

Evaluating native bee community response to fuel-reduction treatments in managed forests.

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- Objective
- Background
- Methods
- Expected Results
- Broader impacts



Study objective: To quantify bee abundance and diversity in sites with fuel break treatments compared to untreated reference sites.



Photo credit: Jane O' Sullivan

Background: The importance of animal pollinators

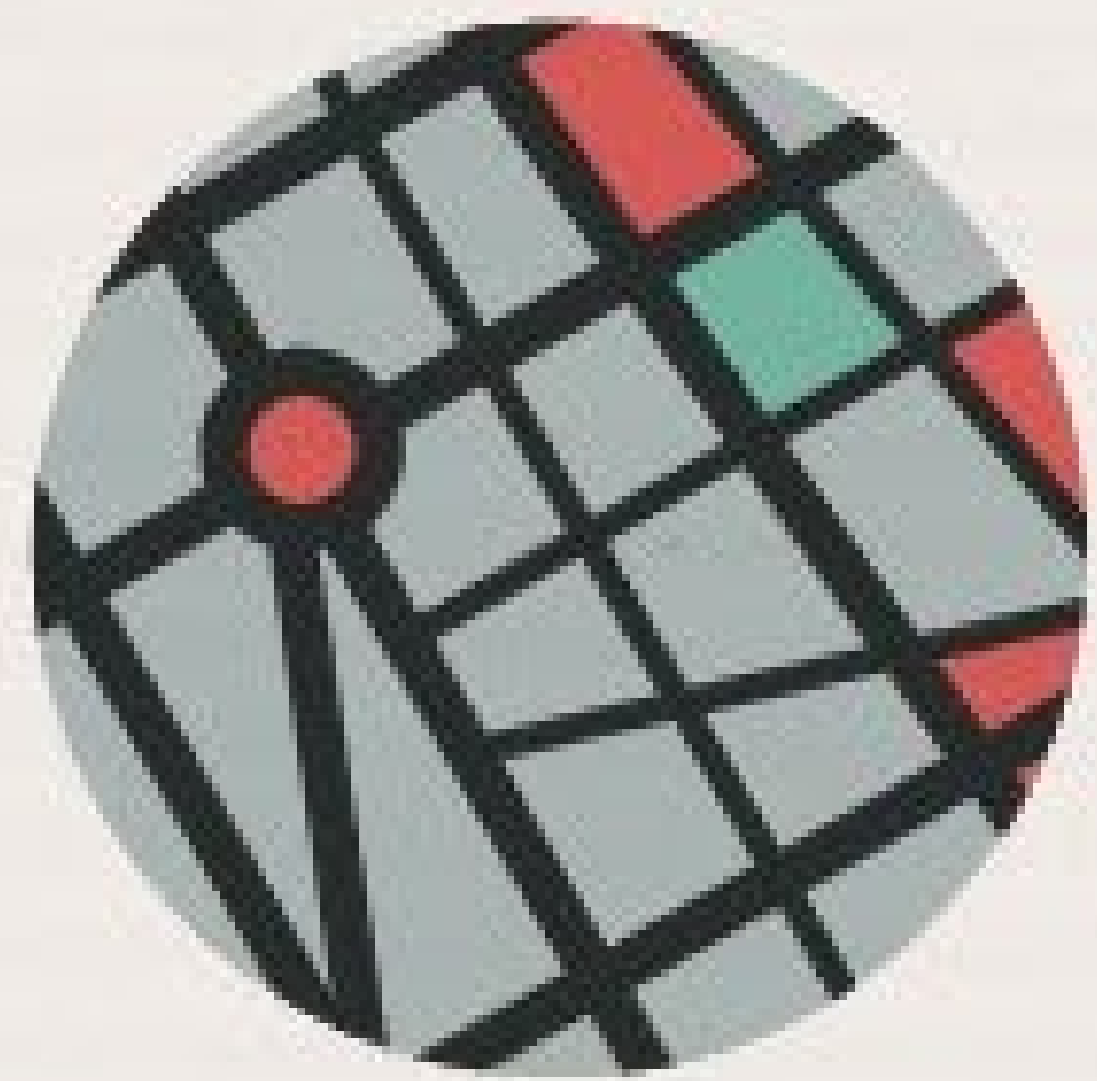
- **90%** of the worlds flowering plants
- **87** out of 115 main global food crops rely on pollinators
- **over \$195 billion** per year in ecosystem services globally



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Bees in decline

WHY ARE POLLINATORS DECLINING?



