Oaks of Sedgwick Reserve

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Donald Bren School of Env. Sci and Mgmt
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Presentation Outline

• Oaks of the World
• Oaks of the California Foothill Woodland
• Local distribution, status and trends
• Acorn ecology
• Oak Related research at Sedgwick Reserve
  – SB County Oak Restoration Project
  – Gene Flow in Valley Oaks
Oaks of the world

- Family Fagaceae
- Genus Quercus
  - ~600 spp. of trees and shrubs, northern hemisphere, origin >40 million years ago
  - Unisexual flowers (male catkin, female scaly cup)
  - Wind pollinated
  - 1 seeded fruit (a nut)

FIG. 1. Generalized distribution of Quercus subsection Quercus in the Northern Hemisphere modified from Carpinus (1936–54), Soepadmo (1972), and Nixon (1985). (A) The distribution of New World sections Lobatae and Protobalanus; (B) the distribution of section Quercus sensu Nixon, emphasizing the distinction between the two groups, Quercus s.s. and section Cerris (Carpinus, 1936–54).
Oaks of California

- 20 species of trees, shrubs
  - 5 endemic to CA
  - All occur at < 7500 ft, most at < 4000 ft.
- Chaparral and desert oaks
- Foothill oaks
- Montane oaks

U.S. Hotspots of rarity and richness

Source: TNC 1999
Oaks of the Foothill Zone

- Valley oak (Q. lobata)
- Blue oak (Q. douglasii)
- Engelmann oak (Q. engelmannii)
- Oregon oak (Q. garryana)
- Interior live oak (Q. wislizeni)
- Coast live oak (Q. agrifolia)
Valley oak

- Ca endemic
- Wide range of conditions and communities
- Winter deciduous, long-lived (400+ years), deep-rooted
- Drought-tolerant
- Shade-intolerant
- Fire-tolerant
- Browse-intolerant

Valley oak reproduction

- Flowers in March
- Acorn fall in Oct-Nov
- No dormancy, “slow” germination
- Dispersal by birds and mammals
- Low seedling establishment and survival in savannas
- Rapid growth
Valley oak (cont’)

- Wood properties and utilization
  - Brittle, cracks and warps during drying
  - Charcoal, firewood, wine barrels
- Wildlife habitat
  - Forage, acorns, nest cavities
  - Support 67 nesting bird species
- Diseases and pests
  - *Laetiporus sulphureus* (fungus), filbert weevils, gall wasps, mistletoe, etc.

Blue oak

- CA endemic
- Most widespread foothill oak (8 million ac, 75% private)
- Winter deciduous, moderately long-lived (250+ years), deep-rooted
- Drought-tolerant
- Shade-intolerant
- Moderately Fire-tolerant
- Browse-tolerant
Blue oak reproduction

- Flowers March
- Acorn drop Sept-Oct
- No dormancy, fast germination
- Dispersal by birds and mammals
- Low seedling survivorship
- Slow above-ground growth

Blue oak (cont’)

- Wood properties and utilization
  - Fence posts, firewood
- Livestock forage
  - 67% of livestock grazing in CA in BO woodland
- Wildlife habitat
  - Forage, acorns (weather-related masting), nest cavities
  - Support 60 nesting bird species
- Diseases and pests
  - Heart rot fungi, filbert worms, filbert weevils, gall wasps, mistletoe, etc.
Coast live oak

- Forest, woodland, riparian
- Evergreen, moderately long-lived (250+ years), extensively-rooted
- Moderately drought-tolerant
- Shade-tolerant
- Very fire-tolerant
- Browse-tolerant

Coast live oak reproduction

- Spring flowering (temperature-dependent)
- Incomplete acorn drop Sept-Oct
- No acorn dormancy, “slow” germination
- Moderate seedling survivorship (esp in shade)
- Rapid growth
Coast live oak (cont‘)

- Wood properties and utilization
  - charcoal, firewood
- Wildlife habitat
  - Preferred habitat for many large vertebrates (bear, deer, gray fox, ferrel pig)
  - Acorns (relatively low quality), nest cavities
- Good regeneration in shrublands and forests
- Poor regeneration in grasslands
- Increasingly fragmented by urbanization and orchards/vineyards

Nutritional value of CALIFORNIA ACORNS

<table>
<thead>
<tr>
<th>Species</th>
<th>Protein</th>
<th>Fat</th>
<th>Carbohydrate</th>
<th>Tannin</th>
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<tbody>
<tr>
<td>Q. agrifolia1</td>
<td>6.26</td>
<td>16.75</td>
<td>54.57</td>
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<tr>
<td>Q. chrysolepis1</td>
<td>4.13</td>
<td>8.65</td>
<td>63.52</td>
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<tr>
<td>Q. douglasii2</td>
<td>3.03</td>
<td>4.77</td>
<td>43.39</td>
<td>3.61</td>
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<td>Q. dumosa2</td>
<td>2.29</td>
<td>3.42</td>
<td>40.65</td>
<td>5.15</td>
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<td>Q. kellogii1</td>
<td>4.56</td>
<td>17.97</td>
<td>55.48</td>
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<tr>
<td>Q. garryanna1</td>
<td>3.94</td>
<td>4.47</td>
<td>68.87</td>
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<tr>
<td>Q. lobata2</td>
<td>2.82</td>
<td>4.25</td>
<td>43.44</td>
<td>3.85</td>
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<td>Q. wislizneii2</td>
<td>3.08</td>
<td>14.47</td>
<td>40.40</td>
<td>4.60</td>
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<tr>
<td>Indian corn4</td>
<td>9.2</td>
<td>1.9</td>
<td>74.4</td>
<td>--</td>
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<tr>
<td>Wheat4</td>
<td>11.40</td>
<td>1.00</td>
<td>75.4</td>
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1Wolf (1945), 2Wagnon (1945), 3Heizer and Elsasser (1980), 4Wagnon (1946)
Acorn predators

