Tree Selection

Factors to Consider in an Era of Global Climate Chaos, Droughts, and Decreasing Diversity

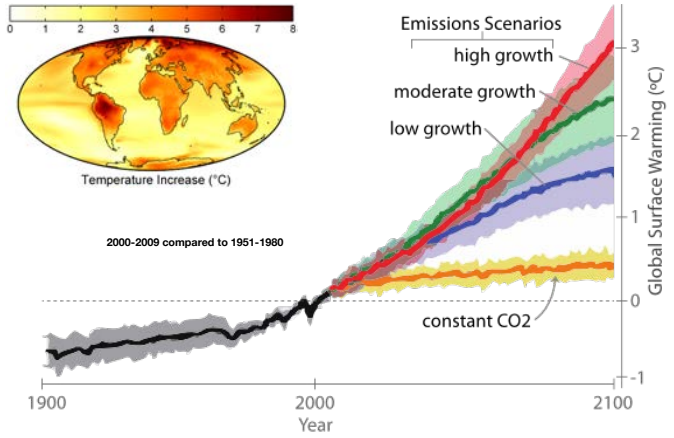
Matt Ritter, Ph.D.

CAL POLY

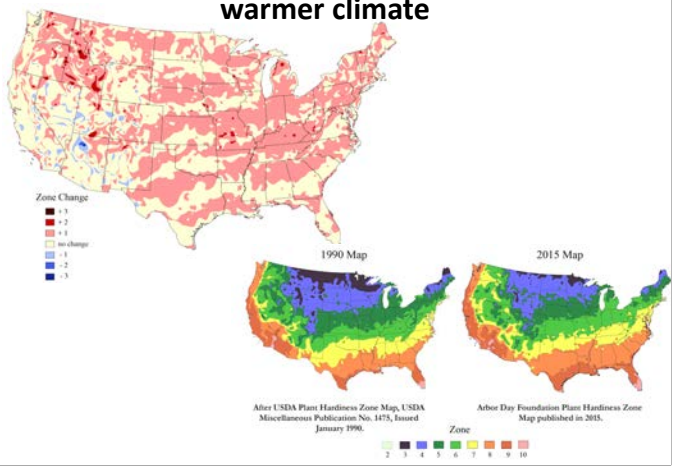
Statistical Abnormalities

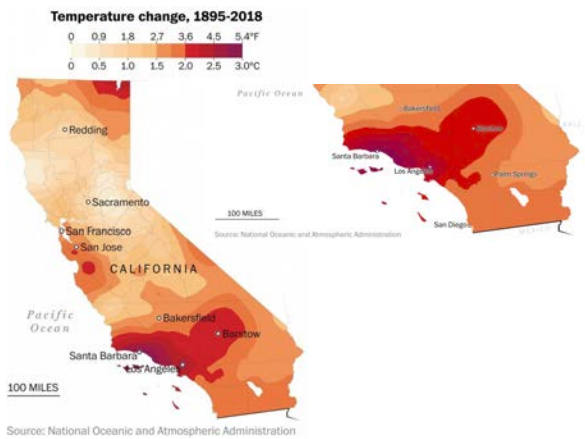
- 16 of the 17 warmest years on record have occurred since 2000
- 15 of the 20 worst fires in California history have occurred since 2000

