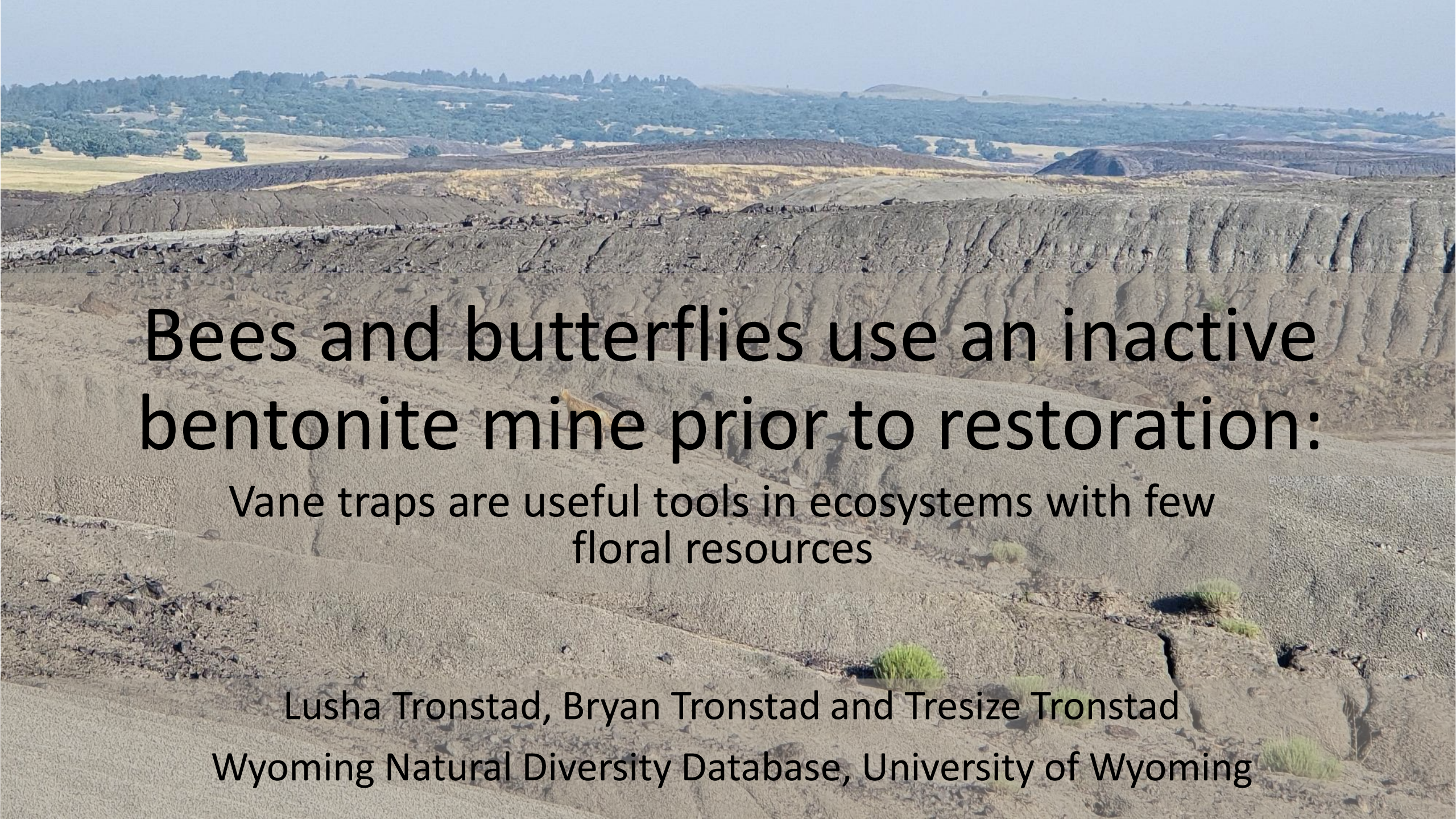




Bees and butterflies use an inactive bentonite mine prior to restoration:

Vane traps are useful tools in ecosystems with few floral resources

Lusha Tronstad, Bryan Tronstad and Tresize Tronstad
Wyoming Natural Diversity Database, University of Wyoming

Bentonite

- Fine clay (montmorillonite) with many uses
 - Pond liner
 - Cat litter
 - Cosmetics
 - Toothpaste
 - Drilling mud
 - Foundry sand binder (iron & steel casting)
 - Additive in animal feed
 - Water treatment
- Wyoming has some of the largest high-quality bentonite deposits



Bentonite mining

- Remove overlying earth
- Mine bentonite
- Refill area with stored topsoil



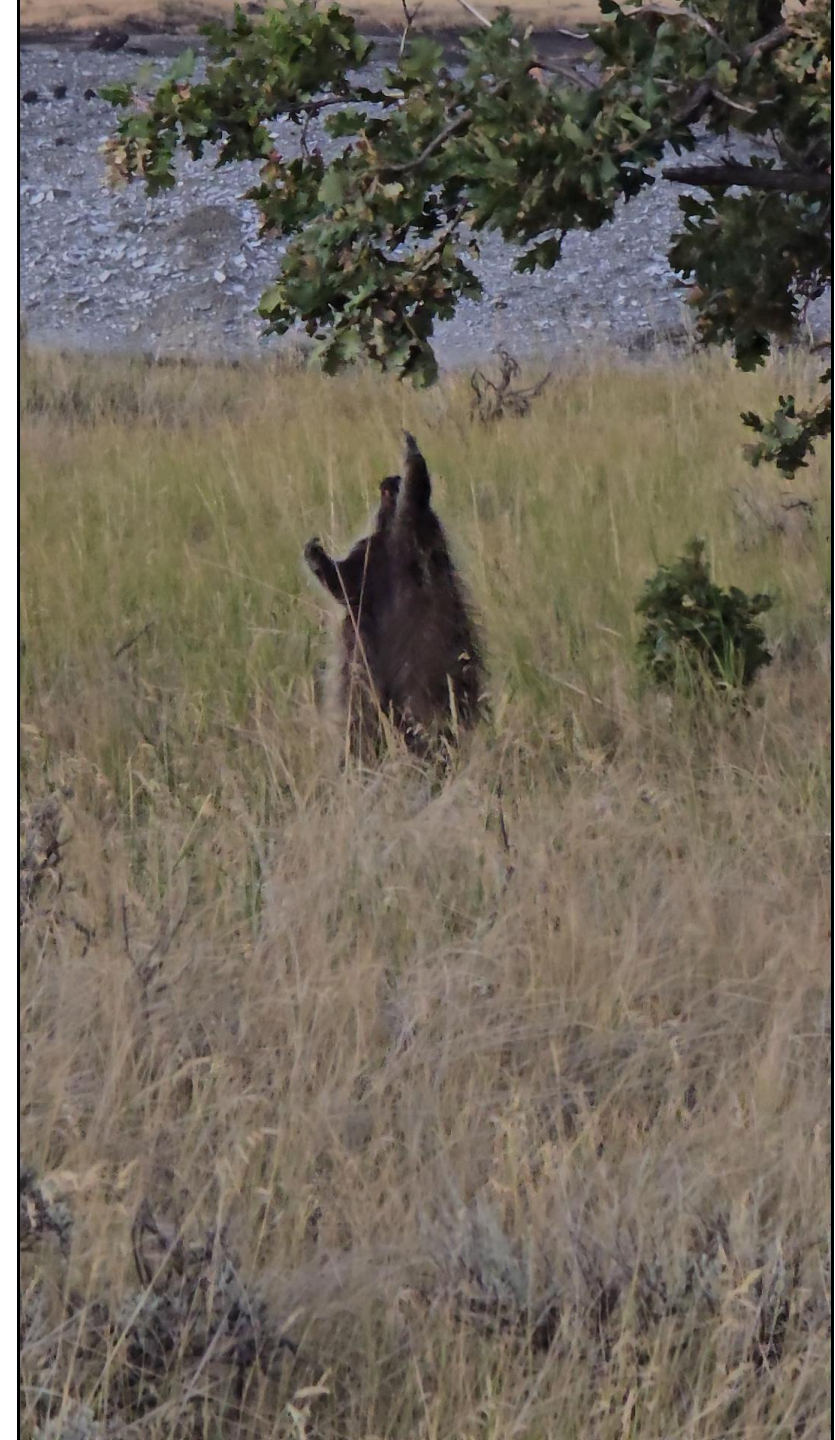
After bentonite mining

- Inactive bentonite mines typically have
 - Abundant bare ground
 - Sparse vegetation
 - Wetlands



