

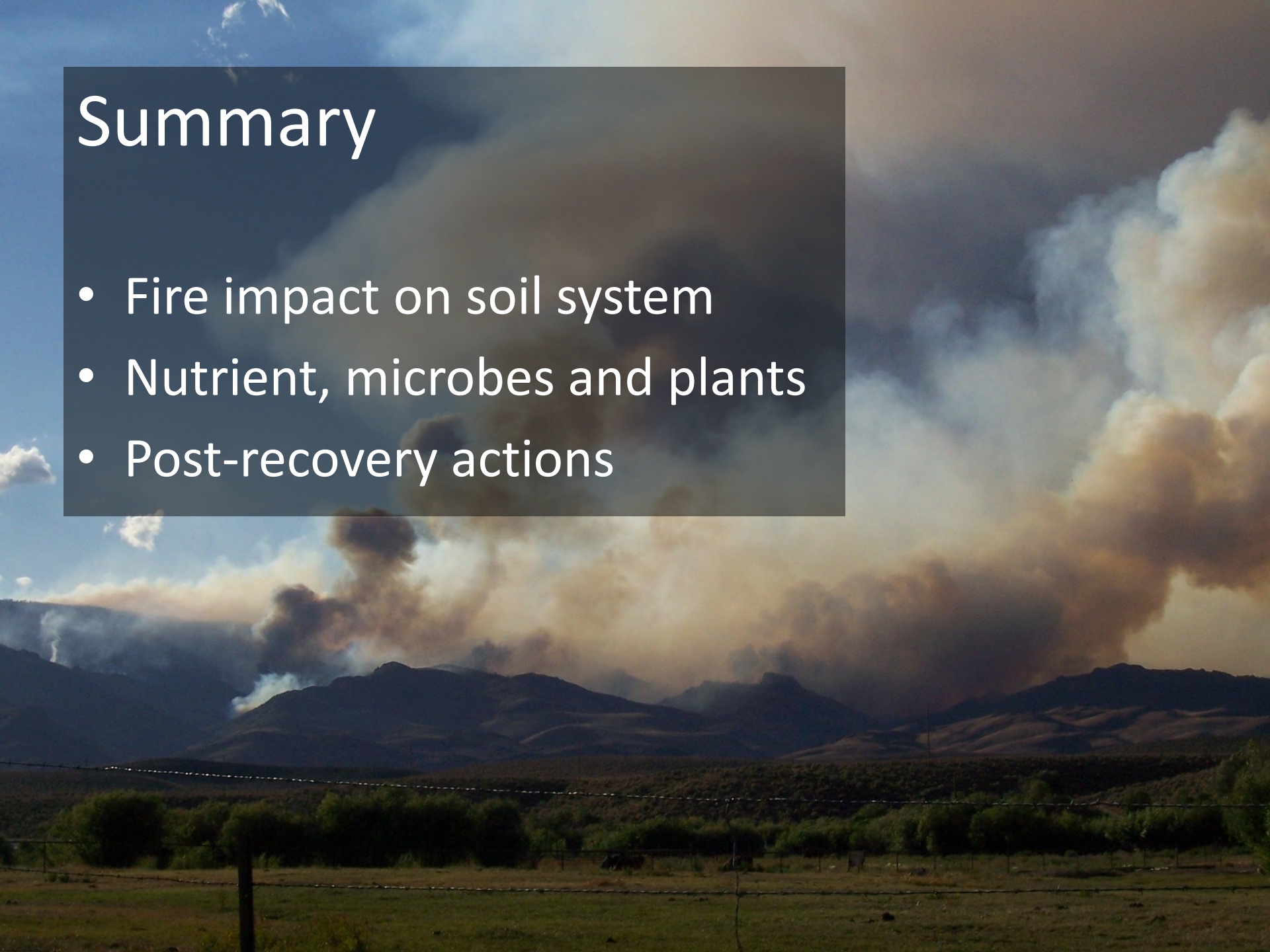
Bringing Soils Back to Life




Building Natural Capital

Summary

- Fire impact on soil system
- Nutrient, microbes and plants
- Post-recovery actions



What are your fire recovery goals?



