

Tree species composition and diversity: IPM & beyond

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With slides from
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University of California
Agriculture and Natural Resources

Cooperative Extension

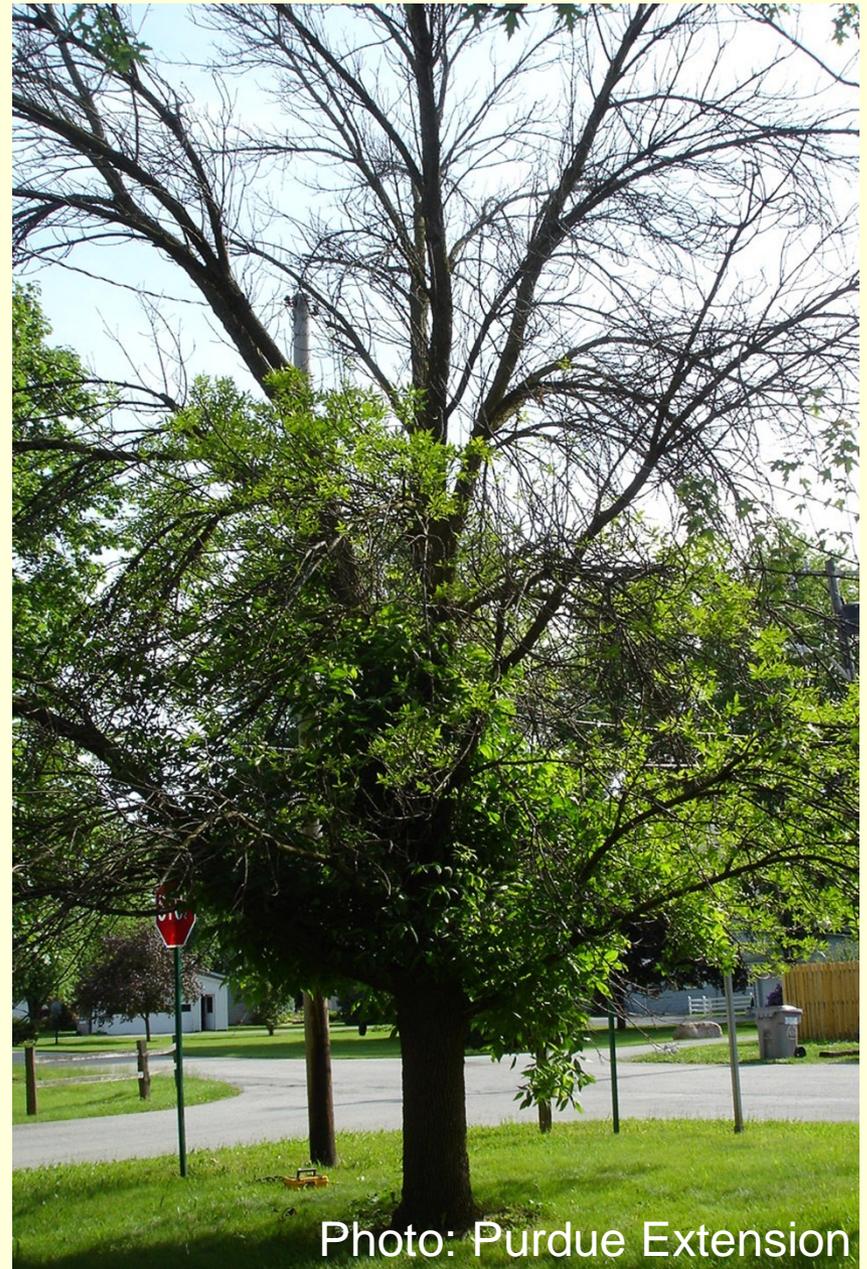
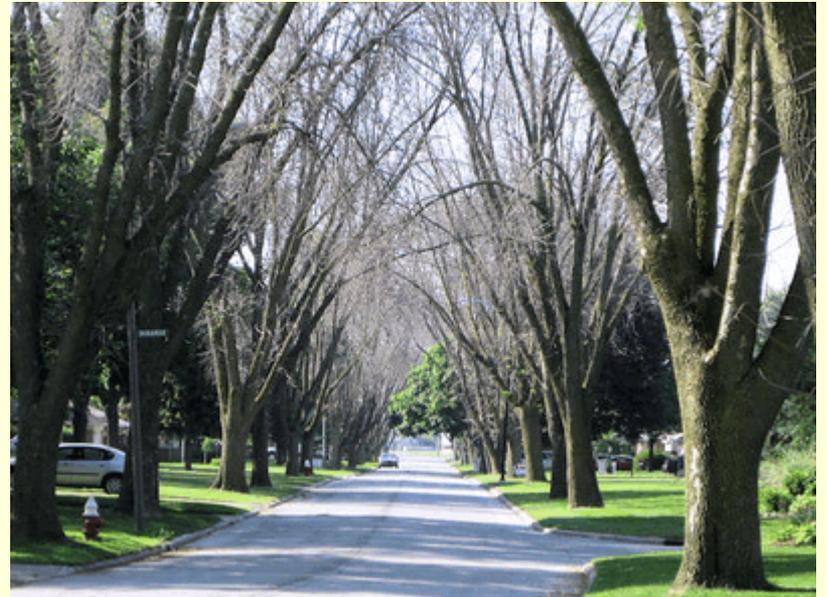


Photo: Purdue Extension

Tree species selection is a critical component of urban forestry



Photos: USDA

Tree species selection is a critical component of urban forestry

& must consider both the individual tree AND the other urban trees



Photos: USDA

Tree species selection: a critical part of urban forest management

Urban tree diversity: *what is it...?*

Past pest disasters: *what have we learned...?*

Tree selection in IPM: *considering individual trees*

Tree selection in IPM: *overall vulnerability, PVM*

Other considerations: *age, climate, water*

Discussion: *the role of UCMGs*

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UCMGs: help shape “healthy choices” in urban tree selection

Defining urban tree diversity

Future City 8

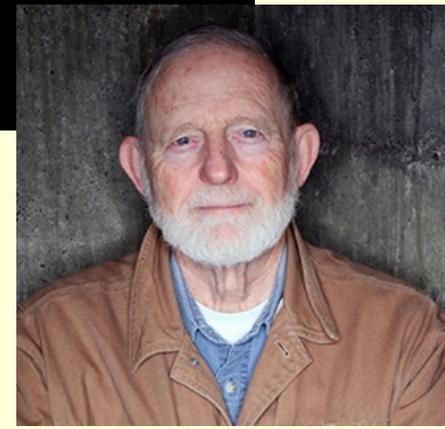


Joe R. McBride

The World's Urban Forests

History, Composition, Design,
Function and Management

“The complexity of tree species composition, the size distribution of trees, and the patterns of distribution of trees within an urban forest”



Species richness varies with many factors...

1. Climate
2. Tree Species Richness of Local Biome
3. History
4. Expert Advice
5. Spiritual/Psychological Values
6. Availability of Planting Stock
7. Epidemics of Insects and Disease
8. Public Popularity

Species richness varies with many factors...

1. Climate

Climate and Species Richness

Koppen Climate	Example City	Average Species Richness
Tropical Moist	Singapore	37
Dry	Cairo	28
Moist, Mid-latitude with mild winters	New York	48
Moist, Mid-latitude with cold winters	Moscow	32
Polar	Murmansk	9

Most warm cities are rich in tree species...



Tree Species Richness in Three California Cities

<u>City</u>	<u>Richness</u>
South Lake Tahoe	35
Menlo Park	145
Santa Barbara	1,226

But species richness is not the whole story...

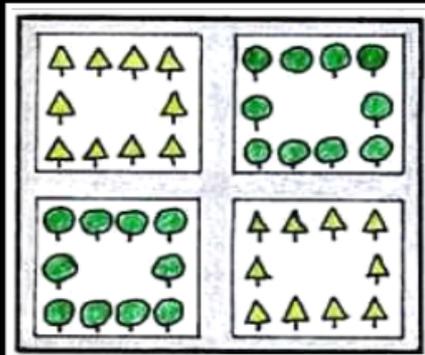
Species Abundance

Species	Urban Forest #1	Urban Forest #2
A	100	380
B	90	15
C	125	15
D	80	15

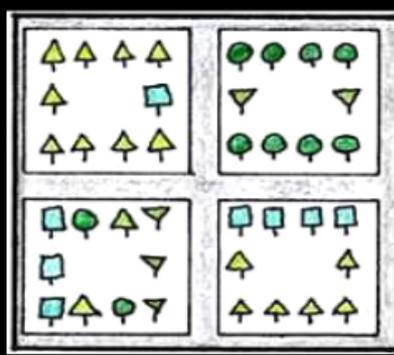
Diversity: richness AND “evenness”

Simpson’s Diversity Indices of Hypothetical Urban Forests

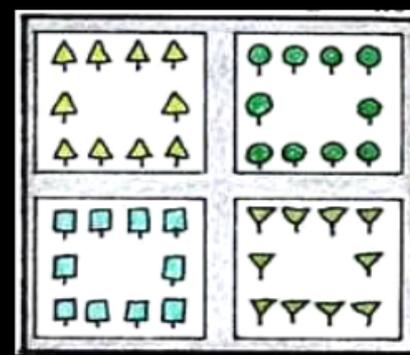
Urban Forest #1



Urban Forest #2



Urban Forest #3



Proportion of Population Represented by Species (p_i)

<u>Forest</u>	<u>Proportion of Population Represented by Species (p_i)</u>				<u>Simpson’s Index</u>
1	0.50	0.50	0	0	2.00
2	0.425	0.25	0.20	0.125	2.98
3	0.25	0.25	0.25	0.25	4.00

Tree species selection: a critical part of urban forest management

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Other considerations: *age, climate, water*

Discussion: *the role of UCMGs*

pest vulnerability
leads to disasters

1930s - today

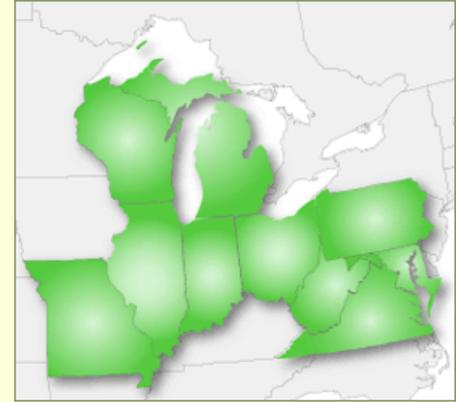
Dutch Elm Disease
(*Ophiostoma ulmi*)



Waukegan (Illinois, USA)

