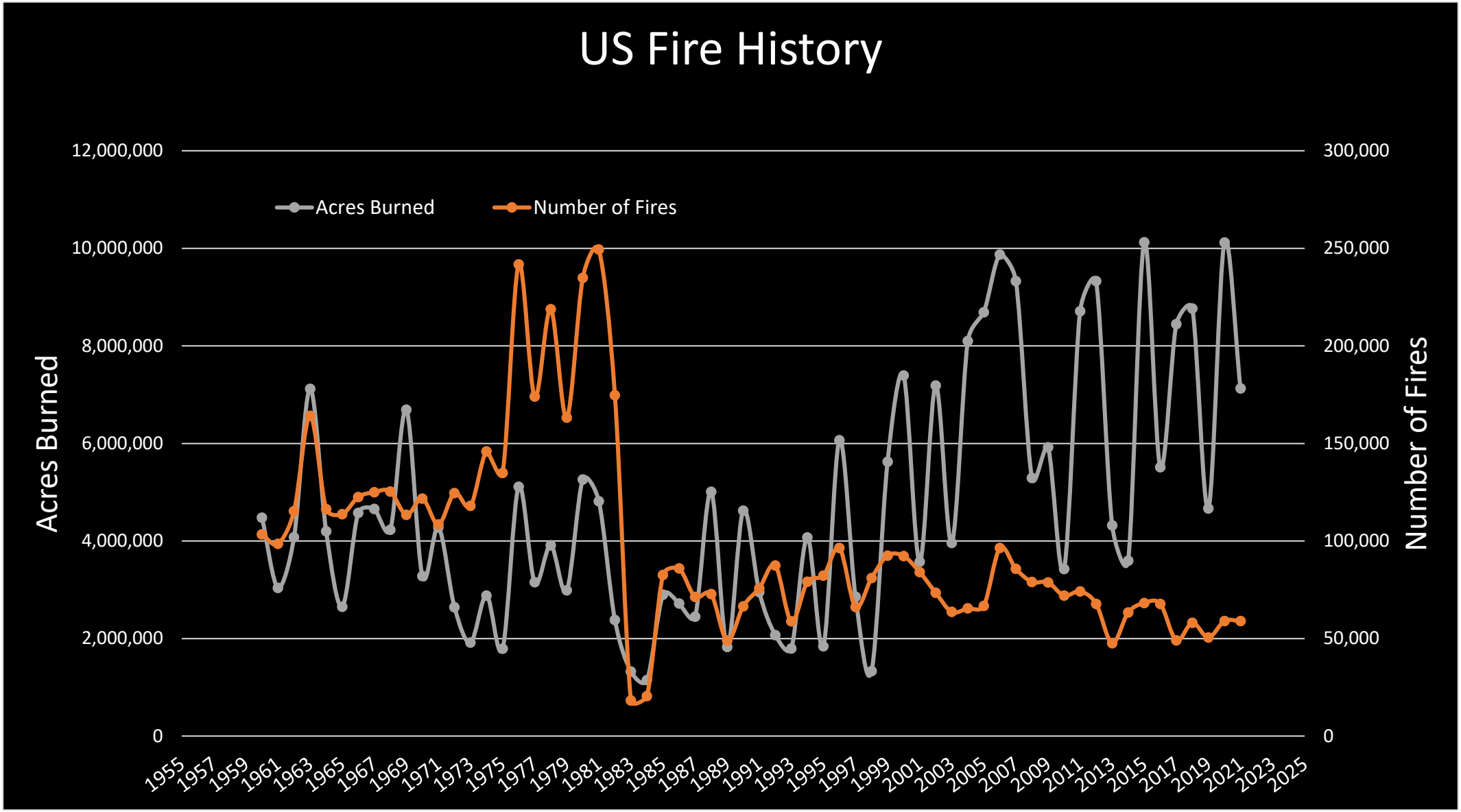
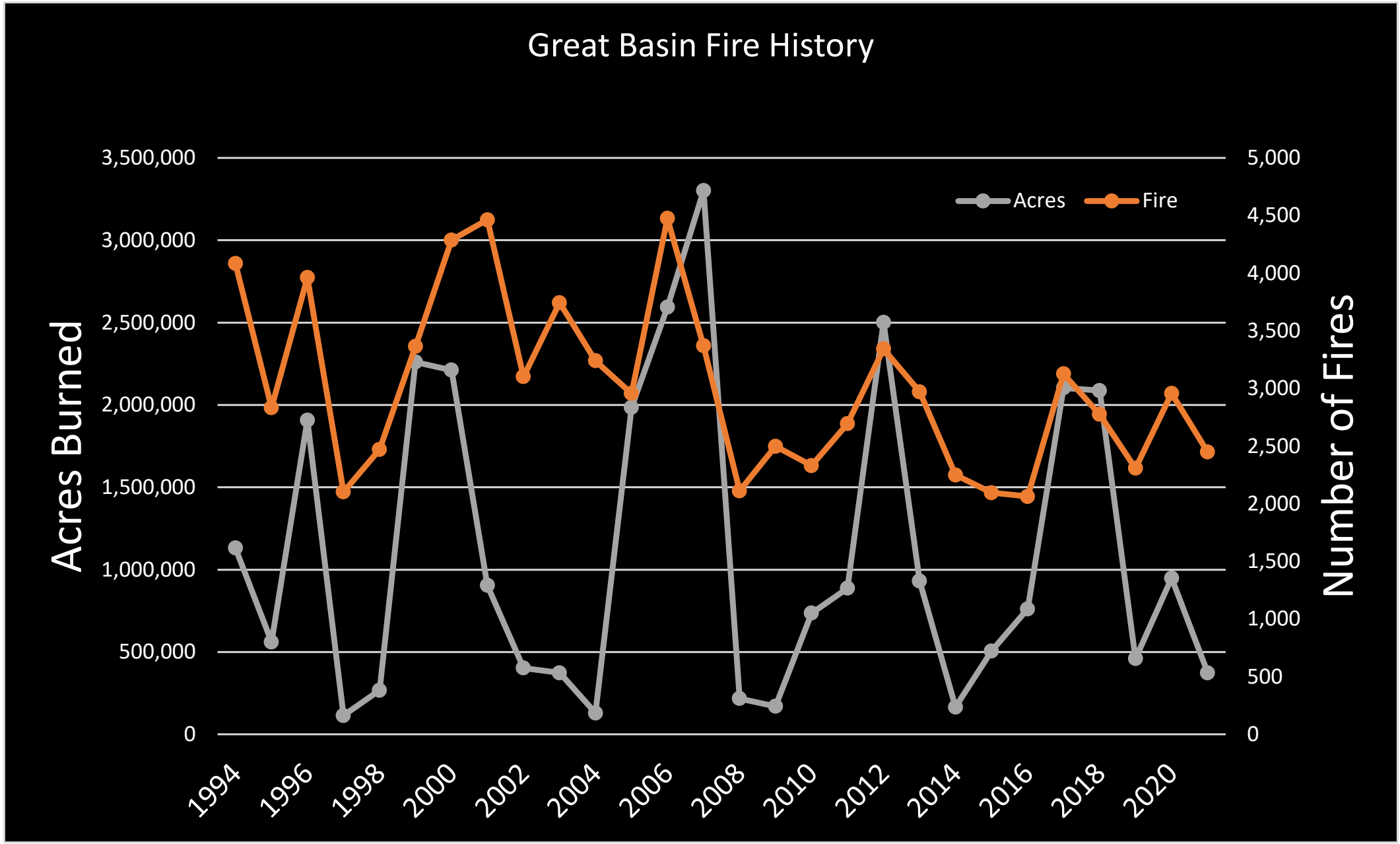
Burning Questions