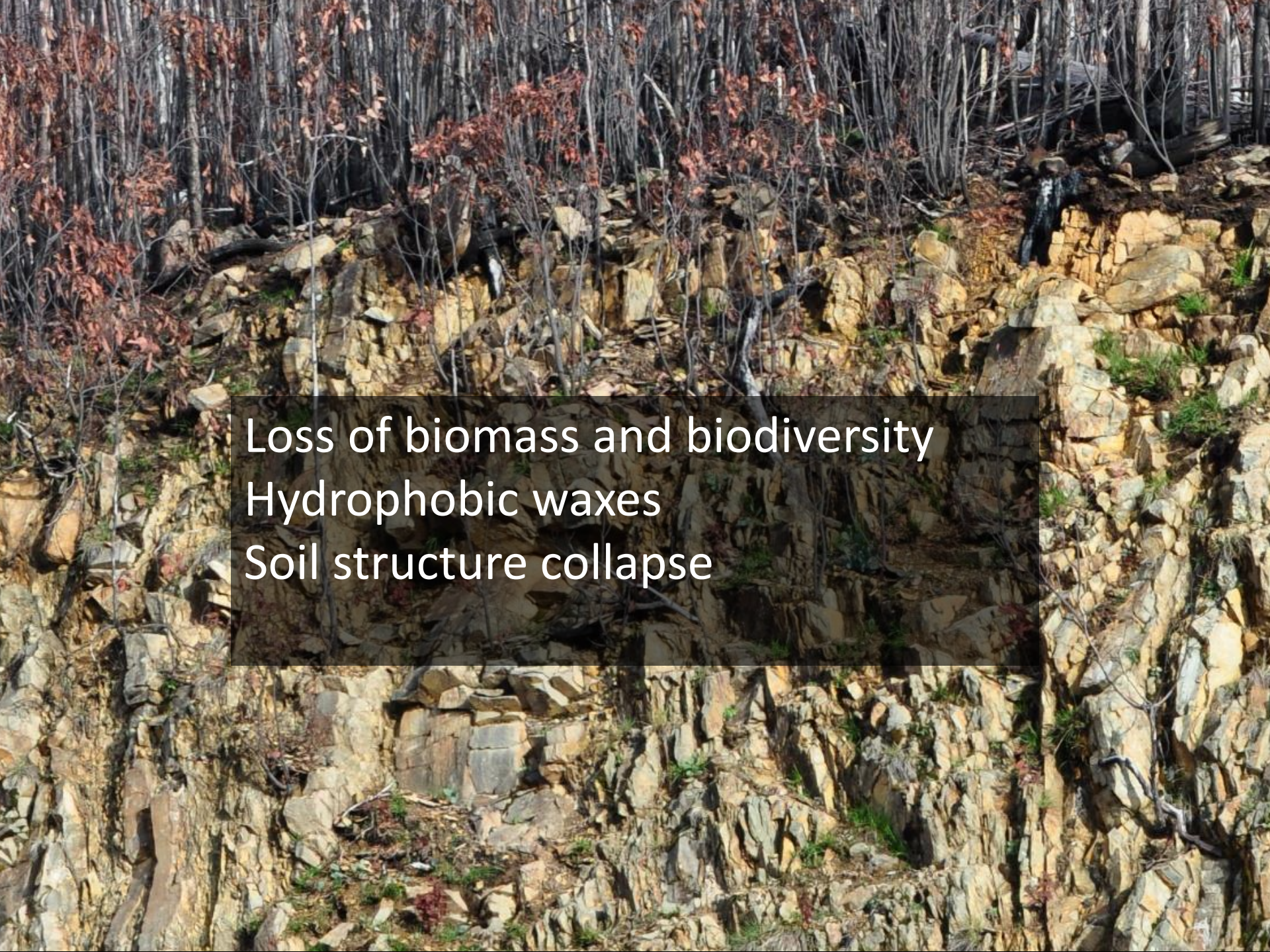
Fire impacts and recovery times dependant on fire duration and temperature

- 1-11 years microbial populations
- >80 years for full soil ecosystem recovery

Fire impacts on soil

Loss of organic matter, increased pH and EC, increased erosion and nutrient and water cycle breakdowns

