Deer Herbivory Significantly Reduces Larval Survivorship in a Rare Pierid, *Euchloe ausonides insulanus*

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photo by J K Combs, 2005

PRESENTATION OUTLINE

- Study species and host plant habitat
- Life history
- Research questions
  - Methods/Results
- Conclusion
- Discussion

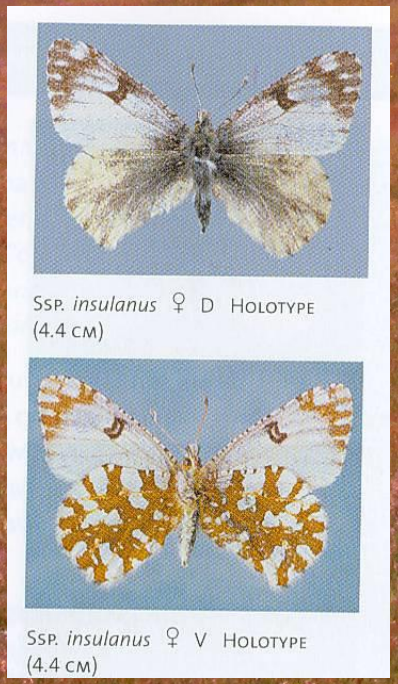
INTRODUCTION

Believed extinct for nearly 100 years

INTRODUCTION

Vancouver Island, British Columbia, Canada

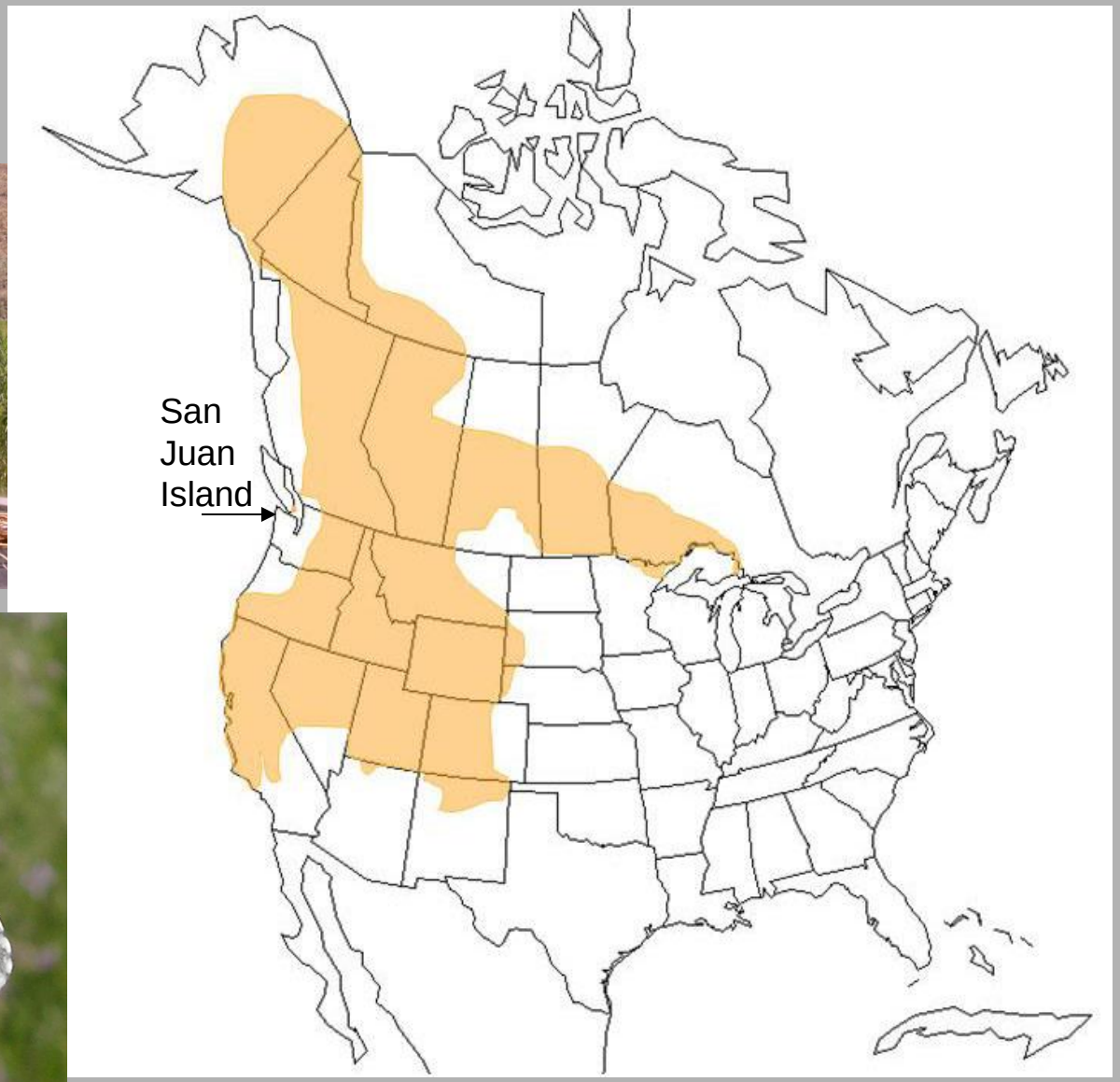
American Camp, San Juan Island National Historical Park, San Juan Island, Washington



Ssp. *insulanus* ♀ D Holotype (4.4 cm)

Ssp. *insulanus* ♀ V Holotype (4.4 cm)

