

Biogeography of San Diego County Oak Mortality

Tom Scott

UC INTEGRATED HARDWOOD RANGE MANAGEMENT PROGRAM
and Department of Environmental Science, Policy, and Management,
University of California, Berkeley

CENTER FOR CONSERVATION BIOLOGY
and Department of Earth Sciences, University of California, Riverside



Distribution of California Oaks

TAXA	COMMON NAME	NARROW DISTRIBUTION
<i>Quercus kelloggii</i> Newb.	BLACK OAK	NO
<i>Quercus agrifolia agrifolia</i> Nee	COAST LIVE OAK	YES
<i>Quercus agrifolia oxyadenia</i>		YES
<i>Quercus wislizeni</i> A. DC. var. <i>wislizeni</i>	INTERIOR LIVE OAK	NO
<i>Quercus wislizeni</i> var. <i>frutescens</i> Engelm.		NO
<i>Quercus peninsularis</i>	PENINSULAR OAK	YES
<i>Quercus parvula</i> Greene var. <i>parvula</i>		YES
<i>Quercus parvula</i> var. <i>shrevei</i> (Muller) Nixon & Muller	SHREVE OAK	YES
<i>Quercus chrysolepis</i> Liebm.	CANYON LIVE OAK	NO
<i>Quercus vaccinifolia</i> Kellogg	HUCKLEBERRY OAK	YES
<i>Quercus tomentella</i> Engelm.	ISLAND OAK	YES
<i>Quercus palmeri</i> (<i>Quercus dunnii</i>).	PALMERS OAK	NO
<i>Quercus cedrosensis</i>	CEDROS ISLAND OAK	YES
<i>Quercus sadleriana</i> R. Brown, Campst.	SADLER OAK	YES
<i>Quercus engelmannii</i> Greene	ENGELMANN OAK	YES
<i>Quercus lobata</i> Nee	VALLEY OAK	NO
<i>Quercus douglasii</i> H. & A.	BLUE OAK	YES
<i>Quercus garryana</i> Dougl. var. <i>garryana</i>	OREGON WHITE OAK	NO
<i>Quercus garryana</i> var. <i>breweri</i> Jeps.		
<i>Quercus garryana</i> var. <i>semota</i>		
<i>Quercus dumosa</i> Nutt. <i>sensus stricto</i>	COASTAL SCRUB OAK	YES
<i>Quercus berberidifolia</i> Liebm	SCRUB OAK	NO
<i>Quercus john-tuckeri</i> Nixon & Muller	TUCKER'S SCRUB OAK	YES
<i>Quercus pacifica</i> Nixon & Muller	PACIFIC OAK	YES
<i>Quercus cornelius-mulleri</i> Nixon & Steele	MULLER OAK	NO
<i>Quercus durata</i> Jeps. var. <i>Durata</i>		YES
<i>Quercus durata</i> var. <i>gabrielensis</i> Nixon & Muller		YES
<i>Quercus turbinella</i> Greene	ARIZONA SCRUB OAK	NO

A large number of oak species and subspecies have a geographically limited distribution

	Wide Distribution		Limited Distribution		Geographic Artifacts
Section Lobatae	3		3		2
Section Protobalanus	2		2		2
Section Quercus Tree Group	2		2		0
Section Quercus Scrub Group	3		4		1

total	10		11		5
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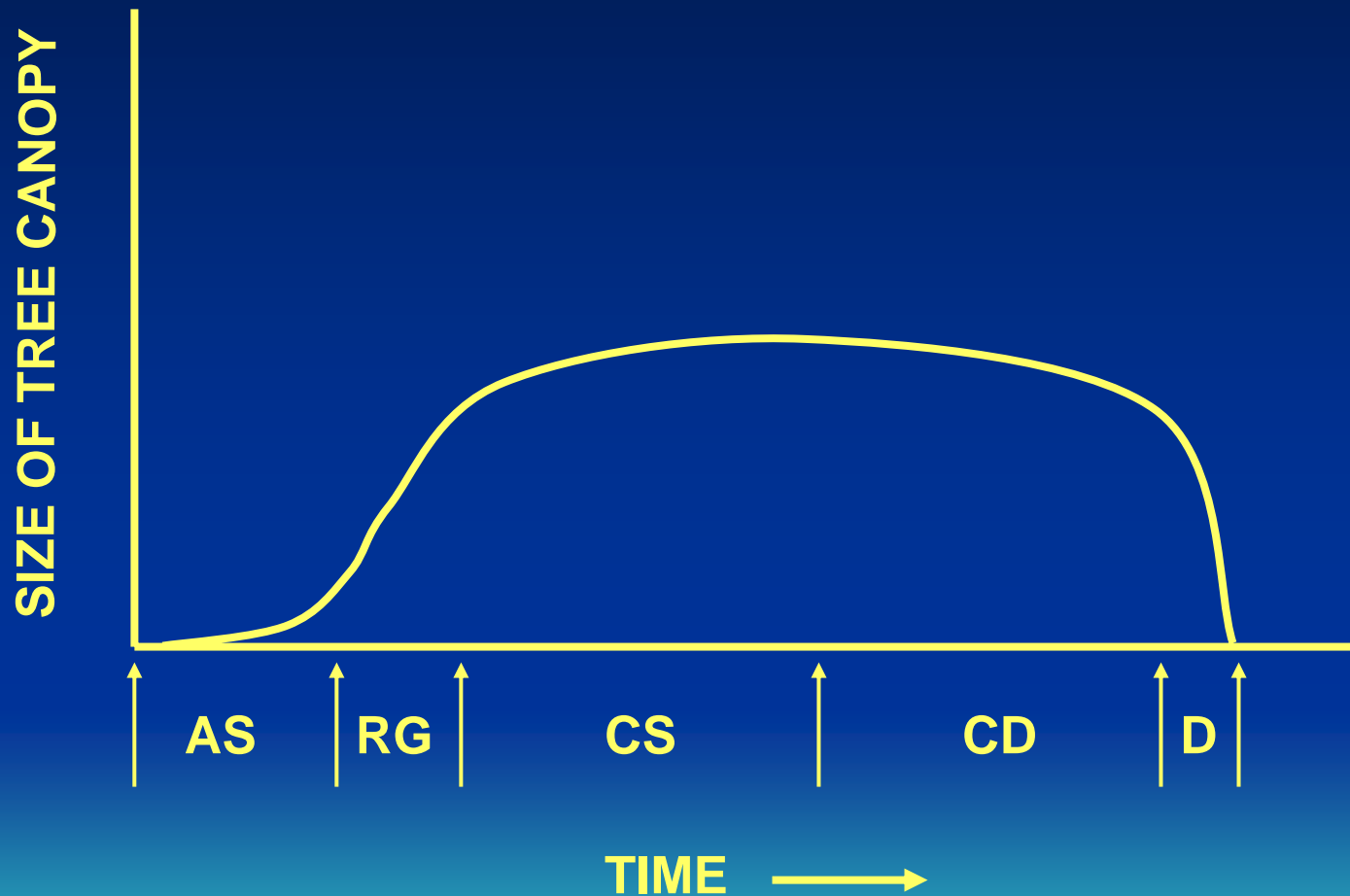
Tree oak Species with narrow distributions in San Diego County