Wildlife use

- Observed
 - Foxes
 - Deer
 - Reptiles
 - Turtles
 - Shorebirds
- Species that use abundant bare ground
 - Nesting bees



Benefits of reclamation

- Add habitat diversity
 - Vegetation
 - Wildlife



Pollinators are a knowledge gap

- Difficult to assess pollinators in areas with few flowers
 - Expect pollinators to be scarce in areas with few flowers
 - Typical bee surveys rely on flowers
 - No flowers = no bees
- Best reclamation methods for pollinators unknown
 - Best forbs to plant
 - Ratio of forb seeds to grass seeds
 - Provide floral resources throughout growing season



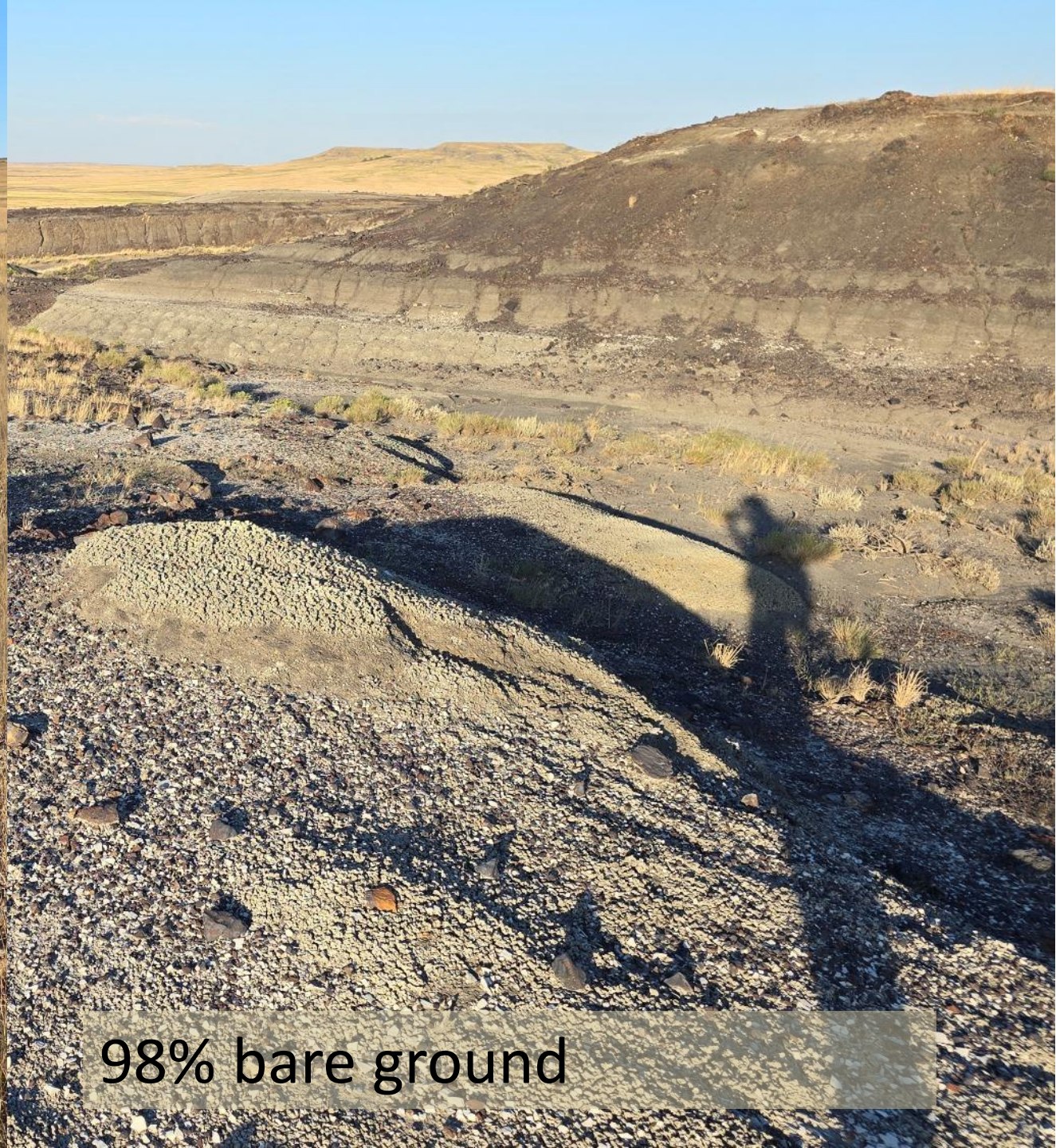
Autumn is critical time for floral resources

- Pollinators are active later into the autumn
- Floral resources are limiting
- Planting late blooming plants critical
 - Rabbitbrush (*Ericameria*)
 - Gumweed (*Grindelia*)





- Mined for bentonite since 1927
- Surrounded by mixed-grass prairie
- 9 sites
- Varied in the degree mined



6% bare ground

98% bare ground

Study area

63%

% Bare ground varied
among sites

98%

45%

45%

13%

16%

6%

13%

61%

N

1 mile



Questions

- Do **visual estimates of ground cover** differ from those calculated from **drone imagery**?
- How **abundant and rich** are **pollinators** prior to restoration?
- To what degree did **ground cover and flowers** influence **pollinators**?
- What are the **best methods to survey for pollinators** in areas with few flowers?

Ground cover estimates

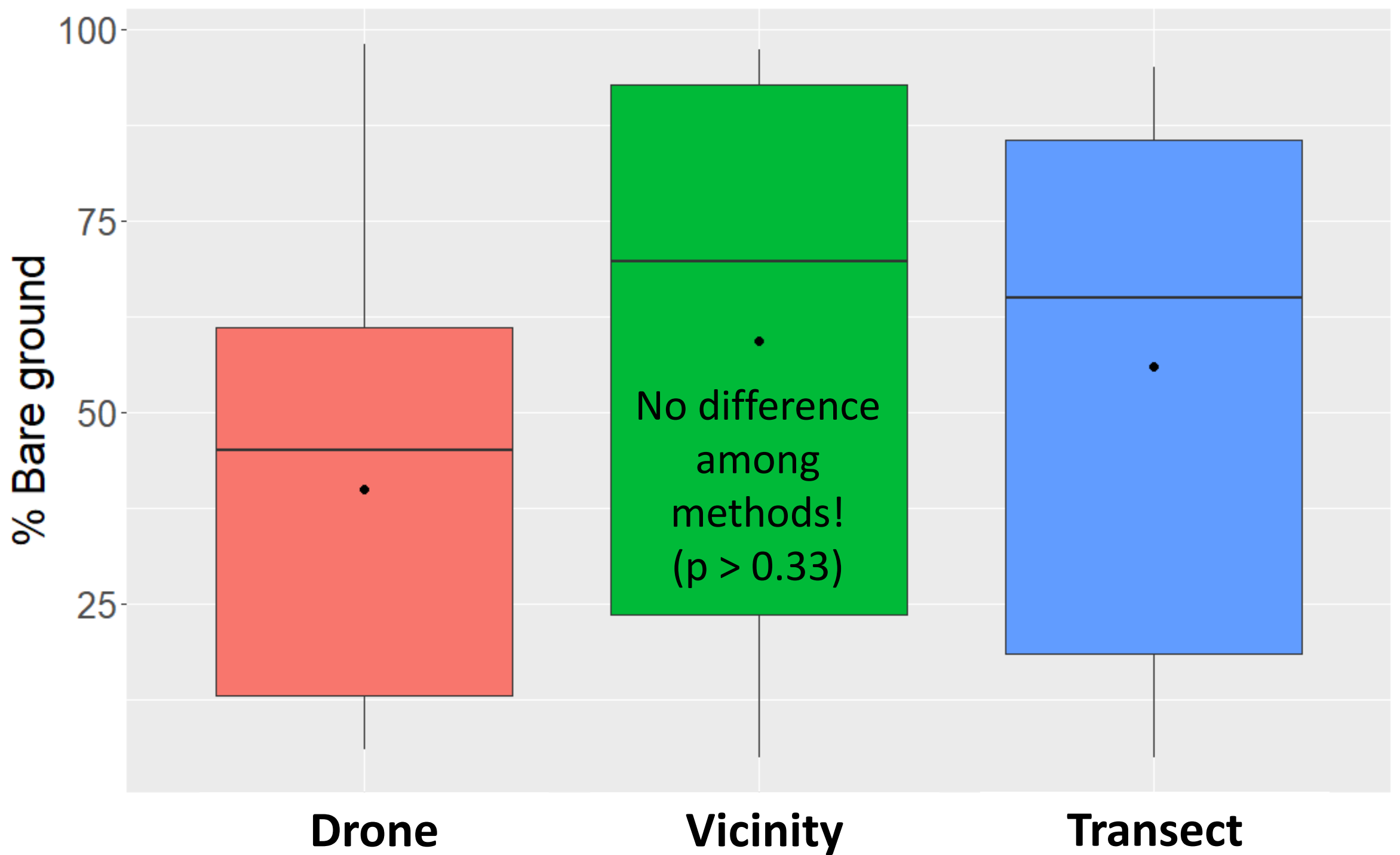
- Drone imagery
 - Bare ground, vegetation & water
- Visual estimates
 - Vicinity = 20 m radius
 - Transect = > 1 km walks
 - Categories
 - Bare ground
 - Grass
 - Forbs
 - Shrubs
 - Ranked flower abundance
 - Floral richness



