“Choosy Plants:” Do More Chromosomes Mean More Bees?

University of Colorado – Boulder
University of Nebraska – Lincoln
rob.laport@gmail.com
www.robertlaport.com

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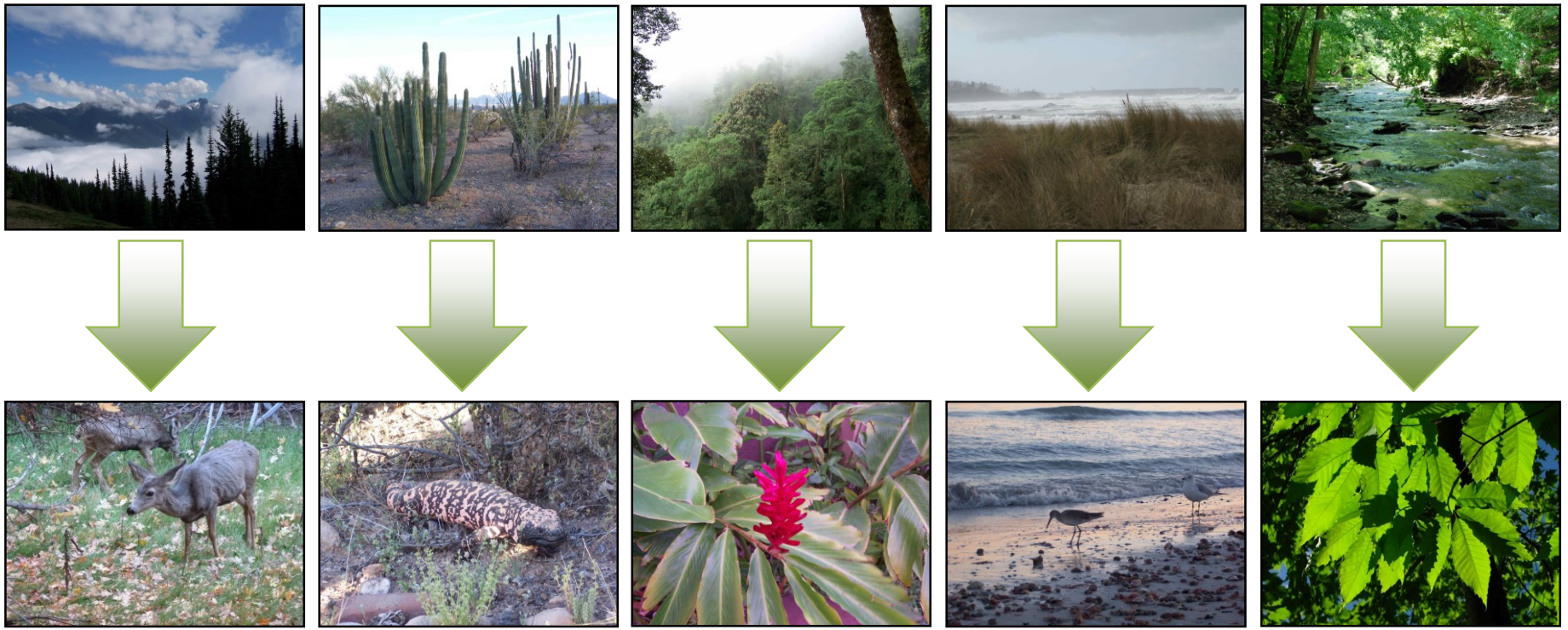
Biodiversity

What processes shape patterns of biodiversity?



