



What does research tell us?

Patterns of conifer
encroachment in
Oregon white oak and
California black oak
woodlands

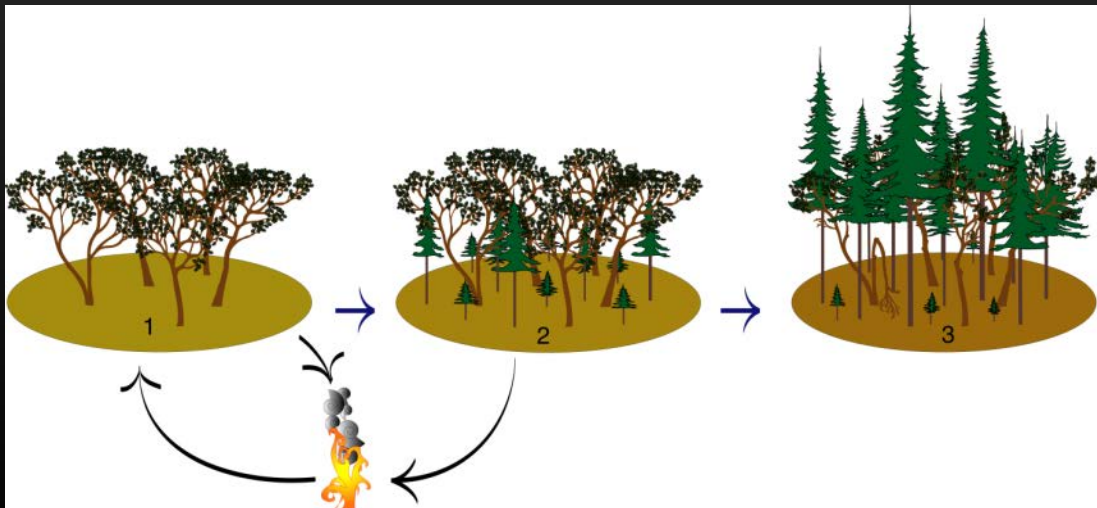
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USDA NRCS, Eureka, CA



Conifer Encroachment

Conifer encroachment is a process under fire exclusion by which native conifers increase in and eventually replace deciduous oak woodlands

Synonyms: Conifer invasion, densification, mesophication, succession



(Cocking *et al.* 2012)

