Forestry and Emerging Technologies Why? CIWMB – April 17, 2006

California Department of Forestry and Fire Protection

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Forests Contain large Amounts of Small Plant Biomass

- California has 40 Mil. Acres of forest and shrubland that produce biomass.
- Annually available biomass is 26.8 mil BDTs Gross and 14.3 mil. BDTs Technical
- Trees 10 inches in diameter and less account for 88% of the total number of trees but only 15% of the total wood volume.

California Biomass Collaborative 2005 Update

- Forest Biomass has greatest number of trees in small diameter classes – Thus not merchantable for traditional solid products, but create the greatest fire and forest health risks.

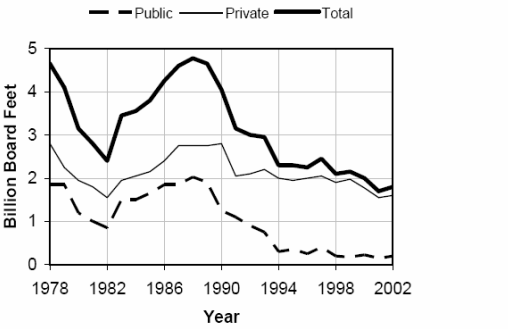


Figure 4. Volume of timber harvest (billion board feet) on public and private lands in California, 1978 – 2002.[22]

Table 1. Estimates of annually available biomass in California, 2005.

(Million dry tons/year except as noted)	Gross[4]	Technical[4]
Total Biomass	***86.0***	***33.6***
Possible Use by Thermal Conversion	69.3	28.9
Possible Use by Biochemical Conversion	16.7	4.6
Total Agricultural	***21.6***	***9.6***
Total Animal Manure	11.8	4.5
Total Cattle Manure	8.3	3.0
Milk Cow Manure	3.8	1.9
Total Orchard and Vine	2.6	1.8
Total Field and Seed	4.9	2.4
Total Vegetable	1.2	0.1
Total Food Processing	1.0	0.8
Total Forestry	***26.8***	***14.3***
Mill Residue	6.2	3.3
Forest Thinnings	7.7	4.1
Logging Slash	8.0	4.3
Chaparral	4.9	2.6
Total Municipal	***37.6***	***9.7***
Biosolids Landfilled	0.1	[2]
Biosolids Diverted	0.6	0.5
Total MSW Biomass Landfilled	18.5	[2]
Total MSW Biomass Diverted	18.4	9.2
Landfill gas	118 BCF/y [1]	79 BCF/y
Biogas from waste-water treatment plants (WWTP)	16 BCF/y[3]	11 BCF/y

[1] Total landfill gas potential is 118 billion cubic feet per year (BCF/y) for an assumed composition of 50% methane from waste already in place. Diversion of MSW shown as landfilled will reduce future landfill gas potential but may increase generating capacity through use of conversion technologies. Increased diversion would also support potential increases in biofuels.
[2] assumed landfilled, resource available as landfill gas.
[3] billion cubic feet per year of biogas (60% methane).
[4] Gross resource refers to total estimated annual biomass produced. Technical resource refers to the amount that can potentially be supplied to utilization activities (see text).

Forest Biomass is a residue and a product

- Products – (< 2 bil. Bd.ft.)
  - Solid Wood (boards, plywood, poles, posts, etc.)
  - Bio-Energy (fuels, bio-oils, electricity)
  - Chemicals (adhesives, solvents, plastics, resins, polymers)
  - Reconstituted (paper, insulation, fiber board, OSB, hardboard,
- Residues – (14.2 mil BDT annual/technical)
  - Logging Slash
  - Mill Residue
  - Forest Thinnings
  - Shrub and Chaparral
- Non -Traditional –
  - Carbon Trading
  - Conservation easement value