Land use change
and loss of habitats



Environmental pollution



Climate change



Intensive agricultural management
and pesticides use



Invasive alien species
and diseases

Critical resources for bees

Food



Flowering plants

Nesting



Cavities in pithy stems, wood
and bare ground

Land management



Natural disturbances

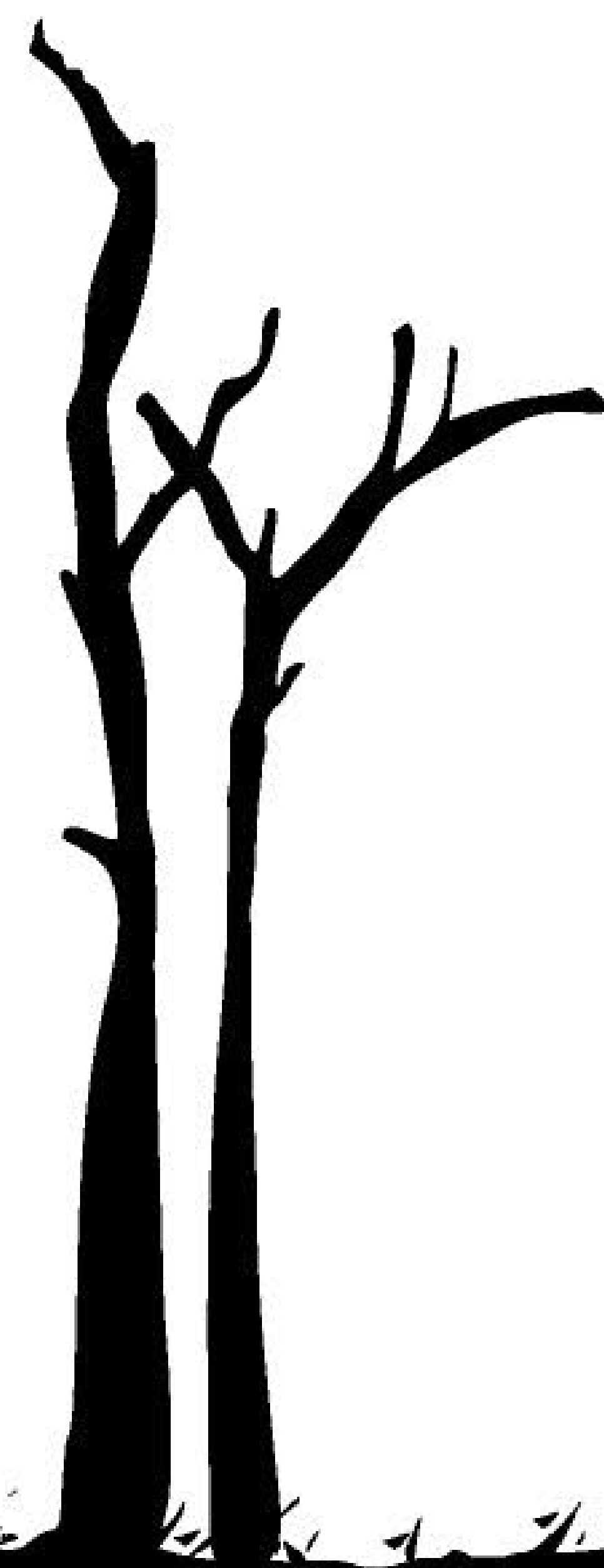


Changing fire regimes

Fire severity and intensity

HIGH INTENSITY

