Insect pollination networks of central Alaskan native plants in the presence of invasive white sweetclover

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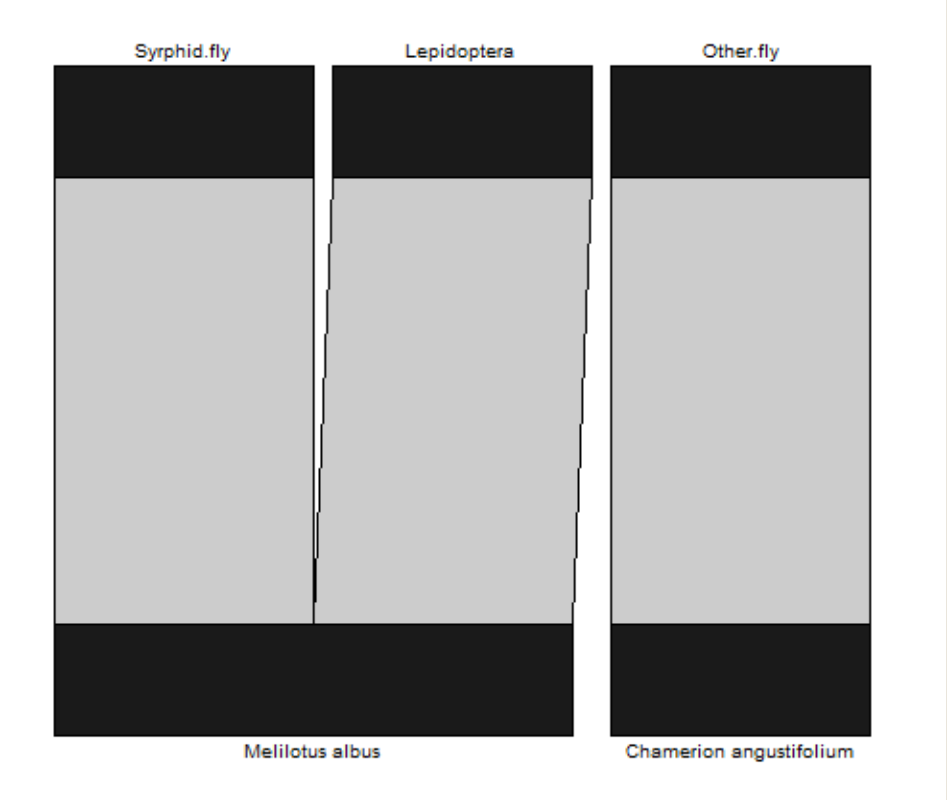
Boreal forest ecology

Boreal forest ecology

Boreal forest ecology

- Generalist plants
- Depend on a variety of pollinators

Network studies



Connectance:

Realized links/possible links

Links/Species:

Mean links/species

Cluster Coefficient:

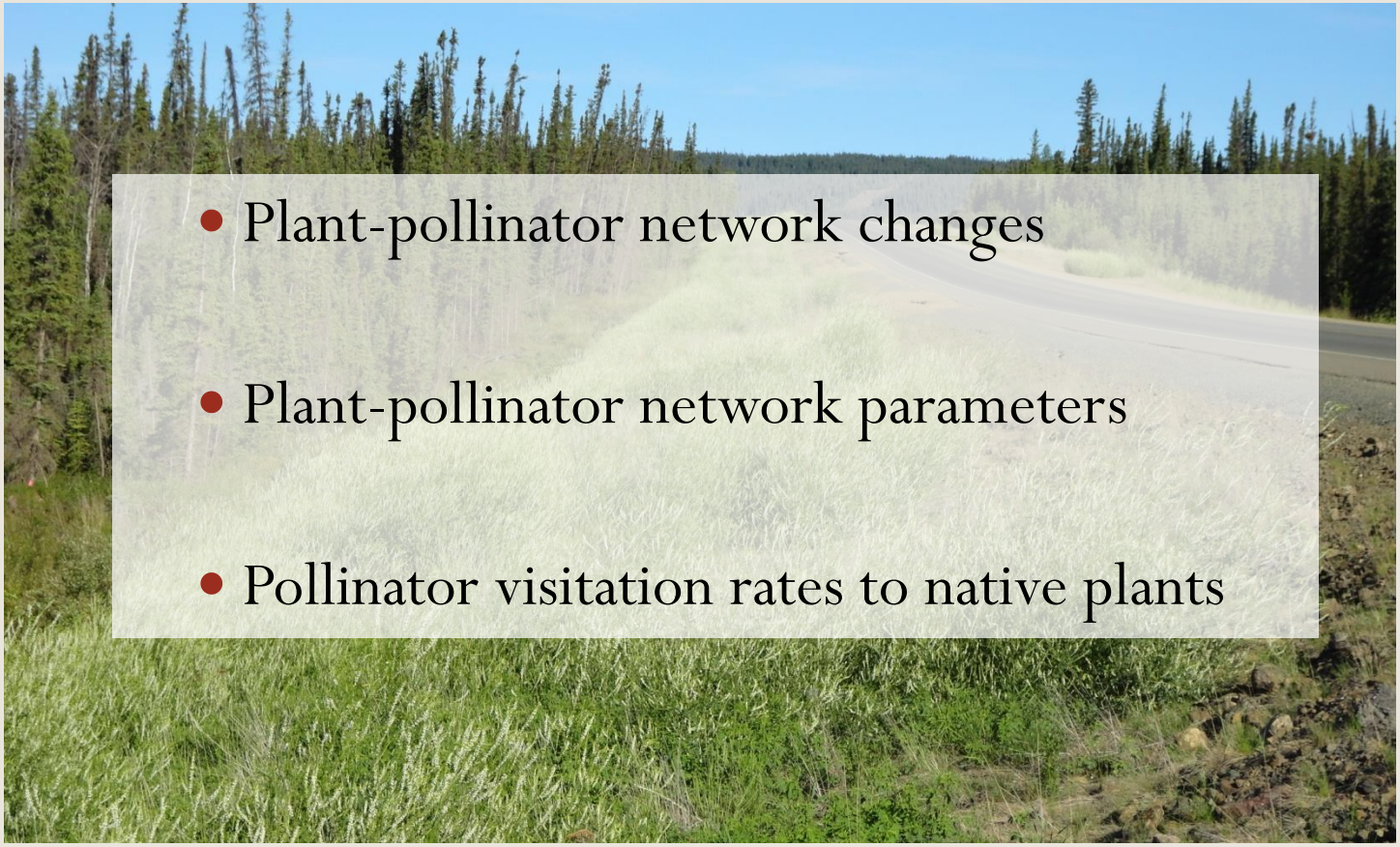
Average across network of realized links/possible links

Nestedness:

Measure of chaos in links (0 = perfectly nested, 100 = perfect chaos)

Plant-pollinator network question

- How does the plant-pollinator network change in boreal Alaska with the invasion of *M. albus*?

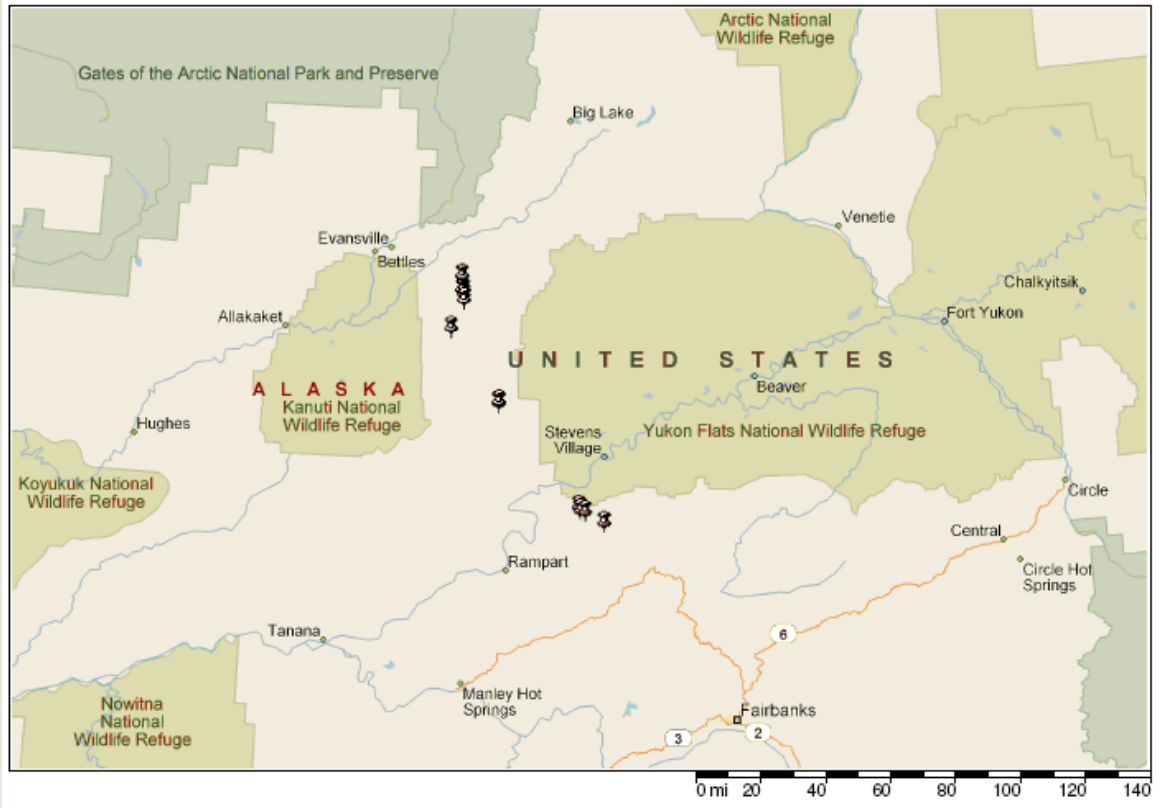


Predictions

- The native plant-pollinator networks will be less connected, with lower nestedness and fewer connections per node, in the presence of *M. albus*
- Pollinator visitation rates to native plants will decrease in the presence of *M. albus*