Ecological Interactions, Evolutionary Forces

Biodiversity

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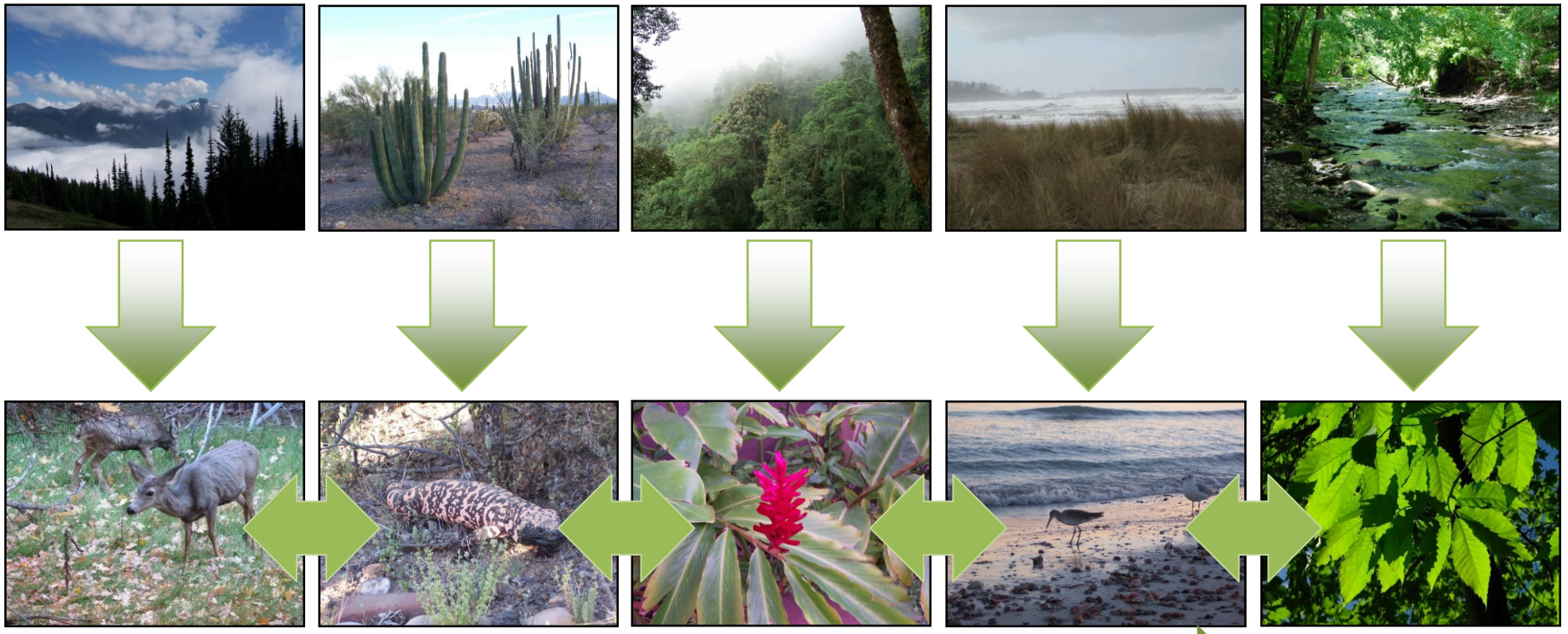


Ec Population Evolutionary Forces Species

Plant-Pollinator Interactions

Why so many different flowers?

Diversity of Size, Shape, Color, and Rewards







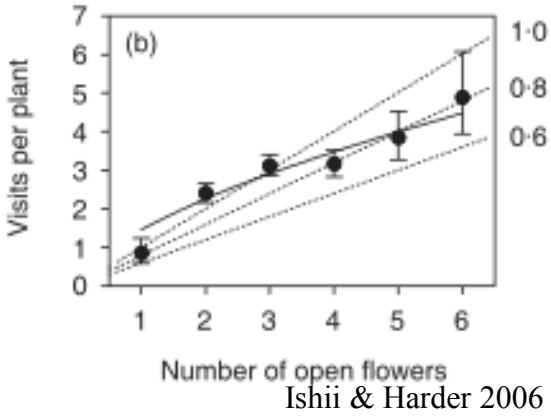


Population ⇔ Species

Why so many different flowers?

Alterations to Size, Shape, Color, Rewards…

Delphinium spp.

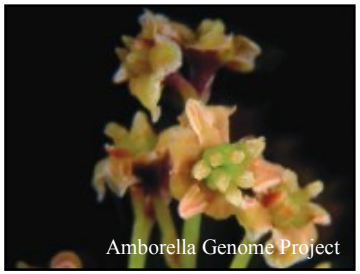


Ishii & Harder 2006

Mutation, Defense, Stress…

Attract New, More, Better Pollinators?

