Wildfire Economics:
Contributions and Knowledge Gaps

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How is wildland fire an economics problem?

Fire is a natural phenomenon and is a necessary process in many ecosystems

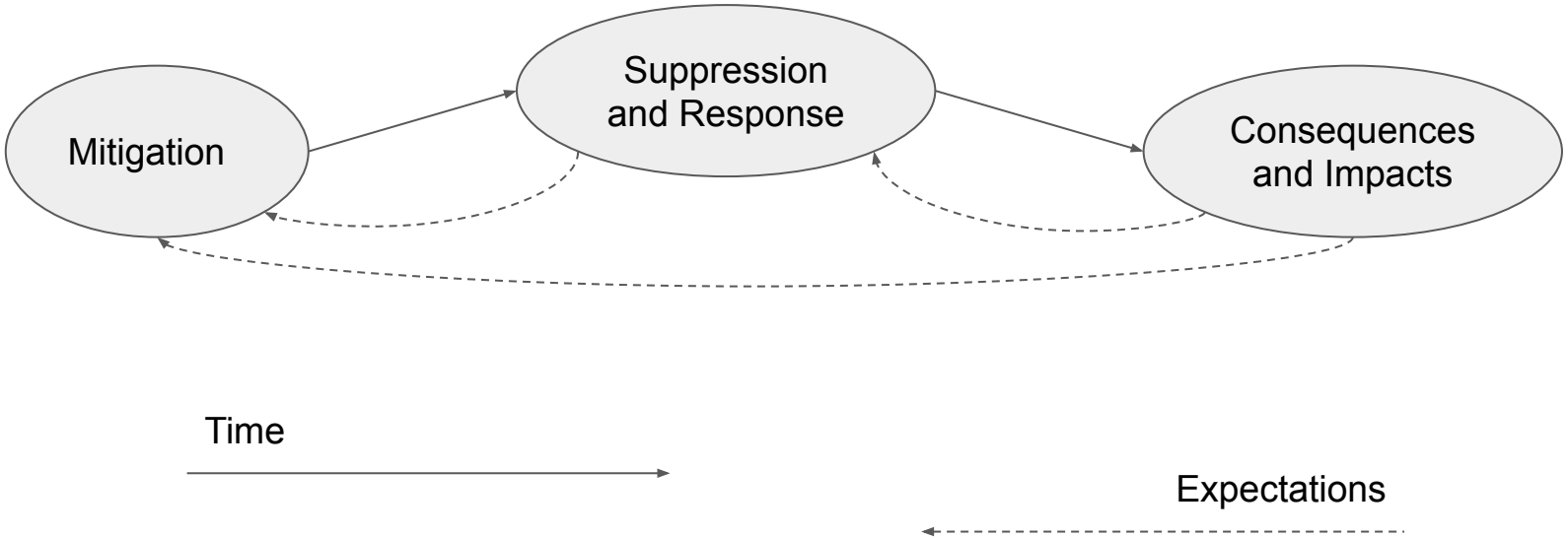
Fire threatens human life and property

Our fundamental challenge is to balance this tradeoff between environmental health/function and impacts to people/property

The problem is dynamic, spatial, uncertain and requires coordination between private and public entities

Economics can help us understand human behavior in relation to wildfire and characterize and quantify the costs and benefits of management strategy or policy

Overview


Mitigation
Suppression and Response
Consequences and Impacts
Time
Expectations

Mitigation

Mitigation Overview

Invest resources now to reduce expected costs
Pr(fire)*Damage

Public investments

- Objectives/agency incentives?
- When and where?
- How and how much? (Rx burning versus mechanical)

Private investments

- Motivations and barriers
- Externalities and behavioral consequences
- Interplay with public investment: Crowding in/out

Development and WUI expansion

Public Investments

What fuel treatments? When? Where? And how should they be done? (Mercer et al., 2008; 2012)

- Disrupt fuel contiguity across space (Finney, 2001; 2007; Wei et al., 2008)
- The arrangement of values at risk and spatial spillovers (Konoshima et al., 2008; 2010; Lauer et al., 2020)
- Liability considerations (Yoder, 2004; 2008; Lauer et al., 2020; Langpap & Wu, 2021)
- Psychology and political factors (Wibbenmeyer et al., 2019)
- Public support (Loomis et al., 2001)
- Value of treatments might be high (Kaval et al., 2007; Loomis et al., 2008)
- Fuel treatment costs are high (Gonzales-Caban, 1986)
- Fuel treatments can reduce future suppression costs and losses (Butry et al., 2010; Taylor et al., 2013) and promote ecosystem services (Warziniack et al., 2019)