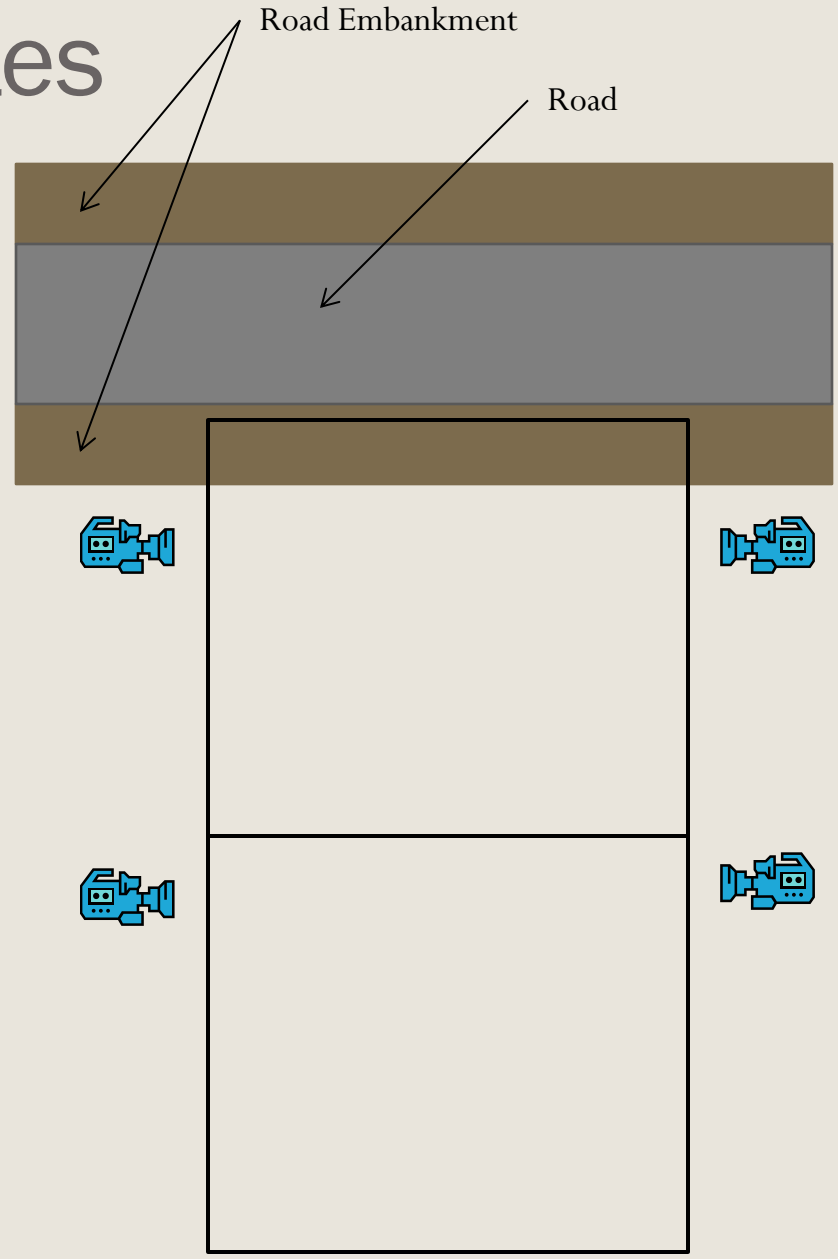
Unmanipulated Sites

- 10 site-pairs on the Dalton Highway
- One *M. albus* site and one non-*M. albus* site in each site-pair, approximately 300 m apart



Unmanipulated Sites

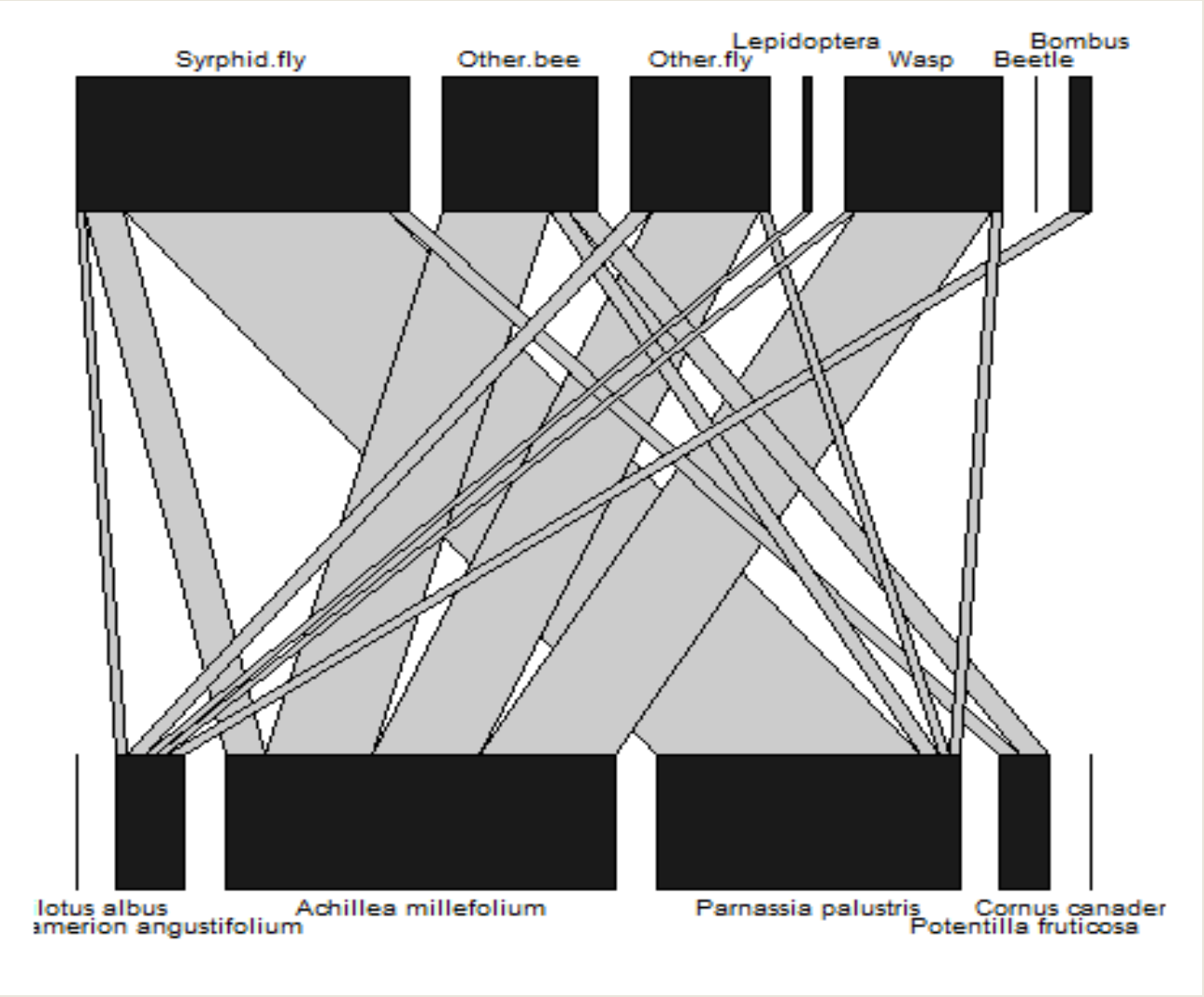
- 2 plots, roadside and non-roadside 10 m x 10 m each
- Video Cameras:
  - 4 Cameras
  - 30 minutes per video
  - 2 videos/site/camera