Polyploidy: Whole Genome Duplication


Diversification; all angiosperms are paleopolyploids

– Amborella Genome Project 2013

Common in temperate & formerly glaciated areas

– Brochmann et al. 2004

~15% of speciation events in angiosperms

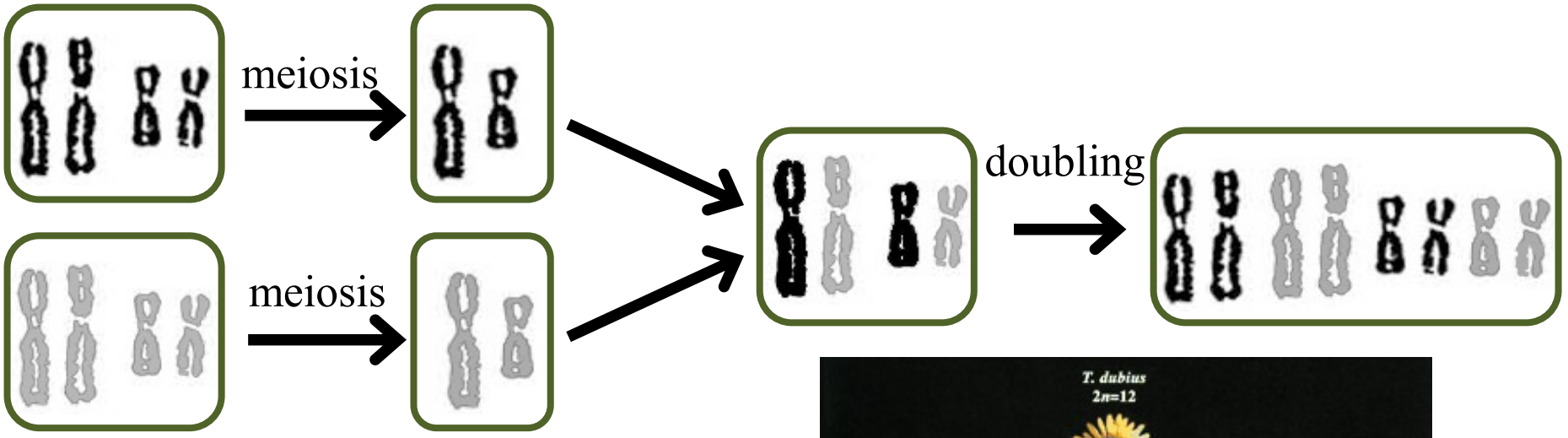
– Wood et al. 2009

Polyploidy: Whole Genome Duplication

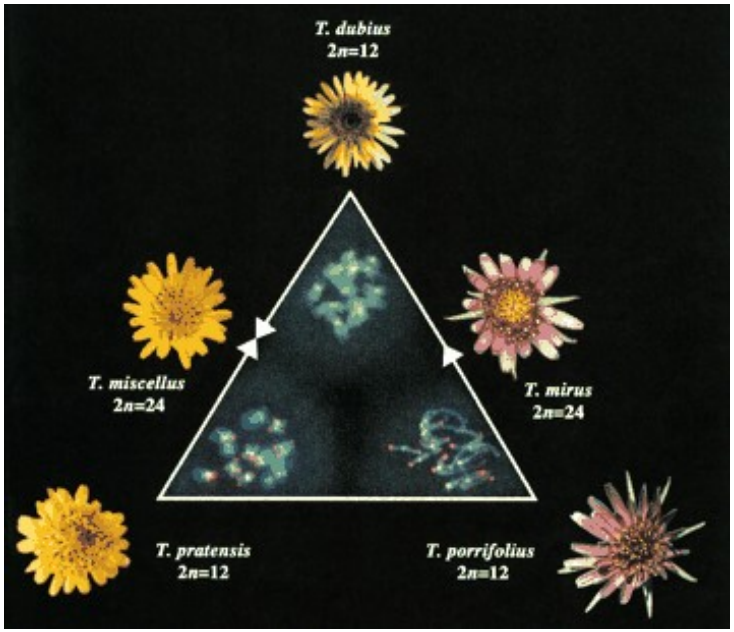
2*x* = diploid

Allopolyploidy

4*x* = tetraploid



Tragopogon spp.