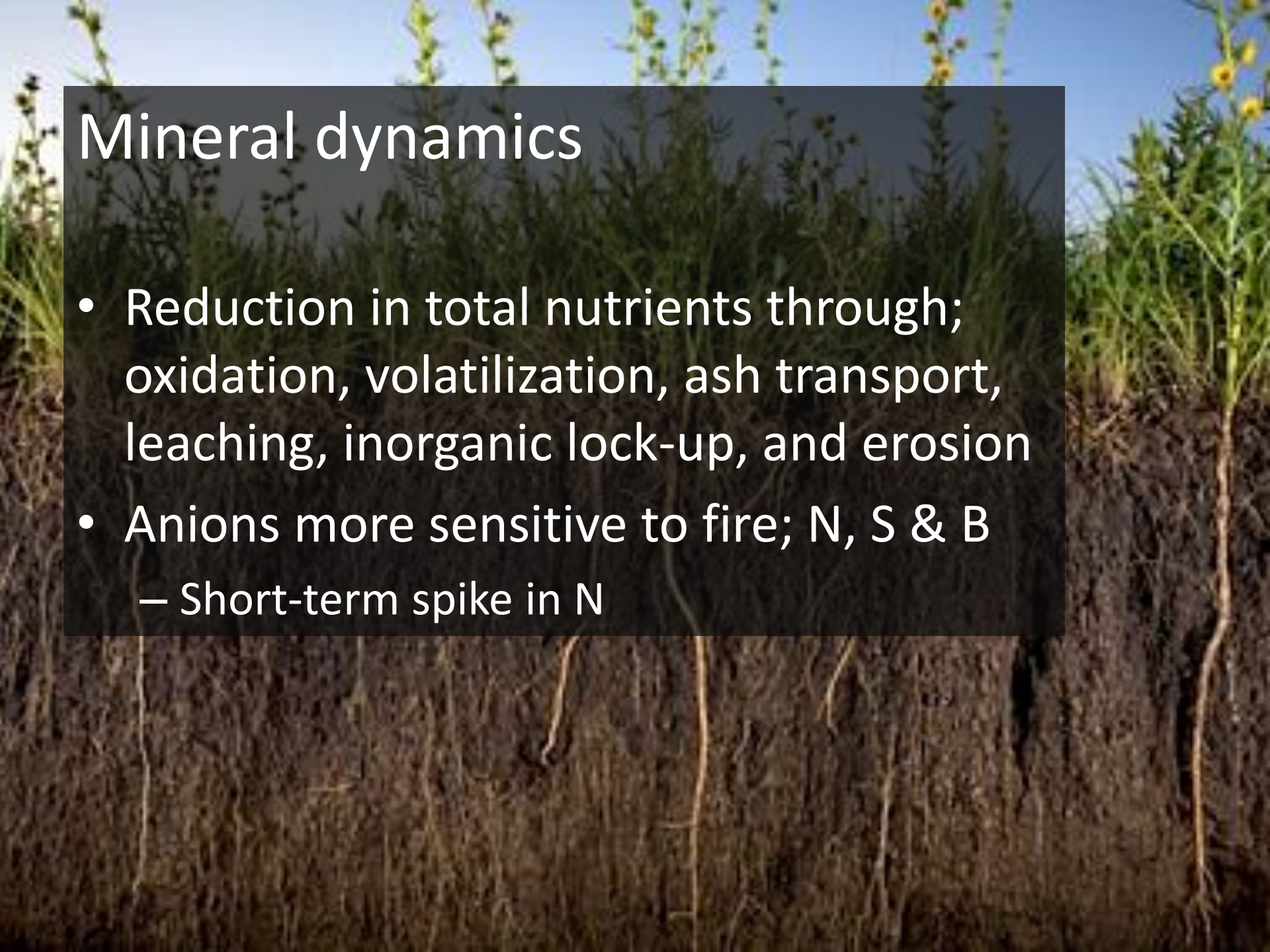




Loss of biomass and biodiversity
Hydrophobic waxes
Soil structure collapse

Mineral dynamics

- Reduction in total nutrients through; oxidation, volatilization, ash transport, leaching, inorganic lock-up, and erosion
- Anions more sensitive to fire; N, S & B
 - Short-term spike in N





Surface may be $> 620^{\circ}\text{C}$

Top 2 inches rarely exceed 148°C

Below 25-30cm typically unaffected

Photo: USDA, Brad Rust

Microbial dynamics

- Loss in biodiversity and community structures
- 50% reduction in fungal diversity and abundance
- Reduction in N-cyclers