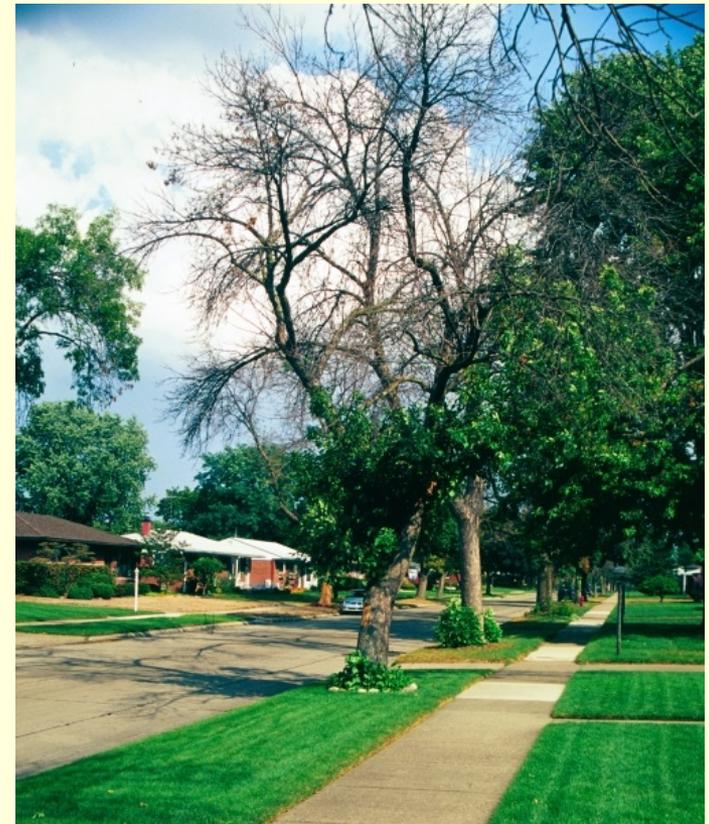


pest vulnerability
leads to disasters (really)



2002 - today

Emerald ash borer
(*Agrilus planipennis*)

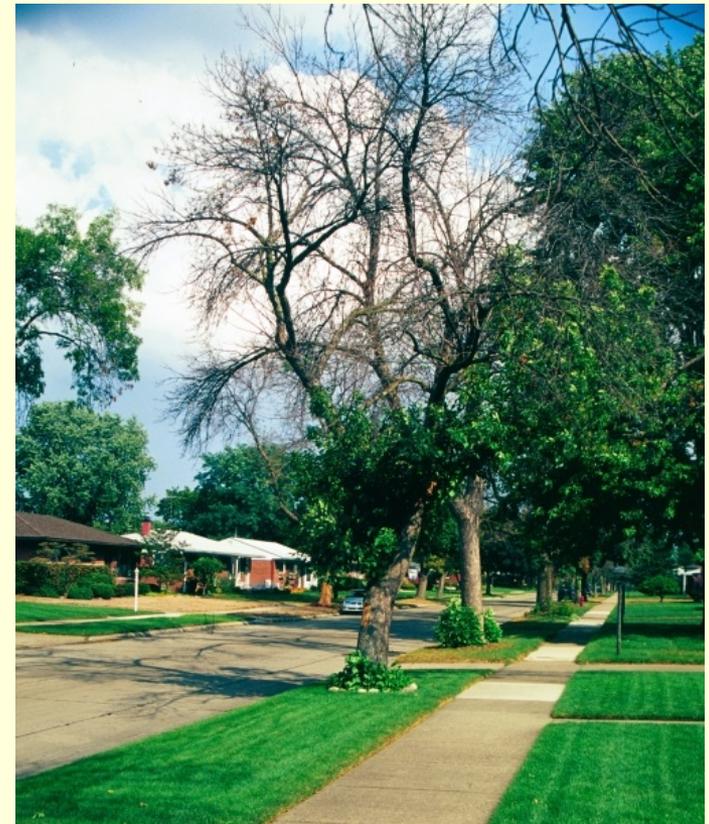


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2002 - today

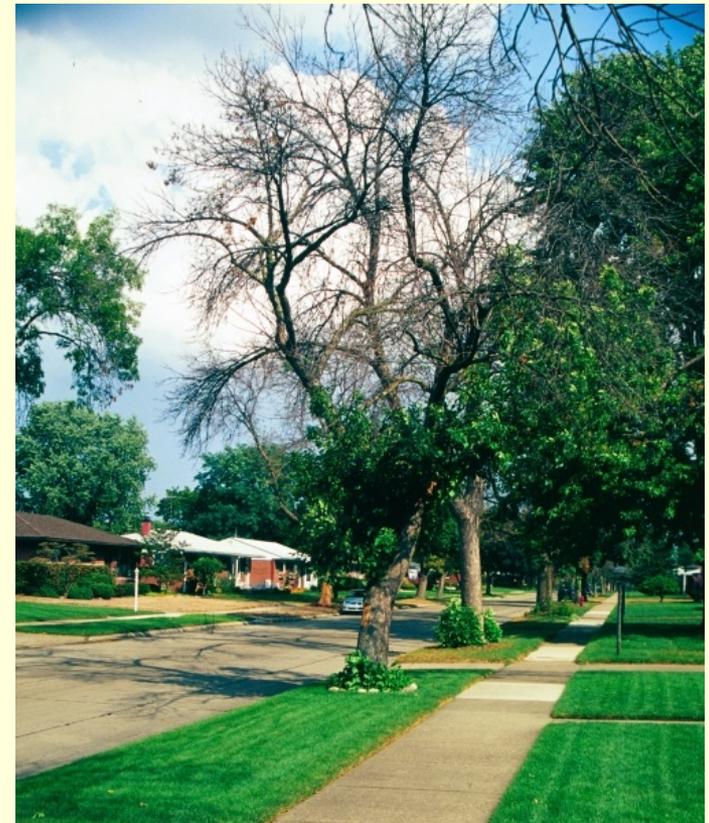
Emerald ash borer
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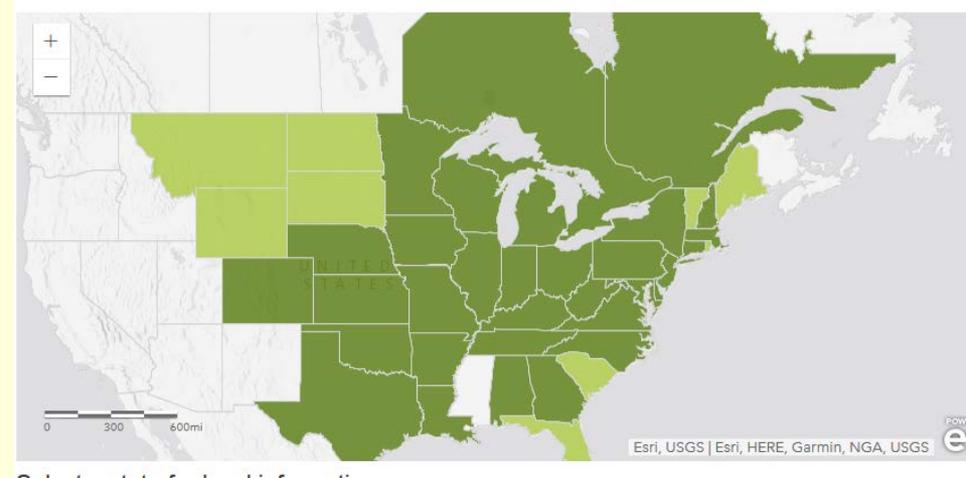
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2002 - today

Emerald ash borer
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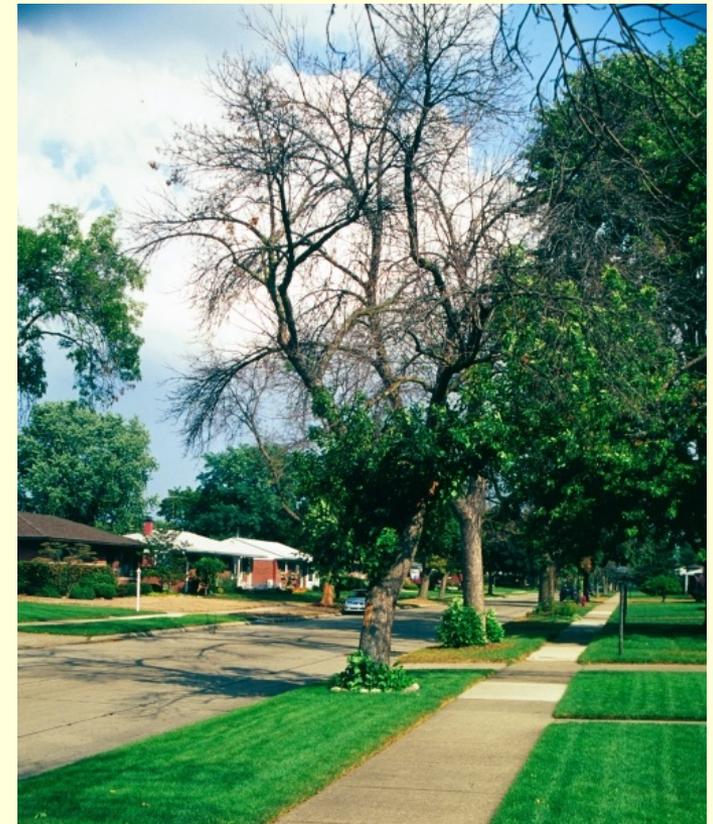


pest vulnerability
leads to disasters (really)