INTRODUCTION



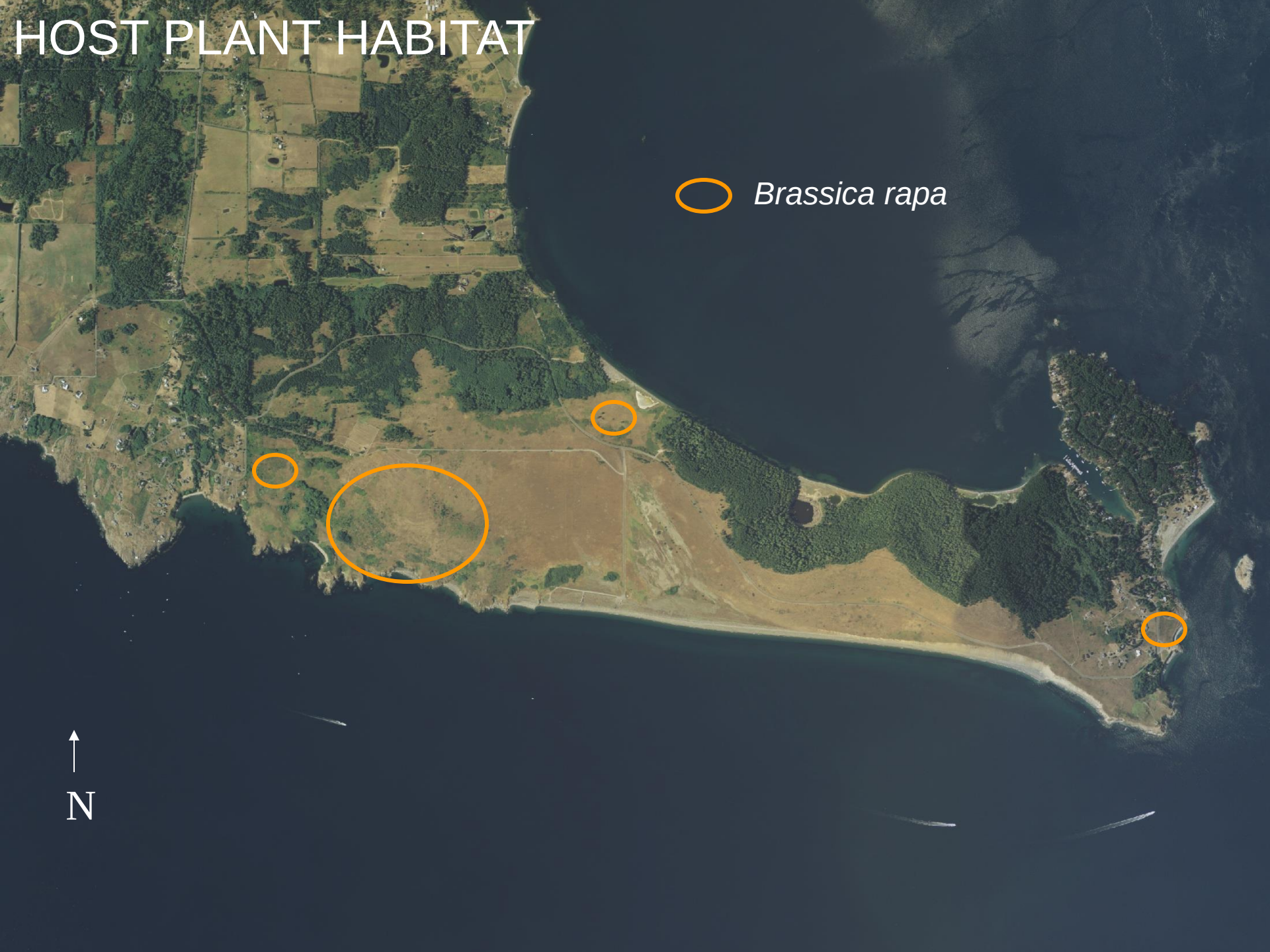
Large marble *Euchloe ausonides* Lucas 1852


STUDY SITE
Mt. Finlayson 87m
N
• open area (full sunlight)
• topographic relief
American Camp, San Juan Island National Historical Park

HOST PLANT HABITAT

NON-NATIVE field mustard
Brassica rapa L. *rapa*

• availability of appropriate host plants (glucosinolates)

