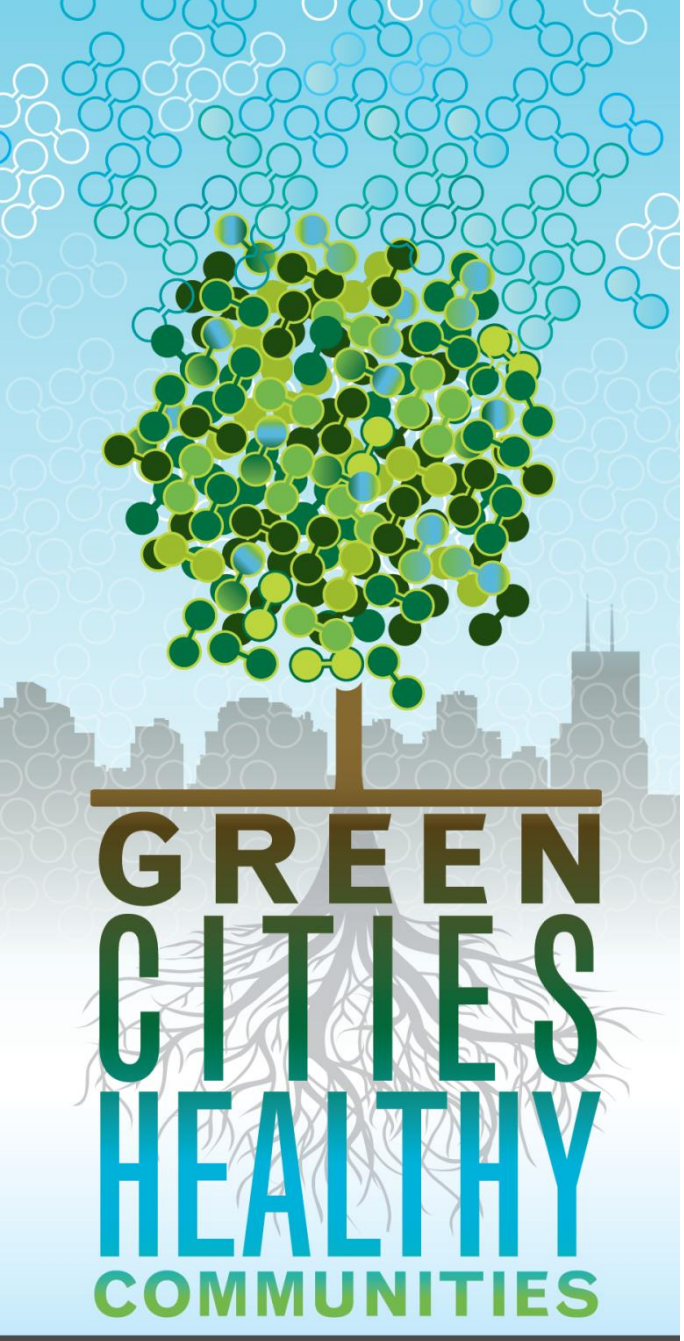


USDA Forest Service

URBAN FOREST CONNECTIONS

webinar series

Second Wednesdays | 1:00 – 2:15 pm ET

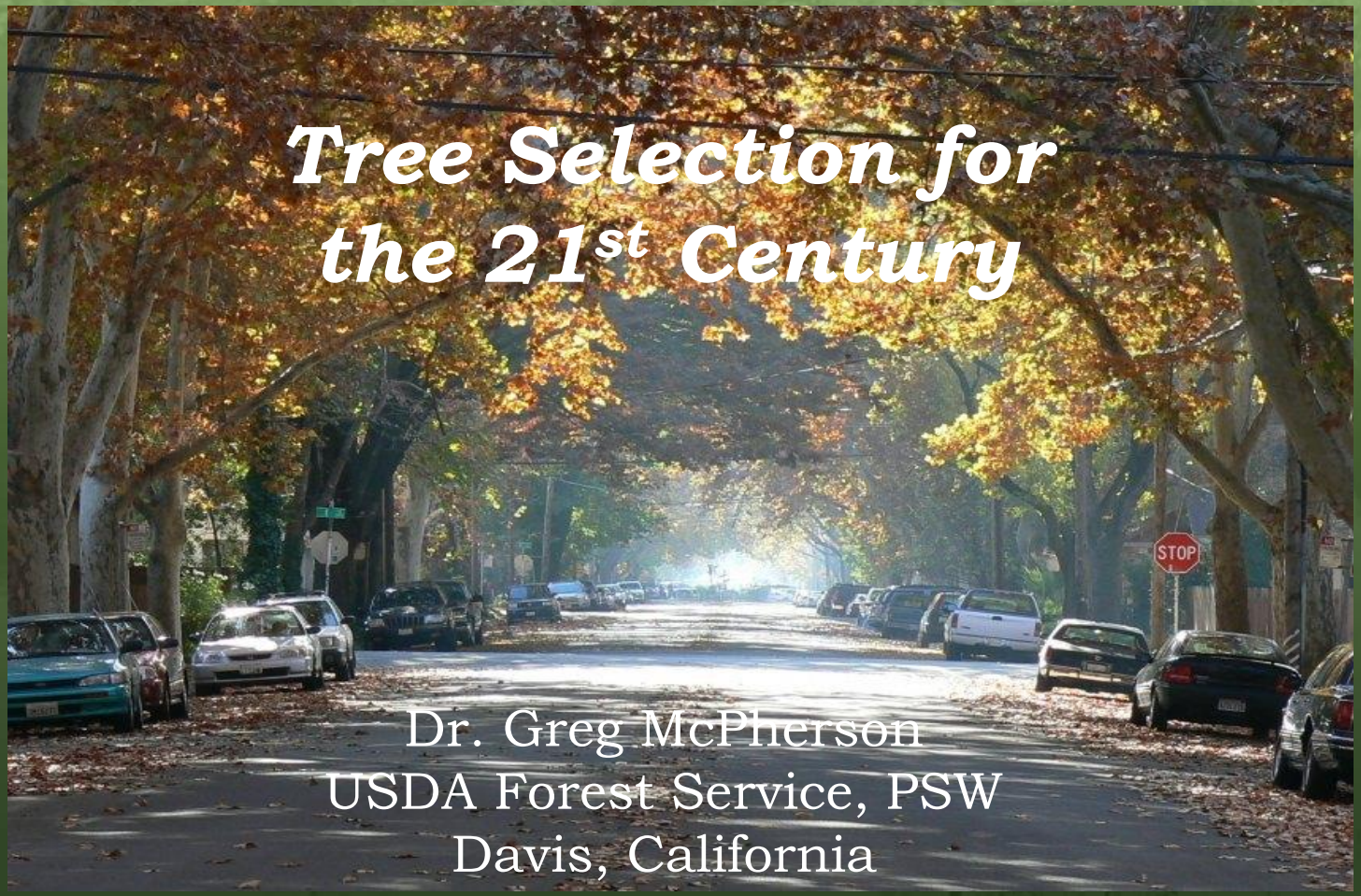
www.fs.fed.us/research/urban-webinars

TREE SELECTION FOR THE 21ST CENTURY

Greg McPherson

Research Forester

USDA Forest Service



Tree Selection for the 21st Century

Dr. Greg McPherson
USDA Forest Service, PSW
Davis, California

Today

- Our Good Health Depends on Trees
- Challenges
- Research You Can Use
  - Climate-Ready Trees Study
  - UTD, Carbon & Rainfall Interception

