

The History, Ecology and Future of Eucalyptus Plantations in the Bay Area

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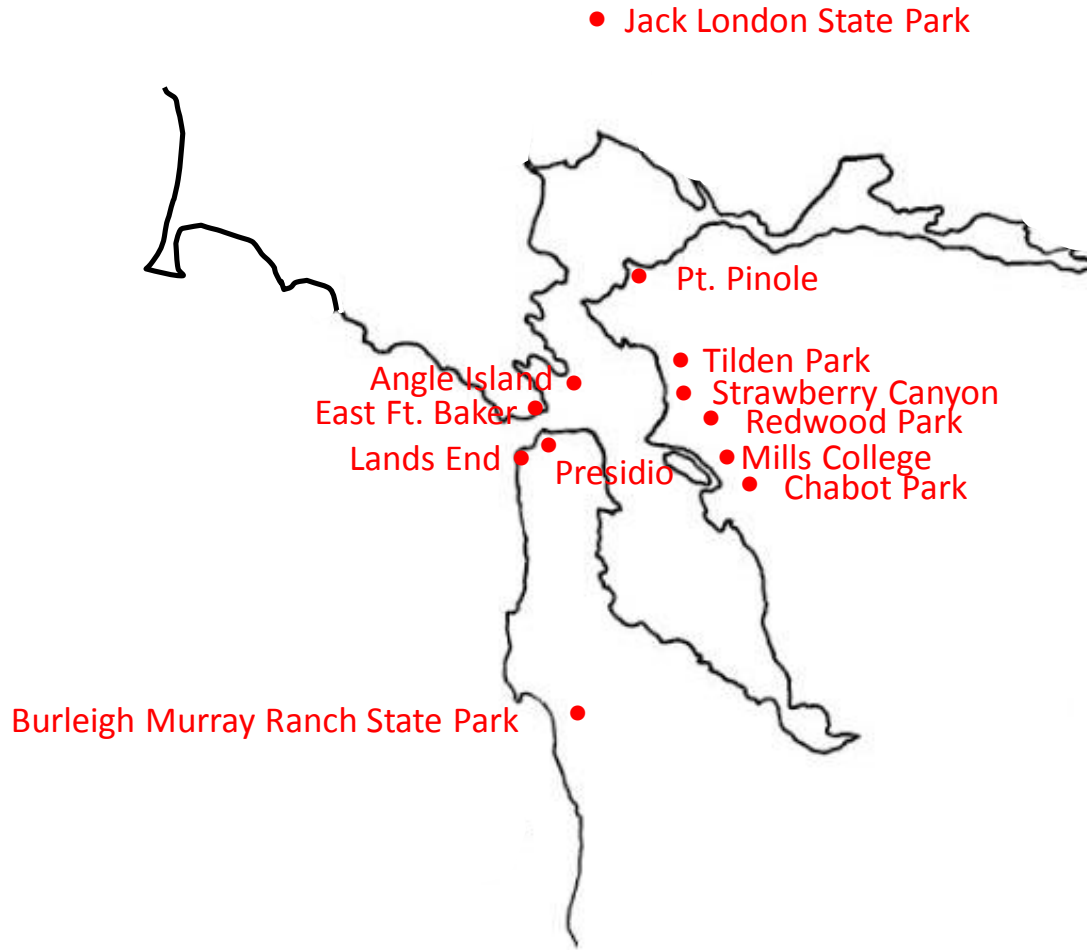
“The Eucalyptus seems an indispensable element of this State’s landscapes, as indigenously Californian as the redwoods, the poppy fields, the long white coastal beaches, the gleaming granite of the High Sierra.”

H. Gilliam, 1965

Overview

1. History of eucalyptus in California
2. Characteristics of eucalyptus plantations
3. Modification of site conditions by eucalyptus
4. Eucalyptus forests as habitat for wildlife
5. Future of eucalyptus plantations in California

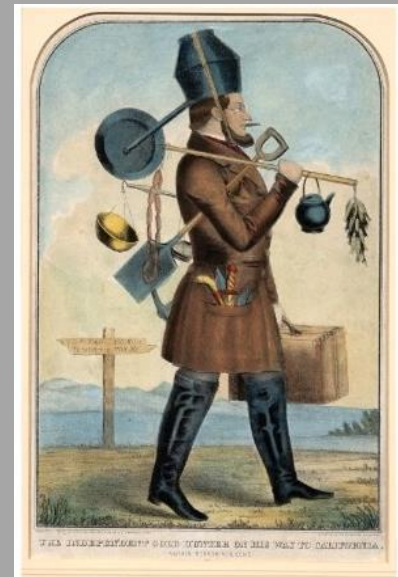
Location of Eucalyptus Study Sites



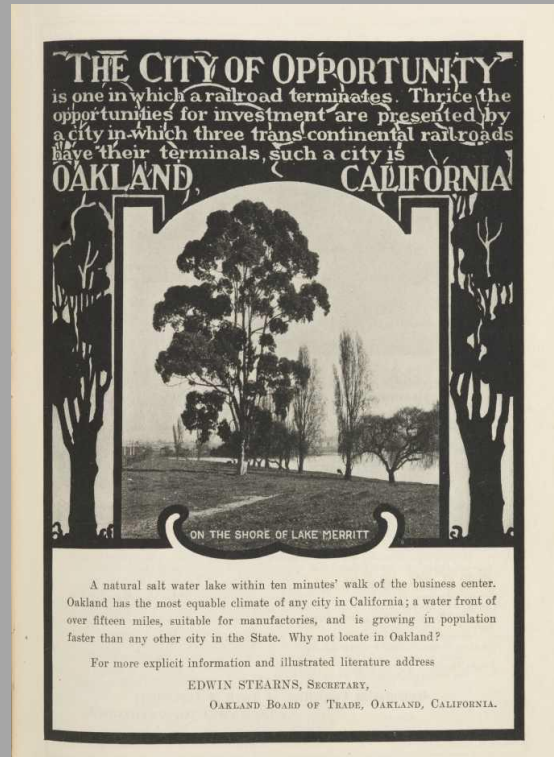
History

- Initial Introduction
- Planting during the 1870s
- Planting from 1906-1913
- Planting in the latter half of the 20th century

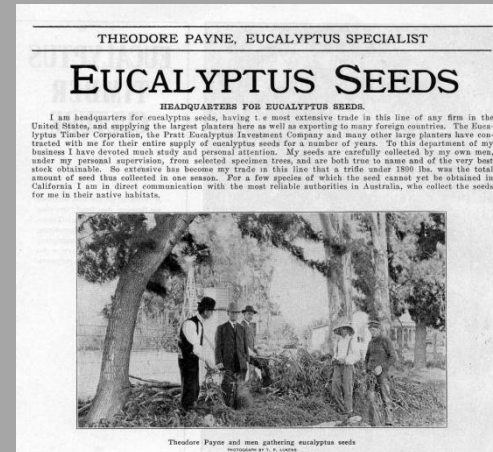
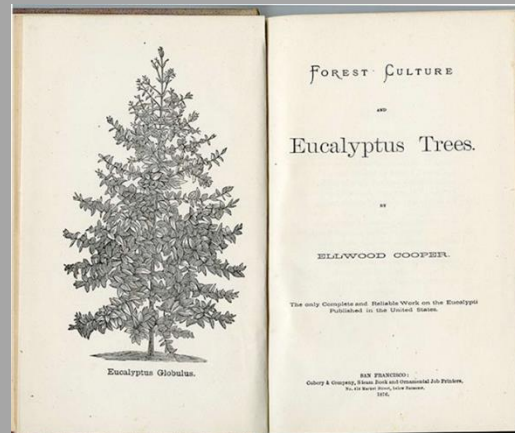
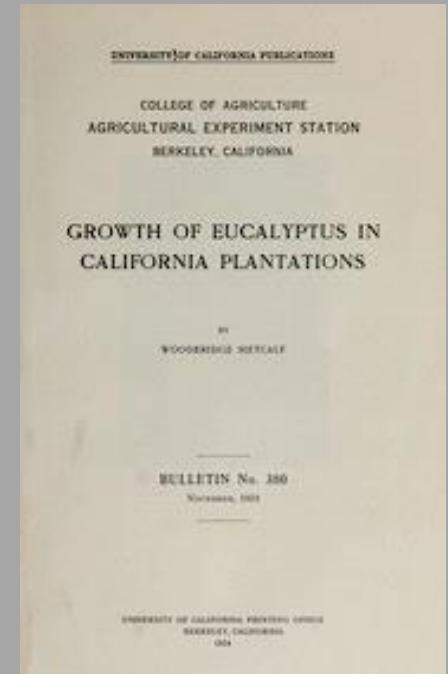
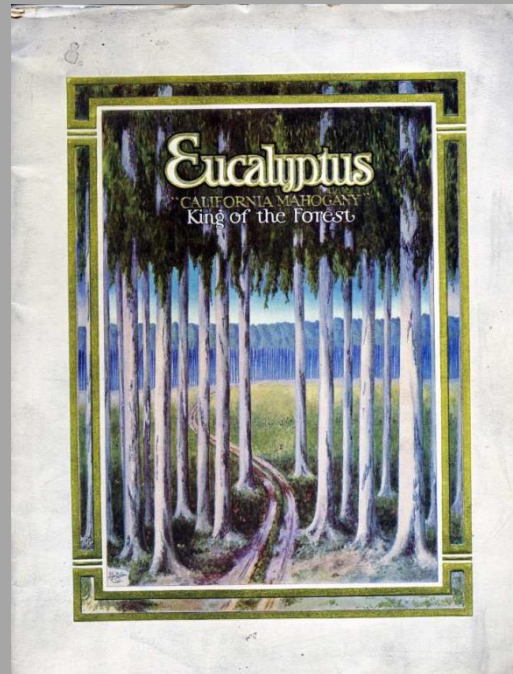
Initial Introduction of Eucalyptus to California



Eucalyptus Planting in the 1870s



Eucalyptus Planting 1906 -1912



Latter Half of the 20th Century

Propagating fast-growing eucalypts for energy crops

Clifford B. Low □ Gary H. Matson □ Roy M. Sachs

High rooting success has been achieved from seedling cuttings



Cuttings are rooted in plastic planting tubes under intermittent misting.



Rooted C-1 eucalyptus stem cutting. Optimizing experimental tree yields.

An advantage of the genetic diversity in present plantings is the variety of trees to choose from for use in cloning. Our present studies have concentrated on red gum (*Eucalyptus camaldulensis*), an easy-to-root, fast-growing species reported to tolerate temperatures down to 20°F (-7°C). These red gums can adapt to a fairly wide range of environmental conditions making them suitable in a large part of California.

by planting of various species at Lodi

Although this response filled the early need, the inherent genetic diversity in these seedlings is greater than is desirable. Trees derived from seedlings selected for uniform initial high growth rates may differ by two- to three-fold in growth rates after transplanting to the field (Table 1).

This difference in growth rate may be compensated during the rearing period after a harvest, the stronger trees get stronger and the weaker trees weaker. With the eventual loss of the weaker trees, gaps begin to form in the plantation, which may reduce the yield potential with a short-rotation harvest schedule.

Clonal material has been suggested to replace seedlings and reduce genetic variability. Clones can be developed through cut or stem or from portions of aerial propagation, but rooting of stem cuttings is still considered the most economical. Although eucalyptus trees have the reputation of being difficult to root, success has been achieved in rooting cuttings taken from seedlings of many eucalyptus species. Frech et al. (1982), a French forest industrial firm, was able to root cuttings taken from seedlings of 20 species, but many became extremely difficult to root shortly after the seedling stage of development. Of more practical value, young leafy shoots (epicotylous shoots) developing from cut stumps or below stem girdles of adult trees have been successfully rooted. Hannon (1979) eucalyptus species, including many candidate species for biomass plantations, that have been rooted from eucalyptus epicotylous shoots, or both (V. J. Hannon, in: *Australian Forestry Research* 18:193-211, 1981).

Source plants

Another source of material comes from trees fast-growing, 18-month-old trees of a hybrid, *E. camaldulensis* x *rupestris* (C-1) and (C-2) on the Delta campus. Most seedlings from this source have proved successful in producing seedlings. Leaves are required for seedling material. Leaves are required for seedling material. Leaves are required for seedling material.

TABLE 1. Variation in tree growth of three seedling eucalyptus plant seedlings selected originally for uniform growth rate.

Species	Range	
	From growth rate	Mean
<i>Eucalyptus camaldulensis</i>	3,254.00	428
<i>E. camaldulensis</i>	3,004.00	367
<i>E. camaldulensis</i>	1,514.00	210
<i>E. camaldulensis</i> x <i>rupestris</i>	1,753.00	302
<i>E. camaldulensis</i>	1,753.00	302
<i>E. camaldulensis</i>	1,004.00	128
<i>E. camaldulensis</i>	1,004.00	128
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Three seedlings, three measurements at 18 months. Trees approximately 1.5 years old and 1.5 m tall. Data from Lodi.

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Trees from eucalyptus seedlings originally selected for uniformity may differ by two- or three-fold after transplanting because of genetic diversity.