Oregon White Oak



California Black Oak



Western Deciduous Oak Woodlands

Oregon white oak
Garry oak
Quercus garryana



California black oak
Quercus kelloggii

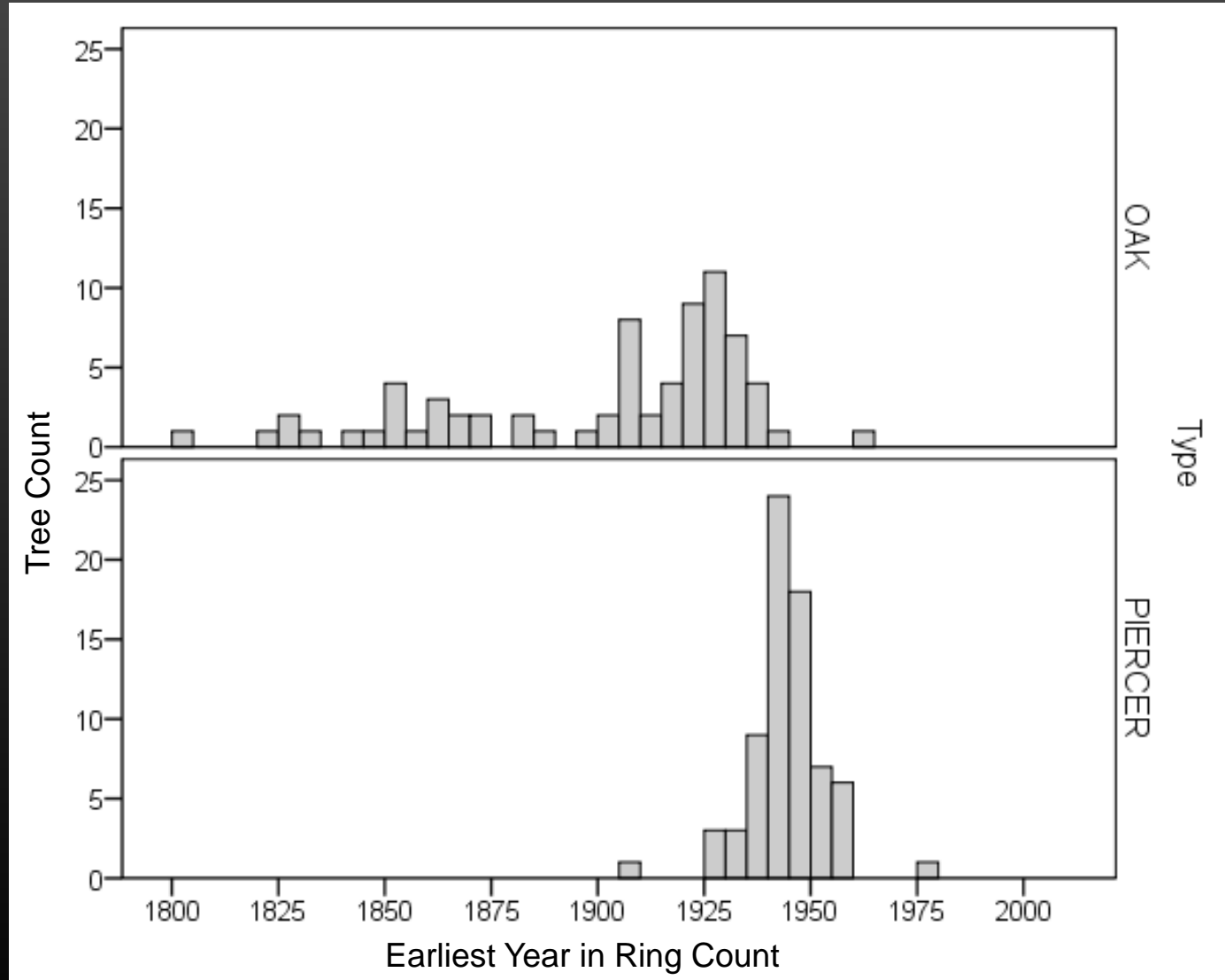


- The majority of oaks we see today are old
 - Gilligan & Muir, up to 429 years, Oregon
 - Kuhn & Johnson, 240+ years, Yosemite

Species	Sample size	Median Age	Min Age	Max Age
<i>Aesculus californica</i>	24	98	50	142
<i>Arbutus menziesii</i>	31	75	23	129
<i>Cedrus decurrens</i>	3	49	29	56
<i>Notholithocarpus densiflorus</i>	2	41	29	53
<i>Pseudotsuga menziesii</i>	707	43	6	142
<i>Quercus agrifolia</i>	3	81	73	107
<i>Q. chrysolepis</i>	9	37	28	100
<i>Q. garryana</i>	502	136	41	324
<i>Q. kelloggii</i>	175	138	45	301
<i>Umbellularia californica</i>	15	74	35	154