Climate Change Projections

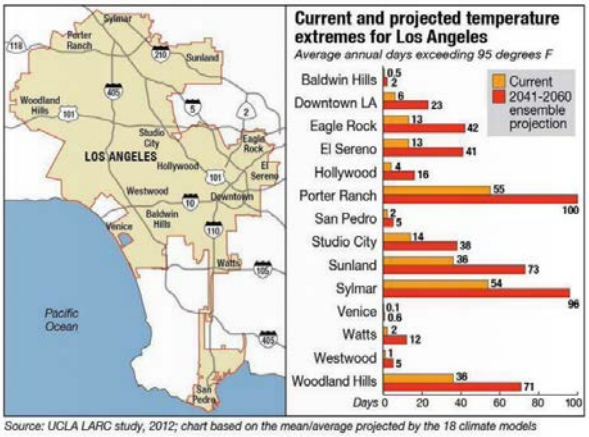


Arbor Day Foundation hardiness zones reflect warmer climate





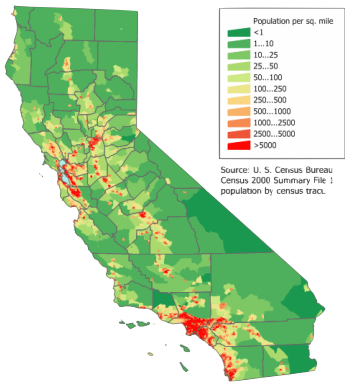
Los Angeles Is Projected to Get Hotter

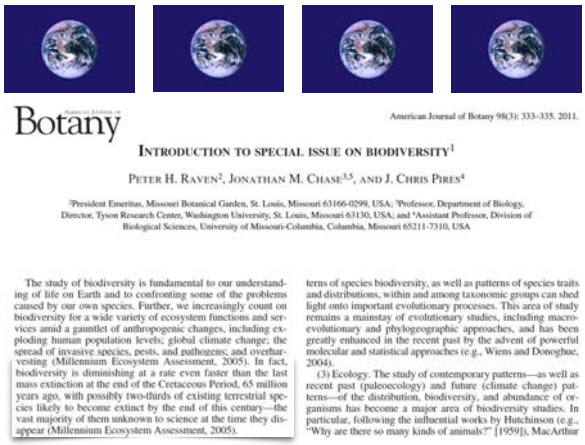


Source: UCLA LARC study, 2012; chart based on the mean/average projected by the 18 climate models

California

- Populations ~40 million
- > 3/4 of the original wild habitat has been lost in 250 years





Botany

American Journal of Botany 98(3): 333–335. 2011.

Introduction to special issue on biodiversity[1]

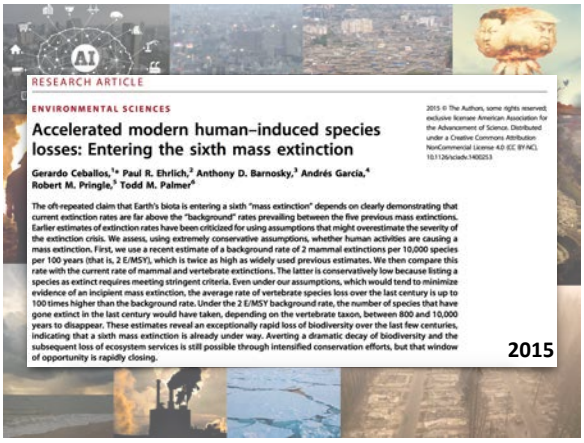
Peter H. Raven[2], Jonathan M. Chase[3,5], and J. Chris Pires[4]

[2]President Emeritus, Missouri Botanical Garden, St. Louis, Missouri 63166-0299, USA; [3]Professor, Department of Biology, Director, Tyson Research Center, Washington University, St. Louis, Missouri 63130, USA; and [4]Assistant Professor, Division of Biological Sciences, University of Missouri-Columbia, Columbia, Missouri 65211-7310, USA

The study of biodiversity is fundamental to our understanding of life on Earth and to confronting some of the problems caused by our own species. Further, we increasingly count on biodiversity for a wide variety of ecosystem functions and services amid a gauntlet of anthropogenic changes, including exploding human population levels; global climate change; the spread of invasive species, pests, and pathogens; and overharvesting (Millennium Ecosystem Assessment, 2005). In fact, biodiversity is diminishing at a rate even faster than the last mass extinction at the end of the Cretaceous Period, 65 million years ago, with possibly two-thirds of existing terrestrial species likely to become extinct by the end of this century—the vast majority of them unknown to science at the time they disappear (Millennium Ecosystem Assessment, 2005).

terns of species biodiversity, as well as patterns of species traits and distributions, within and among taxonomic groups can shed light onto important evolutionary processes. This area of study remains a mainstay of evolutionary studies, including macroevolutionary and phylogeographic approaches, and has been greatly enhanced in the recent past by the advent of powerful molecular and statistical approaches (e.g., Wiens and Donoghue, 2004).

(3) Ecology. The study of contemporary patterns—as well as recent past (paleoecology) and future (climate change) patterns—of the distribution, biodiversity, and abundance of organisms has become a major area of biodiversity studies. In particular, following the influential works by Hutchinson (e.g., "Why are there so many kinds of animals?" [1959]), MacArthur



RESEARCH ARTICLE

ENVIRONMENTAL SCIENCES

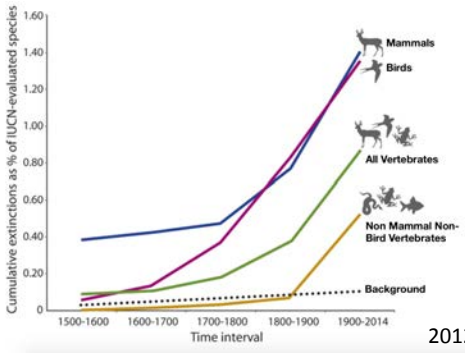
Accelerated modern human–induced species losses: Entering the sixth mass extinction