Polyploidy: Whole Genome Duplication

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Autopolyploidy

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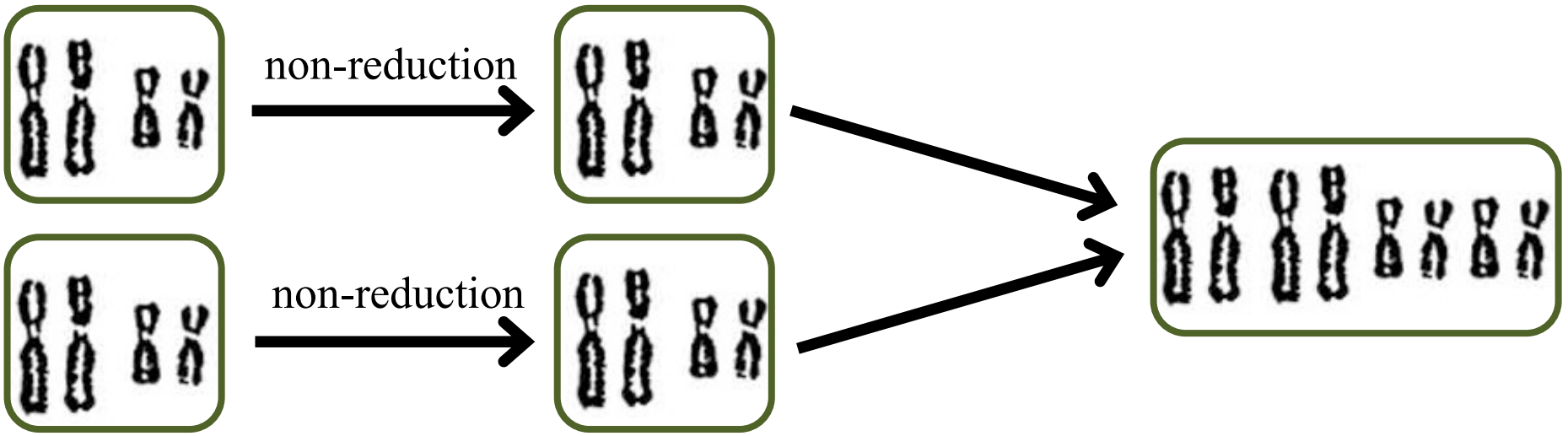
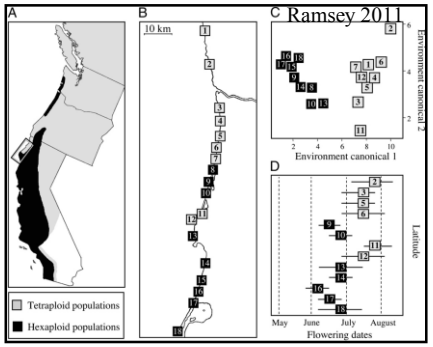