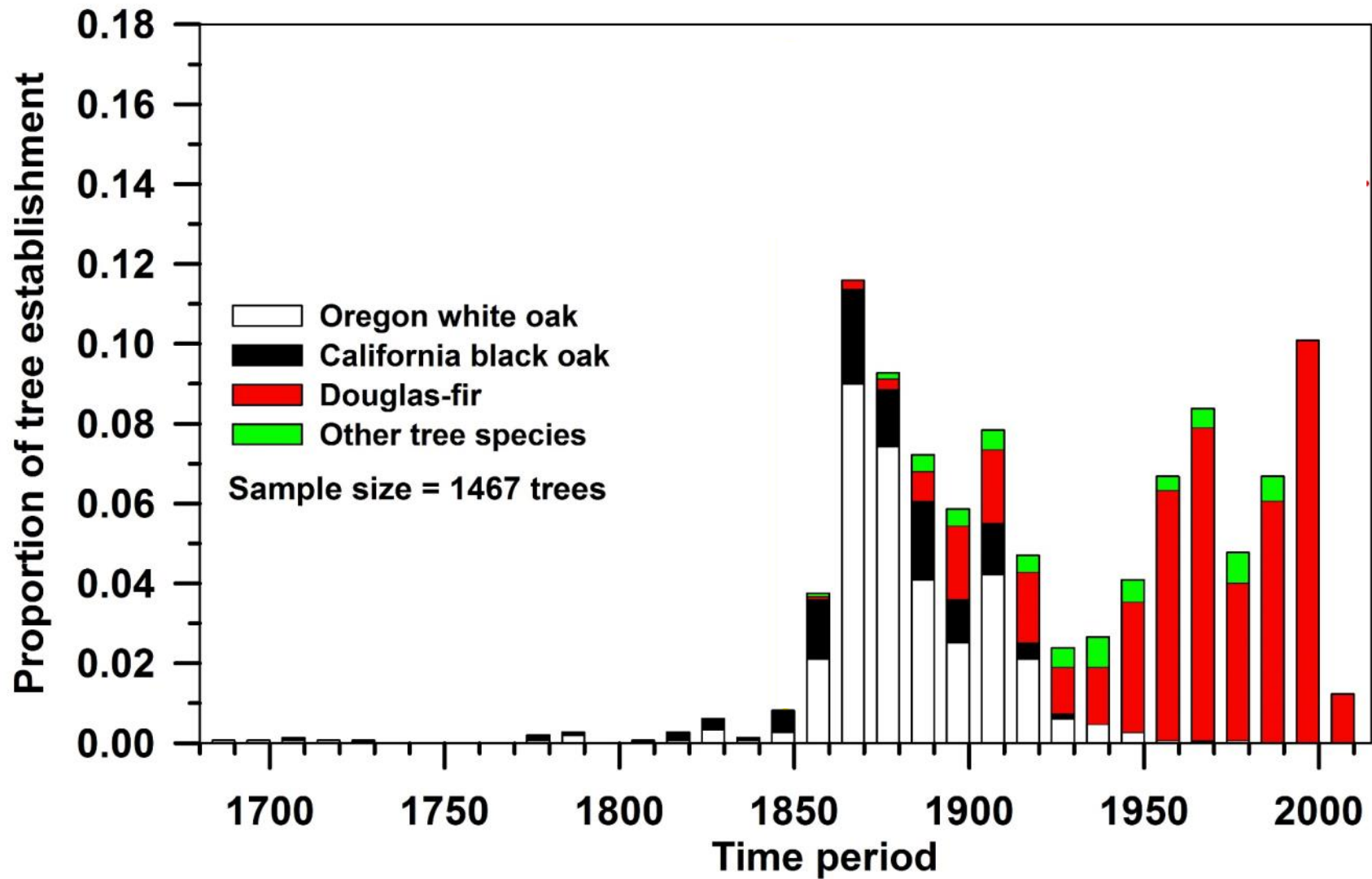


Age Structure: The wave of Douglas-fir



Cocking et al. 2012

Adapted from Hunter & Barbour, 2001





A photograph of a forest scene. In the foreground, there is a dirt path covered with fallen leaves, leading into a wooded area. The trees are mostly bare, suggesting late autumn or winter. The sky is blue with some light clouds. The word "Establishment" is overlaid in the center of the image in a bold, orange-outlined font.

