Economic Viability of Sagebrush Treatments

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Kimberly Rollins, Mimako Kobayashi, Michael H. Taylor,
University of Nevada, Reno

Photo Courtesy of
Jon Bates

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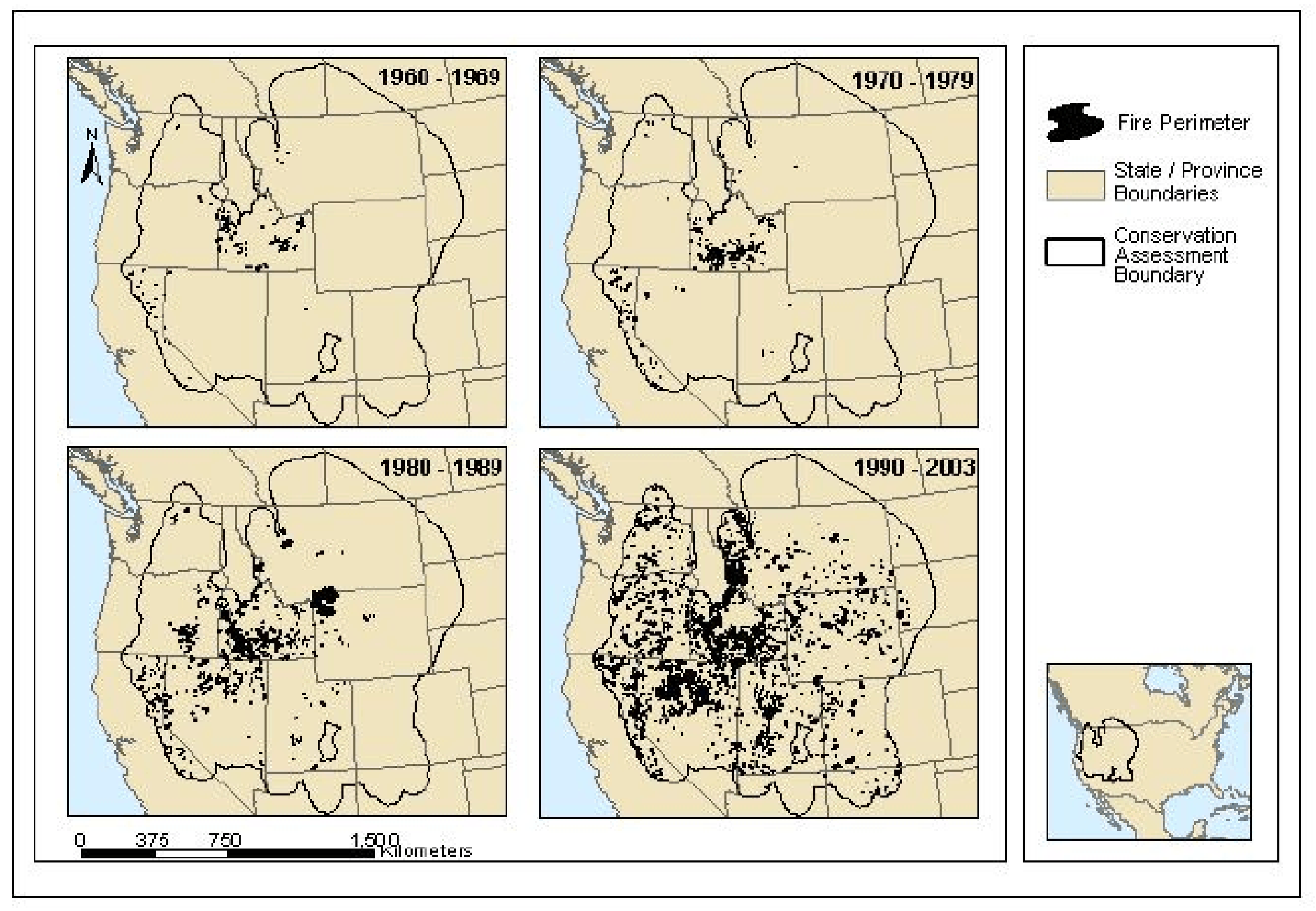
Fires from 1960 to 2003



Re-occurring Questions

- What is the benefits of treatment? The cost of doing nothing?
  - Benefit of management = cost avoided
- Where to Treat?
  - Where geographically should investment in prevention and rehabilitation be directed?
- Prevention vs. Rehabilitation?
  - Should we be investing more in prevention relative to rehabilitation?

Goal:

Demonstrate Economic Approaches to answering these kinds of questions

Challenge: Valuing Ecological Change

- **Ecological change in the Great Basin affects many different rangeland ecosystem goods and services**
  - **Cattle Ranching**
  - **Erosion Control**
  - **Wildfire control**
  - **Water Quality and Quantity**
  - **Wildlife Habitat – Game and Threatened Species**
  - **Recreation (Hiking, Hunting, ATV, etc.)**

Towards an Integrated Framework

- **Economic science is the analysis of Trade-offs**
  - **Efficient management of GB with multiple stakeholders and constrained resources involves identifying and balancing trade-offs**
- **Economic Approach**
  - **Quantify Benefits and Costs in comparable units**
  - **Theory and methods allow valuation of non-market ecosystem services**

An Integrated Framework

Common Ecological Framework: State-and-Transition Model Built into Economic Modeling