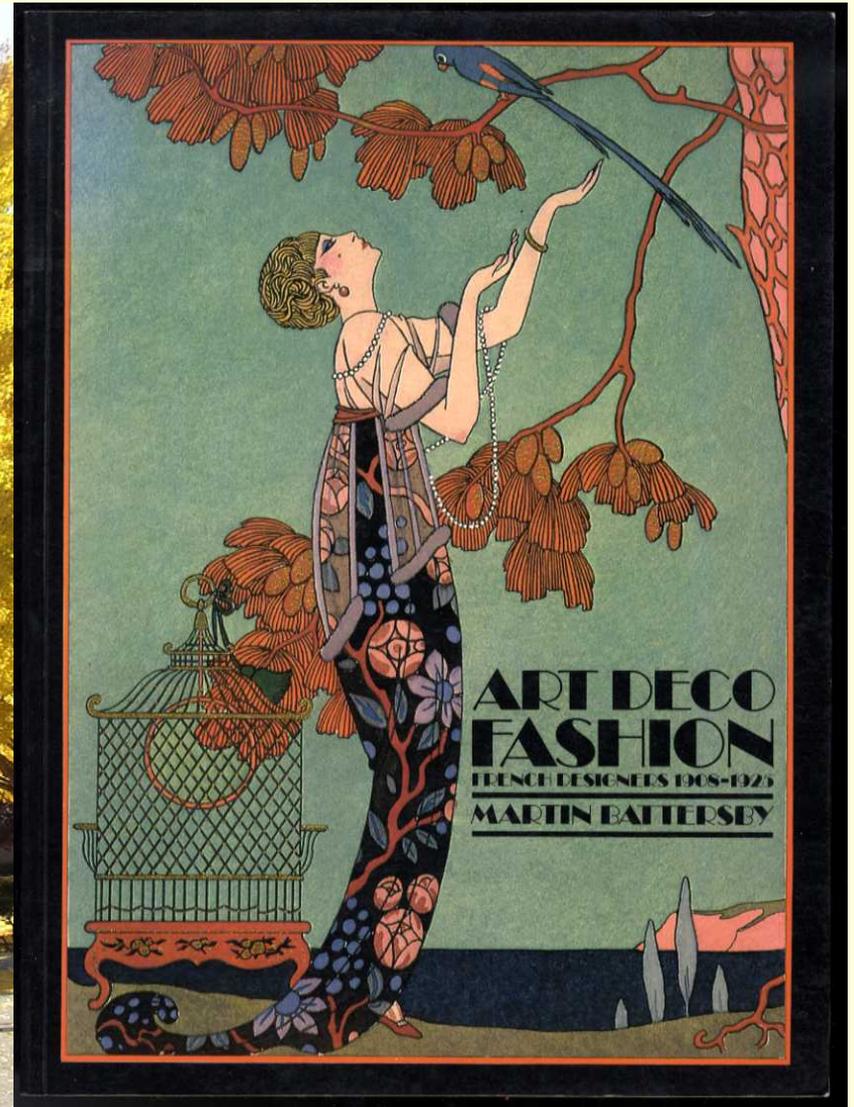


2002 - today

Emerald ash borer
(*Agrilus planipennis*)



Trees go in and out of Fashion.



1780's – *Quercus lobata*



1880's – *Ulmus procera*



1920's – *Platanus x hispanica*



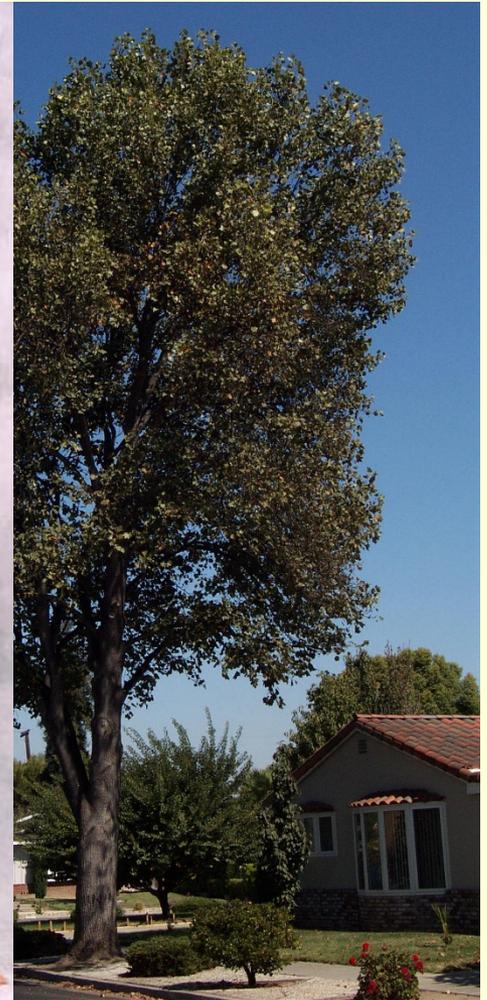
1940's – *Fraxinus velutina* 'Modesto' & *Ulmus parvifolia*



1950's – *Liquidambar styraciflua* & *Zelkova serrata*



1960's – *Ceratonia siliqua* & *Liriodendron tulipifera*



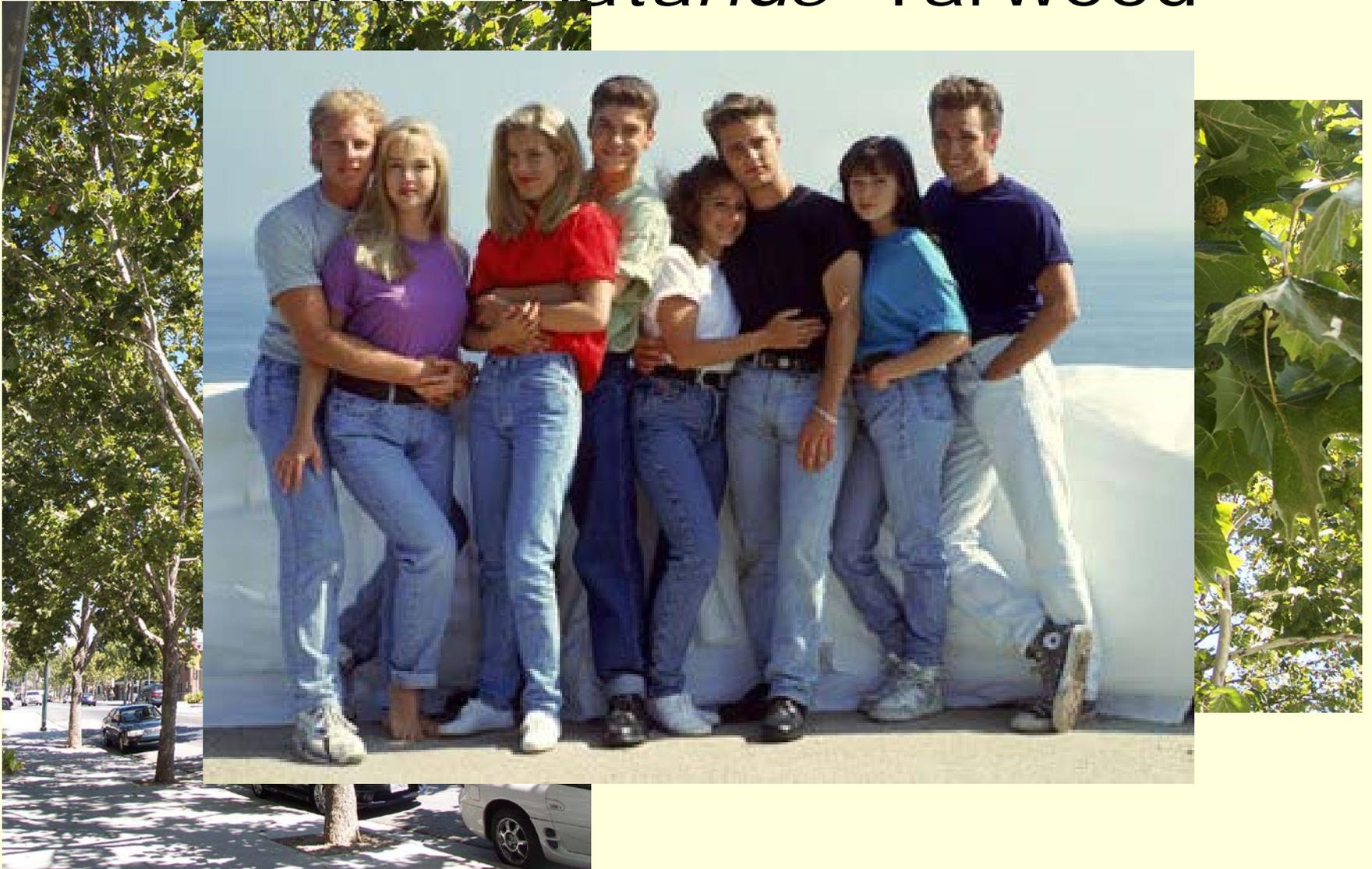
1970's – *Pistacia chinensis* & *Pyrus calleryana* 'Bradford'



1980's – *Lagerstroemia indica* x *fauriei* – Tribes



1990's – *Platanus* 'Yarwood'



2000's – *Fraxinus americana* 'Autumn Purple'



Species richness varies with many factors...

1. Climate
2. Tree Species Richness of Local Biome
3. History
4. Expert Advice
5. Spiritual/Psychological Values
6. Availability of Planting Stock
7. Epidemics of Insects and Disease
8. Public Popularity

UCMGs: criticism is easy...but, often a bad situation has been inherited... let's help shape "healthy choices" today!

It's not just USA...

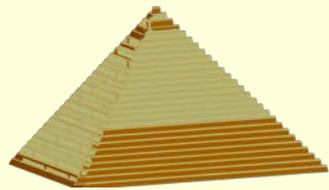
Kyiv (Kiev): the city of horsechestnuts



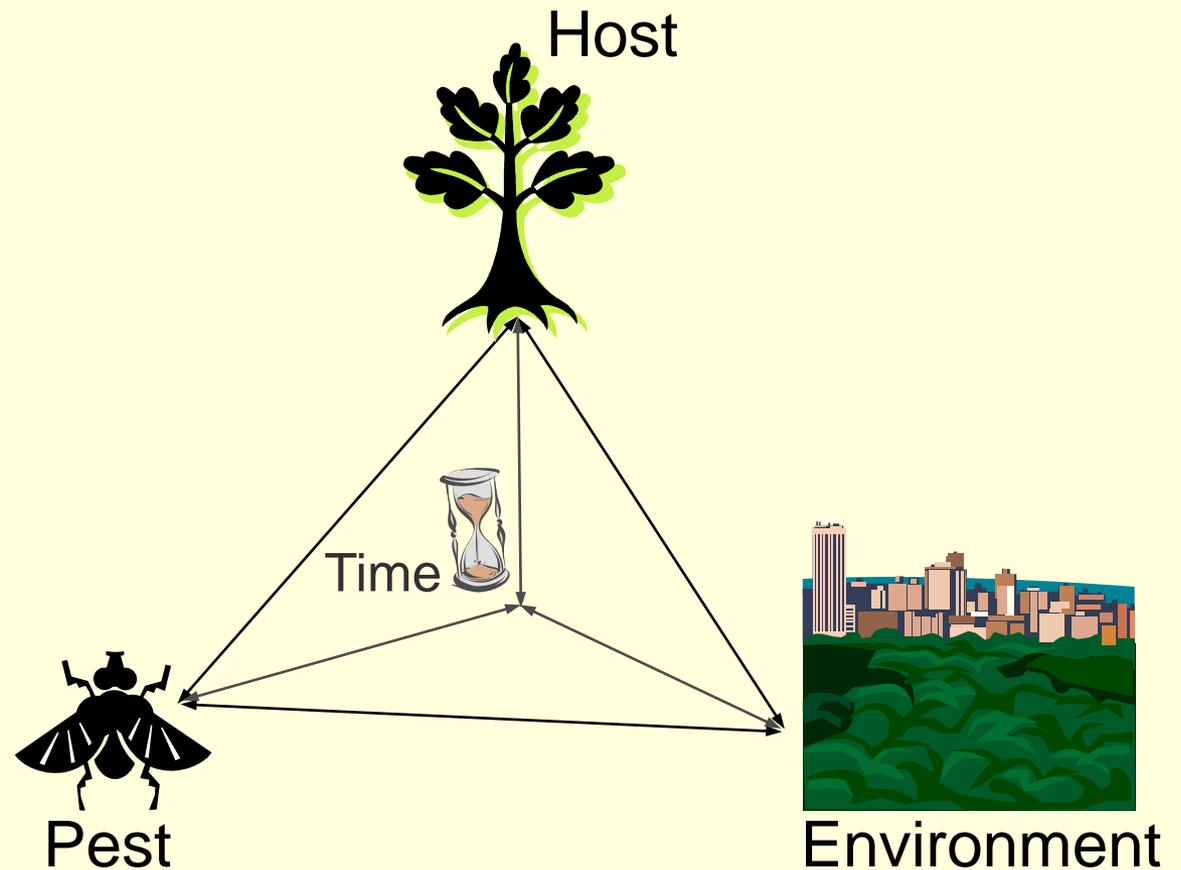
Kyiv (Kiev) The city of ...?