California's Drought

- 2012-2015 severity unprecedented in 1,200+ year record

Geophysical Research Letters

AN AGU JOURNAL

Explore this journal >

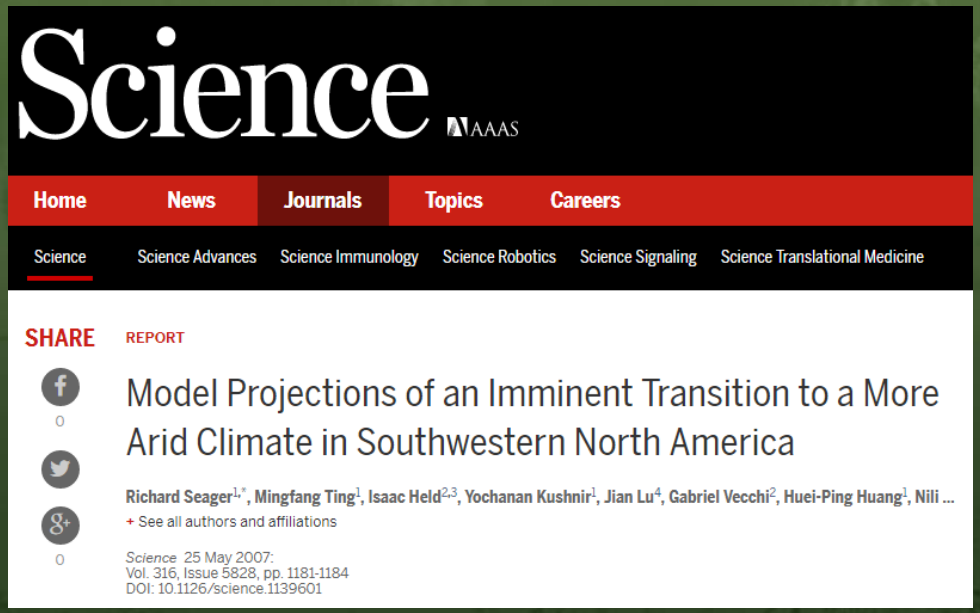
Research Letter

Revisiting the recent California drought as an extreme value

Scott M. Robeson

California's Drought

- Broad consensus that recent drought will be new climatology of SW



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REPORT

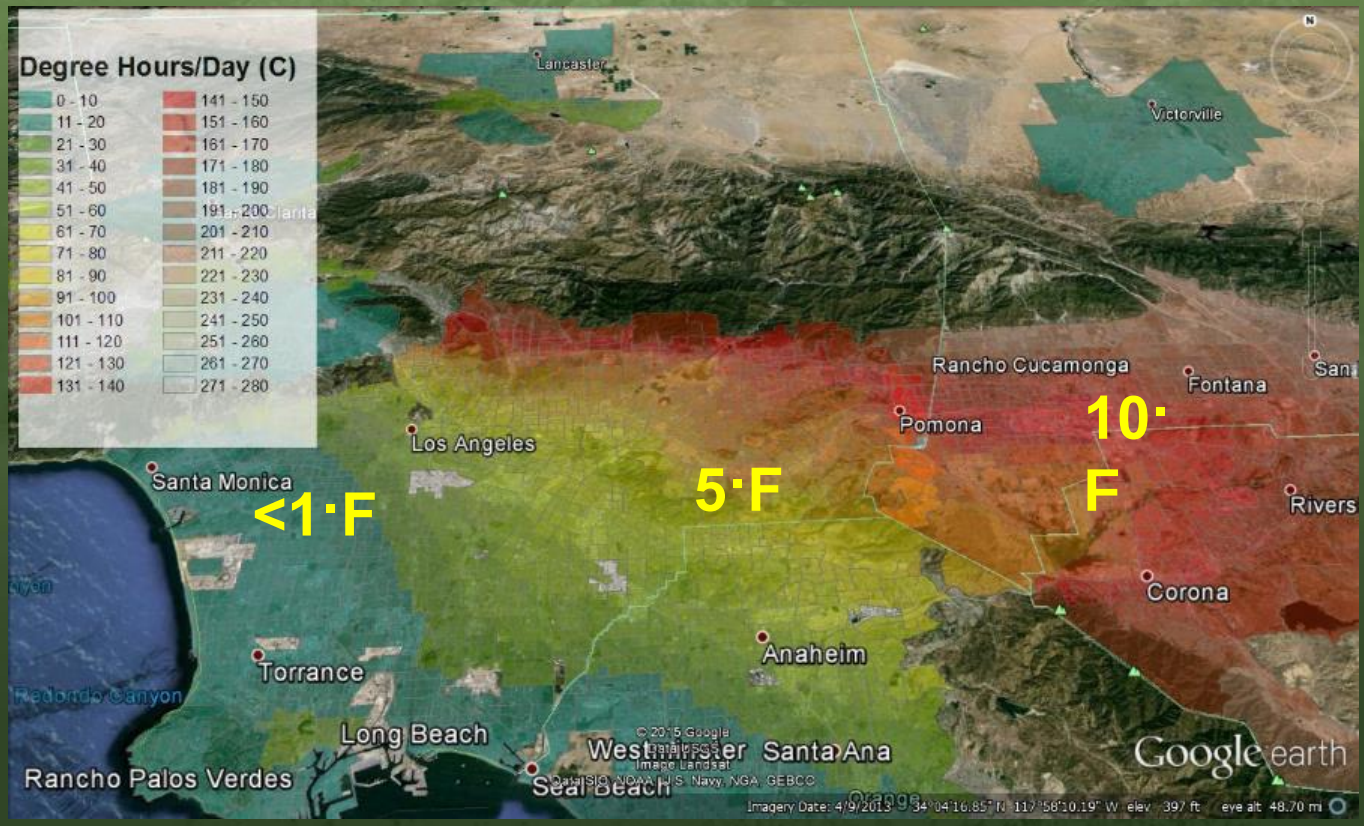
Model Projections of an Imminent Transition to a More Arid Climate in Southwestern North America

Richard Seager[1,*], Mingfang Ting[1], Isaac Held[2,3], Yochanan Kushnir[1], Jian Lu[4], Gabriel Vecchi[2], Huei-Ping Huang[1], Nili ...

+ See all authors and affiliations

Science 25 May 2007:
Vol. 316, Issue 5828, pp. 1181-1184
DOI: 10.1126/science.1139601

Urban Heat Island Index (Cal – EPA)



KMZ downloaded from http://www.calepa.ca.gov/UrbanHeat/Index.htm

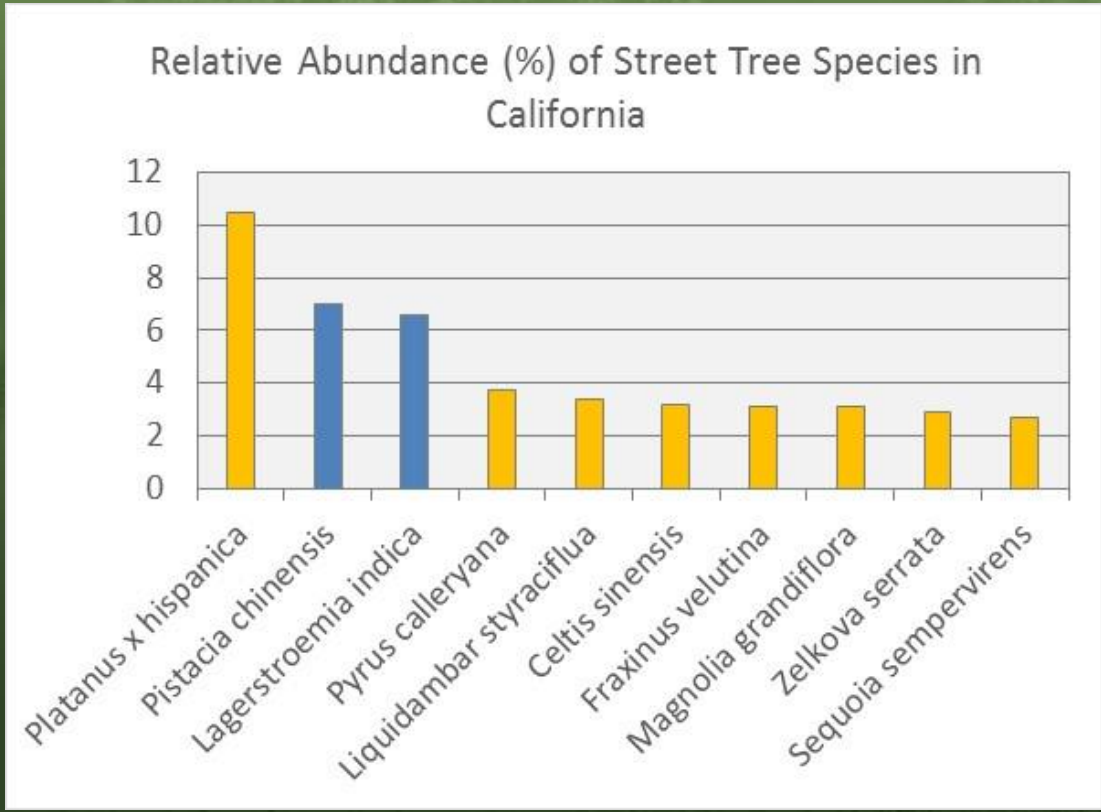
ctions

The Washington Post
Democracy Dies in Darkness

In declaring a drought emergency in April, Gov. Jerry Brown (D) said watering emerald-green grass every day "is a thing of the past." He neglected to say trees were exempt, so residents, businesses and local governments stopped watering them, too.