Full crown defoliation

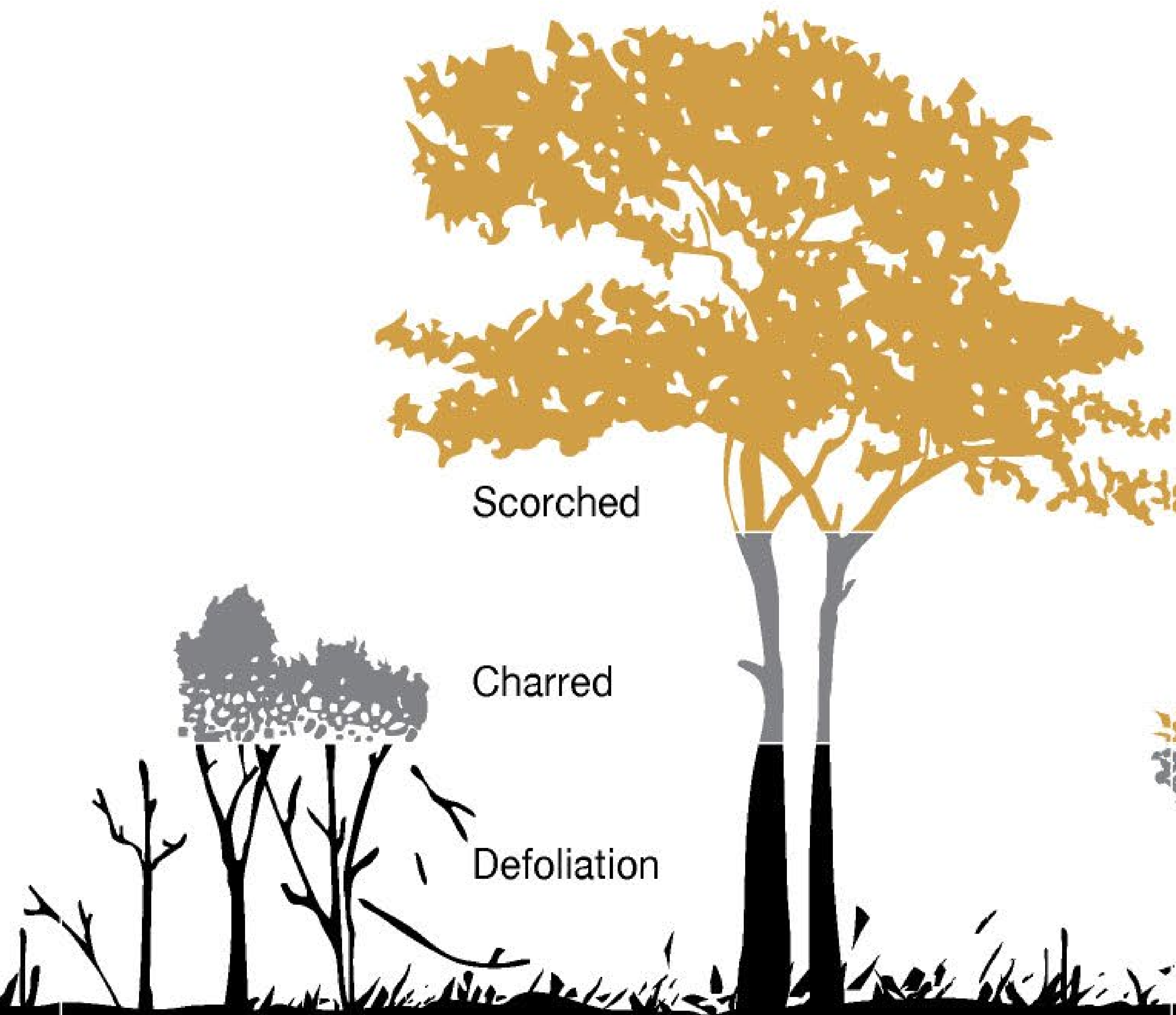


MODERATE INTENSITY

Scorched

Charred

Defoliation

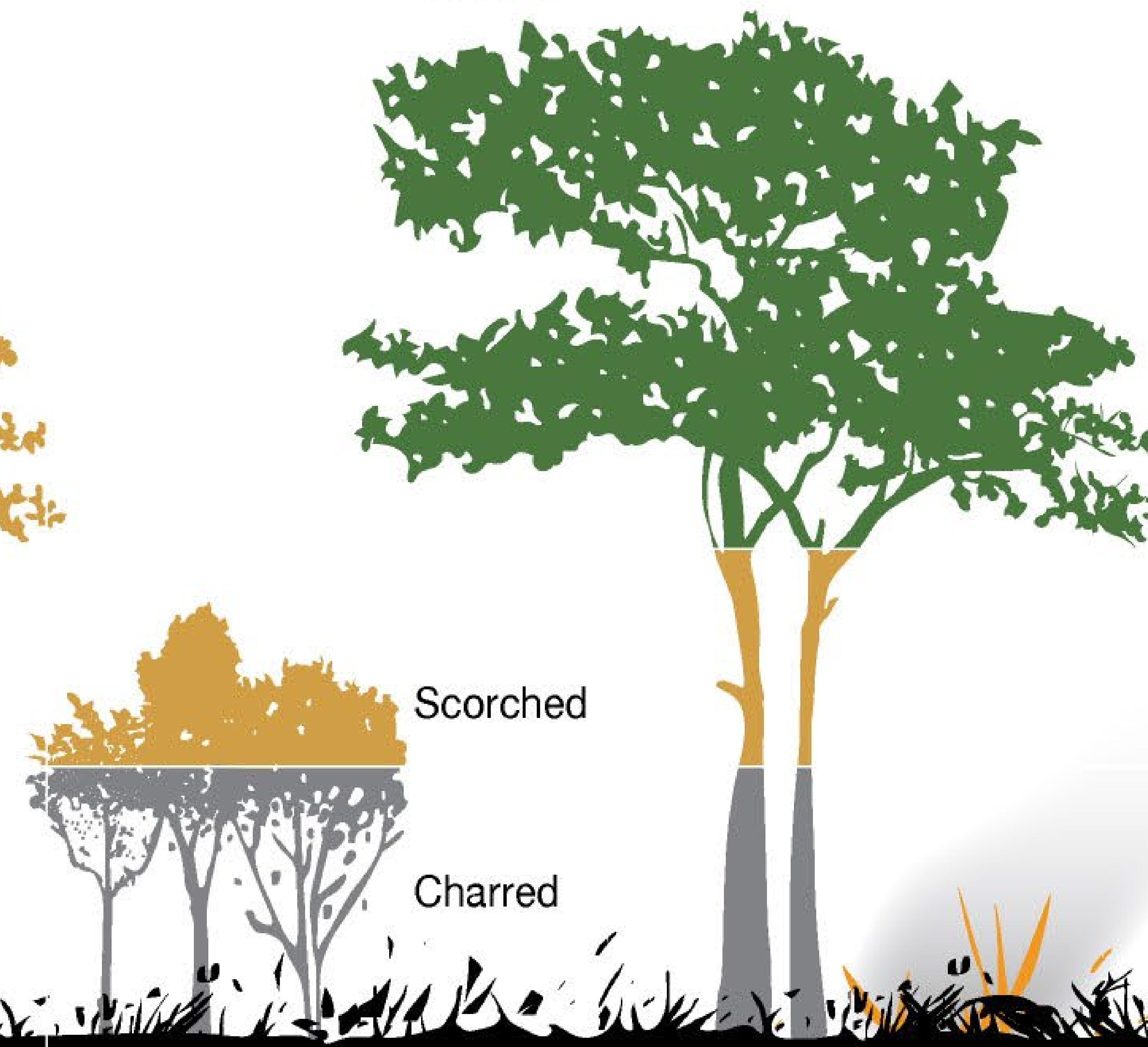


LOW INTENSITY

Unburnt

Scorched

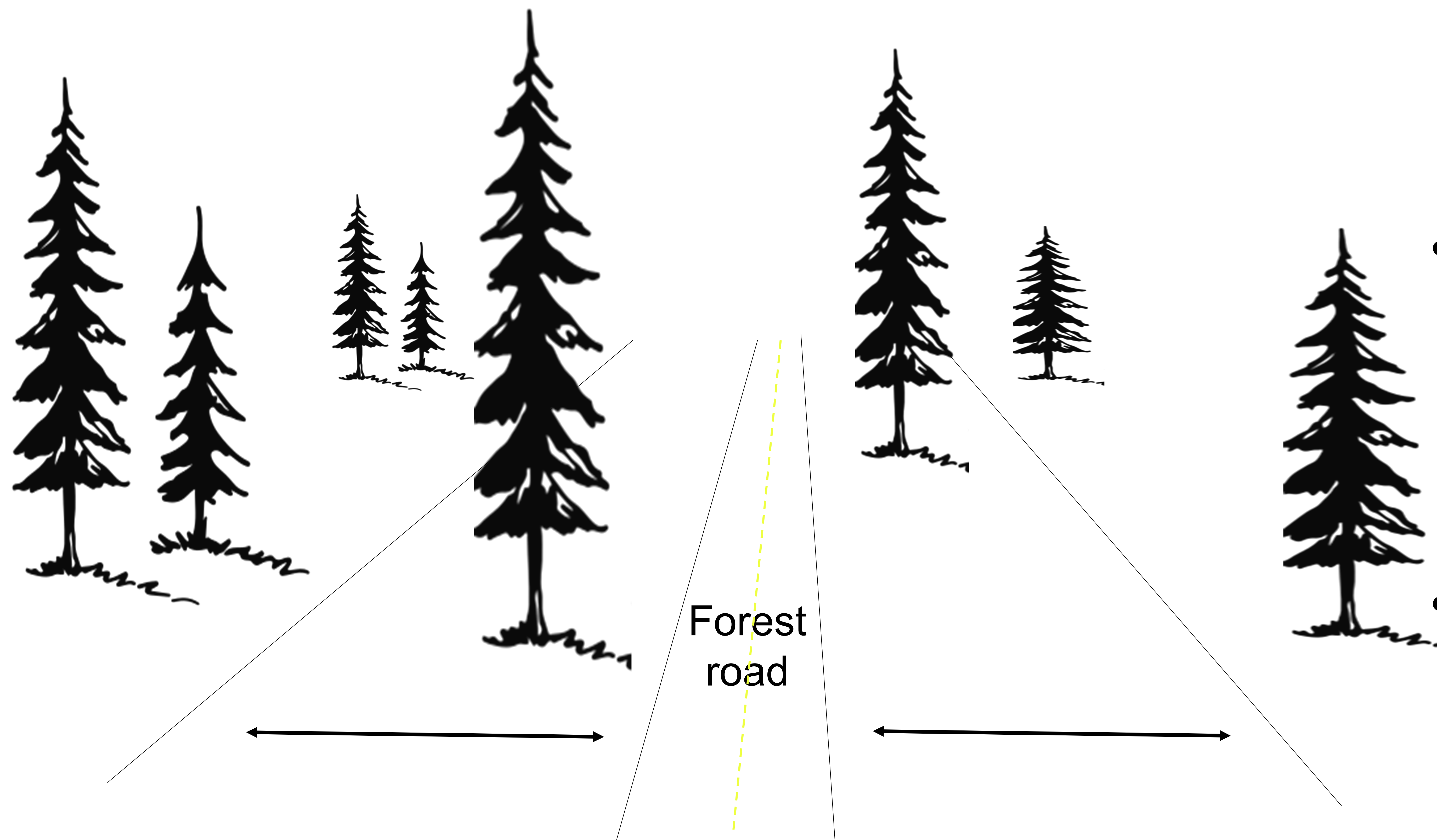
Charred



A need for fuel management



Shaded fuel breaks



- Creates defensible space along an access point
- Removal of large fuels such as trees, shrubs and logs
- Shade keeps the ground cool and damp later into the season