TAXA	COMMON NAME	DISTRIBTUION
<i>Quercus engelmannii</i> Greene	ENGELMANN OAK	Southern Counties
<i>Quercus agrifolia agrifolia</i> Nee	COAST LIVE OAK	Coastal Ranges
<i>Quercus agrifolia oxyadenia</i> Nee	COAST LIVE OAK	Southern California
<i>Quercus kelloggii</i>	BLACK OAK	Baja California to Eastern Sierra, Oregon
<i>Quercus wislizeni</i>	INTERIOR LIVE OAK	California, Baja California, Main Mexico
<i>Quercus chrysolepis</i> Liebm.	CANYON LIVE OAK	California, Arizona, Baja California, Main Mexico

All these species/subspecies or similar taxa have been present in California since the Miocene (25 to 5 Ma)



Restricted distributions but oak trees have exceptional plasticity in growth and life history of oaks



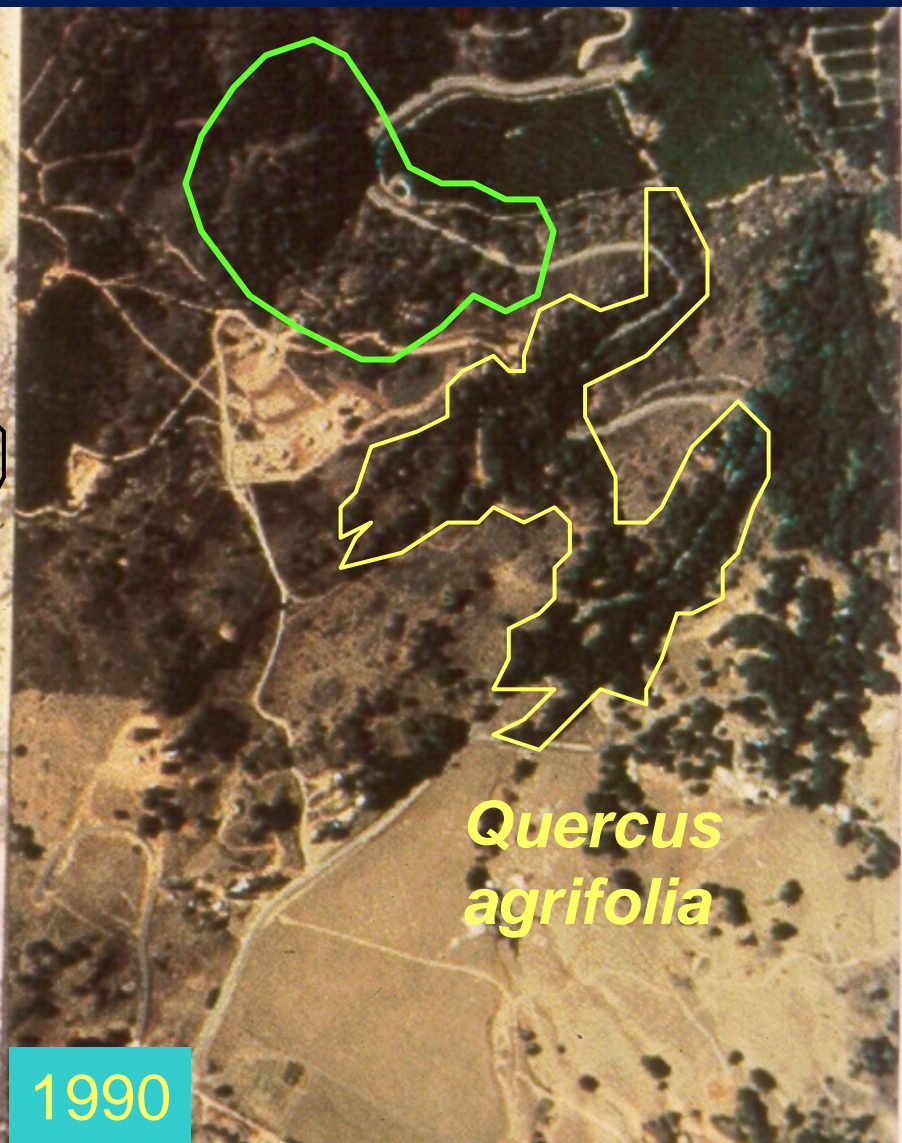
AS = Acorn/Seedling stasis
RG = Rapid growth

CS = Canopy Stasis
CD = Canopy decline

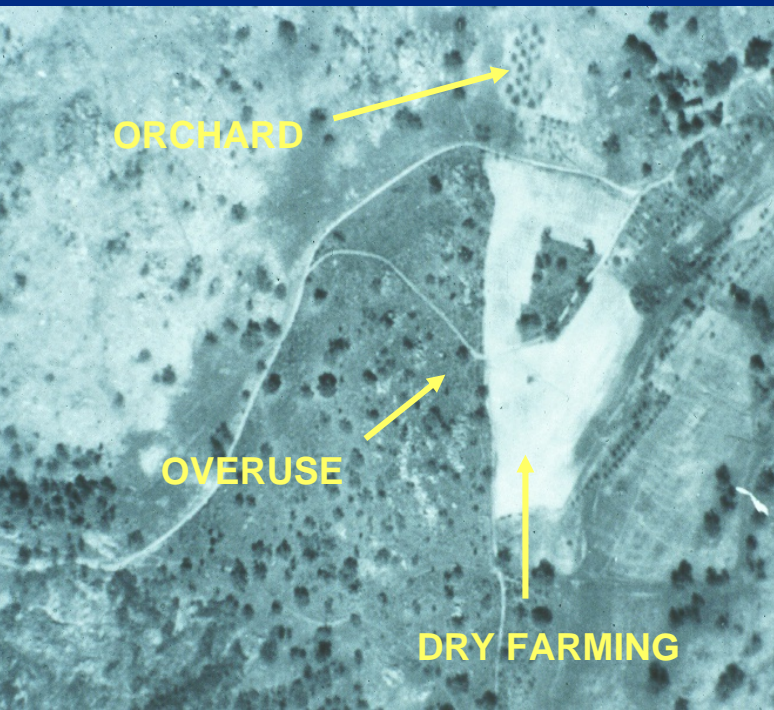
D = Death



Historical photos provide a counter-intuitive result: sequential aerial photographs show an increase in oak woodlands between 1928 and 1990



Strong indication that overuse and drought(s) occurred in San Diego County the late 1800's and early 1900's, as well as a strong recovery of woodlands since that time