Now the state is losing millions of trees that beautify their cities, improve air quality, offer shade in areas where temperatures can reach 100 degrees and provide habitat for untold numbers of squirrels, birds and other animals.

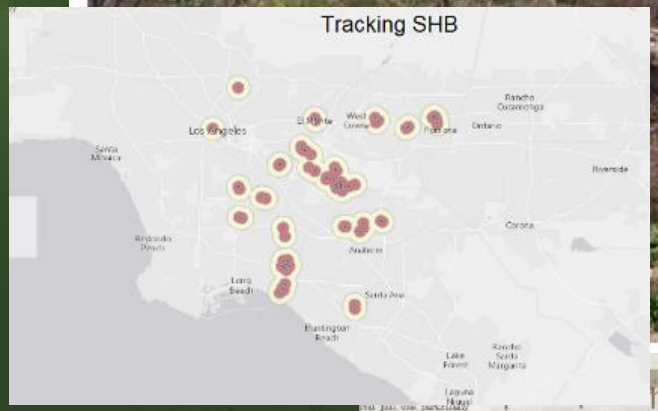
Vulnerability to Drought?



Los Angeles Tim

Newly discovered beetle decimates trees in Tijuana River Valley

September 1, 2016 by Nancy Aziz



Goal: Gradual Transition to More Stable, Healthy and Functional Landscapes

Déjà Vu?

- Risk management
  - Increase diversity
  - Phase out poorly-adapted species
- Primary point of leverage
  - Tree selection

McPherson, E.G.; van Doorn, N.S.; Teach, E. 2017. Evaluation of six drought tolerant trees 17 years after planting in Northern California. Western Arborist. 43(1): 32-37.

Adds increasing awareness of **potential climate change effects**

- Future exposures unlike now
- Regulatory & market-based incentives – GGRF, Water
- Sustainability – wildlife, food, end-of-life products
- Minimize disservices – water, roots, pollutants, maint. costs
- Infill – find space for trees
- Protection – extend service life

Climate-Ready Trees Study

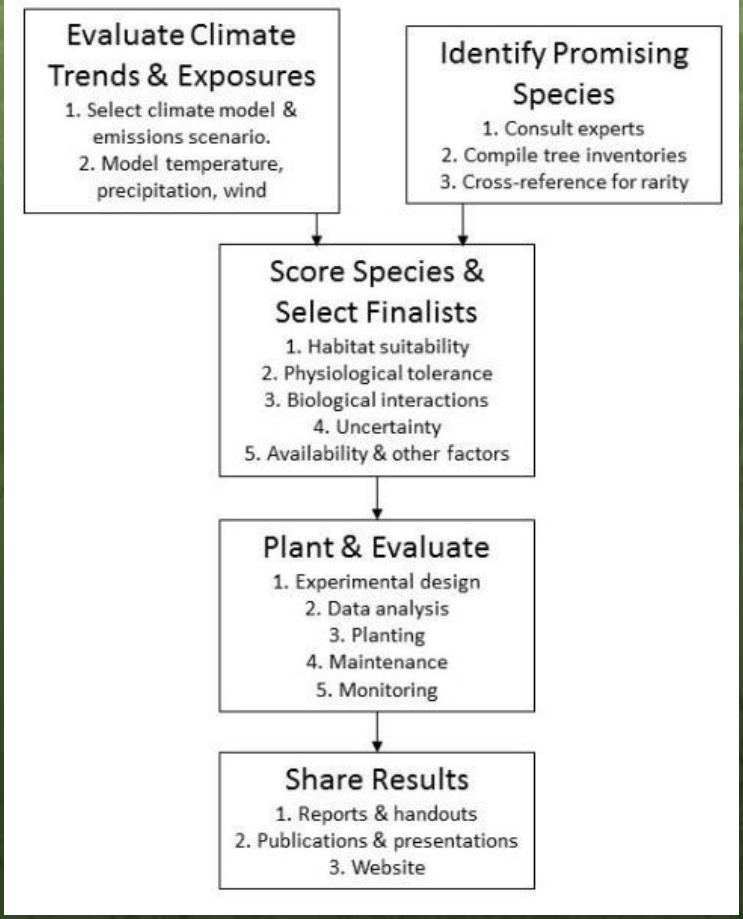
Drs. Greg McPherson, Natalie Van Doorn
Erika Teach
USDA Forest Service
PSW Research Station, Davis, CA

Dr. Alison Berry
Dept. of Plant Sciences
UC Davis, Davis, CA

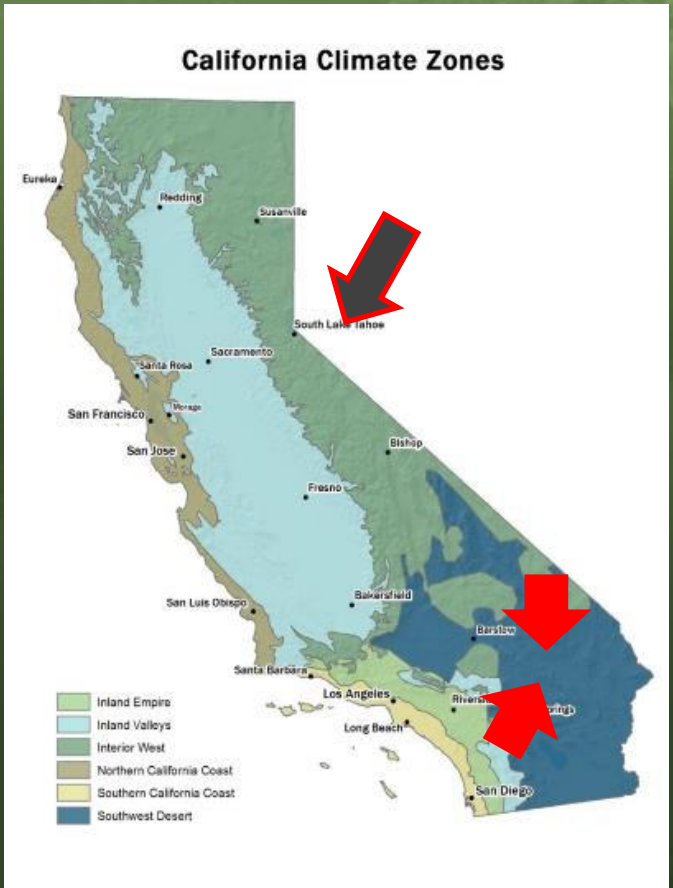
Drs. Jim Downer, Janet Hartin,
Darrel Haver
UC Cooperative Extension

McPherson, E.G.; Berry, A.M.; van Doorn, N.S. 2018. Performance testing to identify climate-ready trees. Urban Forestry & Urban Greening. 29: 28-39.

Five Step Process



Step 1: Climate Trends



Climate zones based on Brenzel (1997)

Study focus:

- Inland Valley, CA
- Inland Empire, CA
- Southern CA Coast

CalAdapt Climate Models Project Changes - 75 Years

1. Temperature (Hardiness)

- Central Valley: 1 ½ zone change
- Inland Empire & S. CA Coast: ½ zone change

2. Precipitation

- More uncertainty
- Generally: **more winter precip, less summer**.

Step 2: ID Promising Species

- Currently not abundant.
- Proven successful in regions with somewhat warmer climates.
- Planting stock currently available in nurseries.
- Diversity of size and genera.

Experts helped identify promising tree species.