Bacteria and archaea



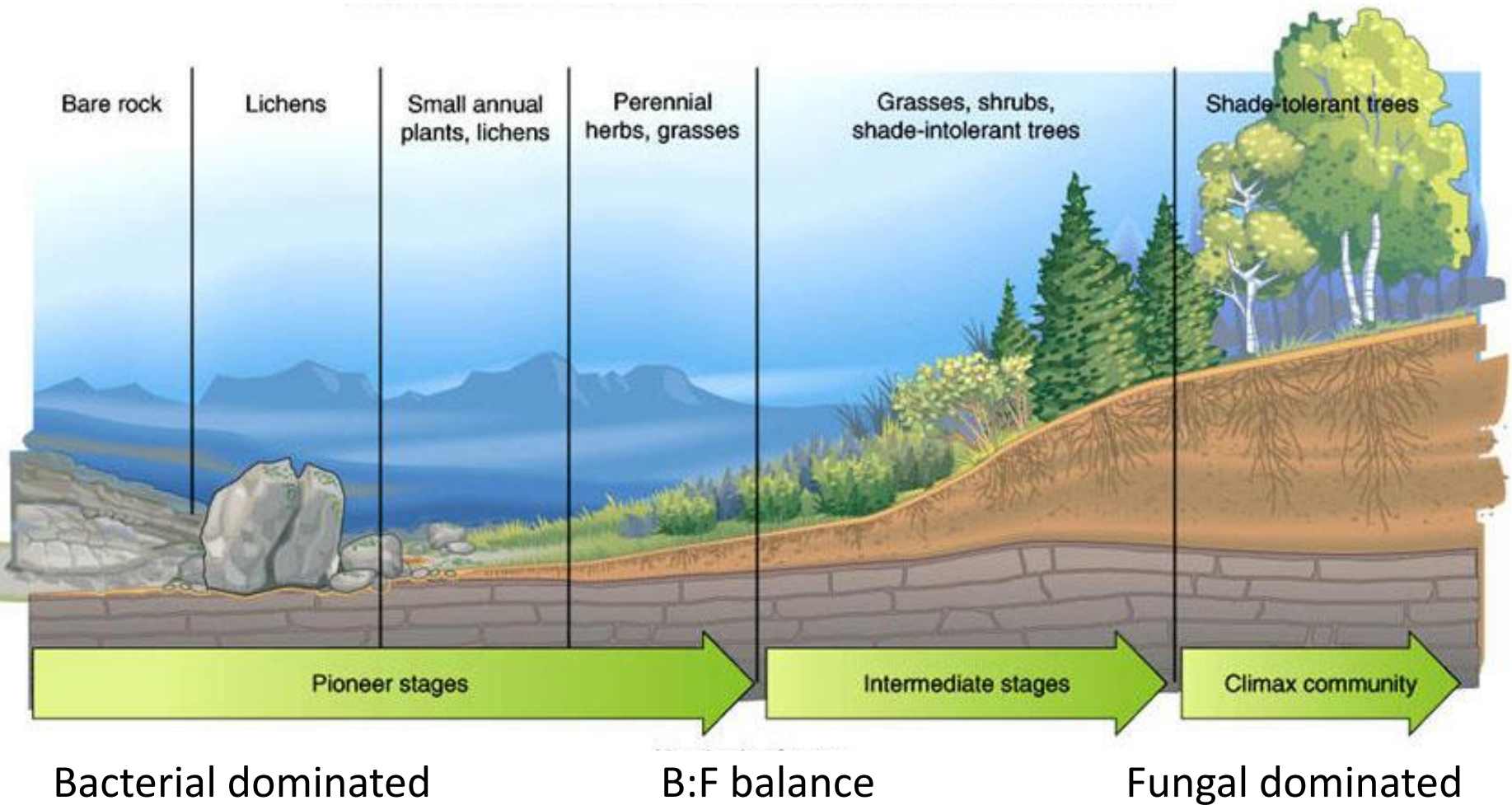
- Oldest, simplest, most numerous organisms
- Involved in: disease suppression, nutrient retention, form soil micro-aggregates





Bacterial dominance post fire creates:

- Fine aggregates/
compaction
- High bacteria and low
predators tie up nutrients
- Germination signal for
many “weeds”





Fungi

- Disease suppression
- Retain nutrients
- Decomposers
- Form soil macroaggregates
- Hold soils together
- Yield



Fungi are vulnerable to fire

- 50% drop in biomass following fires =
 - Increase erosion
 - Decrease in mineral uptake; Ca, P, trace elements
 - Decrease in water holding
- (Dooley and Treseder, 2012)



Esposito, Giuseppe, et al. "Post-fire erosion response in a watershed mantled by volcaniclastic deposits, Sarno Mountains, Southern Italy." *Catena* 152 (2017): 227-241

Changes in diversity

Some bacterial and fungal species increase following fire:

- Bacteria: *Massilia* and *Arthrobacter* genera
- Some fungi: *Penicillium* and *Fusicladium* (pathogens)