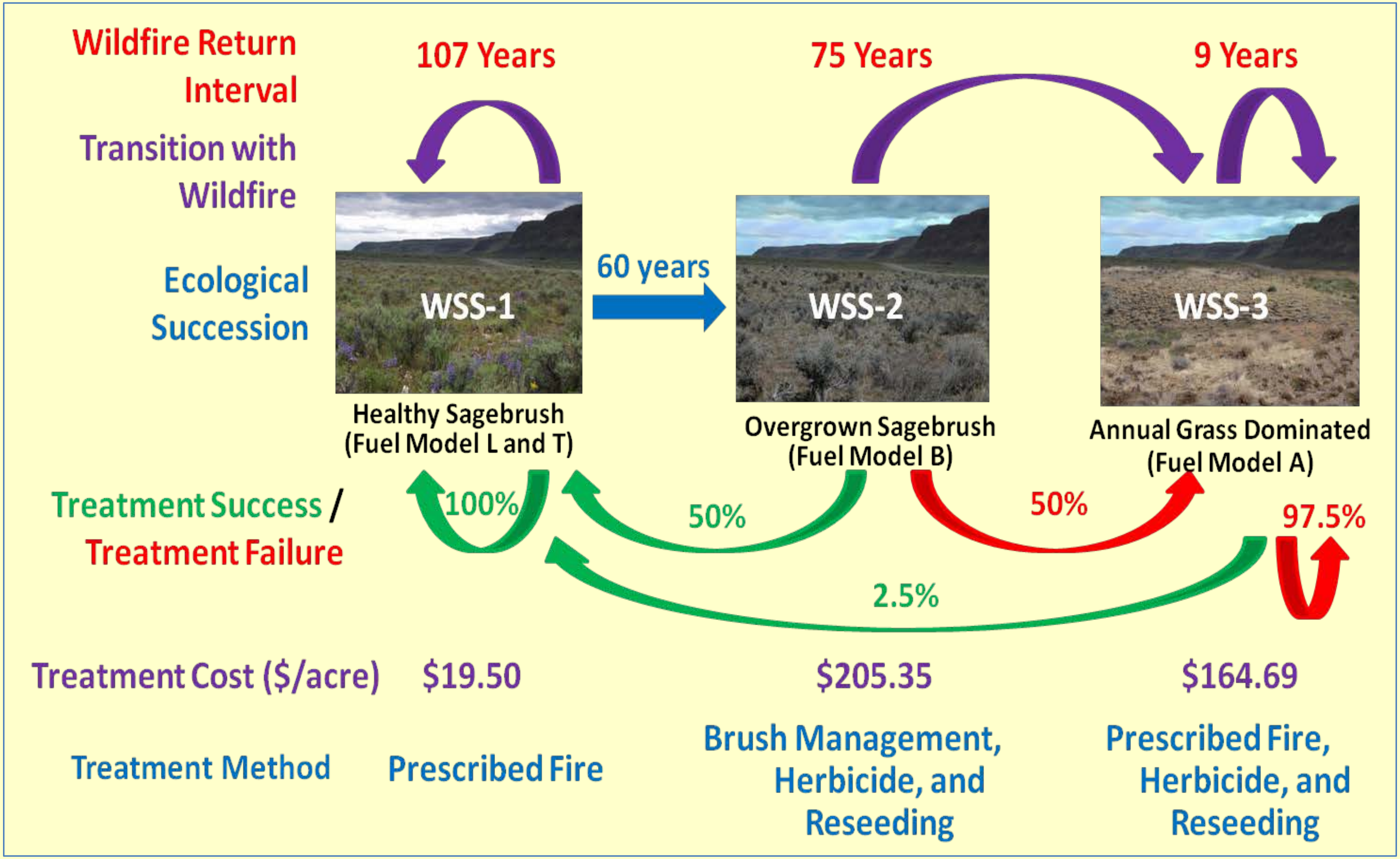
- Component Studies (first three today)
  - I. Wildfire Suppression Costs
  - II. Dynamic Ranch Model
  - III. Non-Market Valuation
  - Economics of Uncertain Ecological Thresholds and Irreversibility

Ecological Framework

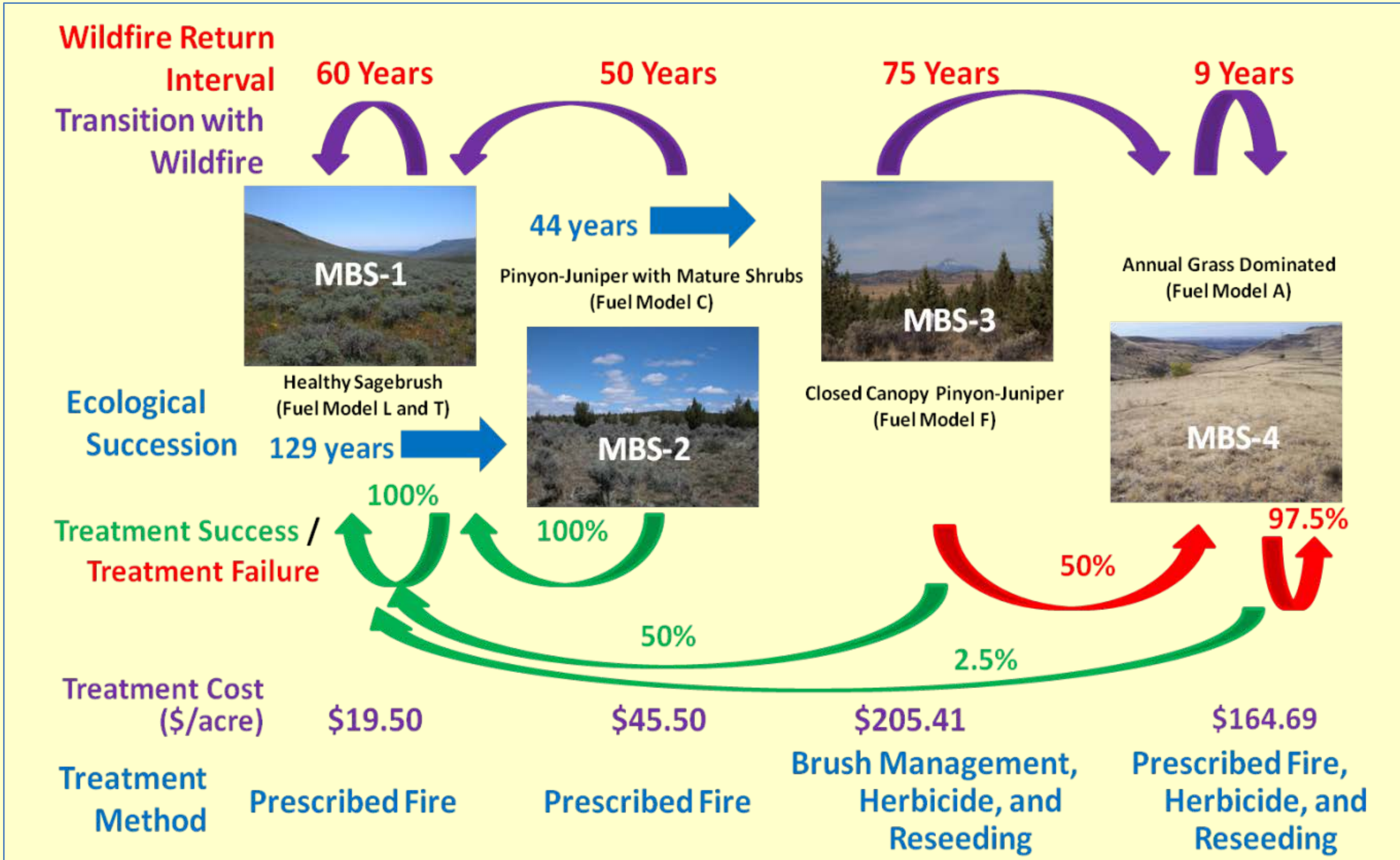
A common ecological framework ensures that each component study evaluats the costs and benefits of the same ecological change