Statistical models

- Generalized mixed effects model (glmmTMB)
- Used distribution that best fit data (beta)
- Multiple comparisons test to differentiate ≥ 3 levels (emmeans)
- Program R





Butterfly and bee surveys



Butterflies

- Measured length
- Counted individuals by group
- Usually flying
- Retained a representative for species identification



Bees

- Timed survey
- Counted individuals
- Netted individuals on flowers



Statistical models

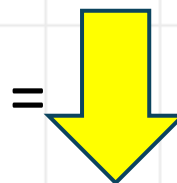
- Generalized additive mixed model
- Used distribution that best fit data
 - Negative binomial
 - Poisson
- Predicted relationship using ggpredict
- Program R



Predicted bee abundance



Bees



Grass



7.5

5.0

2.5

0

10

20

30

40

50

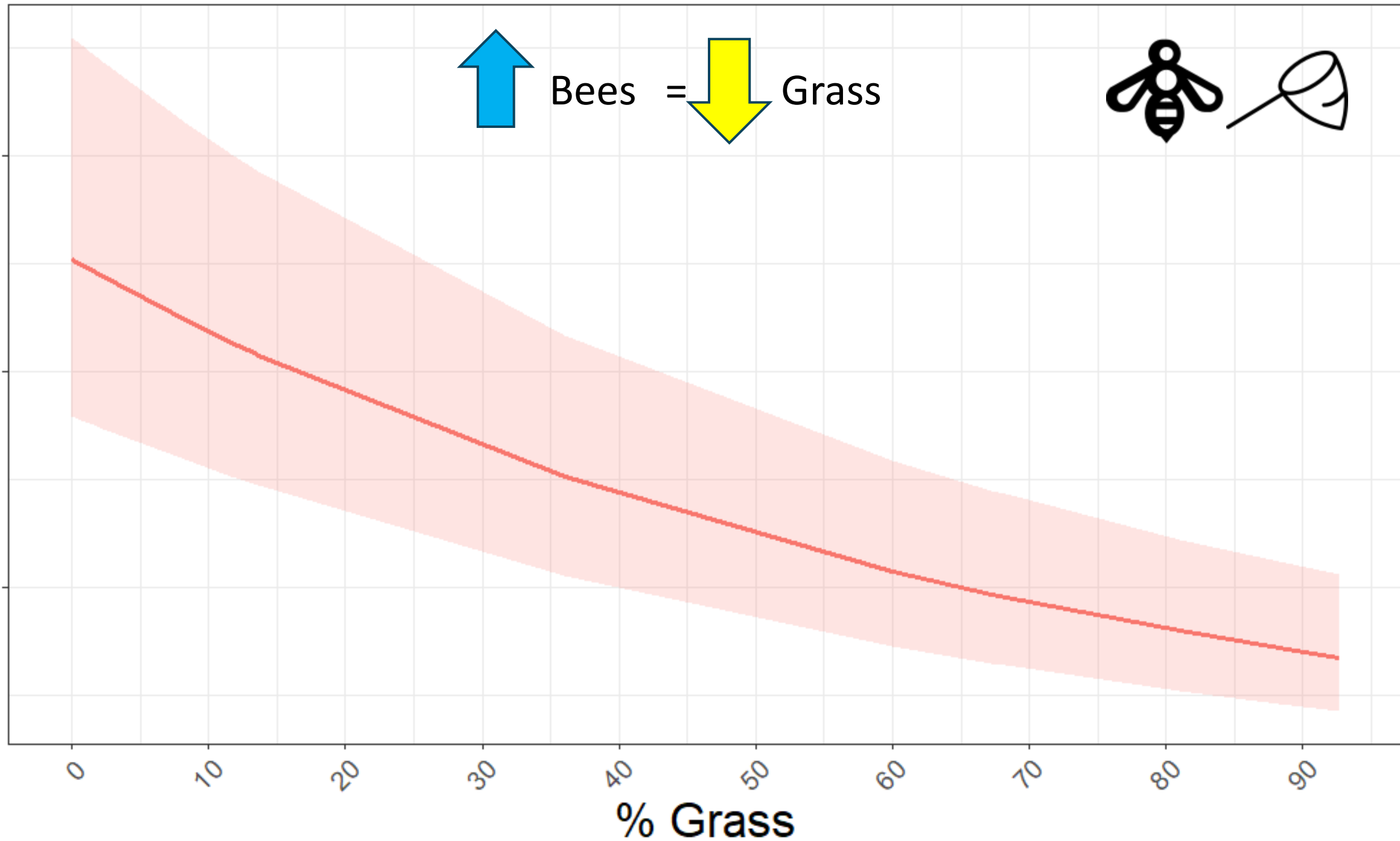
60

70

80

90

% Grass



Predicted bee abundance



Bees



Bare ground





Bees

=



% Cover of water



Predicted bee abundance

50
40
30
20
10

0.0

2.5

5.0

7.5

10.0

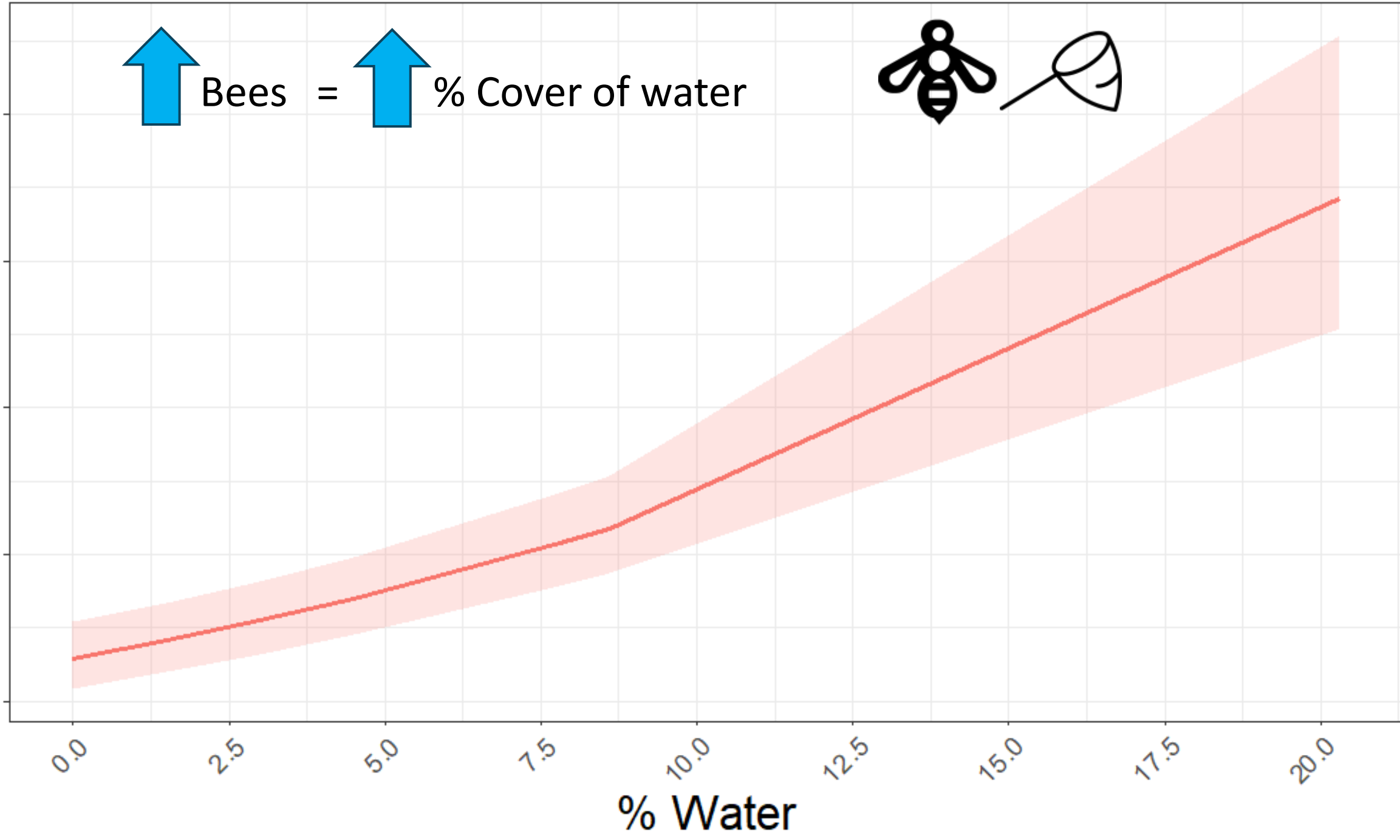
12.5

15.0

17.5

20.0

% Water



Predicted bee abundance



Bees

=



Flower richness



Flower richness

40

30

20

10

0

0

1

2

3

4

5

6

7

0

10

20

30

40

A photograph of a rocky, sloping hillside covered with numerous bright yellow wildflowers. Two orange and black patterned butterflies are visible: one in the upper left and another in the lower center, both perched on the flowers. The background shows dark, crumbly soil and some dry, thin branches. The word "Butterflies" is written in white text on the right side of the image.