United States
Department of
Agriculture

Forest Service

Pacific Southwest
Forest and Range
Experiment Station

Research Paper
FPM-152

Tests of 36 *Eucalyptus* Species in Northern California

James P. King

Stanley L. Krugman



Seven-year performance of eucalyptus species in Napa County

Dean R. Donaldson □ John W. LeBlanc □ Richard B. Standford
Sheri Gallagher □ Charles J. Jourdan □ George E. Miller

Eucalyptus

Eucalyptus was promoted in the early 1900s as the "miracle tree" that would solve wood fiber supply problems in California. Early plantings were intended to be a primary source of lumber, railroad ties, and mining timbers. People began to sour on the eucalyptus "miracle tree" when it was found that eucalyptus was subject to excessive rooting that prevented it from being used for lumber.

At the end of the mid-1970s interest in eucalyptus in on people hoping to use it for pulp and paper. Eucalyptus seedlings of the two species were planted in April 1979 near Calistoga, at the northern end of the Napa Valley. The seedlings were planted on a 5- by 5-foot spacing at a density of 1,742 stems per acre. They were grown in a clay loam soil and were sprinkler-irrigated throughout the seven-year trial to prevent moisture stress. For the first three years, chemical weed control (Surflan [oryzalin]) at 3 pounds active ingredient per acre was applied annually. The trees were fertilized with 200 pounds of actual nitrogen per acre per year.

All surviving trees were measured every two years from planting and again at the final harvest in July 1986. Diameter at breast height (a point 4.5 feet above the ground) and total height were measured. Diameter was also measured along the stem in the second year and at harvest to calculate stem taper and volume. Measured trees were selected from interior blocks of the test plots to avoid an edge effect.

Ten percent of the harvested trees were selected at random for additional measurements. Stem taper fresh weights with and without branches and wood samples were recorded. Wood disk samples of the stem were taken at 2, 25, and 40 feet for wood moisture content and specific gravity determination. Using these data, we developed tree volume and weight equations and used them to calculate yields per acre.

At the time, most pertained to *Eucalyptus*, the species most in California. Other individuals of certain species for increased tree growth rates, and for properties for use as

domestic (river red gum) (mountain gum) were in trials from the best. Both species are easy to grow, have a rapid growth rate, and are able to survive in the wide range of conditions found

in California. The final results of the study with *E. camaldulensis* and *E. dalympiana*. Inter-pretations in California since 1982 and March

Methods

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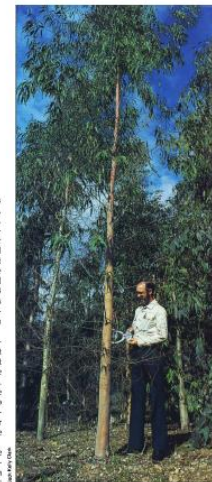
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One eucalyptus species, grown under intensive management in the Napa Valley, in 7 years produced an average of 10 cords of usable wood per acre per year. Author Dean Donaldson measured the DBH (diameter at breast height) halfway through the project.

Results

Of the surviving trees, *E. camaldulensis* showed significantly greater growth than *E. dalympiana* (table 1). At 75 months, the standing trees were measured with a diameter. At 86 months, the harvested trees were measured with a steel tape along the stem. The trees gained little height overall between the two periods.

Eucalyptus camaldulensis also had greater survival and larger yields per acre than *E. dalympiana* (table 2). All mortality occurred within the first two years. The growth rate for the *E. camaldulensis* trees, calculated as the average amount of wood produced per acre per year, appeared to level off near 850 cubic feet. This

Major Species of Eucalyptus Planted in California



Blue Gum



Red Gum



Sugar Gum



Red Ironbark

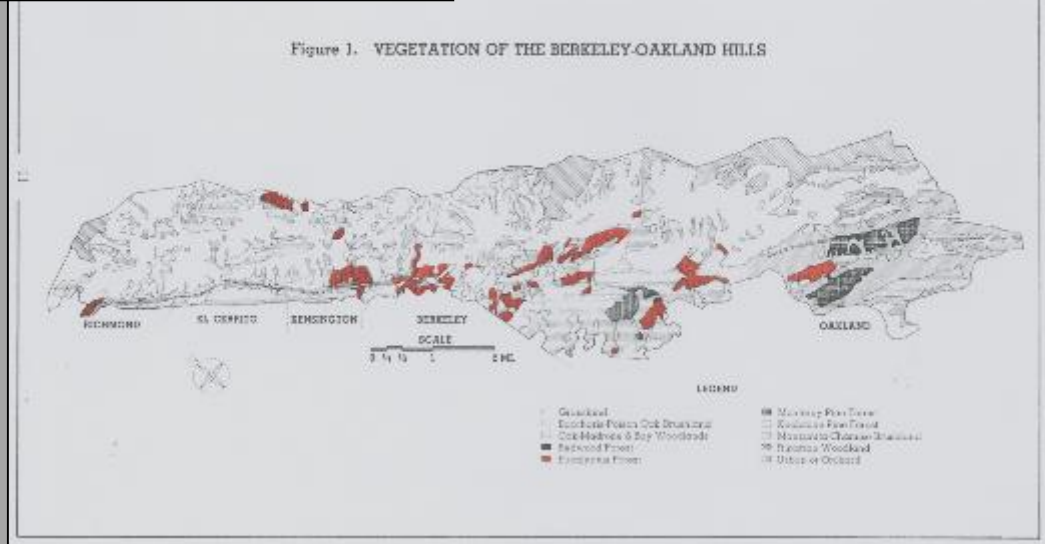


Silver Dollar



Lemon Scented

Distribution of Blue Gum Eucalyptus



Characteristics of Eucalyptus Plantations



Structural Characteristics

Location	Number of Stands	Ave. Stand Area (ac.)	Ave. Max. Height (ft.)	Ave. Max. Diameter (in.)	Ave. Number of trees/acre
Presidio	28	3.7	80	26	163
Land's End	4	2.3	75	26	364
Tilden Park	5	0.7	60	16	540
East Ft. Baker	1	8.1	50	36	1795



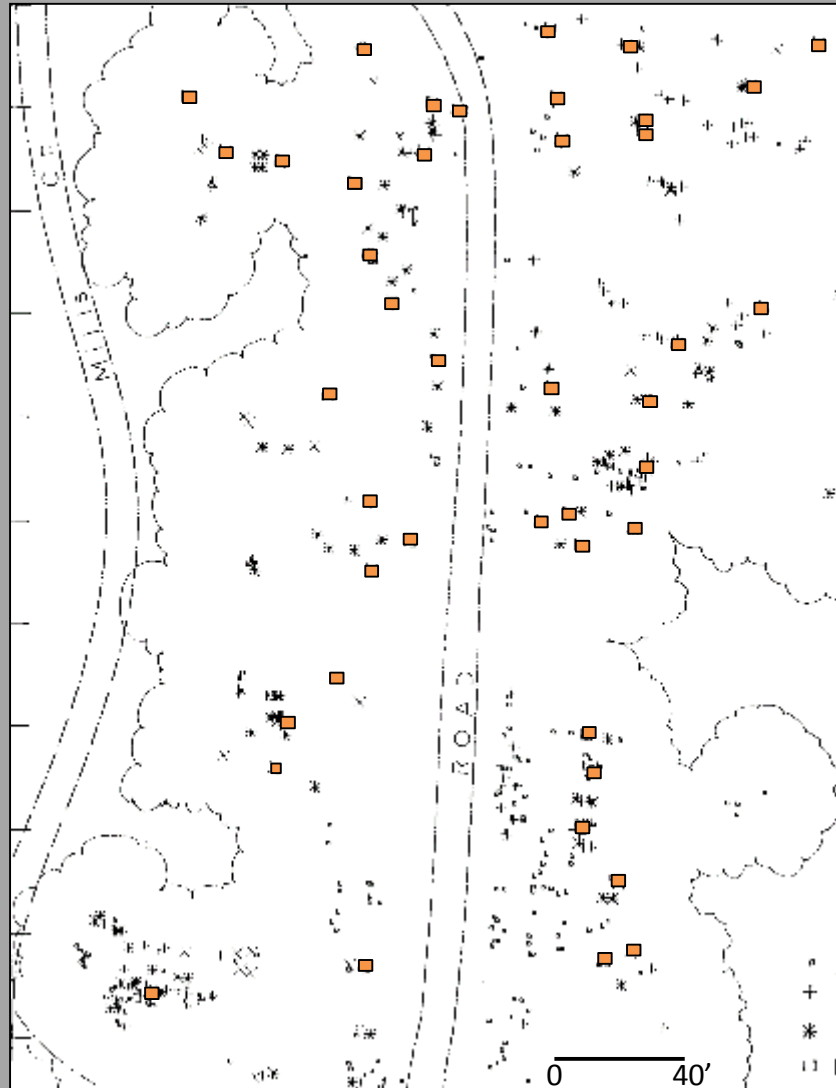
Initial Spacing of Trees in Plantations

(Angel Island State Park)

Plantation Number	Tree Spacing	Trees/Acre
6	8 x 8	680
9	8 x 8	680
10	8 x 8	680
11	8 x 8	680
15	8 x 8	680
1	12 x 12	302
16	12 x 12	302
3	15 x 15	193
12	15 x 15	193
13	25 x 25	70
2	30 x 30	48
5	30 x 30	48
7	30 x 30	48
Average	14 x 14	349
Modal	8 x 8	680

Diameter Distribution of Eucalyptus along Mill Creek

(Burleigh Murray Ranch State Park)



Size Class

- I. ht < 4'8" or dbh ≤ 0.2"
- + II. 0.2" < dbh ≤ 6"
- * III. 6" < dbh ≤ 18"
- IV. 18" < dbh ≤ 36"

<u>Size Class</u>	<u>Density per Acre</u>
I	57
II	27
III	25
IV	17

Species Composition of Eucalyptus Plantations



FAMILY	SCIENTIFIC NAME	COMMON NAME
Amaryllidaceae	<i>Brodiaea puchella</i>	Blue dicks
Anacardiaceae	<i>Toxicodendron diversiloba</i>	Poison oak
Apiaceae	<i>Heracleum lanatum</i>	Cow parsnip
	<i>Sanicula crassicaulis</i>	Snakeroot
Boraginaceae	<i>Cynoglossum occidentale</i>	Hound's tongue
Brassicaceae	<i>Brassica nigra</i>	Black mustard
Caprifoliaceae	<i>Lonicera hispidula</i>	California honeysuckle
	<i>Sambucus caerulea</i>	Blue elderberry
	<i>Symphoricarpus mollis</i>	Snowberry
Compositae	<i>Artemisia douglasiana</i>	California mugwort
	<i>Aster radulinus</i>	Broad-leaf aster
	<i>Cirsium vulgare</i>	Bull thistle
	<i>Solidago californica</i>	California goldenrod
Curcubitaceae	<i>Marah fabaceus</i>	Wild cucumber
Euphorbiaceae	<i>Euphorbia helioscopia</i>	Wartweed
Fagaceae	<i>Quercus agrifolia</i>	Coast live oak
Graminae	<i>Avena fatua</i>	Wild oat
	<i>Bromus diandrus</i>	Ripgut
	<i>Bromus mollis</i>	Soft chess
	<i>Cynosurus echinatus</i>	Dogtail
	<i>Elymus glaucus</i>	Blue wild-rye
Iridaceae	<i>Sisyrinchium bellum</i>	Blue-eyed grass
Labiatae	<i>Mentha pulegium</i>	Pennyroyal
	<i>Mentha arvensis</i>	Field mint
	<i>Stachys bullata</i>	California hedge nettle
	<i>Stachys rigida</i>	Hedge nettle
Lauraceae	<i>Umbellularia californica</i>	Bay
Leguminosae	<i>Lathyrus vestitus</i>	Hillside pea
	<i>Lupinus albifrons</i>	Lupine
	<i>Vicia americana</i>	American vetch
	<i>Vicia sativa</i>	Spring vetch
Plantaginaceae	<i>Plantago lanceolata</i>	English plantain
Polygonaceae	<i>Rumex pulcher</i>	Fiddle dock
Rosaceae	<i>Fragaria californica</i>	Wood strawberry
	<i>Rubus ursinus</i>	California blackberry
Solanaceae	<i>Solanum nigrum</i>	Black nightshade
Umbelliferae	<i>Conium maculatum</i>	Poison hemlock
Crucifereae	<i>Dentaria californica</i>	Milkmaids

Eucalyptus Understory Plant Species Survey (Tilden Park – 1990)