- **The state-and-transition framework divides an ecosystem into a series of “ecological sites” based on characteristic plant communities**
- **A rangeland ecosystem is described as being in one of dby ecological thresholds**
- **Transitions between states are either irreversible or only reversible with costly management effort**

'Stylized' State-and-Transition Model
Wyoming Sagebrush Steppe (4,700 – 6,500 ft)



'Stylized' State-and-Transition Model
Mountain Big Sagebrush (> 6,500 feet)



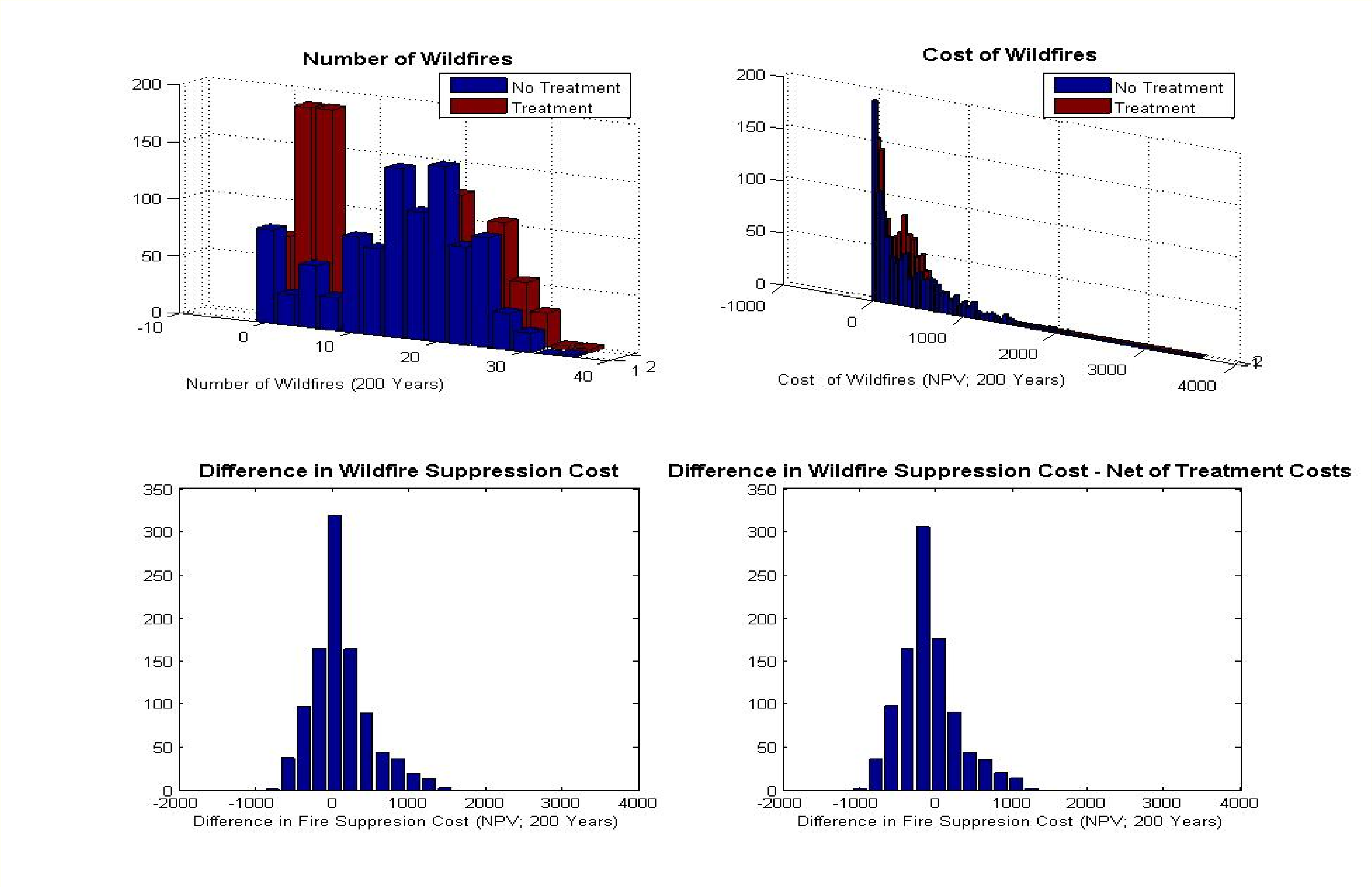
Component Study I: Wildfire Suppression Cost Modeling

- Association between rangeland states and fuel models from almost a decade of fire suppression data on Region 4
- Estimation = contribution of fuel types/states to suppression cost
- Simulation = vegetation treatments to manage which states land is in can save suppression cost in long run (ie, 200 years)

Specific Issues included in model

- Uncertainty regarding whether ecological thresholds have been crossed
- Value of decreasing uncertainty about thresholds
- Costs of Invasive weeds to fire suppression modeled as with and without annual grass
- Variable treatment costs and treatment success rates
- Variable wildfire frequency

Approach: 10,000 simulation runs with stochastic wildfire: with and without treatment



