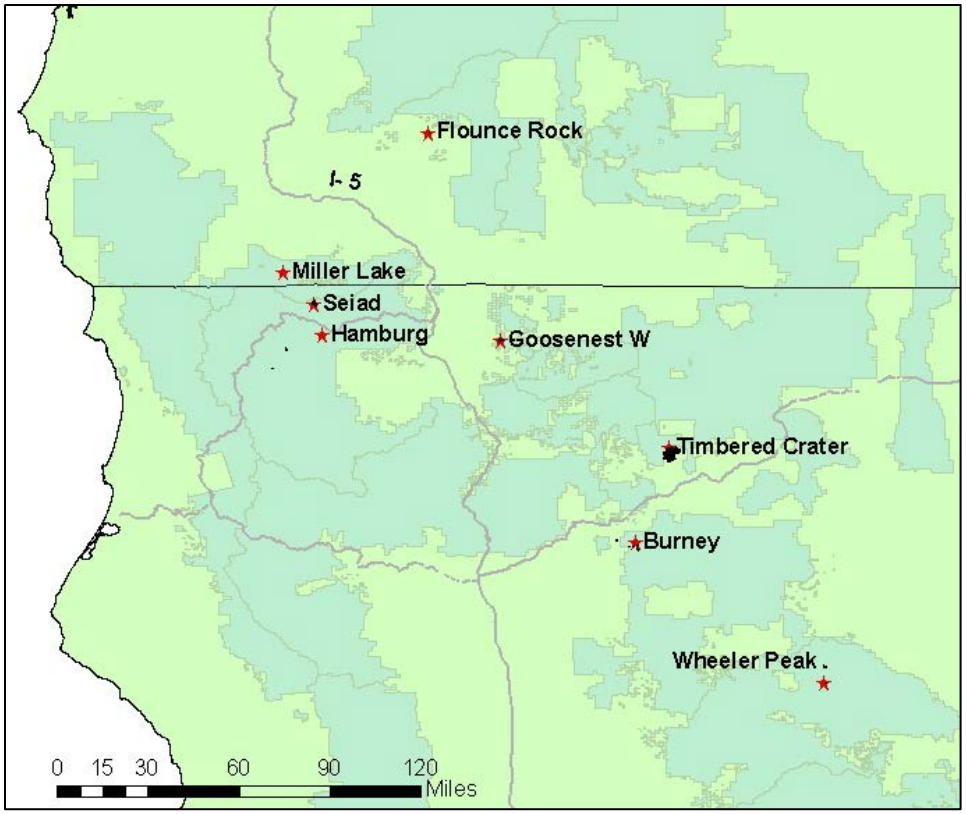
Background

- Fire dependent
  - Serotinous cones
  - Needs bare mineral soil to regenerate
  - Shade intolerant
- Fire suppression has led to overtopping by shade tolerant species in some populations

Merriam and Rentz 2010

Materials and Methods

- Sampled 8 of 11 populations
- 14 allozyme loci used to assess genetic diversity and population structure



Results - Heterozygosity

- 12 loci were polymorphic in at least 1 population

Site	N	%P	H_o	H_e	F
Flounce Rock	30	35.7%	0.100	0.104	0.020
Miller Lake	35	57.1%	0.175	0.221	0.136
Seiad	27	50.0%	0.180	0.211	0.159
Hamburg	31	64.3%	0.224	0.260	0.131
Goosenest	30	57.1%	0.190	0.229	0.143
Timbered Crater	30	50.0%	0.186	0.202	0.091
Burney	30	78.6%	0.222	0.257	0.110
Wheeler Peak	30	50.0%	0.150	0.145	-0.043
Grand Mean		55.4%	0.178	0.204	0.099

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Results - Heterozygosity

- Heterozygote deficiency in most populations

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Results – Population Structure

- Overall F_{ST} = 0.171

	Goosenest	Flounce Rock	Miller Lake	Timbered Crater	Wheeler Peak	Burney	Seiad
Flounce Rock	0.174	-					
Miller Lake	0.062	0.251	-				
Timbered Crater	0.039	0.165	0.043	-			
Wheeler Peak	0.076	0.222	0.055	0.042	-		
Burney	0.018	0.159	0.044	0.037	0.046	-	
Seiad	0.059	0.215	0.025	0.030	0.031	0.034	-
Hamburg	0.053	0.187	0.086	0.073	0.089	0.039	0.091