Private Investments

An array of factors influence individual's decision to mitigate risk

- Risk perception, salience, information, social considerations (Brenkert-Smith et al., 2006; Holmes et al., 2012; Dickinson et al., 2015; Champ et al., 2020)
- Insurance (Busby et al., 2013; Taylor, 2019)
- Spatial externalities (Shafran, 2008; Busby et al., 2013; Warziniack et al., 2019)
- Expectations about suppression (Busby et al., 2013; Kousky et al., 2012a; 2012b; Baylis et al., 2020)

Interdependent with public investments and policy (Busby et al., 2010; Troy, 2007; Baylis et al., 2021)

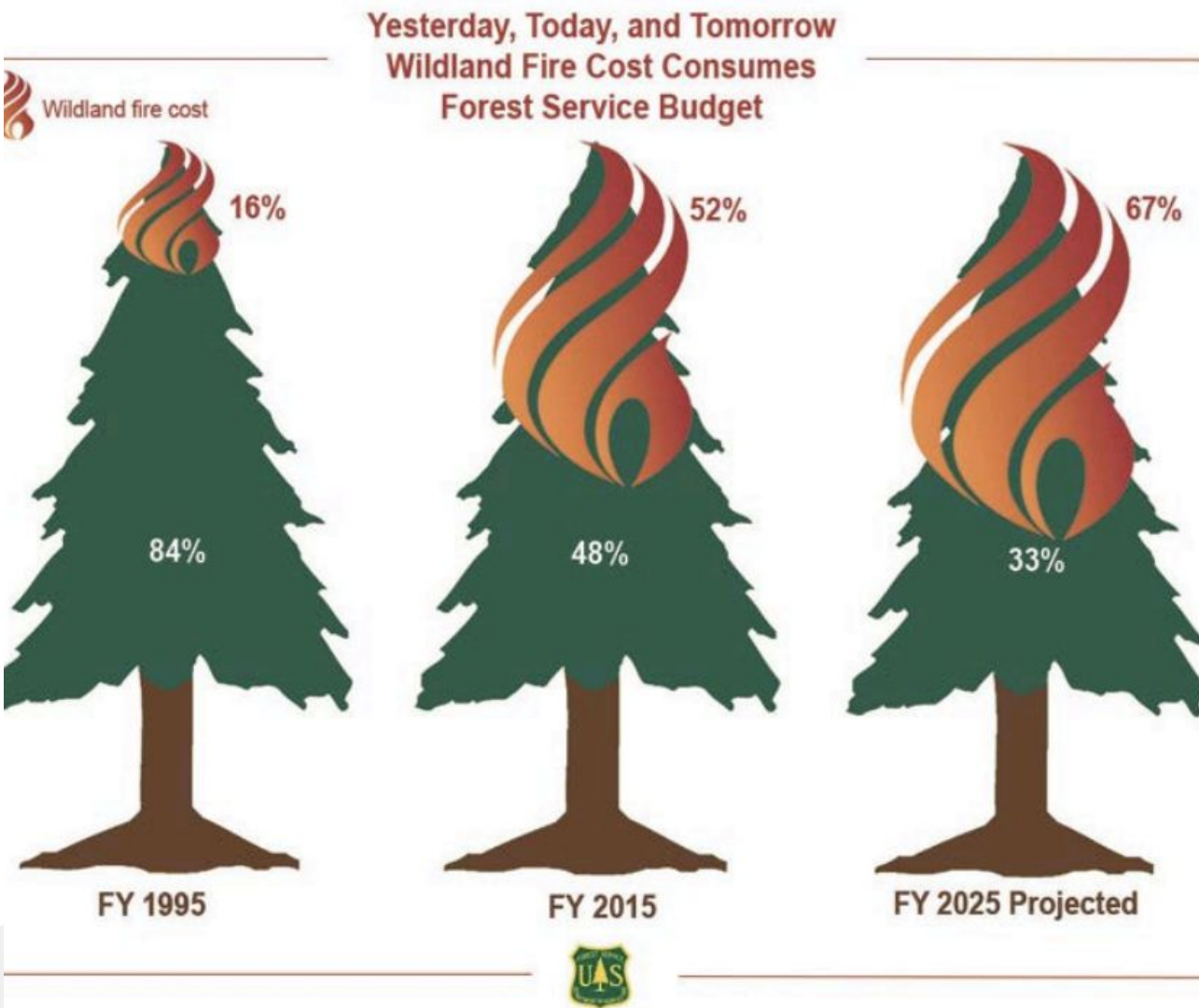
Mitigation Knowledge Gaps

Do public investments in fuel treatments crowd in or crowd out private investments?

More empirical analysis of the value of fuels reduction

Can the economic insights inform decision support tools used to prioritize treatments on the landscape?

