Plant responses to herbivores and pollinators

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April 5, 2013

Photos: B. Inouye, A. Buchanan, D. McNutt

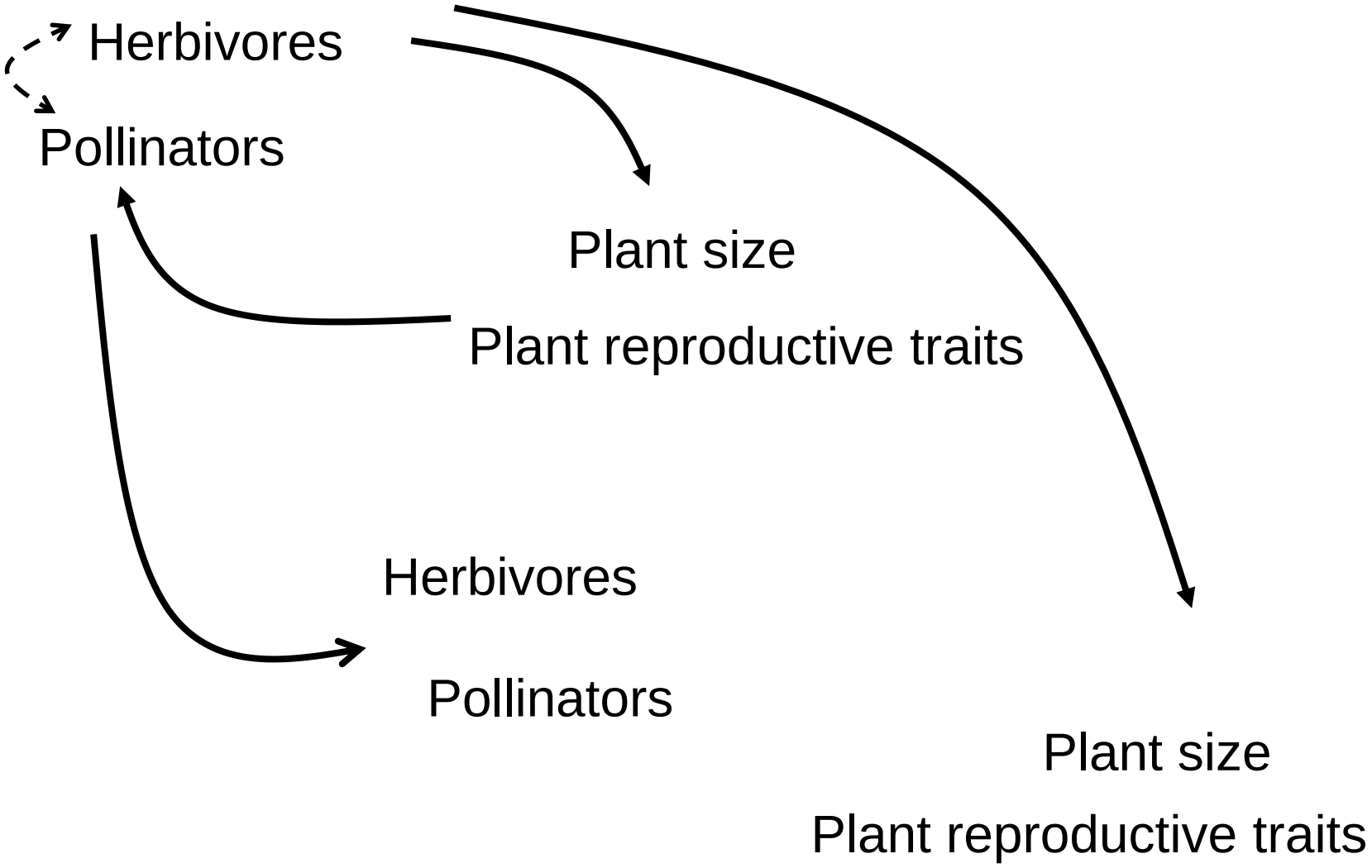
Herbivores

Pollinators

Plant size

Plant reproductive traits

Photos: B. Inouye, A. Buchanan, D. McNutt



How do foragers and plant traits influence one another within and across years?

Study system

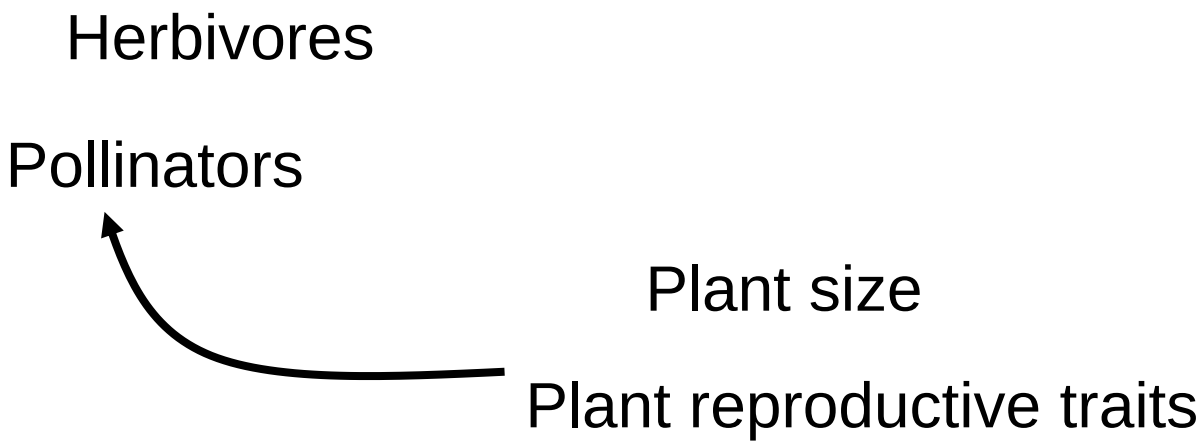
Chamerion angustifolium (fireweed): perennial, clonal, flowering plant

Bombus pollinators

Specialist and generalist leaf herbivores


Cheyenne
Fort Collins
Greeley
Loveland
Longmont
Boulder
Broomfield
Arvada
Denver
Aurora
Englewood
Littleton
Lakewood
Idaho Springs
Vail
Mt Evans
14264
Leadville
Mt Massive
14421
Mt Harvard
14420
Pikes Peak
14110
Colorado Springs
Castle Rock
Fort Morgan
Steamboat Springs
Craig
Meeker
Rifle
Glenwood Springs
Aspen
Grand Junction
Delta
Montrose
Gunnison
Salida
Canon City
Pueblo
Rocky Ford
Ouray
Mt Wilson
14246
Estes Park
Longs Pk
14255
Bridger Pk
11004
5424
COLORADO
PARK RANGE
FRONT RANGE
SAWATCH RANGE
ROAN PLATEAU
UNCOMPAHGRE PLATEAU
Yampa River
White River
Arkansas

Plant effects on foragers



Plant effects on foragers

S — Size manipulation: 50 % stem removal (n = 35)

F — Display manipulation: 50% flower removal (n=12)

C — Control: no removal (n=58)

Plant effects on foragers

Responses:

Percent damage (herbivory)

Fruit number (pollination)

Browsed stems (herbivory)

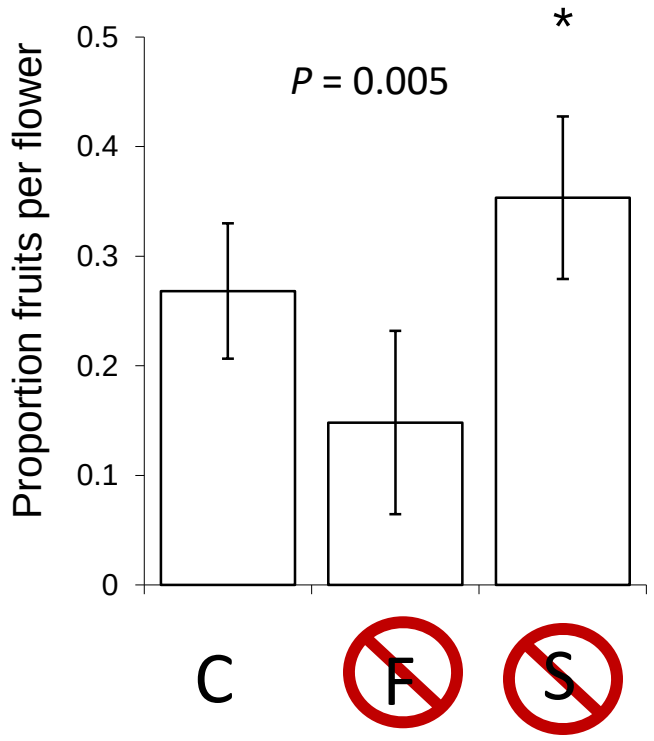
Factors:

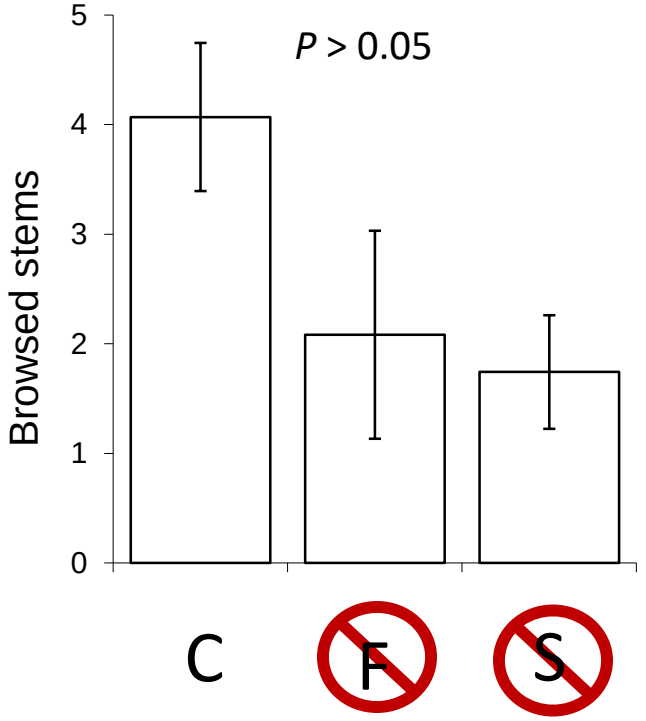
Removal treatment

Flower number

Stem number

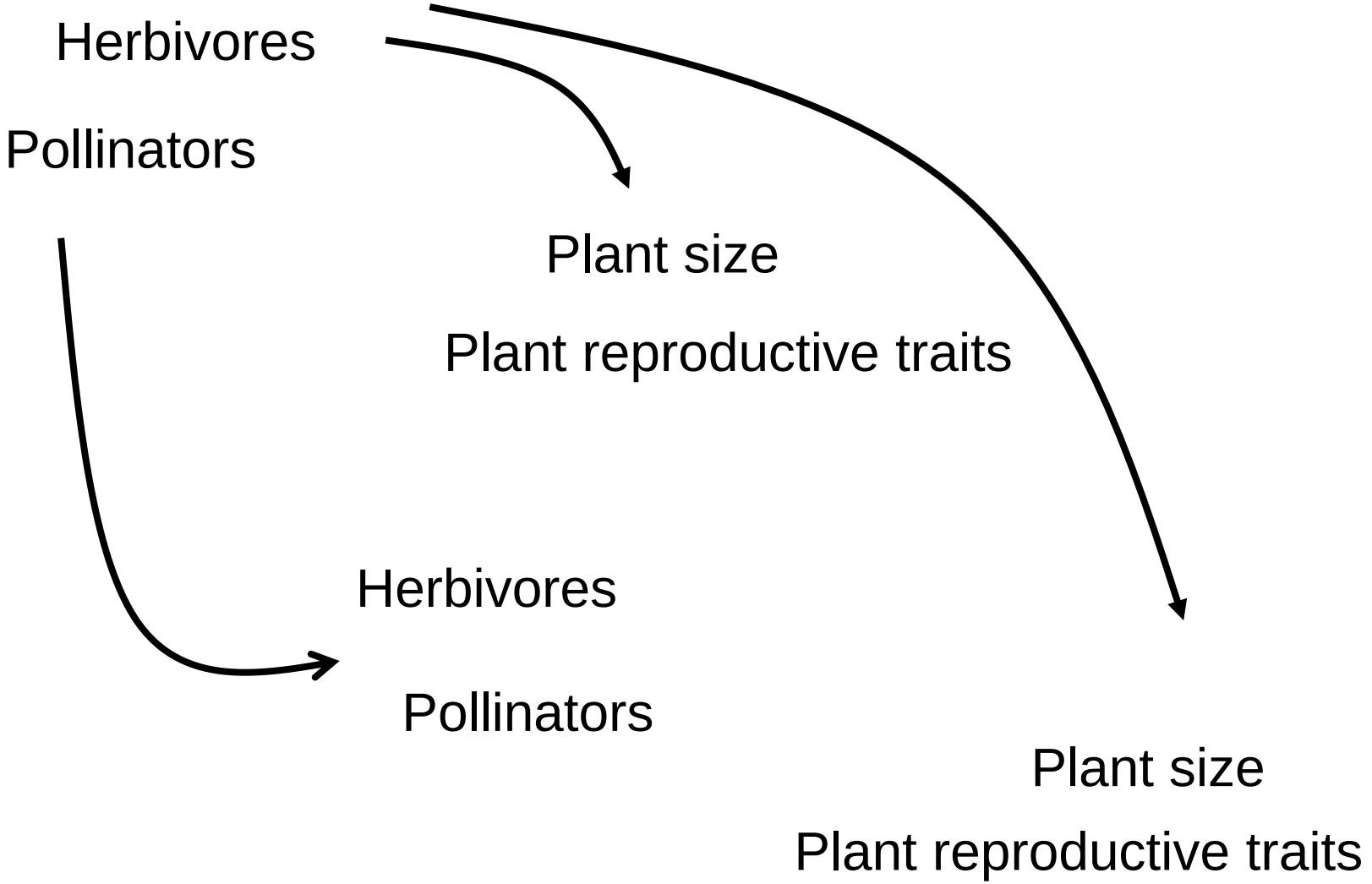
Floral display affects pollination





Buchanan and Underwood 2013, *Oecologia*

Forager effects on plants



Forager effects on plants

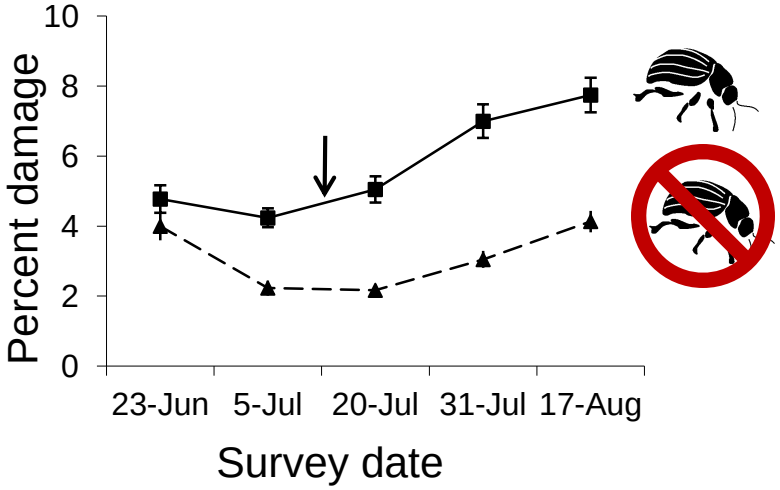
Natural or reduced herbivory

x

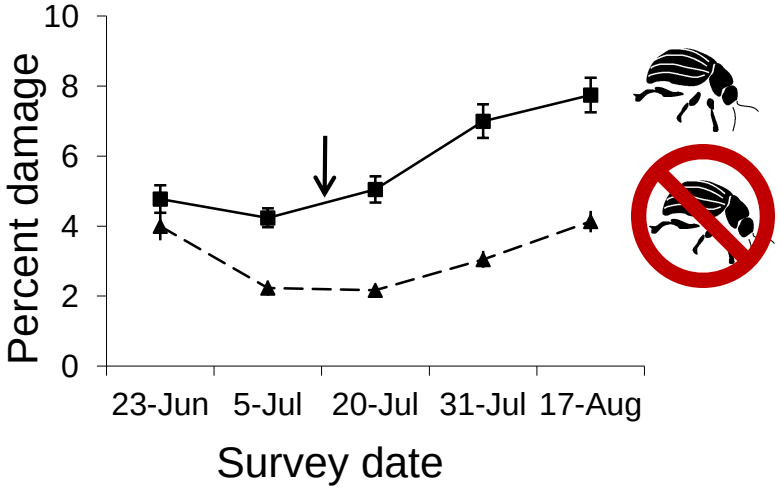
Natural or reduced pollination

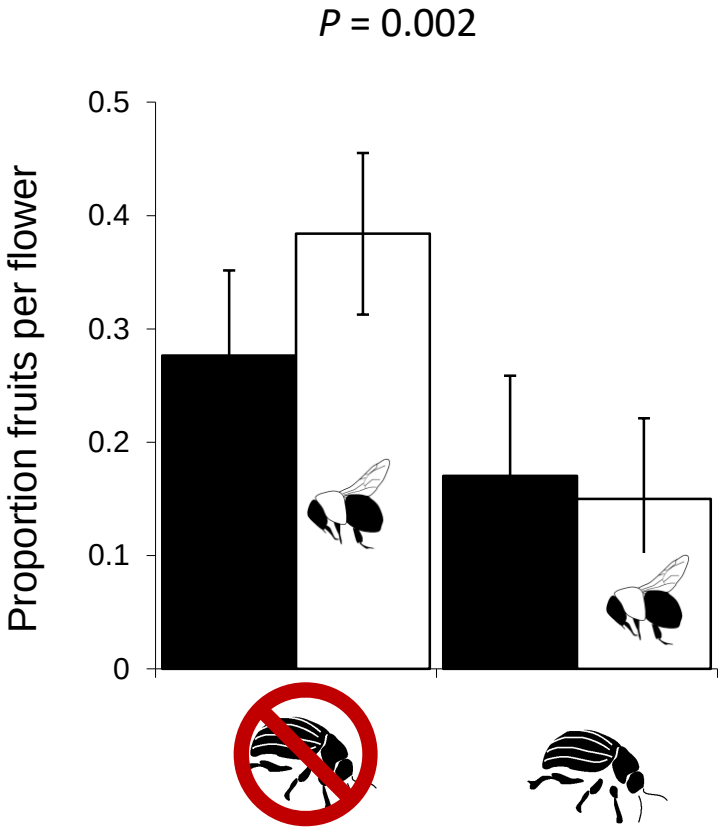
n = 124

Forager effects on plants



Forager effects on plants





Forager effects on plants

Responses:

Stem number

Height

Flower number

Number of flowering stems

Fruit number (pollination)

Percent damage (herbivory)

Factors:

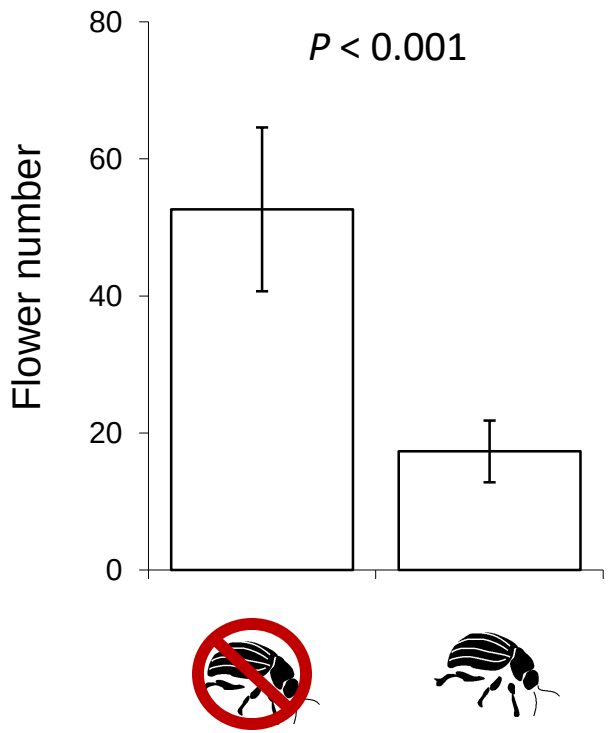
Herbivory treatment

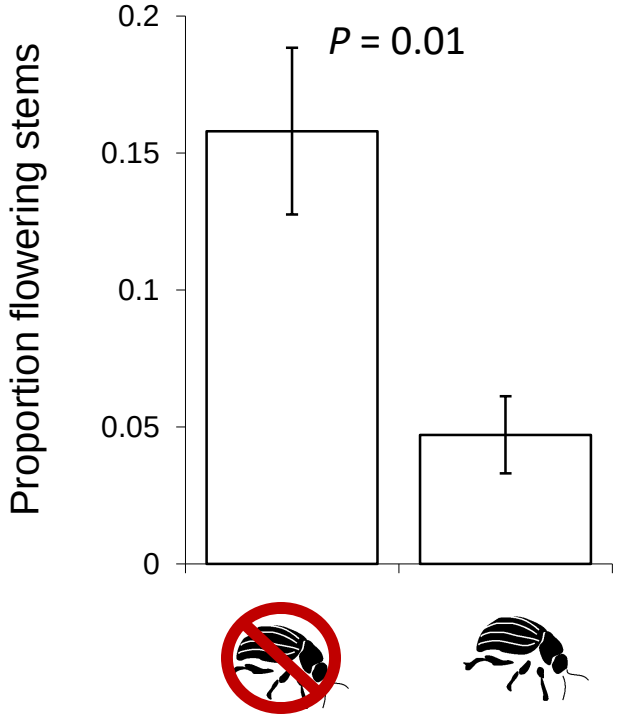
Pollination treatment

Stem number

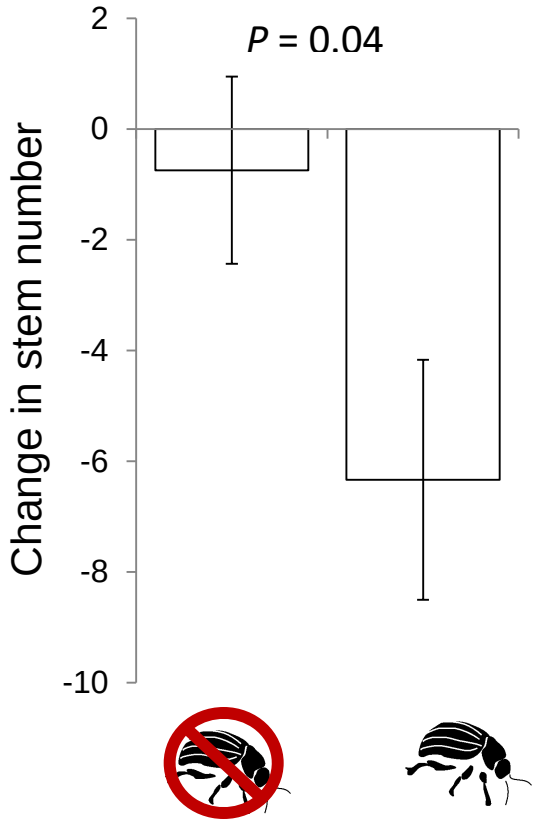
Flower number

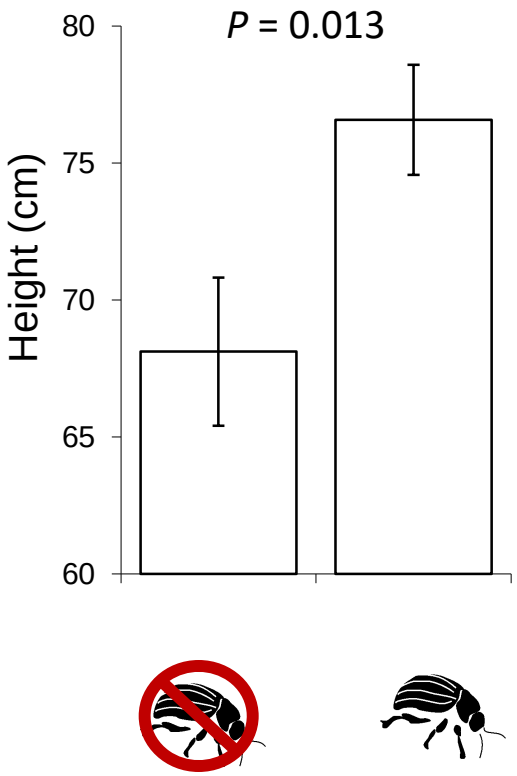
Within years, herbivory decreased flowering



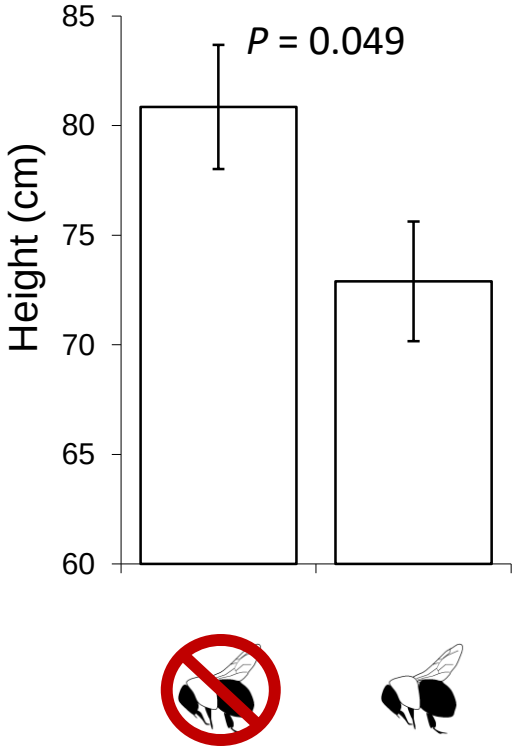


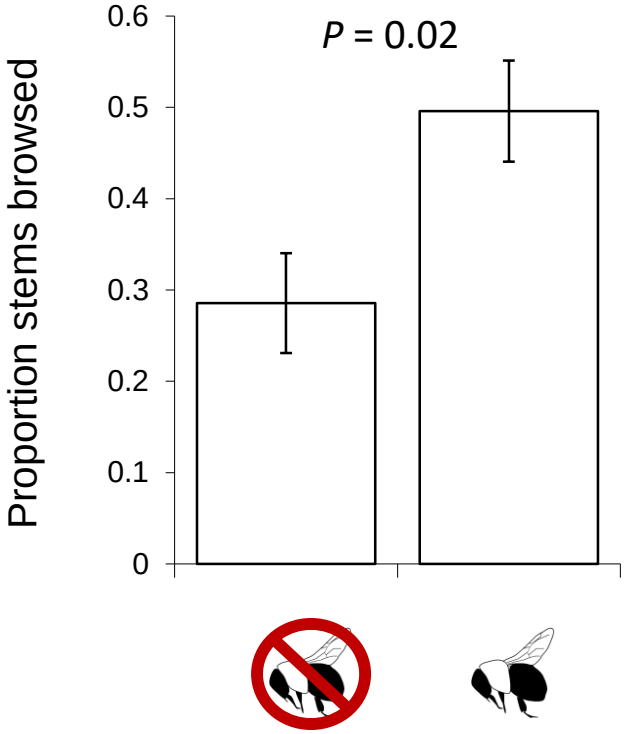
Across years, no consistent effect of herbivory on size