Summary

Number of Families = 21
Number of Genera = 34
Number of Species = 38

FAMILY	SCIENTIFIC NAME	COMMON NAME
Amaryllidaceae	<i>Brodiaea puchella</i>	Blue dicks
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	<i>Sambucus caerulea</i>	Blue elderberry
	<i>Symphoricarpus mollis</i>	Snowberry
	<i>Artemisia douglasiana</i>	California mugwort
Compositae	<i>Aster radulinus</i>	Broad-leaf aster
	<i>Cirsium vulgare</i> *	Bull thistle
	<i>Solidago californica</i>	California goldenrod
	<i>Marah fabaceus</i>	Wild cucumber
Curcubitaceae	<i>Euphorbia helioscopia</i> *	Wartweed
Euphorbiaceae	<i>Quercus agrifolia</i>	Coast live oak
Fagaceae	<i>Avena fatua</i> *	Wild oat
Graminae	<i>Bromus diandrus</i> *	Ripgut
	<i>Bromus mollis</i> *	Soft chess
	<i>Cynosurus echinatus</i> *	Dogtail
	<i>Elymus glaucus</i>	Blue wild-rye
	<i>Sisyrinchium bellum</i>	Blue-eyed grass
Iridaceae	<i>Mentha pulegium</i> *	Pennyroyal
Labiatae	<i>Mentha arvensis</i> *	Field mint
	<i>Stachys bullata</i>	California hedge nettle
	<i>Stachys rigida</i>	Hedge nettle
	<i>Umbellularia californica</i>	Bay
Lauraceae	<i>Lathyrus vestitus</i>	Hillside pea
Leguminosae	<i>Lupinus albifrons</i>	Lupine
	<i>Vicia americana</i>	American vetch
	<i>Vicia sativa</i> *	Spring vetch
	<i>Plantago lanceolata</i> *	English plantain
Plantaginaceae	<i>Rumex pulcher</i> *	Fiddle dock
Polygonaceae	<i>Fragaria californica</i>	Wood strawberry
Rosaceae	<i>Rubus ursinus</i>	California blackberry
	<i>Solanum nigrum</i> *	Black nightshade
Solanaceae	<i>Conium maculatum</i> *	Poison hemlock
Umbelliferae		
Cruciferae	<i>Dentaria californica</i>	Milkmaids

Introduced Species Eucalyptus Understory Plant Species Survey (Tilden Park – 1990)

Summary

Number of Families = 21

Number of Genera = 34

Number of Species = 38

Native to California = 24

*Introduced to California = 14

Comparison of Species composition of Eucalyptus with Oak Woodland

(Tilden Park – 1990)

Eucalyptus Plantation

Number of Families = 21

Number of Genera = 34

Number of Species = 38

Native to California = 24

Introduced to California = 14

Oak Woodland

Number of Families = 16

Number of Genera = 19

Number of Species = 19

Native to California = 14

Introduced to California = 5

Plant Species Richness in Eucalyptus Plantations and Oak Woodlands

<u>Location</u>	<u>Habitat</u>	<u>Vegetation Type</u>	<u>Number of Species</u>
Tilden Park ¹	Upland	Eucalyptus	21
		Oak Woodland	12
Tilden Park ²	Upland	Eucalyptus	38
		Oak Woodland	21
Murray Park ³	Riparian	Eucalyptus	34
		Riparian Woodland	58

1 = Jewell Lake (Contra Costa County); 2 = Golf Course Road (Contra Costa County); 3 = San Mateo County, near Half Moon Bay

Understory Conditions and the Establishment of Plant Species



South Facing Slope
Edge Site: 15 species
Interior Site: 15 species



North Facing Slope
Edge Site: 8 species
Interior Site: 8 species

Variation in Understory Species in Eucalyptus Plantations

Understory Species beneath Eucalyptus Canopy

(Tilden Park - March 19, 2014)

Species	South Facing Slope		North Facing Slope	
	Edge	Interior	Edge	Interior
Bedstraw (<i>Gallium aparine</i>)	•	•	•	•
California Bay (<i>Umbellularia californica</i>)	•	•	•	•
California blackberry (<i>Rubus ursinus</i>)	•	•	•	•
Chickweed (<i>Stellaria media</i>)	•	•	•	•
Coast Live Oak (<i>Quercus agrifolia</i>)	•	•	•	•
Purser oak (<i>Toxicodendron diversiloba</i>)	•	•	•	•
Wild cucumber (<i>Morah fabaceus</i>)		•		•
Annual grass (<i>Poaceae</i>)	•	•		
Cotoneaster (<i>Cotoneaster sp.</i>)	•	•		
Coyote brush (<i>Baccharis pilularis</i>)	•	•		
Millmaids (<i>Dentaria californica</i>)	•	•		
Snakeroot (<i>Sanicula crassicaulis</i>)	•	•		
Snowberry (<i>Symphoricarpos mollis</i>)	•	•		
Checker bloom (<i>Sidalcea malvaeflora</i>)	•			
French Broom (<i>Genista monspessulana</i>)	•			
Wood Rose (<i>Rosa gymnocarpa</i>)	•			
Hedge Nettle (<i>Stachys rigida</i>)		•		
Tayon (<i>Heteromeles arbutifolia</i>)		•		
California Polypody fern (<i>Polypodium californicum</i>)			•	
Giant periwinkle (<i>Viola major</i>)			•	
English ivy (<i>Hedera helix</i>)				•

Ubiquitous Understory Species



California Bay



Coast Live oak



Poison Oak



California Blackberry



Bedstraw



Chickweed

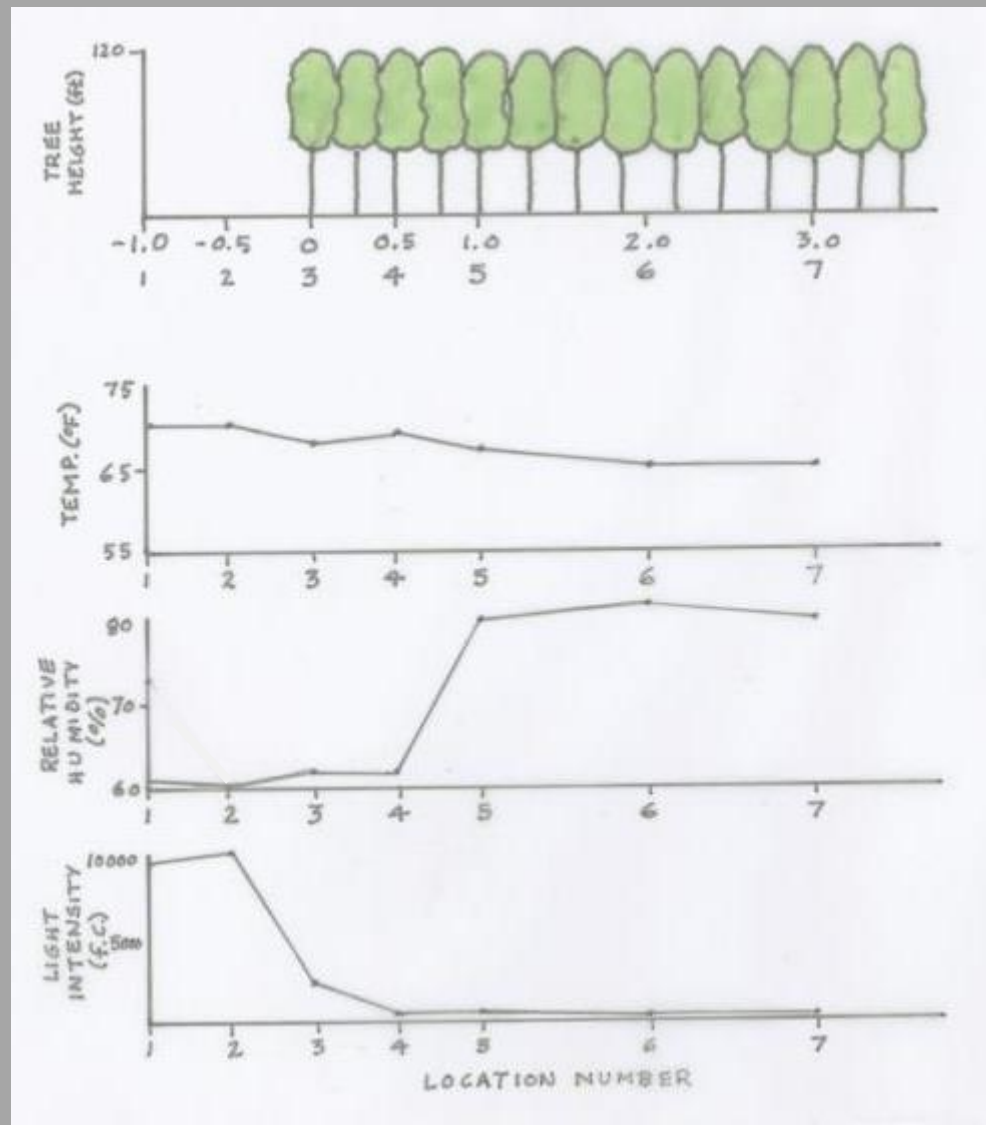
Modification of Site Conditions by Eucalyptus

- Microclimate
- Soil
- Streams



Effects of Eucalyptus Plantation on Microclimate

(Tilden Park, 2101)



Eucalyptus Modification of Grassland Microclimates

(Presidio)

<u>Factor</u>	<u>Modification under Eucalyptus</u>
Temperature (day)	- 10%
Temperature (night)	+ 5%
Relative Humidity	+ 5%
Light Intensity	- 90%
Wind Velocity	- 40%
Precipitation	- 12%
Fog Drip	+ 300%

Effects of Eucalyptus on Soil Characteristics

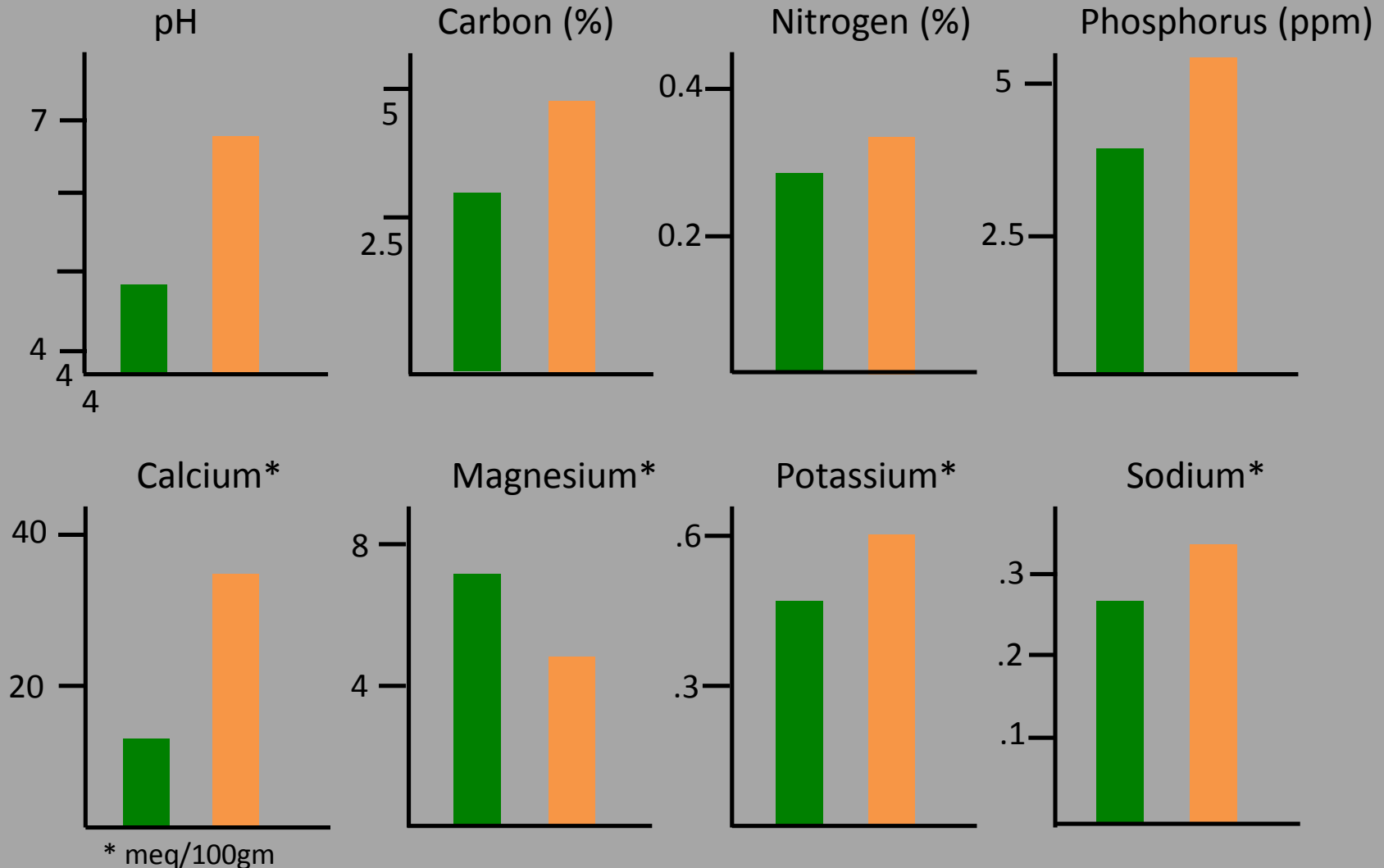


Effects of Eucalyptus on Soil Characteristics

(Zinke *et al*, 1988)

Grassland

Eucalyptus



Allelopathic Effects of Eucalyptus

Reprinted from *MADROÑO*, Volume 18, Number 7, July 1966

VOLATILE GROWTH INHIBITORS PRODUCED BY *EUCALYPTUS GLOBULUS*

HERBERT G. BAKER

The possibility that plants of some species gain advantage in natural competition by the excretion of substances (exocrines or ectocrines) inhibitory to the growth of their potential neighbors is under investigation in a number of laboratories. Among these investigations, the studies by Muller and his co-workers on volatile substances produced by aromatic shrubs have aroused considerable interest. Working particularly with *Salvia* and *Artemisia* they have shown that volatile terpenes from the leaves may inhibit root-growth of *Cucumis* seedlings placed in a closed container with them (Muller, Muller, and Haines, 1964). They have also demonstrated the presence of these terpenes in the air surrounding these shrubs in nature (Muller and Muller, 1964; Muller, 1965) and have postulated how they may enter the cells of victimized seedlings through solution in cuticular lipids (Muller, 1965).