Gerardo Ceballos,[1]* Paul R. Ehrlich,[2] Anthony D. Barnosky,[3] Andrés García,[4] Robert M. Pringle,[5] Todd M. Palmer[6]

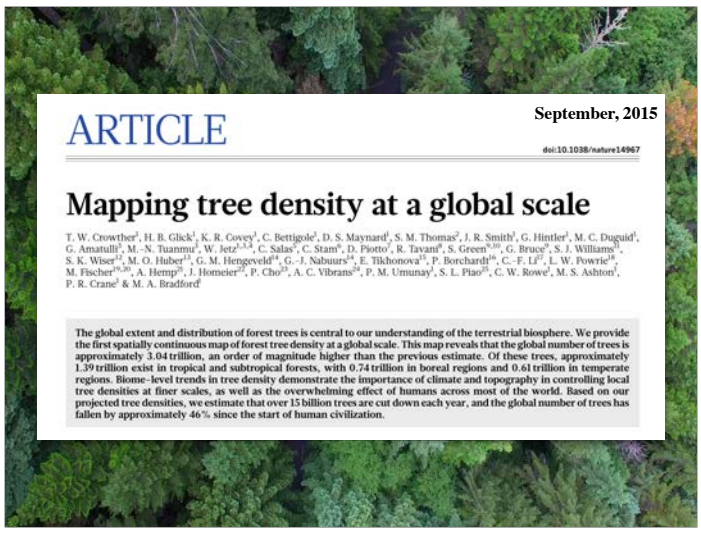
The oft-repeated claim that Earth's biota is entering a sixth "mass extinction" depends on clearly demonstrating that current extinction rates are far above the "background" rates prevailing between the five previous mass extinctions. Earlier estimates of extinction rates have been criticized for using assumptions that might overestimate the severity of the extinction crisis. We assess, using extremely conservative assumptions, whether human activities are causing a mass extinction. First, we use a recent estimate of a background rate of 2 mammal extinctions per 10,000 species per 100 years (that is, 2 E/MSY), which is twice as high as widely used previous estimates. We then compare this rate with the current rate of mammal and vertebrate extinctions. The latter is conservatively low because listing a species as extinct requires meeting stringent criteria. Even under our assumptions, which would tend to minimize evidence of an incipient mass extinction, the average rate of vertebrate species loss over the last century is up to 100 times higher than the background rate. Under the 2 E/MSY background rate, the number of species that have gone extinct in the last century would have taken, depending on the vertebrate taxon, between 800 and 10,000 years to disappear. These estimates reveal an exceptionally rapid loss of biodiversity over the last few centuries, indicating that a sixth mass extinction is already under way. Averting a dramatic decay of biodiversity and the subsequent loss of ecosystem services is still possible through intensified conservation efforts, but that window of opportunity is rapidly closing.

2015

Cumulative vertebrate species recorded as extinct by the International Union of Conservation of Nature



2012 data



ARTICLE

September, 2015

doi:10.1038/nature14967

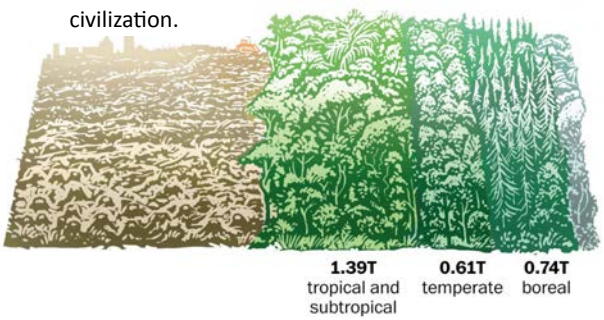
Mapping tree density at a global scale

T. W. Crowther[1], H. B. Glick[1], K. R. Covey[1], C. Bettigole[1], D. S. Maynard[1], S. M. Thomas[2], J. R. Smith[1], G. Hintler[1], M. C. Duguid[1], G. Amatulli[1], M.-N. Tuanmu[1], W. Jetz[1,3,4], C. Salas[5], C. Stam[6], D. Piotto[7], R. Tavani[8], S. Green[9,10], G. Bruce[9], S. J. Williams[11], S. K. Wiser[12], M. O. Huber[13], G. M. Hengeveld[14], G.-J. Nabuurs[15], E. Tikhonova[16], P. Borchardt[16], C.-F. Li[17], L. W. Powrie[18], M. Fischer[19,20], A. Hemp[21], J. Homeier[22], P. Cho[23], A. C. Vibrans[24], P. M. Umunay[4], S. L. Piao[25], C. W. Rowe[4], M. S. Ashton[1], P. R. Crane[1] & M. A. Bradford[1]

The global extent and distribution of forest trees is central to our understanding of the terrestrial biosphere. We provide the first spatially continuous map of forest tree density at a global scale. This map reveals that the global number of trees is approximately 3.04 trillion, an order of magnitude higher than the previous estimate. Of these trees, approximately 1.39 trillion exist in tropical and subtropical forests, with 0.74 trillion in boreal regions and 0.61 trillion in temperate regions. Biome-level trends in tree density demonstrate the importance of climate and topography in controlling local tree densities at finer scales, as well as the overwhelming effect of humans across most of the world. Based on our projected tree densities, we estimate that over 15 billion trees are cut down each year, and the global number of trees has fallen by approximately 46% since the start of human civilization.