Establishment



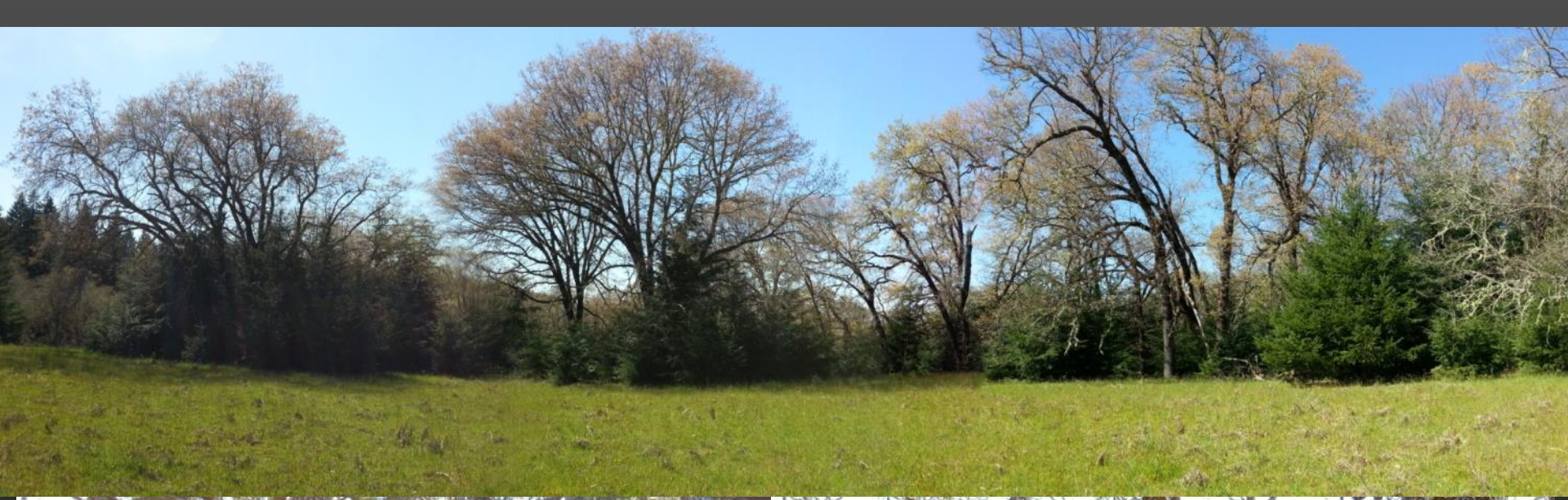
Piercing

A photograph of a dense forest with many tall, thin trees. Sunlight filters through the canopy, creating dappled light on the forest floor. The trees are mostly vertical, with some leaning. The ground is covered with dry leaves and twigs.

Overtopping

A photograph of a forest scene. In the foreground, a man with white hair, wearing a light blue t-shirt, stands with his hands on his hips. Behind him is a large, moss-covered tree trunk that has been cut or broken, with a large section of bark peeling away. The forest is filled with many thin, vertical tree trunks, some of which are also covered in moss. The ground is covered with dry leaves, twigs, and patches of moss. The word "Decadent" is overlaid in the center of the image in a large, orange, sans-serif font.

Decadent



Douglas-fir, Coast Range

Interior Ranges

- Douglas-fir
- Incense-cedar
- white fir



Phot courtesy of Lomakatsi RP

White fir encroachment, Southern Cascades



Western juniper, Shasta River/upper Klamath



Variation by Region

Trends in northern California:

- Gradient from west to east –
 - Shift from Douglas-fir to mixed conifer (white fir and incense cedar)
 - Oaks replaced sooner in wetter, coastal climates due to higher conifer growth rates
- Western juniper in arid parts of northeastern California

Region	Encroaching Species	Understory Cessation (years)	Oak Crown Recession Begins (years)	Oak Mortality Begins (years)	Oaks Replaced (years)
North Coast Ranges	Douglas-fir	5-10	20-30	30-40	60-100
Western Klamath	Douglas-fir	5-10	20-30	40-50	80-120
Central Klamath/Trinity	Douglas-fir, white fir, incense cedar	10-20	30-40	60-80	100-150
Southern Cascades/Northern Sierra	white fir, Douglas-fir	10-20	30-40	60-80	100-150
Eastern Klamath/Shasta Basin	western juniper	20-30	not observed	≥20	not observed
N. Ca. Serpentine Influenced	incense cedar, Jeffrey pine, Douglas-fir	10-20	30-50	60-80	≥100