The simplicity of the experimental set-up used by these workers in their demonstration of root-growth inhibition by volatile substances from shredded *Salvia* leaves suggested that this might form a suitable class exercise in an ecology course. Consequently, it was tried with the Evolutionary Plant Ecology course at the University of California, Berkeley, in the spring semester of 1964, with subsequent additional experiments which have been facilitated by National Science Foundation Research Grant No. G 21821. I am indebted to Charles Quibell who carried out the extra experiments, meantime making very valuable suggestions regarding technique.

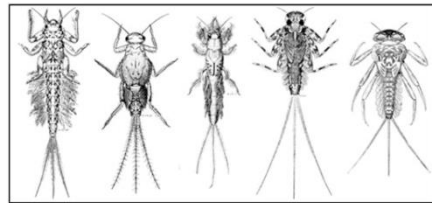
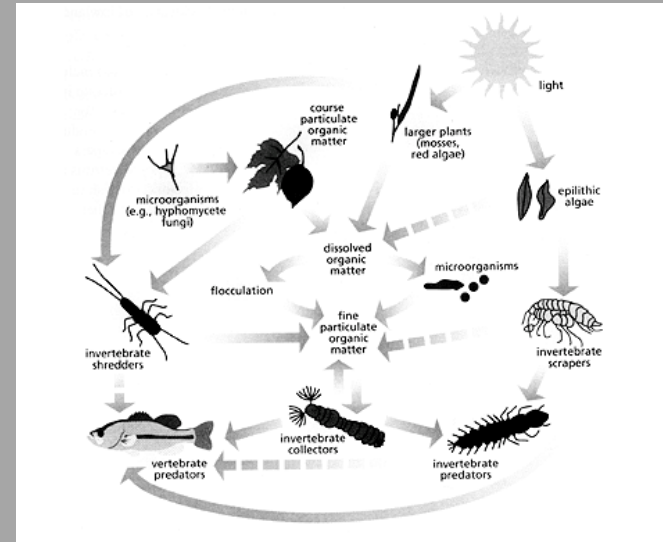
Results obtained by the class were variable until the experimental design was fully standardized. The chambers and contents (fig. 1) were modeled after the setup described in Muller, Muller and Haines (1964). The seeds of *Cucumis sativus* L. were soaked in distilled water for 2 hours and then placed in position on the moist filter paper in the chambers. The glass lid to each chamber was fixed in place with petrolatum. The chambers were then kept together in the dark at 26.7°C (80°F) usually for 48 hours before measurements of root-growth were made. Only main roots were measured, laterals being ignored. The very few ungerminated seeds were also left out of account.

The availability of a small introduced population of *Salvia apiana* Jeps. on Grizzly Peak, Berkeley, enabled the results in Table 1A to be obtained. The differences between controls and test growths are all significant at the 1% level, confirming the findings of Muller et al.

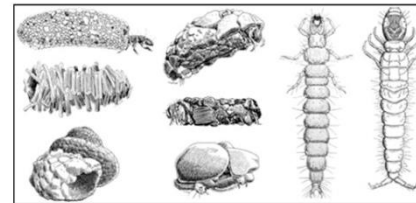
However, it seemed likely that some other, more abundant local source of exocrines could be found. In the vicinity of Berkeley there are numerous plantations of *Eucalyptus globulus* Labill. under which very few



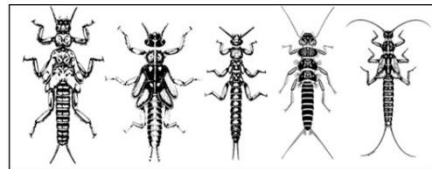
Eucalyptus Litter and Stream Insects



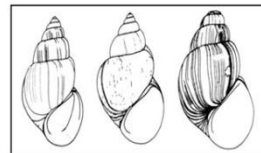
Mayflies



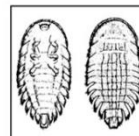
Caddisflies



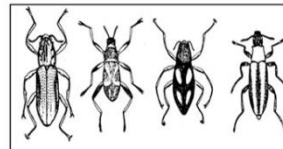
Stoneflies



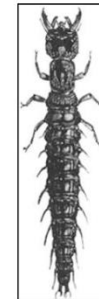
Gilled Snails



Water Pennies



Riffle Beetles



Dobsonflies

Eucalyptus Litter and Stream Insects

(Lacan, Resh, and McBride, 2009)

<u>Litter Type</u>	<u>Annual Input</u>	<u>Decomposition</u>	<u>Macroinvertebrate</u>
Eucalyptus	950 gm/m ² /yr	0.0193 gm/day	species richness species diversity pollution tolerance
Native Riparian	669 gm/m ² /yr	0.0134 gm/day	



no significant difference

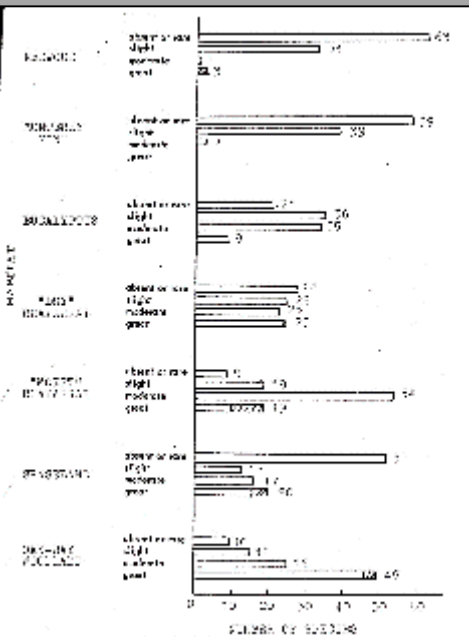
Wildlife Habitat Value of Eucalyptus Plantations



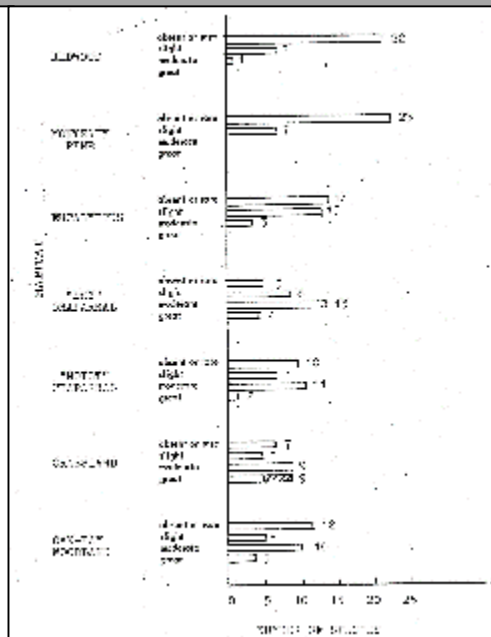
Use of Habitats in the East Bay Regional Parks

(Stebbins, 1978)

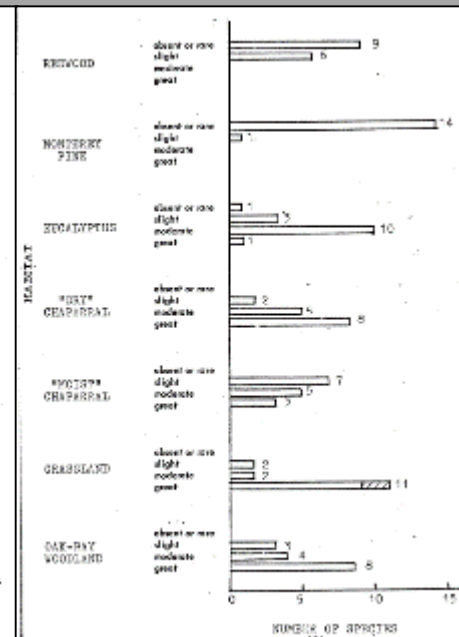
Birds



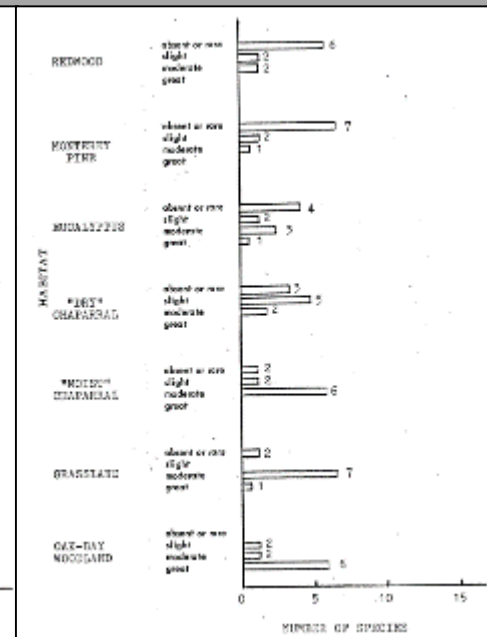
Mammals



Reptiles

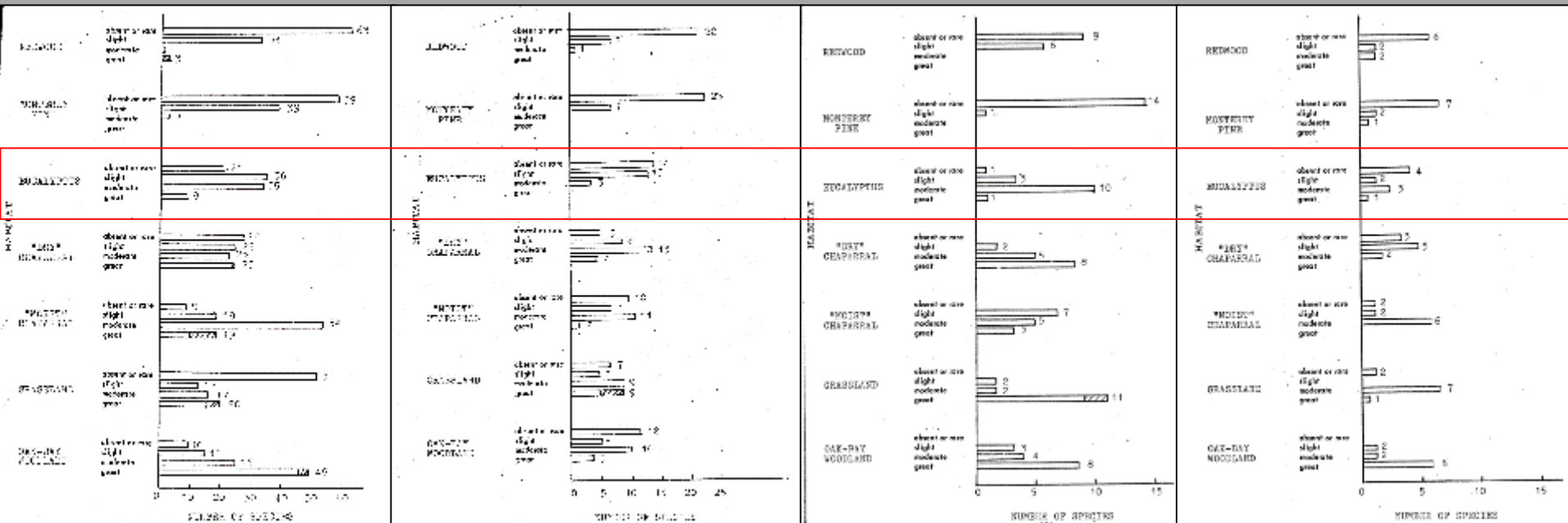


Amphibians



(Stebbins, 1978)

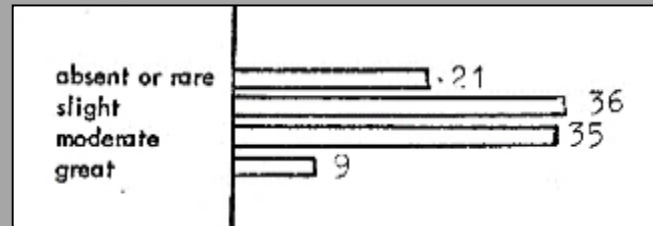
Amphibians



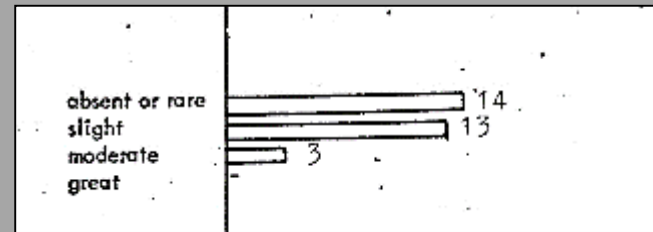
Use of Eucalyptus in the East Bay Regional Parks

(Stebbins, 1978)