Future Research Directions in Water and Wind Erosion After Wildfire

USDA ARS Agricultural Research Service


US Fire History
Acres Burned
Number of Fires
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
300,000
250,000
200,000
150,000
100,000
50,000
0
1955 1957 1959 1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017 2019 2021 2023 2025


Great Basin Fire History
Acres Burned
Number of Fires
Acres
Fire
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1994
1996
1998
2000
2002
2004
2006
2008
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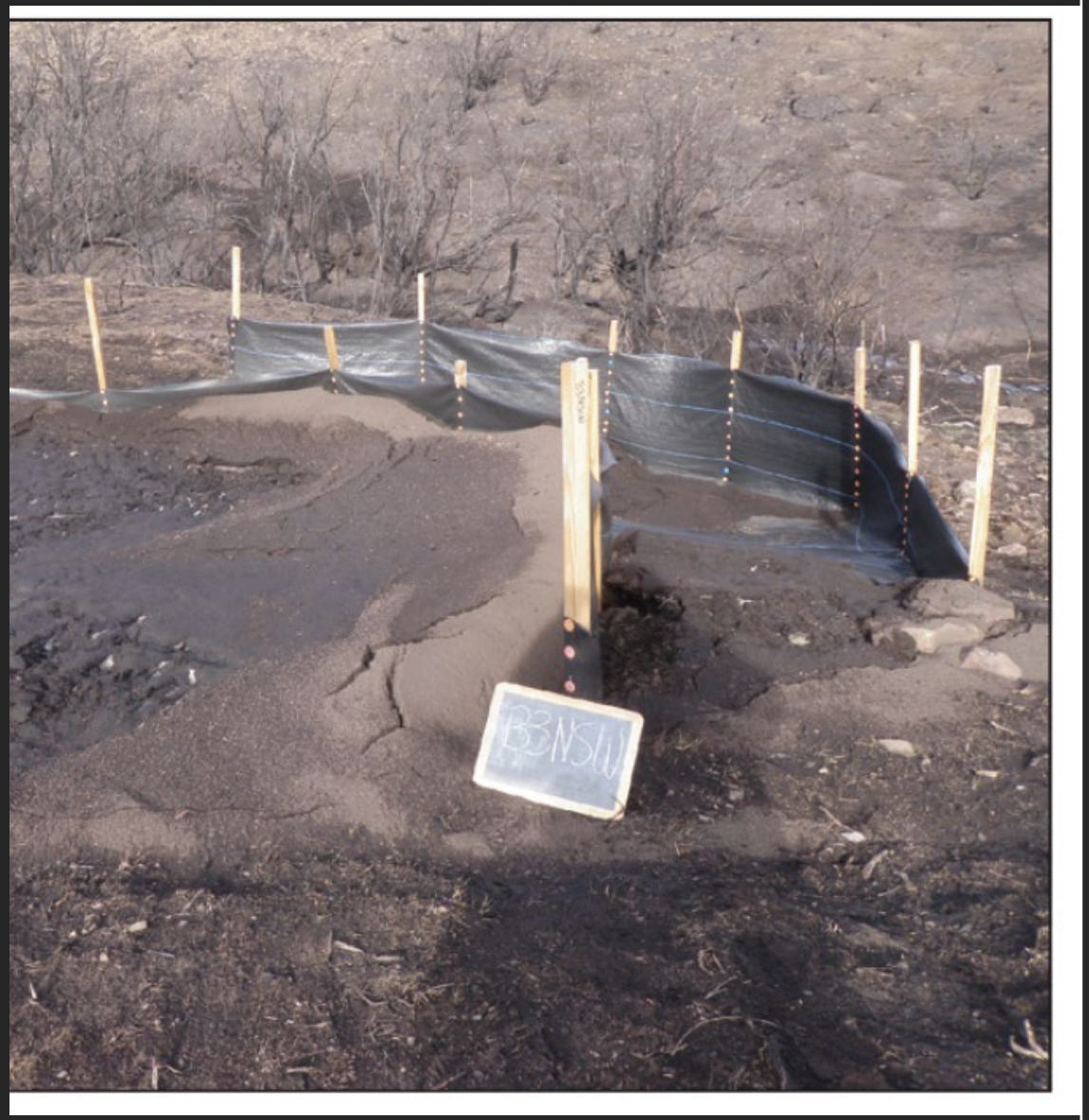
2012
2014
2016
2018