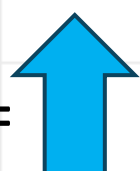
Butterflies

Predicted butterfly abundance



Butterflies

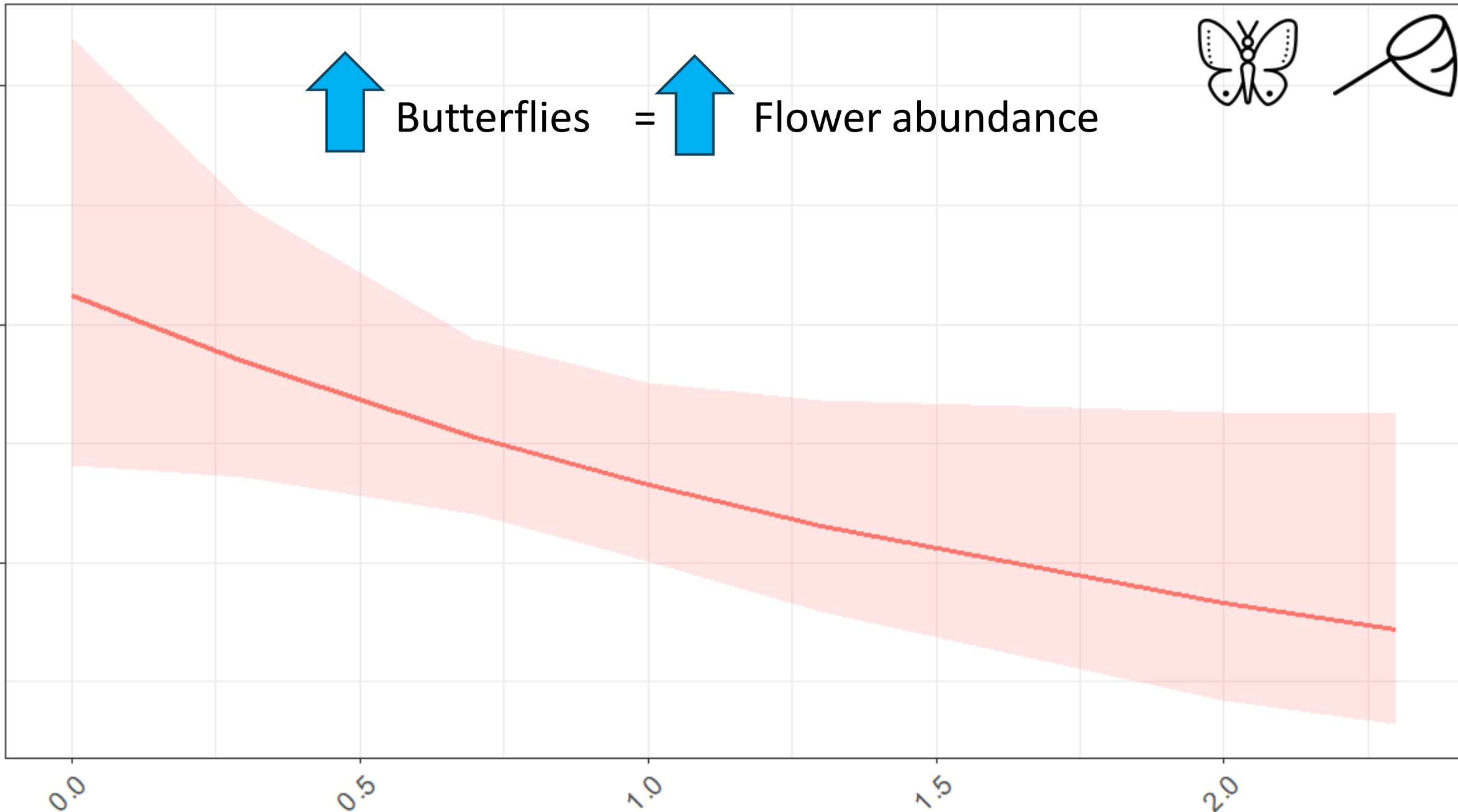
=

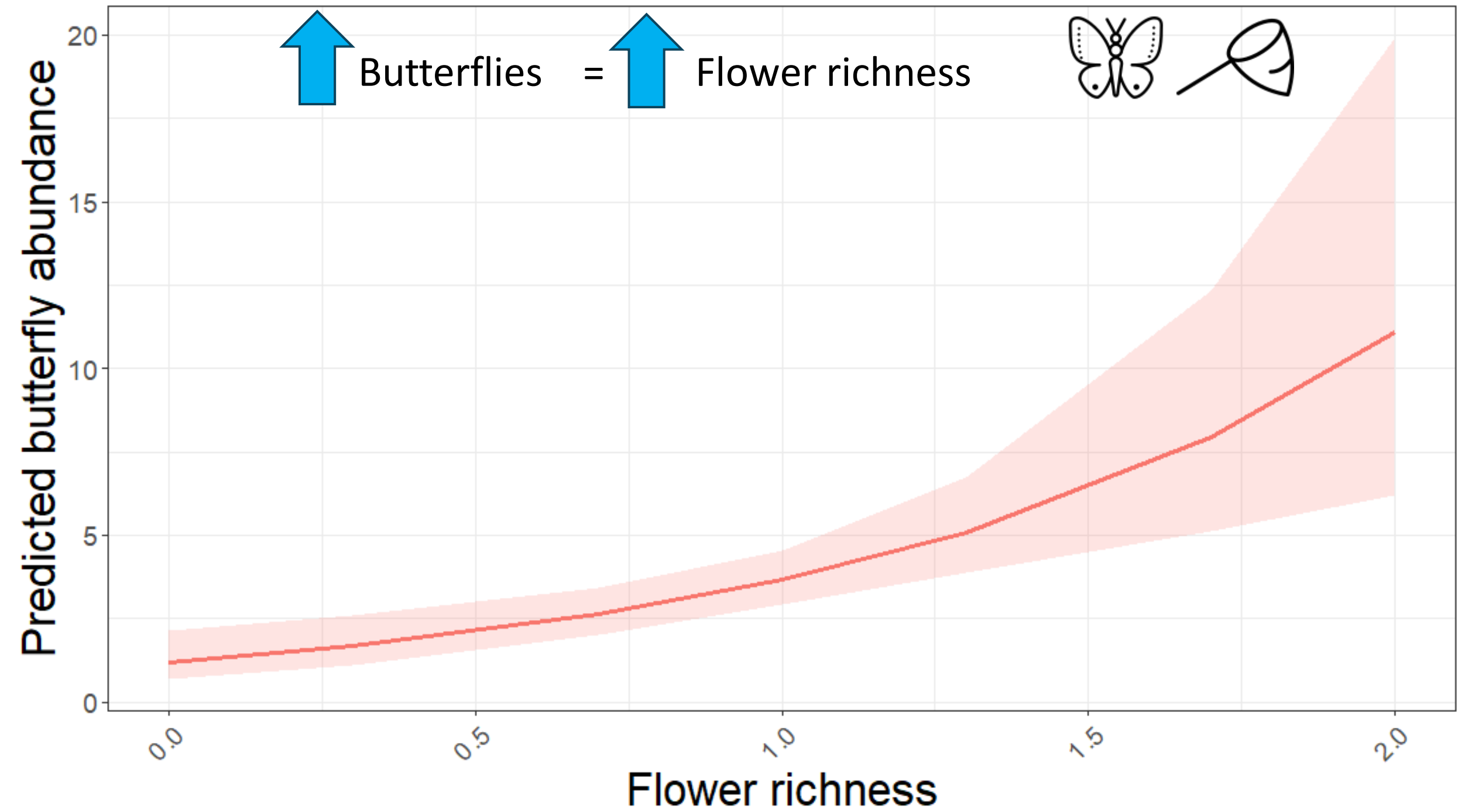


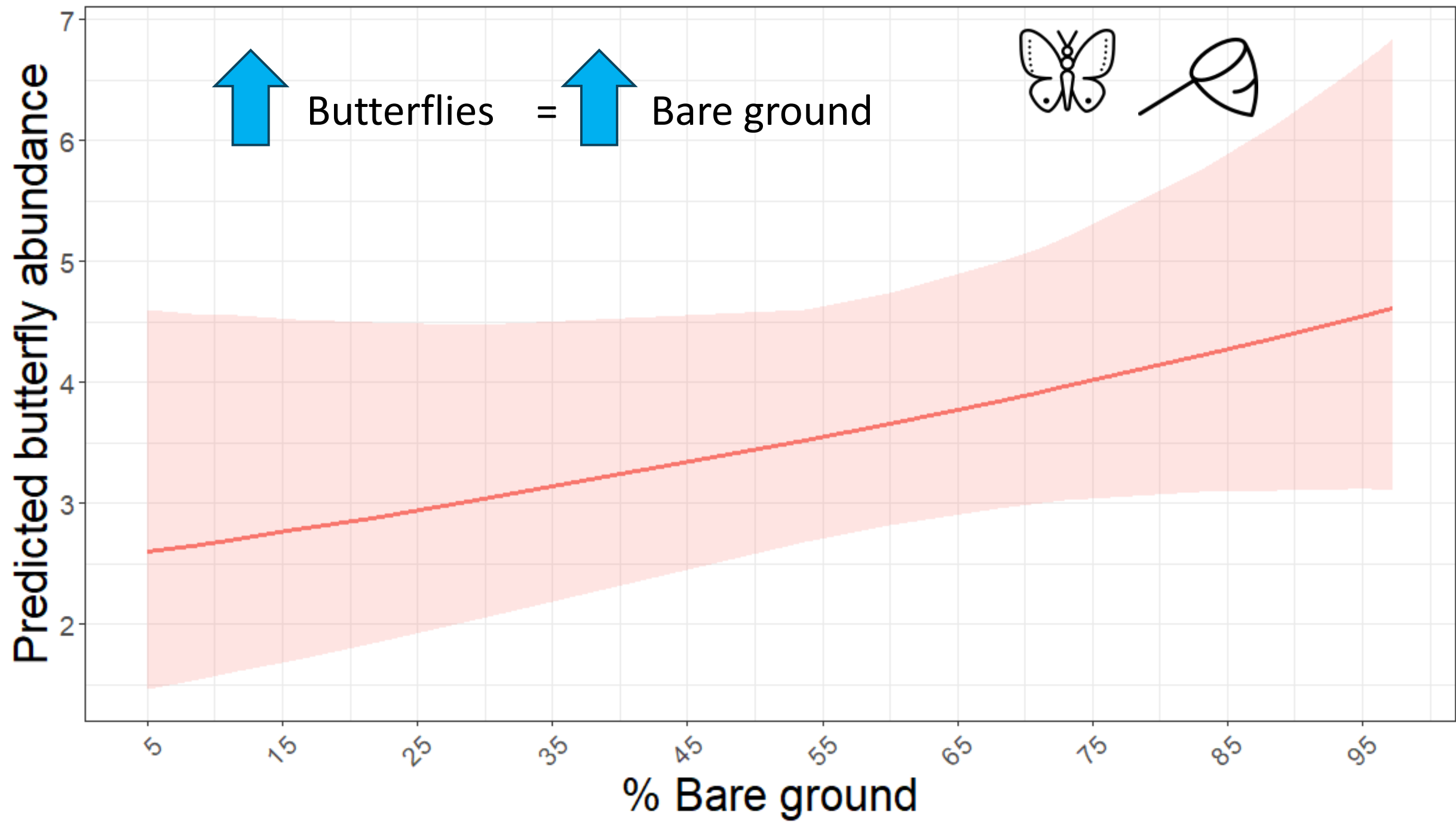
Flower abundance



Flower abundance









Butterflies

=



% Water



Predicted butterfly abundance