Achillea borealis

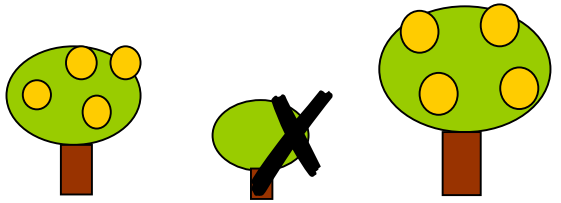
Autopolyploid Speciation

Ecological adaptation



Niche Shifts

Strong reproductive barriers



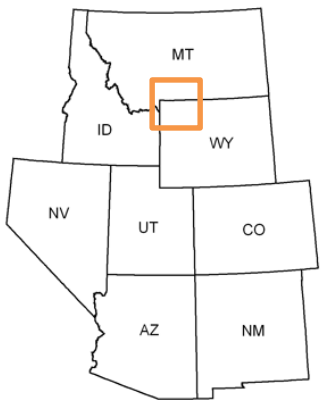
diploid triploid tetraploid

Morphological ambiguity

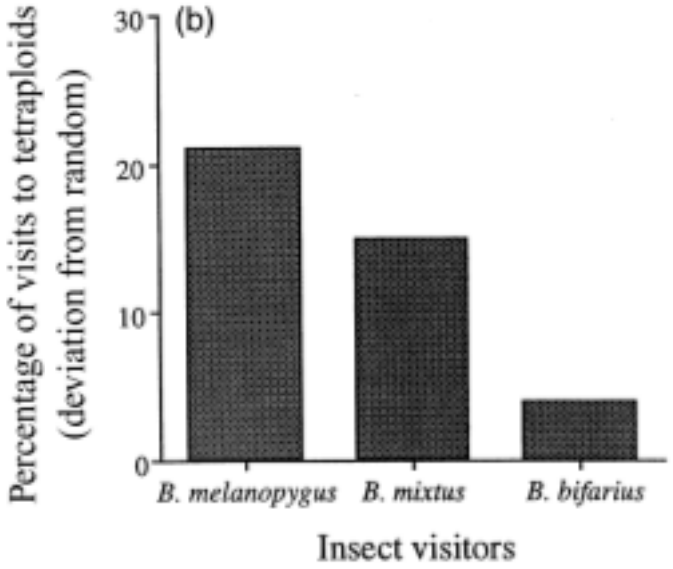
Hedera spp.

How does polyploidy influence pollinator visitation?