four elements of a pest problem

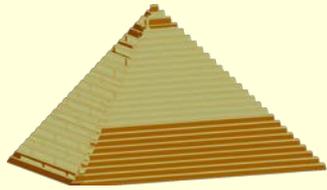


Plant pathology

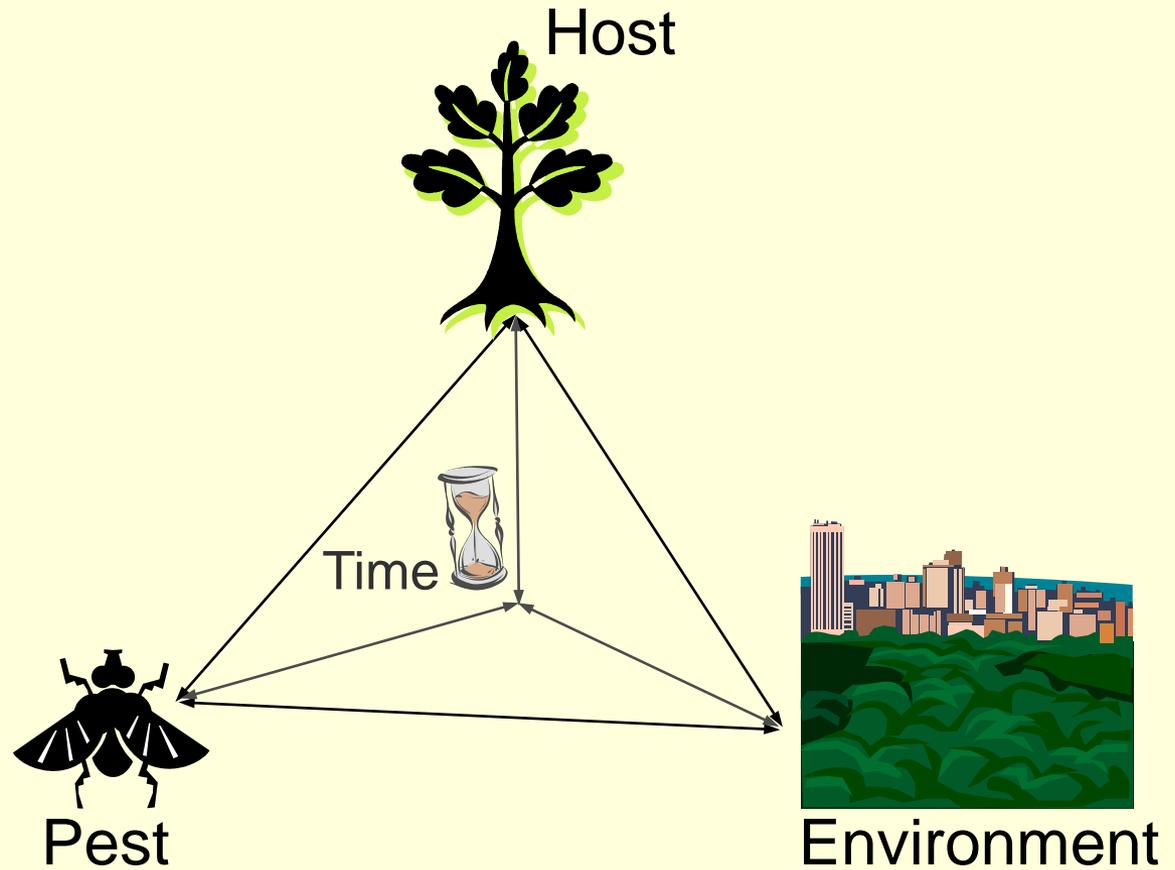


four elements of
a pest problem

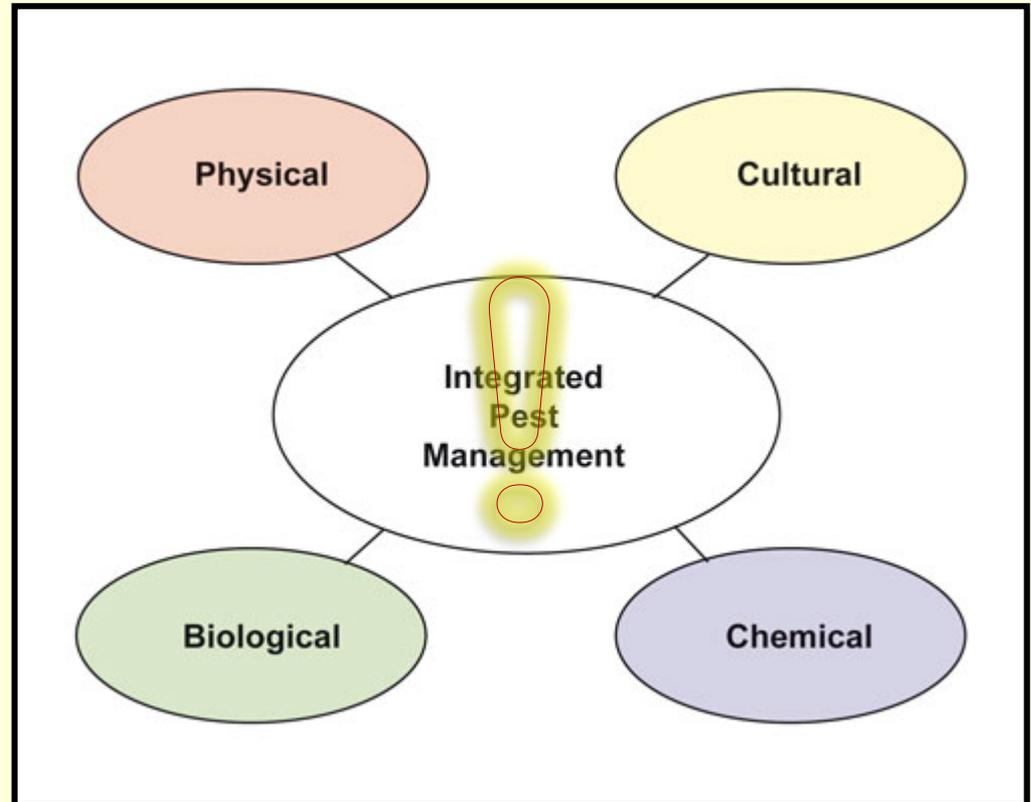
UCMGs: remind the client
that 3 of those can be
managed!



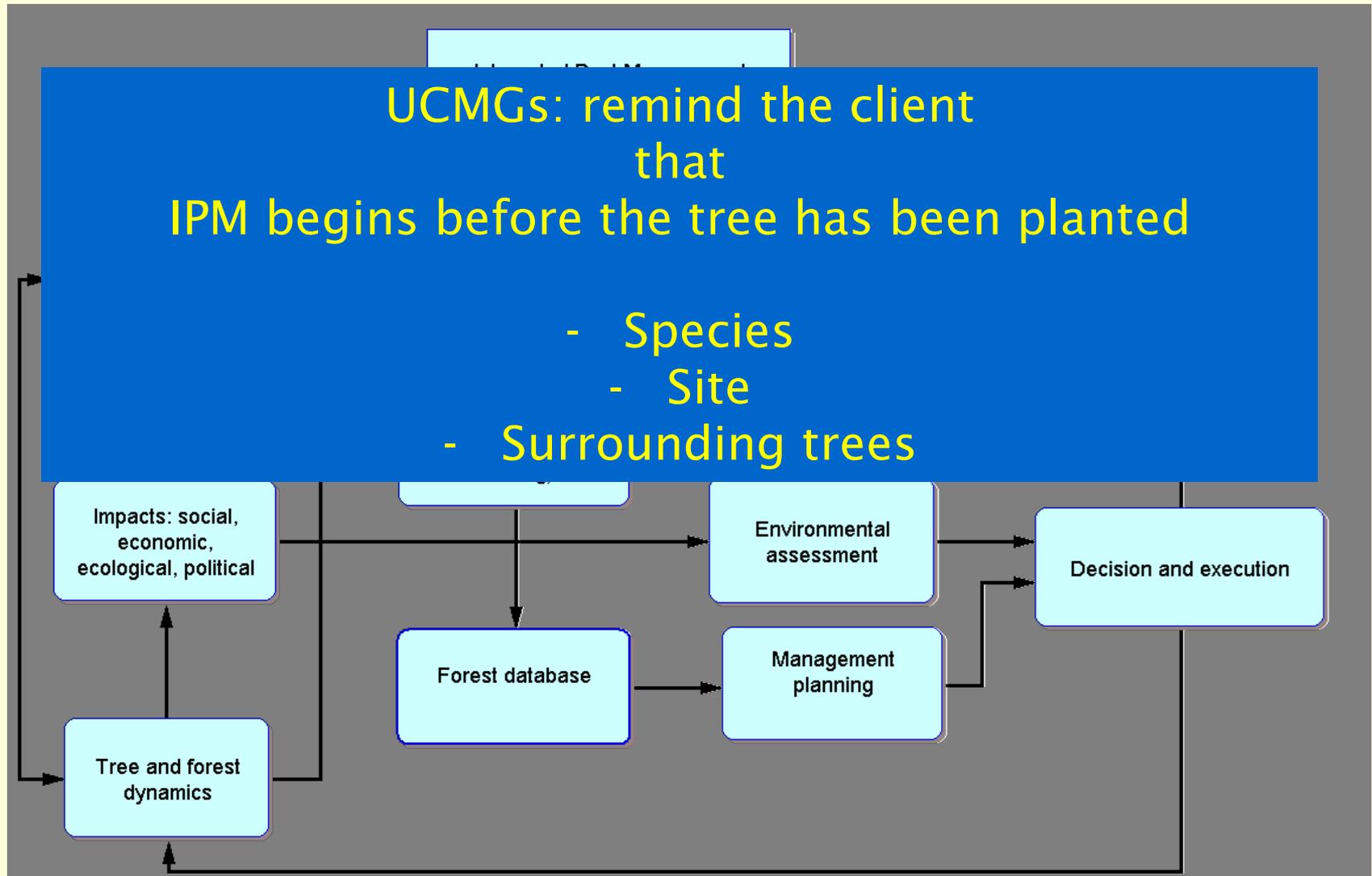
Plant
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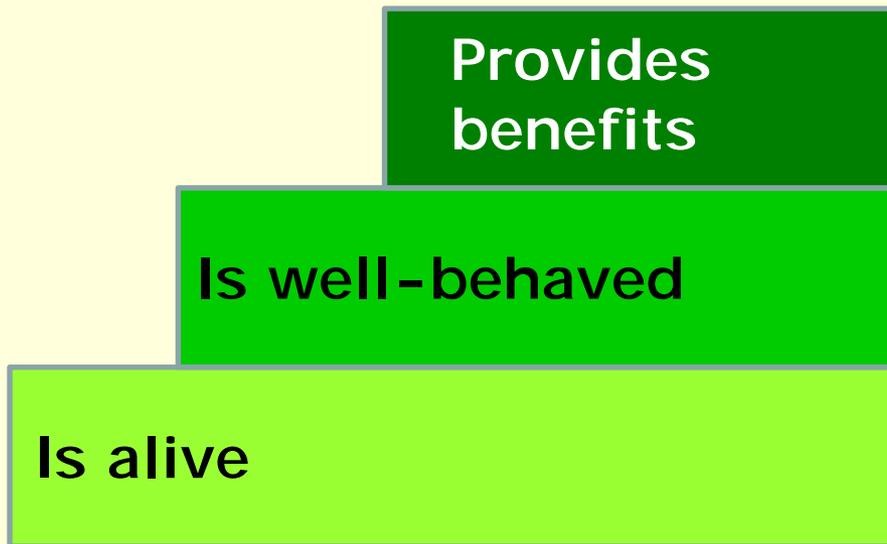
Integrated Pest Management (IPM) is more than
“a combination of control techniques”