6.1 trillion trees before the advent of human civilization.

3.04 trillion trees remain.



1.39T tropical and subtropical

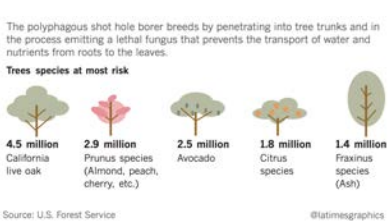
0.61T temperate

0.74T boreal

Each year 15 billion trees cut down and not replaced

Drought, Dying Trees, and Disease

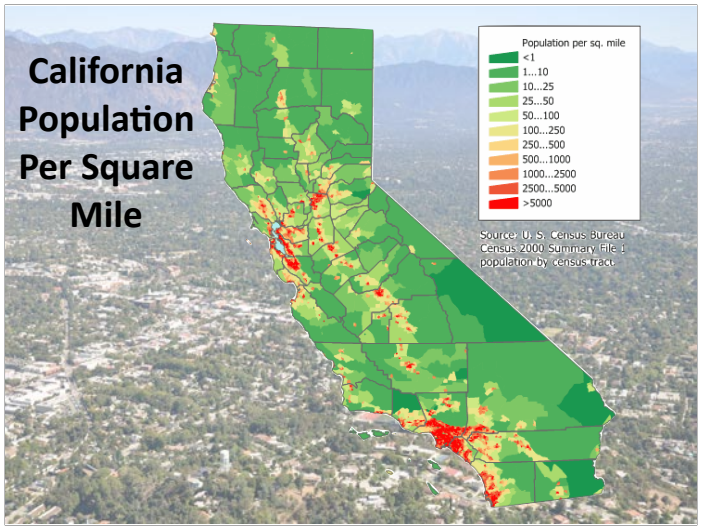
- 180 million dead California trees
- "We're witnessing a transition to a post-oasis landscape in Southern California," says Greg McPherson



Trees Per Person in California

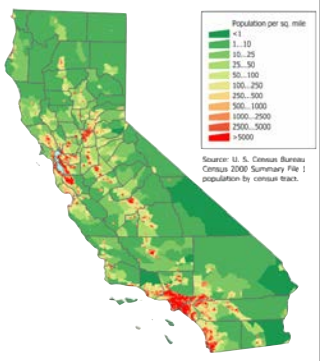
- Total number of trees in CA: ~7,630,000,000
- Land area: 163,695 square miles
- CA Population: ~40 million
- 191 trees per person living in CA = half of the world average

California Population Per Square Mile



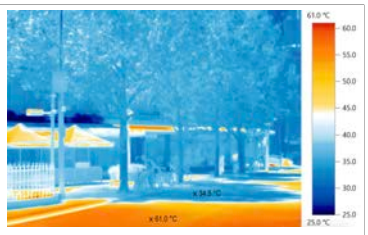
People and Trees in California

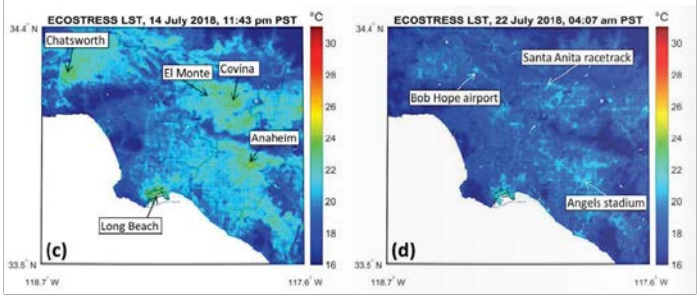
- ~90% of people in 10% of the California's land area
- Trees in California's urban and community areas: ~343,300,000
- Trees per person in California's urban forests: **9.7**