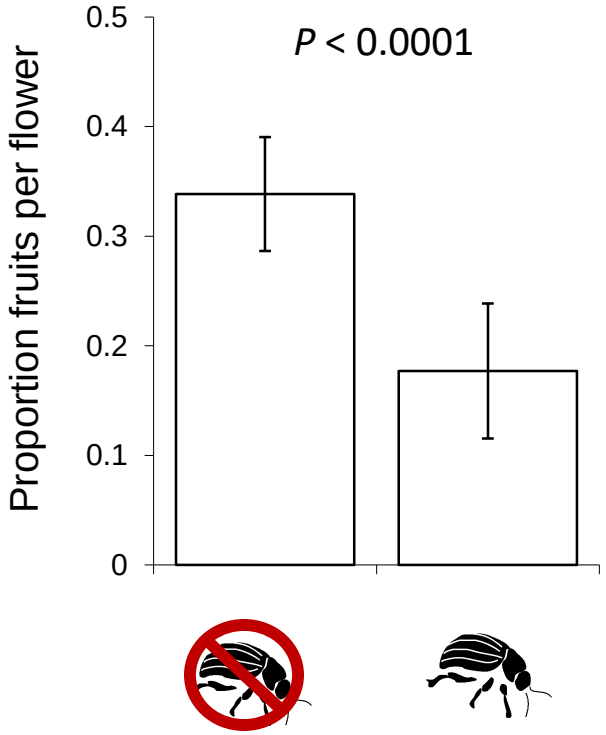


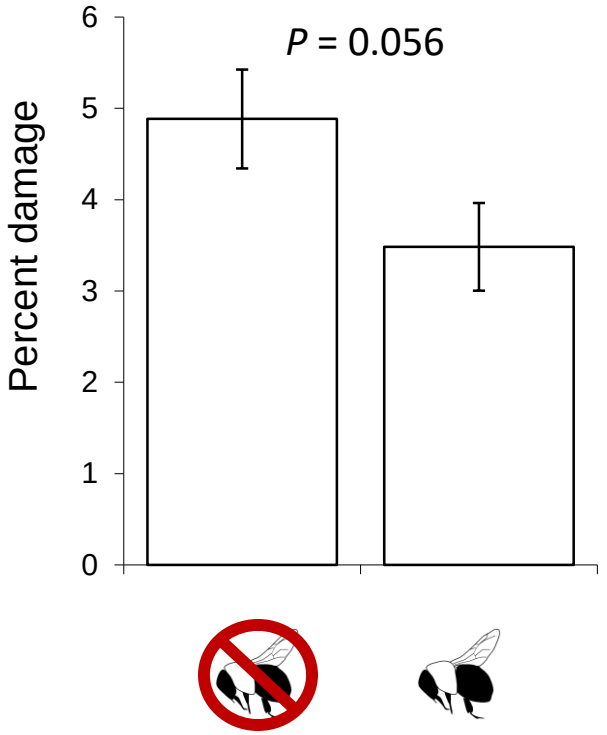
Across years, pollination decreased size and increased browsing



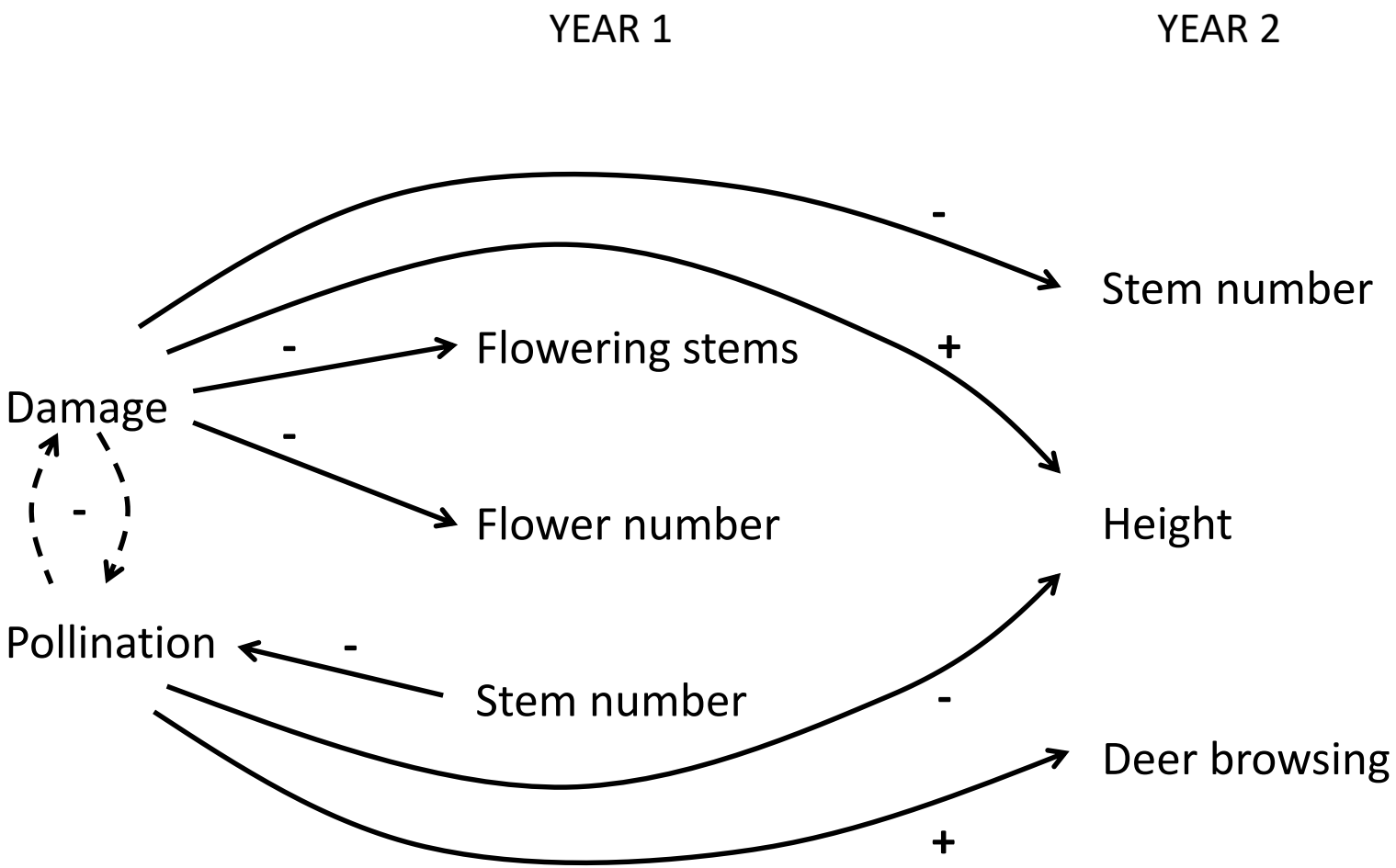


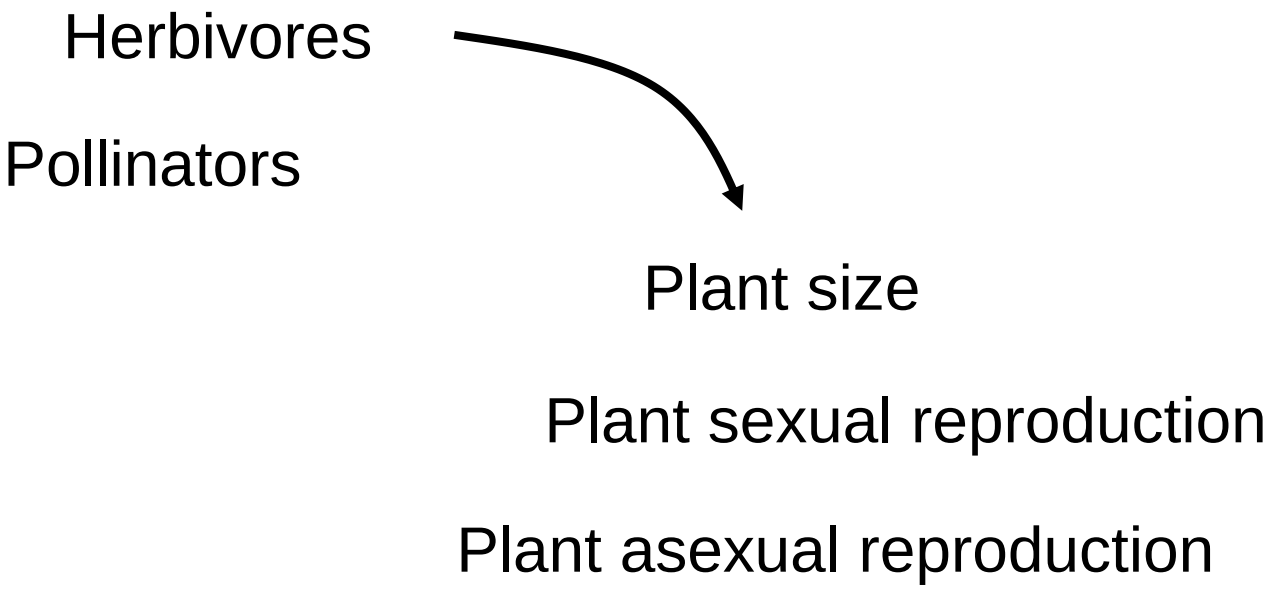
Within years, negative indirect effects between foragers





Summary


YEAR 1
YEAR 2
Damage
Pollination
Flowering stems
Flower number
Stem number
Stem number
Height
Deer browsing
-
-
-
-
-
-
+
+

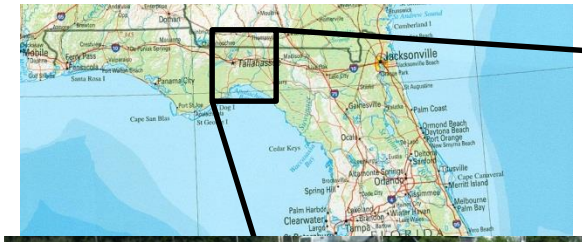


How do foragers influence reproduction in clonal plants?