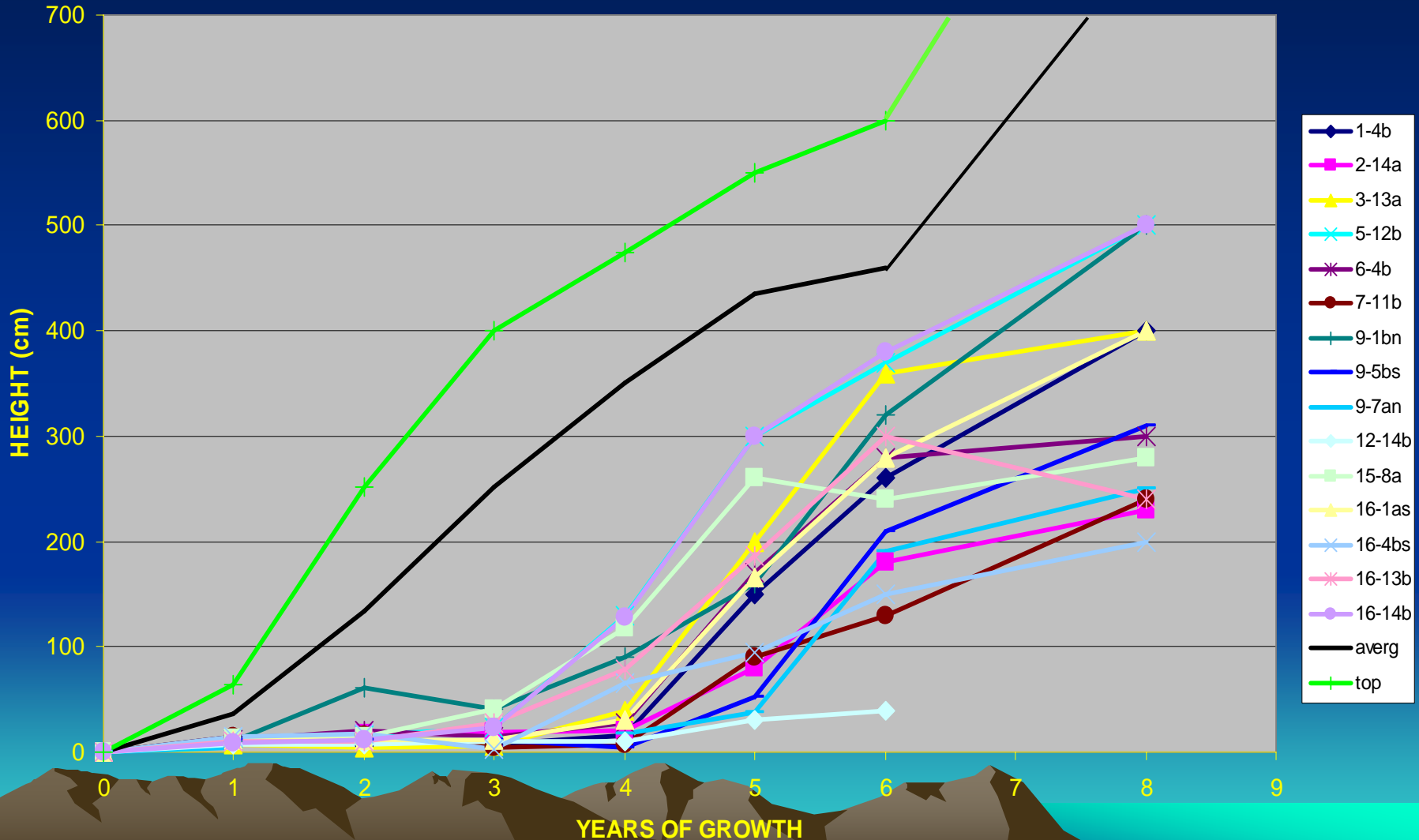


1928

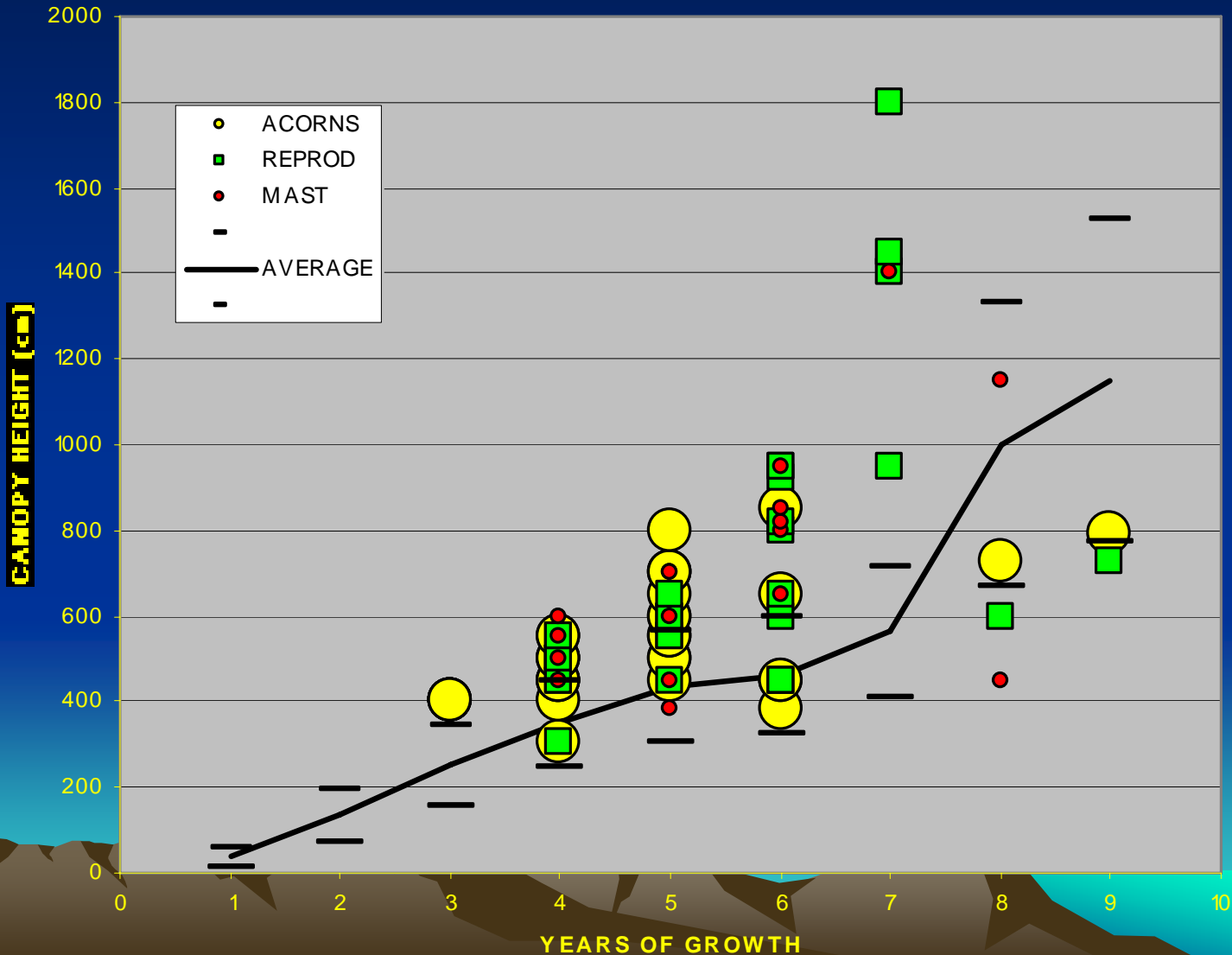


1998

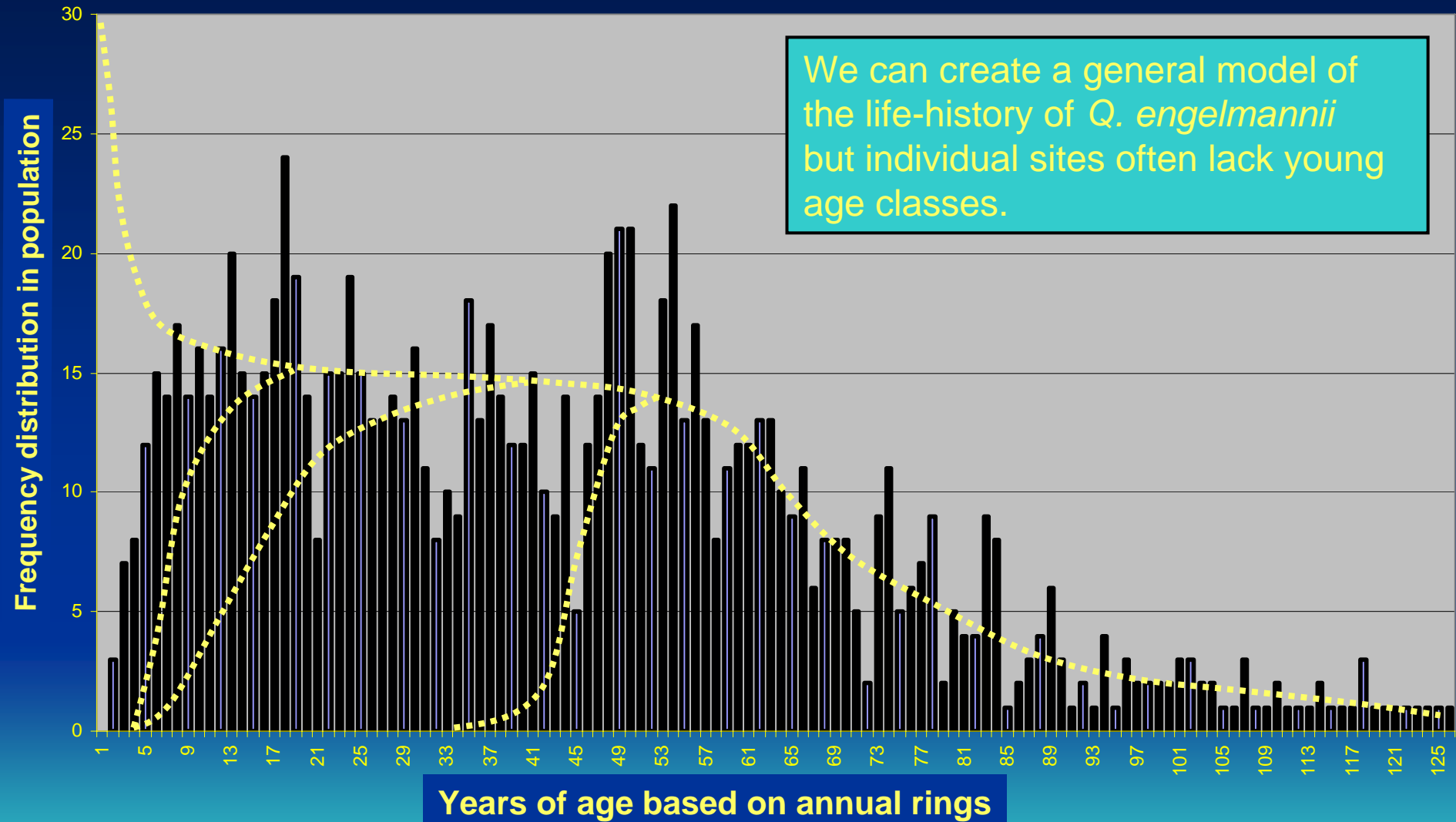
Stasis in oak seedlings: Rates of growth in slowest growing trees in Engelmann Oak (*Q. engelmannii*) plots at South Coast Field Station



Minimum oak generation time: Mast can occur after 3 to 5 years of growth (4 to 6 years after emergence, 5 to 7 after acorn production) (Engelmann Oak (*Q. engelmannii*))

