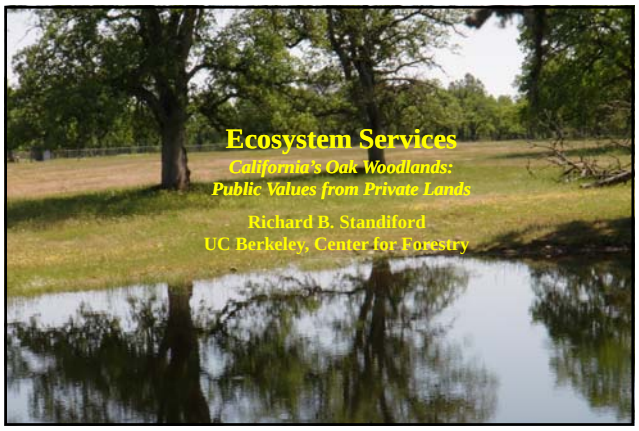


Examples of Ecosystem Services

- Wildlife habitat
- Water quality and quantity
- Aesthetics
- Open space

California's Oak Woodlands

- 4 million hectares (10% of state)
- Tree overstory – *Quercus* genus
- Understory – exotic annual grasses and forbs and occasional native perennials
- 2/3 grazed by domestic livestock – mainly cattle
- 80% privately owned
- Highest biodiversity
  - Over 300 vertebrates, 5000 invertebrates, 2000 plant species

Effect of Oak Trees per Hectare on Land Value

Key Points – Ecosystem Services

- What are ecosystem services?
- How are ecosystem services valued?
- How do ecosystem service values compare to other resource markets?
- How to represent landowner values for ecosystem services
- How to value community benefits of ecosystem services
- Policy instruments to conserve ecosystem services

Normative Modeling Results

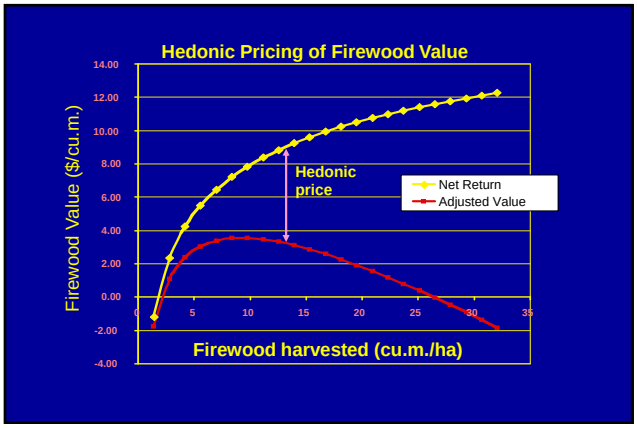
- **Predicts clearing**
- **Doesn't account for environmental and aesthetic utility to landowner**
- **Not consistent with actual current behavior**

Normative Modeling Results

- Predicts clearing
- Doesn't account for environmental self-consumption
- Not consistent with actual current behavior

Positive Modeling Results

- Predicts partial harvest
- Calibrated to actual behavior
- Retain capital stock of trees for environmental, aesthetic values
- More realistic with current management situation



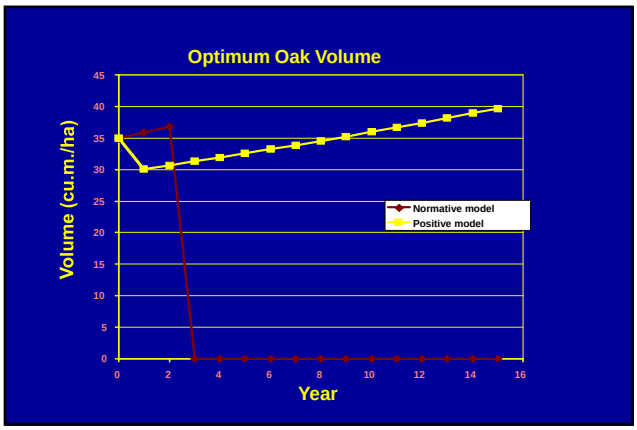
Silvopastoral Model: Positive Mathematic Programming

$$\text{MAX} \sum_{t=0}^{T} \text{Total Revenue}_t\ (\text{firewood}_t, \text{cattle}_t, \text{hunting}_t, \text{cost}_t)$$

Subject to:

Tree growth$_t$ (site, harvest$_t$, current stocking$_t$)
Cattle stocking$_t$ (sales$_t$, birth$_t$, replacement$_t$)
Forage Production$_t$ (site, tree cover$_t$, weather$_t$)
Behavior constraint (actual wood sold$_t$)

Marginal value of Environmental utility



Silvopastoral Model: Positive Mathematic Programming

$$\text{MAX} \sum_{t=0}^{T} \text{Total Revenue}_t\ (\text{firewood}_t, \text{cattle}_t, \text{hunting}_t, \text{cost}_t, \textit{envir. utility})$$

Subject to:

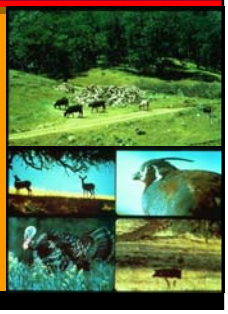
Tree growth$_t$ (site, harvest$_t$, current stocking$_t$)
Cattle stocking$_t$ (sales$_t$, birth$_t$, replacement$_t$)
Forage Production$_t$ (site, tree cover$_t$, weather$_t$)

Hedonic Firewood Prices

- Modeled actual behavior
- High level of firewood harvest has high "cost" for tree removal
- Determined "value" of retaining trees
- Representation of landowner utility for tree retention

Commercial Production from Oak Woodlands - Results

- Livestock enterprise has positive value on average
- Hunting can contribute 40 to 70 percent of total returns
- Low value of wood harvest
  - Marginal value of retained trees for habitat > firewood value
  - Harvest most likely in poor forage years
- Effect of risk
  - Higher risk, higher wood harvest, higher grazing intensity

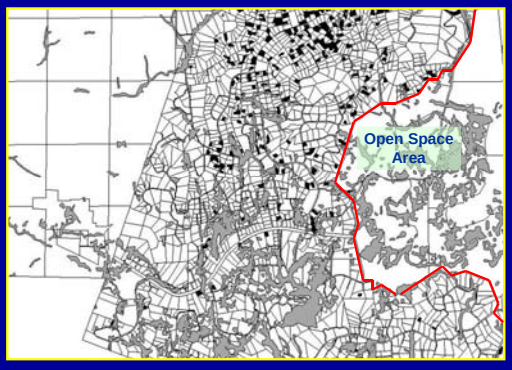


Analysis

Value (house, land) = f(housing characteristics, location, improvements, amenity values)

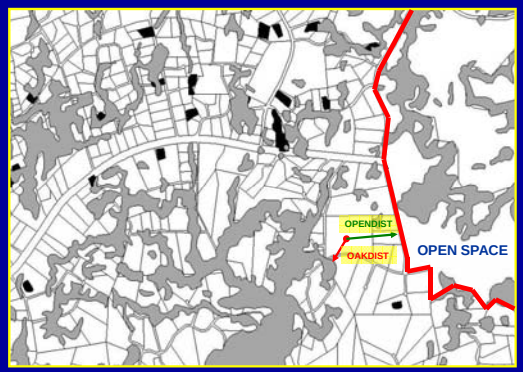
Environmental Services From Working Oak Woodland Landscapes

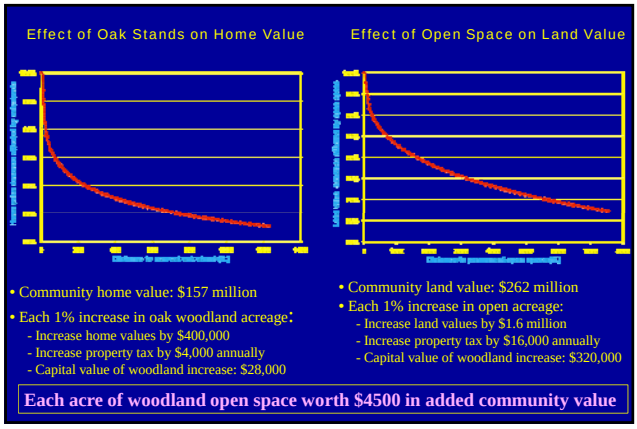
- Migration to rural areas because of amenity values
- Property values correlated with of oak woodland landscapes
- Oak woodland open space increases community value
- New markets for easements, mitigation banks



Value of Open Space: The Santa Rosa Plateau

- Southern end of Santa Ana Mountains (Riverside County)
- Site of 8,400 acre TNC reserve
  - Initial purchases in early 1990's
  - Native grasslands, vernal pool habitats, Engelmann oak
  - 60 "sensitive" plant and animal species
- Surrounded by one of most rapidly growing areas in state





Conservation Easements and Land Trusts - Funding

- Donations – Charitable giving
  - Reduction in income and estate taxes
- Private sources
  - Foundations, developer fees, mitigation banks
- Local public financing – local sales tax surcharges
- Federal and state funding
  - Public bonds, budgeted items

Economic Value of Open Space - Conclusions

- **Open space areas valued for ecological and amenity values**
- **Open space has positive benefits on entire community and individual property owners**
- **Values provide economic incentive for investing in conservation values**
- **Restoration and easement purchase can be financed through community value increases**

Economic Value of Working Silvopastoral Landscapes - Conclusions

- Privately managed oak woodlands valued for ecological services
- Owner's self-consumption of environmental values conserves habitats
- Working landscapes and oak woodland open space benefit entire community
- Added community values provide economic incentive for investing in conservation and restoration
- Opportunity costs of low value grazing enterprises create fragmentation risks
- Increasing role of land trust organizations

Policies to Maintain Open Space

- **Property taxes based on current use, rather than "highest and best use"**
  - **Requires 10 year dedication to current agricultural use**
- **Zoning for open space, agricultural use**
- **Estate tax reform**
- **Conservation easements**