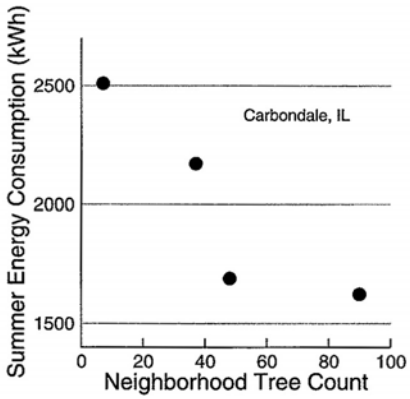
D.J. Nowak, E.J. Greenfield, 2018

Trees Cool Cities



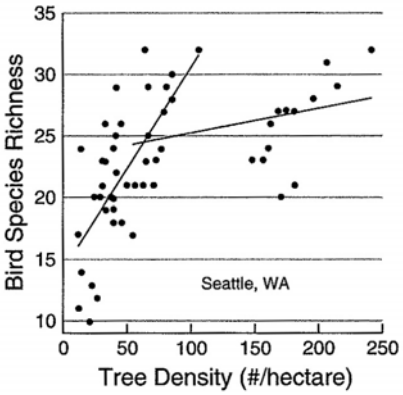


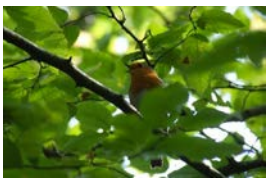
Trees Reduce Energy Consumption



Carver, Unger, and Parks, 2004, Environmental Management 34: 650-655

More Trees = More Wildlife





Donnelly and Marzluff, 2006, Urban Ecosystems 9: 99-117

ENVIRONMENT AND CRIME IN THE INNER CITY
Does Vegetation Reduce Crime?

FRANCES E. KUO *is an assistant professor and codirector of the Human-Environment Research Laboratory at the University of Illinois, Urbana-Champaign. Her research focuses on attention, defensible space, and novice-friendly information.*

WILLIAM C. SULLIVAN *is an associate professor and codirector of the Human-Environment Research Laboratory at the University of Illinois, Urbana-Champaign. His research focuses on the psychological and social benefits of urban nature and citizen participation in environmental decision making.*

ABSTRACT: Although vegetation has been positively linked to fear of crime and crime in a number of settings, recent findings in urban residential areas have hinted at a possible negative relationship: Residents living in "greener" surroundings report lower levels of fear, fewer incivilities, and less aggressive and violent behavior. This study used police crime reports to examine the relationship between vegetation and crime in an inner-city neighborhood. Crime rates for 98 apartment buildings with varying levels of nearby vegetation were compared. Results indicate that although residents were randomly assigned to different levels of nearby vegetation, the greener a building's surroundings were, the fewer crimes reported. Furthermore, this pattern held for both property crimes and violent crimes. The relationship of vegetation to crime held after the number of apartments per building, building height, vacancy rate, and number of occupied units per building were accounted for.

More Trees Correlate with Lower Crime

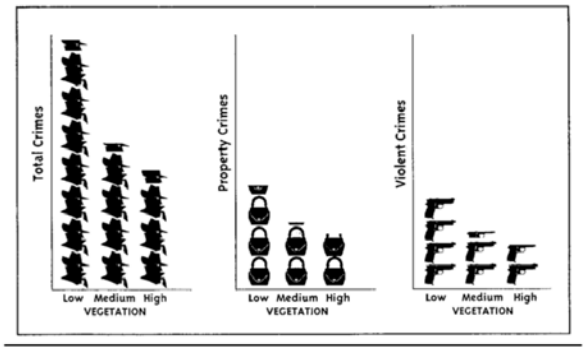
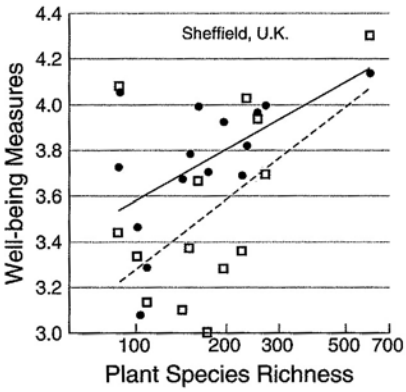
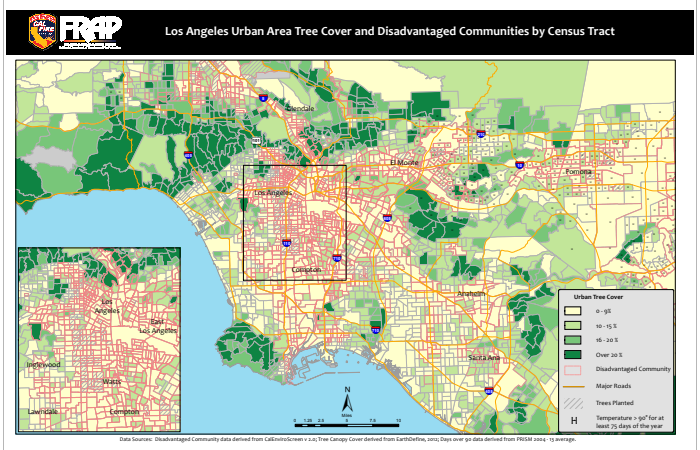