- Weevils, filbert weevil, filbertworms
- Acorn woodpeckers
- Scrub jays
- Gophers, Mice
- Deer, Pigs, Cows

http://bio.sbcc.net/img/19970703.htm

Patterns of Acorn Production by California Oaks

Walt Koenig and Jean Knops
Hastings Reservation and Museum of Vertebrate Zoology
University of California Berkeley

Mean blue oak acorn crops are correlated between all localities surveyed

Mean April temperature (degrees C)

Valley oak acorn crops are larger following warm, dry springs
**Sudden oak death**

- Caused by water mold, *Phytophthora ramorum*
- Big Sur to Southern Mendicino County
- Tanoak most severely affected
- Many hosts, but not white oaks
- Potentially very serious

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**Distribution and ownership of Foothill woodlands (green) and Grasslands (yellow)**

<table>
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<tr>
<th>Community</th>
<th>% Public</th>
<th>% Private</th>
<th>% in Ecological reserves</th>
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<tr>
<td>Valley oak woodland</td>
<td>5.4</td>
<td>94.6</td>
<td>1.3</td>
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<tr>
<td>Blue oak woodland</td>
<td>16.3</td>
<td>83.7</td>
<td>3.8</td>
</tr>
<tr>
<td>Coast live oak woodland</td>
<td>12.6</td>
<td>87.4</td>
<td>4.1</td>
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<tr>
<td>Pinyon juniper woodland</td>
<td>76</td>
<td>24</td>
<td>35.5</td>
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<tr>
<td>Sierran Mixed conifer forest</td>
<td>58.0</td>
<td>42.0</td>
<td>9.7</td>
</tr>
<tr>
<td>Alpine dwarf scrub</td>
<td>99.9</td>
<td>0.1</td>
<td>63.0</td>
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Overstory mortality in 12 Valley oak savanna stands, Santa Ynez Valley, 1938-1989 (Brown and Davis 1991)
Overstory mortality in valley oak and mixed oak woodlands and savanna, Sedgwick Reserve, 1943-1989 (Davis et al. 1996)
Key Points

• Great diversity of oaks worldwide and in California
• 3 major oak species on Sedgwick Reserve with similar but distinctive life histories, ecology and habitat relationships
• These oaks are extremely important for wildlife habitat relations
• Regeneration most limited in valley oak, least limited in coast live oak.
• Oak cover has systematically declined in woodlands and savannas of SY Valley and SR over past century

Factors Limiting Recruitment in Valley and Coast Live Oaks

Santa Barbara County
Oak Restoration Program

Claudia Tyler, Bruce Mahall, Frank Davis (UC Santa Barbara), and Mike Hall (Cal Poly, San Luis Obispo)
Program Goals

- Determine the role of cattle grazing and other factors in limiting or promoting oak recruitment
- Determine methods for successful low-cost regeneration and restoration of oaks on a large landscape scale
Q. agrifolia - 1996/97, 97/98
Q. lobata - 1996/97, 97/98
Q. agrifolia - 1999/2000
Q. lobata - 1999/2000
Q. agrifolia – 2000/2001
Q. lobata – 2000/2001

fenced/caged

diameter = 18"
diameter = 6"
3’ hardware cloth
5’ t-post
4’ rebar
buried ~12"
Three-year old *Quercus lobata* saplings protected from small mammals (L) and protected from large grazers only (R).

Three-year old *Quercus lobata* sapling protected from small mammals.

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**Seedlings planted in Jan 2001**

![Bar chart showing % emergence May/June 2001 for *Q. agrifolia* and *Q. lobata* under different grazing and rodent conditions.]

- Open: light grey bars
- No lg grazers: dark grey bars
- No rodents: white bars

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*Q. agrifolia* and *Q. lobata* seedlings planted in Jan 2001.
Seedlings planted in Jan 2000

Seedlings planted in Jan 1998
Total number of seedlings of each oak species in each age class surviving to June 2001

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Quercus lobata</strong></td>
<td>9</td>
<td>300</td>
<td>-</td>
<td>273</td>
<td>160</td>
</tr>
<tr>
<td><strong>Quercus agrifolia</strong></td>
<td>4</td>
<td>226</td>
<td>-</td>
<td>64</td>
<td>245</td>
</tr>
</tbody>
</table>

Summary

• variation in rainfall is primary factor in inter-annual differences in seedling recruitment

• seed predation and herbivory by small mammals significantly reduces emergence and establishment

• survivorship of protected acorns & seedlings is comparable in grazed and ungrazed areas

• survivorship patterns are very similar for valley oak & coast live oak
Pollen movement in Valley Oak: Where have all the fathers gone?

Victoria Sork, U. Missouri
Frank Davis, UCSB
Peter Smouse, Rutgers

Figueroa Creek Site
Genetic Sampling

[Diagram showing genetic sampling locations with distances indicated in meters]

[Map showing genetic sampling locations with various symbols and labels]
Pollen dispersal patterns

Spatial modeling of pollen movement at Figueroa Creek

Relative contribution of four trees

- Contour 15m
- Relative Contribution
  - 0
  - 0 - 0.001
  - 0.001 - 0.01
  - 0.01 - 0.2
  - 0.2 - 0.4
Changes in pollen movement

What This Means So Far

- Low effective number of fathers in Valley oak
- Pollen is not moving far in wind-pollinated species
- Stand thinning may have implications for gene flow and fruit production
• Coast Range Oak Woodland Network