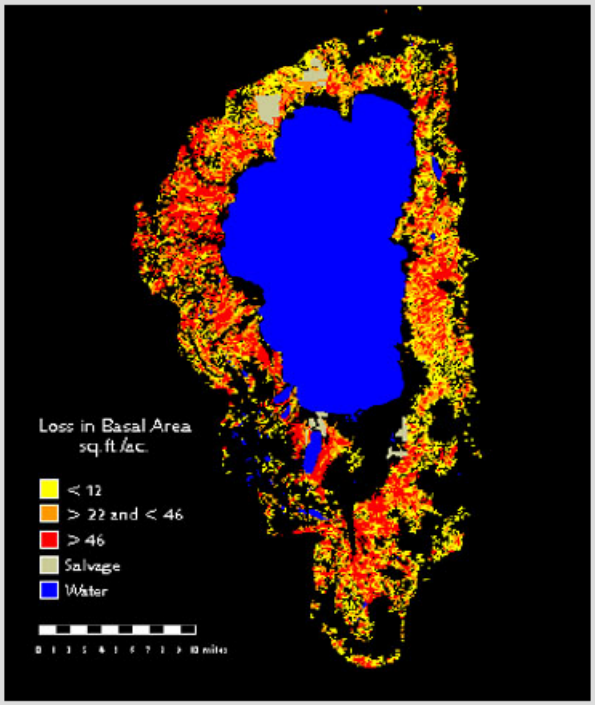
Biomass is also a Threat

- Forest Health
  - Stands/Moisture out of balance -
    - Localized droughts in So Cal & Eastside Sierra.
  - Increased Potential for Insect Mortality -
    - Southern California has severe impact on >600K acres.
    - 3.5 mil/ac with risk of 25% mortality in the next 15 years.
  - Growth potential –
    - Final Climate Act Team – Using high/Low climate model, the potential exists of a 20% loss of growth potential.

Visual Examples -

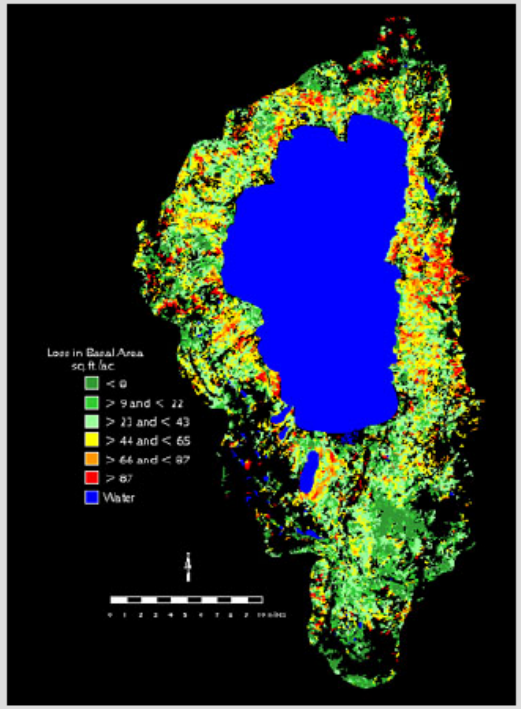
- Tahoe two time periods of Mortality – 90's drought
  - Red > 45 square foot of basal area lost – Green > 6 to >22 sqft loss.
  - Drought induced insect infestations were cause.

Figure 2. Loss in basal area (ft^2 per acre) between 1988 and 1991



Source: Collins and Woodcock, 1995

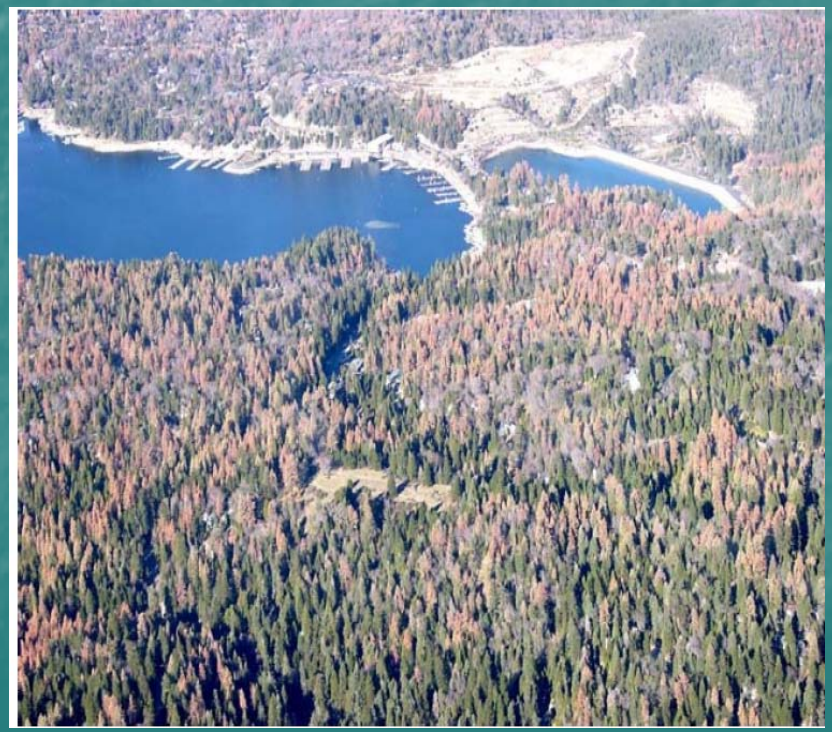
Figure 3. Loss in basal area (ft^2 per acre) between 1992 and 1994