2*x* & 4*x* *Chamerion angustifolium*



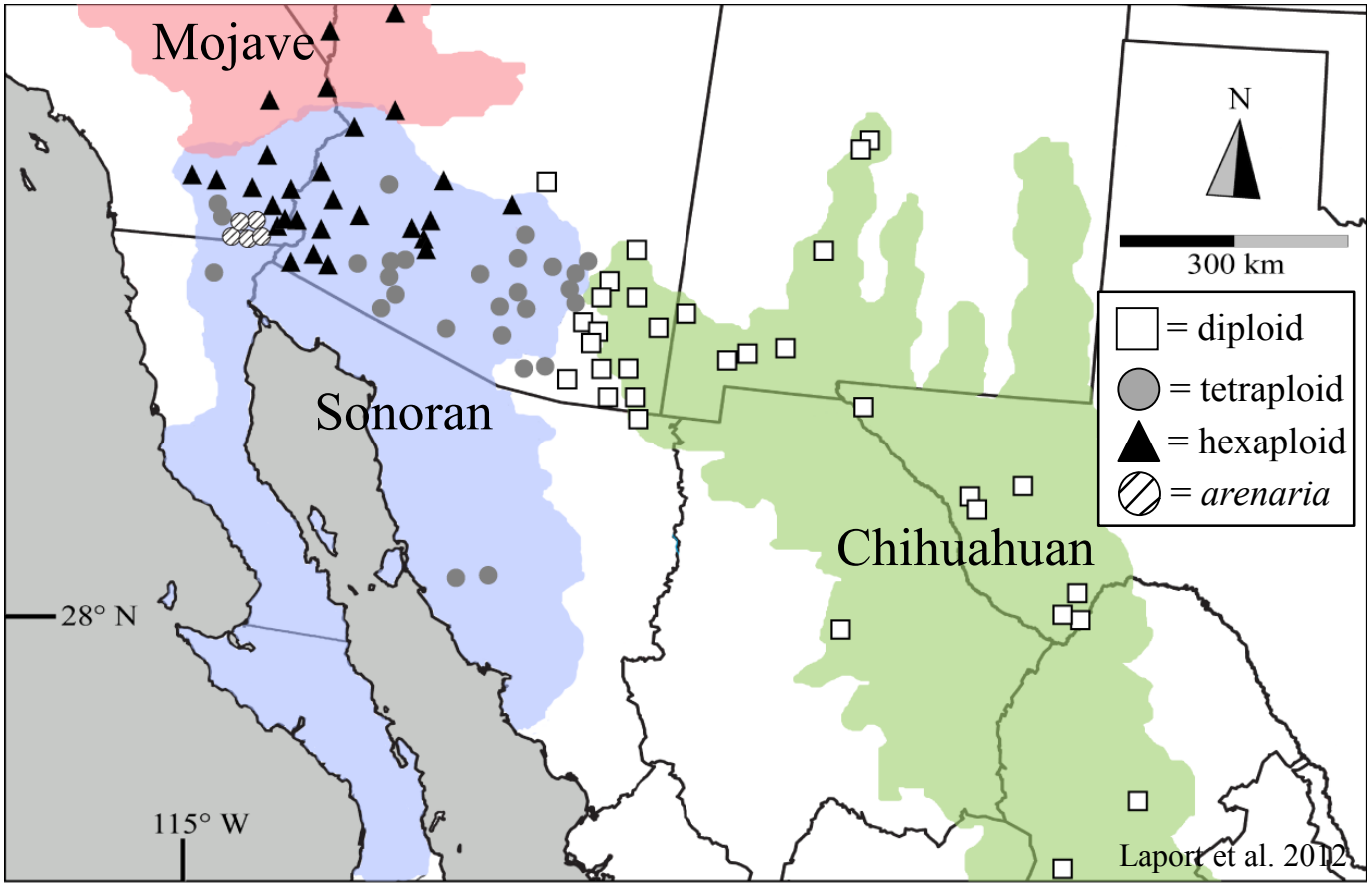
Fireweed



Husband & Schemske 2000

Larrea tridentata (DC.) Coville

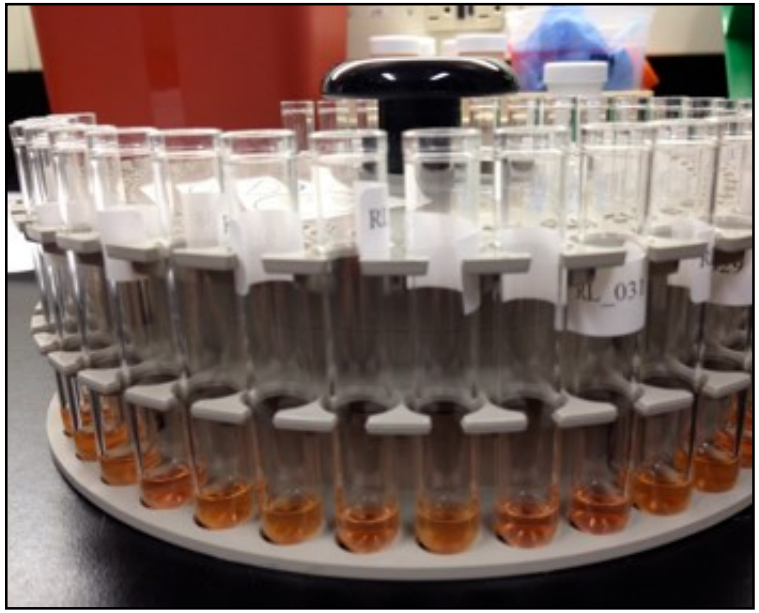