Wildfire Suppression Costs Averted

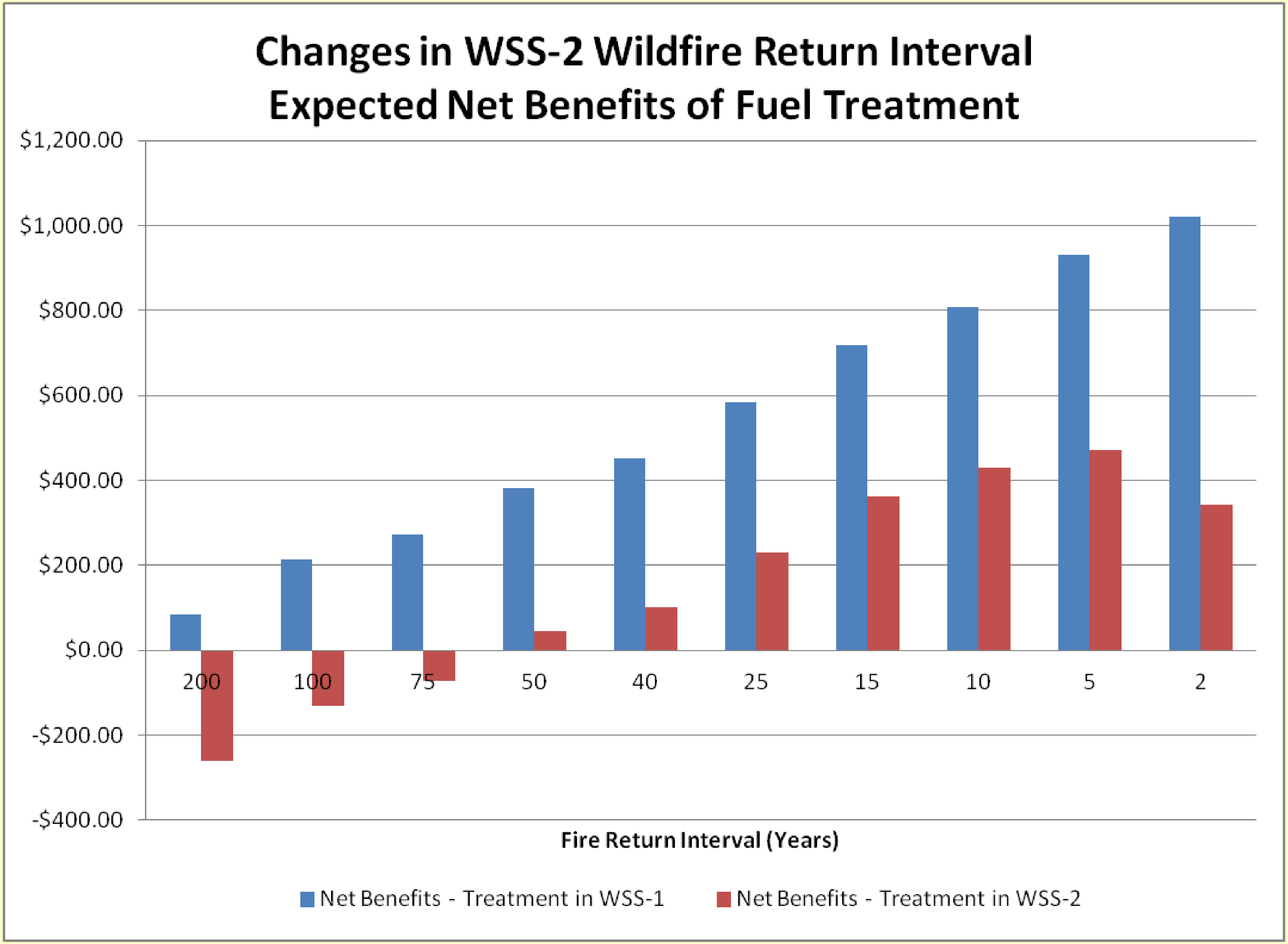
Wyoming Sagebrush Steppe (4,700 – 6,500 feet)
($ per acre; 2010 dollars; 3% discount rate; 200 Years; 10,000 runs)
(%5, %95)

	Initial Ecological State		
	Healthy sagebrush	**Mature woody brush with annual grass**	**Annual Grass Dominated**
Avg. Total Suppression Costs (NPV) – No Treatment	**$350** **($0 , $1,141)**	**$364** **($0, $1,219)**	**$390** **($150, $703)**
Avg. Total Suppression Costs (NPV)– With Treatment	**$56** **($0, $250)**	**$231** **($0, $659)**	**$251** **($2.8, $608)**
Average Wildfire NET Suppression Costs Savings (NPV)	**$272** **(-$24, $1,022)**	**-$72** **(-$636, $728)**	**-$2,782** **(-$4,965, -$108)**
Average Benefit Cost Ratio (NPV)	**13.3**	**0.7**	**0.06**