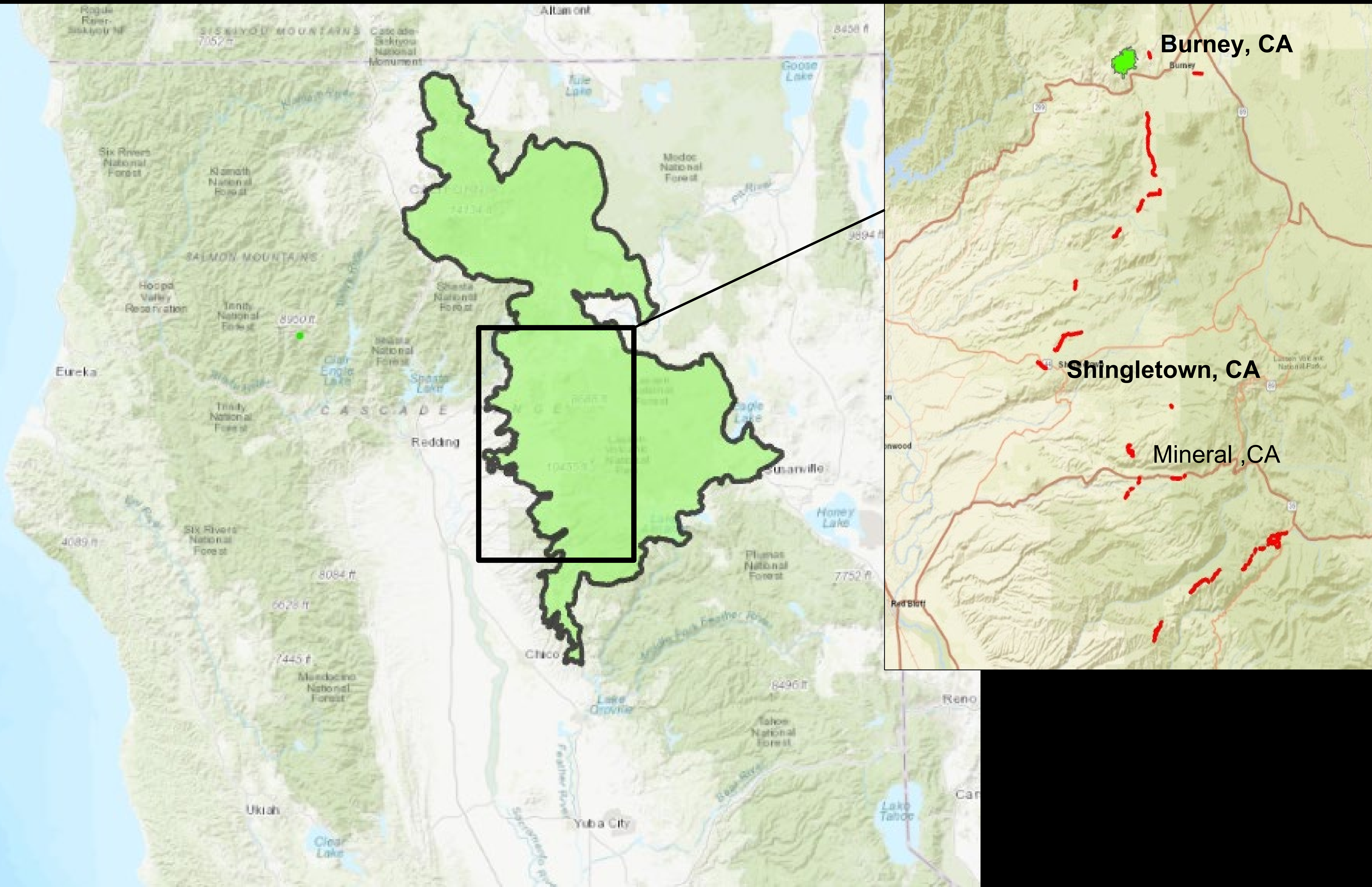


Untreated

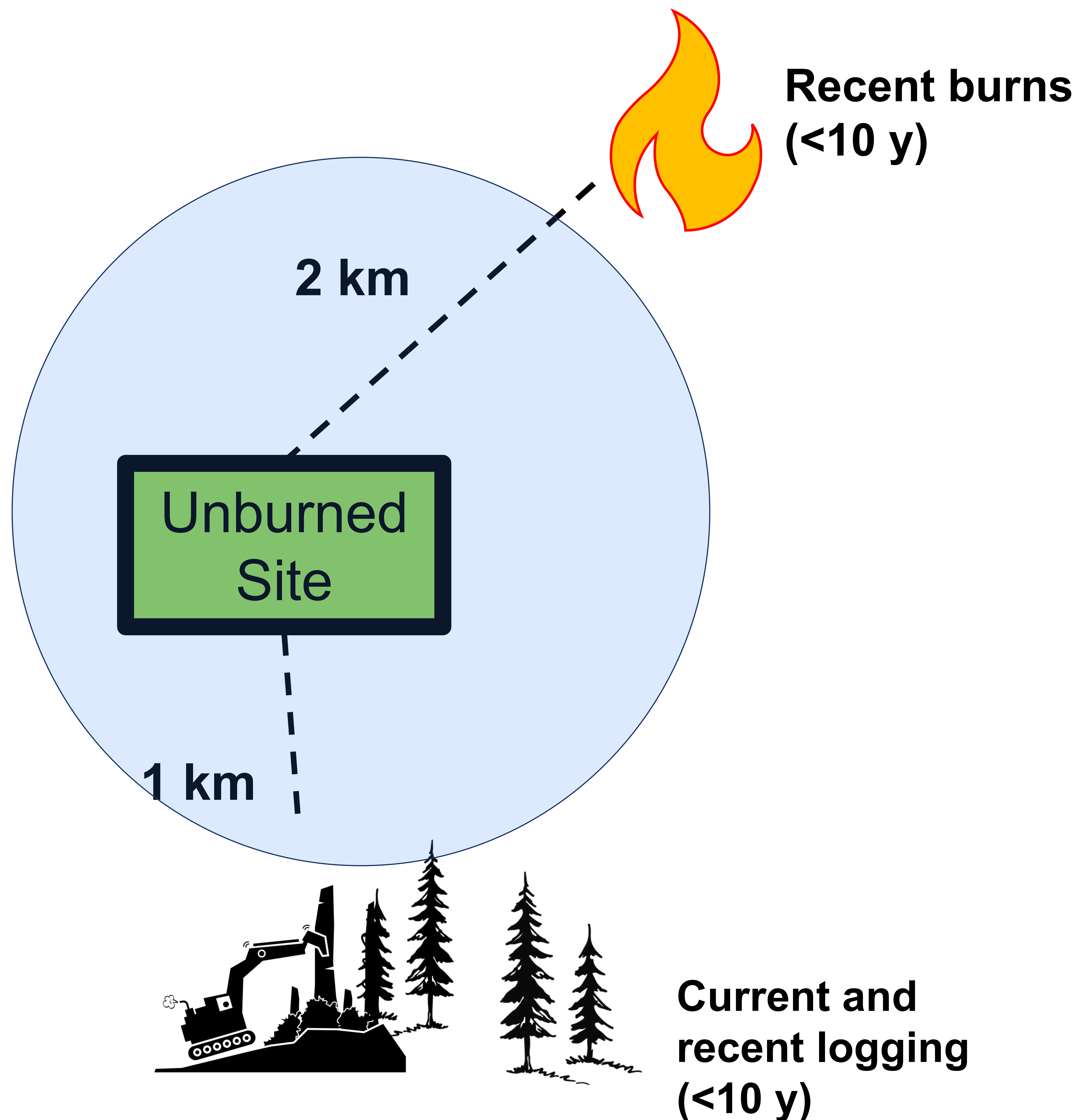


Treated

Study Area: Northern California, Cascades Eco-Region



Site Selection



All sites:

- Unburned in last 10 years
- At least 40 meters on either side of the road.
- Sites are at least 1 km in length

26 Treated Fuel Breaks

- Range of years 2017-2022

8 Reference Sites

- Greater than 60% canopy cover
- Stand age 10+ years

Shaded fuel breaks





Reference sites





Methods

1. Bees



2. Floral resources



3. Vegetation survey



4. Pollen



5. Reed nesting traps



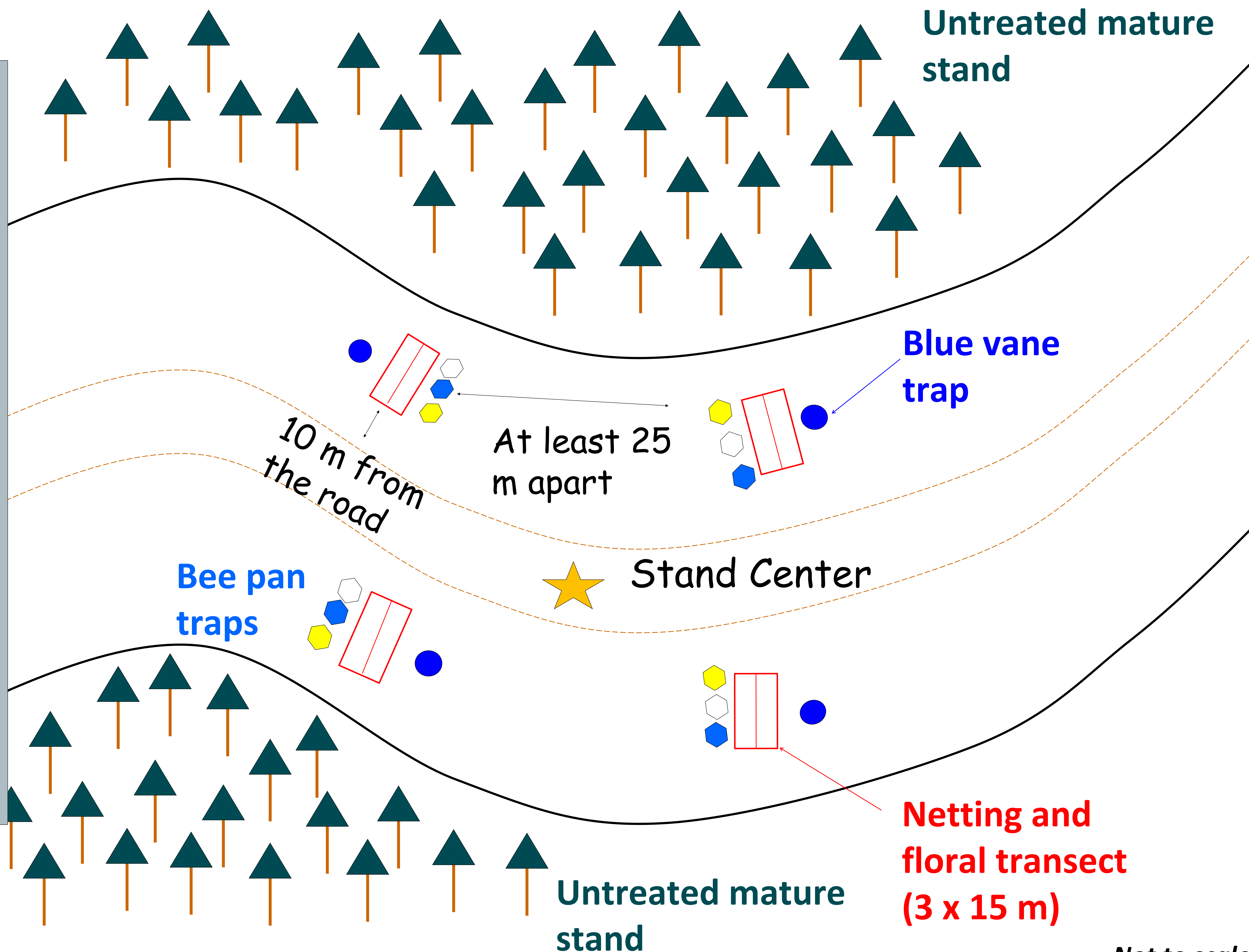
2023- 2 sampling
rounds

2024 – 3 sampling
rounds

Fuel break sampling design

Per Site:

- 4 transects
- Netting - 15 min per transect for bees (2 hr total)
- Trapping - 12 pan traps, 4 blue vane traps
- Floral resources



Not to scale!

Bee sampling methods



(left to right) Crew member Adrienne Martineau netting in a transect, blue vane trap on t-post, yellow pan trap with soapy water.

Netting Rounds

- Hand netted bees off flowers
- Checked for species of concern including the western bumble bee (*Bombus occidentalis*)
- Queens were released after taking photos to minimize impacts on colony