2020



Impacts of Erosion

Wind Erosion

- **Nutrient transport and ecosystem productivity**
  - Decreased productivity on site
  - Increased productivity with deposition
- **Feedbacks with Climate**
  - Temperature affects through radiation budgets
- **Human Health**
  - Valley Fever
  - Cardiovascular and Respiratory Illness
  - Visibility

Water Erosion

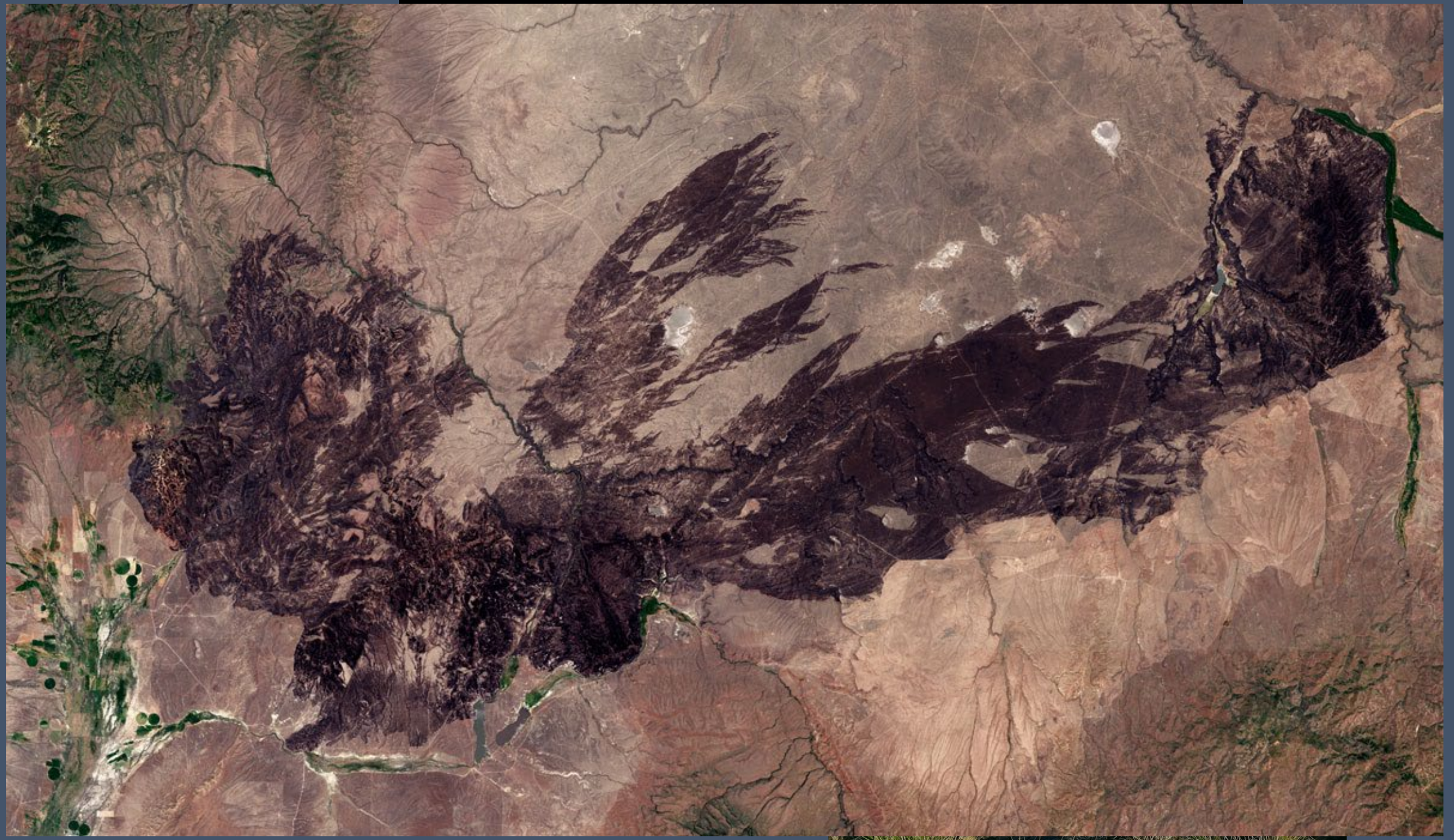
- **Nutrient transport and ecosystem productivity**
  - Transport of Nutrients from Hillslopes to Riparia
- **Increased Runoff**
  - Increased Sediment Loads
  - Decreased Reservoir Storage
  - Decreased Water Quality