Suppression and Response



Suppression/ Response Overview

Wildfire response is complex

Economic theory has structured how we think about the objectives, incentives, constraints, and tradeoffs

Simulation modeling has operationalized some of the theory, but often lacks calibration to observed data

Empirical work has quantified association but causal inference has been challenging

Conceptual framework

Cost + Net Value Change (Sparhawk, 1925; Donovan and Rideout, 2003; Rideout et al., 2008)

Sequential C + NVC recognizes fragmented decision process (Rossi and Kuusela, 2019)

Risk perception and characteristics of IC/IMT (Canton-Thompson et al., 2008; Hand et al., 2015; 2017; Stonesifer et al., 2017; Rossi and Kuusela, 2020)

Institutional factors (Bradshaw & Lueck, 2012; Lueck & Yoder, 2015; 2016)

Risk management (Calkin et al., 2011; 2014)

Simulation and Empirical Modeling

Extensive literature on simulation (see Duff & Tolhurst, 2015 for review)

Factors associated with increasing costs (Calkin et al., 2005; Gebert et al., 2007; Holmes et al., 2008; 2012; Abt et al., 2008; 2009; Donovan et al., 2011; Hand et al., 2014)

Costs are a function of decisions that depend on values at risk, institutional factors and environmental conditions (Gebert et al., 2007; 2008; Liang et al., 2008, Yoder & Gebert, 2012; Clark et al., 2016; Bayham & Yoder, 2020; Bayham et al. 2020)

Benefits of suppression are complex and difficult to quantify (Houtman et al., 2013; Calkin et al., 2014; Gannon et al., 2020; Plantinga et al., 2021)

Suppression/Response Knowledge Gaps

What are the benefits of suppression strategies (e.g., point protection vs. containment)? Under what conditions are the benefits likely to hold?

What is the counterfactual?

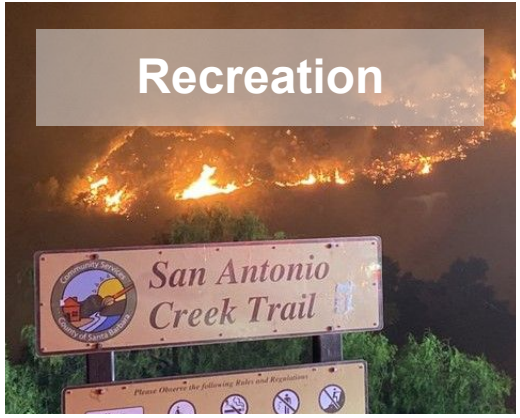
How do the benefits compare to the costs?

Structural models of suppression resource allocation designed to test hypotheses about priorities amongst objectives

Accurate data on resource assignments/tasks and associated costs are critical to test theory. GPS and related tech. will open up new opportunities.

Consequences and Impacts of Fire

Consequences Overview



Consequences: Human health and property

Smoke (Kochi et al., 2010; 2012; 2016; Moeltner et al., 2013; Richardson et al., 2012; 2013; Jones 2017; 2018)

Property (Huggett 2003; Loomis 2004; Donovan et al., 2007; Champ et al., 2009; Mueller et al., 2009; Stetler et al., 2010; Mueller and Loomis, 2014; McCoy & Walsh, 2018)

Consequences: Recreation, water quality

Recreation

- Wilderness (Englin et al., 2001; 2008)
- Hiking and Biking (Hesseln et al., 2003; 2004; Garnache & Lupi, 2018; Tanner et al., 2019)
- Camping (Lee, 2021)

Water quality impacts (Warziniack & Thompson, 2013; Warziniack et al., 2017)

Consequences Knowledge Gaps

Human health and well-being:

- More robust evidence of the *cost* of smoke damages - may justify further investments in fuel treatment
- Reframe Rx smoke “How do you want your smoke?”

Economic cost of evacuation and displacement

More valuation of wildfire impacts on recreation via emerging data (rec.gov, cell phone data)

Cost of wildfire impacts to water quality

Summary and next steps

Large literature on the economics of wildfire but many questions remain

Need for a tighter coupling between theory and empirics

Improved and emerging data will allow deeper empirical investigation into causal relationships

More interdisciplinary collaborations to leverage advances in geospatial modeling and data

What topics have we missed?

Knowledge Gap Overview

Mitigation

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Can the economic insights inform decision support tools used to prioritize treatments on the landscape?

Suppression

What are the benefits of suppression strategies (e.g., point protection vs. containment)? Under what conditions are the benefits likely to hold?

What is the counterfactual?

How do the benefits compare to the costs?

Structural models of suppression resource allocation

Accurate data on resource assignments/tasks and associated costs

Consequences

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Thank you

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