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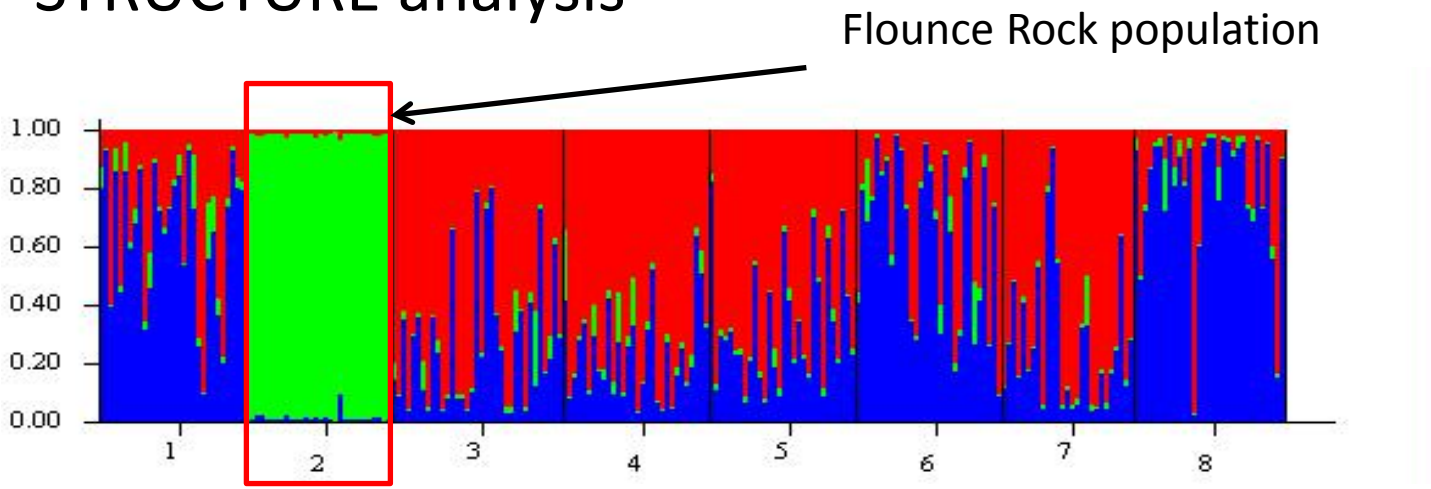
Flounce Rock

- Northernmost population
- Very small population (~1-2 acres)
- No natural regeneration
- High average tree age
- Poor vigor