Dr. Andrew S. says: “IPM is a decision-making process”



Goal: a “successful urban tree”

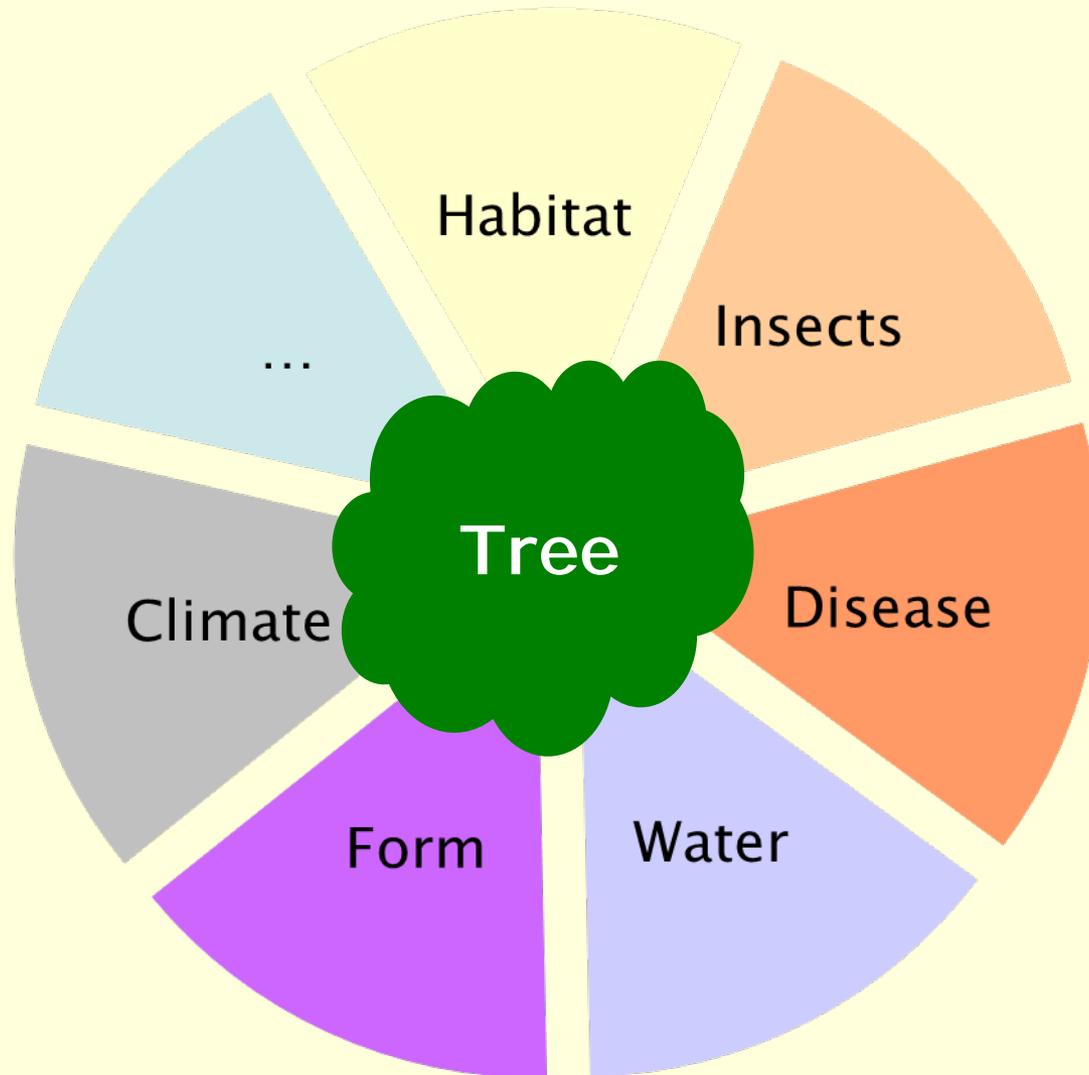


whose value exceeds the costs of maintenance

does not cause problems (roots; pollen; litter)

lives and grows in the desired location

Tree species selection 1: Individual considerations



Armillaria as example of single-tree considerations

Habitat

Tree

Water

Oak root fungus

Poor cultural practices

Untreatable, lethal



Armillaria signs: mycelium



University of California



Armillaria diagnosis and management

- Kendra Baumgartner found that root collar excavations in grape gave partial control of *Armillaria* in vineyards.



Armillaria “management”

UCMGs: help the client evaluate their site, to minimize the chances of developing a problem



Dr. Jim D. says: Beware of snake oil!

- Products that purport to give you that miracle are termed snake oil.
- Snake oil products almost always offer numerous **testimonials** to support their use.
- Those who provide testimonials are usually not active, independent, university researchers.

The most creative and effectively marketed snake oil products often cite sound biological facts or knowledge and then attempt to link their product to this knowledge, but references to the published research about their product are always missing.

Another example of single-tree considerations

Climate

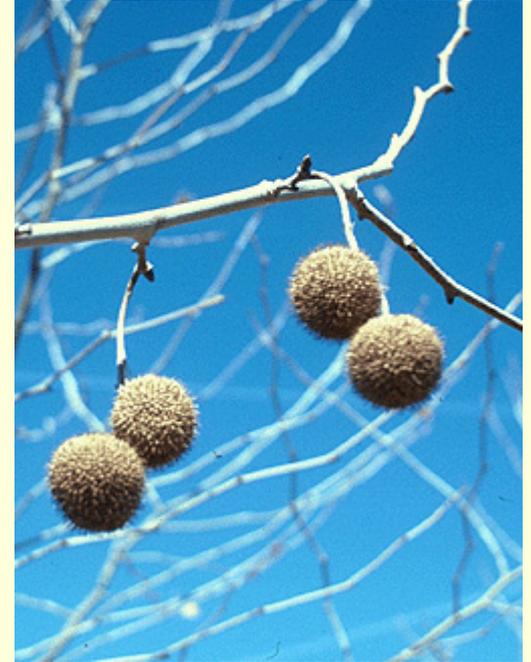
Tree

Form

Anthracnose and powdery mildew on plane trees

Cultivars resistant (and not)





Sycamore/Planetree Powdery Mildew

Powdery mildews:

<> fungal disease

<> many pathogens,
even more hosts

<>Some are
host-specific

<> Like moisture, but not water

<> Like shade, humidity, density

<> For planetree: *Erysiphe platani* (= *Microsphaera* p.)



Sycamore/Planetree Powdery Mildew

Management

- >> fungicides impractical (protectant, not curative)
- >> importance of sanitation: remove dropped leaves and other plant material
- >> can try improving airflow – but do not over-prune!
- >> Resistant cultivars are available – use them!
(Columbia; or Yarwood for pollarded trees)

Sycamore/Planetree Anthracnose

Anthracnoses:

- ◆ fungal disease
- ◆ many pathogens, many hosts
- ◆ Most are host-specific
- ◆ Need water to spread & infect (wet spring = worry)
- ◆ *Apiognomonina veneta* / *Discula platani*



Sycamore/Planetree

Anthracnose

“If defoliation, branch dieback, or cankering does not occur every year, anthracnose will not seriously harm plants.”

Management: if symptomatic, too late

- ◆ fungicides not used on planetree (rarely on ash!)
- ◆ Pruning: twigs & small branches; in winter
- ◆ Irrigation: Do not spray leaves!
- ◆ Cultivar resistance