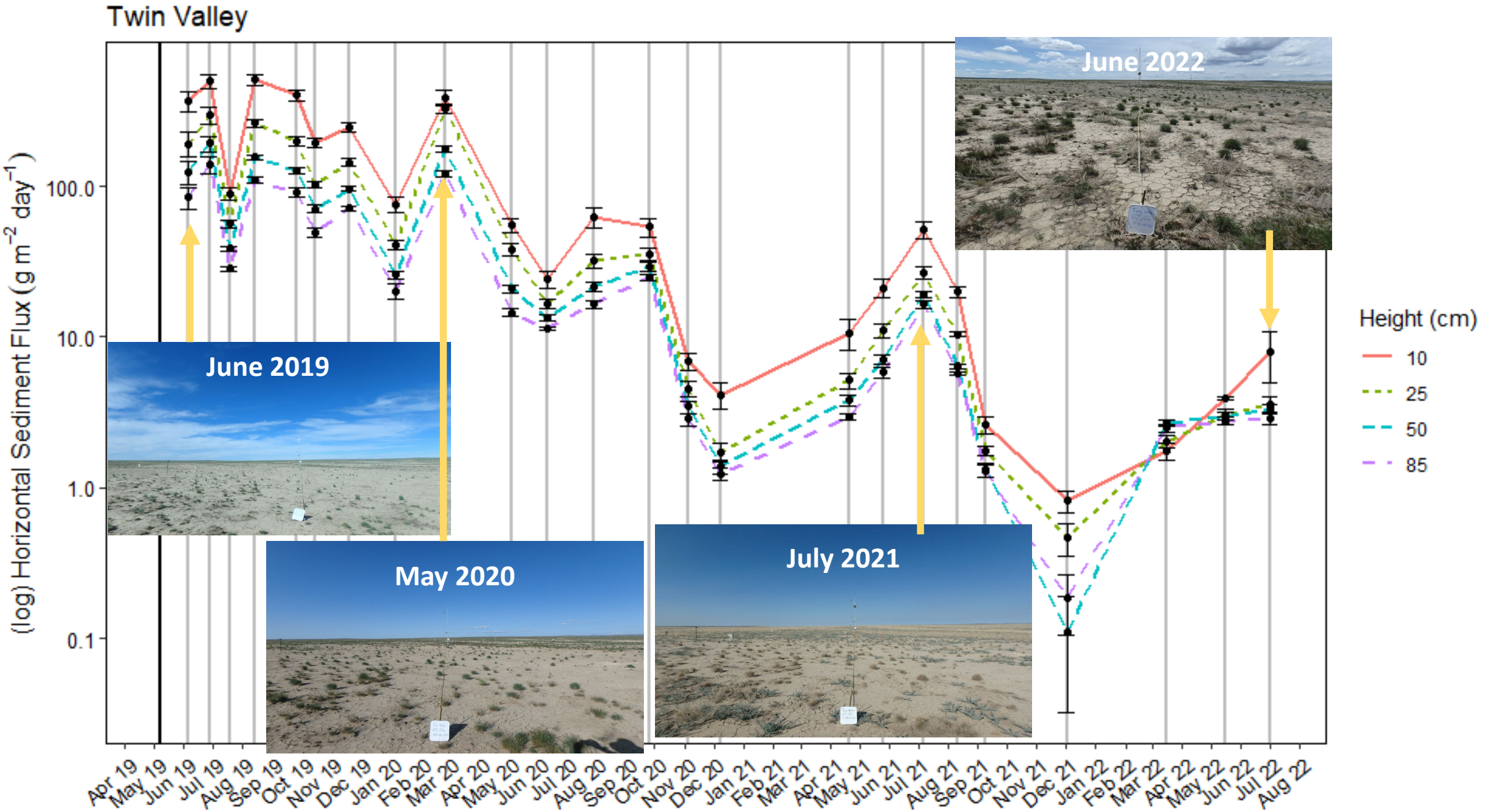
Research Needs

- How **Vegetation Changes** Alter *Soil Erosion* in Dryland Ecosystems
- How to Measure **Relative** Contributions of *Wind* and *Water* Erosion to Calculate *Total Sediment Flux*
- Degree to Which One Process Contributes to the Other
  - Wind Deposition into Stream Channels
  - Overland Flow Deposition Available for Entrainment
- **Scaling** Issues with Both Wind and Water Erosion