Study system

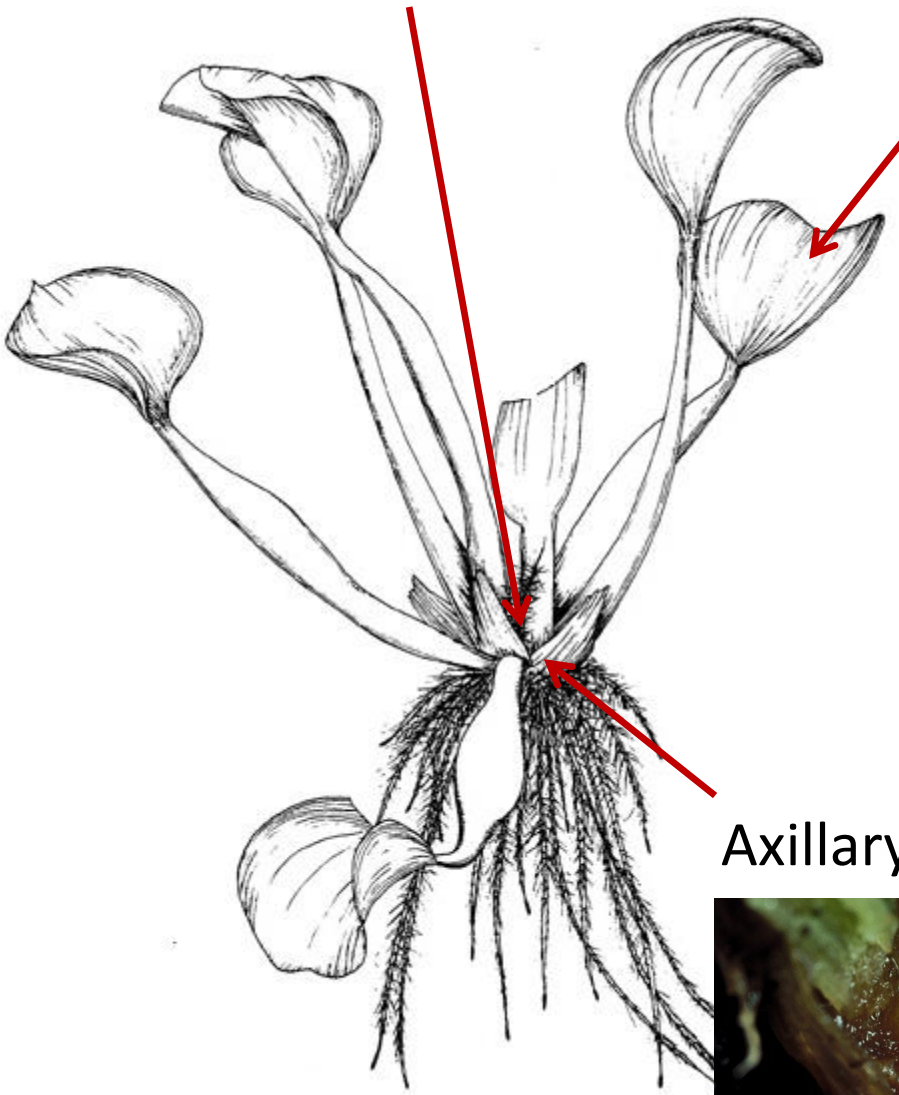
*Eichhornia crassipes (*water hyacinth)*:* perennial, clonal, flowering aquatic plant

Specialist herbivores *Neochetina eichhorniae* and *N. bruchi* (mottled and chevroned water hyacinth weevil)


Jacksonville
Tallahassee
Gainesville
Orlando
Clearwater
Tampa
Palm Coast
Daytona Beach
Melbourne
Cape Canaveral
Panama City
Pensacola
Mobile

Apical damage

Leaf damage (~25%)



Axillary damage

Forager effects on plants

Apical meristem damage

Axillary meristem damage

Leaf damage

No damage

x

Hand pollination

No pollination

Experiment 1: acute axillary damage, 37-day responses

Experiment 2: chronic axillary damage, 11-day responses, pollination treatments

Analysis

Responses:

Change in leaf number

Clonal offspring produced

Flowers produced (y/n)

Survival

Fruit number

Seed mass

Factors:

Damage treatment (4 levels)

Population of origin (2 or 3 levels)

Spatial block (tank)

Initial plant mass (g)

Initial leaf number

Pollination treatment (2 levels)

Analysis

Responses:

Change in leaf number

Clonal offspring produced

Flowers produced (y/n)

Survival

Fruit number

Seed mass

Factors:

Damage treatment (4 levels)

Population of origin (2 or 3 levels)

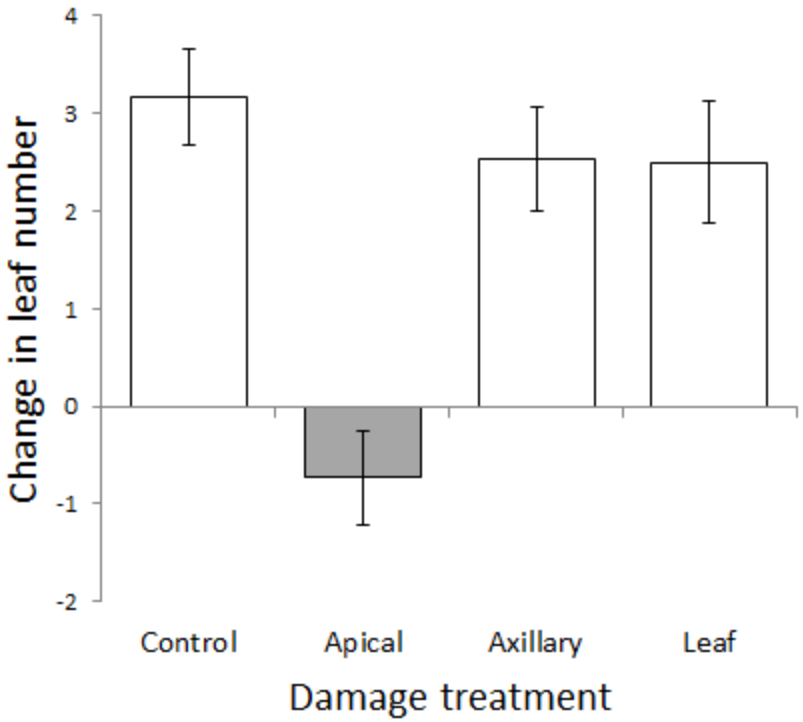
Spatial block (tank)

Initial plant mass (g)

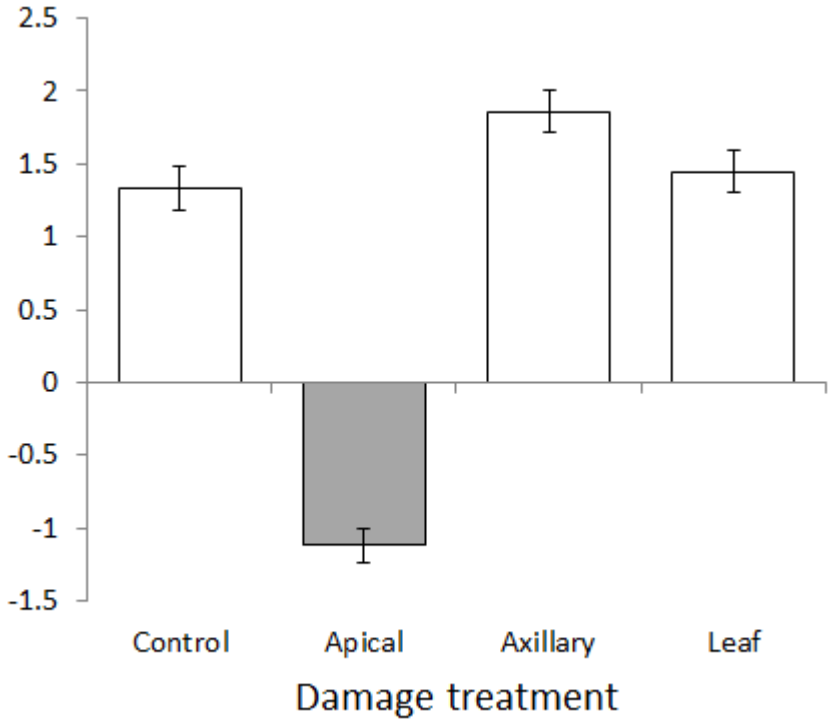
Initial leaf number

Pollination treatment (2 levels)

Apical damage decreased leaf production (short and long term)