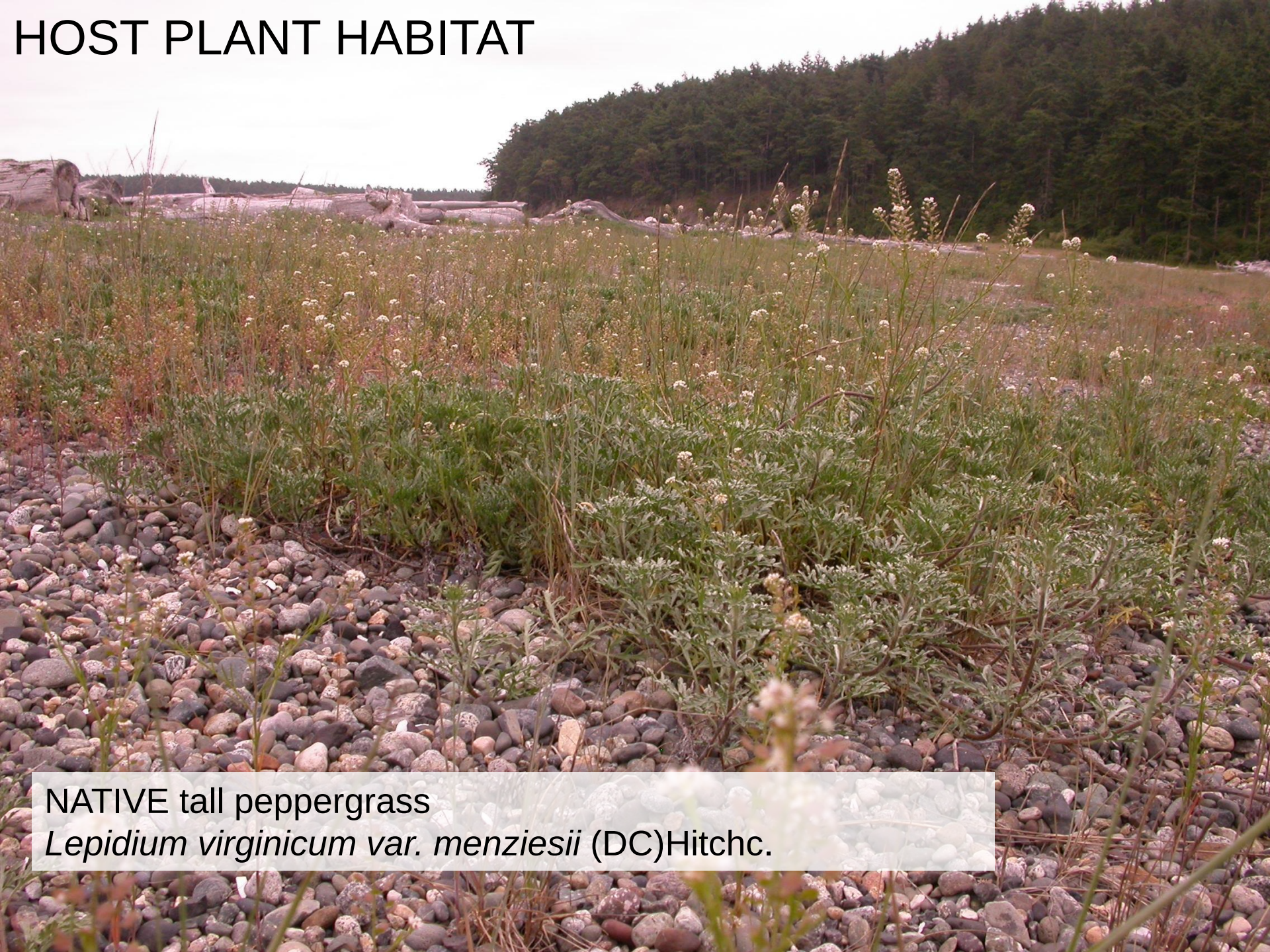

HOST PLANT HABITAT
Brassica rapa
N

HOST PLANT HABITAT

NON-NATIVE tumble mustard
Sisymbrium altissimum L.

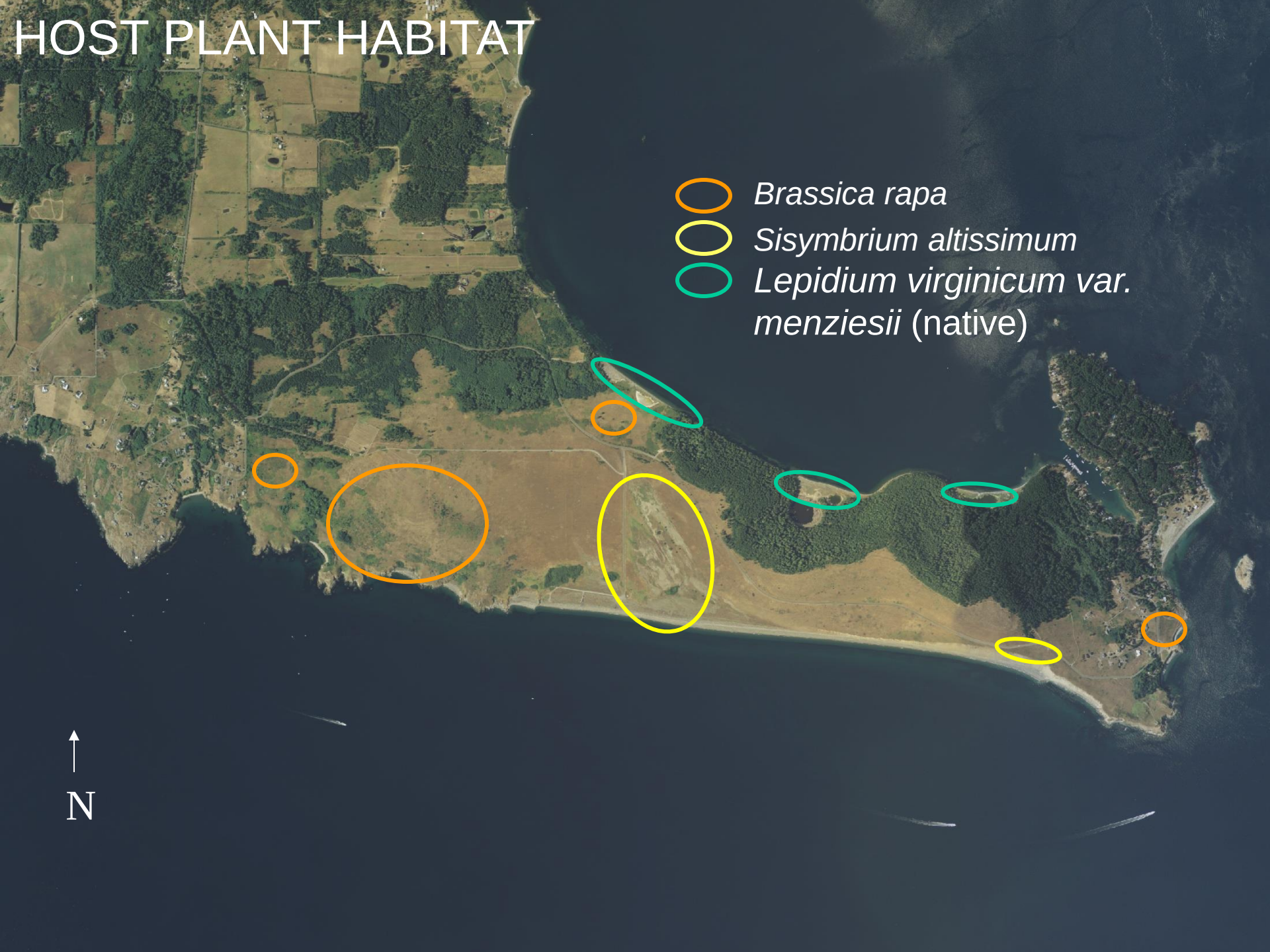

HOST PLANT HABITAT
Brassica rapa
Sisymbrium altissimum
N

HOST PLANT HABITAT



NATIVE tall peppergrass
Lepidium virginicum var. menziesii (DC)Hitchc.