Figure 3: Mean Number of Crimes Reported Per Building for Apartment Buildings With Different Amounts of Vegetation (each icon represents one reported crime)

Trees Promote Happiness



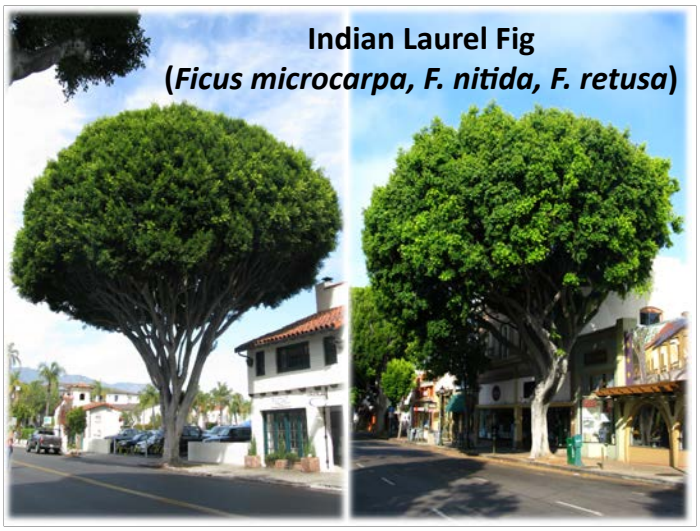
Fuller et. al., 2007, Biology Letters 3: 390-394



Successful Tree Planting

- Human benefits (health, aesthetics, and well being)
- Carbon sequestration (climate change mitigation)
- Conservation of biodiversity

Species Selection + **Site Conditions** = **Success**



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Search by Name

Search Trees by Characteristics

Search Help

SelecTree: A Tree Selection Guide

Search for trees: Enter a tree name — Search

- Tree Characteristics Glossary
- Search Help

- An interactive tree selection guide
- Database of over 1,500 species
- ~75 characters for each species
- ~9,000 photos

Urban Forest Ecosystems Institute · CAL POLY SAN LUIS OBISPO

SelecTree: A Tree Selection Guide

Height and Shape
- Maximum height
- Canopy width
- Growth rate
- Longevity
- Tree shape
- Habit
- Functional form

Foliage
- Foliage type
- Foliage fall color
- Foliage growth color
- Foliage shape
- Density out of leaf
- Density in leaf

Fruit
- Fruiting habit
- Fruiting time
- Fruit value
- Fruit size
- Fruit color
- Fruit type

Flower
- Flower color
- Flower showiness
- Flower time
- Male/female flower
- Fragrance

Bark and branch
- Bark color
- Bark texture
- Branch strength
- Has thorns

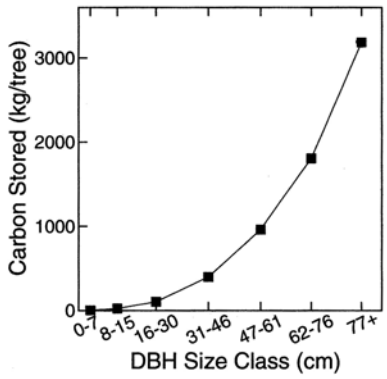
Other Characters
- Sunset Climate Zone
- USDA Hardiness Zone
- Soil pH
- Soil texture
- Soil moisture
- Drought tolerant
- Exposure
- Seaside tolerance
- Salinity tolerance
- Native to?
- Tropical
- Calif. invasive (Cal-IPC)

Potential issues or concerns
- Litter type
- Health hazard
- Biogenic emissions
- Attracts wildlife
- Deer palatable
- Root damage potential

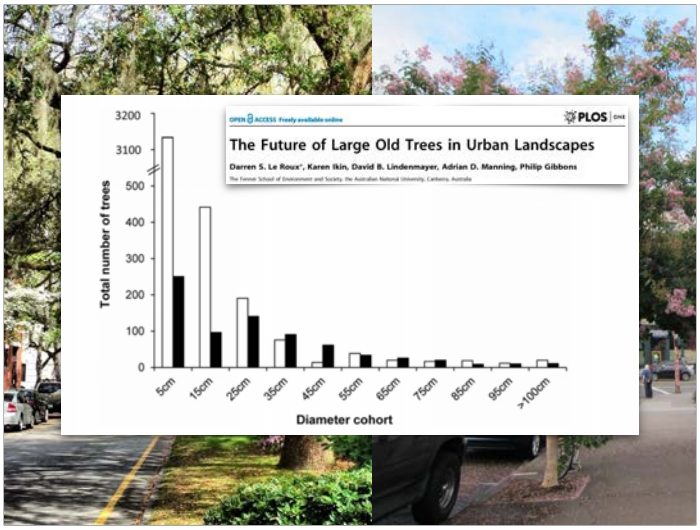
Use in the Landscape
- Landscape application
- Ornamental use
- Desirable wildlife plant