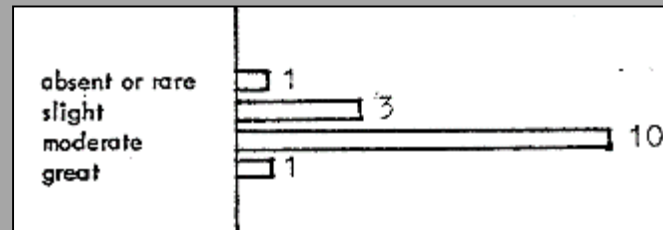
Birds



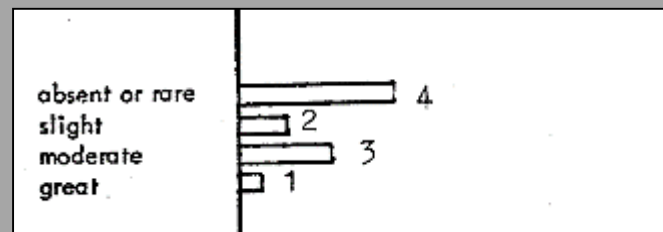
Mammals



Reptiles



Amphibians



Birds making “great” use of Eucalyptus habitat



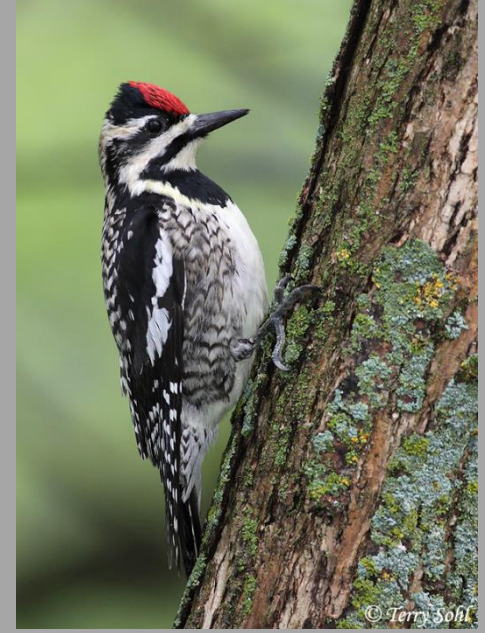
Mourning Dove



Great Horned Owl



Steller Jay



Yellow-bellied Sapsucker



Allen Hummingbird



Olive-sided Flycatcher



Brown Creeper



Dark-eyed Junco



Audubon Warbler

Reptiles and Amphibians making “great” use of Eucalyptus habitat



Southern Alligator Lizard



Slender Salamander

Small Mammal Use of Eucalyptus Plantations

(Tilden Park, 1990)

Number of Animals Captured*

<u>Vegetation Type</u>	<u>Deer Mouse</u>	<u>California Meadow Mouse</u>
Eucalyptus	35	0
Grassland	3	1

(*200 trap nights)



Deer Mouse
(*Peromyscus maniculatus*)

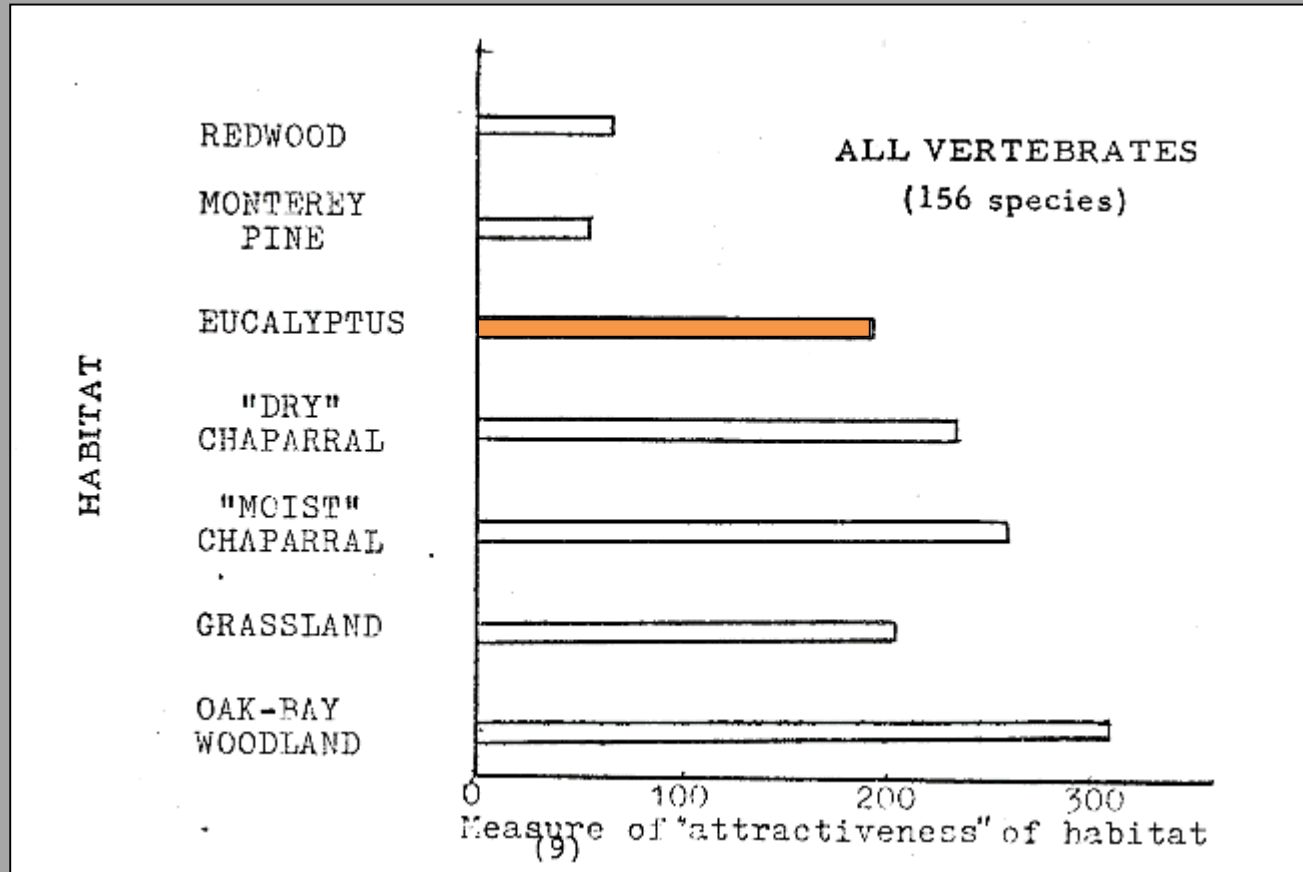


California Meadow Mouse
(*Microtus californicus*)

Attractiveness of Habitats in the East Bay Regional Parks

(Stebbins, 1978)

All Species Making Use of Habitat



Use of Eucalyptus Plantations by Insects



Eucalyptus and Monarch Butterflies



Site	County	Number	Tree
Presidio Park	San Diego	900	Eucalyptus
UCSD	" "	4,500	Eucalyptus
Hosp Grove	" "	900	Eucalyptus
Doheny Grove	Orange	1,000	Not specified
Huntington Central Park	" "	3,500	Eucalyptus
Norma Gibbs Park	" "	700	Not specified
Leo Carrillo State Beach	Los Angeles	800	Eucalyptus
Camino Real Park	Ventura	10,000	Eucalyptus
Harbor Boulevard	" "	23,000	Eucalyptus
Ellwood Main	Santa Barbara	85,000	Not specified
Tecolote Canyon	" " "	22,000	Eucalyptus
Refugio State Beach	" " "	2,500	Palm & Eucalyptus
Oceano Campground	San Luis Obispo	20,000	Monterey cypress
Pismo State Beach	" " "	110,000	Not specified
Los Osos, Sweet Springs	" " "	8,000	Not specified
Andrew Molera State Park	Monterey	10,000	Eucalyptus
Pacific Grove	" "	45,000	Monterey pine
Lighthouse Field State Beach	Santa Cruz	50,000	Monterey cypress & Eucalyptus
Natural Bridges State Beach	" "	95,000	Not specified
New Park Mall	Alameda	500	Eucalyptus
Ardenwood Regional Reserve	" "	20,000	Eucalyptus
San Leandro Golf Course	" "	25,000	Eucalyptus
Muir Beach	Marin	4,000	Monterey cypress
Bolinas Terrace	"	18,000	Not specified
Bodega Dunes Campground	Sonoma	400	Eucalyptus & Monterey cypress

Eucalyptus Longhorned Borer

(*Phorocantha semipunctata*)



Parasitic Wasp of Eucalyptus Longhorned Borer

(*Avetianella longoi*)



Red Gum Lerp Psyllid



UC Berkeley entomologist Don Dahlsten counts the number of red gum lerp psyllids, a new eucalyptus pest, on river red gum foliage in Ardenwood Park, Alameda County.

Scientists have released *Psyllaephagus bliteus* (shown next to white lerp cover) and are monitoring to see if the parasitic wasp controls red gum lerp psyllid.



Jack Kelly Clark



Jack Kelly Clark

The life stages of red gum lerp psyllid. Clockwise from bottom: eggs, late instar, white cover and adult.

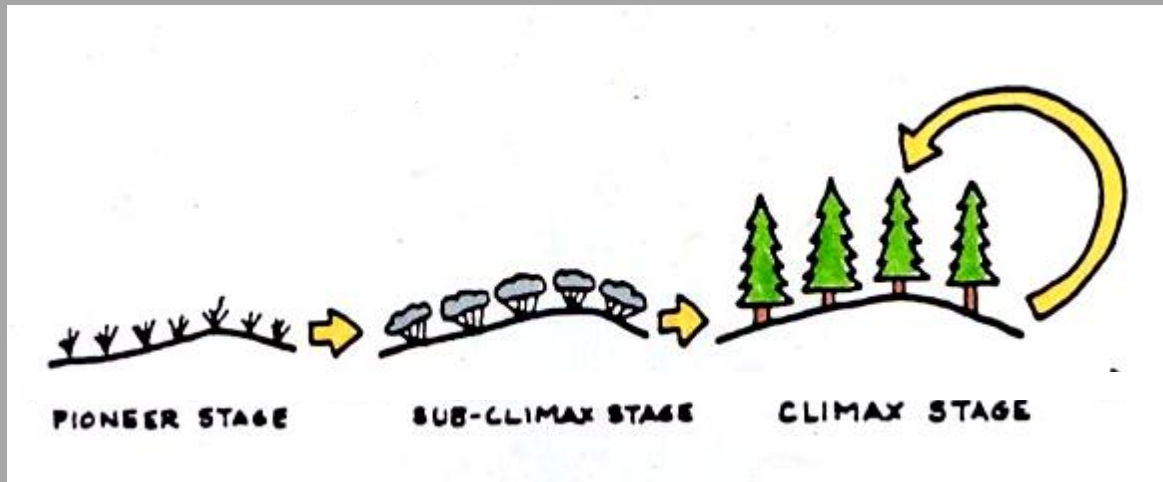
Future of eucalyptus plantations in the San Francisco Bay Area

- Successional change
- Invasion of adjacent vegetation types
- Potential impacts of naturalized pest species

Plant Succession in Eucalyptus Plantations

- Concept of succession
- Current trends in the understory of Eucalyptus plantations

Plant Succession



Plant Succession in Eucalyptus Plantations



Coast Live oak



California Bay



Comparative Shade Tolerance



<u>Species</u>	<u>Shade Tolerance</u>
Eucalyptus	intolerant
Coast Live Oak	tolerant
California Bay	very tolerant