Research Describing Encroachment on Oregon white oak

Gedalof et al. 2006

Dunwiddie et al. 2011

Devine & Harrington 2006

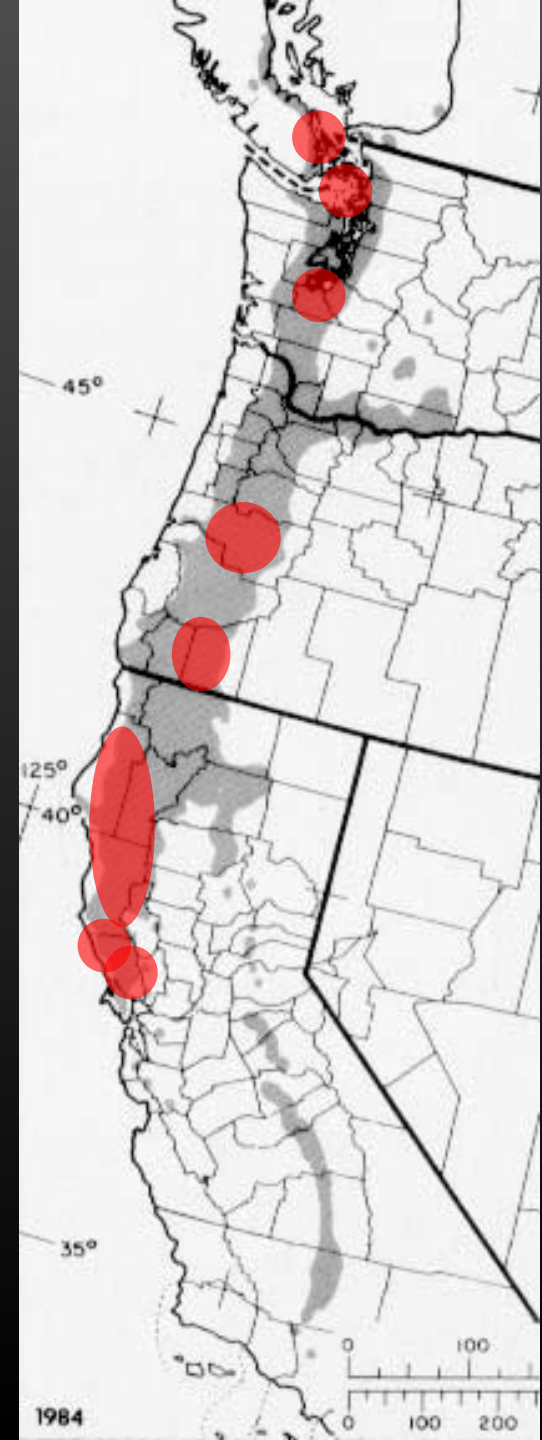
Chiller et al. 2000

Gilligan & Muir 2011

Schrivver 2015

Hunter and Barbour 2001

Barnhart et al. 1996



Research Describing Encroachment on California black oak

Gilligan & Muir 2011

Stewman 2001

Cocking et al. 2012

Schriver 2015

Cocking et al. 2014

Garrison et al. 2002

Parsons & DeBenedetti 1979