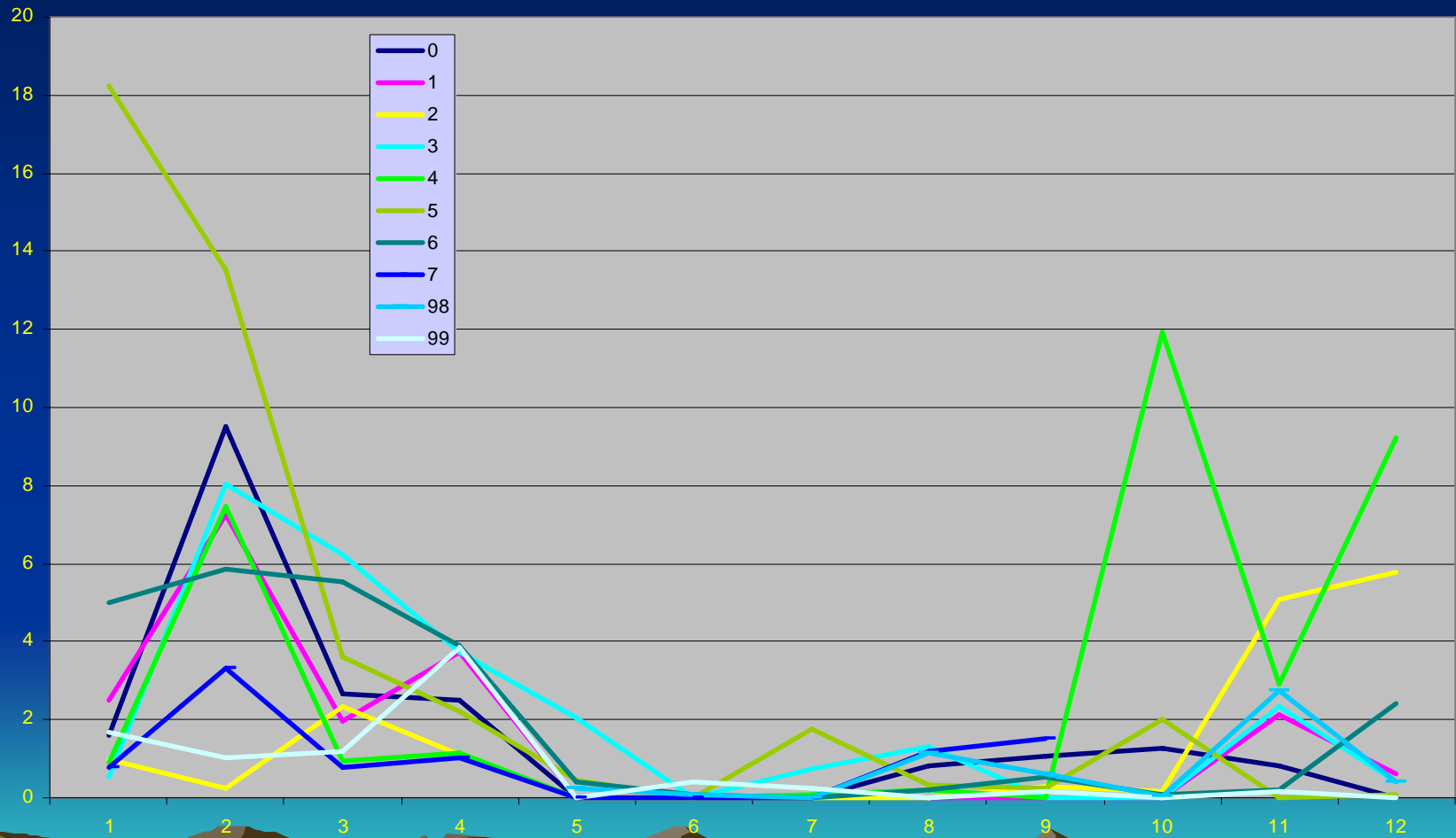


Engelmann oaks live about 70 years then start a slow decline

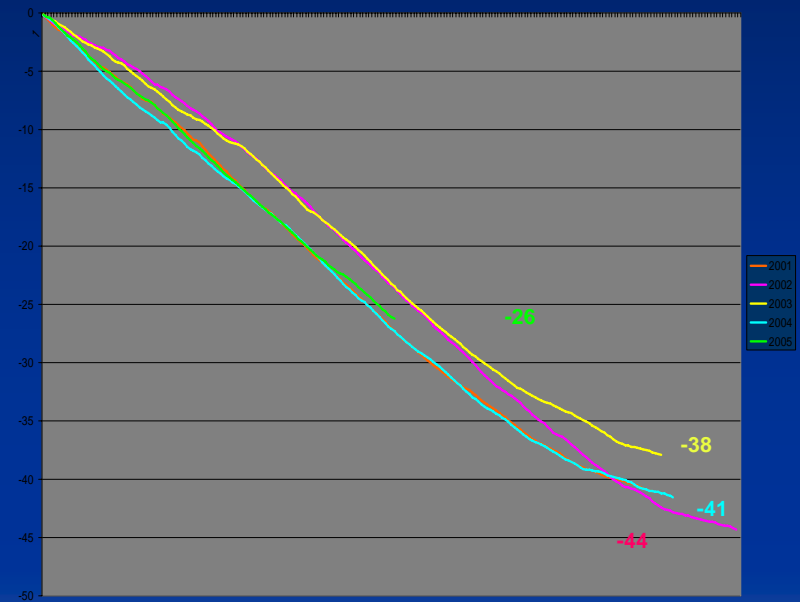
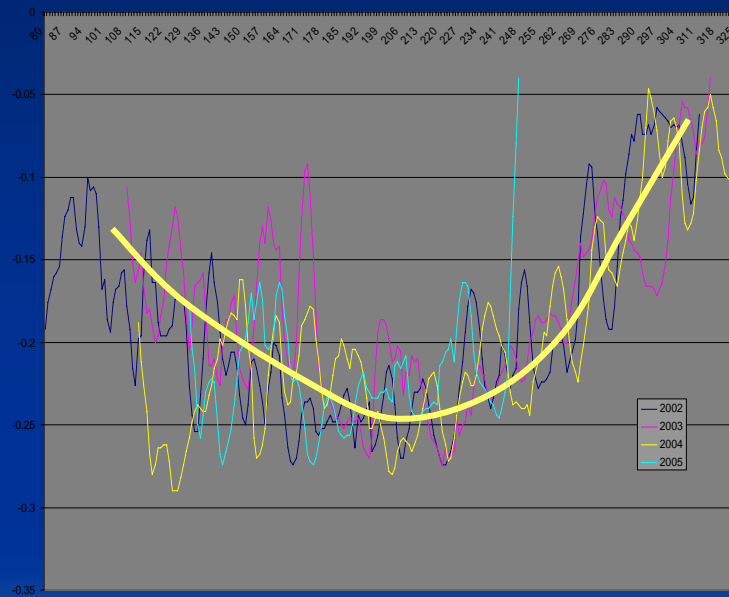


What governs oak distribution?

Monthly precipitation is concentrated in February and March
(Palomar Mountain data)