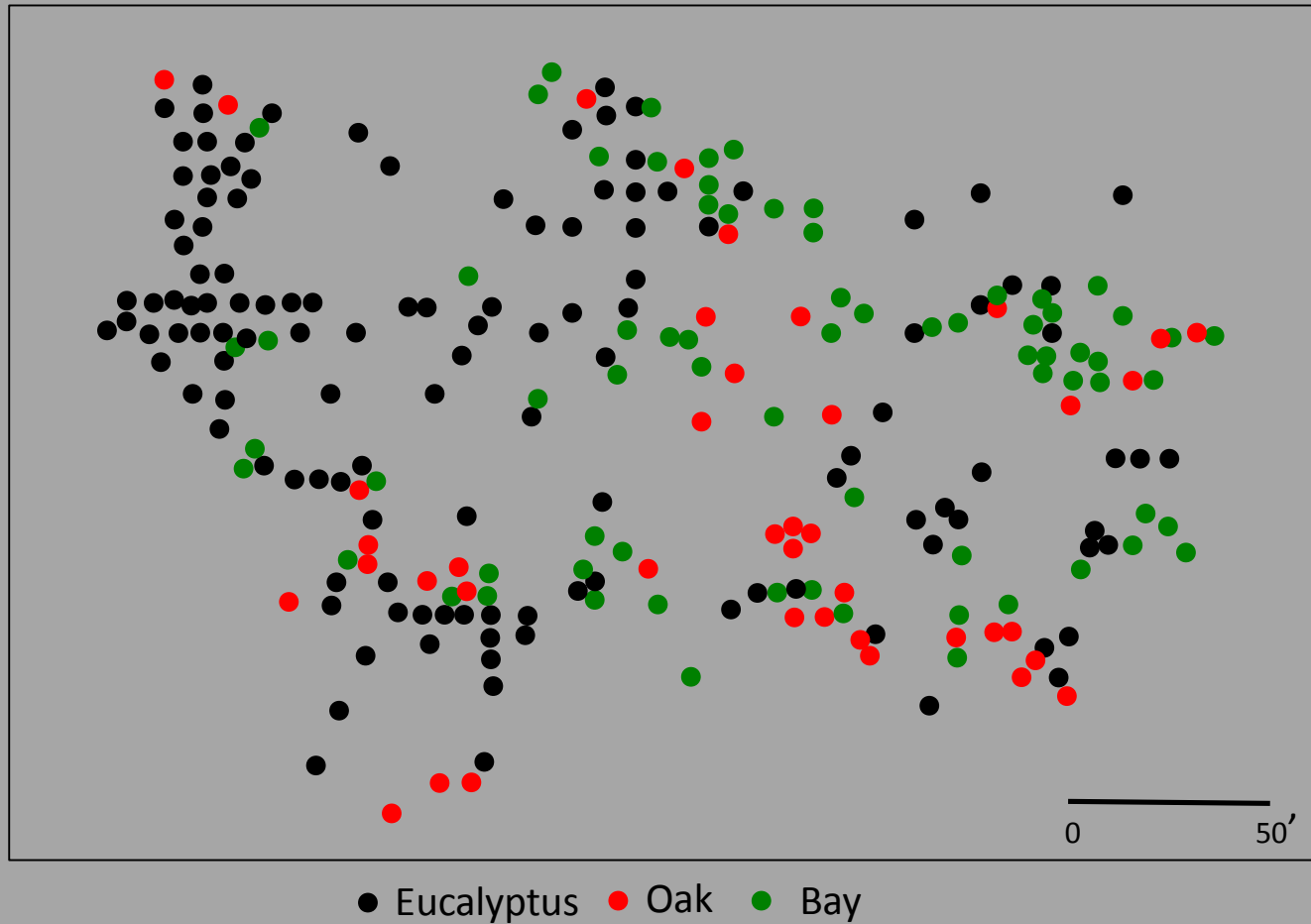
Oak and Bay in Understory of Eucalyptus

(Tilden Park)



Occurrence of Oak and Bay in Eucalyptus Understory

(Tilden Park, 1990)

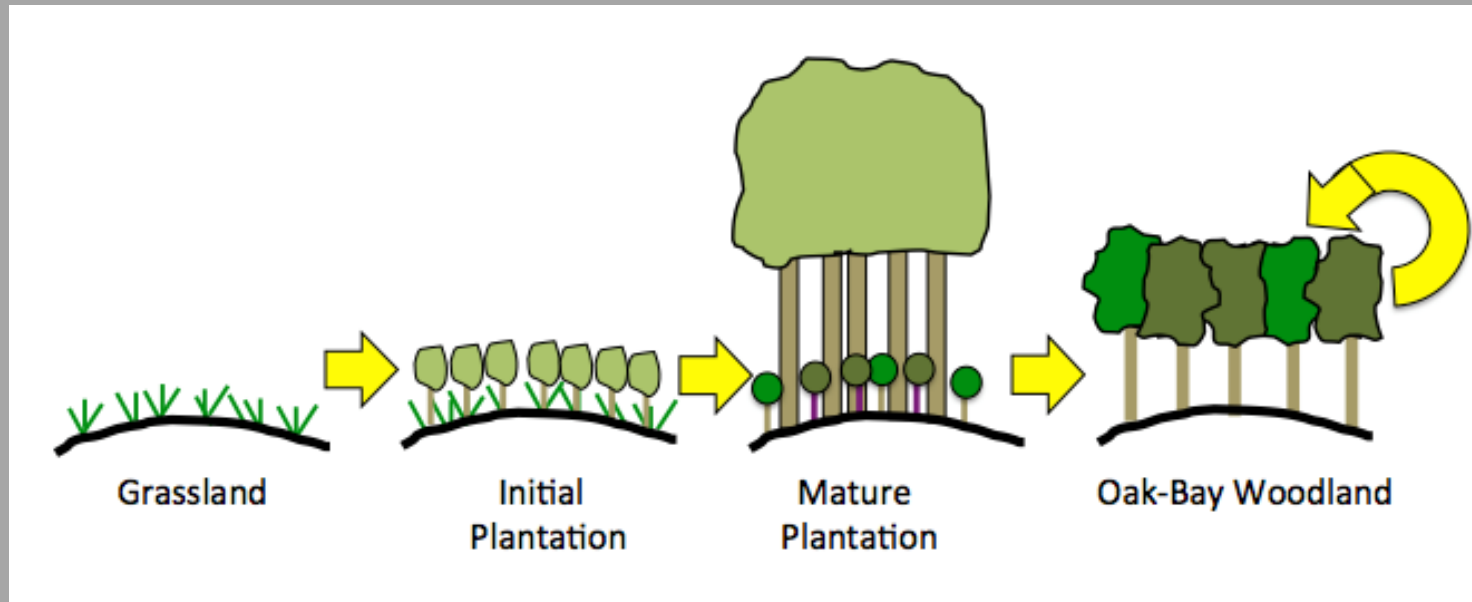


Oak and Bay Trees in Eucalyptus Plantations

(Tilden Park, 1990)

Stand Number	Number of Trees per Acre		
	Eucalyptus	Coast Live Oak	California Bay
1	477	74	97
2	520	42	33
3	530	41	32
4	697	22	129
5	416	10	0
Average	540	38	58

Succession in Eucalyptus Plantations



Fire and Eucalyptus



Fuel Loading in Eucalyptus Plantations



FUEL ELEMENT	Live Component	Dead Component	Live Component	Dead Component	Live Component	Dead Component
Herbs and grasses	0.03	0.02	0.42	0.18	0.31	0.17
Shrubs and saplings	0.49	0.0	0.27	0.01	0.25	0.03
Fine twigs (1-hour)		1.33		0.69		1.18
Small branches (10-hour)		2.94		1.93		4.60
Medium branches (100 hour)		1.41		2.67		2.40
Logs (1,000 hour)		19.63		11.06		0.69
Litter (leaves, bark, needles, etc.)		4.99		1.70		2.19
TOTAL FUELS	Eucalyptus - 30.84 tons per acre		California Bay - 18.93 tons per acre		Coast Live Oak - 11.82 tons per acre	

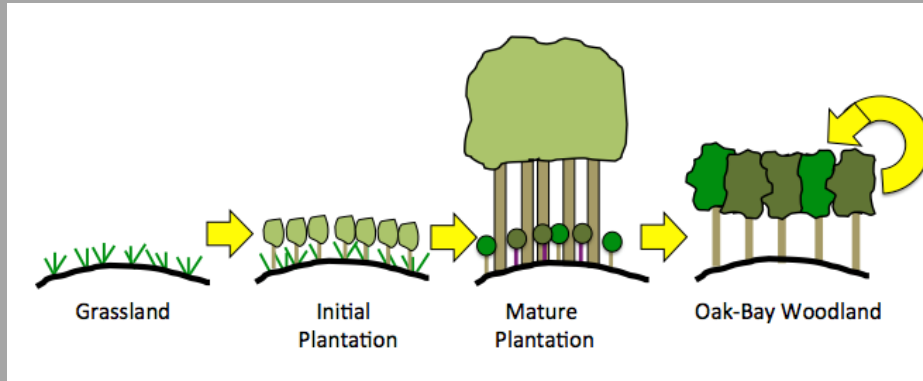
From: U. S. National Park Service

Response of Eucalyptus to Burning

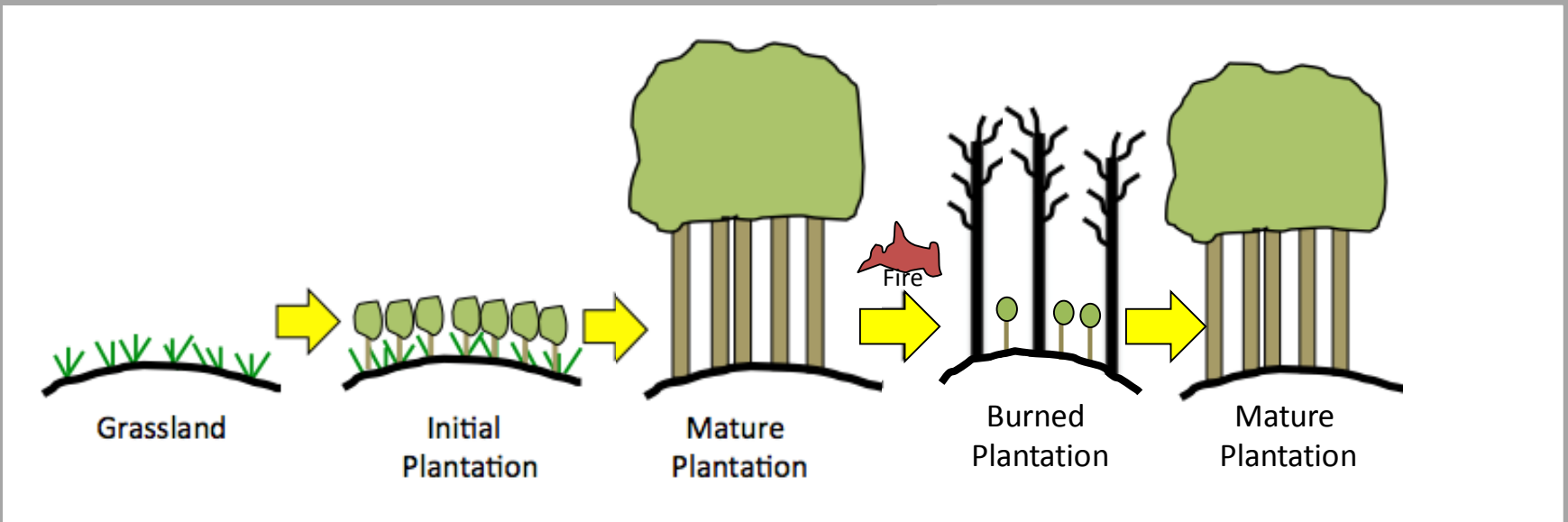


Succession in Eucalyptus Plantations

Without Fire:



With Fire:

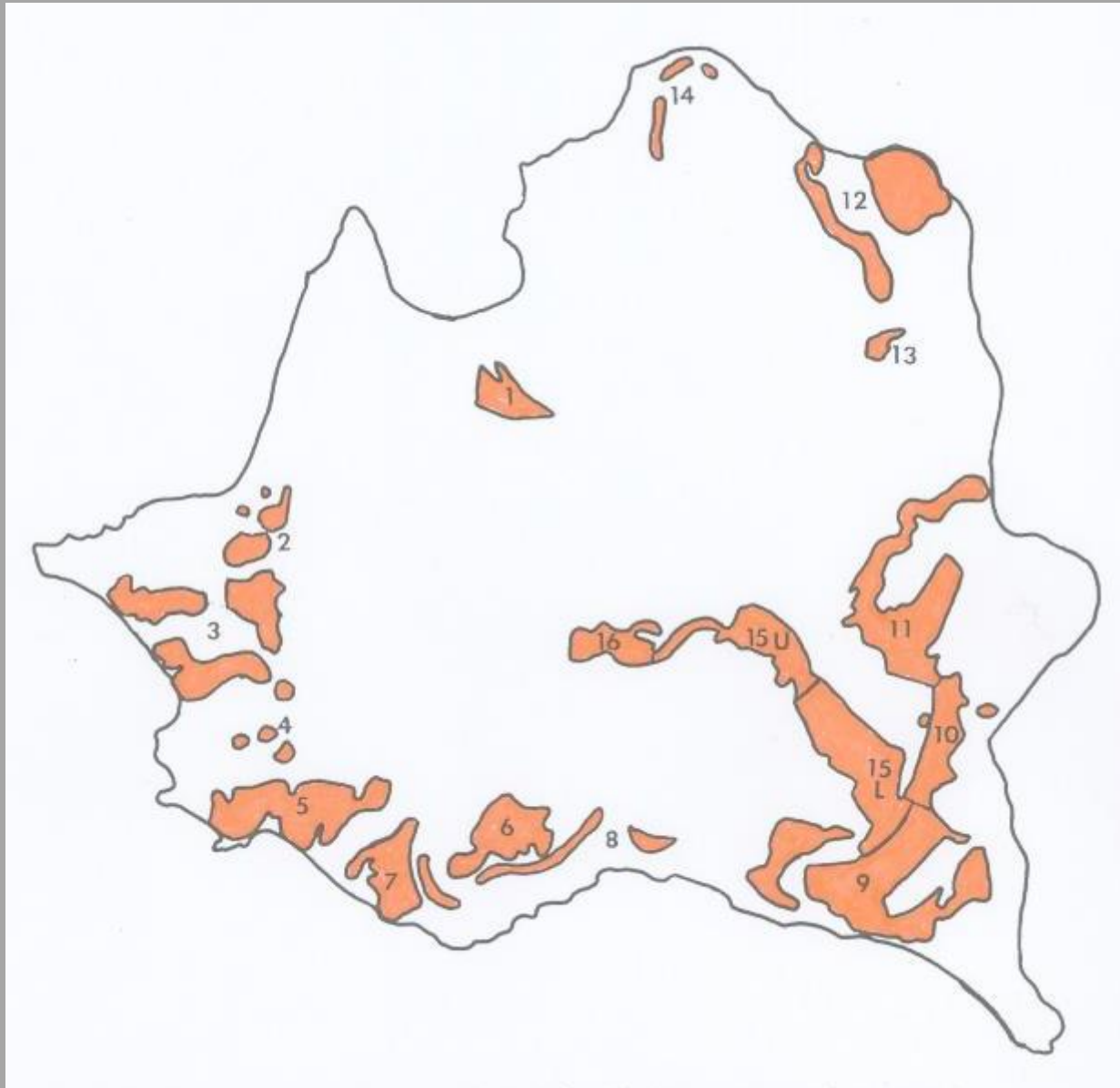


Future of Eucalyptus Plantations in the San Francisco Bay Area

- Successional change
- Invasion of adjacent vegetation types
- Management objectives