10

5

0

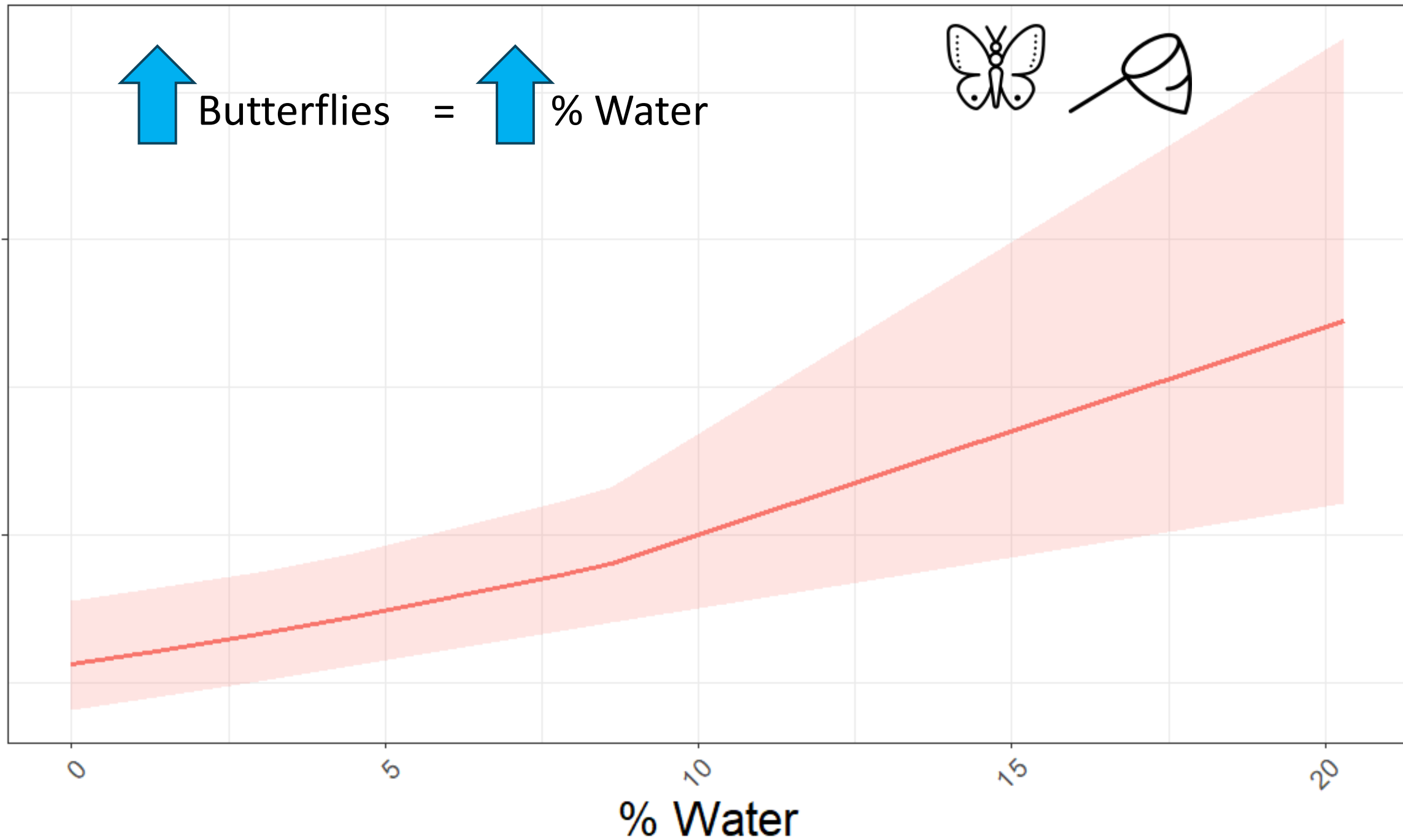
5

10

15

20

% Water



Passive sampling with vane traps

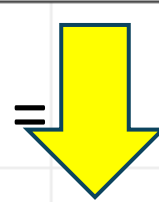
- Function as a flower
- No attractants
- No preservatives
- Can use non-lethally
- Deployed for <48 hours
- Used 5 basin colors
- Calculate bees/day