Merriam and Rentz 2010

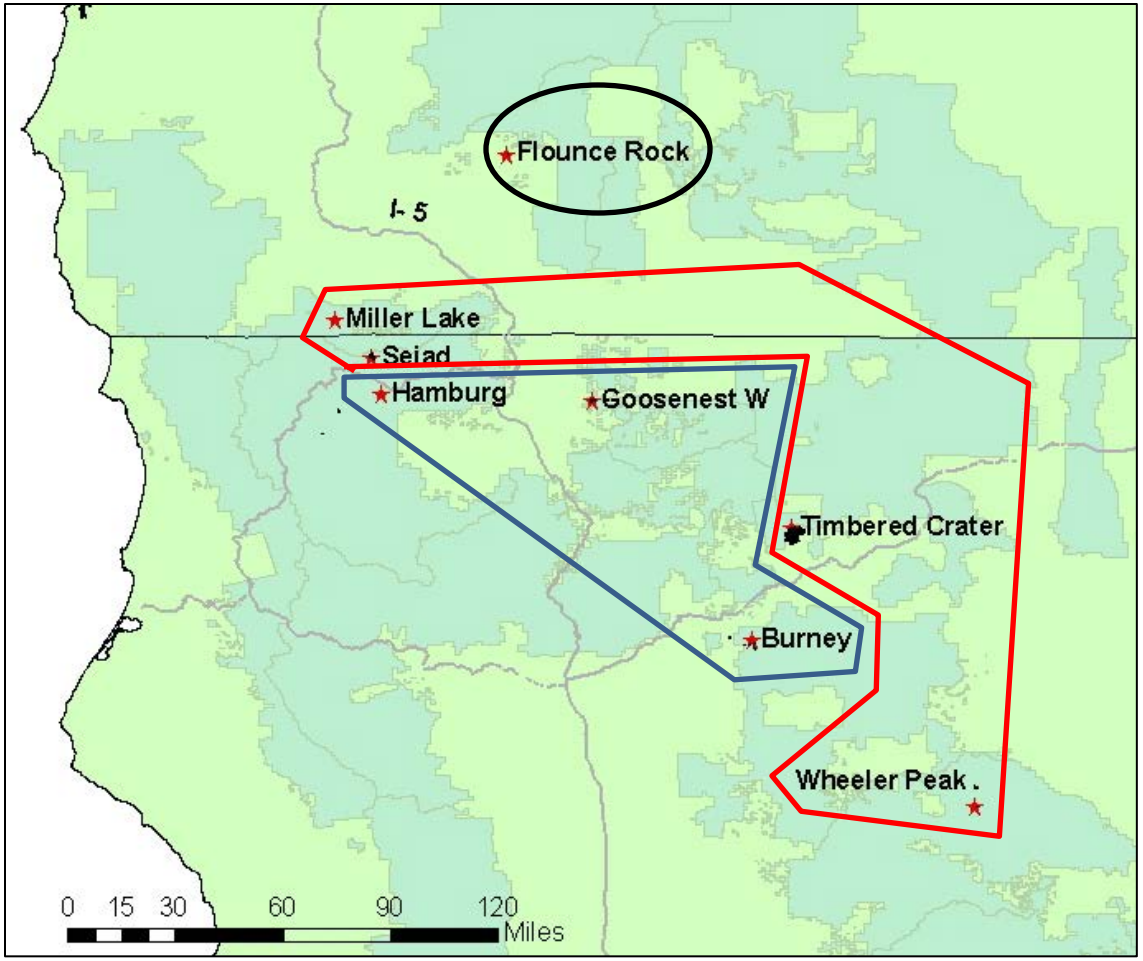
Population Structure

- STRUCTURE analysis



- 3 “clusters”
  - Flounce Rock
  - All other populations form 2 “clusters”
- NO clear geographic patterns among other populations

Population Structure



Results

- Excluding Flounce Rock:
  - $H_o = 0.178 \Rightarrow 0.189$
  - $H_e = 0.204 \Rightarrow 0.218$
  - $F_{ST} = 0.171 \Rightarrow 0.089$

Discussion - Diversity

- Relatively high heterozygosity (0.204)
  - Tecate cypress – 0.112
  - Monterey cypress – 0.177
  - Brewers spruce – 0.129
  - Knobcone, bishop, Monterey pines 0.138-0.160

- This suggests:
  - Relatively recent reduction from a more widespread distribution in the past
  - Serotiny may maintain high population genetic diversity

Discussion - Diversity

- Heterozygote deficiency suggests likely inbreeding
  - Release of seed post fire results in “islands” of related individuals
- Wahlund effect
  - Patchy fire distribution resulting in uneven aged pockets where age class is related to fire history

Discussion – Population Structure

- With Flounce Rock excluded, population structure was relatively low (0.089)
  - Tecate cypress – 0.016
  - Monterey cypress – 0.012
  - Knobcone, bishop, Monterey pines 0.012-0.022

- This supports the idea of a relatively recent contraction with insufficient time for drift to diverge populations more.

Discussion – Population Structure

- STRUCTURE analysis and F_{ST} show that Flounce Rock is genetically differentiated

- Other populations form 2 genetic clusters
  - These 2 clusters are more closely related to each other than either are to Flounce Rock
  - No geographic clustering

Conclusions

- Flounce Rock should be managed as a distinct genetic population – no seed movement into or out of this population
- Other populations are relatively similar genetically so seed movement among them is likely to be safe
  - However, no information on adaptive traits known so when possible it is best to limit seed movement among populations

Conclusions

- Silvicultural treatments are likely to provide the greatest benefit to these stands
  - Thinning and burning
- Seed collection for genetic conservation and reforestation if needed

2007 Moonlight fire at Mud Lake RNA and carpet of regeneration (Merriam and Rentz 2010)

Acknowledgements

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