Video camera sample

Unmanipulated Sites

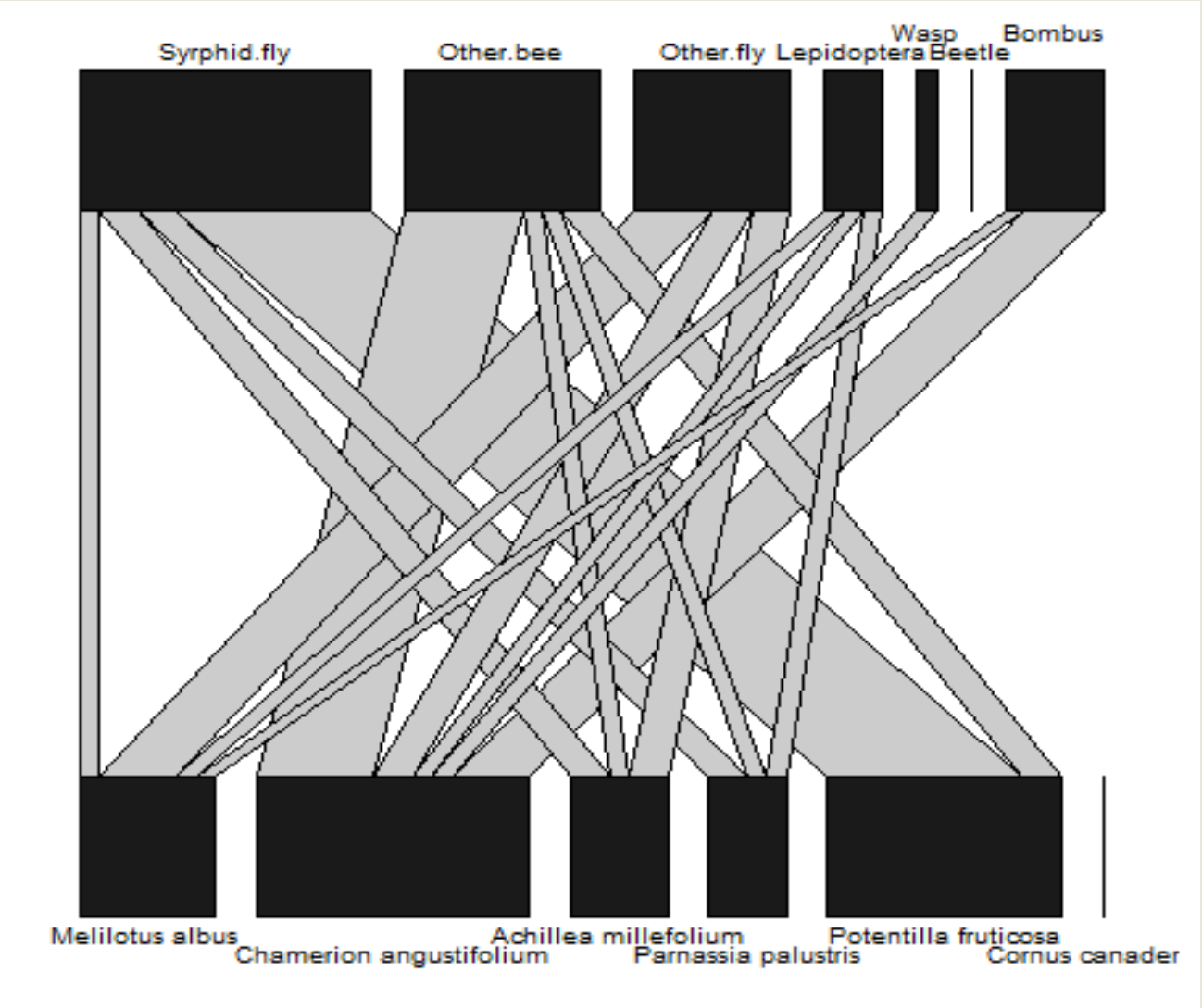
Unmanipulated site network (without *M. albus*)



Video observations of sites without *M. albus*:

C = 0.429
L/S = 1.250
CC = 0.600
N = 7.752

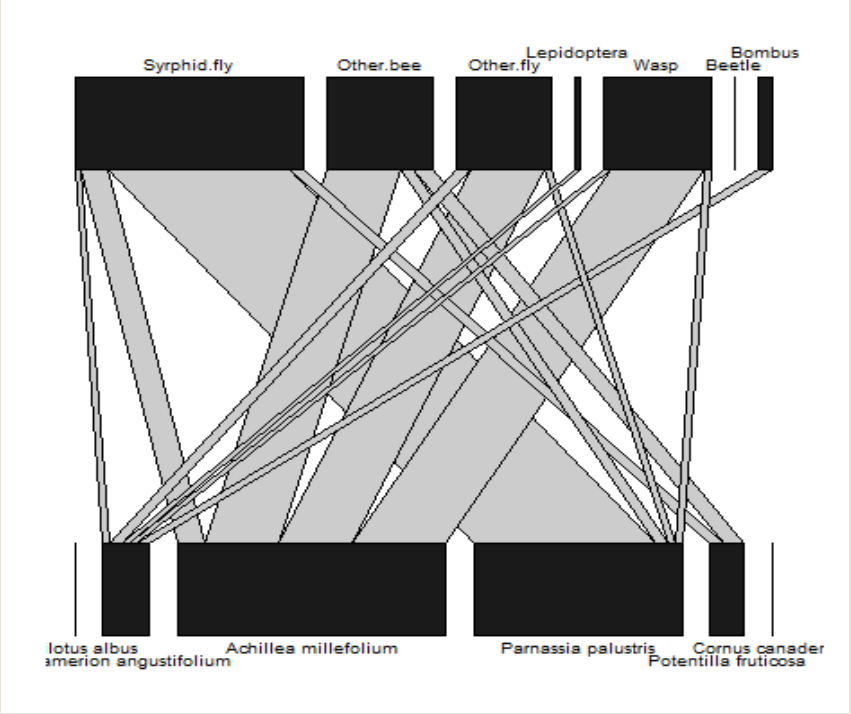
Unmanipulated site network (with *M. albus*)



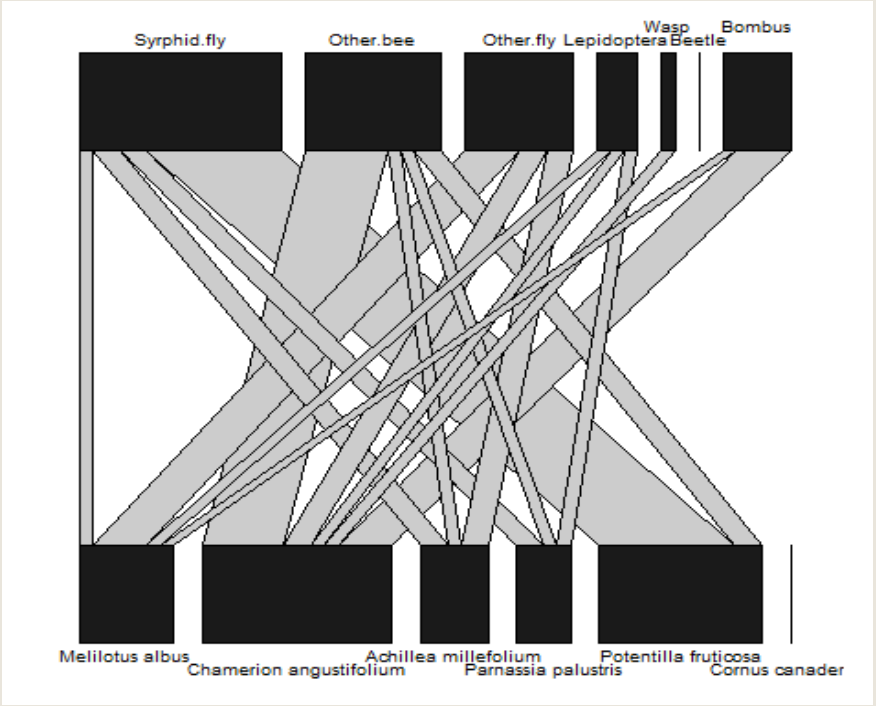
Video observations of sites with *M. albus*:

C = 0.404
L/S = 1.307
CC = 0.500
N = 10.588

Network parameters
Unmanipulated sites



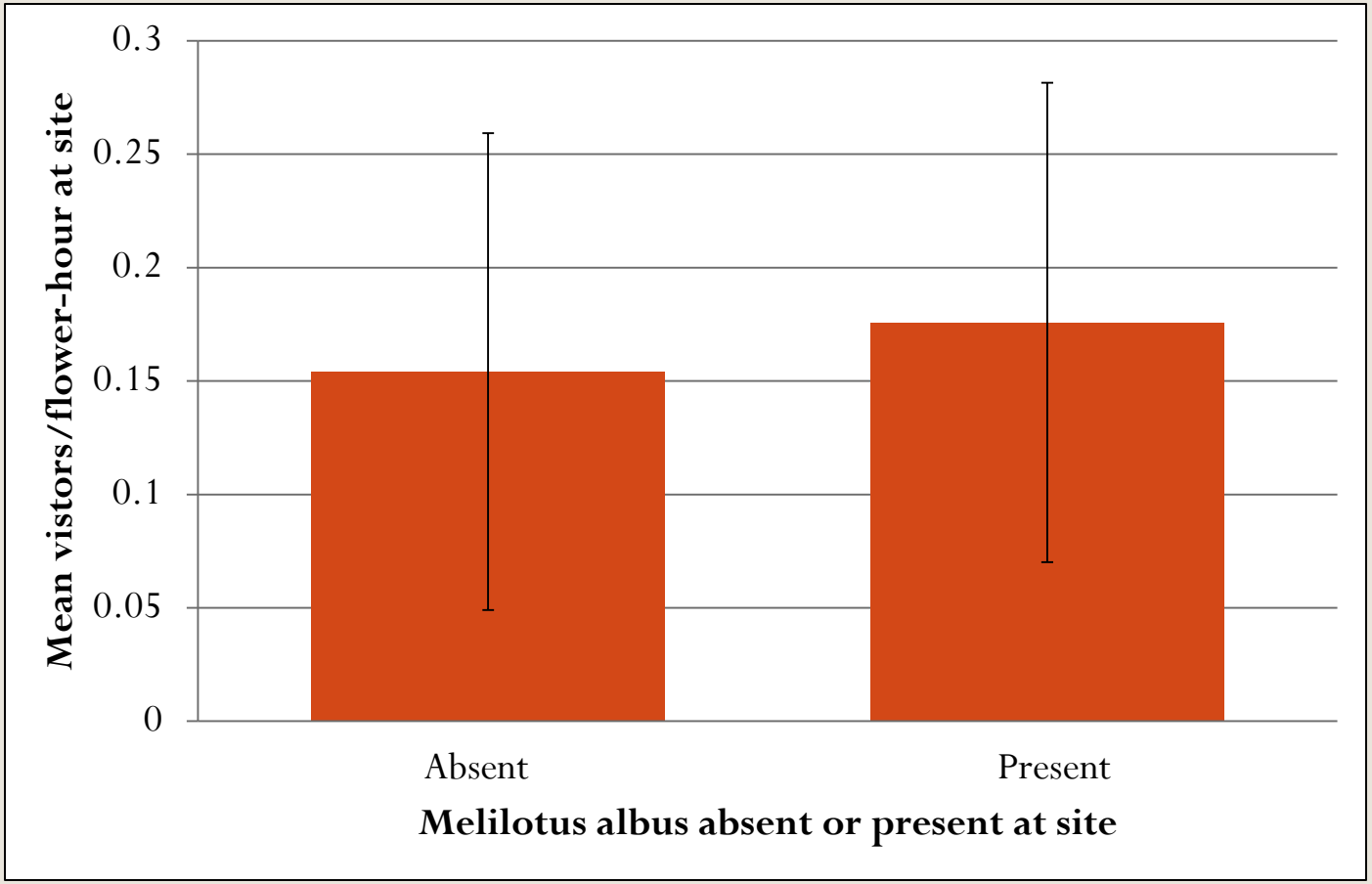
Video observations of sites without *M. albus* (C = 0.429, L/S = 1.250, CC = 0.600, N = 7.752)



Video observations of sites with *M. albus* (C = 0.404, L/S = 1.308, CC = 0.500, N = 10.588)

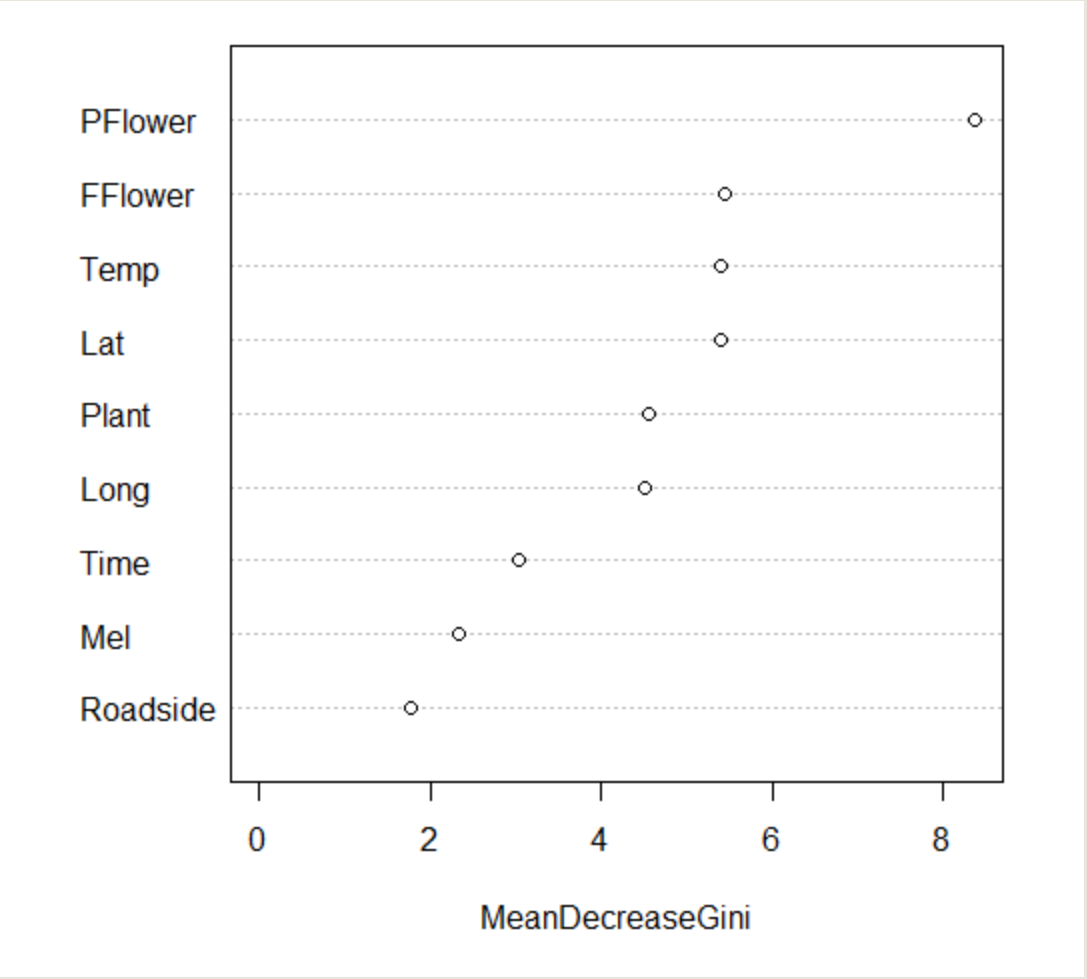
(*M. albus* removed from calculations: C = 0.371, L/S = 1.083, CC = 0.400, N = 6.459)

Pollinator visitation rates Unmanipulated sites



Pollinator visitation rates to native plants at unmanipulated sites with and without *M. albus* present. Error bars = +/- 1 S.E. (1 Outlier removed)

Variables that influence pollinator visitation at unmanipulated sites



Variable importance plot of variables influencing likelihood of visitation at experimental sites.