Eucalyptus Plantations on Angel Island

(1988)

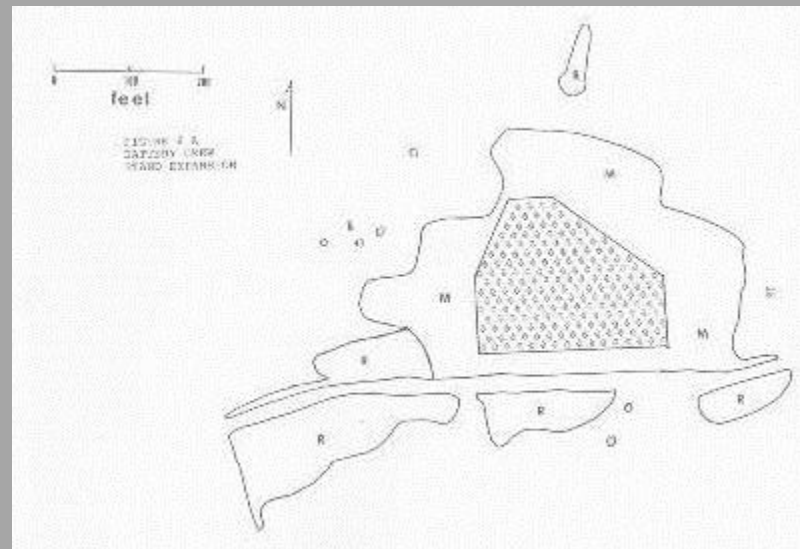
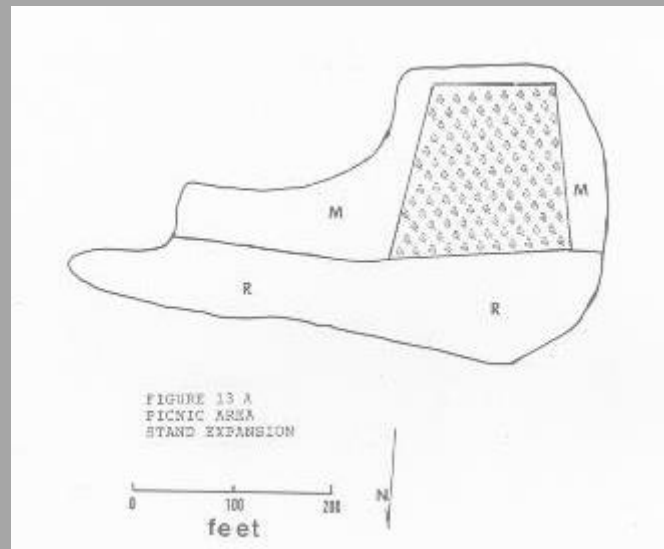
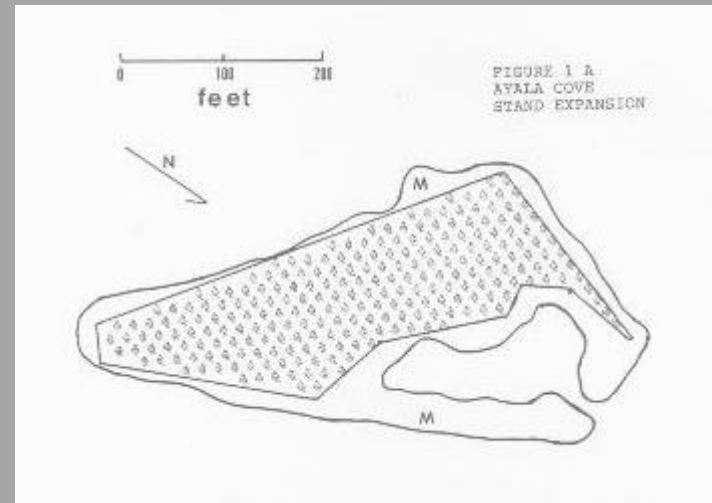
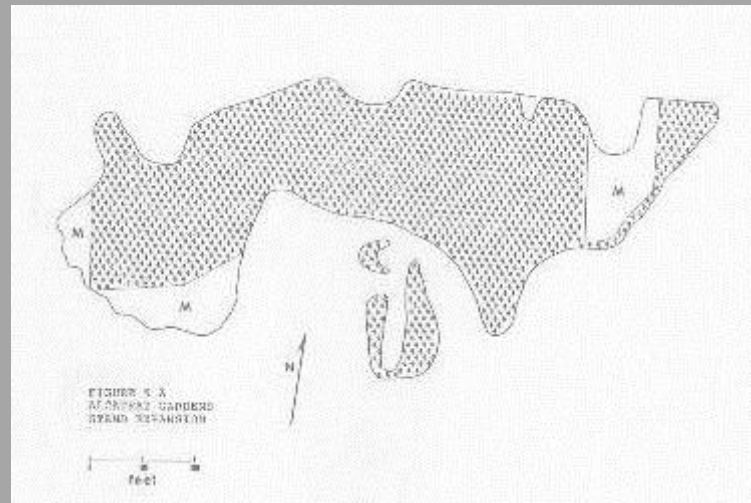


Expansion of Eucalyptus Plantations on Angel Island

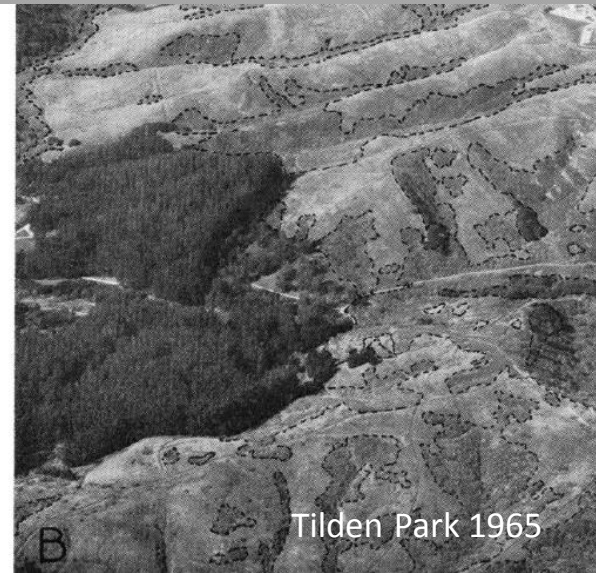
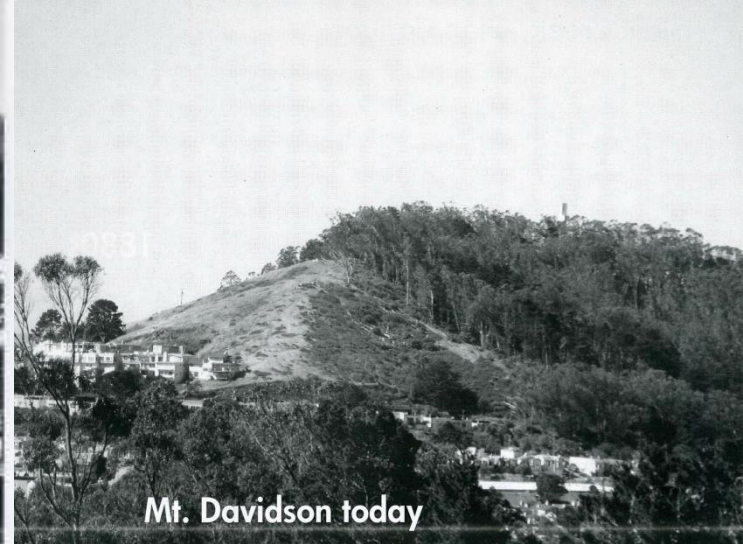
TABLE 1. AREA COVERED BY EUCALYPTUS STANDS

Map Unit	Acres Planted	Total Acres	Expansion Acres
1	1.2	1.9	0.7
2	1.6	2.5	0.9
3	0.1	9.3	9.2
4	0.1	1.5	1.4
5	1.2	8.2	7.0
6	1.0	3.9	2.9
7	2.2	4.4	2.2
8	0.1	1.5	1.4
9	4.3	14.9	10.6
10	1.0	4.9	3.9
11	3.1	10.6	7.5
12	0.7	4.4	3.7
13	0.6	2.2	1.6
14	0.1	0.8	0.7
15	6.0	12.6	6.6
16	0.3	2.5	2.2
Total	23.6	86.1	62.5

Expansion of Eucalyptus Plantations on Angel Island



Stable Boundaries of Eucalyptus Plantations



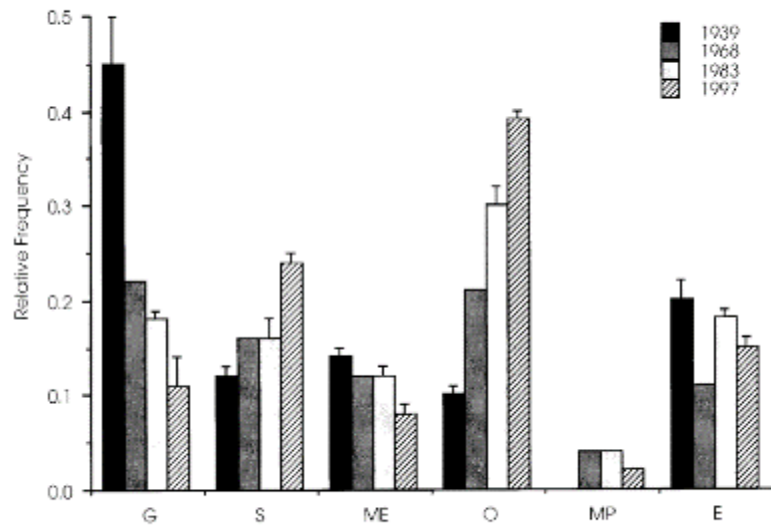


Fig. 2. Relative frequency of six vegetation types (G: grass, S: shrub, ME: mixed evergreen, O: oak woodlands and savannas, MP: Monterey pine, E: eucalyptus), in Chabot Regional Park. Error bars indicate 1 S.E.

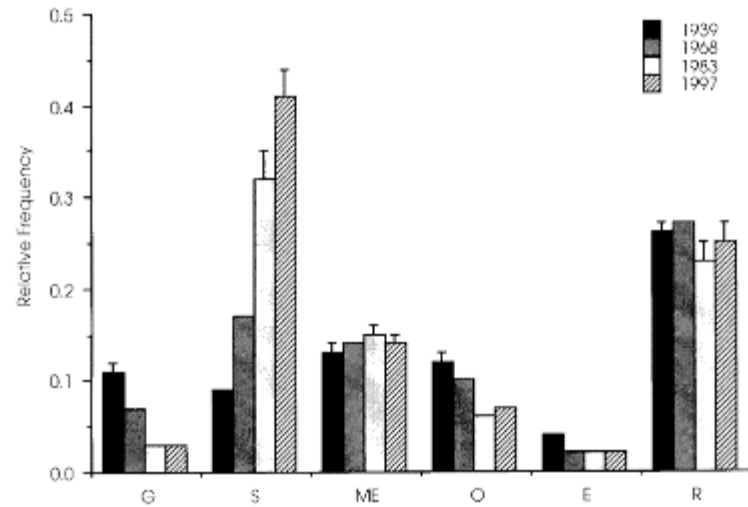


Fig. 3. Relative frequency of six vegetation types (G: grass, S: shrub, ME: mixed evergreen, O: oak woodlands and savannas, E: eucalyptus, R: redwood), in Redwood Regional Park. Error bars indicate 1 S.E.