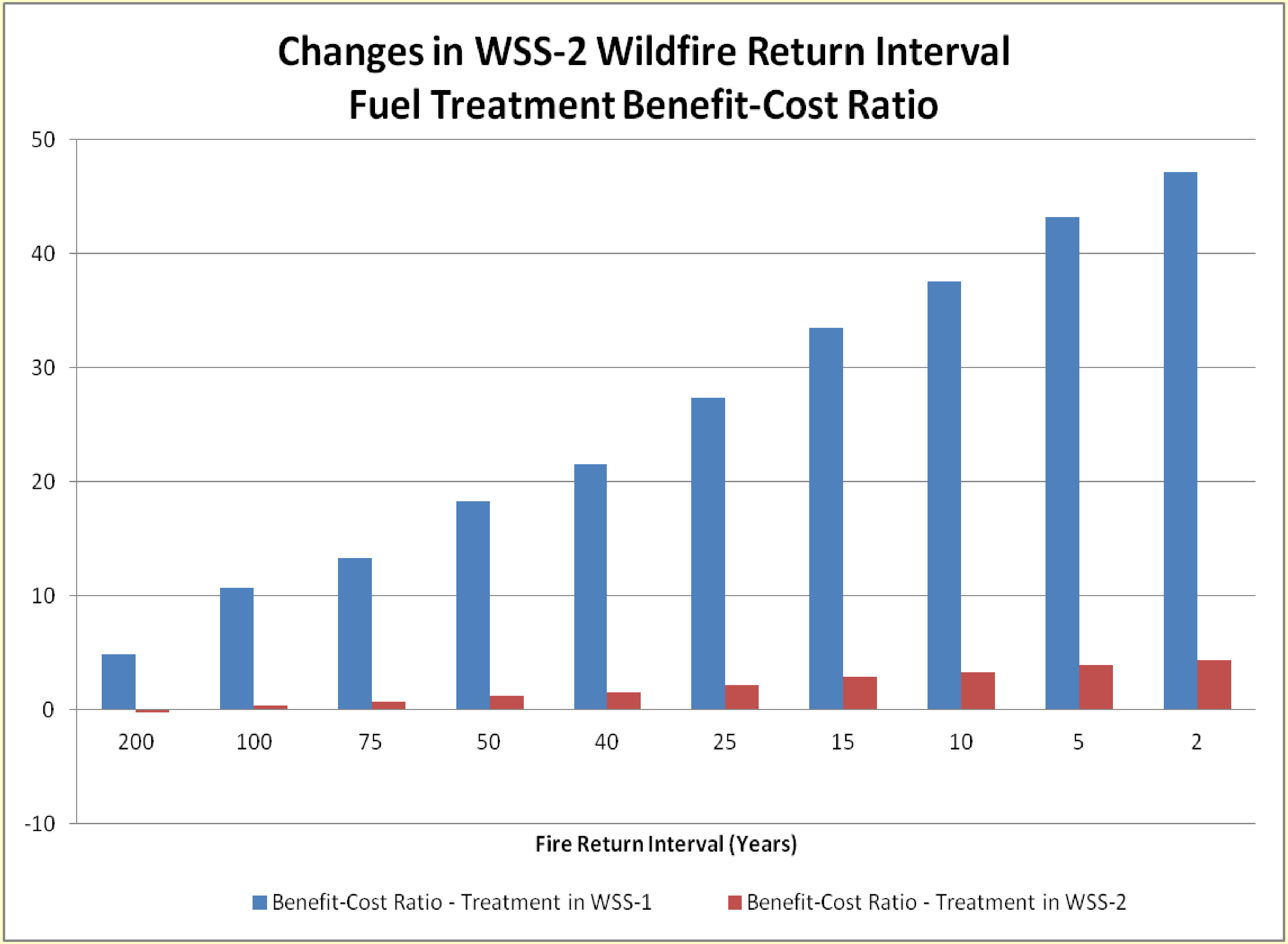
Wildfire Suppression Costs Averted

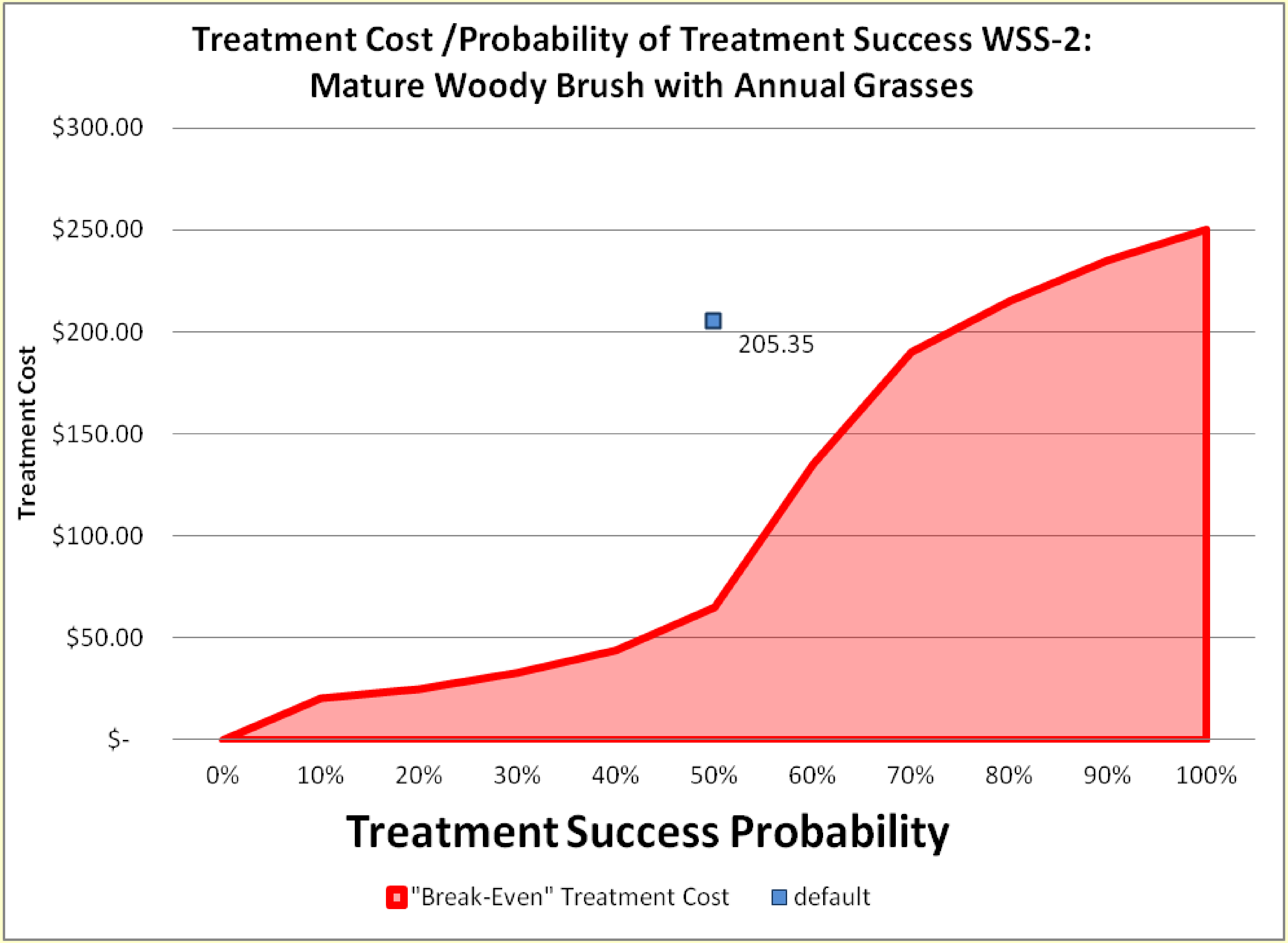
Mountain Big Sagebrush with PJ Encroachment (>6,500 feet)