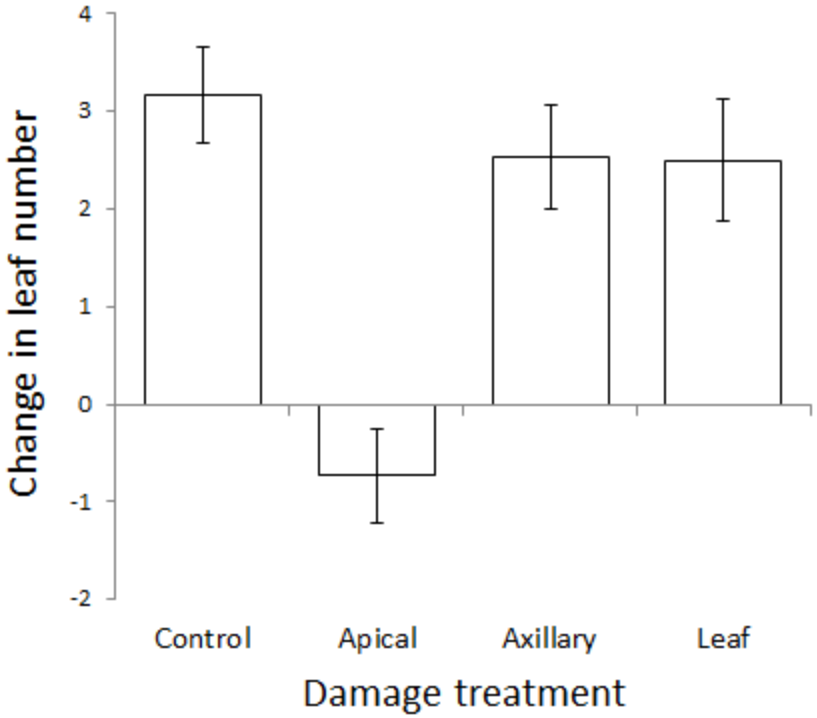


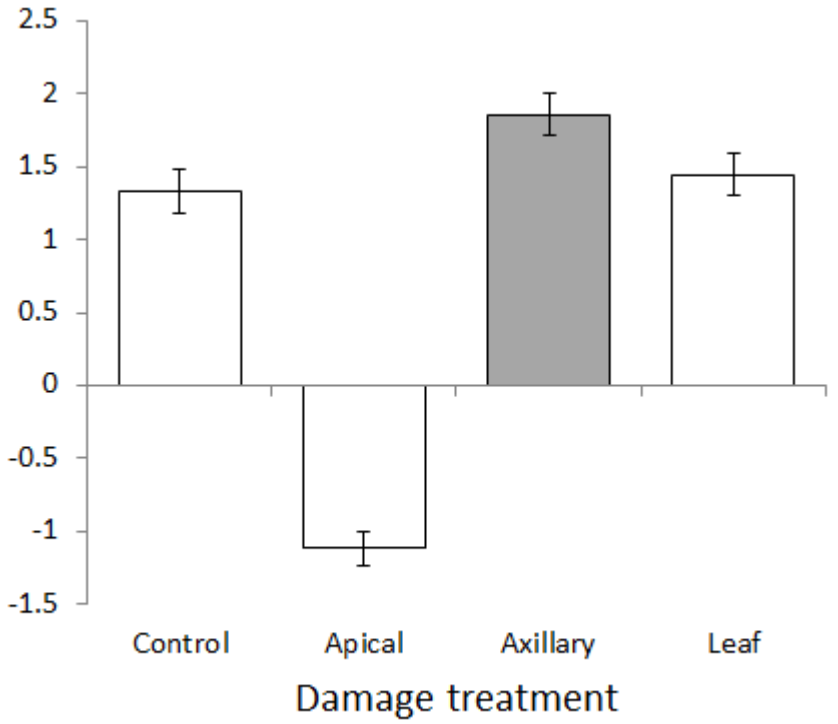
ANOVA, $P < 0.0001$



ANOVA, $P < 0.0001$

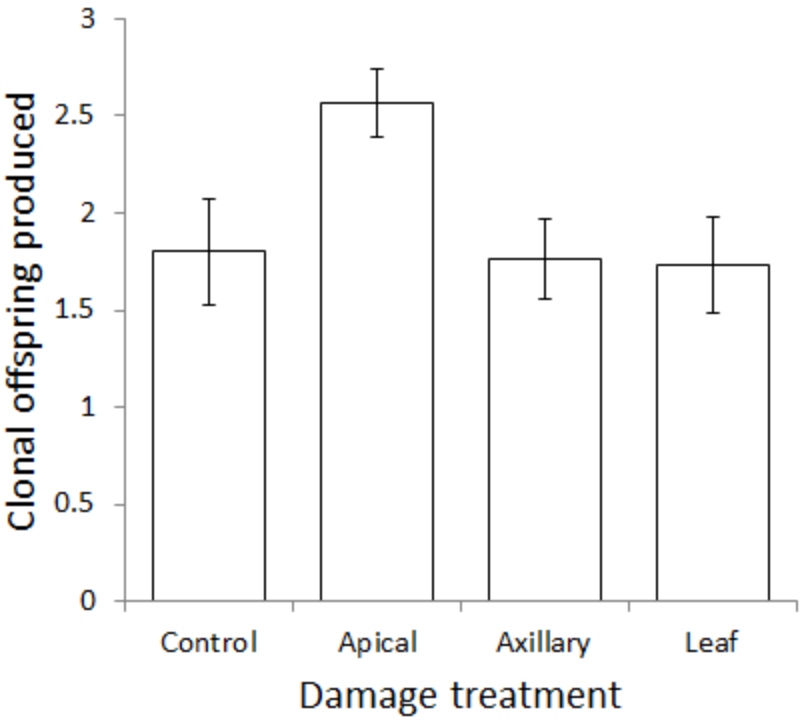
Axillary damage (chronic) increased leaf production

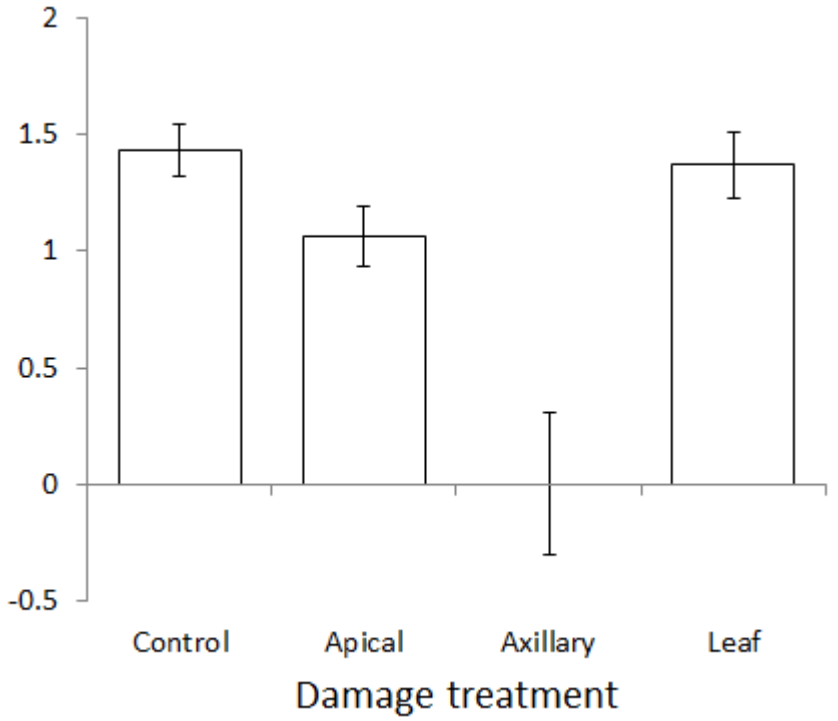




ANOVA, $P < 0.0001$

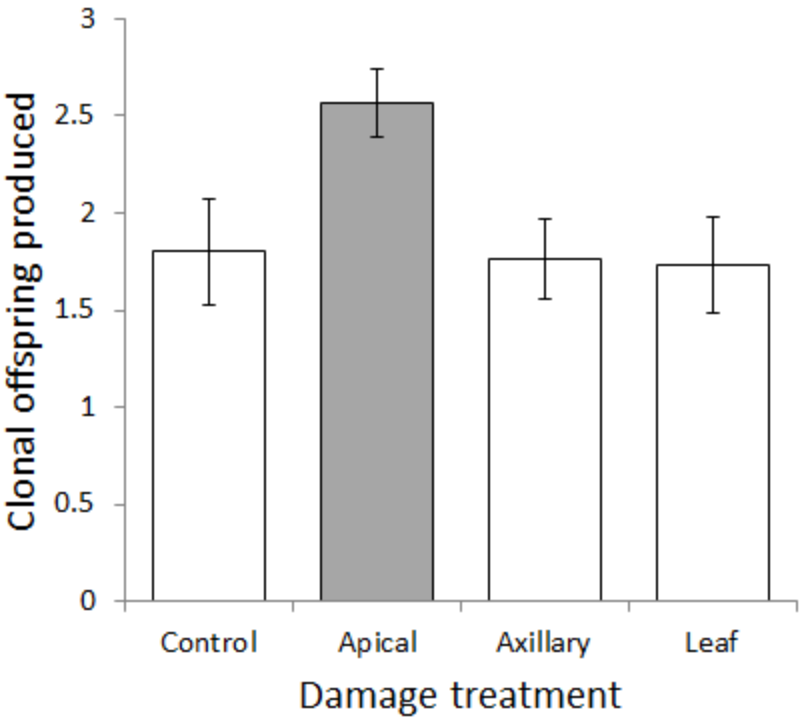
Axillary damage (chronic) decreased clone production