Step 3: Score Species

Habitat	Physiology	Biological interactions
Soil moisture	Drought tolerance	Invasiveness
Soil texture and pH	Wind tolerance	Major or minor pest and disease threats
Sunlight exposure	Salt tolerance	Emerging pest and disease threats

Based on System for Assessing Vulnerability of Species (Bagne et al., 2012)

Added Special Features

Special Features		
Biogenic emissions	SelecTree	(+1) Species has low biogenic emissions.
Root damage potential	SelecTree	(+1) Species has low root damage potential.
Longevity	SelecTree	(+1) Species' longevity is over 150 years.
Carbon storage	Urban growth equations	(+1) relatively high biomass for stature class

Special Features (cont'd)		
Aesthetics	SelecTree	(+1) Species has flowers or fall colors.
Tree litter	SelecTree	(+1) Species produces minimal litter
Shade potential	SelecTree	(+1) Species has moderate OR moderately dense in and out of leaf shade capacity
Biodiversity	Municipal inventories	(+1) Species is <1% of total abundance in climate zone or not in top 10 importance value

12 Species Selected for Each Zone

Scientific Name	Common Name
California native	
Celtis reticulata	Netleaf hackberry
Hesperocyparis forbesii	Tecate cypress
Prunus ilicifolia ssp. Lyonii	Catalina cherry
Quercus tomentella	Island oak
Australia	
Acacia aneura	Mulga
Corymbia papuana	Ghost gum
Southwest US	
Mariosousa willardiana	Palo blanco
Oklahoma-Texas-Western US	
Prosopis glandulosa 'Maverick'	Maverick mesquite
Quercus fusiformis	Escarpment live oak
Asia/South America	
Dalbergia sissoo	Rosewood
Cedrela fissilis	Brazilian cedarwood
Other	
Pistacia 'Red Push'	Red Push pistache

Step 4: Plant and Evaluate

- Climate Zones
  - Central Valley
  - Coastal SoCal
  - Inland SoCal
- Reference Sites
  - 4 replicates
  - Excellent care
- Park Sites
  - 4 parks
  - 2 replicates each
  - Variable care


Climate Ready Tree Sites
Climate Ready Tree Parks
Reference Sites
Inland
Coastal
Holleigh Bernson Memorial Park
Hansen Dam Recreation Areas
Valley Plaza
Woodley Park
Jim Gilliam Recreation Center
Westchester
Vista Del Mar
Bogdanovich
UC Riverside Citrus Research Center
UC South Coast Research and Extension Center
N
0 3.75 7.5 15 22.5 30
Miles
© OpenStreetMap (and) contributors, CC-BY-SA

Planting days

Tree Monitoring

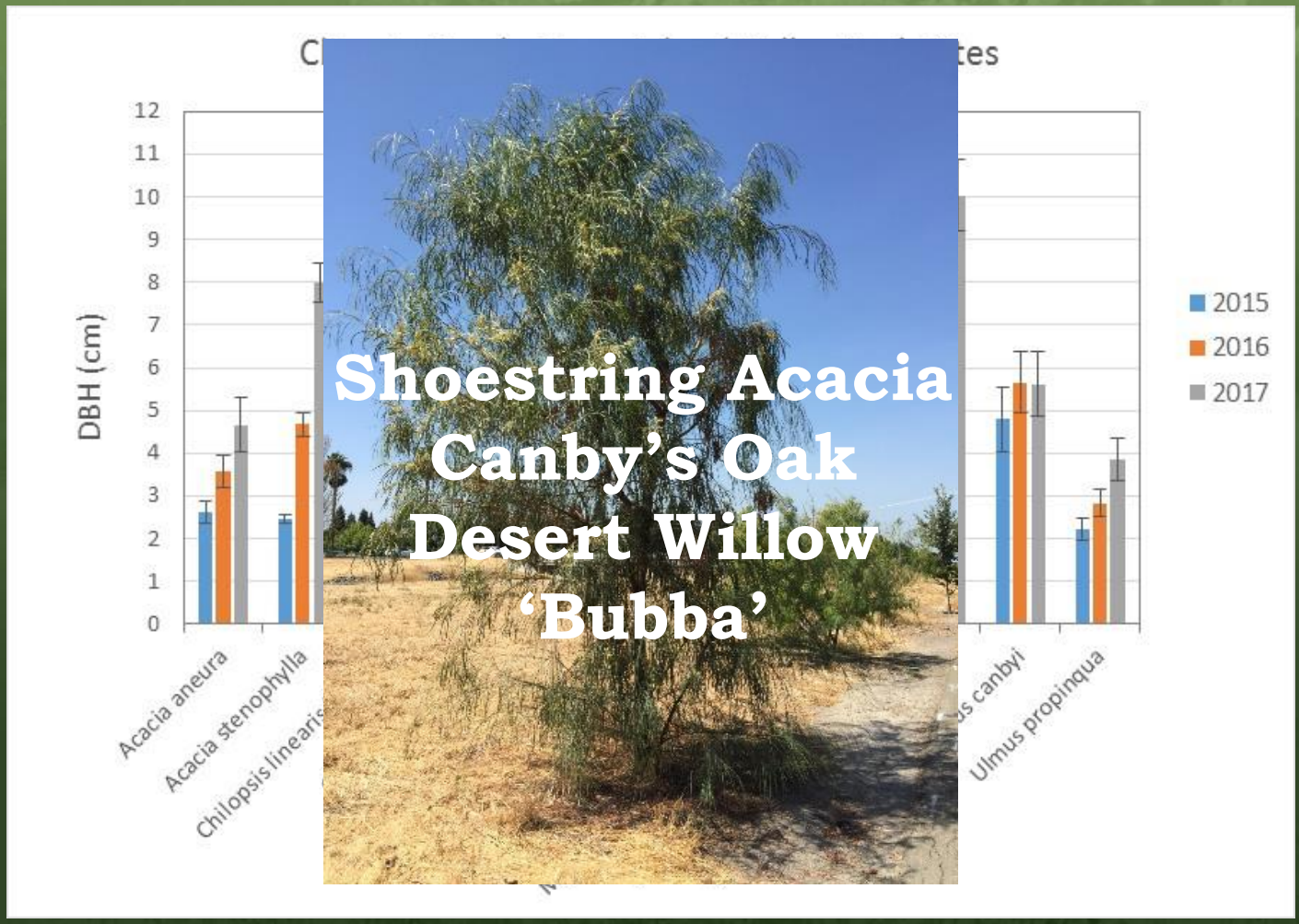
When?
- Every year for first 5 years
- Every 3 years after that

Measurements:
- Tree size: height, DBH, canopy diameter.
- Soil type: texture, nutrients, bulk density

Monitor:
- Tree structure (branching, roots)
- Pruning done
- Any pests or diseases
- Potential causes for mortality

Environmental factors:
- Irrigation applied
- ET, minimum temperatures (CIMIS)

Data Analyses



Step 5: Share Results

http://climatereadytrees.ucdavis.edu/

Urban Tree Database

- USDA Forest Service – 14 year effort
- 14,400 trees in 17 U.S. cities
- 171 unique species
- 365 sets of growth curves (1,825 equations)