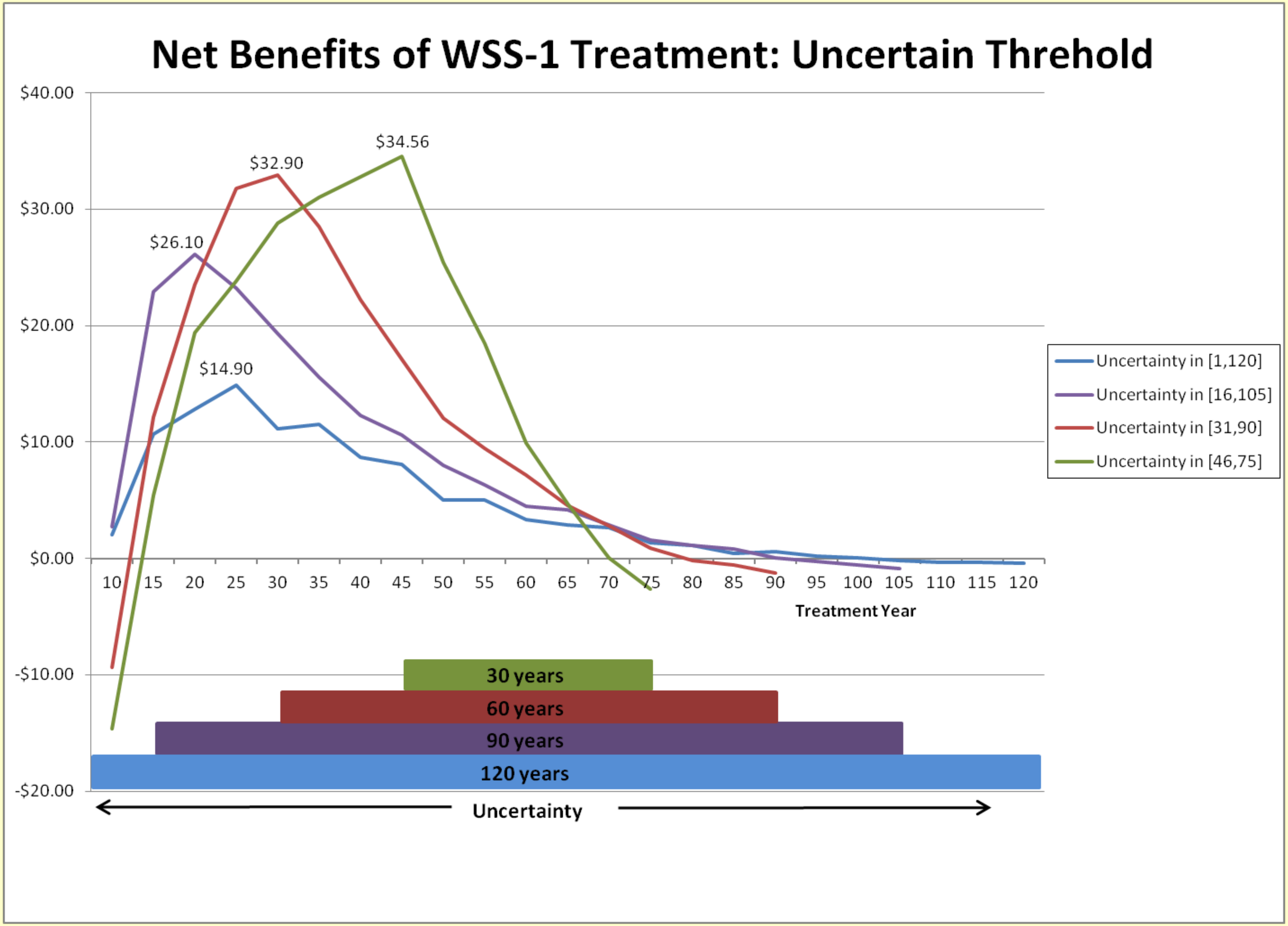
	Initial Ecological State			
	Healthy sagebrush	PJ, mature sagebrush &cheatgrass	Closed-canopy PJ & cheatgrass	Cheatgrass dominated
Avg. Total Suppression Costs (NPV) – No Treatment	$26	$561	$576	$1,448
	($0, $69)	($0, $1,903)	($0, $1,937)	($352, $2,884)
Avg. Total Suppression Costs (NPV) – With Treatment	$10	$158	$793	$894
	(-$22, $45)	($1, $498)	($6, $2,444)	($28, $2,381)
Ave Wildfire NET Suppression Costs Savings (NPV)	$8	$358	-$419	-$2,3325
	(-$24, $43)	(-$126, $1,530)	($2,091, $978)	(-$4,928, $937)
Ave. Benefit Cost Ratio (NPV)	5.2	9.0	-1.1	0.2



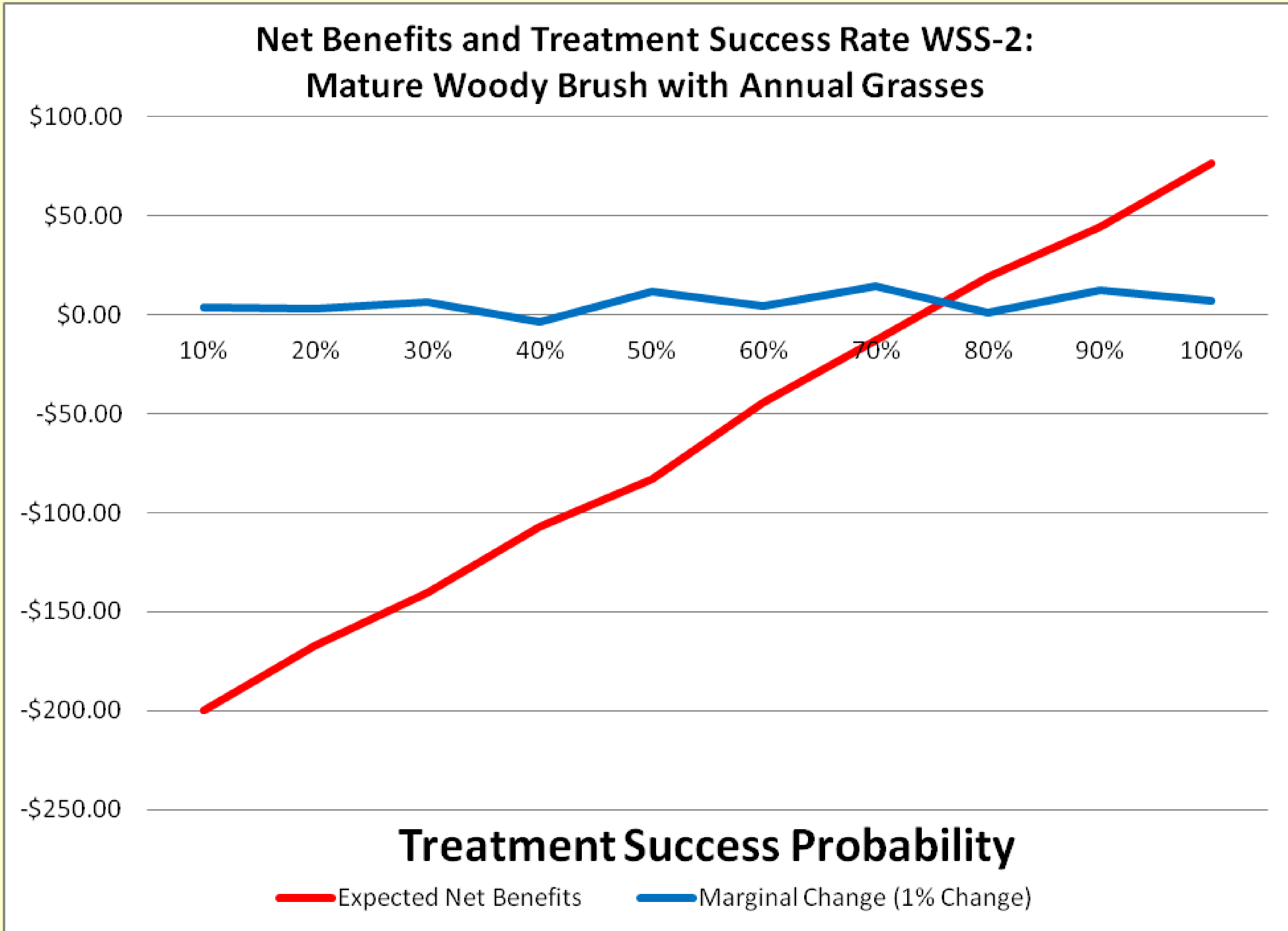
Changes in WSS-2 Wildfire Return Interval
Expected Net Benefits of Fuel Treatment
$1,200.00
$1,000.00
$800.00
$600.00
$400.00
$200.00
$0.00
-$200.00
-$400.00
200
100
75
50
40
25
15
10
5
2
Fire Return Interval (Years)
Net Benefits - Treatment in WSS-1
Net Benefits - Treatment in WSS-2