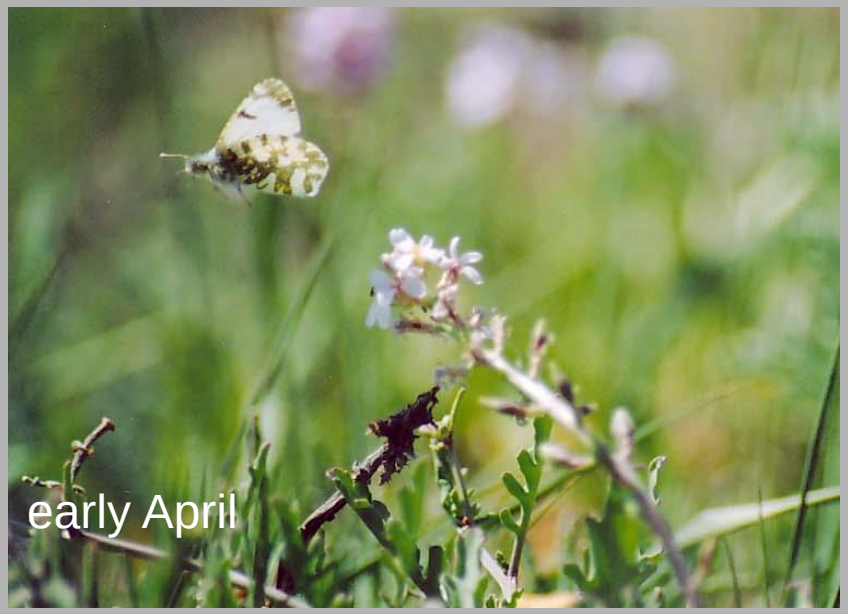
HOST PLANT HABITAT



HOST PLANT HABITAT

- suitable state of growth (i.e., plant phenology)

LIFE HISTORY



LIFE HISTORY

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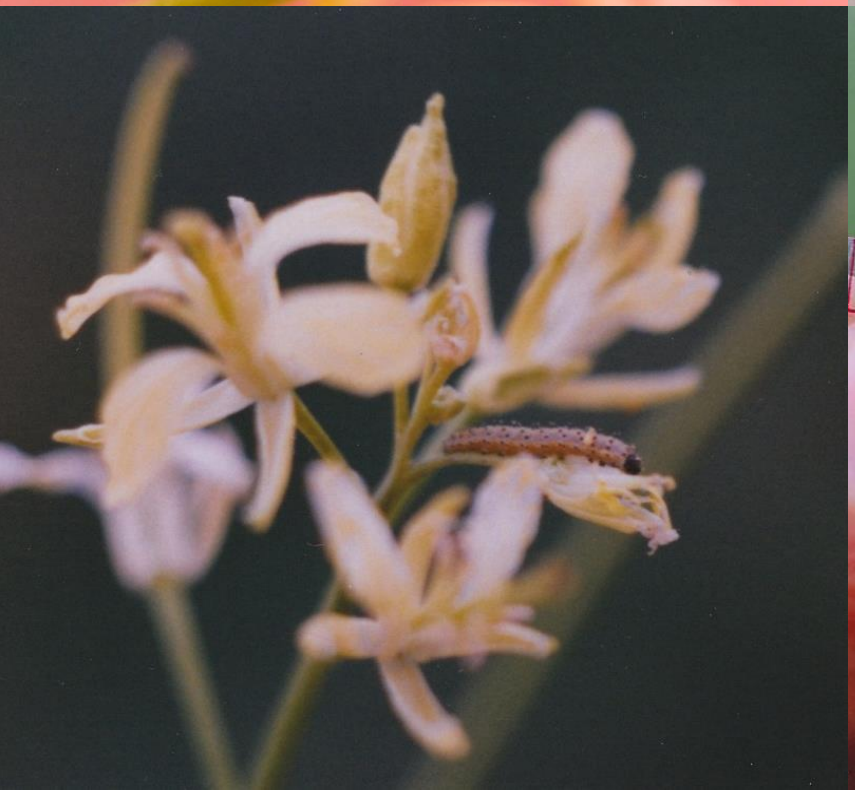
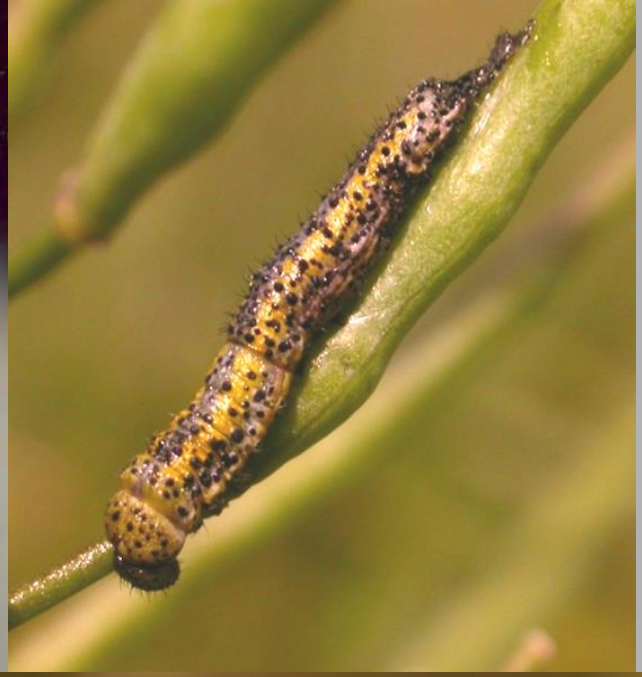


LIFE HISTORY



LIFE HISTORY

LIFE HISTORY

LIFE HISTORY

June 25 - May 24

INTRODUCTION

Many factors influence the rarity of butterflies:

- Weather, climate change
- Interaction with enemies (e.g., predators) Dempster 1967
- Adult resources (shelter, mate location and nectar resources)
- Host plant traits (size, phenology, structure) Courtney and Duggan 1983
- Larval habitat quality (early successional vegetation) Cappuccino and Kareiva 1985
- Adult dispersal (vagility)
- Patch area, isolation and habitat quality (aspect, structure, soil moisture)

- Impacts of deer browsing
  - ➢ Consumption of eggs
  - ➢ Reduction of oviposition sites
  - ➢ Reduces host plant abundance