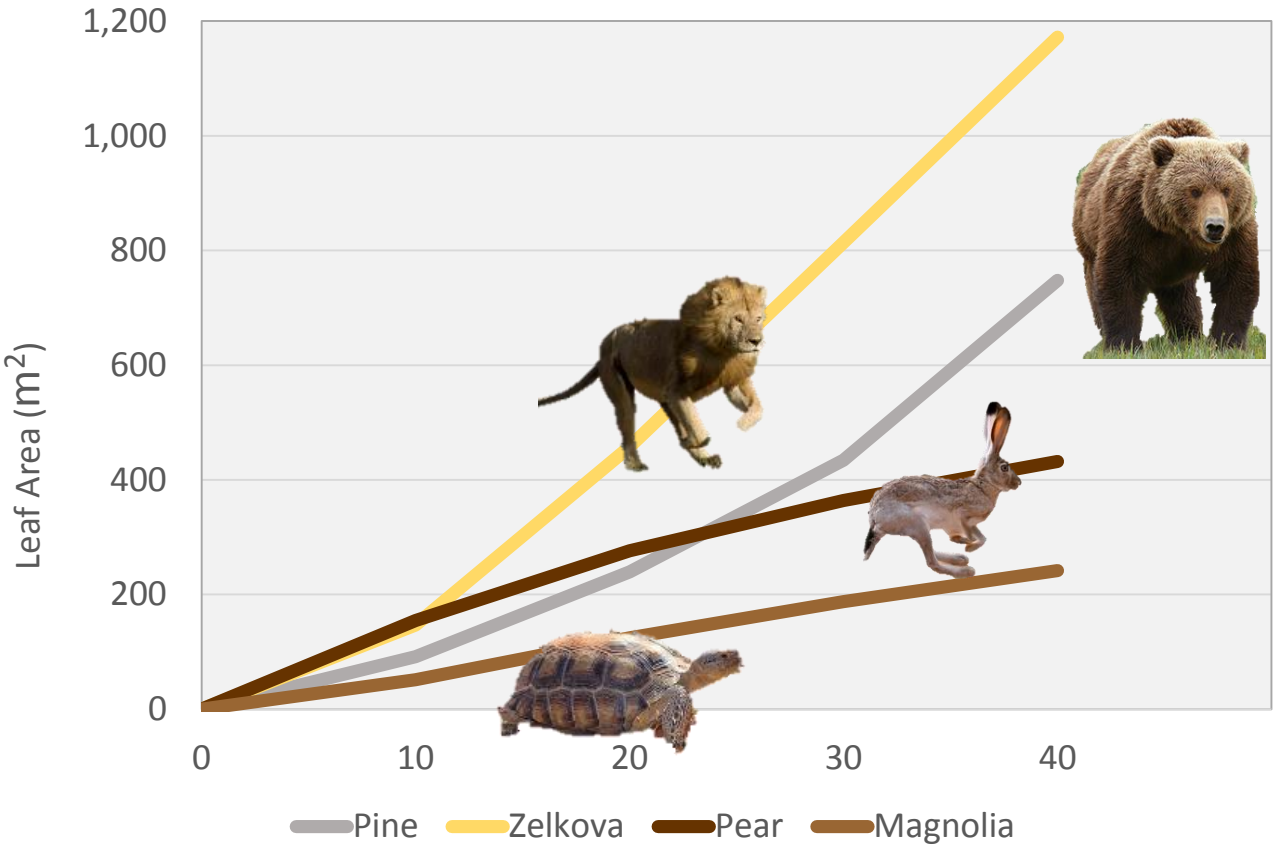
From Age to DBH

From DBH

- Tree Height
- Crown Diameter
- Crown Height
- Leaf Area
- Crown Projection

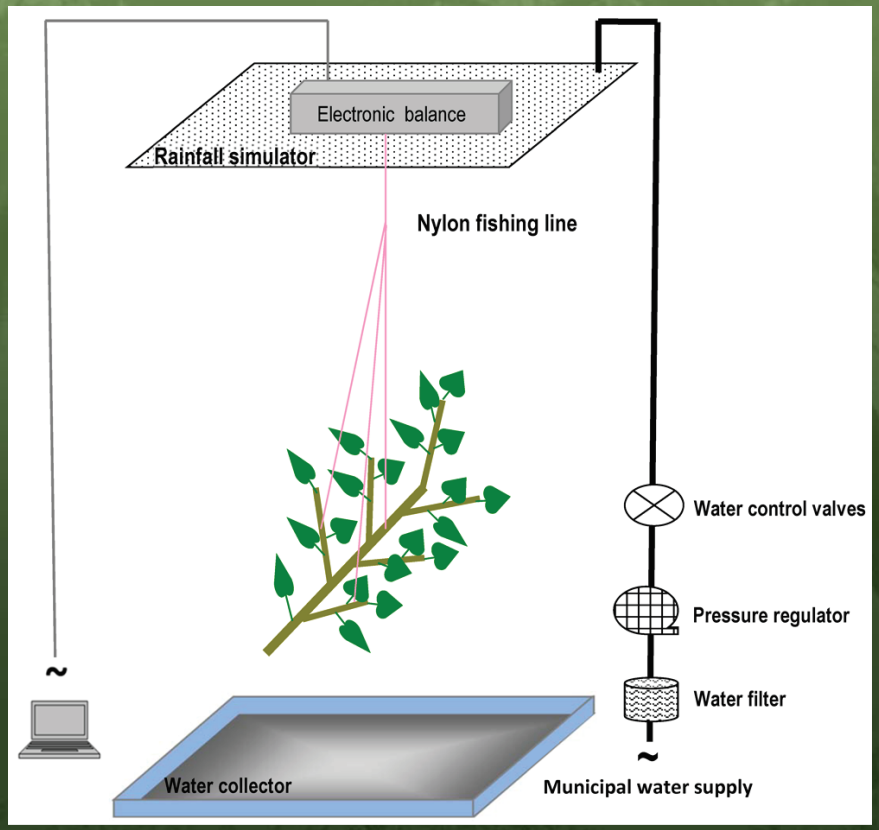
http://dx.doi.org/10.2737/RDS-2016-0005

Growth Rate & Mature Size



Surface Storage of Rainfall

- Urban forests and GI
  - Soil storage
  - Crown storage
- Interception
  - Total leaf & stem area
  - Foliation period
  - Surface storage depth
- Rainfall simulator



Findings

- Three-fold difference among species
- Four-fold for leaves vs. stems only
- Surface traits critical

Surface Water Storage (mm)

- Low (0.5-0.7)
- Moderate (0.7-0.8)
- High (0.8-1)
- Very High (1-1.8)

Carbon Storage & Wood Density (kg/m^3)

- Low (360-420)
- Moderate (420-500)
- High (500-600)
- Very High (600-820)

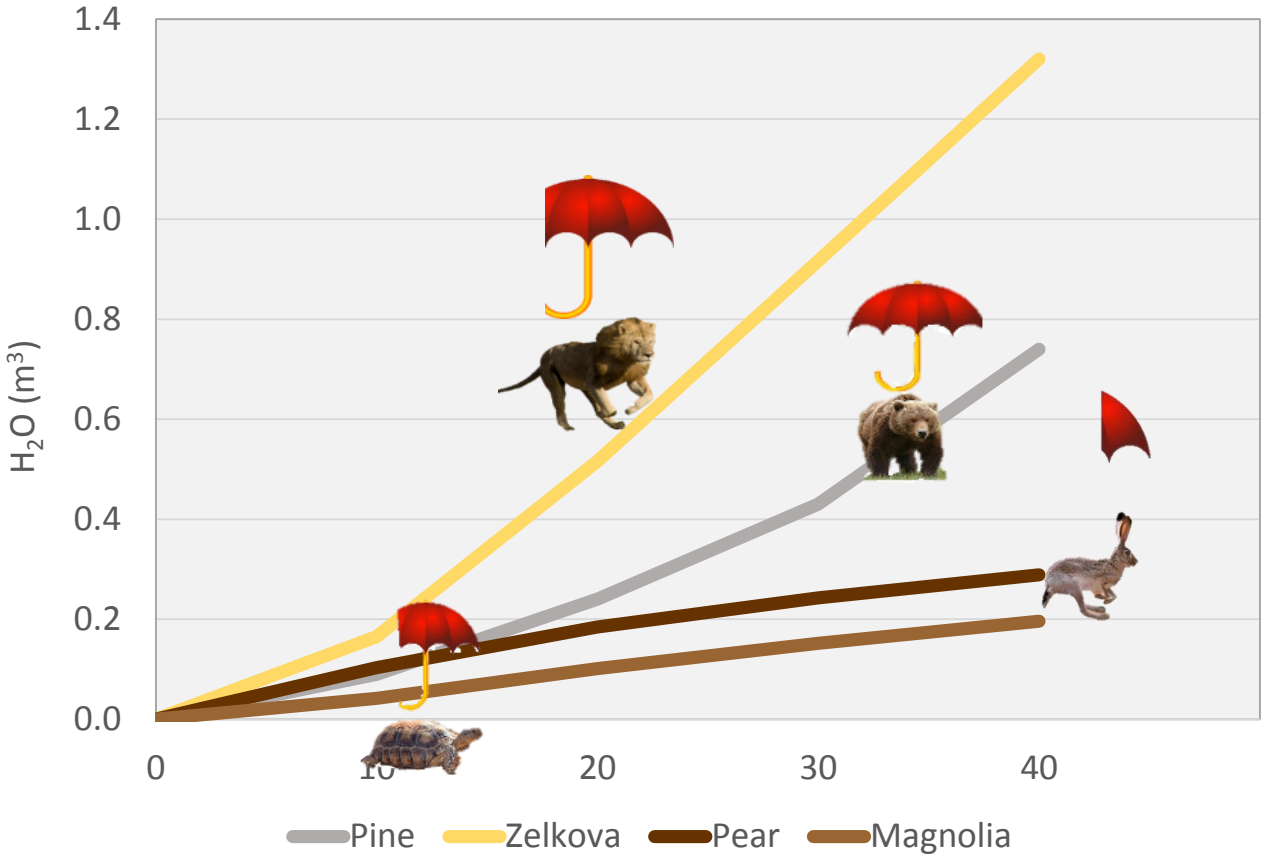
Carbon dioxide stored per tree at each 5-year interval for 40 years (kg).