Case Study

Wind Erosion




Twin Valley
(log) Horizontal Sediment Flux (g m^{-2} day^{-1})
100.0
10.0
1.0
0.1
June 2022
June 2019
May 2020
July 2021
Height (cm)
10
25
50
85
Apr 19
May 19
Jun 19
Jul 19
Aug 19
Sep 19
Oct 19
Nov 19
Dec 19
Jan 20
Feb 20
Mar 20
Apr 20
May 20
Jun 20
Jul 20
Aug 20
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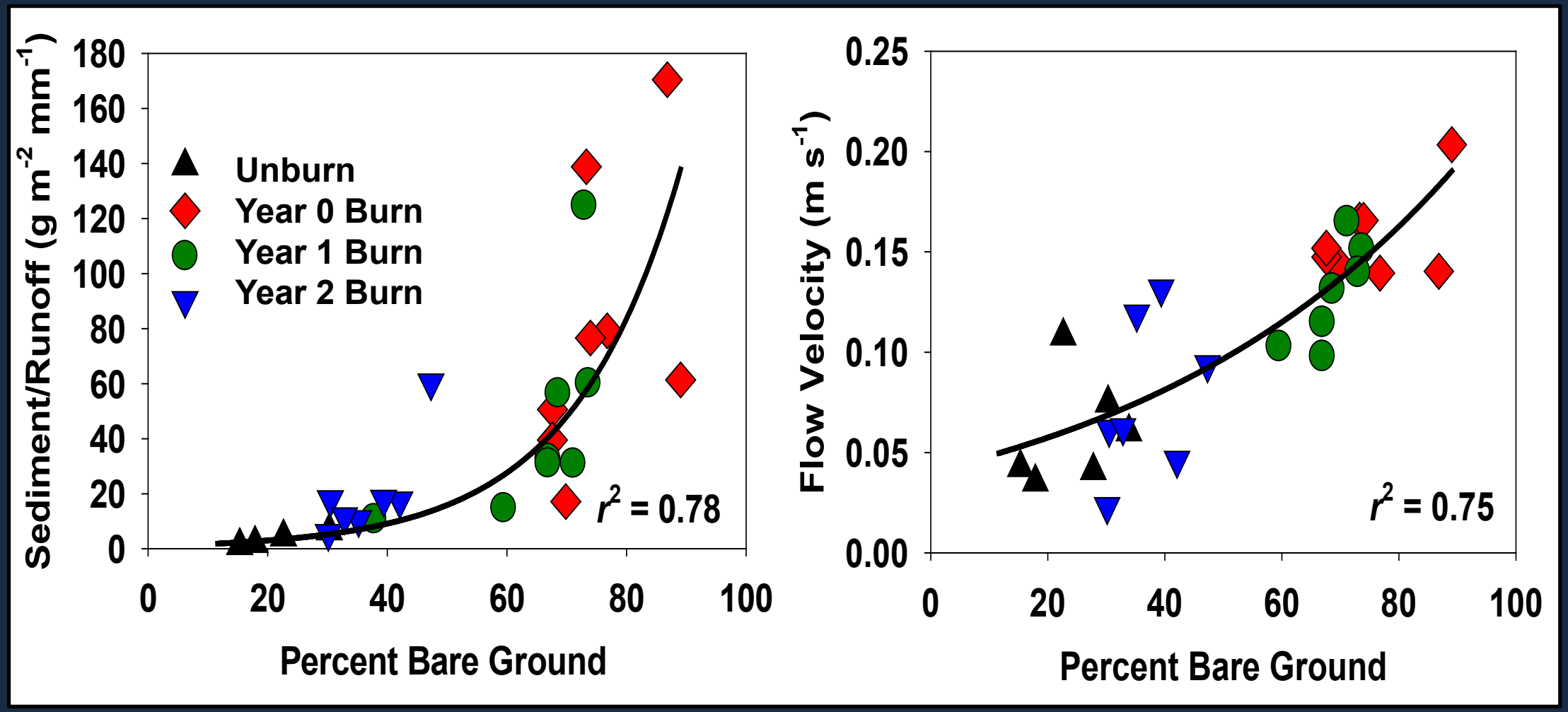
Jul 22
Aug 22