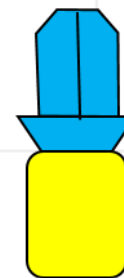
Predicted bees/day



Bees



Flower abundance



30

20

10

0

0.0

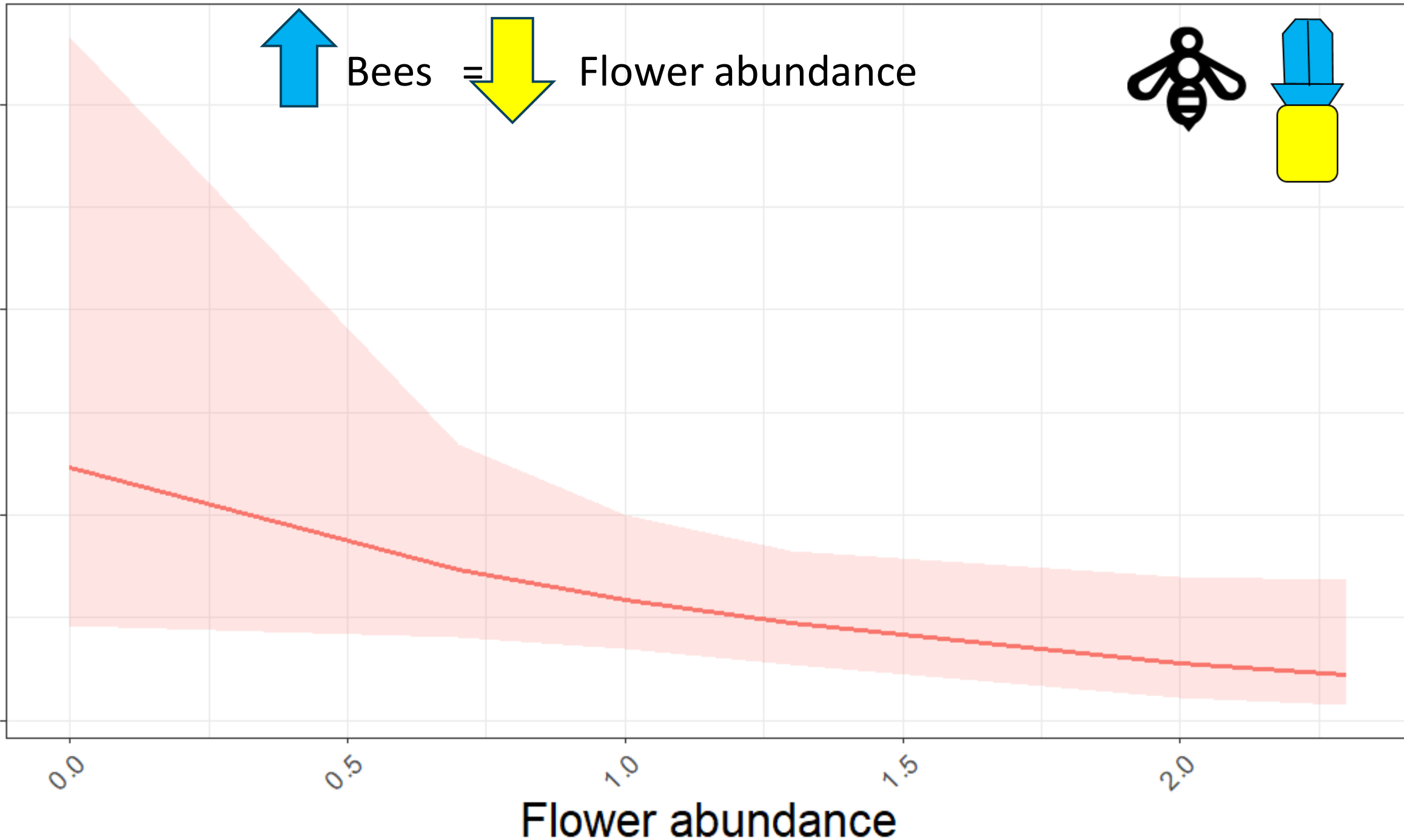
0.5

1.0

1.5

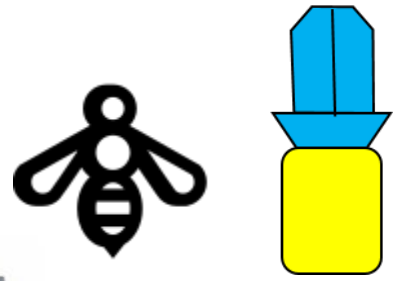
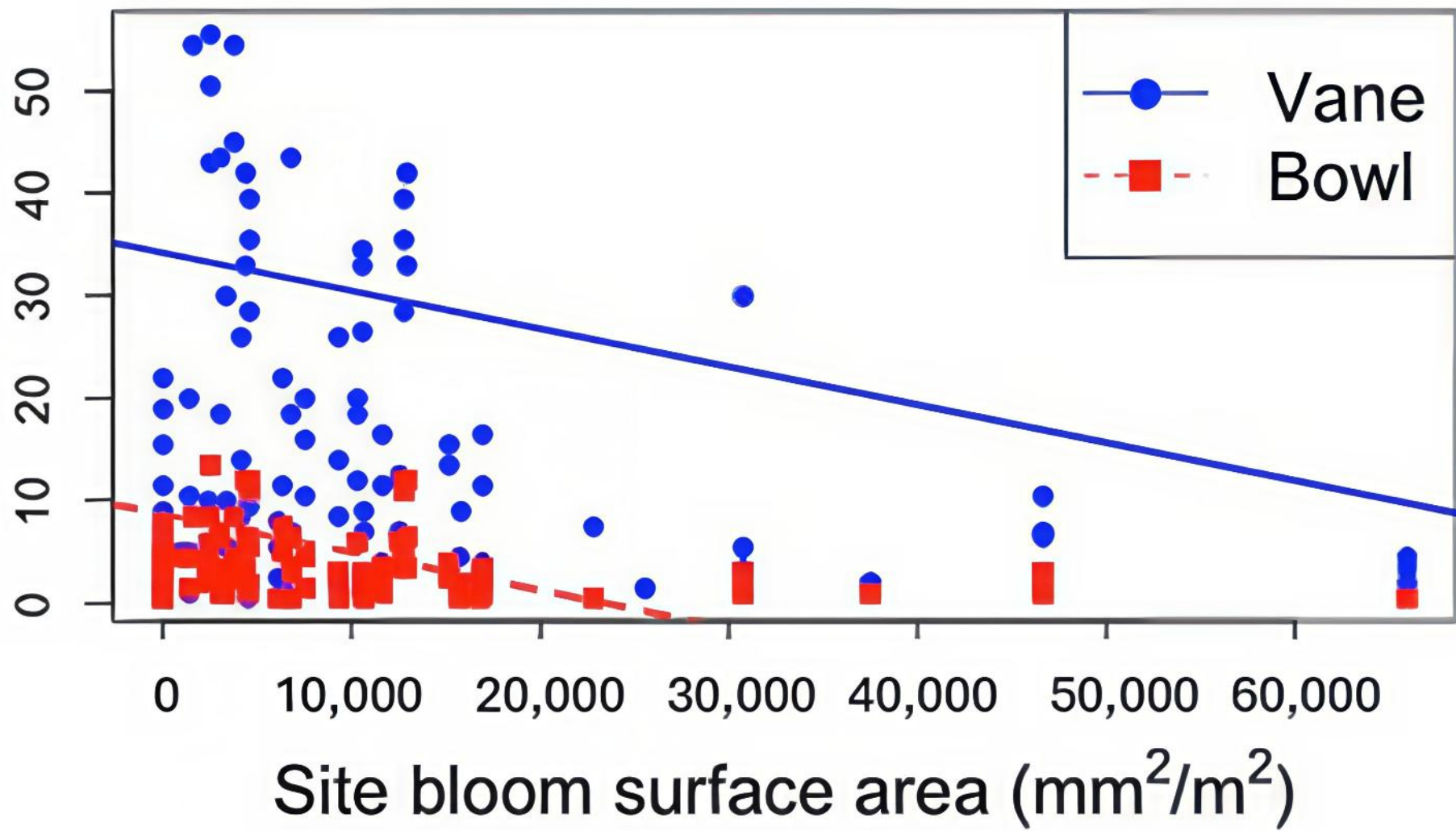
2.0

Flower abundance



Bee abundance (indiv/day)

