

Measuring the Economic Value of Fire and Fire Surrogate Treatments

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Common framework links economics with ecology

- State and transition framework basis for economic analysis for consistency over several economic research components:
 - I. Wildfire suppression costs averted
 - II. Valuation of ecological goods and services
 - III. Ranch-level benefits
 - IV. Deviation between ranch incentives and social benefits
- Next Steps: Policy design to align incentives among diverse societal interests for cost effective ecosystem maintenance / management

I. Benefits of treatments: fire suppression costs averted

- BLM & USFS wildfire suppression costs exceed \$1 billion/yr in 4 of 7 years from 1999 to 2006
- 397 large wildfires in Great Basin from 1995 to 2007 (USFS Rocky Mountain Research Station)
- Suppression costs/fire: \$117 to \$52,400,000
 - area burned per fire: 100 to 194,496 acres
 - average size: 6,813 acres.
- Pre-fire vegetation management widely recognized as reducing these costs (GAO 2009)

Results: present value of wildfire suppression costs/acre averted

	Healthy Sagebrush	Decadent sage with some cheatgrass	Cheatgrass Dominated
Lower elevation: Wyoming Sagebrush (< 6,500 feet)			
Fire Suppression Cost Savings	\$29,610	\$-22,180	\$230
95% CI	\$17,730 - \$41,500	\$-19,850 - \$-24,520	\$110-\$350
Higher elevation: Mountain Big Sagebrush without PJ encroachment (>4,700 feet)			
Fire Suppression Cost Savings	\$5,850	\$71,160	\$360
95% CI	\$3,930 - \$7,770	\$40,460 - \$101,860	\$20 - \$710

Higher elevation: Mountain Big Sagebrush with PJ encroachment (>4,700 feet)				
Fire Suppression Cost Savings	Healthy Sagebrush	PJ, Sagebrush and some cheatgrass	Closed PJ with some cheatgrass	Cheatgrass Dominated
Fire Suppression Cost Savings	\$990	\$32,3170	\$14,690	\$80
95% CI	\$600 - \$1,390	\$19,170 - \$45,460	\$490 - \$24,480	\$4 - \$165

Implications

- Prevention is economically superior to rehabilitation from a cheatgrass-dominated state.
- Contrast with observed practice, where post-fire restoration takes priority over pre-fire prevention.
- Next steps: net out treatment costs and include benefits from other costs averted.
- This analysis takes into account only fire suppression costs averted. Total costs averted by treatment are likely to be higher.

II. Valuation of environmental goods and services

- Willingness to Pay (WTP) to support programs to treat landscape vegetation in the GB that would:
 - Arrest further losses
 - Restore areas already converted
- Results:
 - General public WTP \$38 - \$52 per household per year
 - Preventing loss more highly valued than restoration
 - Less likely to support if identify as Ag, but more likely to support if agree that grazing is a priority
 - Less likely to oppose if employment related to public land management, and more years of education

III. Ranch benefits (Modeled)

- What is value of treatment for livestock production?
- How does rangeland state influence private incentives to undertake fuels removal treatments?
- How do herd size adjustments depend on rangeland ecological state and ranch size?
- What is ranchers' optimal adjustment to herd size in response to wildfire?

Ranch level results summary

- Ranch benefits do NOT include benefits that accrue to others, current and future: fire suppression costs, benefits indicated by WTP.
- Return to rancher alone is less than the cost of treatment (break-even for livestock production alone is less than \$5/acre).
- Once these are taken into account, what would be a 'socially efficient' ranching scenario that takes into account ecological change and costs and benefits to society?

IV. Social net benefits

- Socially optimal net benefits of treatment
 - Includes both ranch productivity and non-ranch benefits (wildfire suppression costs averted, ecological goods and services)
- What is socially optimal herd size and grazing pressure in response to state and transition changes and wildfire?
- How great is deviation between private rancher incentives and socially optimal treatment levels?
- How would production and fuels treatment decisions change if private incentives altered (through some policy mechanism) to take into account fire suppression costs and non-ranch rangeland values?

Results: Summary

- Taking into account ranch profits only:
 - Treatment is not optimal at cost of \$20/acre
 - Incentives for treatment are stronger in healthy rangeland states because herd sizes (and hence the cost of wildfire) are greater
 - Incentives for treatment are weaker for large ranches because they have 'buffering capacity' to deal with wildfire costs
- “Social Optimum”: Internalizing Fire Suppression Costs **Only**
 - Fuels treatment is undertaken at \$20/acre
 - Incentive for treatment higher in degraded rangeland states because of higher wildfire frequency and severity
- Break-even point for optimal treatment will increase much more once value of ecosystem goods and services to general public is taken into acct (~\$45 per household per year)

Thank-You

- Questions?

Results summary (more details)

- Herd Size is larger in healthy rangeland states
- Less Wildfire = Larger but more variable herd sizes
 - Large herd sizes mean that more cattle must be sold after wildfires in emergency sales (at lower prices)
 - Less wildfire means greater herd sizes AND greater herd size reductions when fire does occur – higher but more variable income
- Ranch Size and Wildfires
 - Large ranches more able to adjust production in response to wildfire
 - Larger ranches to maintain larger herds (increasing returns to scale)
 - Might consider cooperative programs for ranching on leased lands with range ‘banking’ to promote more sustainable livestock grazing

Approach

- Numerical optimal control problem
- Solve with continuous-state stochastic dynamic programming (SDP)
- 2 state variables: cattle, fuel stock
- 2 control variables: cattle sales, land treatment
- Rancher's profit maximization
 - Cow-calf operation (dynamic herd size management)
 - Treatment: pre-fire fuel removal
 - Interactions between land treatment decisions and cattle raising decisions?
- Contrast with alternative specification that includes costs of wildfire suppression and (eventually) the value of ecological goods and services