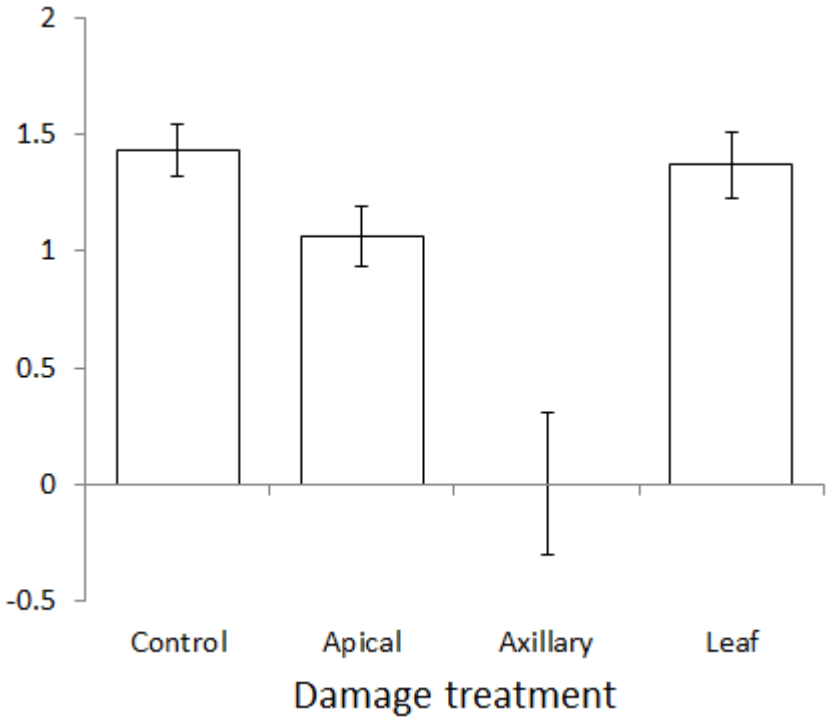




ANOVA, $P < 0.0001$

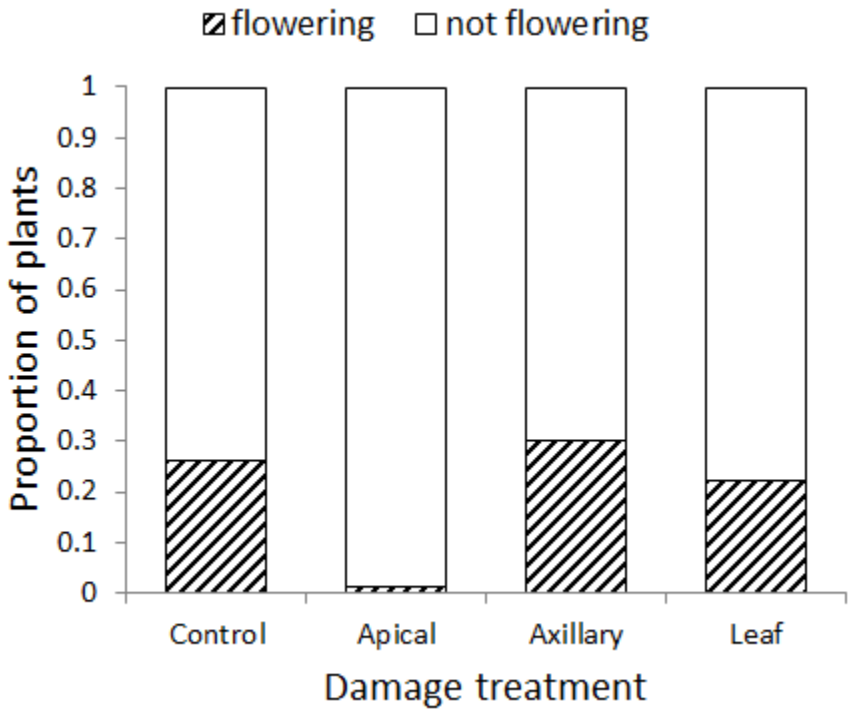
Apical damage increased clone production (long term)