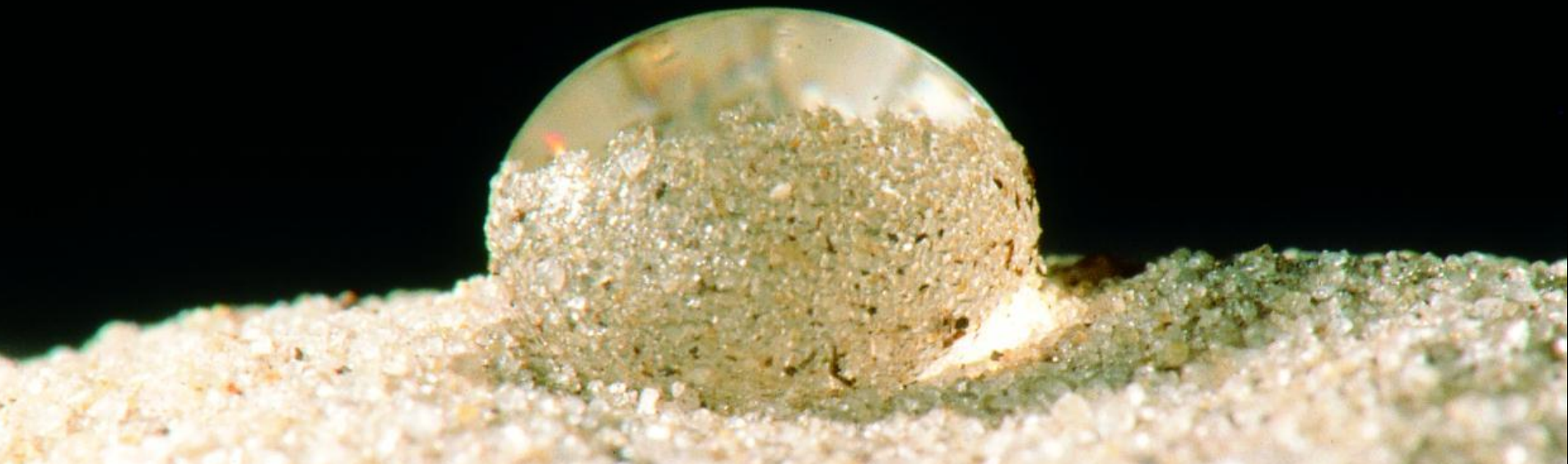
Hydrophobic soils

Soils become water repellent under extreme heat and under certain vegetation



Hydrophobic conditions

- By-products of organic materials
 - Aggregate around soil particles
 - Move through profile to form impervious layers
- Created by microbes



Managing hydrophobic soils

- Low rates of alkaline products
 - Liquid / fine limes
 - Milk
- Vermicast
- Seed dressings of the above inputs



Vermicast

- A vital fire recovery tool
- Contains biology and signals to kick-start soil rebuilding processes – the elixir of life!



Vermicast

- Contains microbes which EAT hydrophobic coatings;
 - *Pseudomonas fluorescens*,
Serratia marcescens and *Bacillus*
spp



Optimising biological diversity and biomass is critical

- Plant health and nutrition is driven by biological functions
 - More communities= more signals=more gene expression= increased crop health and resilience
 - Without community, full gene expression cannot occur!

Actions for remediation

Kick-start biological processes asap



Bio-stimulants

- Fish hydrolysate – provides bioavailable P, N, S and oils to stimulate fungi
- Liquid limes - feed biology, breakdown hydrophobic layers
- Molasses – feed bacteria, kick start life





Soil Program post fire:

7 litres fish

1 litre Molasses

15 ltr Liquid lime

Post treatment
5% plant yield recovery in
control
vs 74% in treatment
(Dr Peter Espie, AgScience)



Generic recipe

<u>Application</u>	<u>Rate Ha</u>
Fish Bio-Stimulant	10 ltr
Molasses/liquid sugar	500 mls
Vermliquid	5 litres
Liquid Lime	25 litres
Humic Acid	1 litre

- Fungal diverse
compost/extracts
- Vermicast/vermiliquid
- microbially balanced



Extractors











Seed treatment

- 5 litres vermiliquid/T seed
- Fine limes
- Liquid humic acid
- Seaweed
- Korean Natural Farming : LAB, EM, BIM

Extract seed coating

- 100mls milk
 - 10mls molasses
 - 1 litre of sieved compost
 - Water (amount varies - pancake batter)
-
- Mix 1 litre slurry to 20kg seed
 - Dry seed







Using animals



Whole systems approach

- Create environment for plant recovery
- Address water infiltration
 - Chemical or physical restraints
 - If using mechanical interventions, FEED microbes!
- Plants build soil
 - Support optimal plant health, seed dressings

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