Decline in Area of Eucalyptus (1939–1997)

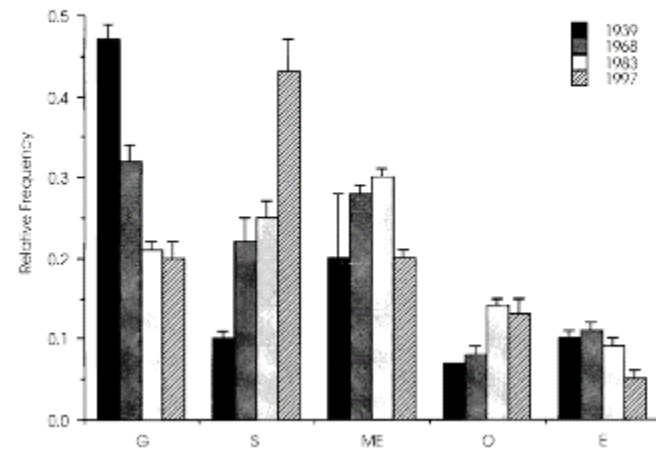
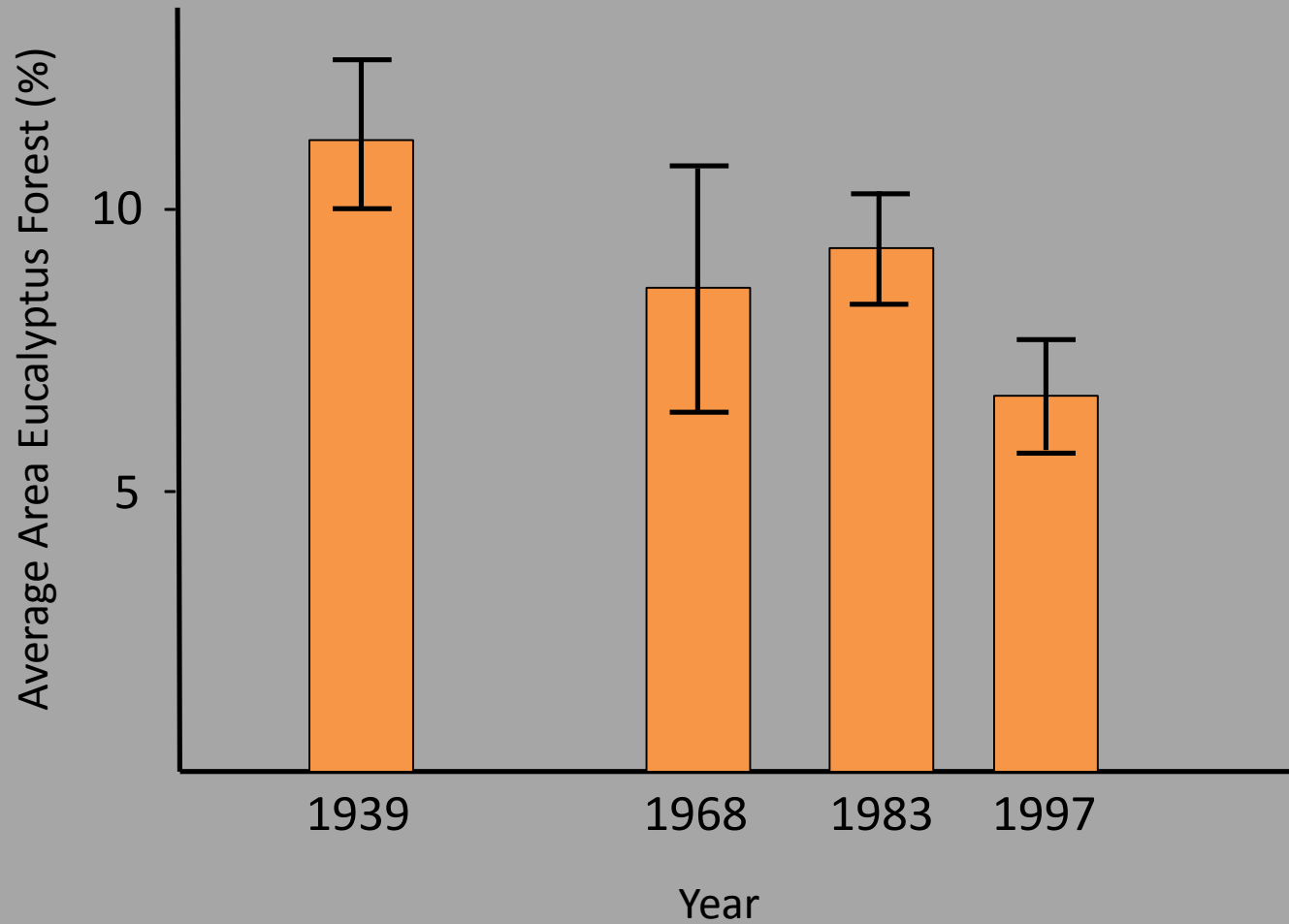


Fig. 4. Relative frequency of five vegetation types (G: grass, S: shrub, ME: mixed evergreen, O: oak woodlands and savannas, E: eucalyptus), in Tilden Regional Park. Error bars indicate 1 S.E.

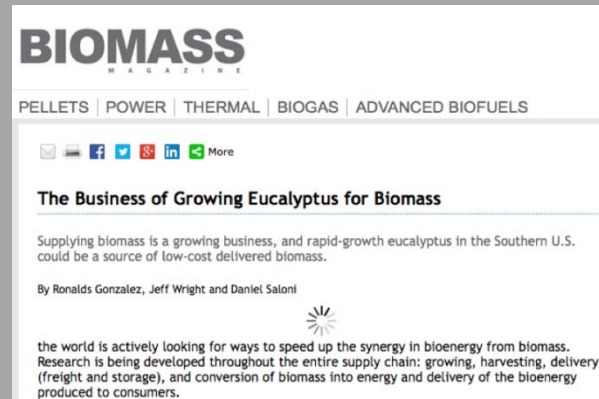
Decline in Eucalyptus in Three East Bay Parks



Alternative Management Objectives for Eucalyptus Plantations



Recreation



Wood Products



Removal

January 12, 2014

The Great Eucalyptus Debate: A Love/Hate Relationship

SF Chronicle "Insight"

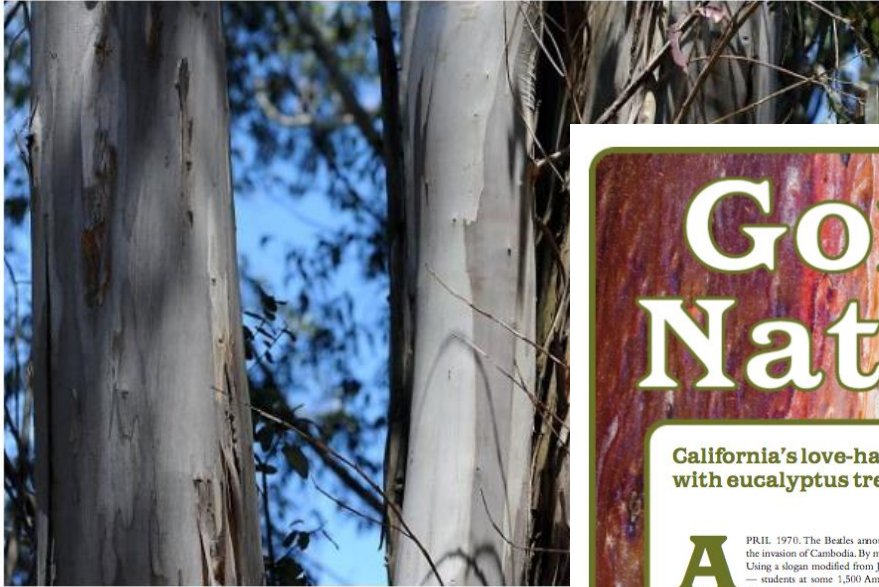
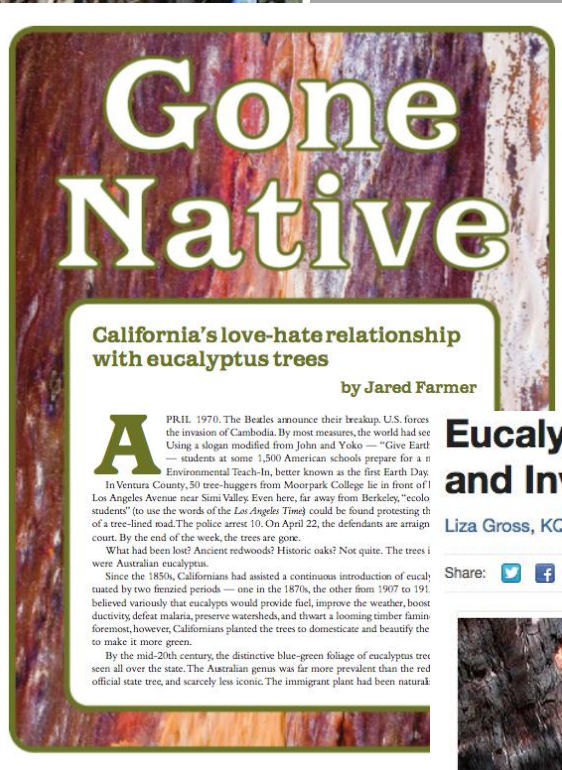


Photo by Michael Short, Special to the Chronicle
(Posted by John Maybury, Pacifica Riptide, Pacifica, California)



Eucalyptus: California Icon, Fire Hazard and Invasive Species

Liza Gross, KQED Science Contributor | June 12, 2013 | 42 Comments

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Specialized reproductive structures called "epicormic shoots" sprout from buds on the bushfire damaged trunk of a Eucalyptus tree, about two years after the 2003 Eastern Victorian alpine bushfires. Near Anglers Rest, Victoria, Australia. (Photo: jiron)



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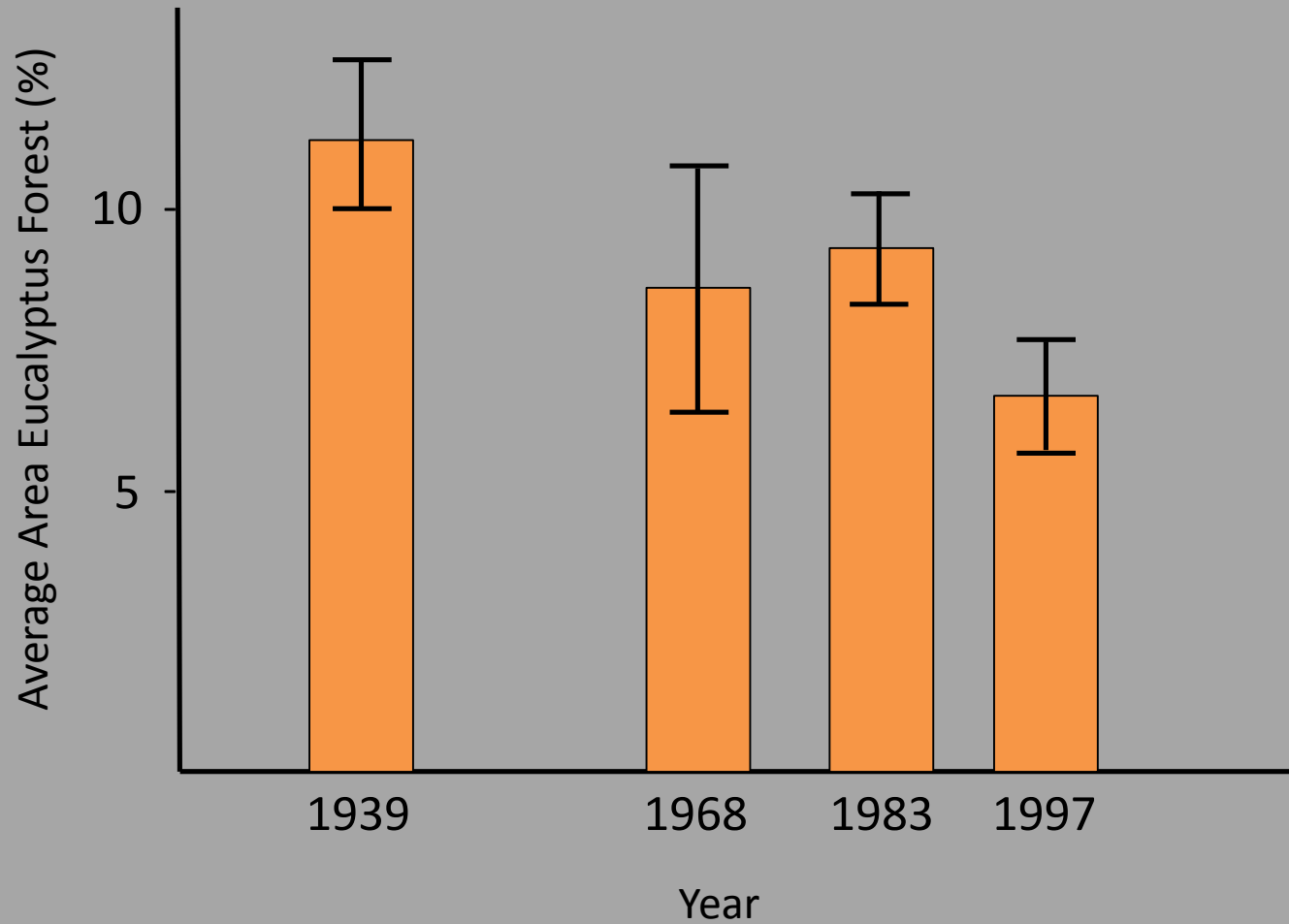
End

California Bay in Understory of Eucalyptus

(Tilden Park)



Decline in Eucalyptus in Three East Bay Parks



Attractiveness of Habitats in the East Bay Regional Parks

(Stebbins, 1978)