INTRODUCTION

Island marble *E. ausonides insulanus* resting on field mustard *Brassica rapa* L. *rapa*

INTRODUCTION

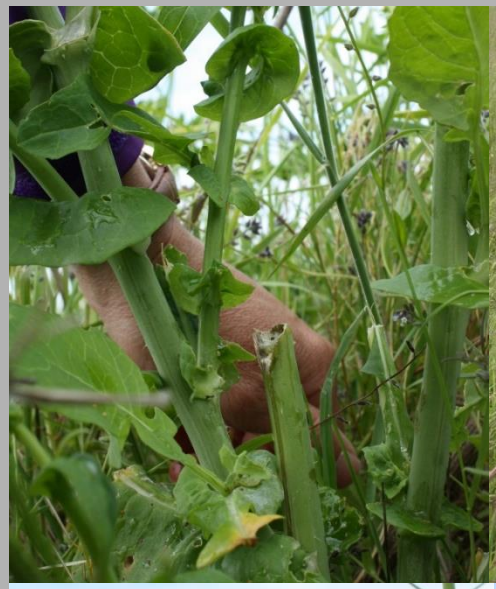
- Increase in density of deer and browsing pressure on field mustard, *Brassica rapa*

2007

2013

INTRODUCTION

Clipped and damaged primary raceme



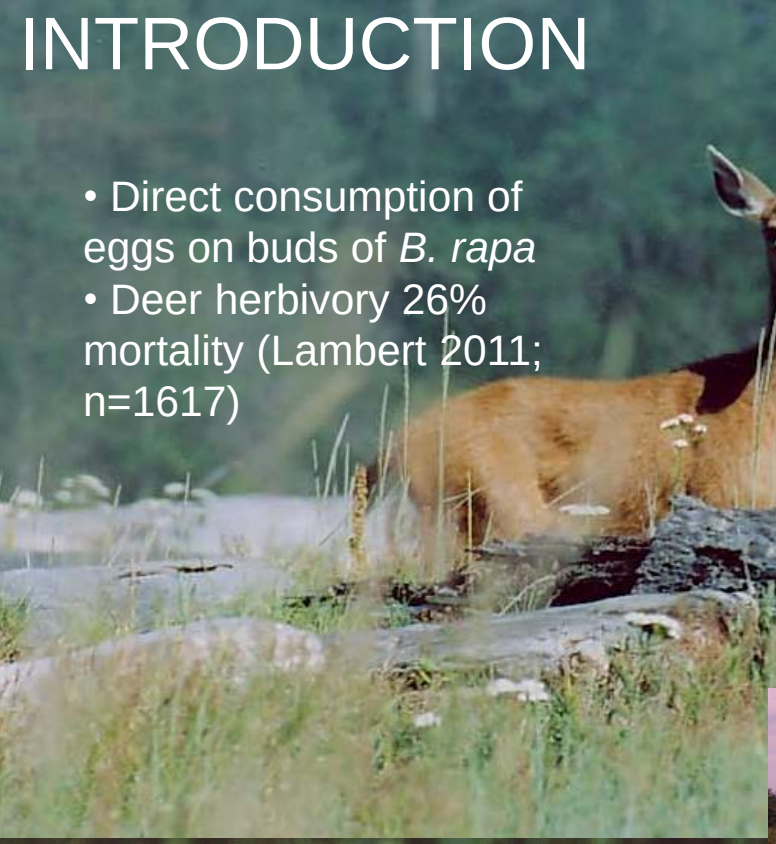
Compacted grasses the size and shape of deer

Torn stems of mature plant racemes

The absence of buds/flowers at the top of host plants between host plant surveys

INTRODUCTION

- Direct consumption of eggs on buds of *B. rapa*
- Deer herbivory 26% mortality (Lambert 2011; n=1617)



RESEARCH QUESTIONS

Do the causes of mortality differ when deer are excluded?

Does excluding deer increase overall survivorship?

METHODS

- Two study sites (each w/ control and exclosure)
- Complete census of eggs on *Brassica rapa*
- 118 eggs tracked, May 23-July 9, 2013

METHODS

- Survey 3-5 days, instar III and IV every 1-2 days, instar V several times a day
- Identified larval instars based on coloration of eggs, larvae size and morphology (Lambert 2011)
- Tracked immature stages until death or disappearance (neighboring host plants examined for larva)
- Recorded sources of mortality
- Logistic regression models of survival: mortality due to deer herbivory, site, treatment (fenced and control)