Columbia: resistant to both PMil and Anth

Yarwood: resistant to PMil But NOT Anth

Bloodgood: resistant to Anth, but a mess with PMil

Sycamore/Planetree common problems

UCMGs: help the client
evaluate their site,

pick the best (better?) cultivar

understand cultural options

◆ Cultivar resistance

Columbia: resistant to both PMil and Anth

Yarwood: resistant to PMil But NOT Anth

Bloodgood: resistant to Anth, but a mess with PMil

Tree species selection 2: considering all trees

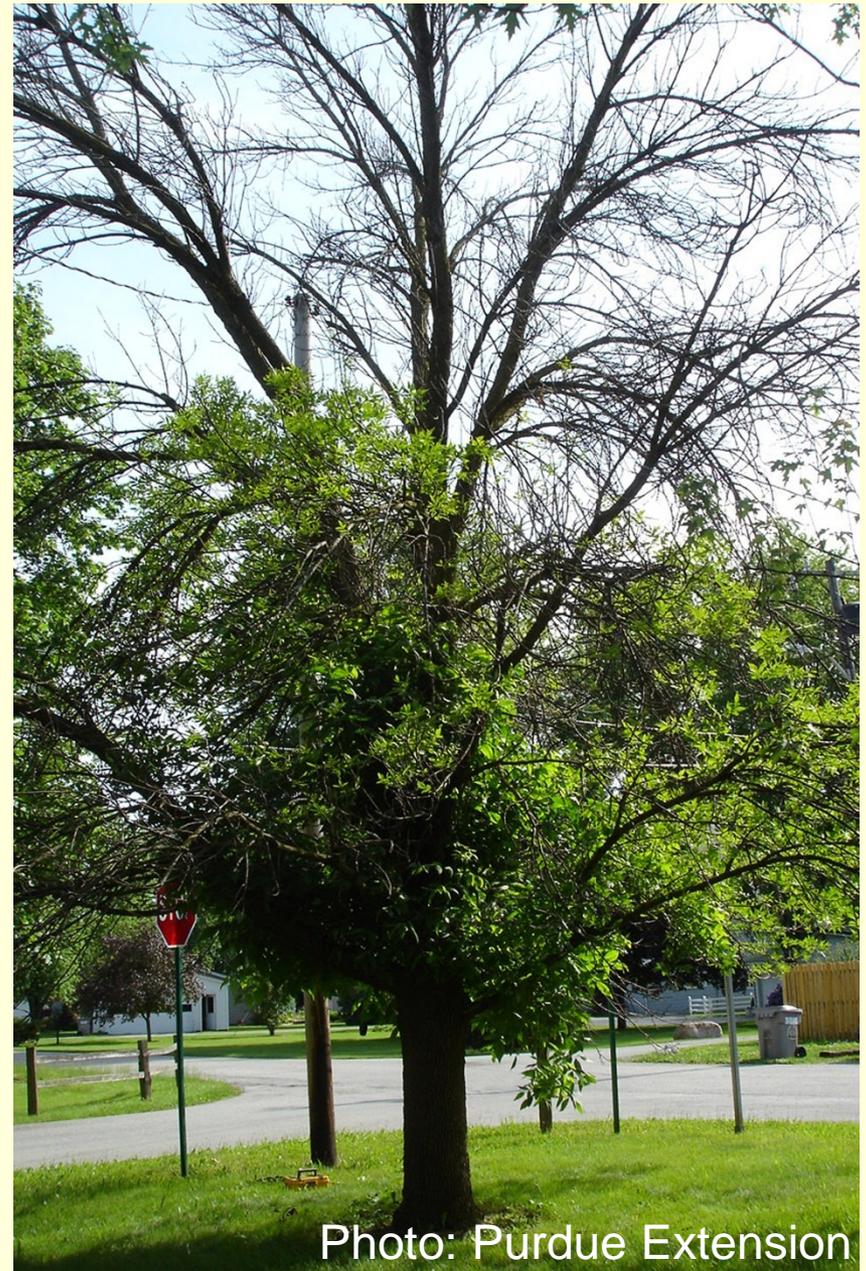
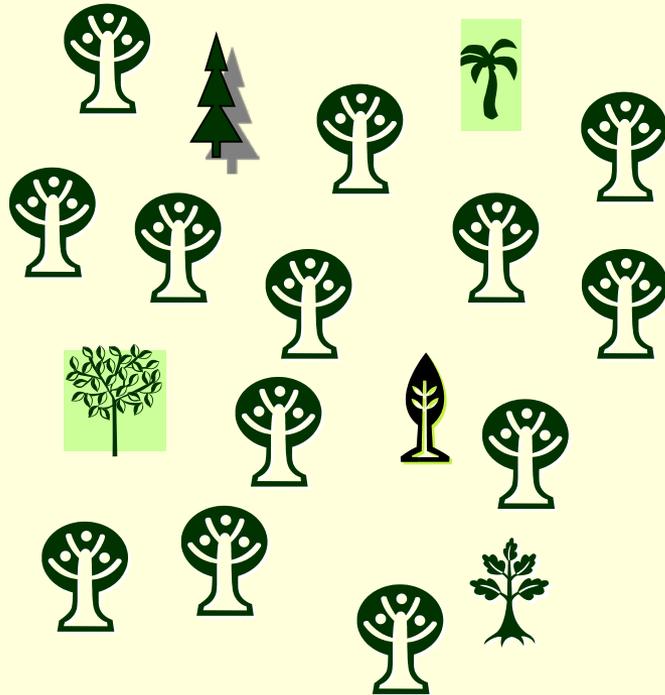


Photo: Purdue Extension

managing pest vulnerability in urban forests

Diversify!

10 – 20 – 30 rule
Sp Gen Fam

“For maximum protection against the ravages of “new” pests or outbreaks of “old” pests, the urban forest should contain:

1. No more than 10% of any single tree species.
2. No more than 20% of species in any tree genus.
3. No more than 30% of species in any tree family.”

(F. S. Santamour, 1990)

common species are... well... common...

Most Frequently Encountered Street Trees in Survey of 33 Cities

Common Name	Scientific Name
1. London Plane Tree	<i>Platanus x acerifolia</i>
2. Rowan	<i>Sorbus aucuparia</i>
3. Common Lime	<i>Tilia europea</i>
4. Canary Island Date palm	<i>Phoenix canariensis</i>
5. Norway Maple	<i>Acer platanoides</i>
6. Honey Locust	<i>Gleditsia triacanthos</i>
7. Jacaranda	<i>Jacaranda mimosaeifolia</i>
8. Angsana	<i>Pterocarpus indicus</i>
9. Carolina poplar	<i>Populus x canadensis</i>
10. Silver Birch	<i>Betula pendula</i>

managing multi-host pests

But, what about Asian Longhorned Beetle?
(*Anoplophora glabripennis*)



Acer, Aesculus, Betula, Celtis, Fraxinus, Platanus, Populus, Salix, Ulmus...



Shothole Borers
John Kabashima, UCCE



Photo: Richard Stouthamer



Host Range FD/PSHB

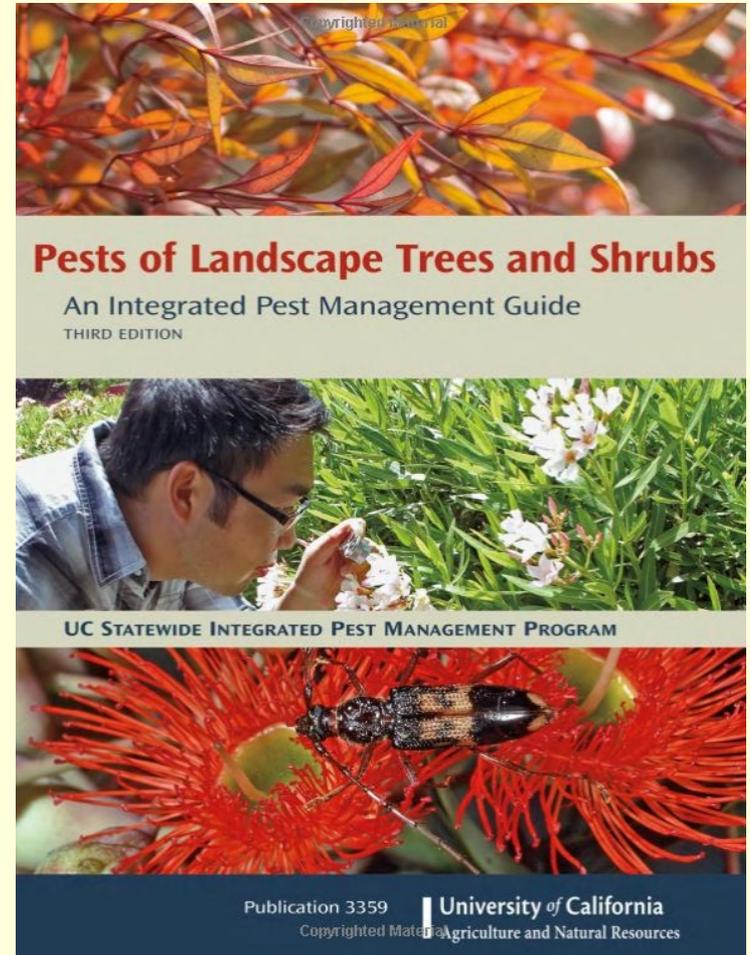
	2012	2015
Tree Species Attacked by Beetle	286	303
Tree Species Infected by Fungus	117	138
Agricultural Crops	13	13
California Native Tree Species	11	18
Number of Tree Families	62	64
Number of Reproductive Hosts	19	38

1. Box elder (*Acer negundo*) *
2. Big leaf maple (*Acer macrophyllum*)*
3. Evergreen Maple (*Acer paxii*)
4. Trident maple (*Acer buergerianum*)
5. Japanese maple (*Acer palmatum*)
6. Castor bean (*Ricinus communis*)
7. California sycamore (*Platanus racemosa*) *
8. Red willow (*Salix laevigata*) *
9. Avocado (*Persea americana*)
10. Mimosa (*Albizia julibrissin*)
11. English Oak (*Quercus robur*)
12. Coast live oak (*Quercus agrifolia*)*
13. London plane (*Platanus x acerfolia*)
14. Cottonwood (*Populus fremontii*)*
15. White Alder (*Alnus rhombifolia*)*
16. Titoki (*Alectryon excelsus*)
17. Engelmann oak (*Quercus engelmannii*) *
18. Cork Oak (*Quercus suber*)
19. Valley oak (*Quercus lobata*) *
20. Coral tree (*Erythrina corallodendron*)
21. Blue palo verde (*Cercidium aculeata*) *
22. Palo verde (*Parkinsonia aculeata*)
23. Moreton Bay Chestnut (*Castanospermum australe*)
24. Brea (*Cercidium sonora*)
25. Mesquite (*Prosopis articulata*)*
26. Weeping willow (*Salix babylonica*)
27. Chinese holly (*Ilex cornuta*)
28. Camelia (*Camellia semiserrata*)
29. Acacia (*Acacia* spp.)
30. Liquidambar (*Liquidambar styraciflua*)
31. Red Flowering Gum (*Eucalyptus ficifolia*)
32. Japanese wisteria (*Wisteria floribunda*)
33. Black Cottonwood (*Populus trichocarpa*)*
34. Goodding's black willow (*Salix gooddingii*)
35. Goodding's black willow (*Salix gooddingii*)*
36. Tree of heaven (*Ailanthus altissima*)
37. Kurrajong (*Brachychiton populneus*)
38. Black mission fig (*Ficus carica*)

Pest Vulnerability Matrix

Construction

- 1 Obtain pest-host information
- 2 Arrange in table, indicate severity
- 3 Verify local importance



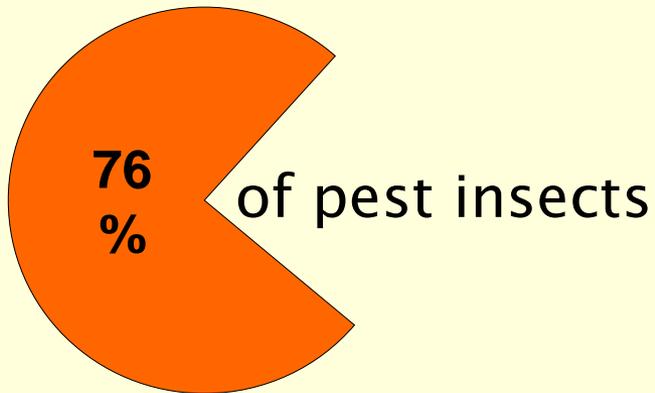
Pest	Pest count >>>							% Tree species affected	Proportion of tree population affected
	London plane tree	Maple	Honey Locust	Callery pear	Linden	Zelkova			
	5	6	3	1	2	2			
	Proportion of all trees >>>								
	0.4	0.2	0.1	0.1	0.1	0.1			
Anthracnose (fungal disease)								50%	70%
Defoliating caterpillars								50%	70%
Soft scales (insect)								50%	70%
Aphids (other)								50%	70%
Asian longhorned beetle								33%	60%
Spider mites (combined)								33%	30%
Armillaria root rot or Oak root fungus.								17%	10%
Fireblight (bacterial disease)								17%	10%
Other native borers (combined)								17%	10%

does this really work...?