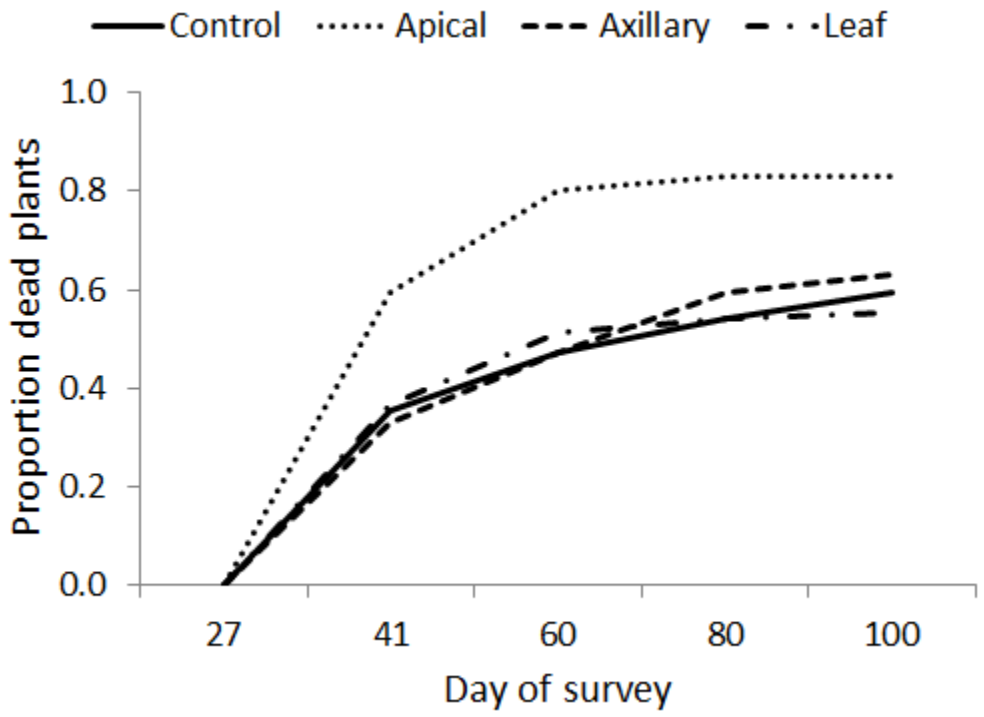
ANOVA, $P = 0.012$

Apical damage decreased flowering



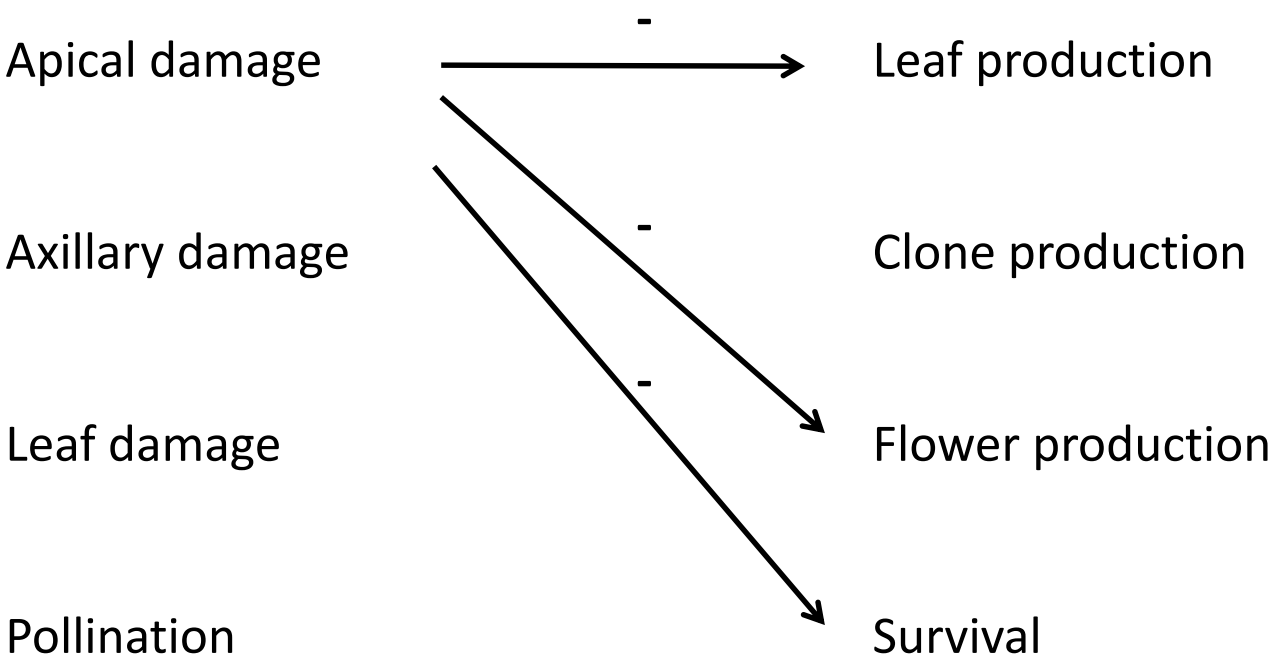
X^2, $P < 0.0001$

Apical damage decreased survival



χ^2, P = 0.001

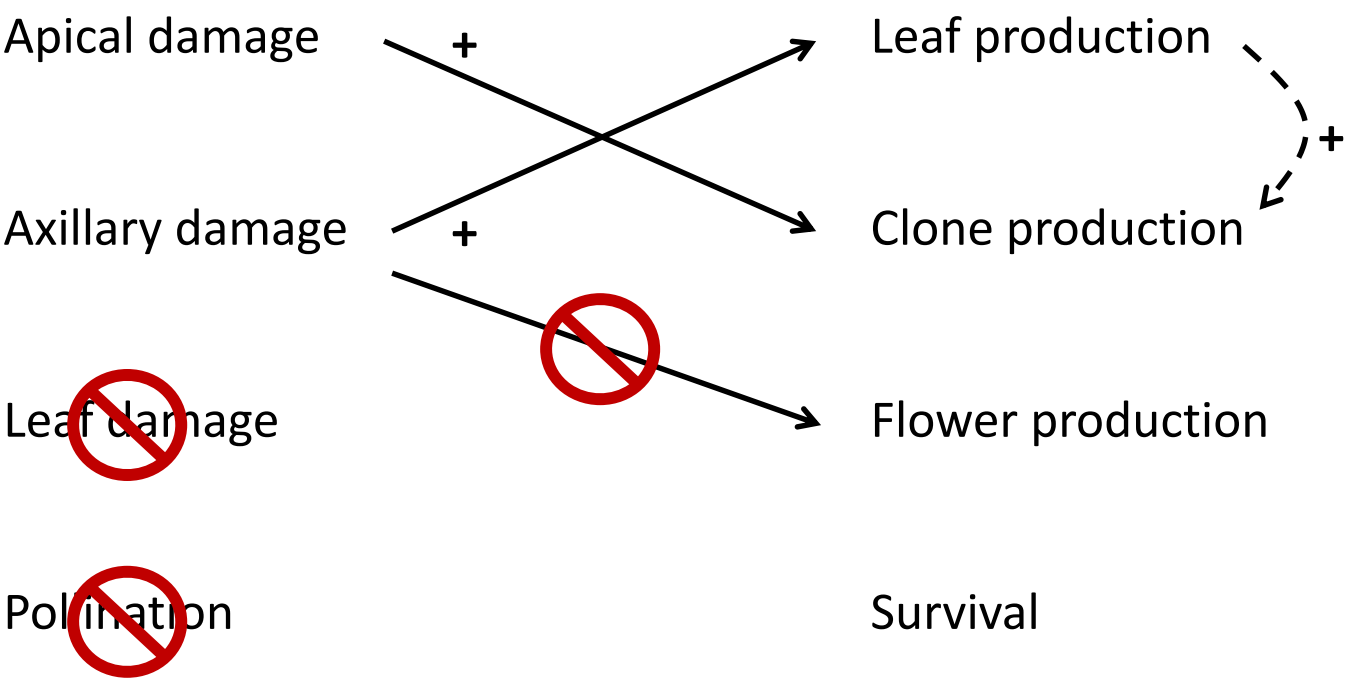
Summary


Apical damage
Axillary damage
Leaf damage
Pollination
-
-
-
Leaf production
Clone production
Flower production
Survival

Summary

Apical damage		Leaf production
Axillary damage	- →	Clone production
Leaf damage		Flower production
Pollination		Survival

Summary


Apical damage
Axillary damage
Leaf damage
Pollination
+
+
Leaf production
+
Clone production
Flower production
Survival

Induced resistance in *E. crassipes*

Does *E. crassipes* induce resistance to *Neochetina* damage?

Does *E. crassipes* induce resistance to manual damage?

What are the implications for *Neochetina* biocontrol of *E. crassipes*?

Induced resistance to insect damage

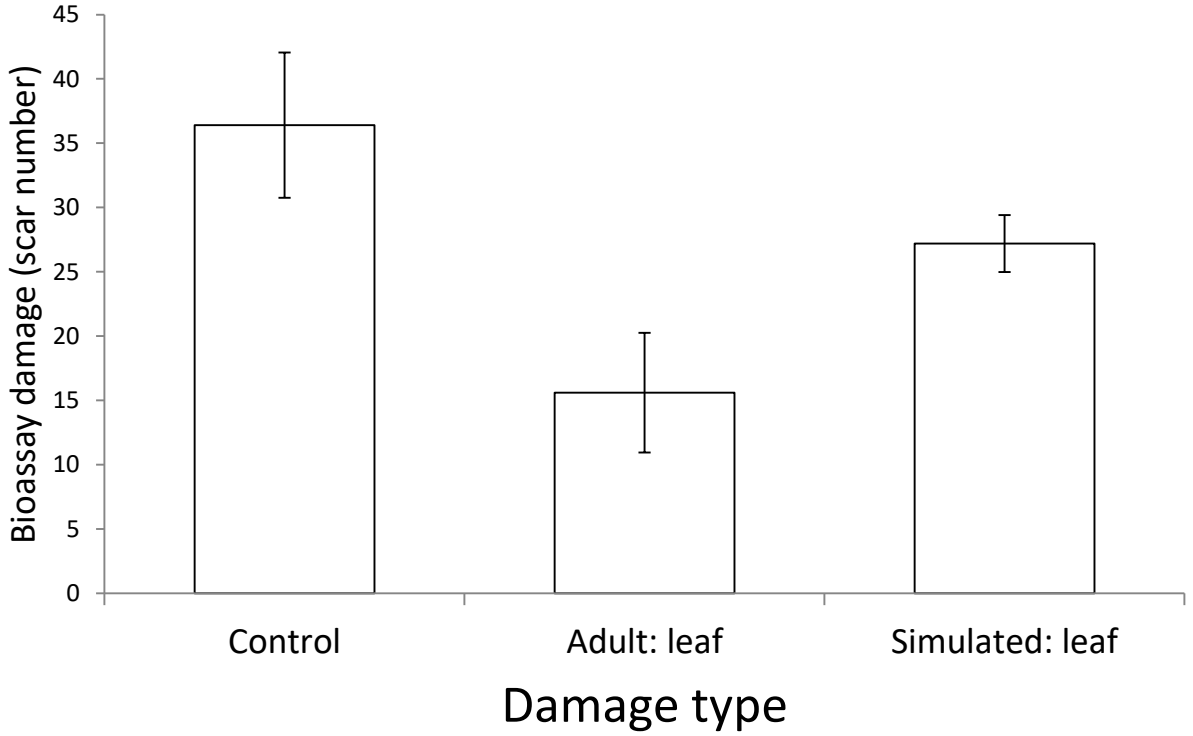
Whole plants caged with adults

Manual leaf damage

No damage

Adult weevil bioassay

Insect leaf damage decreases subsequent damage



$P < 0.01$

Buchanan 2013, *Florida Entomologist*

Induced resistance to manual damage

Apical damage

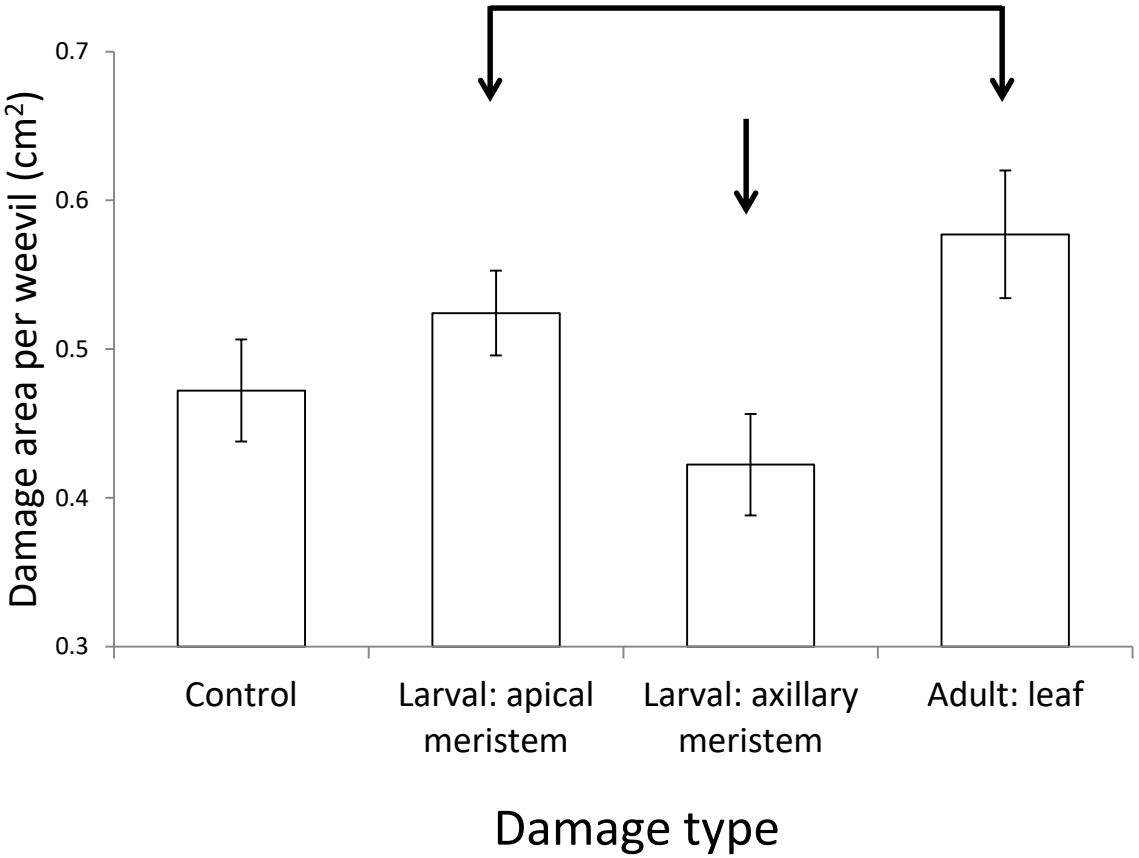
Axillary damage

Leaf damage

No damage

Adult weevil bioassay

Manual leaf damage does not affect subsequent damage, relative to controls



P = 0.02

Acknowledgements

Nora Underwood & Brian Inouye
Alice Winn, Tom Miller
Underwood/Inouye/Lee lab group
E&E grads, David McNutt

FSU Dissertation Research Grant
Short Scholarship in Zoology
Godfrey Endowment in Botany
Morton Invasive Plant Research Grant