


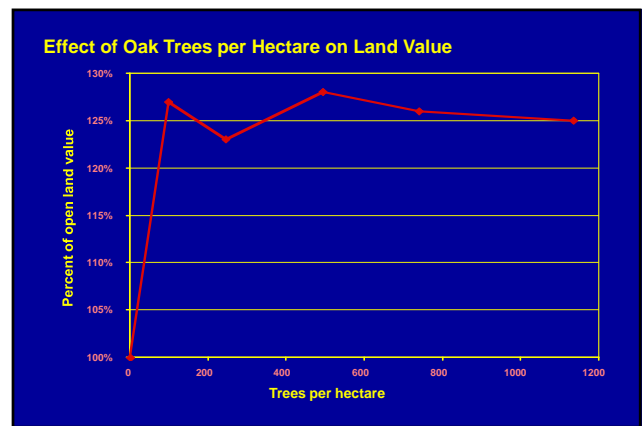
Examples of Ecosystem Services

- 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






Key Points – Ecosystem Services


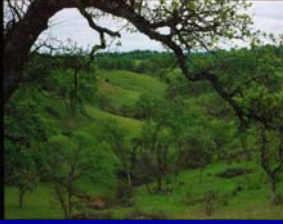
- What are ecosystem services?
- How are ecosystem services valued?
- How do ecosystem service values compare to other resource markets?
- How to represent landowner values for ecosystem services
- How to value community benefits of ecosystem services
- Policy instruments to conserve ecosystem services

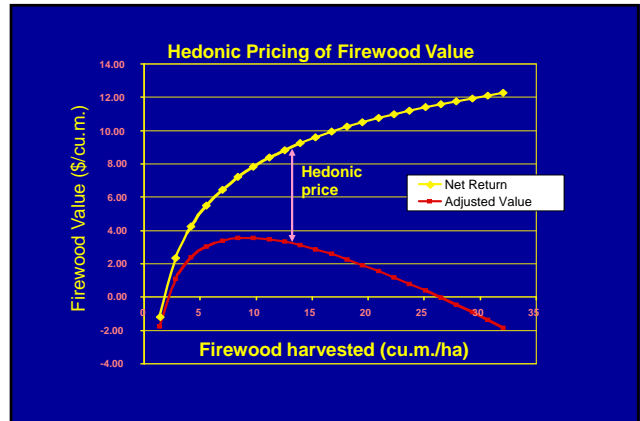



Normative Modeling Results



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

Normative Modeling Results	Positive Modeling Results
 <ul style="list-style-type: none"> • Predicts clearing • Doesn't account for environmental self-consumption • Not consistent with actual current behavior 	 <ul style="list-style-type: none"> • Predicts partial harvest • Calibrated to actual behavior • Retain capital stock of trees for environmental, aesthetic values • More realistic with current management situation



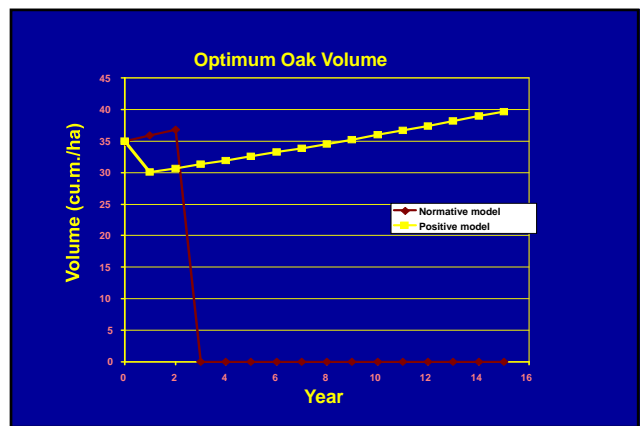
Silvopastoral Model: Positive Mathematic Programming

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

Subject to:

- Tree growth, (site, harvest_t, current stocking)
- Cattle stocking, (sales_t, birth_t, replacement_t)
- Forage Production, (site, tree cover_t, weather_t)
- Behavior constraint (actual wood sold)

Marginal value of Environmental utility



Silvopastoral Model: Positive Mathematic Programming

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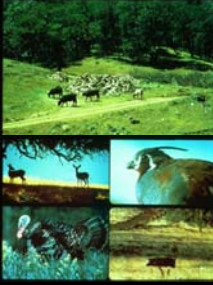
Hedonic Firewood Prices

- 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



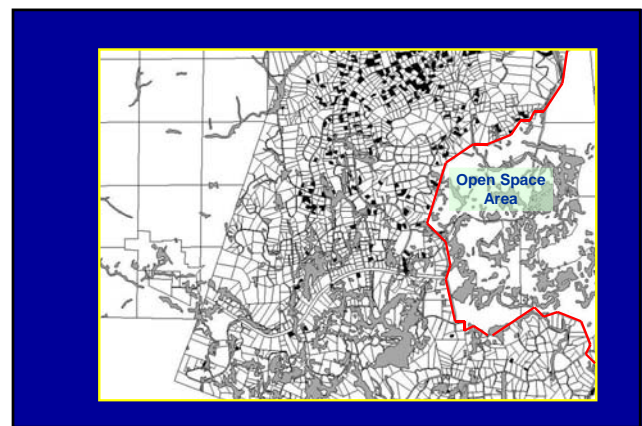
Analysis

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




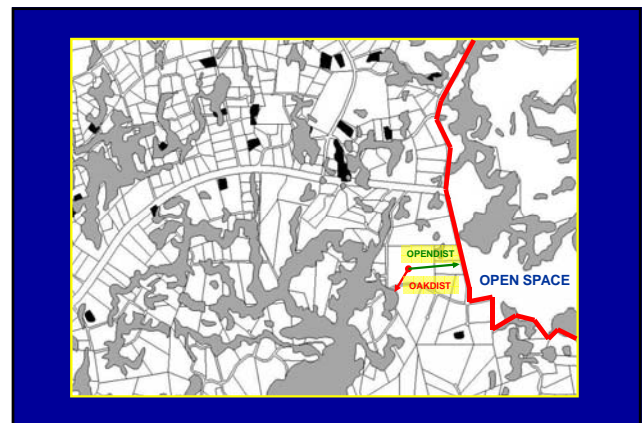
Environmental Services From Working Oak Woodland Landscapes

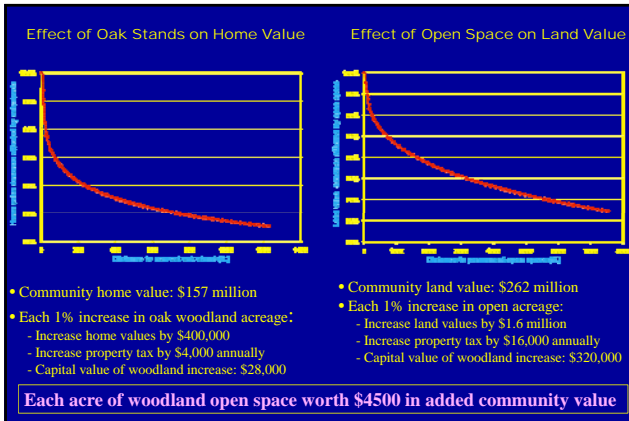
- Migration to rural areas because of amenity values
- Property values correlated with of oak woodland landscapes
- Oak woodland open space increases community value
- New markets for easements, mitigation banks

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

Questions ?