Key to variables

Pflower: Number of flowers in 1 m^2 plot around camera

Fflower: Number of flowers in camera frame

Temp: Air temperature

Lat: Site latitude

Plant: Focal plant species

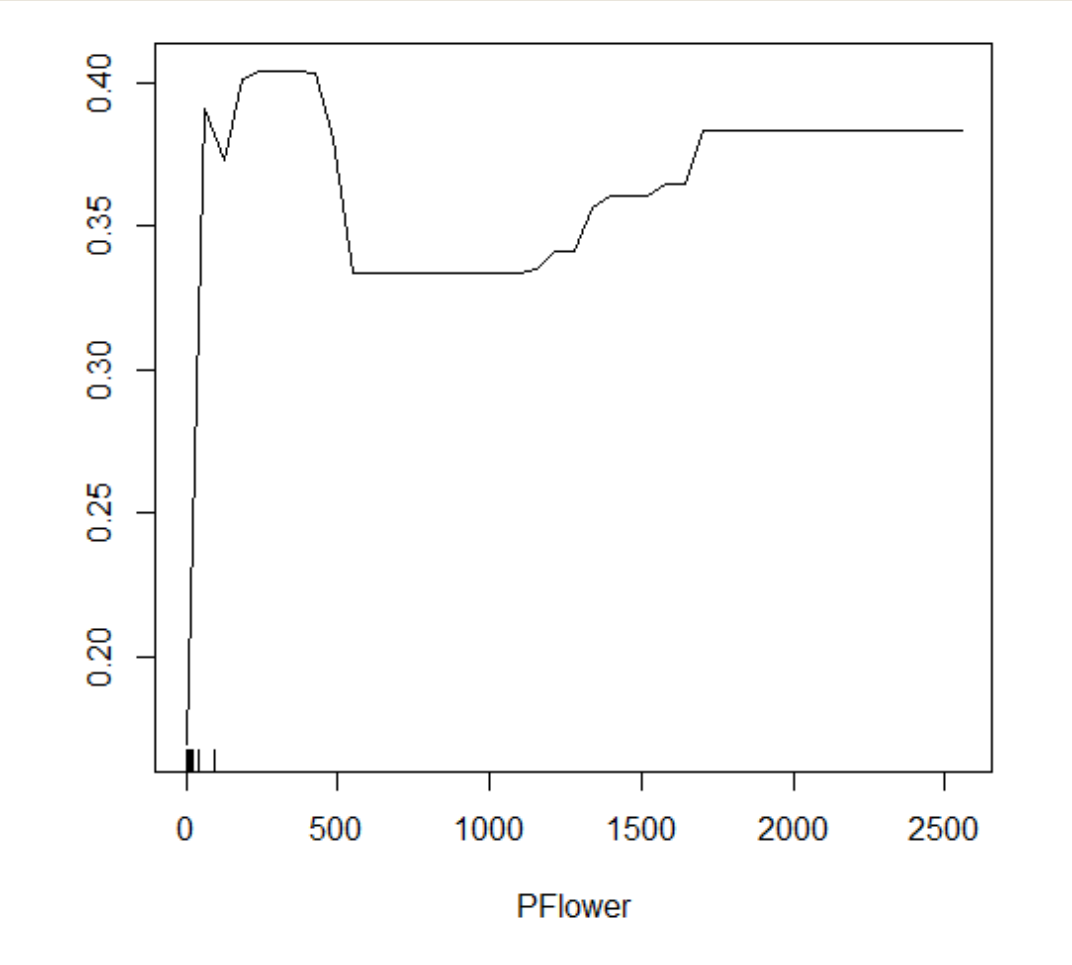
Long: Site longitude

Time: Time of day

Mel: *M. albus* patch size

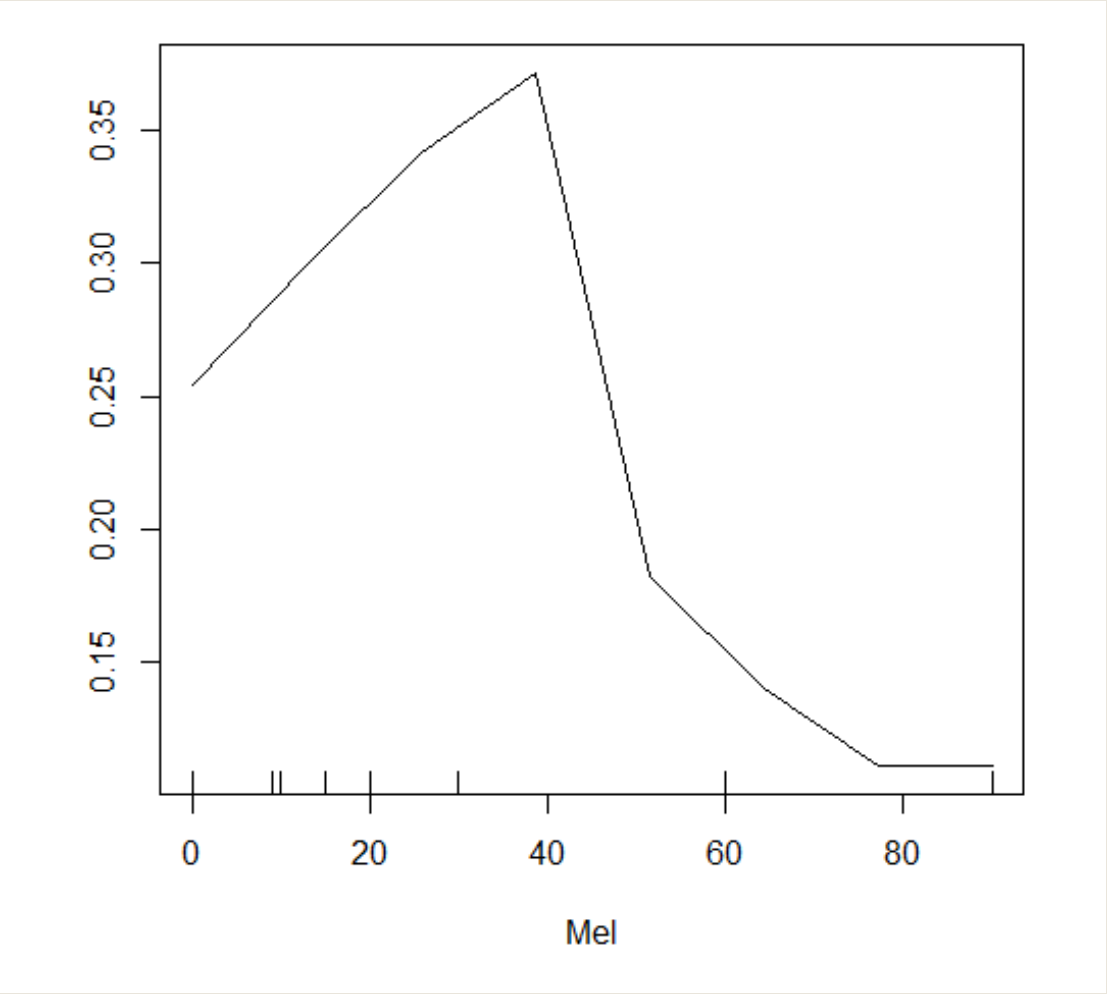
Roadside: Camera distance from road edge (0 m or 10 m)

How do the individual variables influence pollinator visitation?



Partial dependence plot of the influence of number of flowers in a 1 m^2 plot around camera on likelihood of pollinator visitation to native plants at unmanipulated sites.

How do the individual variables influence pollinator visitation?



Partial dependence plot of the influence of *M.albus* patch size on likelihood of pollinator visitation to native plants at unmanipulated sites.

Insect families collected during observations (unmanipulated sites)

	M. Albus present	*M. Albus* absent
Apidae		X
Apidae - *Bombus*	X	X
Megachilidae	X	X
Vespidae	X	
Bombyliidae	X	X
Calliphoridae	X	
Muscidae	X	
Sarcophagidae	X	
Syrphidae	X	X
Tachinidae	X	
Lepidoptera	X	X