Trapping Rounds



Quantifying floral resources



Vegetation survey in 2024



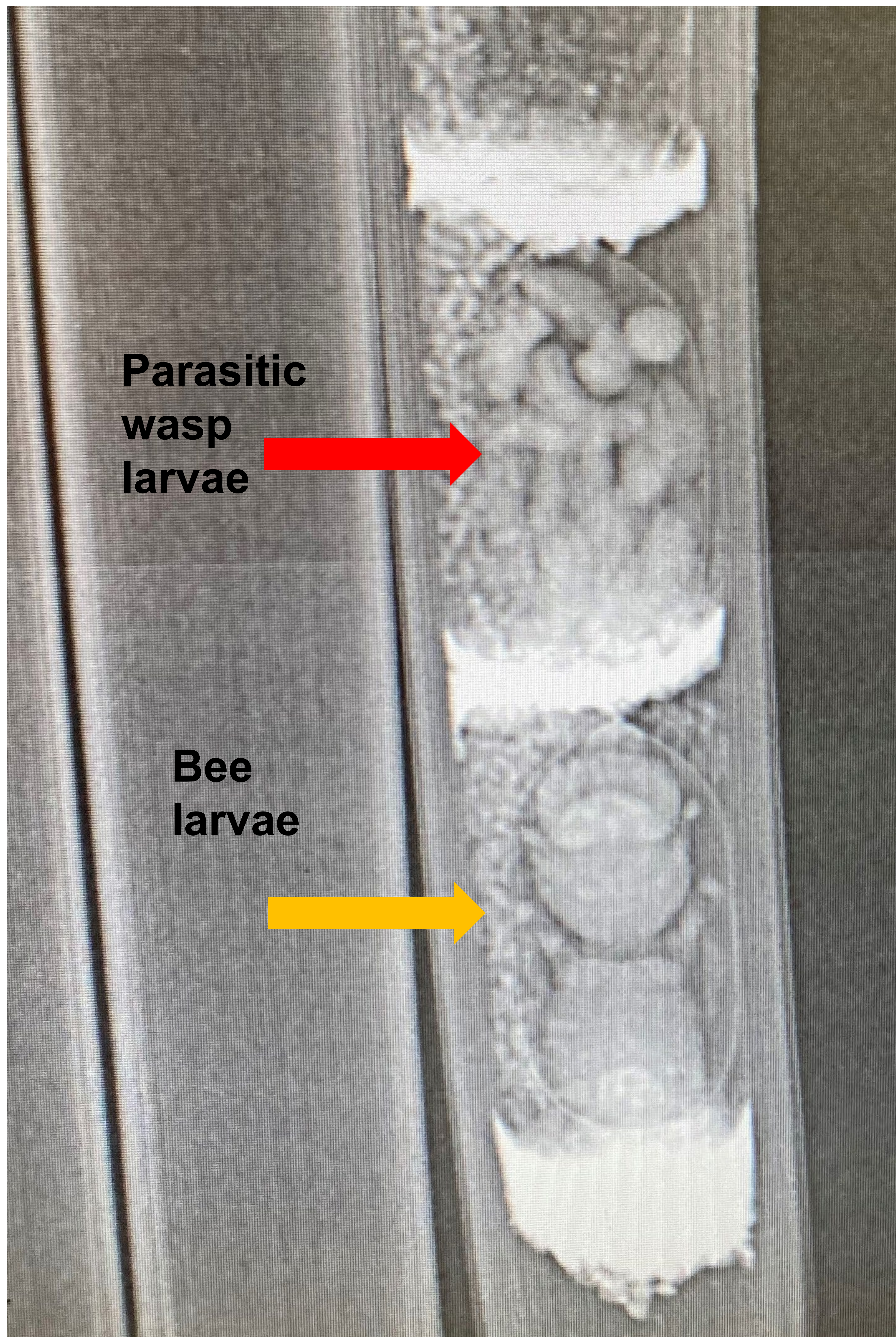
- Stand density
- Canopy cover
- Shrub cover
- Bare ground
- Woody debris

Additional studies: Pollen bees



Reed traps

- What bees and wasps will colonize the provided nests?
- Xray back at the lab to look for bee and parasitic wasp larvae



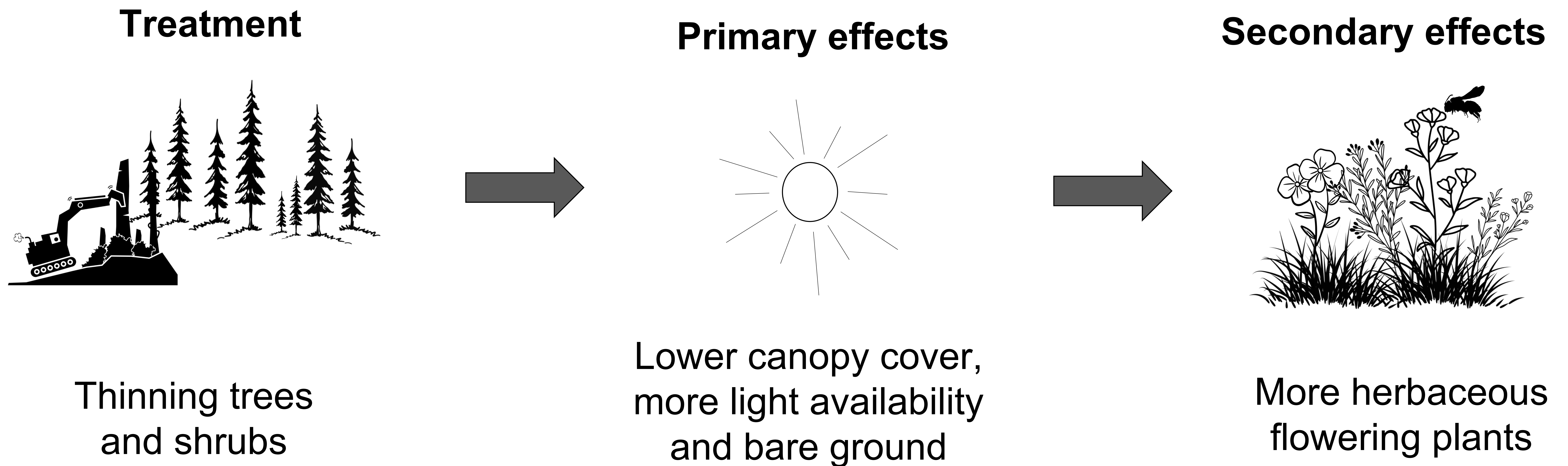
Specimen processing



Lab technicians: Amanda Hopper-Moore, Christoph Anderson, Erin Leal, Jaden Torres, Jane O' Sullivan (photo), Sophia Gutierrez

Expected Results

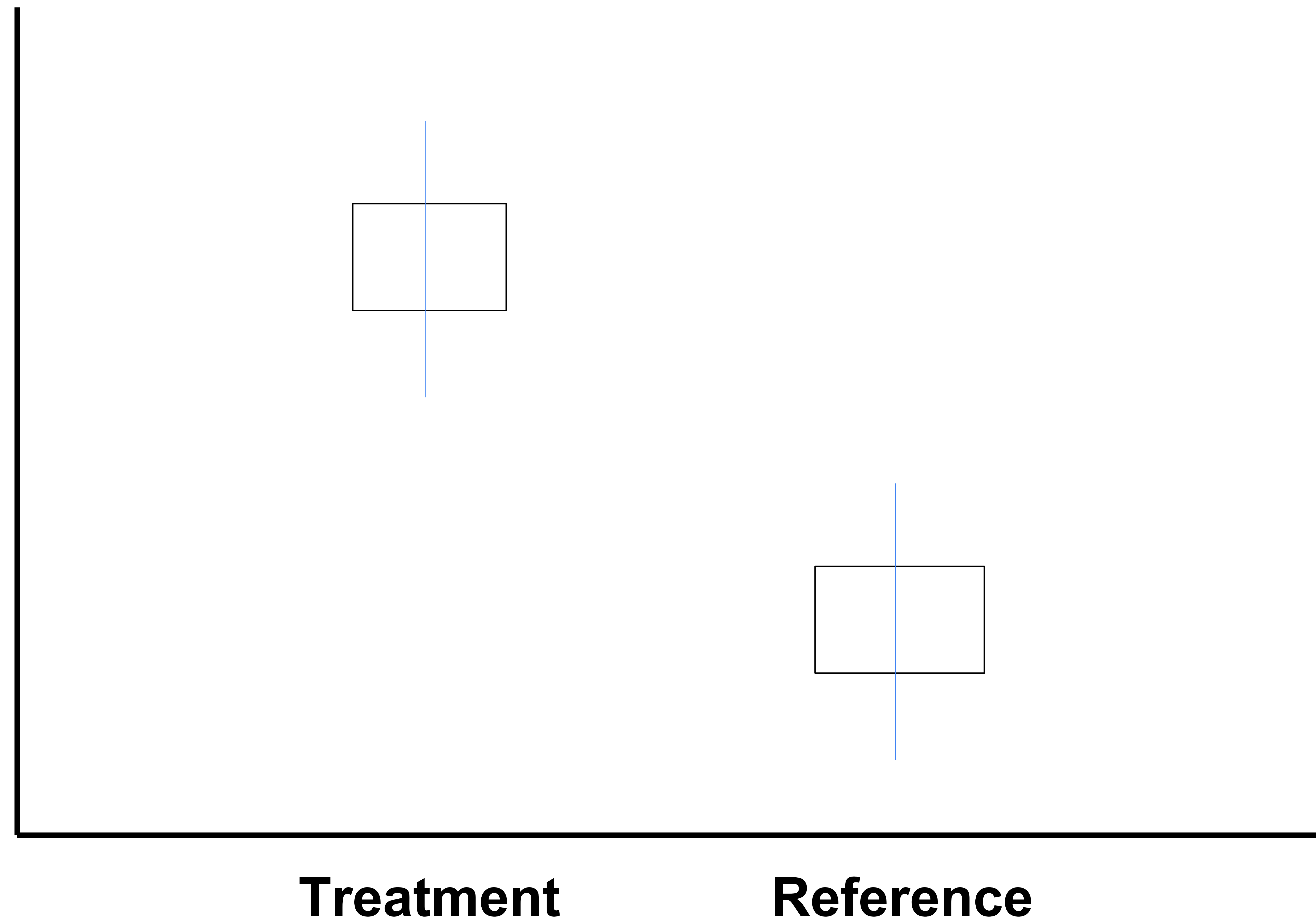
Fuel break treatment effects on floral resources