2007 survey:

Questions about: important pests; common trees

given the 5 most common trees in a city, we can predict



UCMGs: help the client
 1st: understand the “key pests” for the desired tree species
 2nd: understand how their desired species affects the overall vulnerability of their landscape

How to Manage Pests

Pests in Gardens and Landscapes

[More trees and shrubs](#)

**Cypress—*Cupressus* spp.
 False cypress—*Chamaecyparis* spp.
 Family Cupressaceae (Cypress family)**

Plant Identification

Cypress and false cypress are coniferous evergreen trees. They are useful as hedges, screens, and specimen trees.

Optimum conditions for growth

Cypress and false cypress can grow in several climatic zones depending on the species. They do best when grown in full sun or only part shade. Cypress does best with little water once established; false cypress needs a little more water.



Yellow foliage of false cypress



Pests and disorders of *Cupressus* spp. and *Chamaecyparis* spp.

Invertebrates

- [Aphids](#)
 - Arborvitae aphid
- [Armored scales](#)
 - Juniper scale
 - Minute cypress scale
- [Bark beetles](#)
 - Cedar and cypress bark beetles
- [Cypress bark mealybug](#)
- [Cypress bark moths](#)
- [Cypress tip miner](#)
- [Foliage-feeding caterpillars](#)
 - Cypress leaf tier
 - Cypress webber
- [Monterey cypress scale](#)
- [Sawflies](#)
 - Conifer sawfly
 - Cypress sawfly
- [Spider mites](#)
 - Spruce spider mite

Diseases

- [Canker diseases](#)
 - Cypress canker
 - Cytospora canker
 - Phomopsis canker
- [Collar, root, and crown rots](#)
 - Port-Orford cedar root disease
- [Needle blight](#)
- [Rusts/Witches' broom](#)
 - Gymnosporangium rusts
- [Scab](#)

Environmental disorders

- [Browning and shedding](#)
- [Frost](#)
- [Lace lichen](#)
- [Mineral deficiencies](#)
- [Nutrient and mineral excesses](#)
- [Poor water management](#)

Weeds

Vertebrates

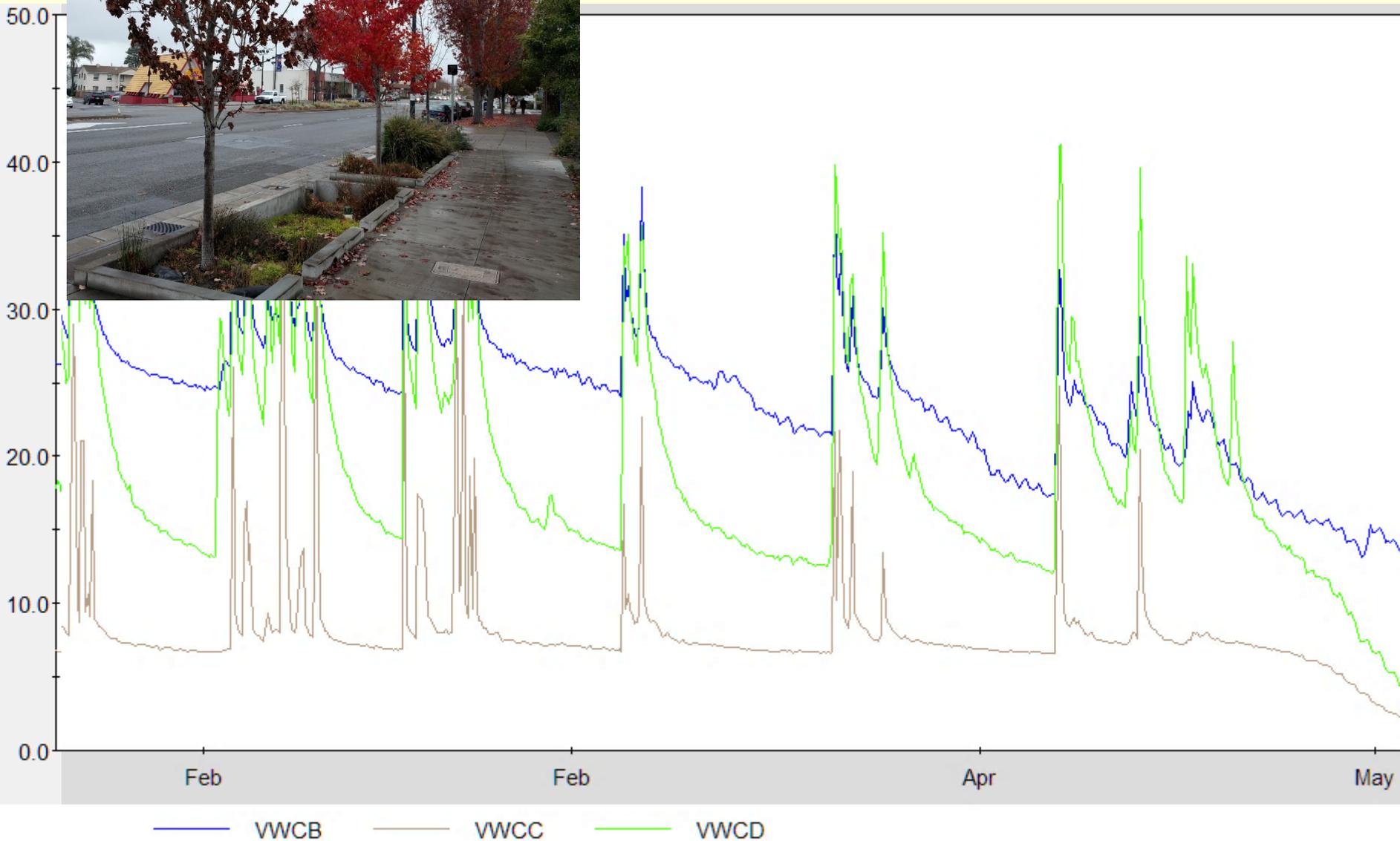
- HOME
- SEARCH
- ON THIS SITE
 - What is IPM?
 - Home & landscape pests
 - Agricultural pests
 - Natural environment pests
 - Exotic & invasive pests
 - Weed gallery
 - Natural enemies gallery
 - Weather, models & degree-days
 - Pesticide information
 - Research
 - Publications
 - Events & training
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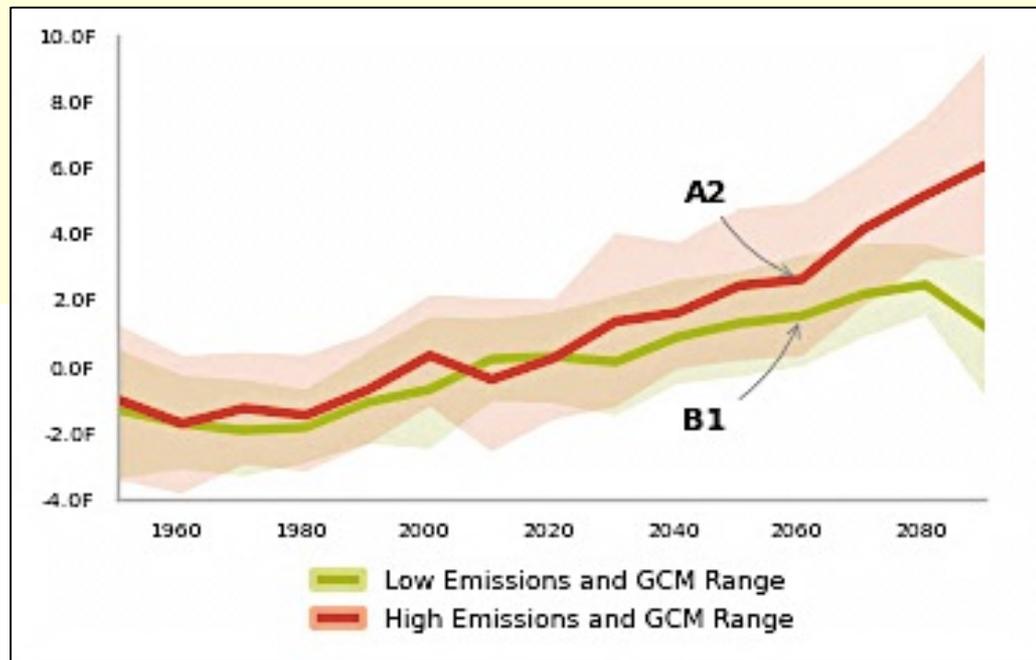
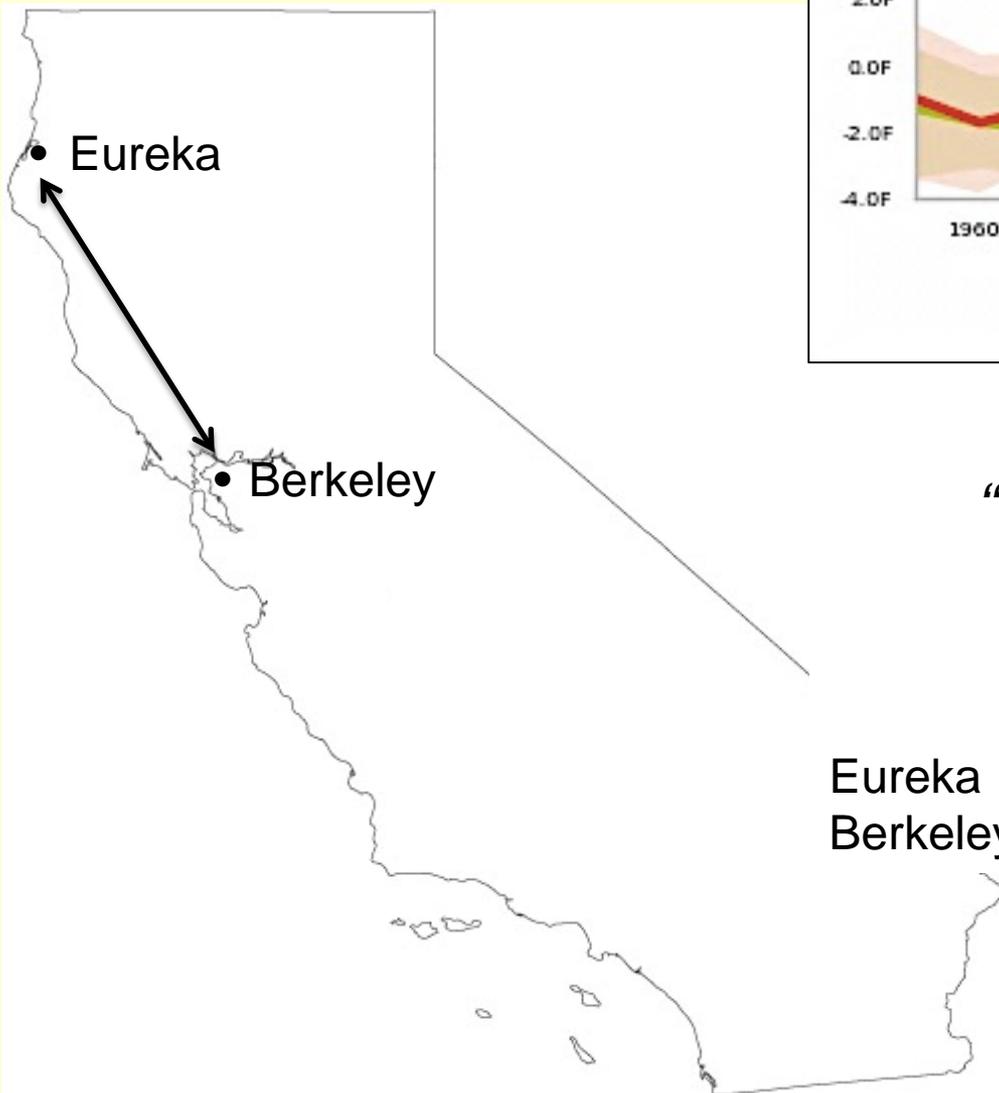
(2) Water issues: e.g.,
green
infrastructure
(bioswales)