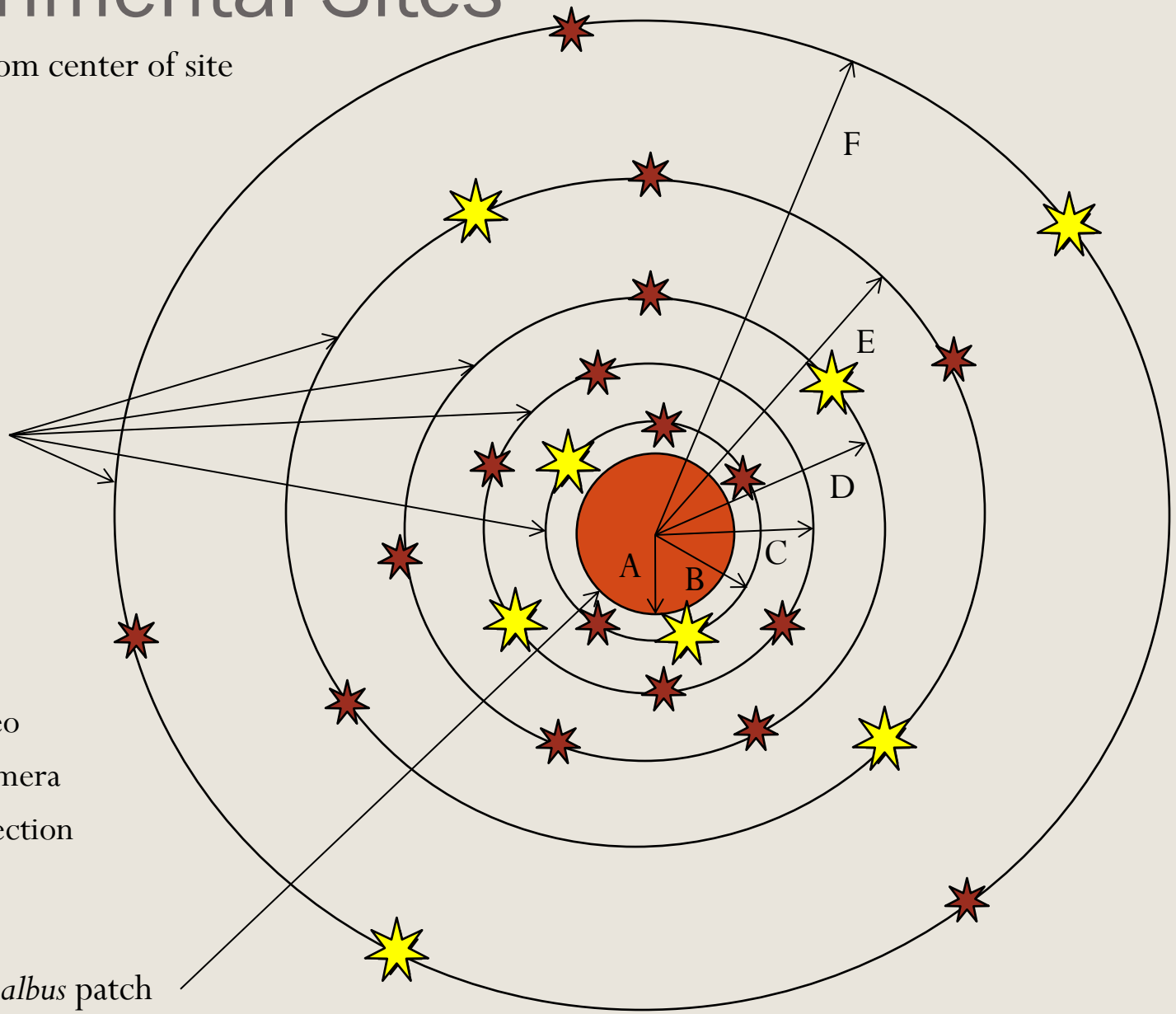
Experimental sites

- Location
  - Bonanza Creek Experimental Forest
  - Caribou-Poker Creeks Research Watershed
- 8 sites
  - 4 control sites
  - 4 *M. albus* addition sites
    - Added approximately 40 greenhouse-grown white sweetclover plants in a 2 m diameter patch in center of site in *M. albus* sites

Experimental Sites

Distance of orbit from center of site

A. 1 m
B. 1-2 m
C. 3-5 m
D. 8-10 m
E. 15-20 m
F. >25 m

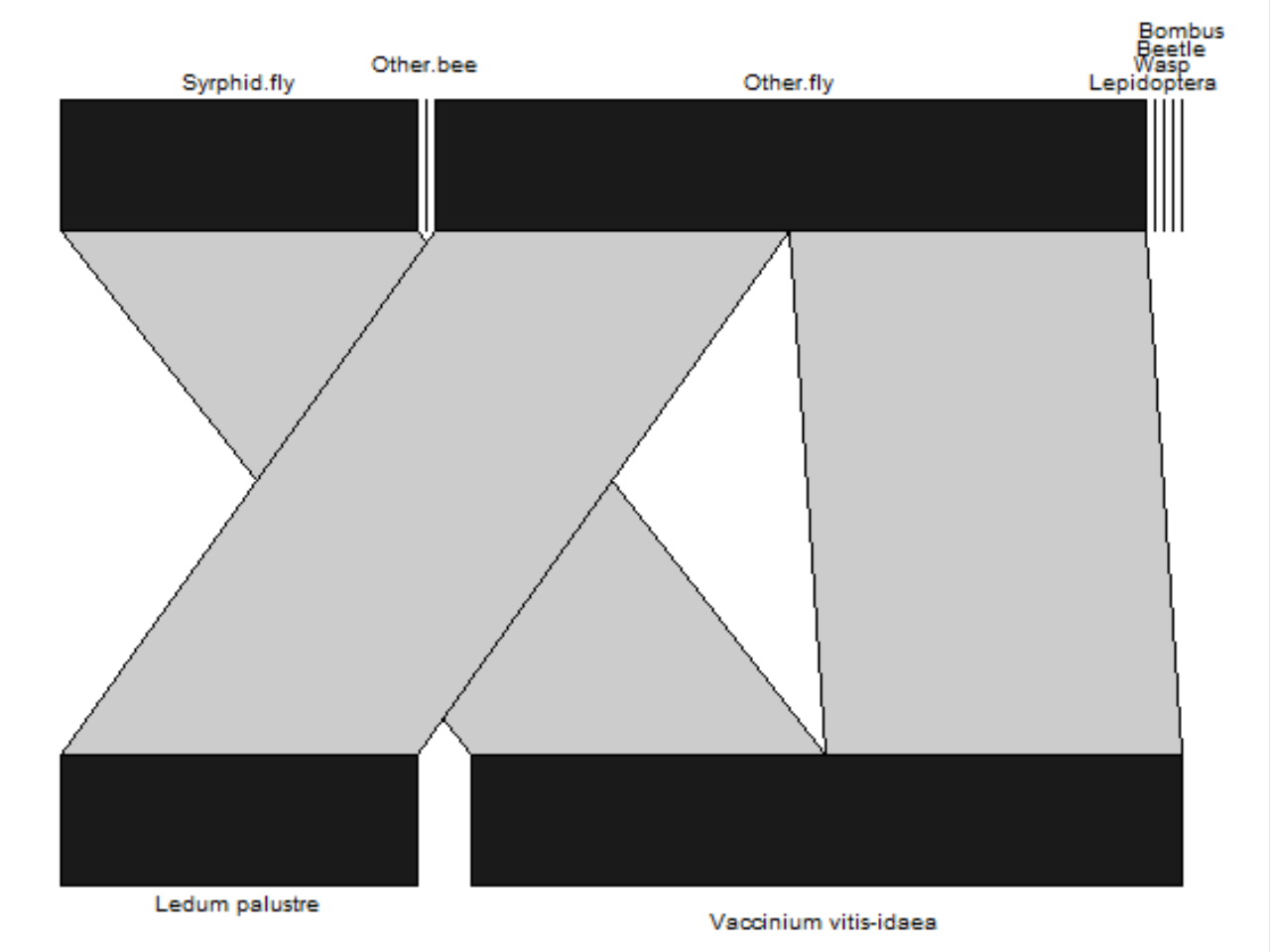


Video Cameras:

- 4 Cameras
- 30 minutes /video
- 2 videos/site/camera
- Random plot selection

Experimental Sites

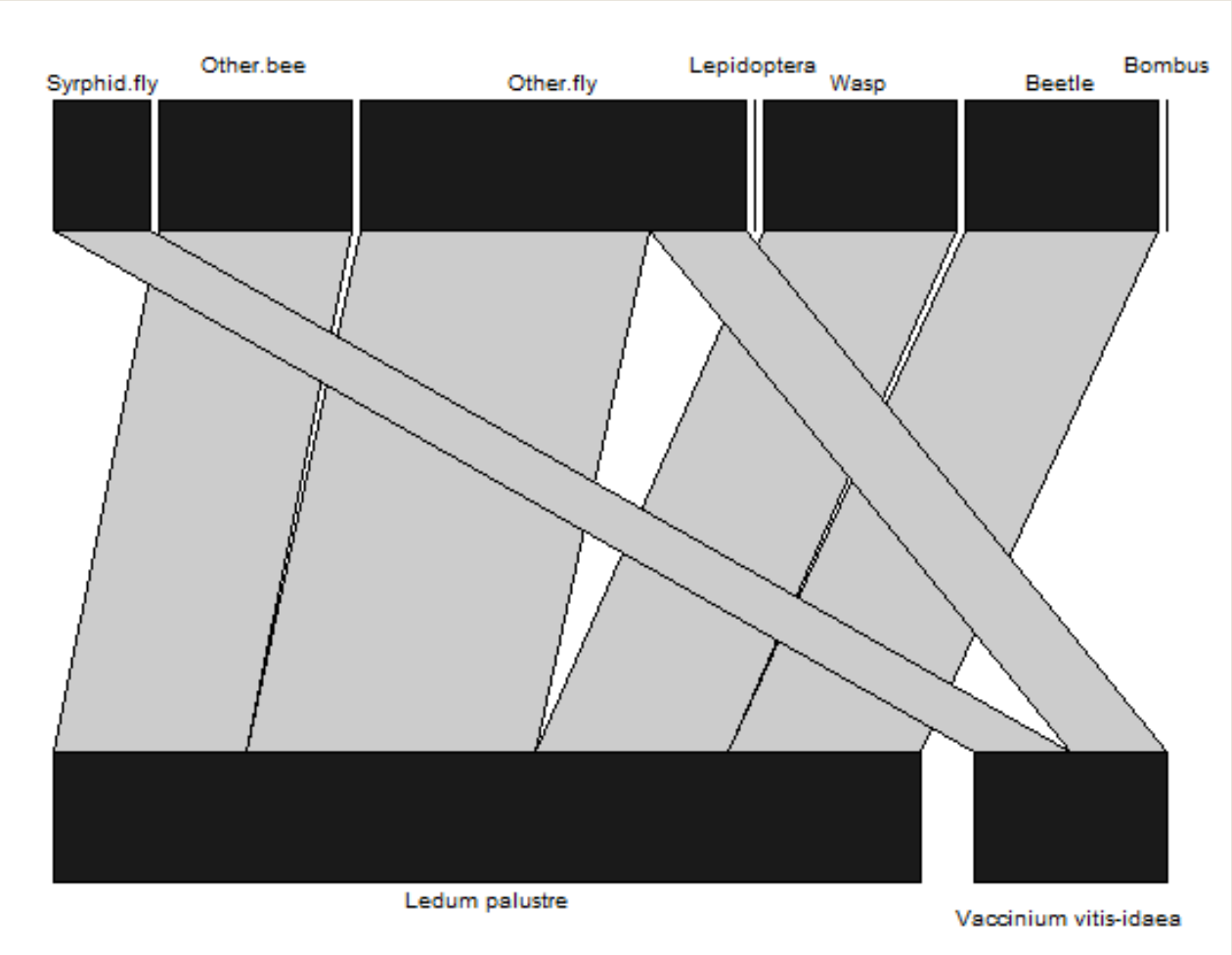
Plant-pollinator network
Control sites



Video observations of sites without added *M. albus*

C = 0.214
L/S = 0.333
CC = 0.000
N = 1.626)

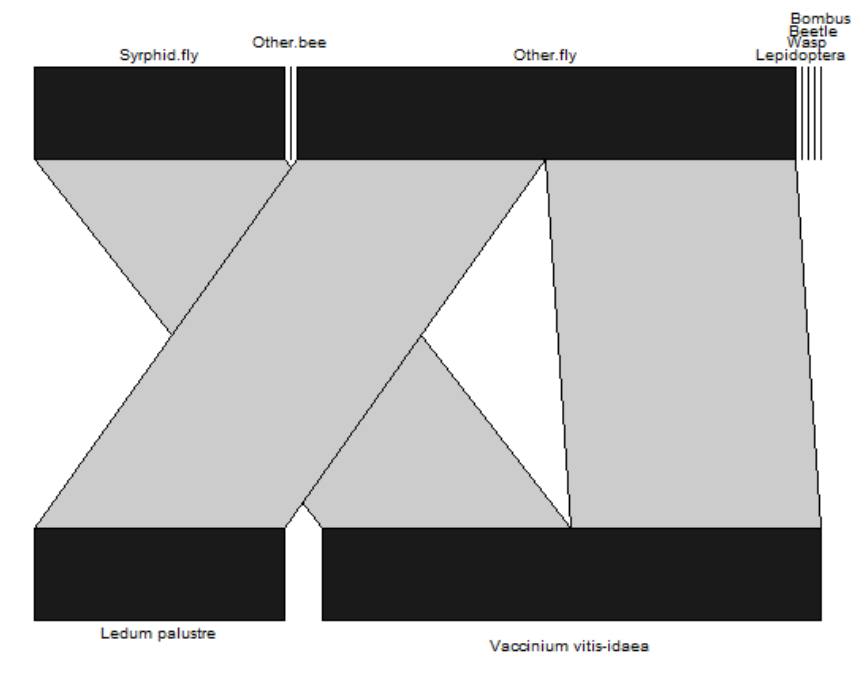
Plant-pollinator network *M.albus* addition sites



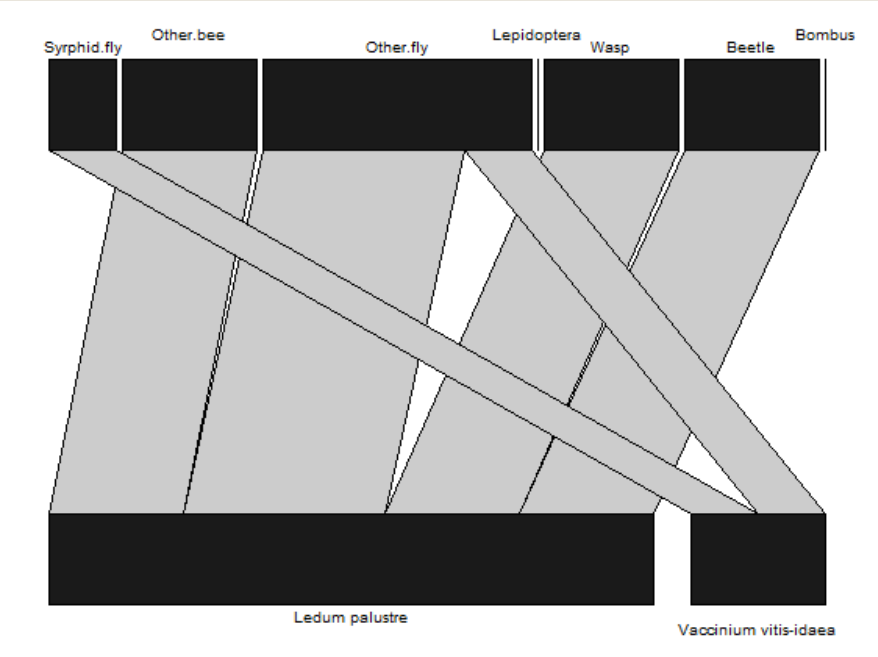
Video observations of sites with added *M. albus*. (Calculations without *M. albus*.)

C = 0.423
L/S = 0.667
CC = 0.500
N = 9.181)

Network parameters
Experimental sites

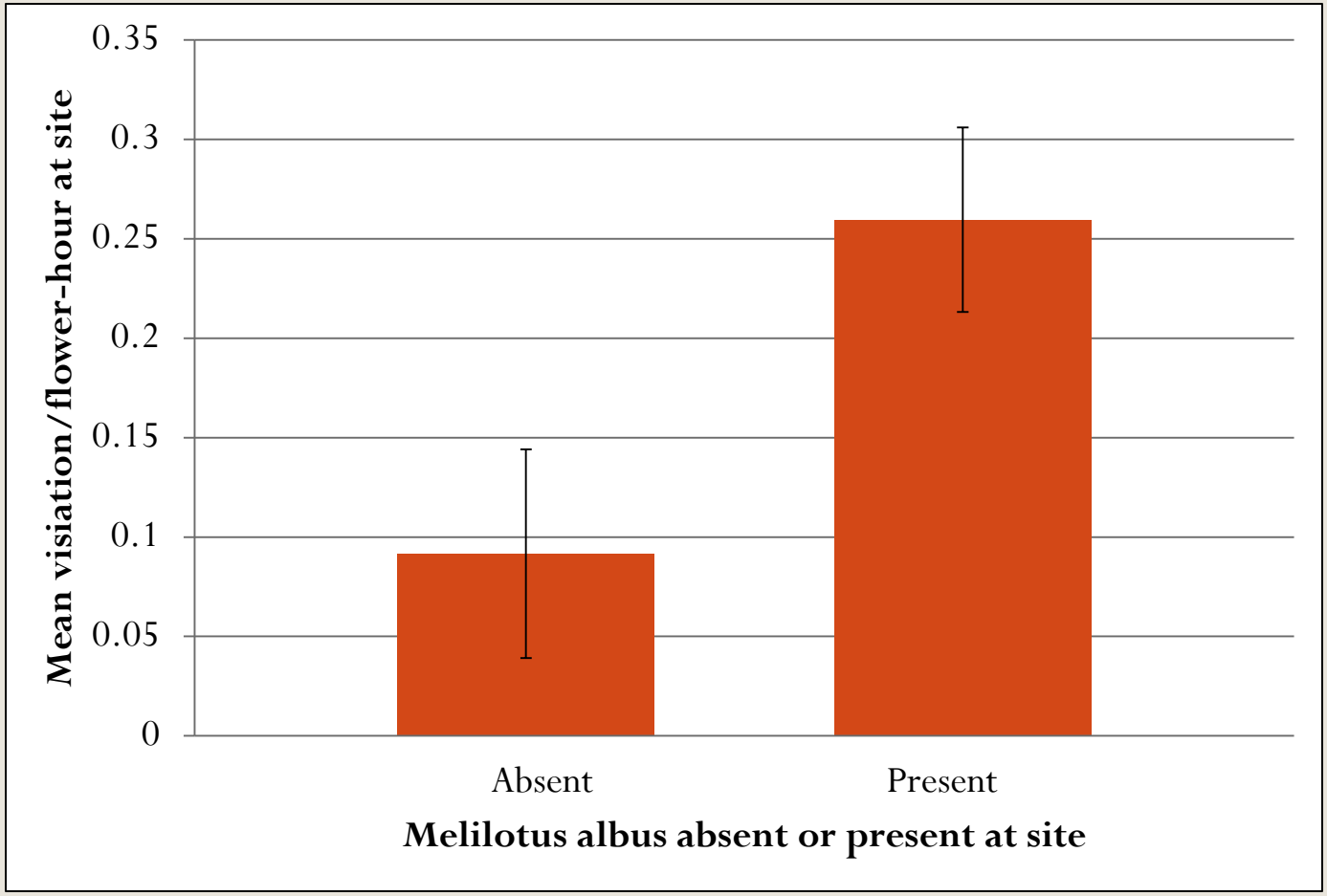


Video observations of sites without added *M. albus* (C = 0.214, L/S = 0.333, CC = 0.000, N = 1.626)