Prediction 1: Floral resources will be more abundant in treatment sites with lower canopy cover and less abundant in reference sites with higher canopy cover



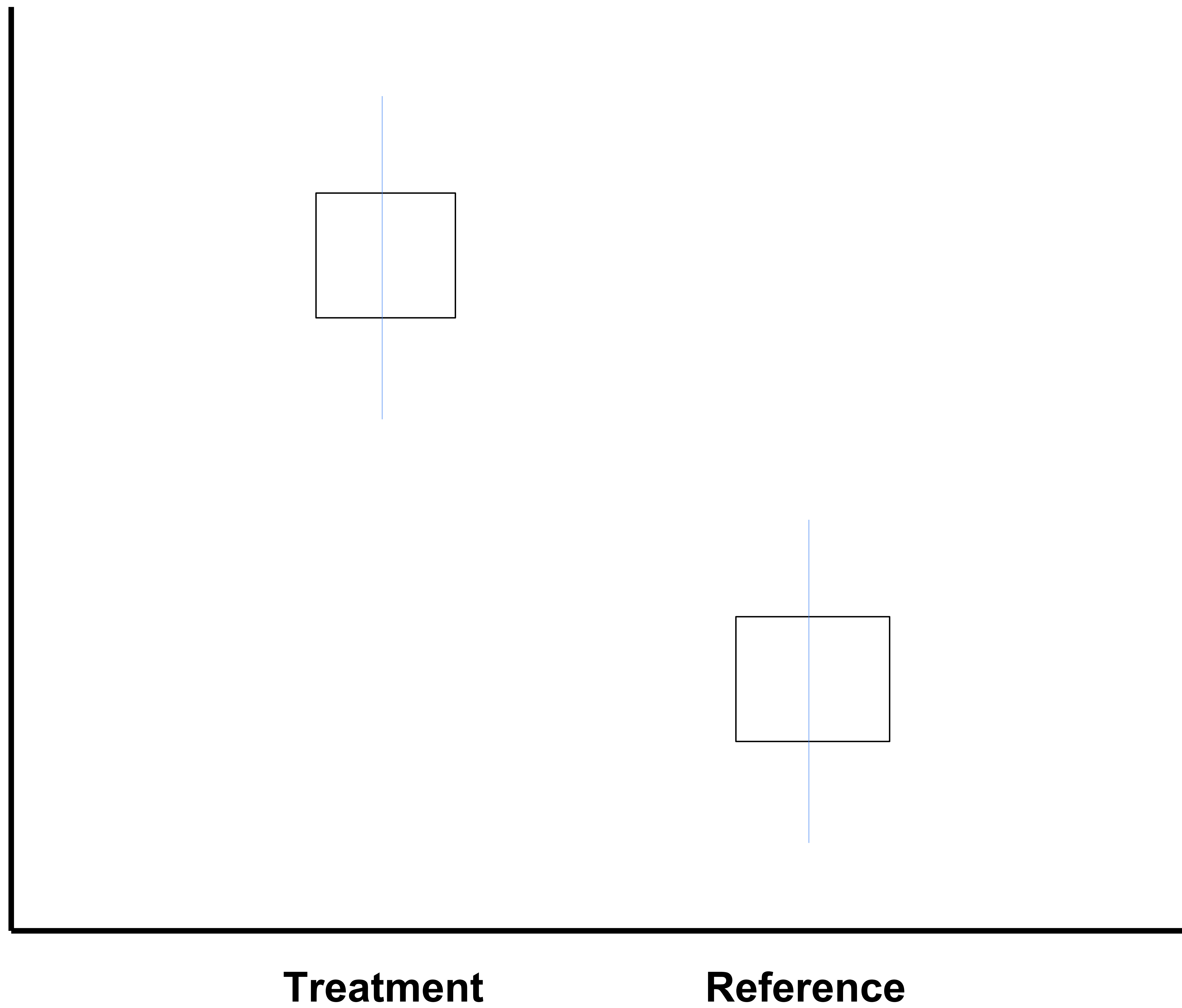
Floral and bee abundance



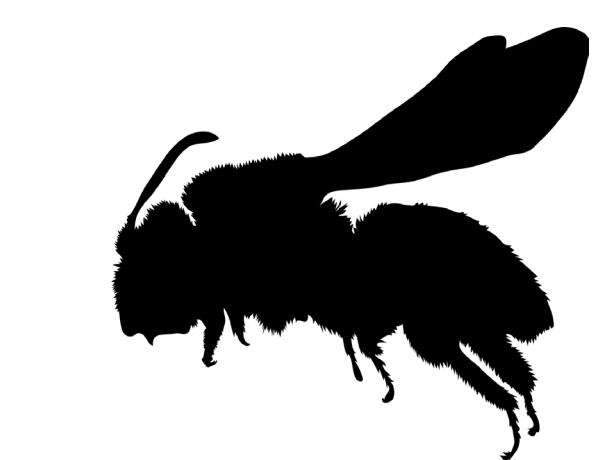
Prediction 2: Bee richness will be higher in fuel break treatments relative to reference sites.



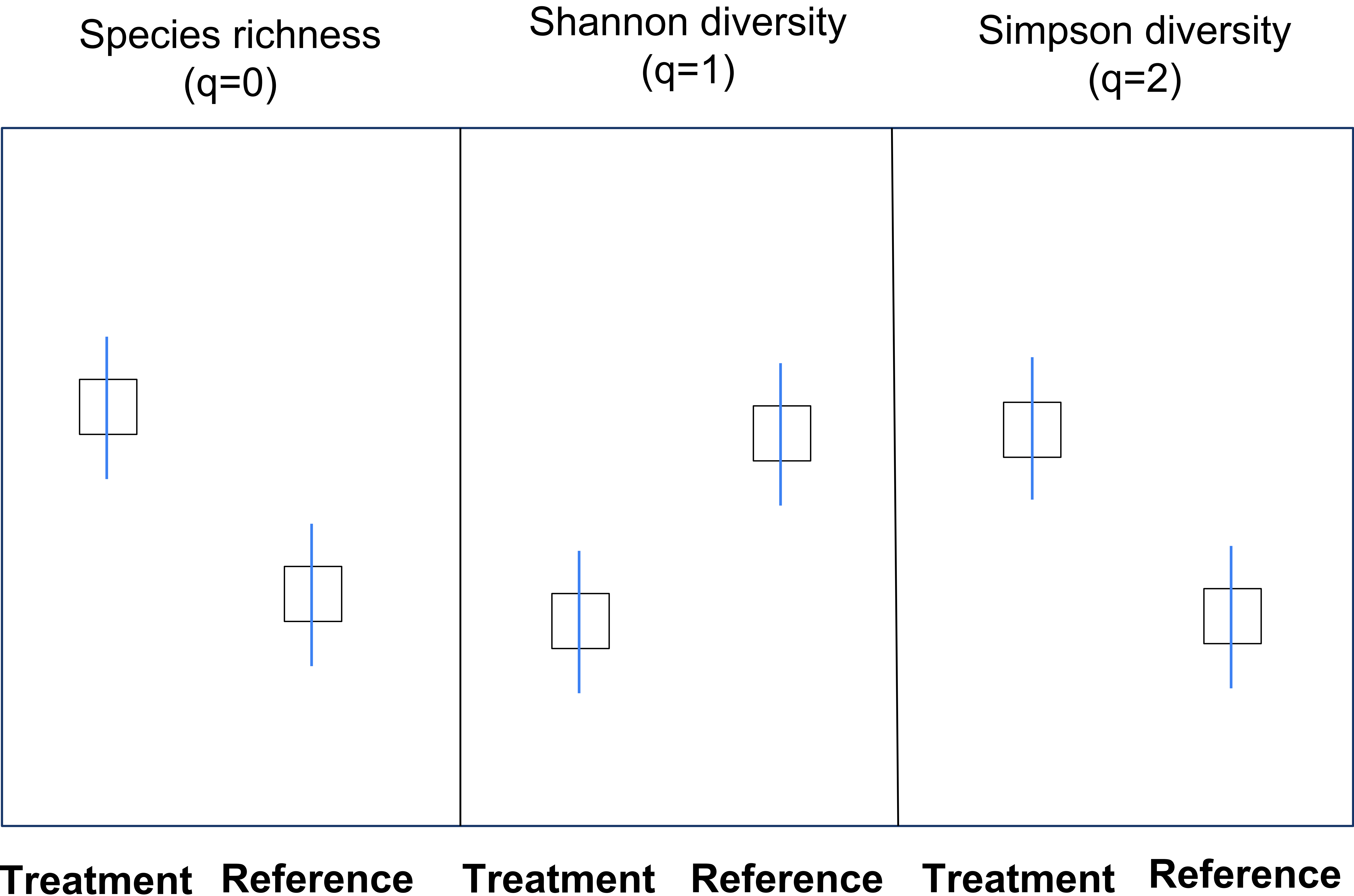
**Bee
Richness**



Prediction 3: Diversity will differ between sites when rare species are weighted more.