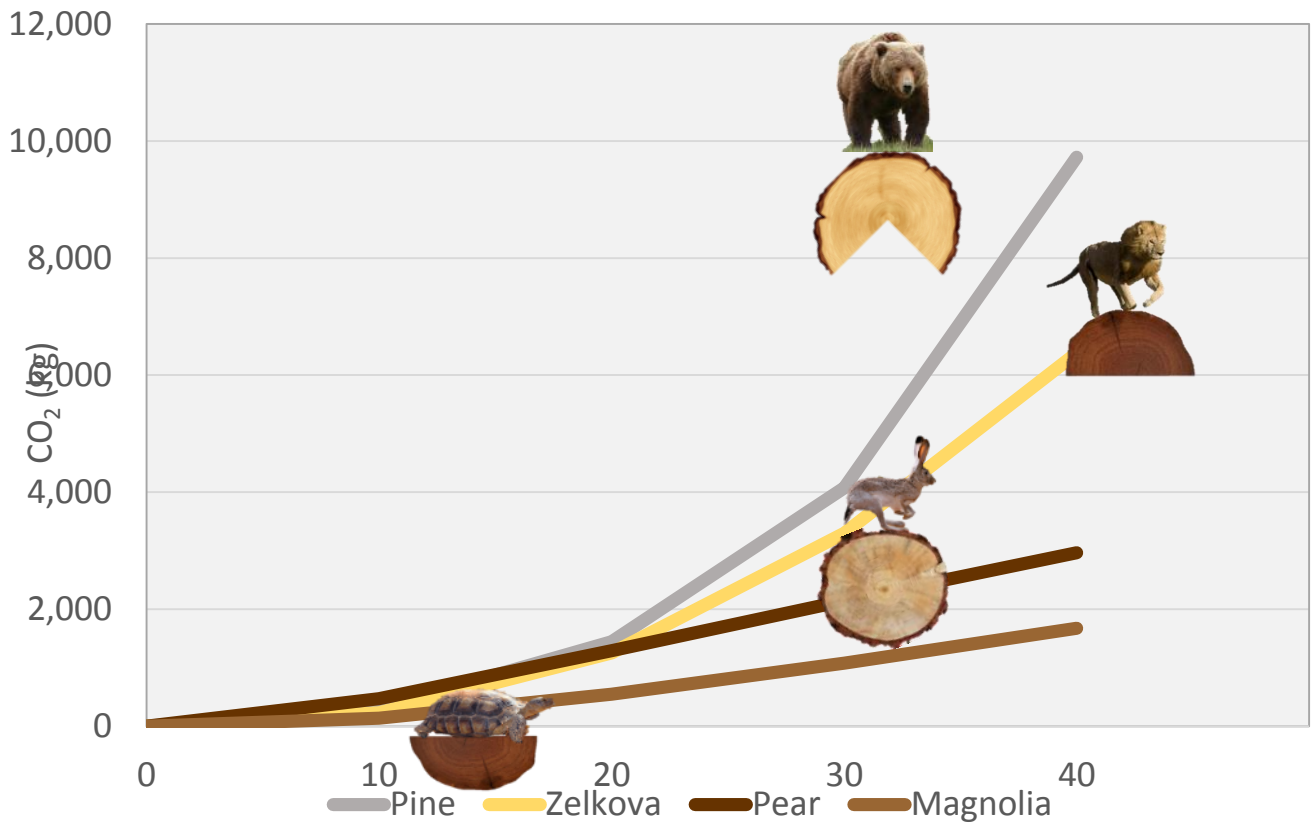
Growth / Size	Botanical Name	5	10	15	20	25	30	35	40	DW Density (kg/m3)
	Celtis sinensis	217	665	1,201	1,749	2,278	2,780	3,267	3,761	490
	Quercus ilex	28	127	331	674	1,188	1,906	2,858	4,075	820
	Pinus canariensis	62	305	754	1,444	2,483	4,074	6,483	9,722	610
	Fraxinus angustifolia	34	109	223	367	531	706	880	1,046	510
	Gleditsia triacanthos	77	238	502	880	1,378	2,004	2,764	3,661	600
	Picea pungens	16	74	179	330	523	756	1,026	1,332	360
	Eucalyptus globulus	87	463	1,238	2,442	4,058	6,044	8,350	10,923	620
	Fraxinus uhdei	173	927	2,097	3,530	5,136	6,864	8,680	10,559	510
	Ginkgo biloba	48	203	459	793	1,178	1,595	2,030	2,474	520
	Lagerstroemia indica	38	104	187	278	370	460	551	647	571
	Liquidambar styraciflua	51	193	445	813	1,287	1,854	2,497	3,195	460
	Pistacia chinensis	48	250	580	998	1,477	1,997	2,546	3,115	685
	Platanus x acerifolia	38	145	346	654	1,078	1,620	2,281	3,059	500
	Pyrus calleryana	250	469	870	1,292	1,718	2,142	2,558	2,966	600
	Quercus lobata	46	181	408	716	1,095	1,528	2,002	2,505	550
	Zelkova serrata	45	231	620	1,250	2,142	3,300	4,717	6,375	520
	Cinnamomum camphora	60	244	586	1,102	1,793	2,652	3,663	4,808	520
	Magnolia grandiflora	25	138	320	545	801	1,077	1,369	1,672	460
	Sequoia sempervirens	34	256	818	1,838	3,416	5,623	8,513	12,114	380
	Pinus pinea	22	103	280	589	1,062	1,734	2,635	3,799	500

Potential rainfall stored per tree at each 5-year interval for 40 years (gals).

Leaf Area 40 Yrs. (m2)	CommonName	5	10	15	20	25	30	35	40	Sur. Stor. Cap. (mm)
426	Chinese hackberry	9	27	45	62	77	90	102	114	0.71
608	holly oak	6	14	25	39	57	79	104	13	0.82
748	Canary Island pine	8	24	43	63	86	114	149	19	0.99
241	Raywood ash	1	4	10	18	27	36	45	5	0.6
303	honeylocust	1	4	9	16	26	38	52	7	0.67
409	blue spruce	14	39	67	95	123	149	173	1	1.81
681	blue gum eucalyptus	12	29	46	63	80	96	111	1	0.7
809	evergreen ash	9	33	59	83	106	128	148	1	0.78
269	ginkgo	3	10	18	26	34	42	50	5	0.64
107	crapemyrtle	3	5	8	10	12	14	15	1	0.59
659	sweetgum	20	49	81	113	145	175	203	2	0.95
577	Chinese pistache	19	59	98	133	164	193	220	2	1.17
630	London planetree	15	37	62	90	118	147	175	2	0.87
432	Callery pear	13	27	39	49	57	64	71		0.51
539	valley oak	12	35	61	87	114	139	163	1	0.91
1,172	Japanese zelkova	12	44	87	136	189	242	296	3	0.84
538	camphor tree	6	18	33	48	64	81	97	1	0.79
242	southern magnolia	3	11	19	27	34	40	46	5	0.81
757	coast redwood	10	28	53	83	117	154	193	232	1.16
704	Italian stone pine	4	12	27	48	75	109	148	193	1.04

Rainfall Intercepted (m^3)




Carbon Dioxide Stored (kg)
12,000
10,000
8,000
6,000
4,000
2,000
0
CO_2 (kg)
0
10
20
30
40
Pine
Zelkova
Pear
Magnolia

Conclusions

- What Benefits? When?
  - Improved models
  - Improved biometrics (UTD)
- Climate-Ready Tree Evaluation
  - Goal: Shift palette, gradual transition
- Right Tree, Right Place,
  Right Purpose, Right Time