Case Study

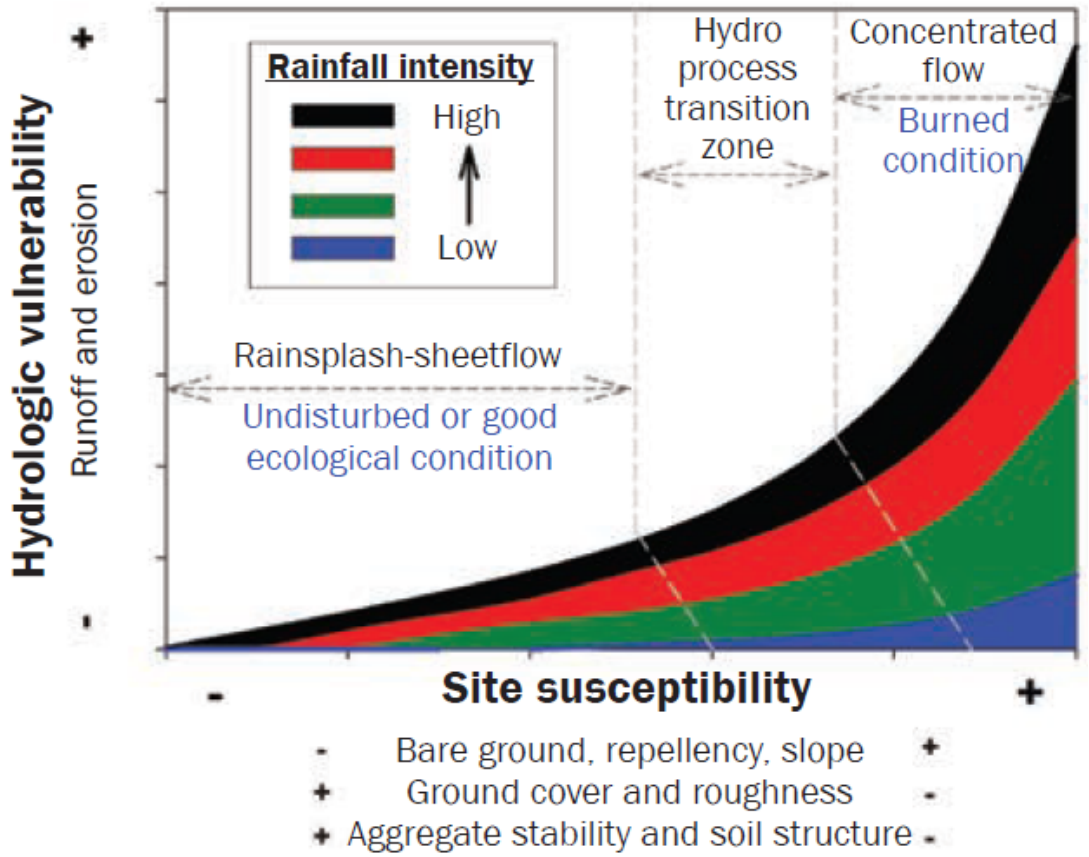
Water Erosion

Reynold Creek Experimental Watershed



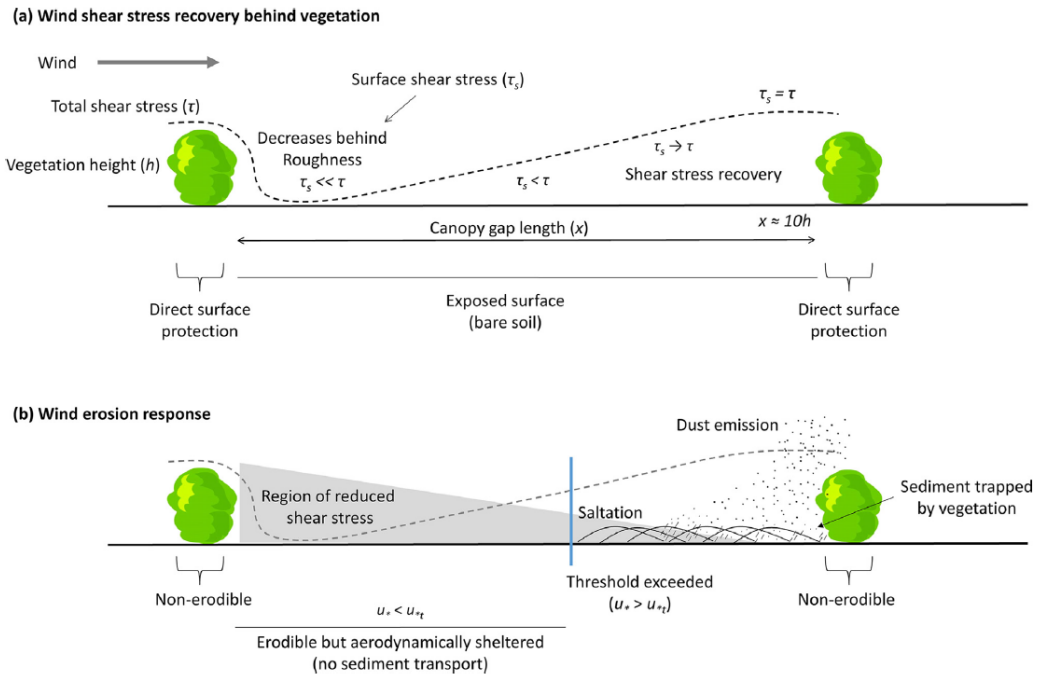
Pierson et al. 2009