a



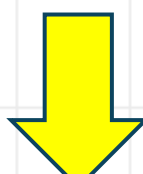
From Mazur et al. 2025

Predicted bees/day

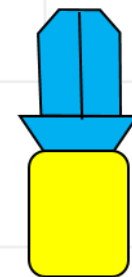


Bees

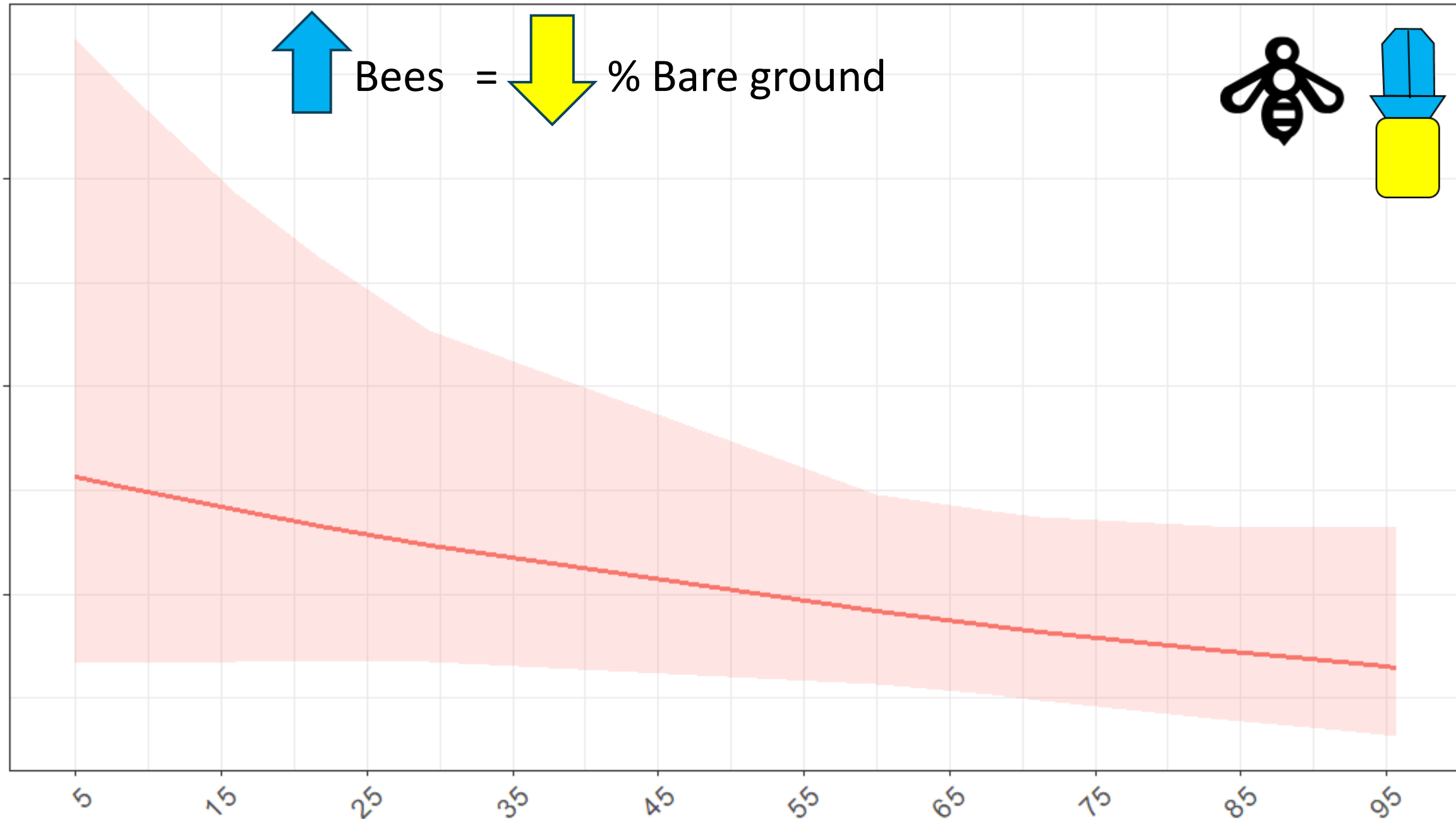
=



% Bare ground



% Bareground

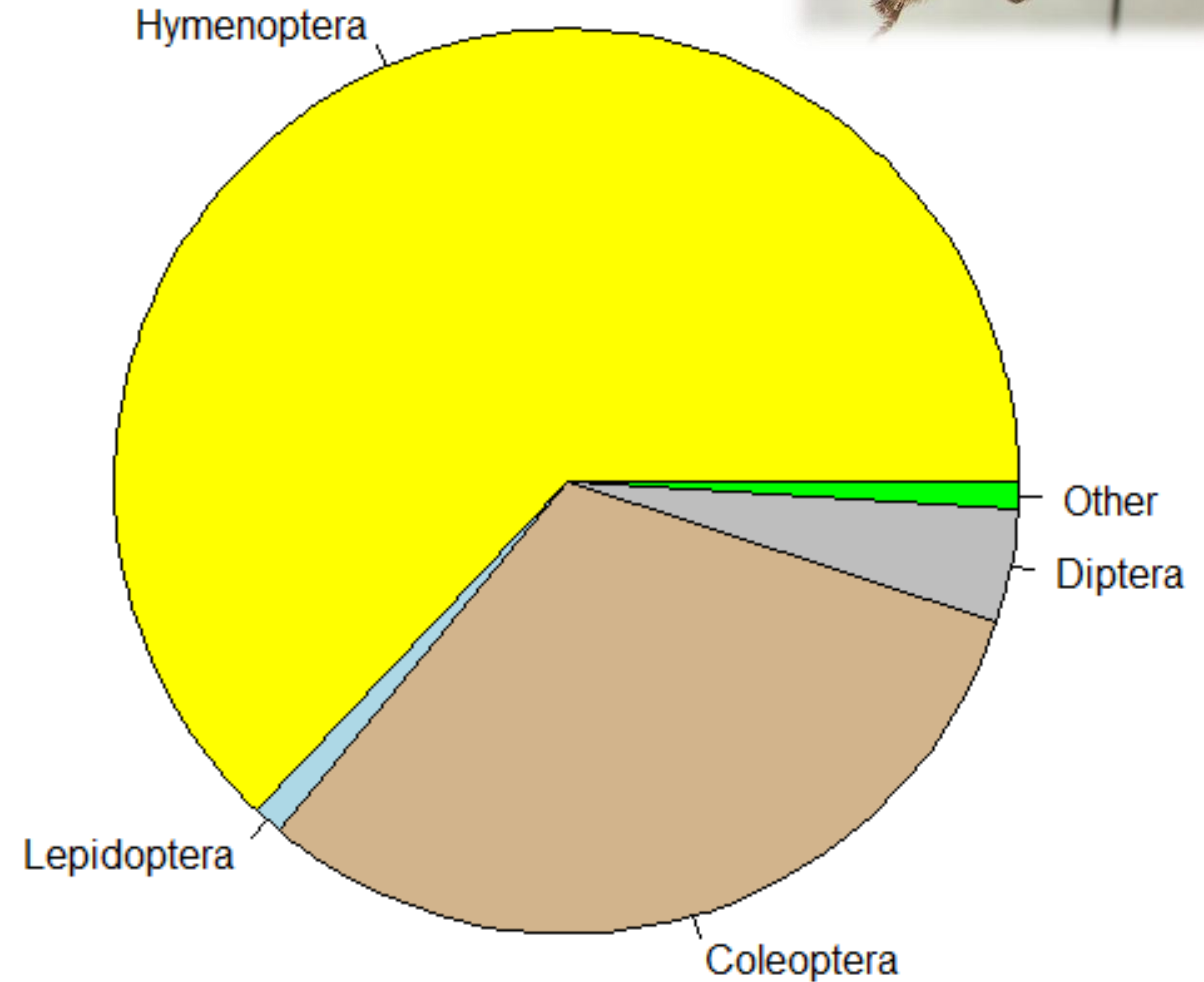


- Pollinators are using an inactive bentonite mine
- Often high densities on scarce flowers
- Vane traps results in 4x more observations
- Habitat characteristics affected catch differently between active and passive methods



Total catch among methods

- **85 taxa total**
- Bees = 20 genera and 47 species
- Butterflies = 9 species
- Other = spiders, Neuroptera, Orthoptera and Hemiptera



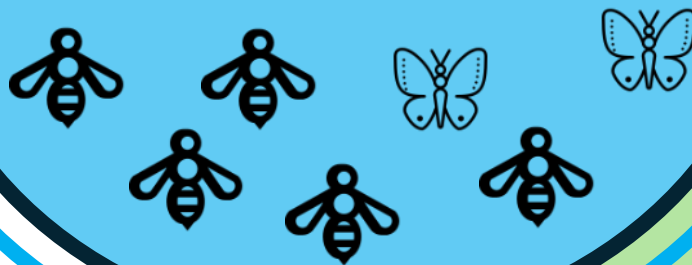


Agapostemon coloradinus
female

Vane traps



66 pollinator taxa
47 bee taxa
2 butterfly species



Bee transects

12 bee taxa



9 butterfly species

Butterfly transects



Melissodes agilis
female

A close-up photograph of a Bombus occidentalis specimen, showing its dark, fuzzy body, yellow and black striped abdomen, and transparent wings. It is mounted on a black pin.