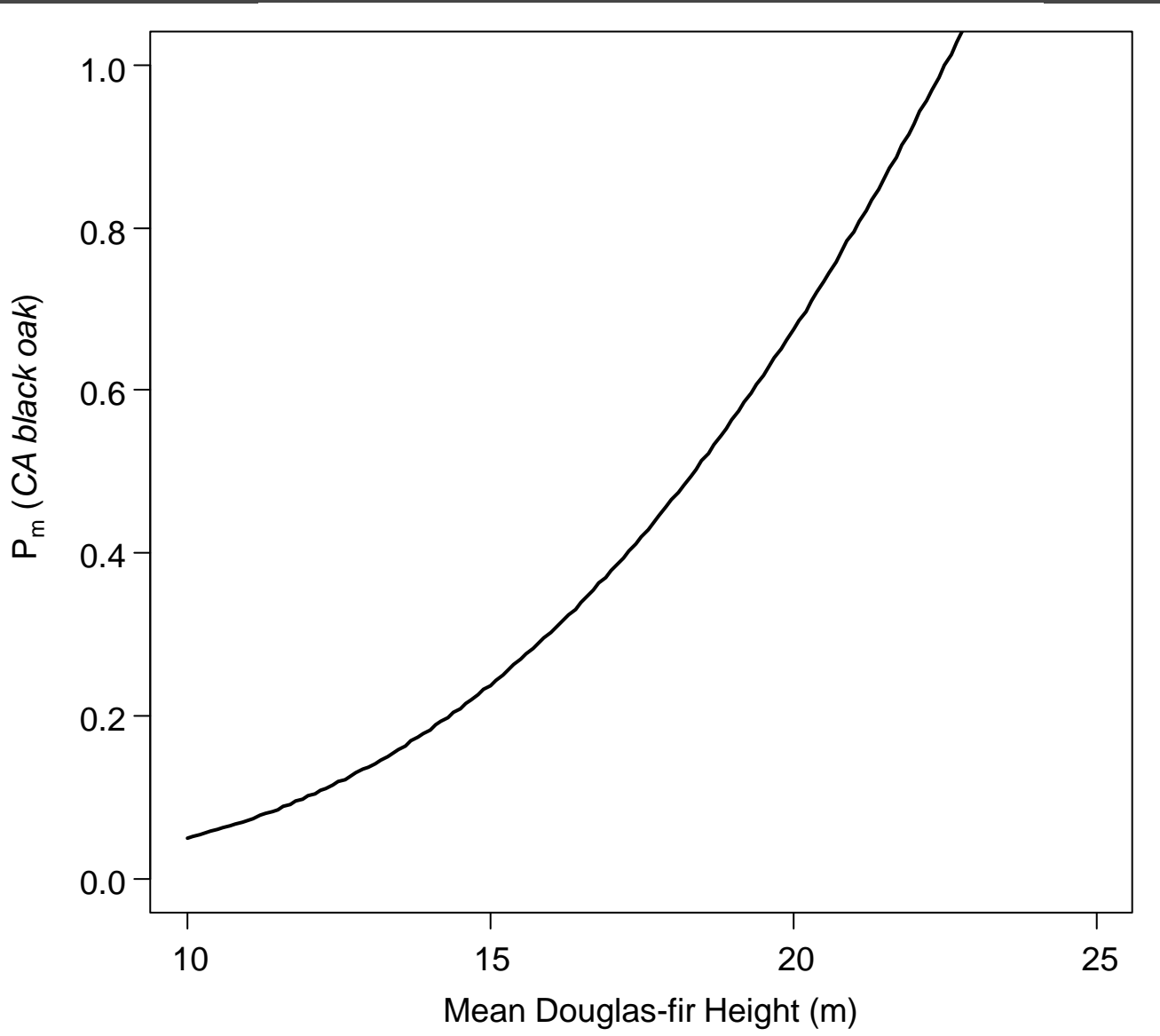


Effects on Oak Woodland Health



Eff

- Conif (2006)
- Conif (2013)
- Grow fir (S)
- Proba more
- Oak v encro



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Exacerbating the Conifer Encroachment Trend

Unencroached/Early Encroached

Encroached

- White oak
- Black oak

Seedlings

84%

12%

Saplings

6%

2%



- Research consistently reports poor oak regeneration for both California black oak and Oregon white oak