Water Erosion

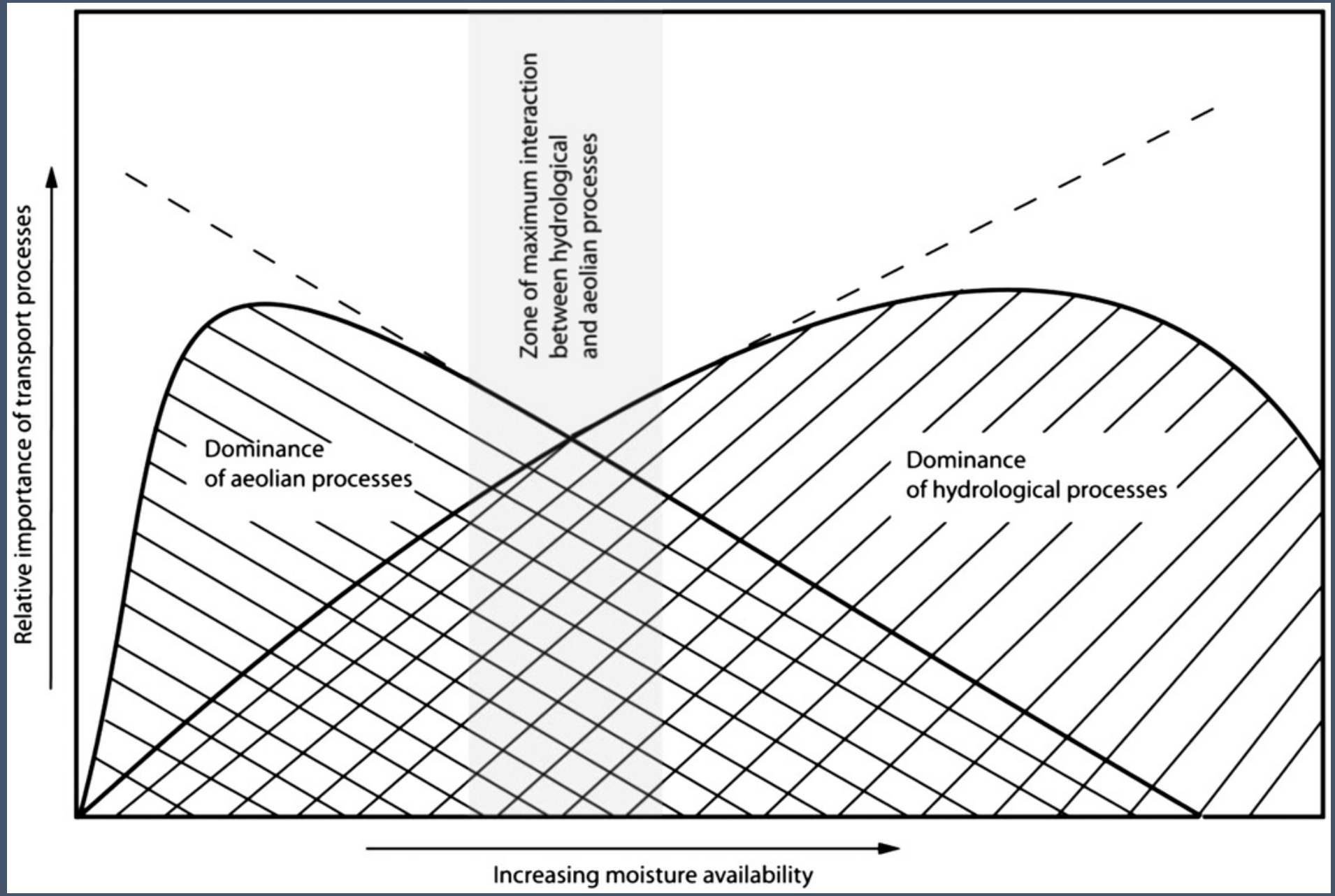


Edwards et al. 2019

Wind Erosion



Webb et al. 2021



Ravi et al. 2010

Post-Fire Erosion Team (PfErT)