Pest and Disease
- Disease resistant
- Pest resistant
- Disease susceptibility
- Pest susceptibility

Older and Larger Trees Store More Carbon



Nowak 1994, USDA FS Technical Report, Radnor, PA, pp. 83-94



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SelecTree: A Tree Selection Guide

- **Height and Shape**
- Maximum height
- Canopy width
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- Habit
- Functional form

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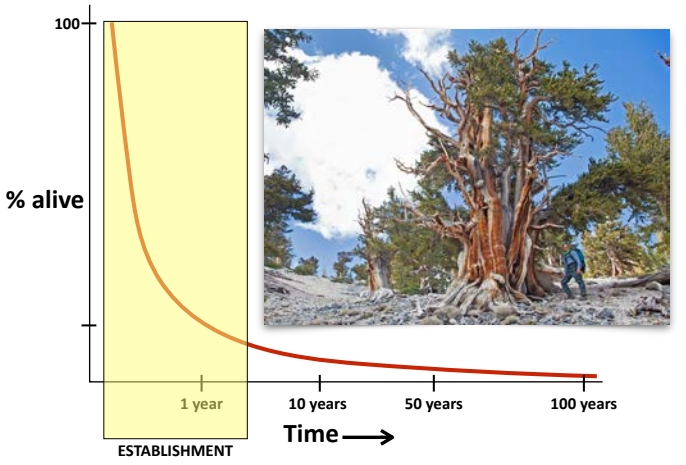


Journal
Journal of Sustainable Forestry
Latest Articles

- ~ 300, 000 plant species
- 60,065 tree species
- ~ 1,500 species used in worldwide urban forestry


Taylor & Francis

GlobalTreeSearch: The first complete global database of tree species and country distributions

E. Beech[a], M. Rivers[a,b], S. Oldfield[a], and P. P. Smith[a]

[a]Botanic Gardens Conservation International, Richmond, United Kingdom; [b]IUCN/SSC Global Tree Specialist Group

ABSTRACT

This article presents, for the first time, an overview of all known tree species by scientific name and country level distribution, and describes an online database—GlobalTreeSearch—that provides access to this information. Based on our comprehensive analysis of published data sources and expert input, the number of tree species currently known to science is 60,065, representing 20% of all angiosperm and gymnosperm plant species. Nearly half of all tree species (45%) are found in just 10 families, with the 3 most tree-rich families being Leguminosae, Rubiaceae, and Myrtaceae. Geographically, Brazil, Colombia, and Indonesia are the countries with the most tree species. The countries with the most country-endemic tree species reflect broader plant diversity trends (Brazil, Australia, China) or islands where isolation has resulted in speciation (Madagascar, Papua New Guinea, Indonesia). Nearly 58% of all tree species are single-country endemics. Our intention is for GlobalTreeSearch to be used as a tool for monitoring and managing tree species diversity, forests, and carbon stocks on a global, regional, and/or national level. It will also be used as the basis of the Global Tree Assessment, which aims to assess the conservation status of all of the world's tree species by 2020.

KEYWORDS

Global tree assessment; GlobalTreeSearch; tree database; tree distribution; tree diversity; tree endemism

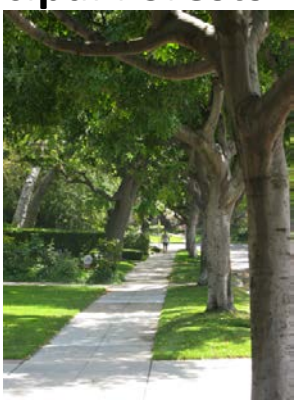
Journal
Journal of Sustainable Forestry
Latest Articles

60,065 Total Tree Species

Species in the World's Urban Forests
~1.7%

Diversity in Municipal Forests

- 188 – Average # of species on California municipality tree surveys
- 49 – Average # of species on California municipality approved planting lists
- Only 26% of existing species are approved for future planting
- **Our current species palette could be inappropriate for the future**