Bee
Diversity



- $q=0$: species equally weighted
- $q<1$: more weight given to rare species
- $q>1$: more weight given to abundant species

Broader impacts:

- Management decisions
- Policy
- Bee habitat and populations





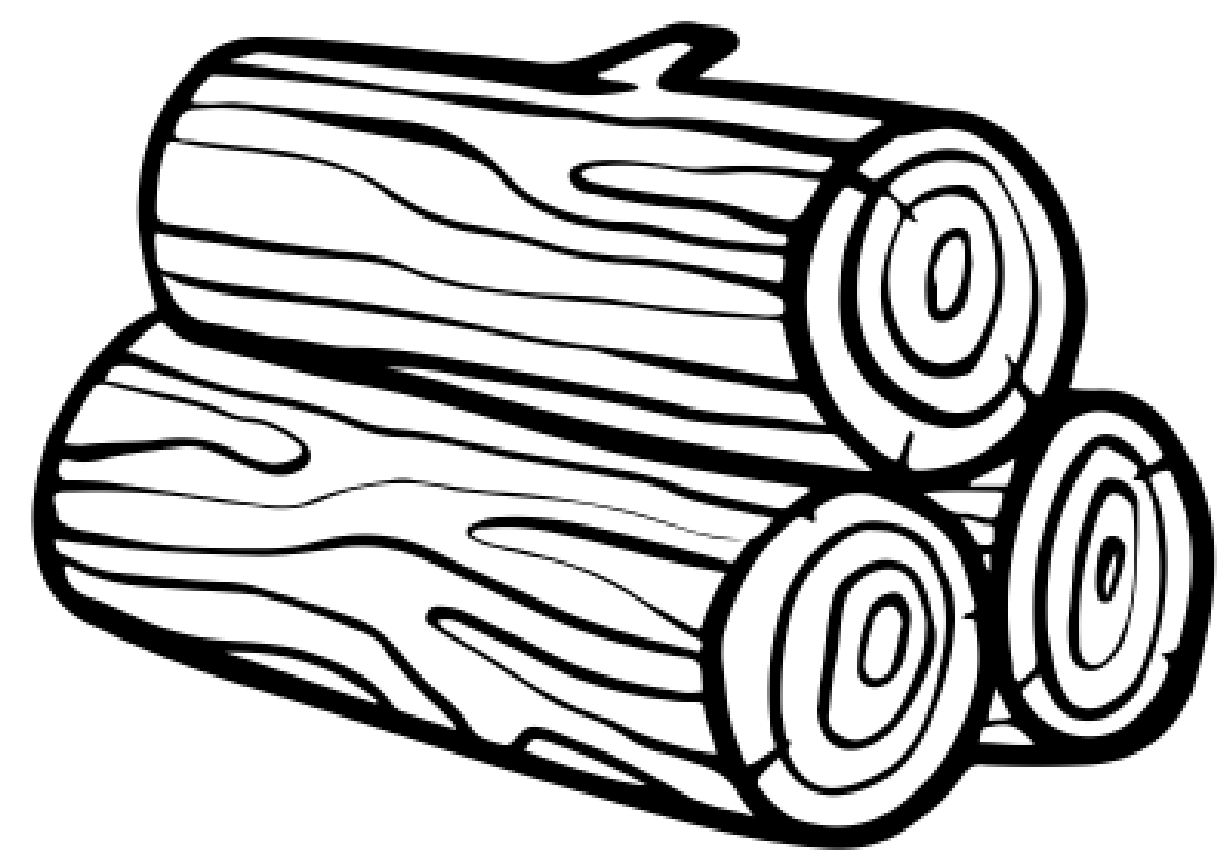
Left to right: Adrienne Martineau, Amy Stephens, Riley Forrestall, Silas Pickhardt, Elizabeth Uemura