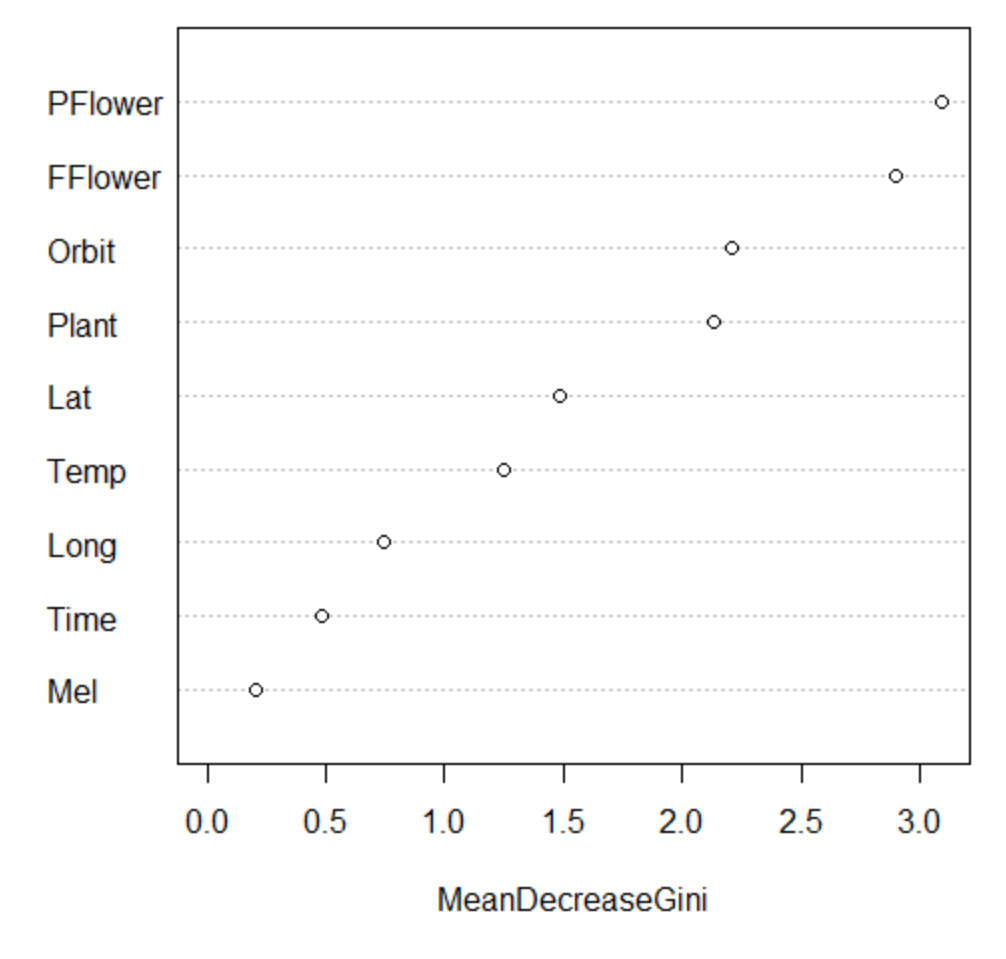
Video observations of sites with added *M. albus* (Calculations without *M. albus*: C = 0.423, L/S = 0.667, CC = 0.500, N = 9.181)

Pollinator visitation rates
Experimental sites



Pollinator visitation rates to native plants at manipulated sites with added *M. albus* and control sites. Error bars = +/- 1 S.E.

Variables that influence pollinator visitation at experimental sites



Variable importance plot of variables influencing likelihood of visitation at experimental sites.

Key to variables

Pflower: Number of flowers in 1 m^2 plot around camera

Fflower: Number of flowers in camera frame

Orbit: Distance from *M. albus* addition/center of site

Plant: Focal plant species

Lat: Site latitude

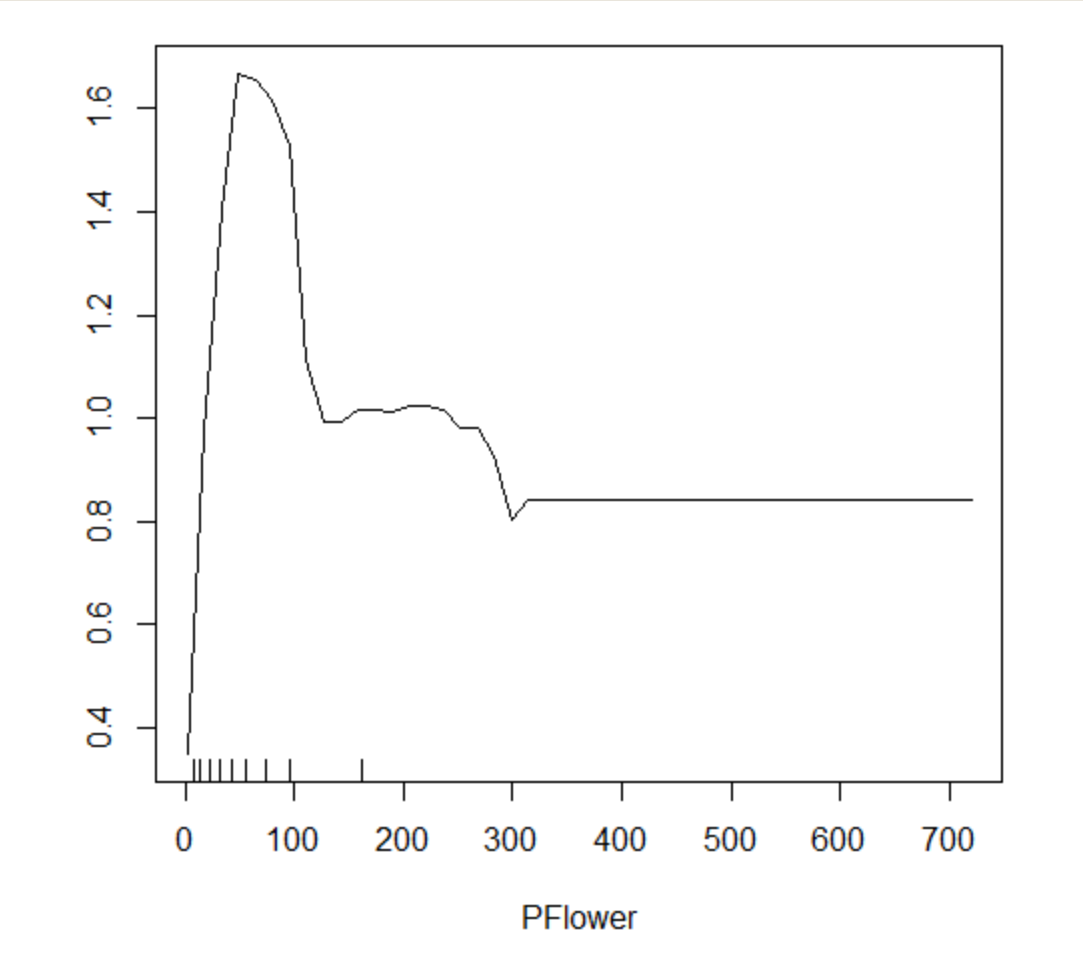
Temp: Air temperature

Long: Site longitude

Time: Time of day

Mel: *M. albus* presence or absence

How do the individual variables influence pollinator visitation?



Partial dependence plot of the influence of number of flowers in a 1 m^2 plot around camera on likelihood of pollinator visitation to native plants at unmanipulated sites.

Conclusions

- In each network, presence of *M. albus* appears to affect plant-pollinator interactions.
  - Connectance, links/species, cluster coefficient, and nestedness all change in the networks in the presence of *M. albus*, but in opposite directions in each type of site (unmanipulated vs. experimental).
- Variable importance plot explores relative importance of *M. albus* to other variables, and shows it is less important for predicting visitation.
- Number of flowers around camera and in the camera frame are the most importance variables in determining whether a specific plant will be visited by a pollinator.
- This has a potential effect on incipient *M. albus* populations, potentially giving them pollinator competition from already established native plants.
- Incipient *M. albus* populations may also help bolster existing pollinator populations, leading to the suggestion of more pollinator visitation to native plants in the presence of *M. albus*.

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Questions