- Black oak

14%

0%

- Douglas-fir

26%

54%



Closed/ Late Encroached

- White oak
- Black oak
- Douglas-fir

22%

18%

7%

0%

0%

4%

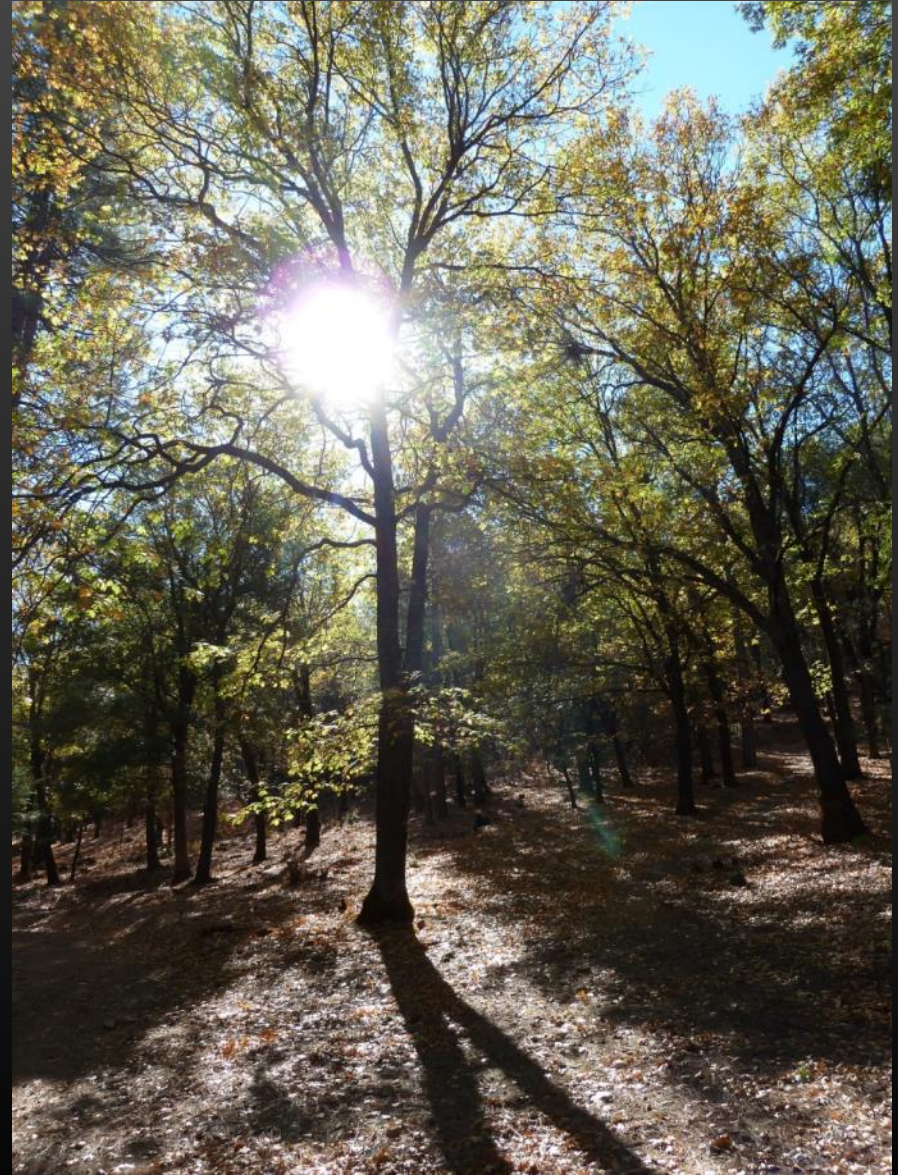


The Fire Escape! (sort of)



What research tells us?

- 1) Oaks are generally very old
- 2) Conifer encroachment is happening at many sites and is novel (after 1900)
- 3) Oaks are adversely affected by conifer encroachment
- 4) Oak trees respond to release treatments
- 5) Oak regeneration is currently in a very disturbing state
- 6) Other things – flammability, fire effects, understory



So what?

What do the patterns revealed by research tell us about society's value of these oak ecosystems?

The relative value we (society as a whole) attach to oak woodlands and what they provide is the engine behind progress and conservation.

Research describes patterns, numbers, function. Value is a human application.

Values at Risk

- Biodiversity – Keystone Ecosystems
 - Mast loss of other species due to sudden oak death



- Rangeland



- Water



- Cultural values (past and present)

- Food
- Fiber
- ...



Oak Woodland Understory



Species (Subspecies)	Primary Structural Layer ¹			Cavity Nester	Edges ²	Patch Size ³
	Canopy/ Sub-canopy	Shrub/ Midstory	Ground/ Shrub			
Obligate or Near-Obligate						
Acorn Woodpecker	X			X		
Ash-throated Flycatcher	X					
Blue-gray Gnatcatcher						
California Towhee						
Oak Titmouse	X					
White-breasted Nuthatch	X					
Highly Associated						
Bewick's Wren						
Black-capped Chickadee	X					
Black-headed Grosbeak	X					
Black-throated Gray Warbler	X					
Bushtit						
Cassin's Vireo	X					
Chipping Sparrow						
Downy Woodpecker	X					
House Wren		X		X		
Hutton's Vireo		X				X
Lazuli Bunting			X			
Lesser Goldfinch					X	
Lewis's Woodpecker	X			X		
Nashville Warbler		X				
Purple Finch	X					X
Spotted Towhee			X			
Western Bluebird			X	X		
Western Scrub-jay					X	
Western Tanager	X				X	
Western Wood-pewee	X				X	
Oak Savannah/Grassland Associates						
American Kestrel				X		
Lark Sparrow			X			
Vesper Sparrow			X			
Western Kingbird	X					
Western Meadowlark			X			

Table 2. Oak-associated bird species designated as being of conservation concern by the primary wildlife natural resource agencies in the Pacific Northwest

Species (Subspecies)	USFWS ¹	ODFW ²	WDFW ³
Acorn Woodpecker		W	
Blue-gray Gnatcatcher		K	
Chipping Sparrow		W	
Vesper Sparrow (Oregon)	X	KW	P
Lewis's Woodpecker		K	
White-breasted Nuthatch		W	P
Western Bluebird		W	P
Western Meadowlark		W	



John White



Maggie Howard (ca. 1870-1947), AKA Tabuce, Paiute
Courtesy Yosemite Research Library, Yosemite National Park



Photo, Erin Banwell, 2013

Citations

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Acknowledgements and Citations

USDA Natural Resources Conservation Service
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