RESULTS

Causes of mortality

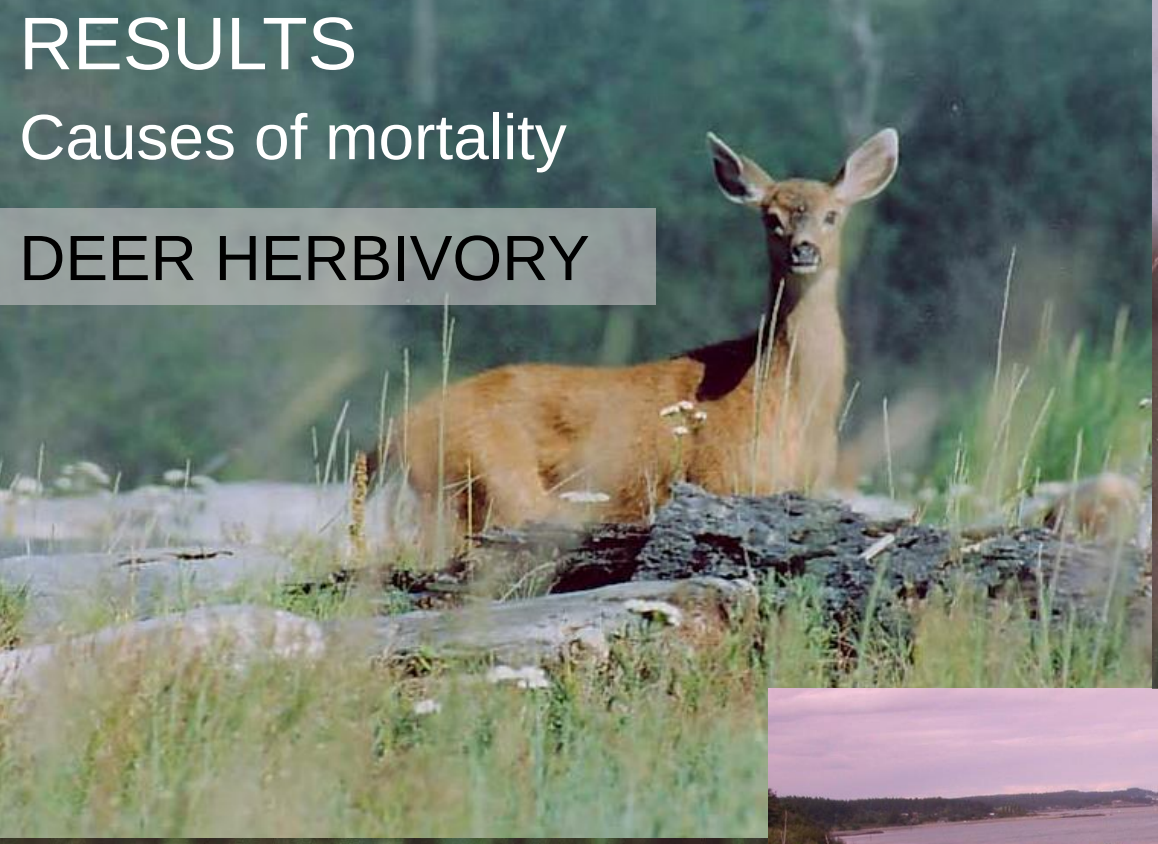
PREDATION

Family Lycosidae
(wolf spider)

RESULTS

Causes of mortality

DEER HERBIVORY



RESULTS

Causes of mortality

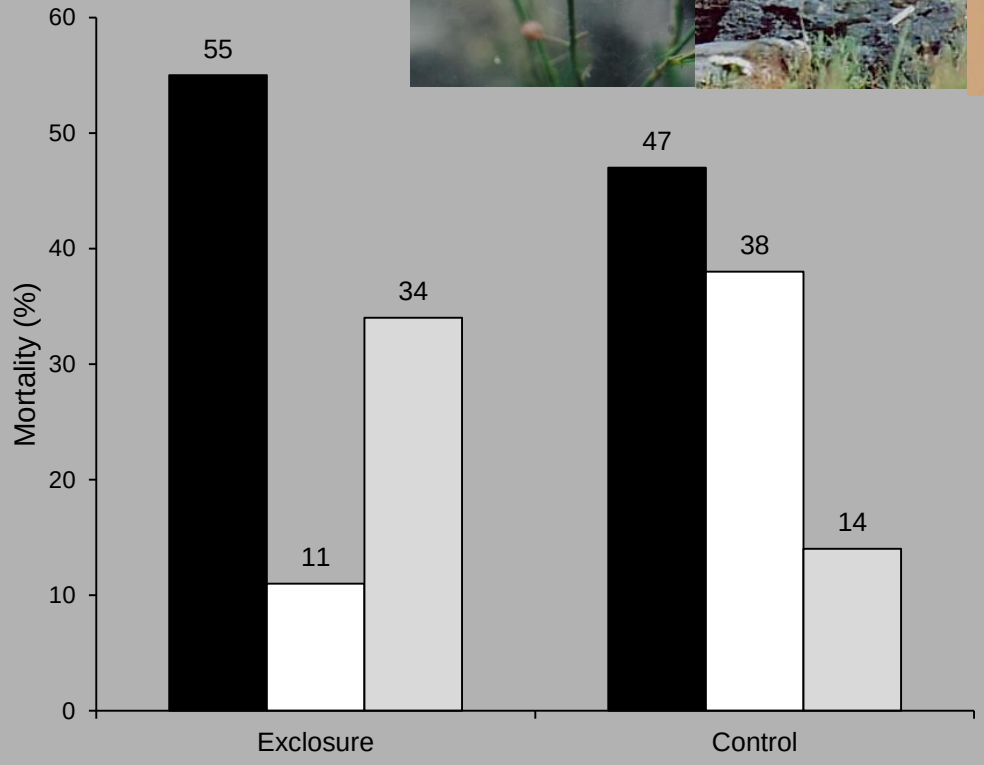
STARVATION

Family Cercopidaea
(spittle bug)

RESULTS

Causes of mortality

Sources of mortality of all life stages on *Brassica rapa* in control and exclosure study sites, 2013 (n=118)



*The odds of mortality due to deer in control sites was estimated to be 0.199 times higher than the odds of mortality in fenced sites (95% CI [0.074-0.539], p=0.001).