Source: Collins and Woodcock, 1995

Visual Example

- Lake Arrowhead – So Cal >600K acres
  - Up to 90% mortality.
  - >3 bil. cu ft of biomass in mortality.
  - Drought induced.
  - 2003 “Old” fire – 91.000 acres ->1,000 structures destroyed.



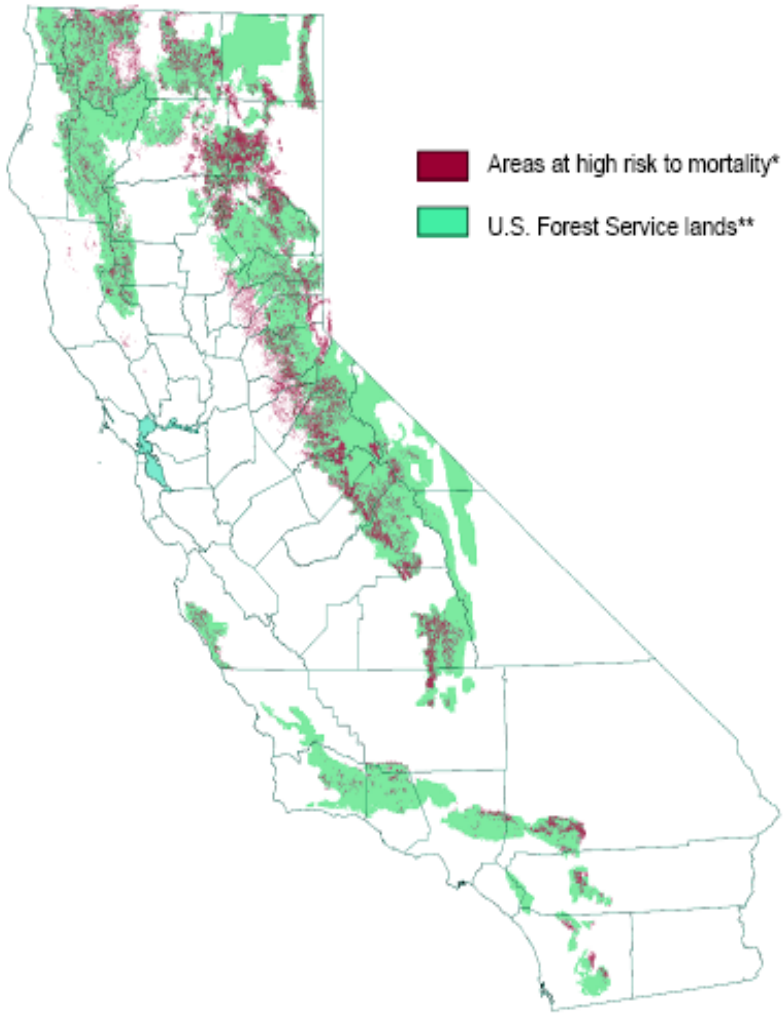
Visual Example

- Loss of ornamental & Native Monterey Pine – Pitch Canker.
- 25% mortality in next 10 years.
- Monterey, bishop, knobcone, ponderosa, doug-Fir, ornamentals susceptible.

Visual Example

- High risk that 25% mortality will occur by 2015.
- This includes 60% of the Ponderosa Pine stands.
- Imported disease – Pitch Canker, Sudden Oak Death
- Imported Insects – Eucalyptus Long-Horned borer.
- Drought induced insect infestations.
- Adaptation in the form of reduced stocking a viable risk reduction.