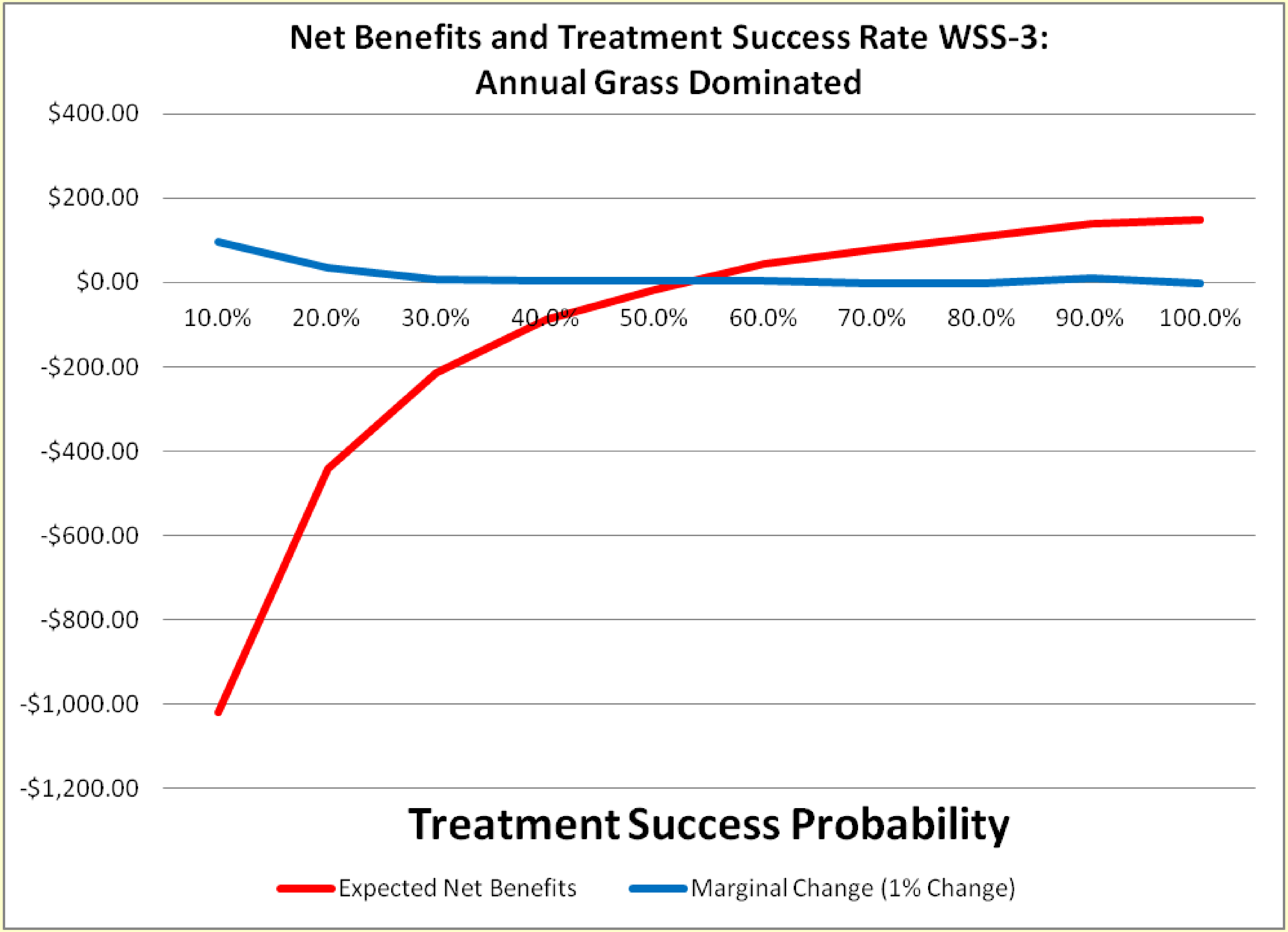

Changes in WSS-2 Wildfire Return Interval
Fuel Treatment Benefit-Cost Ratio
50
40
30
20
10
0
-10
200
100
75
50
40
25
15
10
5
2
Fire Return Interval (Years)
Benefit-Cost Ratio - Treatment in WSS-1
Benefit-Cost Ratio - Treatment in WSS-2


Treatment Cost /Probability of Treatment Success WSS-2:
Mature Woody Brush with Annual Grasses
$300.00
$250.00
$200.00
$150.00
$100.00
$50.00
$-
Treatment Cost
205.35
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Treatment Success Probability
"Break-Even" Treatment Cost
default



Net Benefits of WSS-1 Treatment: Uncertain Threhold
$40.00
$30.00
$20.00
$10.00
$0.00
-$10.00
-$20.00
$34.56
$32.90
$26.10
$14.90
10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120
Treatment Year
Uncertainty in [1,120]
Uncertainty in [16,105]
Uncertainty in [31,90]
Uncertainty in [46,75]
30 years
60 years
90 years
120 years
Uncertainty