RESULTS

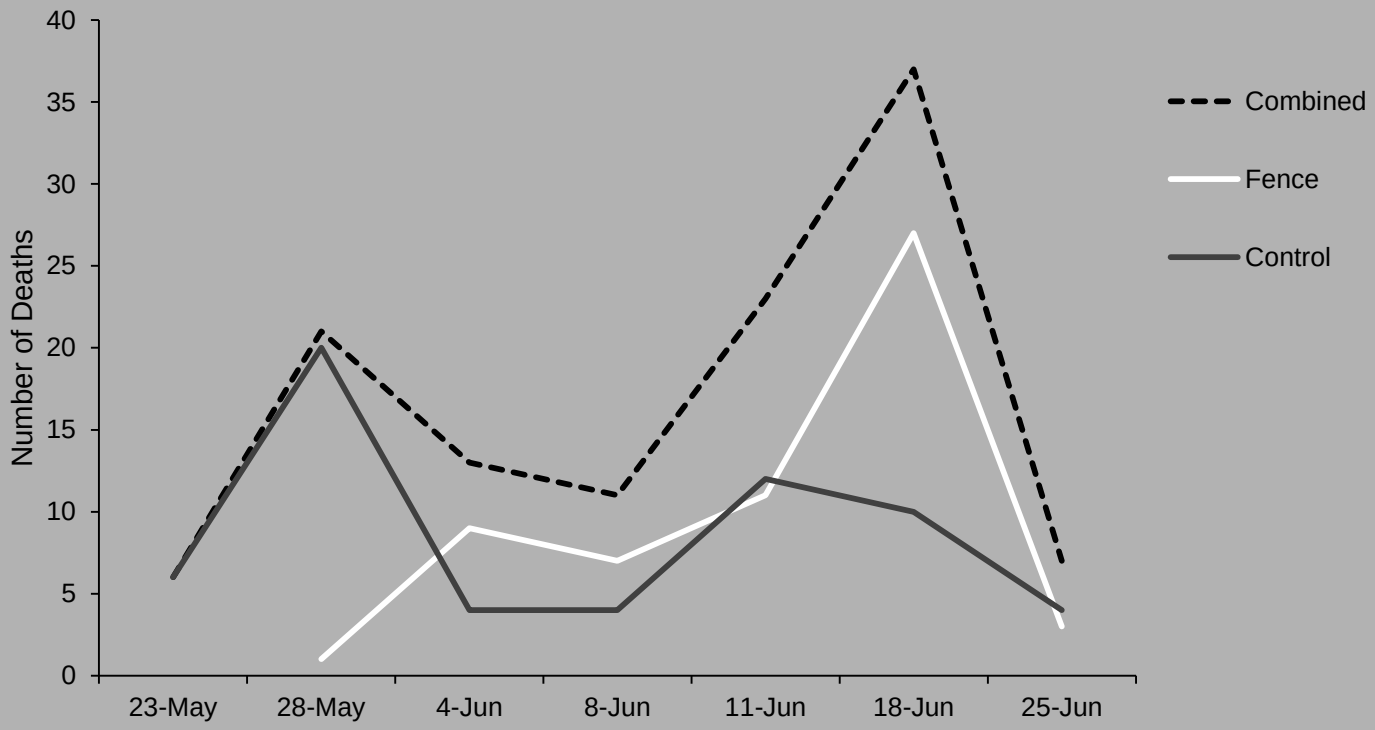
Survivorship

Stage-specific survivorship on *Brassica rapa* in control and exclosure study sites, 2013 (n=118)

RESULTS

Mortality

Trends in mortality over time on *Brassica rapa* in control and exclosure study sites, 2013 (n=118)



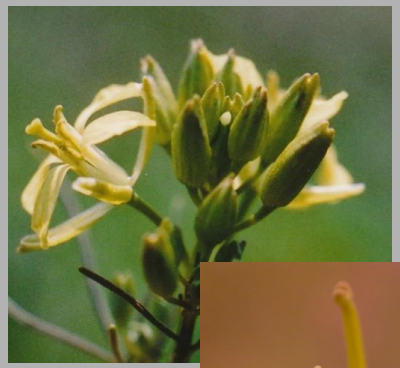
CONCLUSION

- Predation is the greatest source of mortality, 47% (n=56) followed by deer herbivory, 24% (n=28)

- Excluding deer increases survival of eggs and instar I

- Time of mortality (or date of death) is partly explained by predation

- Plants not “pruned” by deer early in the season (Apr/May) mature at a faster rate increasing starvation



DISCUSSION

- Impacts of deer browsing on *E. ausonides insulanus* are complex
- Fences are difficult to maintain especially at large scales
- Reduction of deer browsing does not increase overall survivorship (e.g., Instar III-instar IV 6% in 2005-2008; n=544)

Negative Deer Effects	Positive Deer Effects
Reduces oviposition sites (Apr/May)	Increases oviposition sites (late May/June)
Consumption of eggs and larva	Browsing increases plant longevity
Likely reduces seed set	

MANAGEMENT RECOMMENDATIONS

- Restore *Brassica rapa* host plant habitat

- Continue to exclude deer early in the season when egg density is the greatest

- Experimental study to investigate the effects of browsing on plant phenology and fecundity

- Further investigate factors that cause mortality late in the season when survivorship is low