Muller and Bornstein
Arb. & Urb. For. 2010. 36(1): 18–27

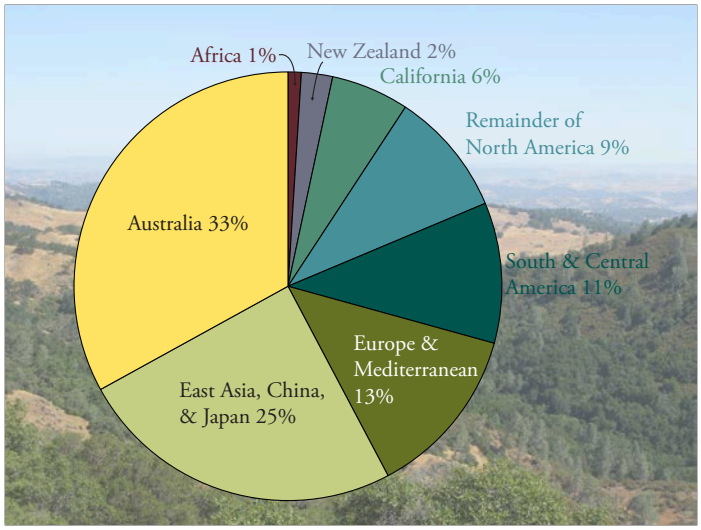
15 Most Commonly Grown Species in Los Angeles County

1. ***Lagerstroemia indica*** **(CRAPE MYRTLE)**
2. ***Magnolia grandiflora*** **(SOUTHERN MAGNOLIA)**
3. ***Washingtonia robusta*** **(MEXICAN FAN PALM)**
4. ***Liquidambar styraciflua*** **(AMERICAN SWEETGUM)**
5. ***Pinus canariensis*** **(CANARY ISLAND PINE)**
6. ***Jacaranda mimosifolia*** **(JACARANDA)**
7. ***Cupaniopsis anacardioides*** **(CARROTWOOD)**
8. ***Pyrus calleryana*** **(ORNAMENTAL PEAR)**
9. ***Ulmus parvifolia*** **(CHINESE ELM)**
10. ***Syagrus romanzoffiana*** **(QUEEN PALM)**
11. ***Cinnamomum camphora*** **(CAMPHOR TREE)**
12. ***Platanus × hispanica*** **(LONDON PLANE)**
13. ***Lophostemon confertus*** **(BRISBANE BOX)**
14. ***Quercus agrifolia*** **(COAST LIVE OAK)**
15. ***Ficus microcarpa*** **(INDIAN LAURAL FIG)**

Biodiversity Conservation in the Urban Forest

Red Flowering Gum (*Corymbia ficifolia*)

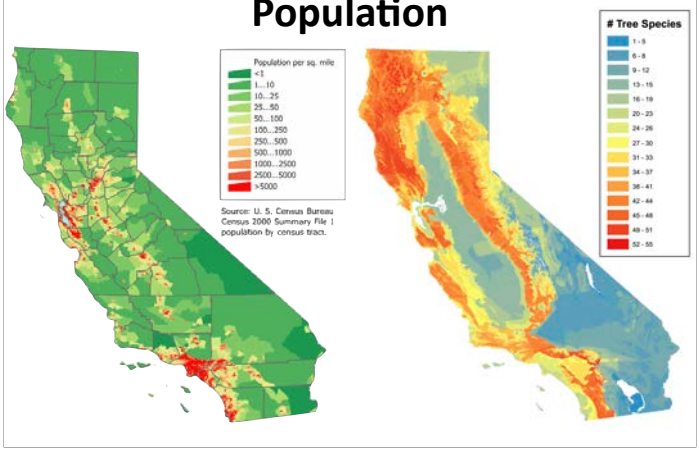
Engelmann Oak (*Quercus engelmannii*)



The California Flora

- **~6,000** native species
- **~80 "Tree" species**
- **40** native species found regularly in the urban forest
- **10-15** natives commonly grown

Native Tree Biodiversity vs. Population



Native Urban Trees?

LA City Native Trees:

1. *Acer negundo*
2. *Acer macrophyllum*
3. *Alnus rhombifolia*
4. ***Juglans californica***
5. *Platanus racemosa*
6. *Populus fremontii*
7. ***Quercus agrifolia***

LA County Native Trees:

1. ***Aesculus californica***
2. *Fraxinus velutina*
3. ***Quercus chrysolepis***
4. ***Quercus engelmannii***
5. ***Quercus lobata***
6. ***Quercus wislizeni***
7. *Umbellularia californica*

Successful Tree Planting

- Human benefits (health, aesthetics, and well being)
- Carbon sequestration (climate change mitigation)
- Conservation of biodiversity

Species Selection + **Site Conditions** = **Success**

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