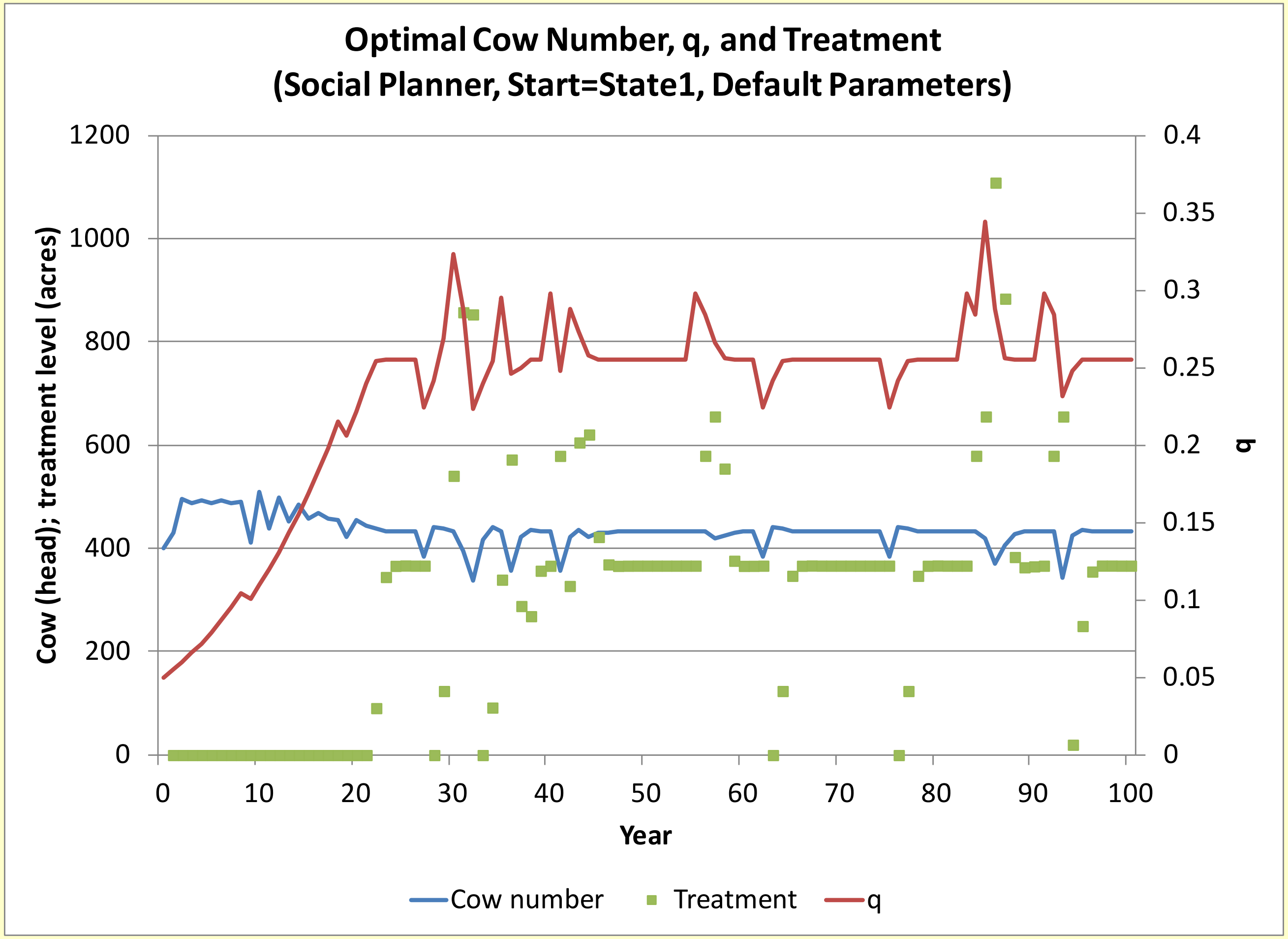

Net Benefits and Treatment Success Rate WSS-2:
Mature Woody Brush with Annual Grasses
$100.00
$50.00
$0.00
-$50.00
-$100.00
-$150.00
-$200.00
-$250.00
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Treatment Success Probability
Expected Net Benefits
Marginal Change (1% Change)


Net Benefits and Treatment Success Rate WSS-3:
Annual Grass Dominated
$400.00
$200.00
$0.00
-$200.00
-$400.00
-$600.00
-$800.00
-$1,000.00
-$1,200.00
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
Treatment Success Probability
Expected Net Benefits
Marginal Change (1% Change)

II. Decision Making Model with Ranch Profits, Treatment, and non-ranch benefits and costs with stochastic wildfire

- Link states, modeling state 3 as irreversible.
- Cost of transition includes increasing likelihood of eventual loss of productivity to state 3
- Forage productivity and supplementary feeding requirements consistent with STM
- How do ranch profits differ between States?
- Under what circumstances is it profitable to treat?
- How do optimal ranch decisions differ from optimal societal choice of cattle operations and treatments?

Example of output



III. Value of GB Ecosystem Services to the "Average" Great Basin Household

- Use Non-market valuation
- Data collected to support different methods of estimation
- 'Pilot' model
- We are in the process of expanding model and data collection to be sensitive to specific states, timing, and spatial scales
- Preliminary results presented here

Annual Value per Nevada Household of Preventing further losses to Great Basin $\hat{P}$ $\hat{P}$ Ecosystems: Willingness to Pay using three methods measuring probability of support

Method	Obs.	Mean	Median	95% CI
(1)	1577	$39.83	$39.35	($35.58, $44.09)
(2)	1577	$94.22	$89.44	($88.55, $99.89)
(3)	1577	$80.71	$78.56	($75.76, $85.65)

Variables that affect the probability of willingness to pay to support programs

Probability of being supportive is:

- Positively correlated with income, agree grazing should be a management priority, employment in the ag sector, trades,
- Negatively correlated with employment in recreation/entertainment industry, yrs education, belief that regulation of public land use is too strict, program cost, employment in natural resources sector

Probability of NOT being supportive is:

- Positively correlated with residence in large rural towns, agree that fire should only be suppressed if human life is at risk,
- Negatively correlated with employment in mining sector, program to reverse past losses versus prevention of future losses.

Probability of being unsure

- Positively correlated with cost, education, belief that public land regulations are too strict,
- Negatively correlated with income, employment in natural resource sector, residence in large rural town, belief that all fires should be suppressed, too little information about the topic

Next Steps

- Work further with ecologists to use models to simulate cost and benefits of various scenarios
- Research on economic incentive mechanisms to increase the effectiveness and level of private/public partnerships – with effectiveness measured as increases in landscape acreage conserved
- Economic policy to deal with deviation between private decision-maker and socially optimal treatment and ranching operations


Thank You!
Questions?

Changes in Valuation when allowing for Respondent Uncertainty