Right Tree, Right Place

- Space
- Soil
- Social
- Safety

Context-Sensitive Selection

- Street
- Neighborhood
- City
- Stewardship

Right Purpose, Right Time

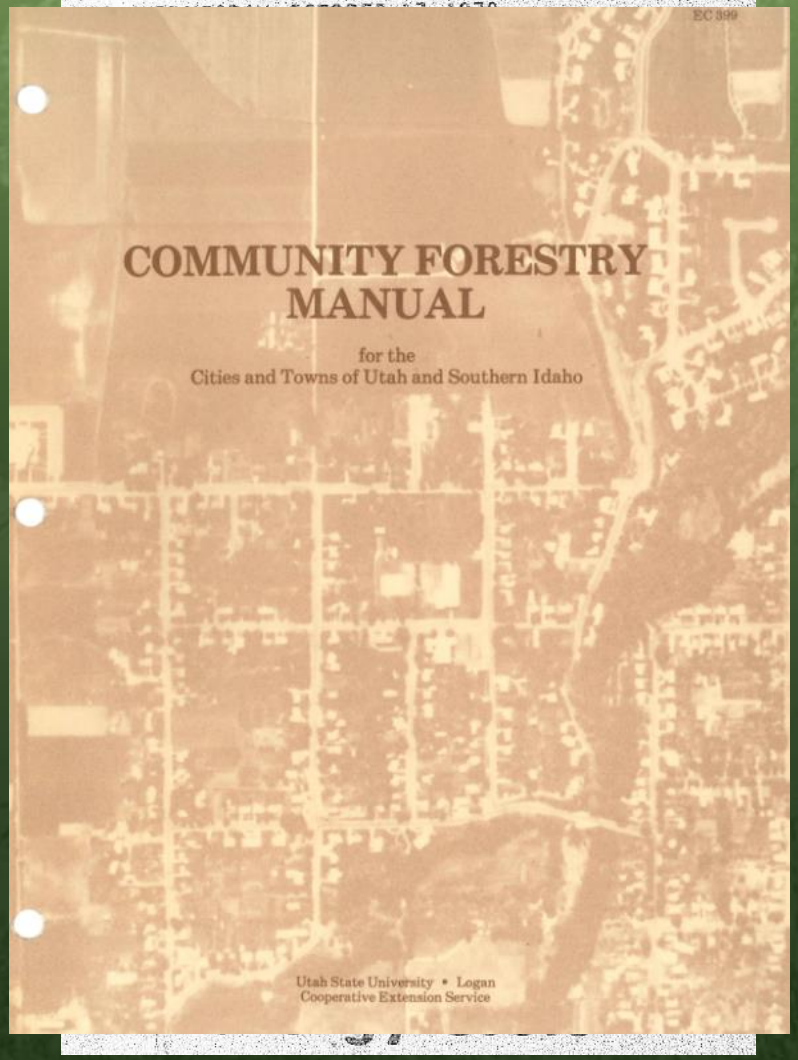
- What Purposes?
- When in Future?

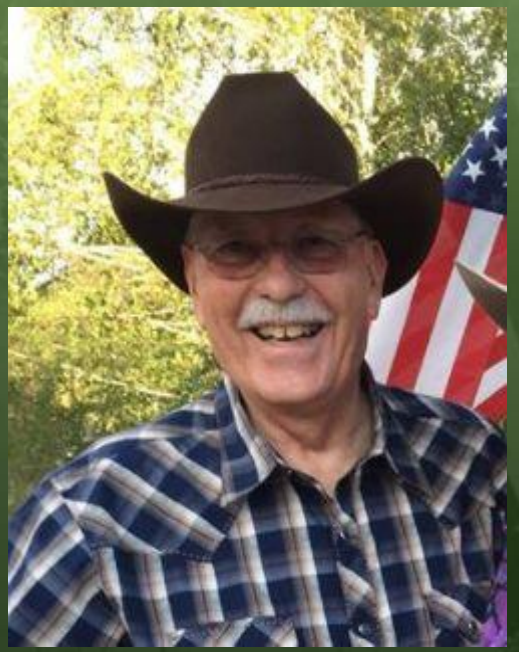
Questions?

http://www.fs.fed.us/psw/topics/urban_forestry/

Reflections and Tributes

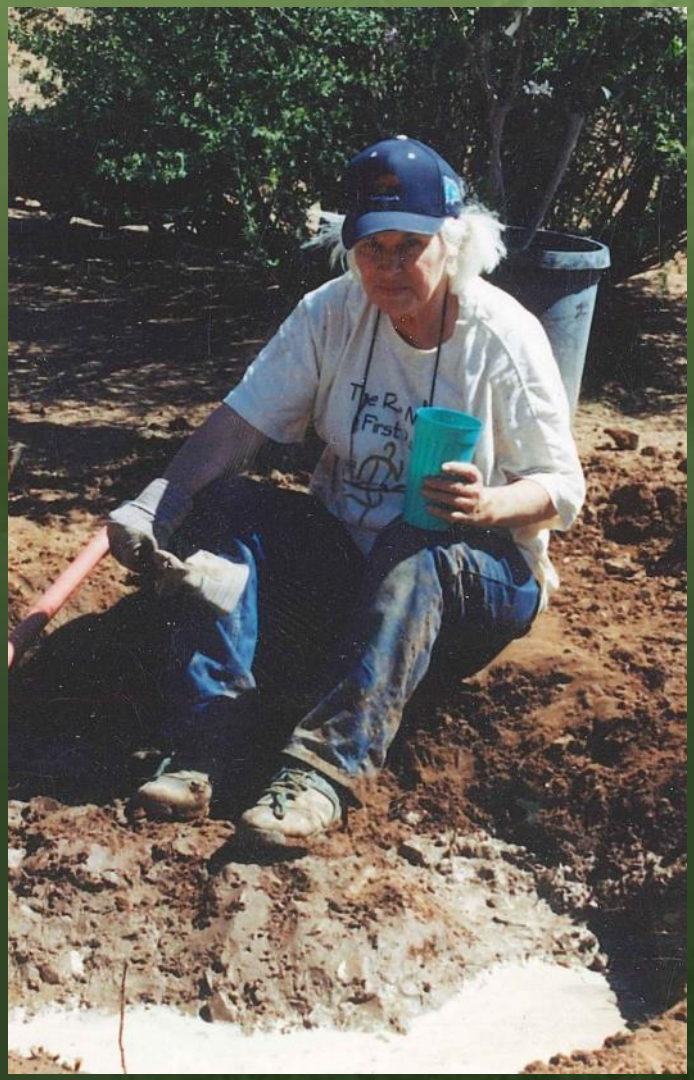
Craig Johnson & Fred Deneke





Rowan Rowntree

Joan Lionetti



Tucson & Ariz

hursday, November 5, 1987 Tucson Citizen

GARY GAYNOR/Tucson Citize

Howard Gerson, who owns a demolition company, saved the eucalyptus tree in the background.

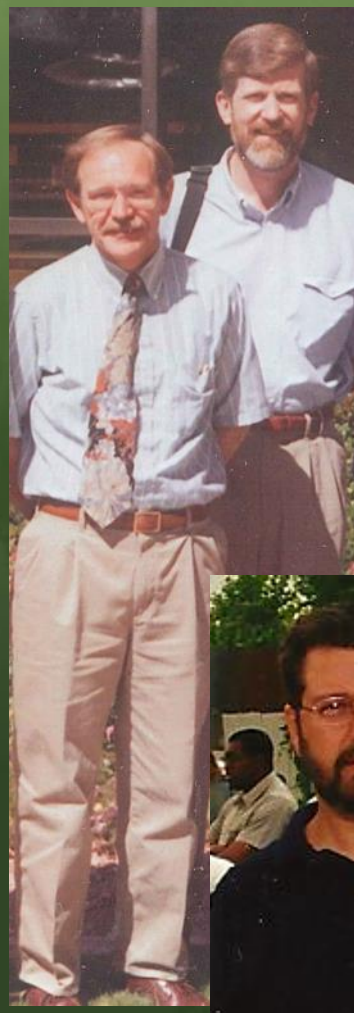
Demolition expert turned tree savior to be honored

By STELLA PEÑA
Citizen Staff Writer

increase public awareness of the value of trees, which he said are as

saving the tree. The assistant phys cal plant director agreed and

Ray Tretheway



June 1, 1995

The Honorable Ralph Regula
Chairman, Appropriations Subcommittee on
Interior and Related Agencies
B 308 Rayburn House Office Building
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

The Alliance for Community Trees, the American Association of Nurserymen, American Forests, the International Society of Arboriculture, the National Arbor Day Foundation, the National Association of State Foresters, the National Urban and Community Forestry Advisory Council, and the National Urban Forest Council are joining together to urge your continued strong support for the Urban and Community Forestry (U&CF) and Urban Forestry Research (UFR) programs within the USDA Forest Service. While we recognize the need to make tough choices and reduce the Federal deficit, we strongly believe funding of the U&CF and UFR programs is imperative.