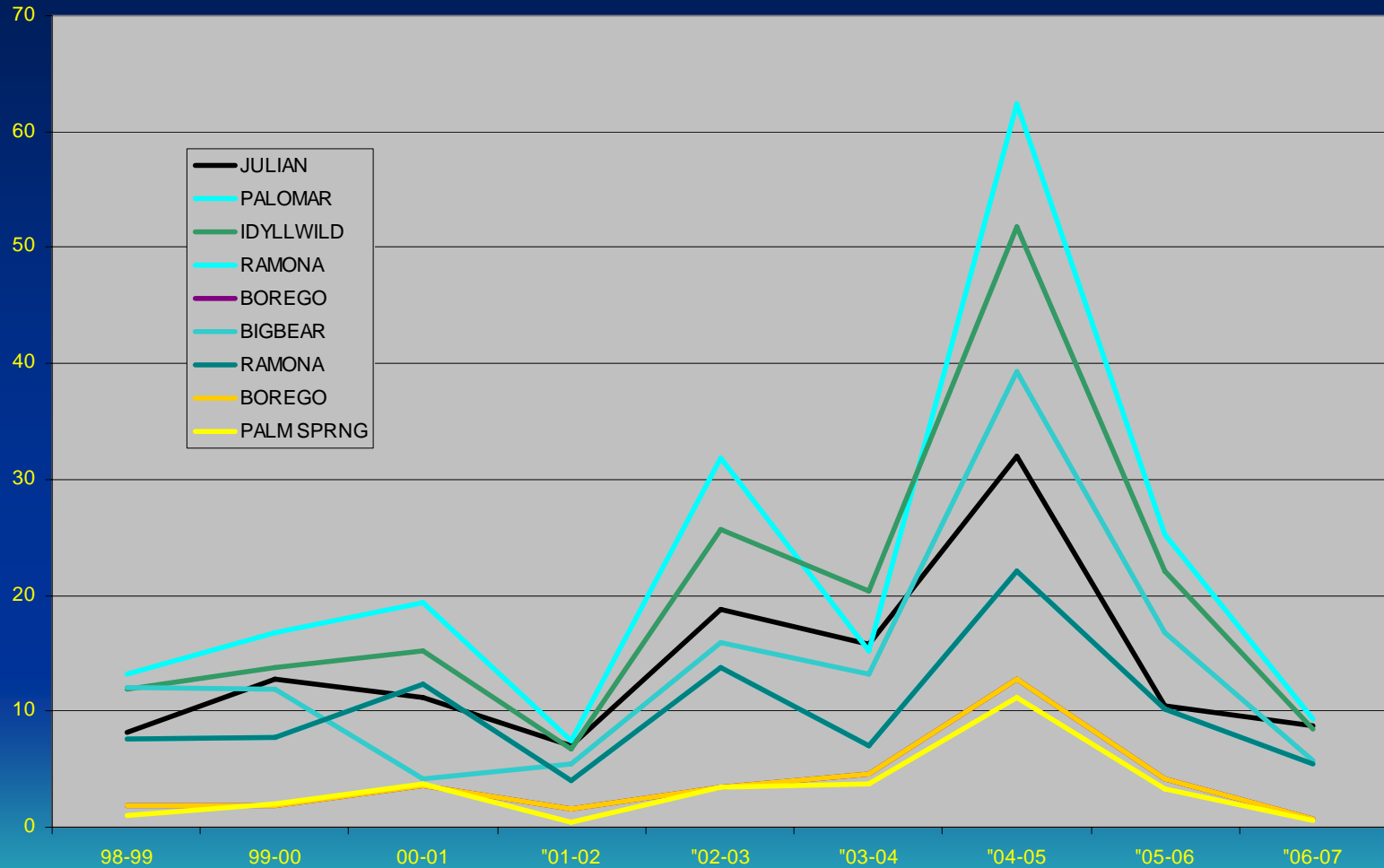


Evapotranspiration (ET) depicted as a U-shaped curve of daily rates, and as cumulative water-loss in summer droughts.

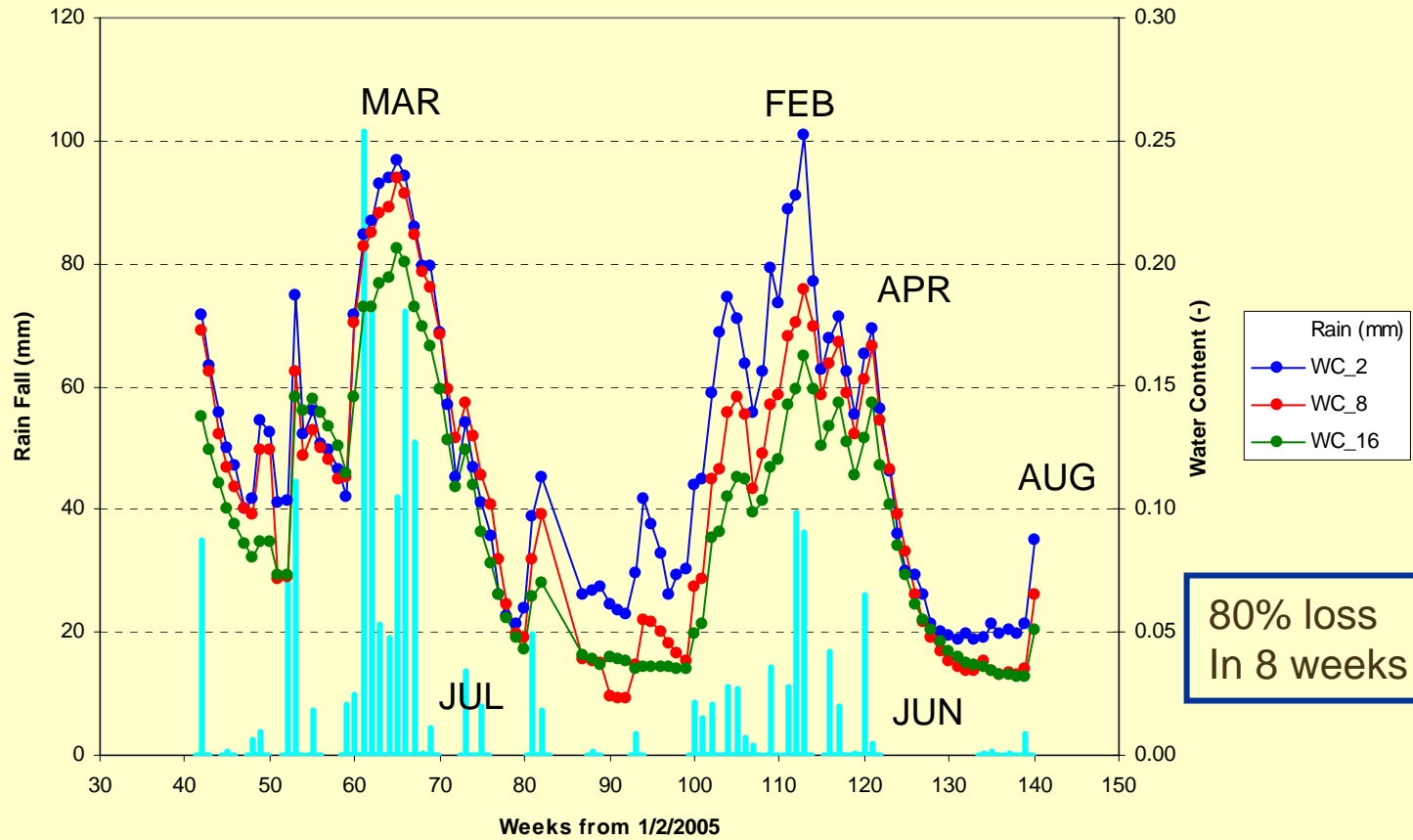


Estimated daily rates of water loss (ET_o, inches/day) at the UC Riverside CIMIS station. Figure 2A shows a traditional representation of daily variation in ETo but fails to show the cumulative effect of long-term dry-downs on Mediterranean ecosystems. Figure 2B shows the cumulative water loss (inches) occurring in summer droughts, which can last as long as 260 days. These annual droughts can extract 3 to 7 times the amount of water entering ecosystems as winter rain.

Variation in precipitation among last by 9 water years at seven southern California locations