ACKNOWLEDGEMENTS

Co-Authors

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RESULTS

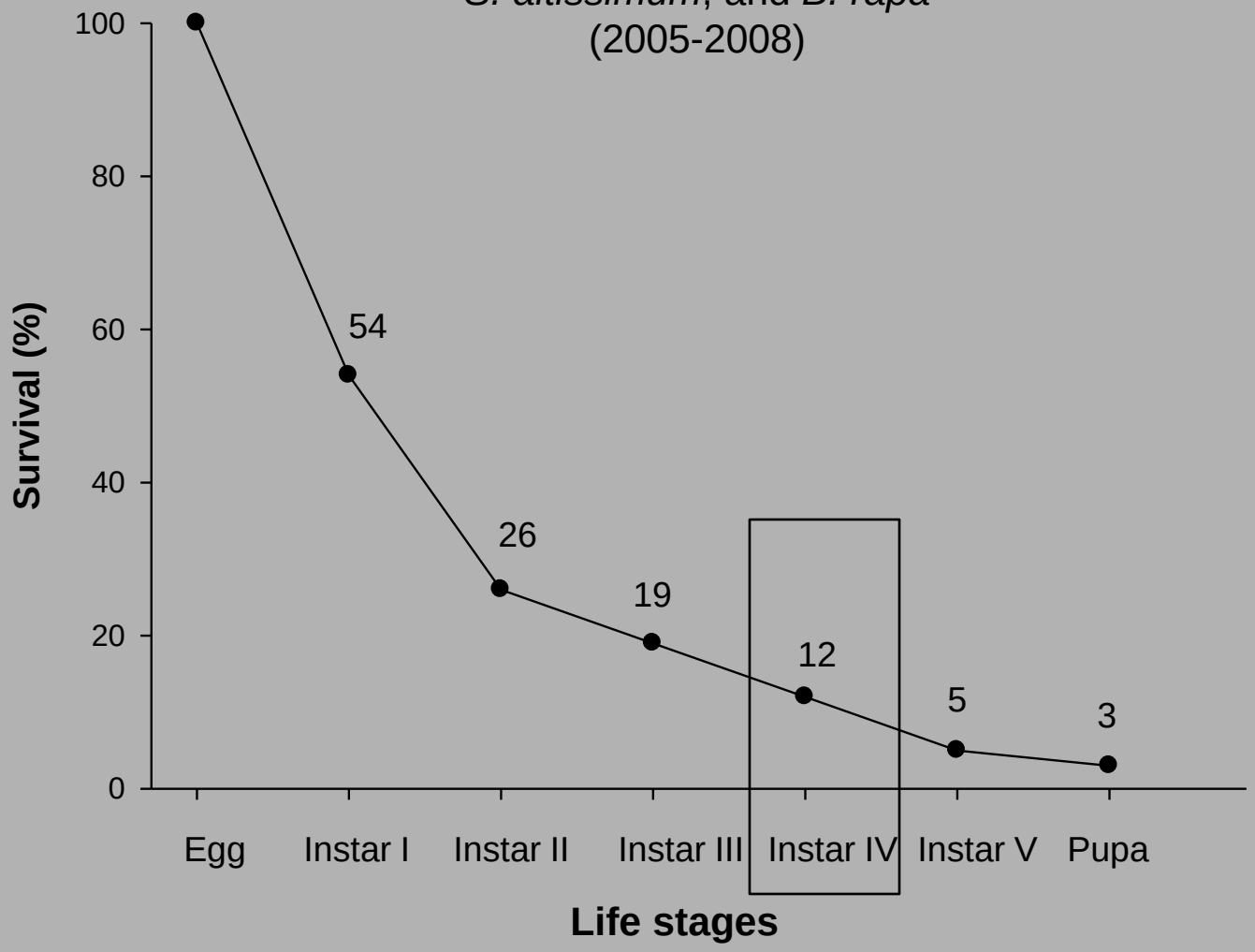
Survivorship and mortality

Bridgepix.com

Photo by: Beatriz Moisset

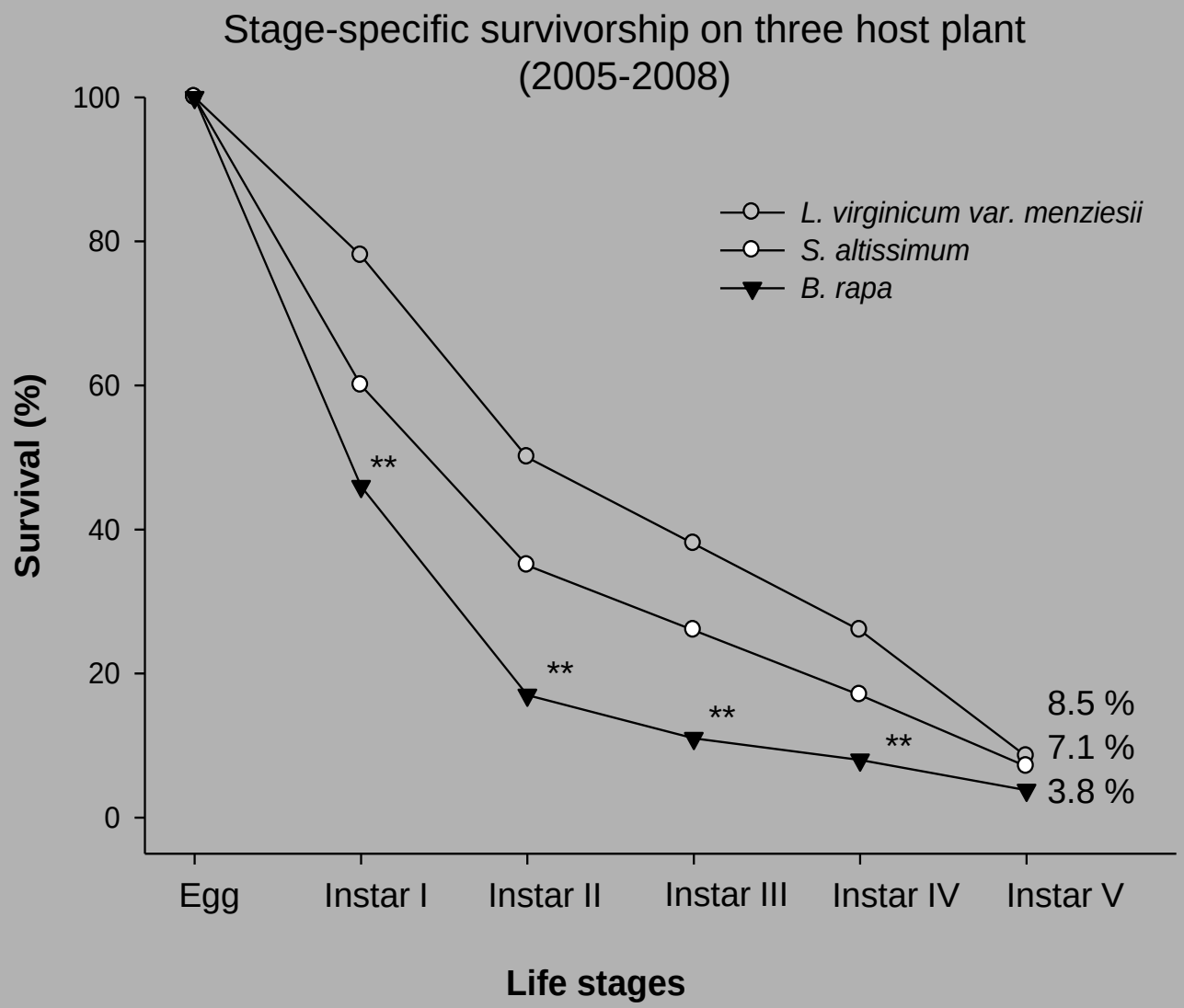
Photo by: Kevin McKereghan

Percent survivorship of eggs (n=1617) among all sites and three host plant species, *L. virginicum* var. *menziesii*, *S. altissimum*, and *B. rapa* (2005-2008)



RESULTS

Survivorship and mortality



** $P < 0.01$