Fuel break treatment effects on nesting resources

Treatment method



Removal of large
woody debris and soil
disturbance



Leaving large woody
debris

Primary effects

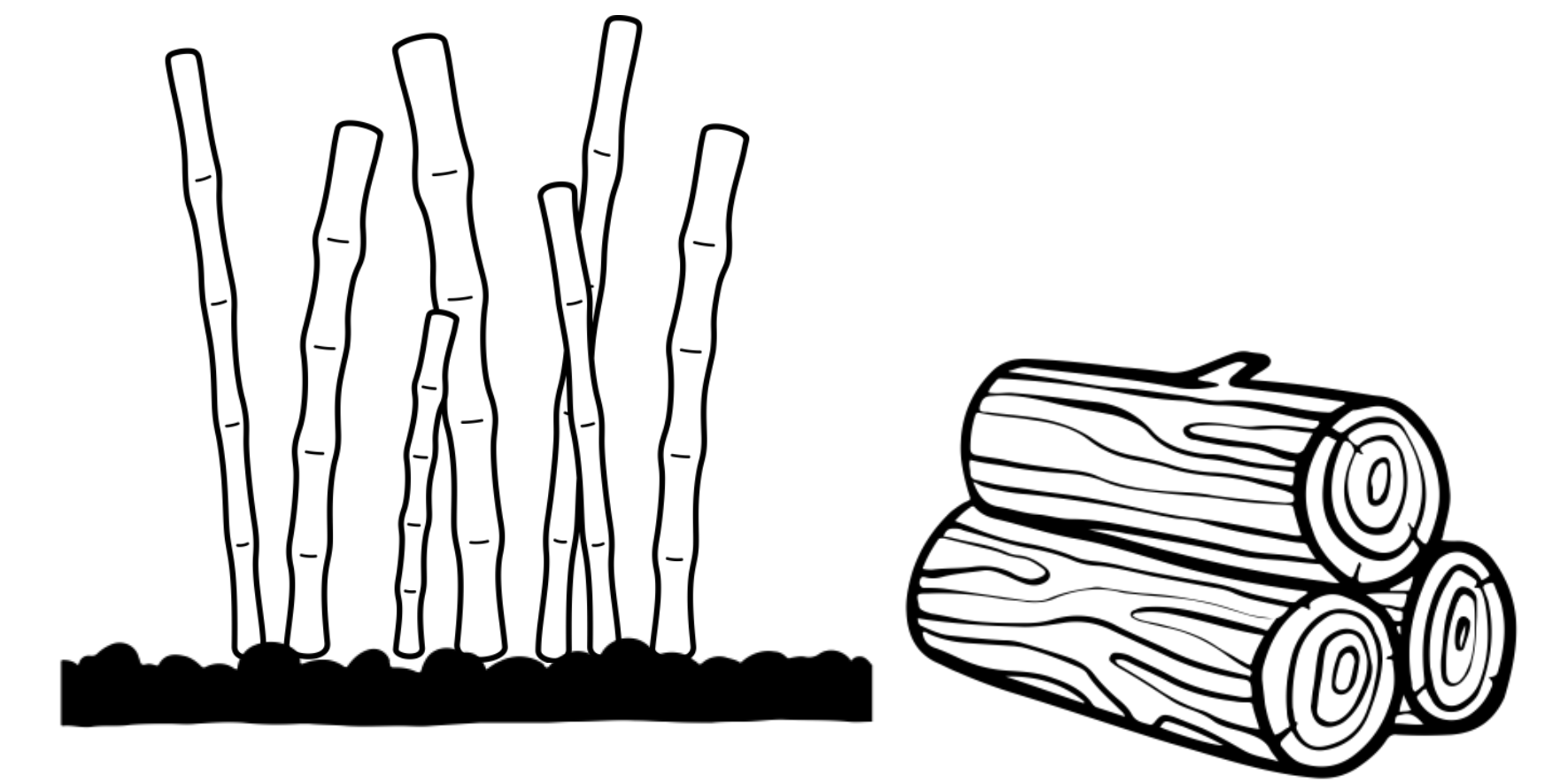


More bare ground

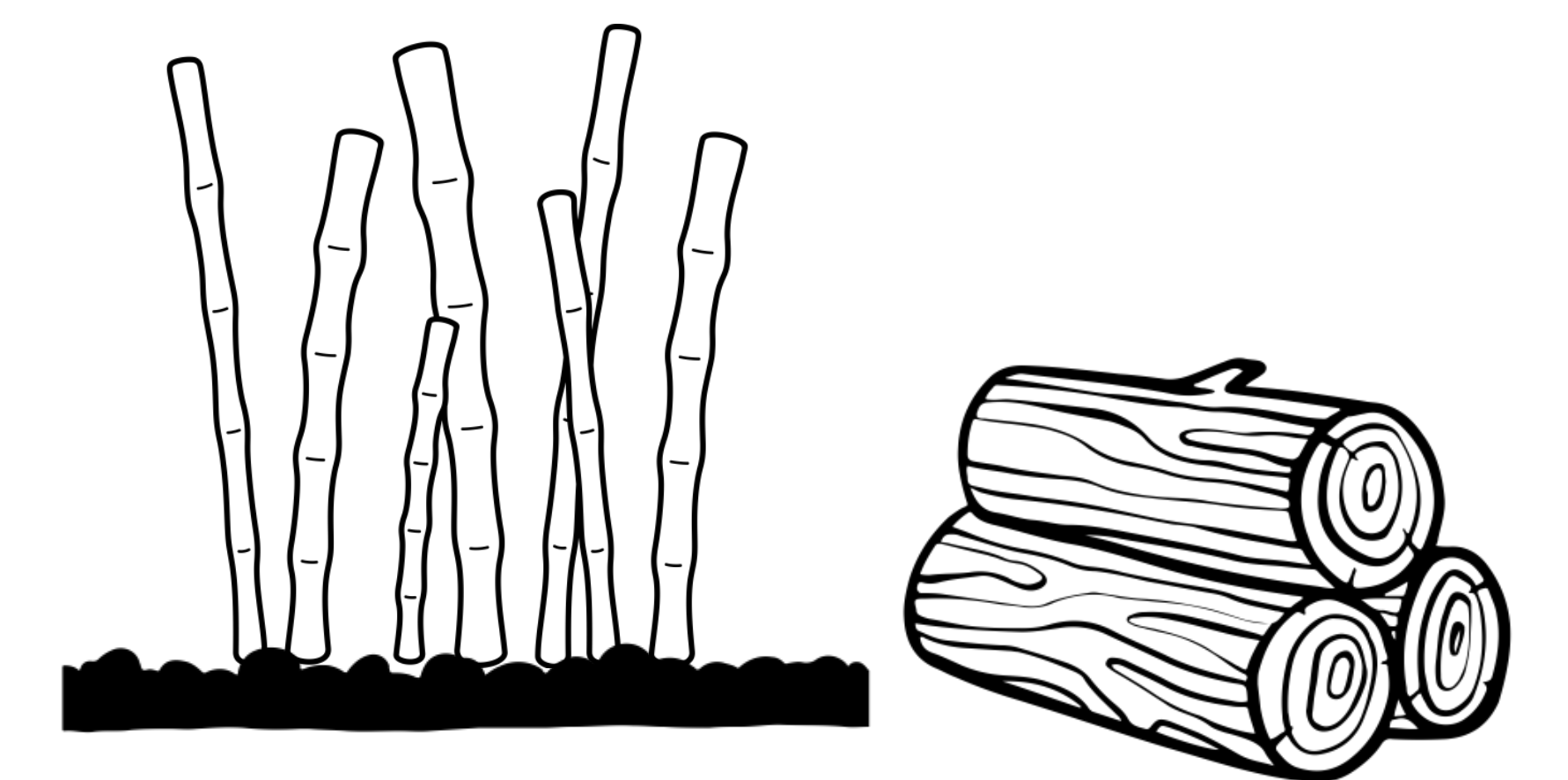


Less bare ground

Secondary effects



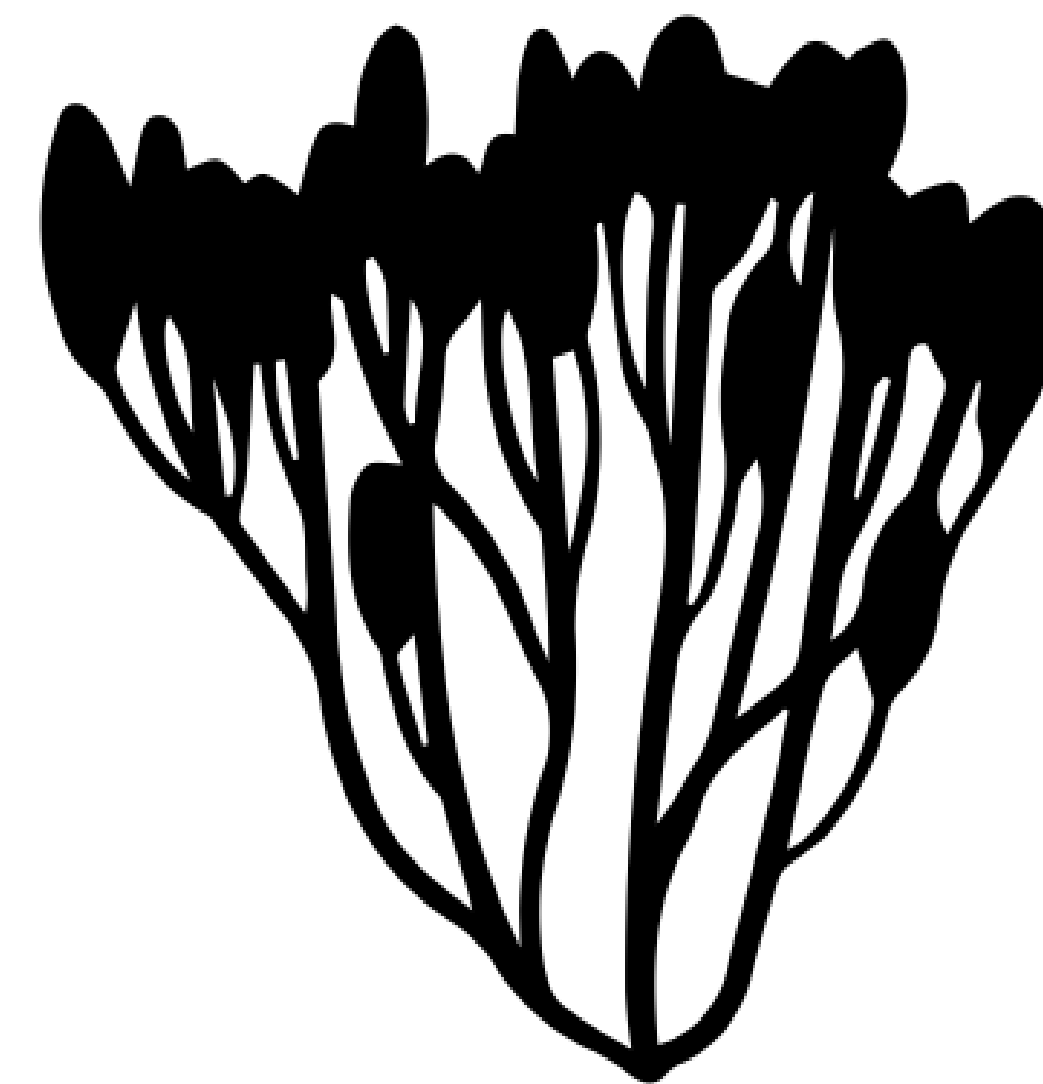
Less cavity nesting
resources- reeds/beetle
holes



More cavity nesting
resources- reeds/beetle
holes



Removal of shrubs
in site, but still on
edges



Less native flowering
shrubs like manzanita
and more bare ground



More flowering plants
Possibly non-native

Time since treatment

Since our study is in dry forests, growth is slower, and canopy closure may take longer than in previous studies of canopy closure in wet forests, so time since treatment may not be as closely related to canopy closure in these systems