Over 80 percent of our citizens now live in towns and cities. It is incumbent upon us to recognize this population shift from rural areas and it's implications on where we must serve our citizens. The urban forest resource has major, direct impacts on the quality of life for the vast majority of Americans. With over 69 million acres of urban forests, an increased emphasis in urban and community programs is in line with national needs.

We must also come to better understanding of the sociological and economic benefits of trees in the urban ecosystem, and especially the benefits to our multi-cultural urban population. These increasingly concentrated populations must have improved access to natural experiences which reduce stress and tendencies towards conflict. Support for U&CF and UFR programs will facilitate this understanding and allow resource managers to take proactive steps to address these problems.

Research has shown that trees and other plants can positively alter the urban environment. Trees moderate climate, improve air quality through carbon dioxide sequestration and air pollution reduction, conservation and cycling of water, erosion control, reducing energy costs and directly improving the quality of urban life. However, in order for the urban forest to perform to its fullest potential, current research efforts must be maintained and expanded.

Many advances have been made in urban forestry in recent years, yet much more needs to be done. We hope that you share our concerns and will support funding for U&CF and UFR as you prioritize program needs. Please call upon us for additional information or support.

Respectfully.

Alliance for Community Trees

American Forests

National Arbor Day Foundation

National Urban & Community
Forestry Advisory Council

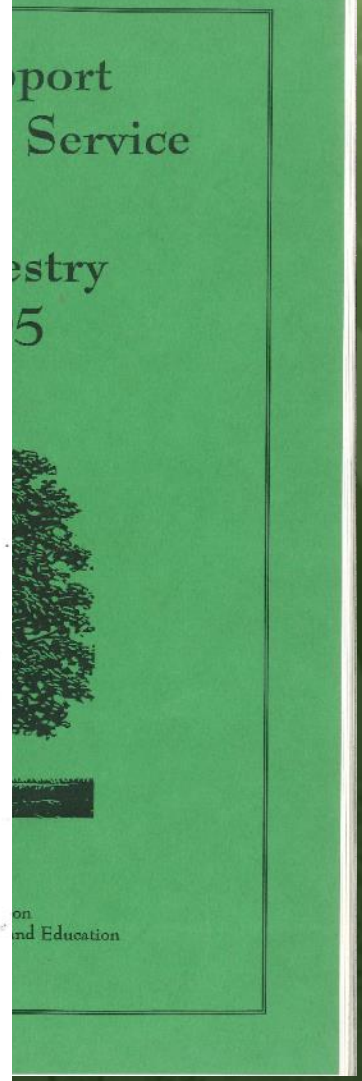
American Association of Nurserymen

International Association of Arboriculture

National Association of State Foresters

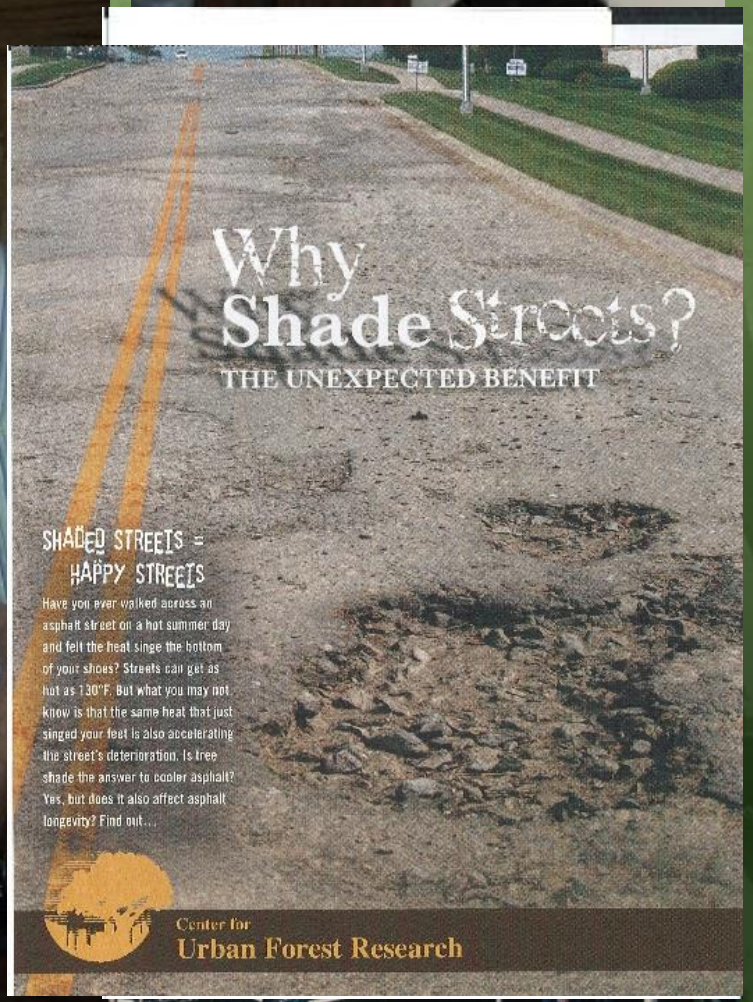
National Urban Forest Council

cc: Jack Ward Thomas, Chief, USDA Forest Service

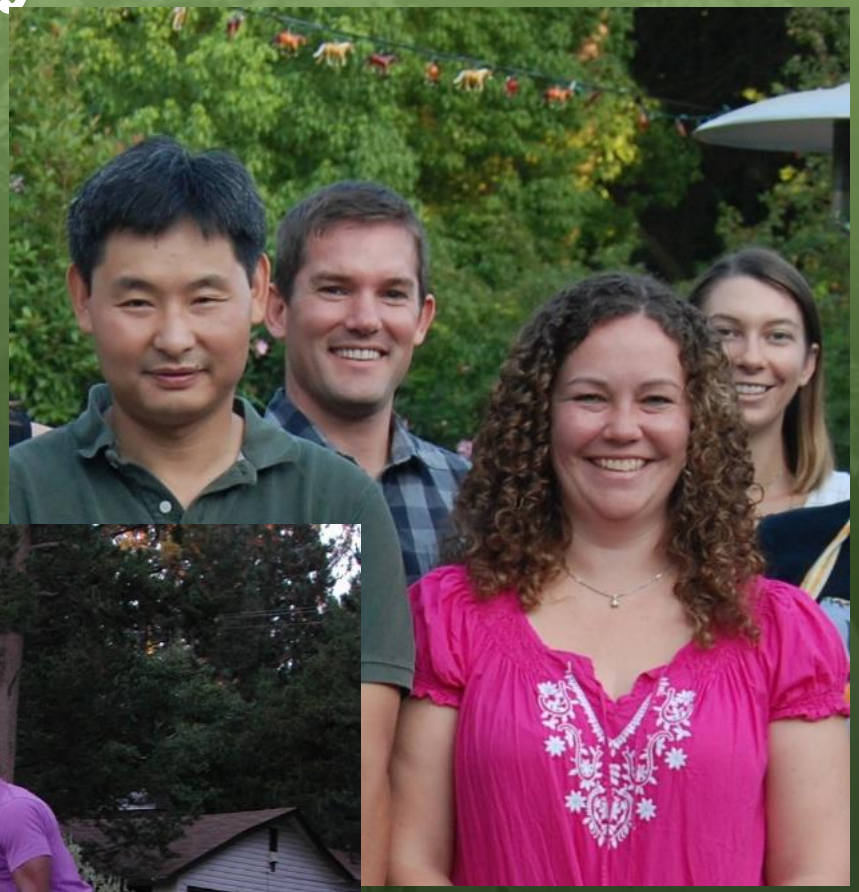


American Forests, ACT, Andy, Shannon, Marcia, Nancy and Others

Jim Simpson, Palua Peper, Qingfu Xiao and Jim Geiger



Tommy, Kelaine, Scott, Sara, Dan and So Many Others



Pacific Southwest Research Station
Urban Forest Research Products
1992 - 2017

Jim Simpson, Paula Peper, Qingfu Xiao and Jim Geiger's talents were primary in producing these products and more for our customers

https://www.fs.fed.us/psw/topics/urban_forestry

Natalie van Doorn
Erika Teach

Thank You One and All!