Creosotebush

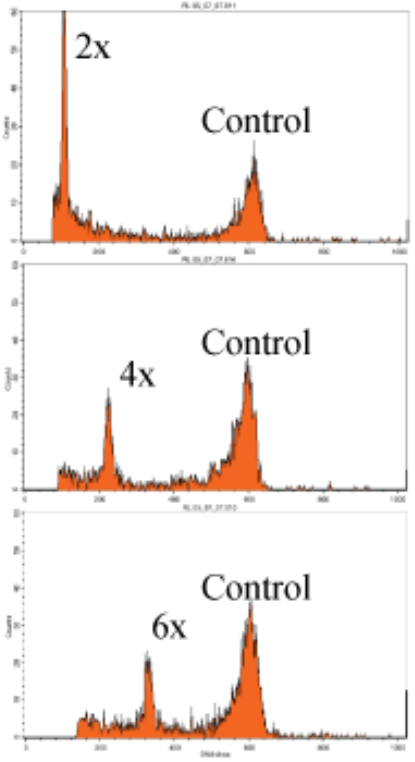


Long-lived desert “keystone” species

Flow Cytometry

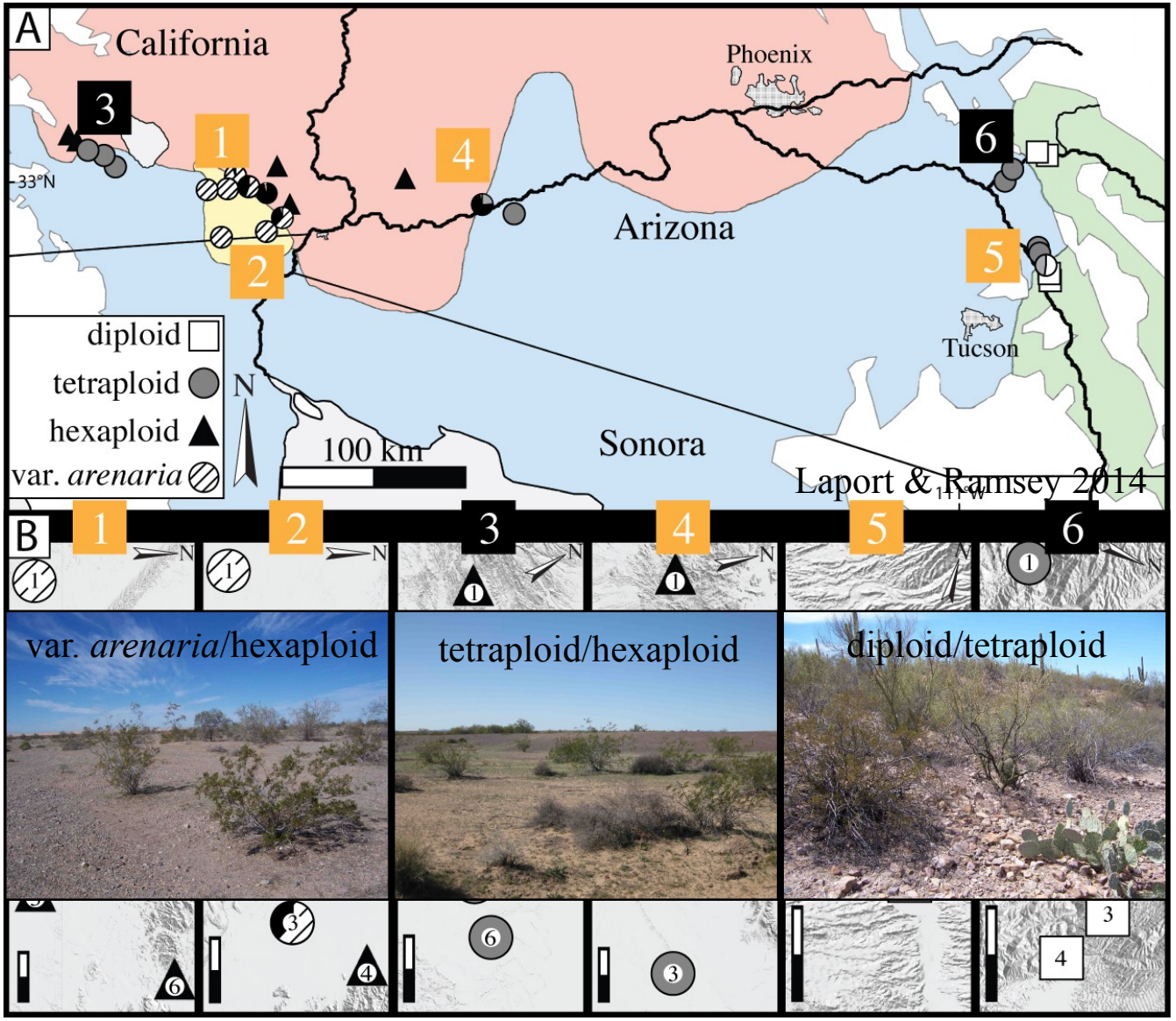
Fluorescent analysis of DNA content