*Bombus
occidentalis*

A close-up photograph of a Bombus pensylvanicus specimen, showing its dark, fuzzy body, yellow and black striped abdomen, and transparent wings. It is mounted on a black pin.

*Bombus
pensylvanicus*

**We're being considered
for federal protection**

**Observed in our
surveys!**

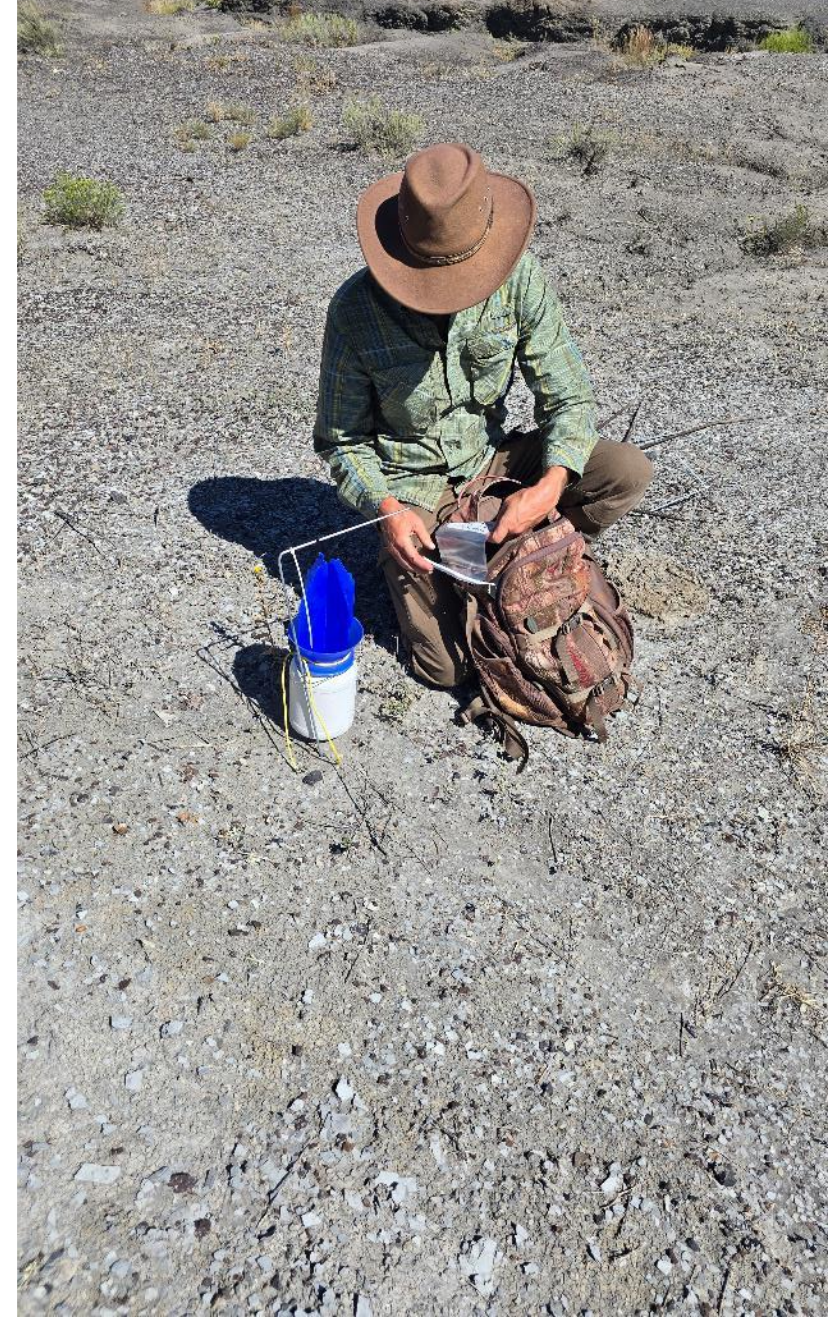
**Only in
vane traps**



- Should not assume pollinators are scarce or absent in areas with high cover of bare ground or few flowers
- Abundant nesting habitat in mined area
- Floral resources (nectar and pollen) limiting!
- Successfully reclaimed lands can provide more resources for pollinators

Sampling Recommendations in areas with abundant bare ground

- **Bees:** deploy vane traps for short periods (<24 hours) and monitored closely
- **Butterflies:** walk transects and count flying individuals



Thanks for Bureau of Land
Management for funding



Thanks for Bureau of Land
Management for funding



Questions?