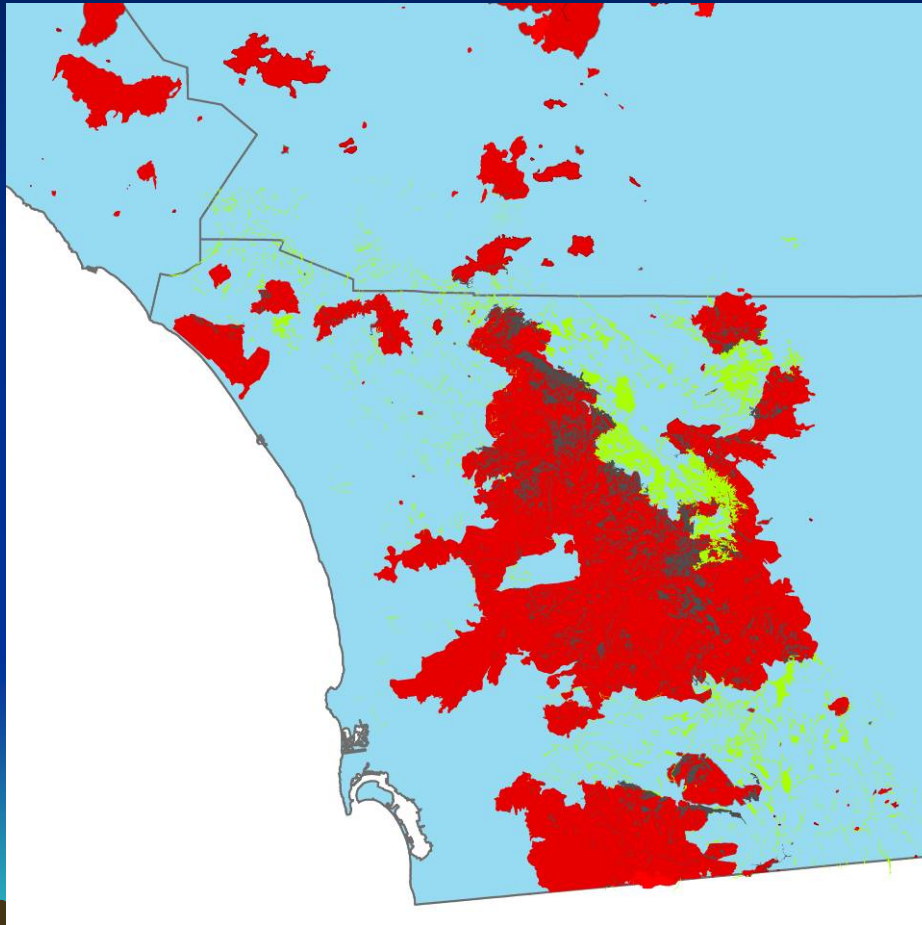


Weekly Rain Fall Vs Soil Water Content

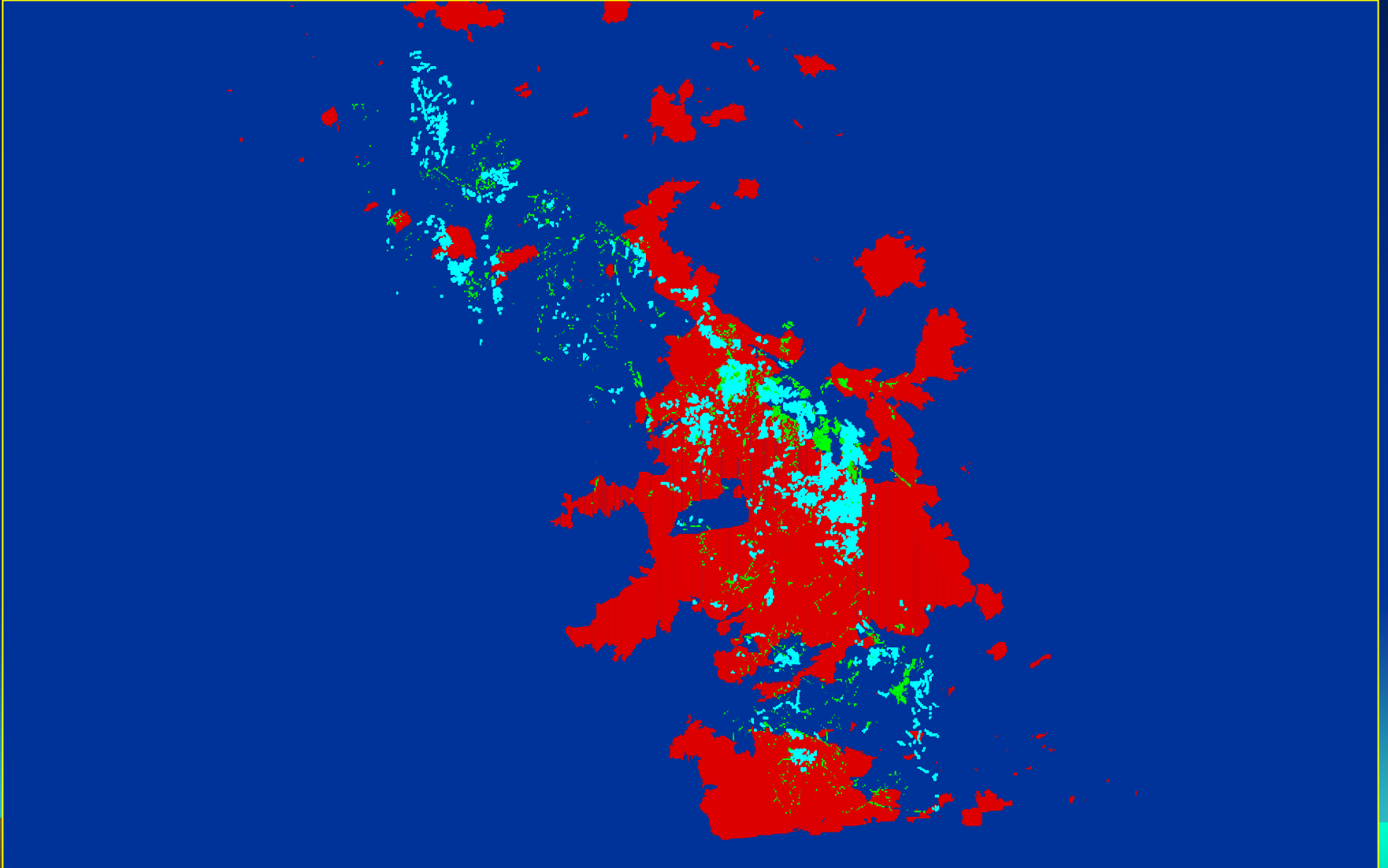


80% loss
In 8 weeks

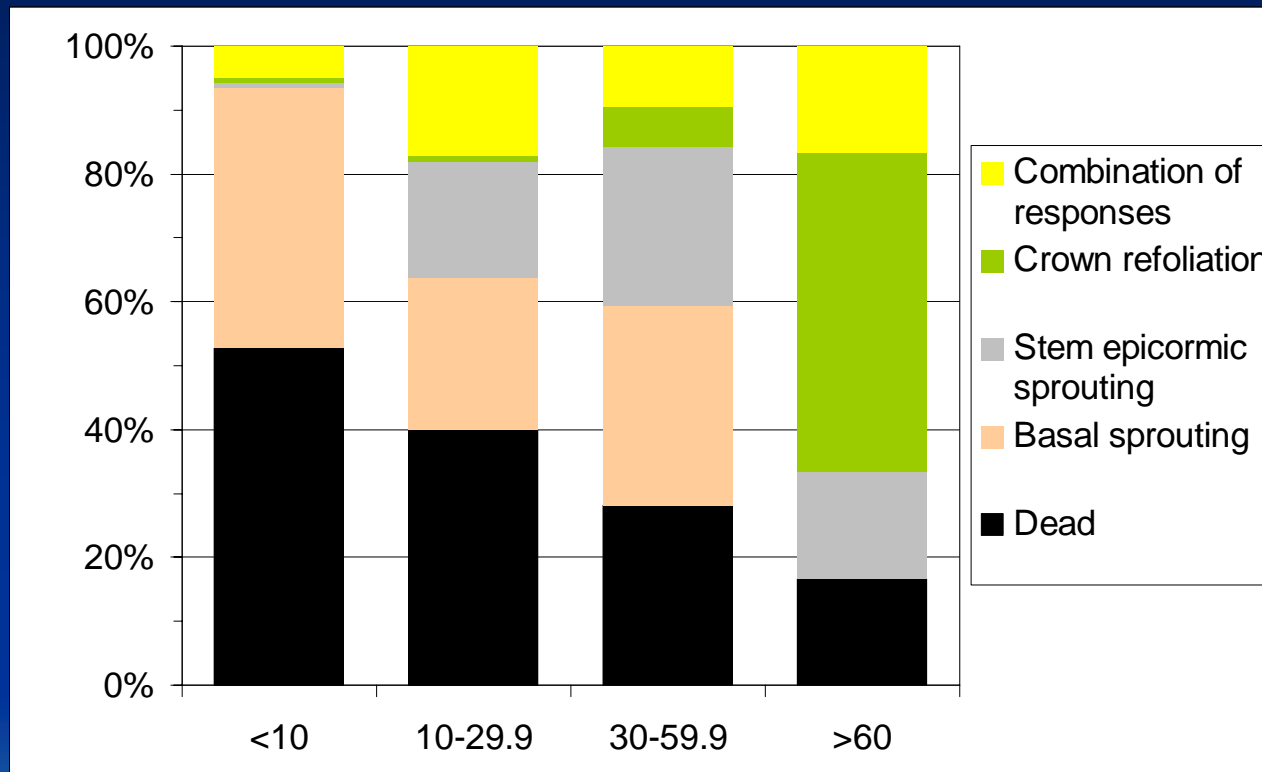
About 46% of the distribution of Coast Live Oak (*Quercus agrifolia*) burned Between 2003 and 2007



Concern over oak persistence: >60% of Engelmann oak (*Quercus engelmannii*) woodlands burned in 2003 and 2007



Mortality and survivorship of Engelman oaks in burned plots by size classes (cm)

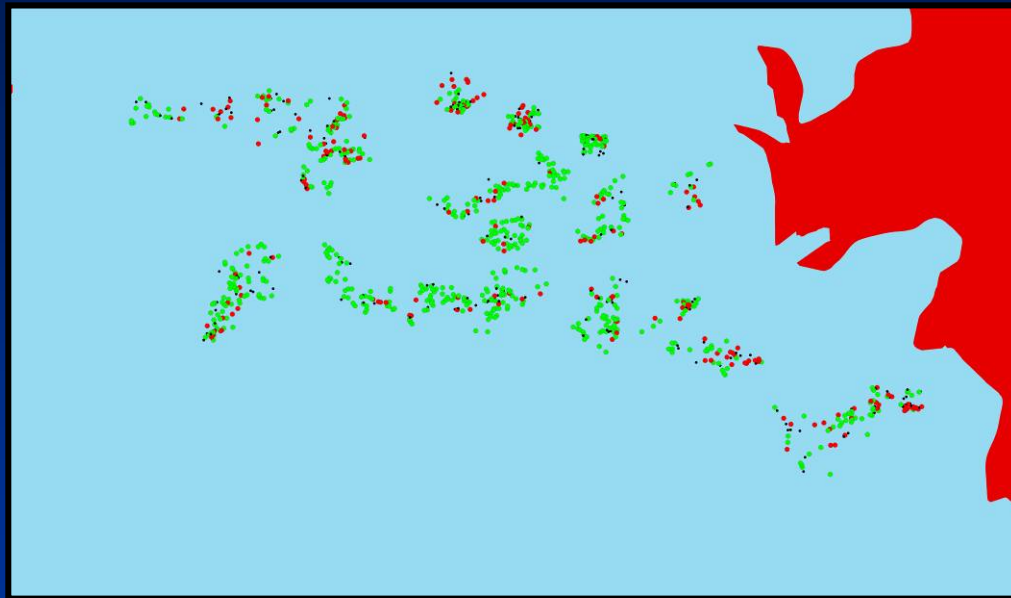


Large stems tend to survive better, but do not sprout as easily from root crowns

Coast Live Oak (*Quercus agrifolia*) Trees decline in San Diego County