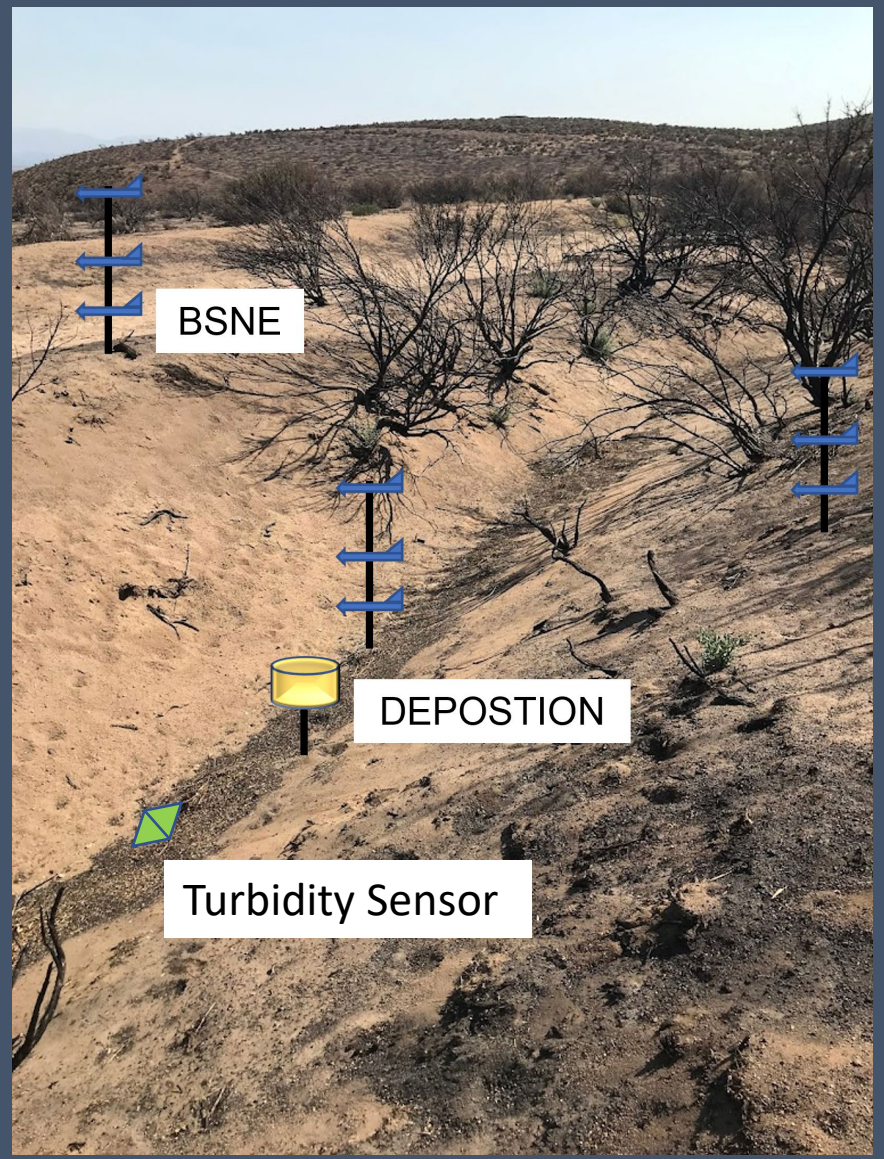
Future Direction

PfErT Overview

- Advance Understanding of Wind ↔ Water Interactions
  - Methods to measure both processes
  - How does one process contribute to the other
- Establish Protocols for Rapid-Response Field Teams
  - Deploy Equipment Immediately following Wildfire
- Recommend Post-Fire Emergency Stabilization Practices

Instrumentation

Channel Processes



Hillslope Processes

Challenges

- Fires Burn Over Large, Complex Terrain
  - Wind Erosion Designed for Negligible Slope
  - Minimal Hydrologic Runoff Without Slope
- Scale of Processes vs Measurement
- Monitoring Protocols Relevant to Both Wind and Water

Summary

- Erosion Expected to Increase with Future Fire Regimes in the Great Basin
- Wind and Water Processes are Coupled
- Understanding How Wind and Water Interact can Inform ESR Activities

Collaborators and Thanks

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QUESTIONS?