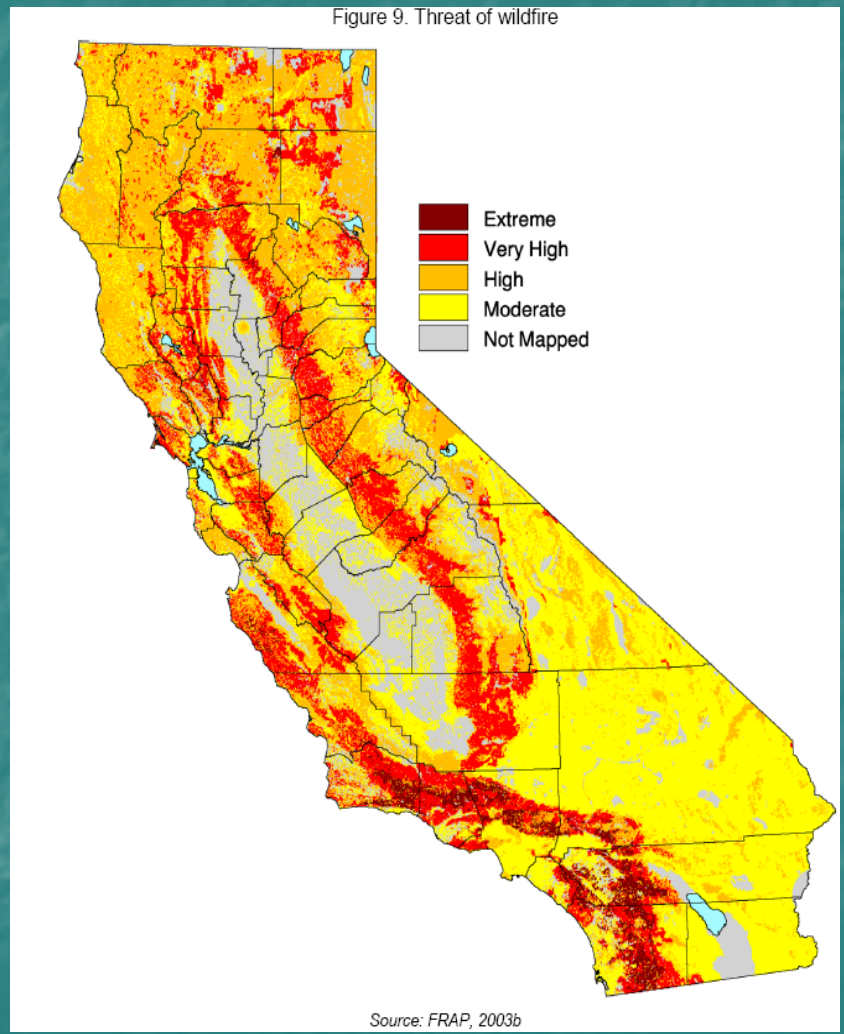
Figure 11. Areas at high risk to mortality* from insects through 2015



** greater than 25% tree mortality expected*

Fire Threat

- 48 % of States wildlands in high, very high, or extreme fire threat class.
- Combination of fire frequency and fire behavior.
- Forest stand structure changes increase fire intensity & crown fires.
- Increased wildland development increases ignitions on bad fire weather days.
- Limited resources dictate prioritizing fuel hazard reduction treament.