 (percent of healthy trees in 1996 by condition in 2006)

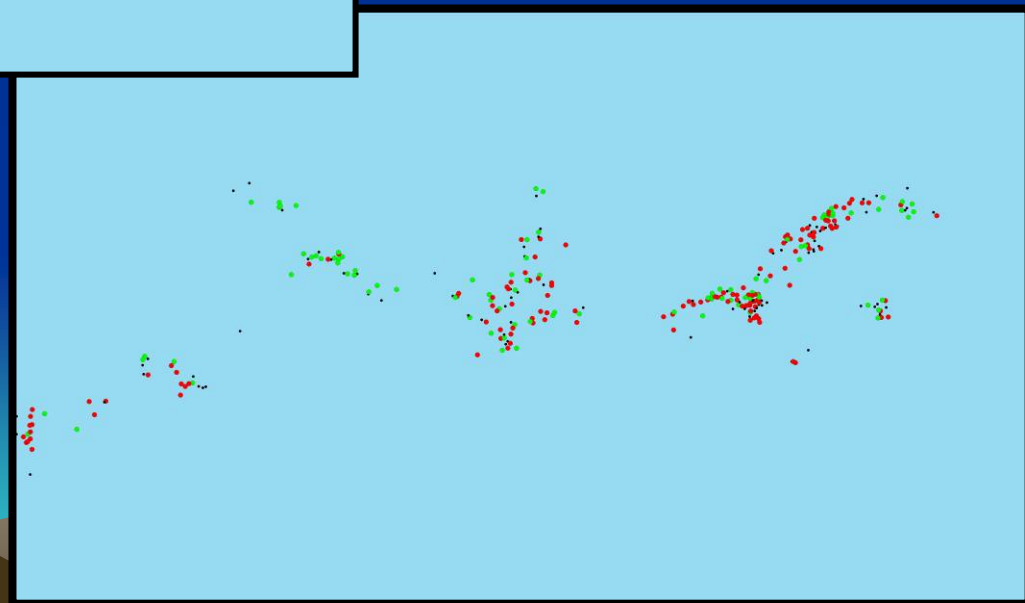
	Declining	Unknown	Okay 06
Descanso_C	0.85	0.07	0.07
McCain_Valley_B	0.70	0.19	0.11
Campo_And_West	0.66	0.16	0.18
Rincon_Indian_Reservation	0.58	0.17	0.25
Cibbets_Flat_A Total	0.56	0.25	0.20
McCain_Valley_A	0.47	0.29	0.24
Morena_Village	0.46	0.22	0.32
Mesa_Grande_Indian_Reserv	0.33	0.21	0.45
Valley_Center	0.29	0.30	0.41
Pala_Indian_Reservation	0.28	0.23	0.50
Alpine	0.21	0.28	0.51
Chihuahua_Valley	0.15	0.19	0.65

Oak tree declines in northern and southern parts of San Diego County



Northern

Southern



Red circles = declining
Green circles = healthy