Bioswales dry quickly... (irrigation? species selection?)



(3) Street trees & climate change

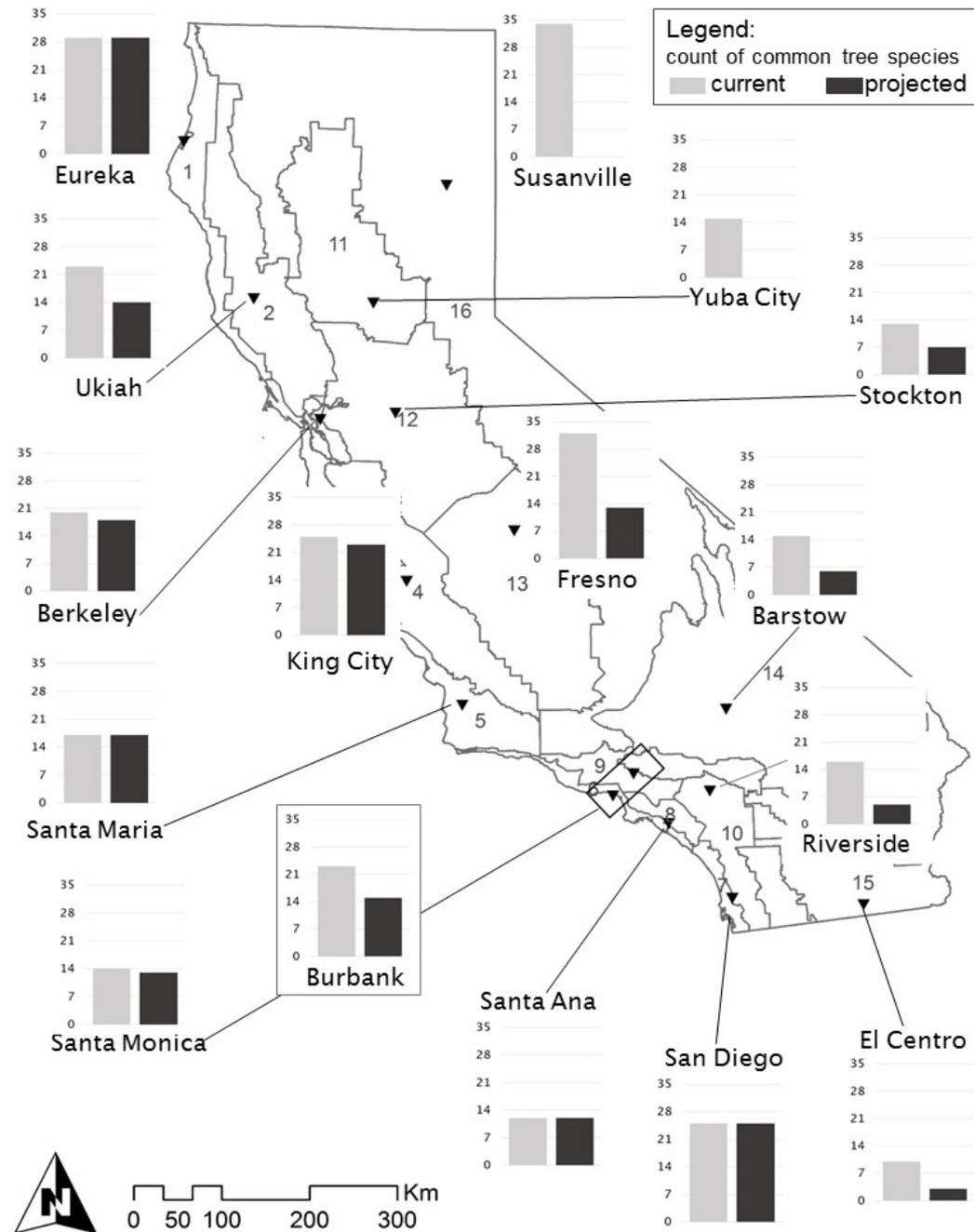


“substituting space for time”

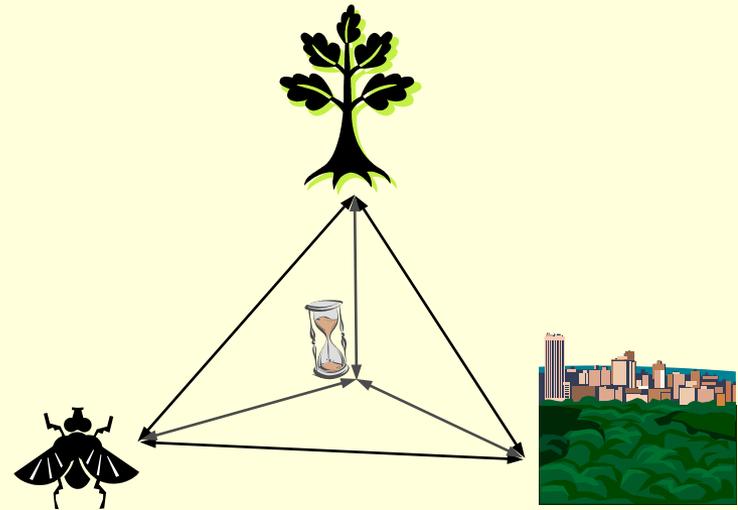
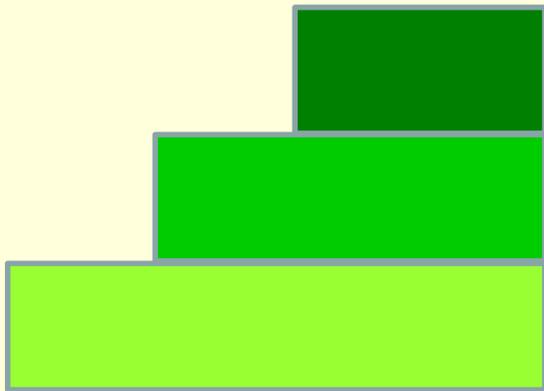
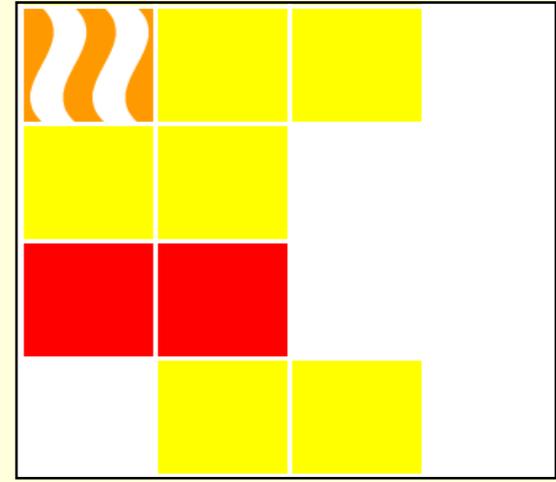
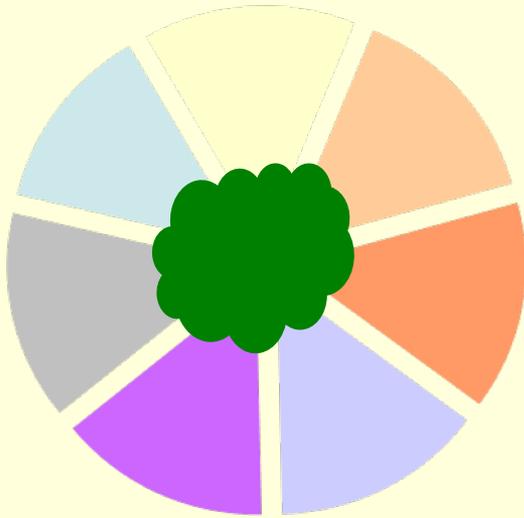
	Temperature °F	
	<u>Current Ave. July Max. Temp.</u>	<u>Predicted Ave. July Max.</u>
Eureka	62	70
Berkeley	70	

An arrow points from the '70' in the Berkeley row to the '70' in the Eureka row, indicating that the predicted temperature for Berkeley is equivalent to the current temperature of Eureka.

Many common street tree species are unsuitable for a warmer climate



summary



UCMGs and Urban Tree Diversity

UCMGs: help the client

assess their site conditions,

evaluate their tree composition

pick the best species or cultivars

(based on key pests/conditions, and neighbors)

understand the best cultural options

understand other components of IPM

UCMGs: help their community

make healthy choices in selecting trees likely to

succeed at the site, while contributing to

long-term climate resilience and

minimizing the chance of pest outbreaks.

Thank you!

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CE

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