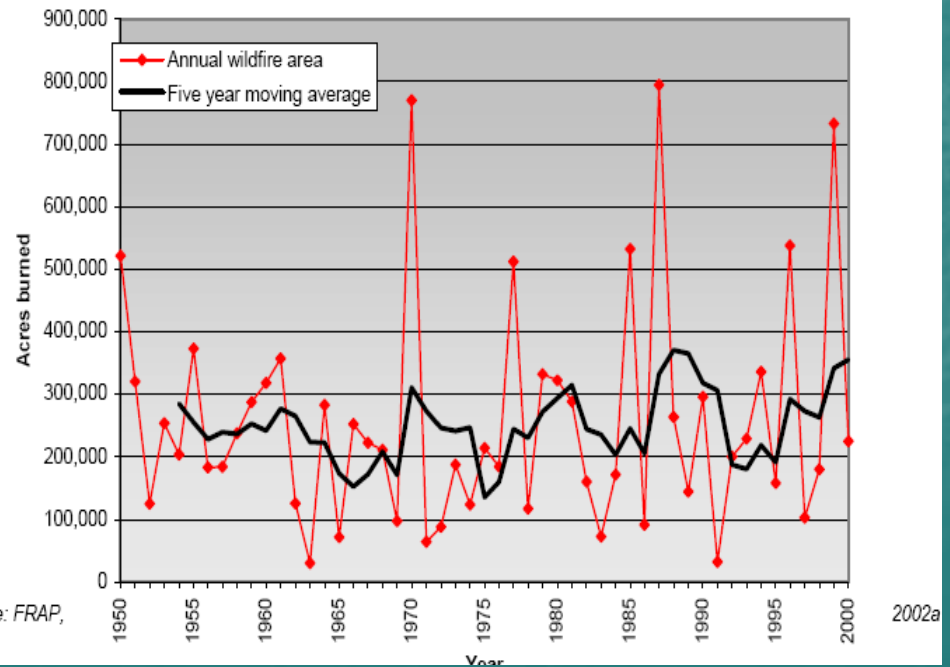
Fire Size Trends -

- **Fire size trends shows 5 year average increase.**

- **Causes for increase include -**
  - Past suppression.
  - Increased fire hazard.
  - Movement into wildlands.
  - Increased large fires after ’70 due to higher fuels loading and climate.

Photo courtesy of the Bureau of Land Management.

Figure 4. Annual area burned in California, 1950-2000



Source: FRAP, 2002a

Fire Risk Increase -

- Increase Structure Loss
- 5.5 mil acres at significant risk in Wildland Urban Interface areas.
- 78% of the states 17 mil. acres of timberland at high or extreme risk.

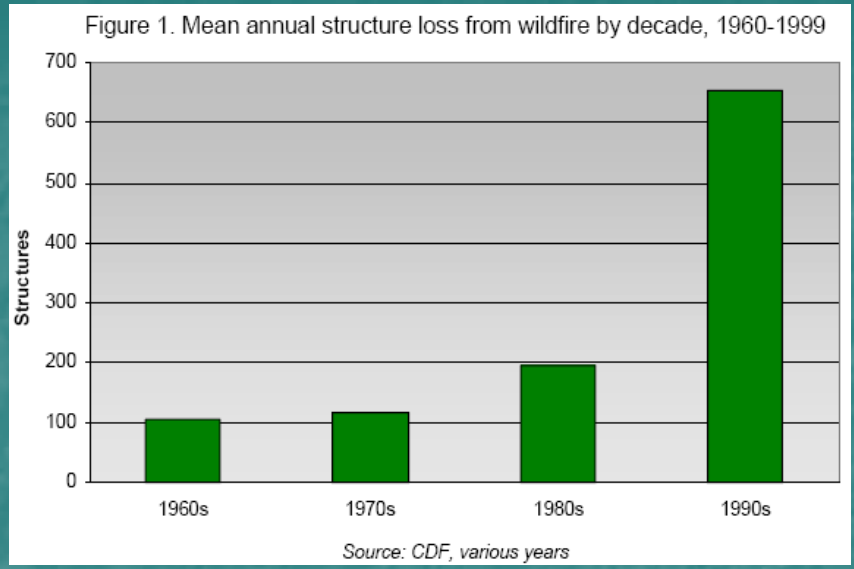


Table 3. Housing units in the wildland urban interface by density class and fire threat, 2000

Density class	Total housing units	Housing units by fire threat class				
		Extreme	Very High	High	Moderate	None
Rural	323,284	49,167	178,491	41,793	47,842	5,989
Interface	597,498	109,892	316,246	83,347	80,000	8,012
Urban	10,886,540	380,220	2,131,667	1,624,185	6,627,360	123,104
Total	11,807,323	539,279	2,626,404	1,749,325	6,755,202	137,105

Source: FRAP, 2003a

Emerging Technology Opportunities

- Bio-Energy (Alternative fuels & electricity)
  - Gasification
  - Anaerobic Digestion
  - Thermo-chemical
- Chemicals
  - Resins
  - Polymers
- Reconstituted Wood Products
  - Plastic Composites
  - Oriented Strand Board
- Niche Markets
  - **Compressed Beams**
  - **Hardwood Industry**

CTL forwarders can operate with less than five percent soil disturbance.