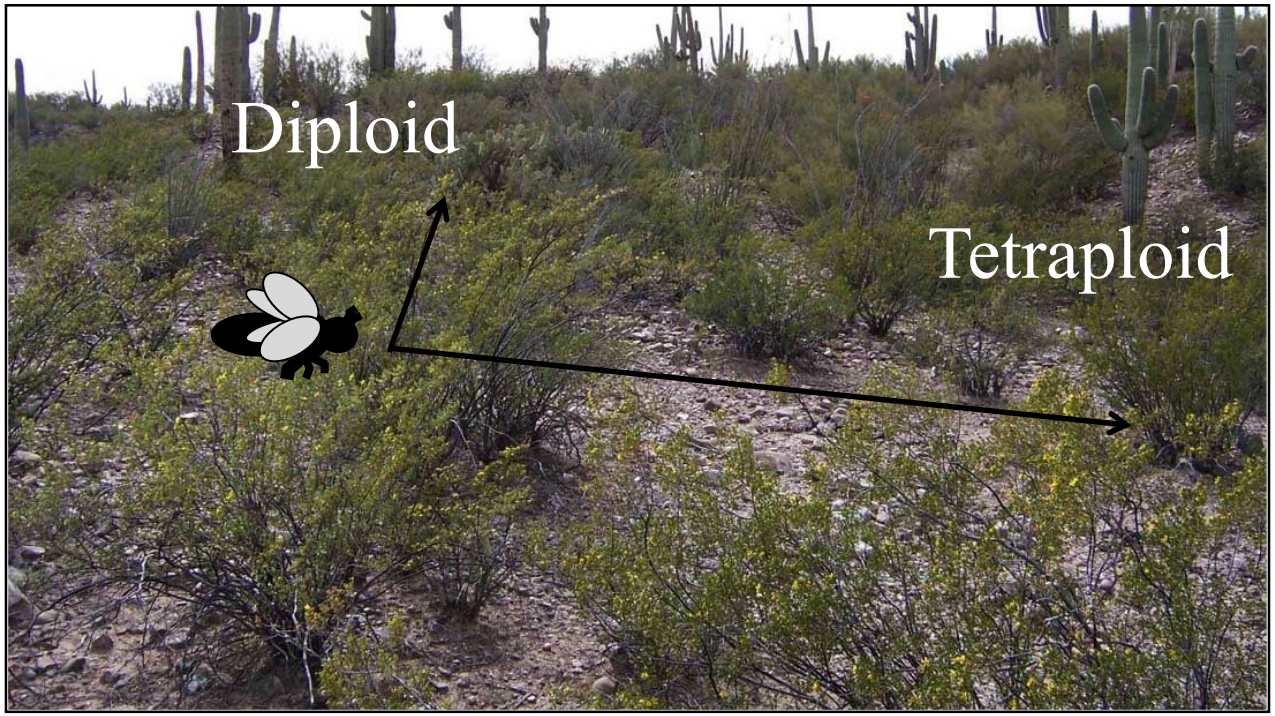


Replicated Permanent Transects

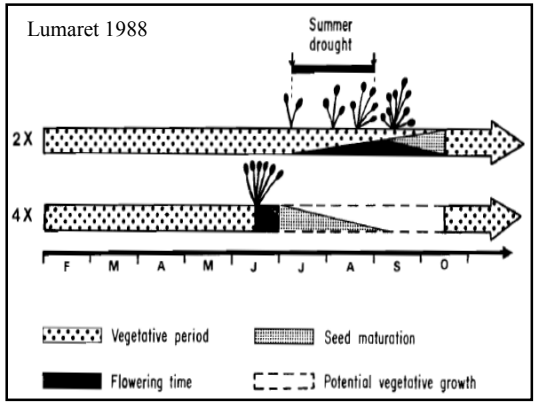
28 sites, ~1,500 plants



Does polyploidy influence pollinator visitation?



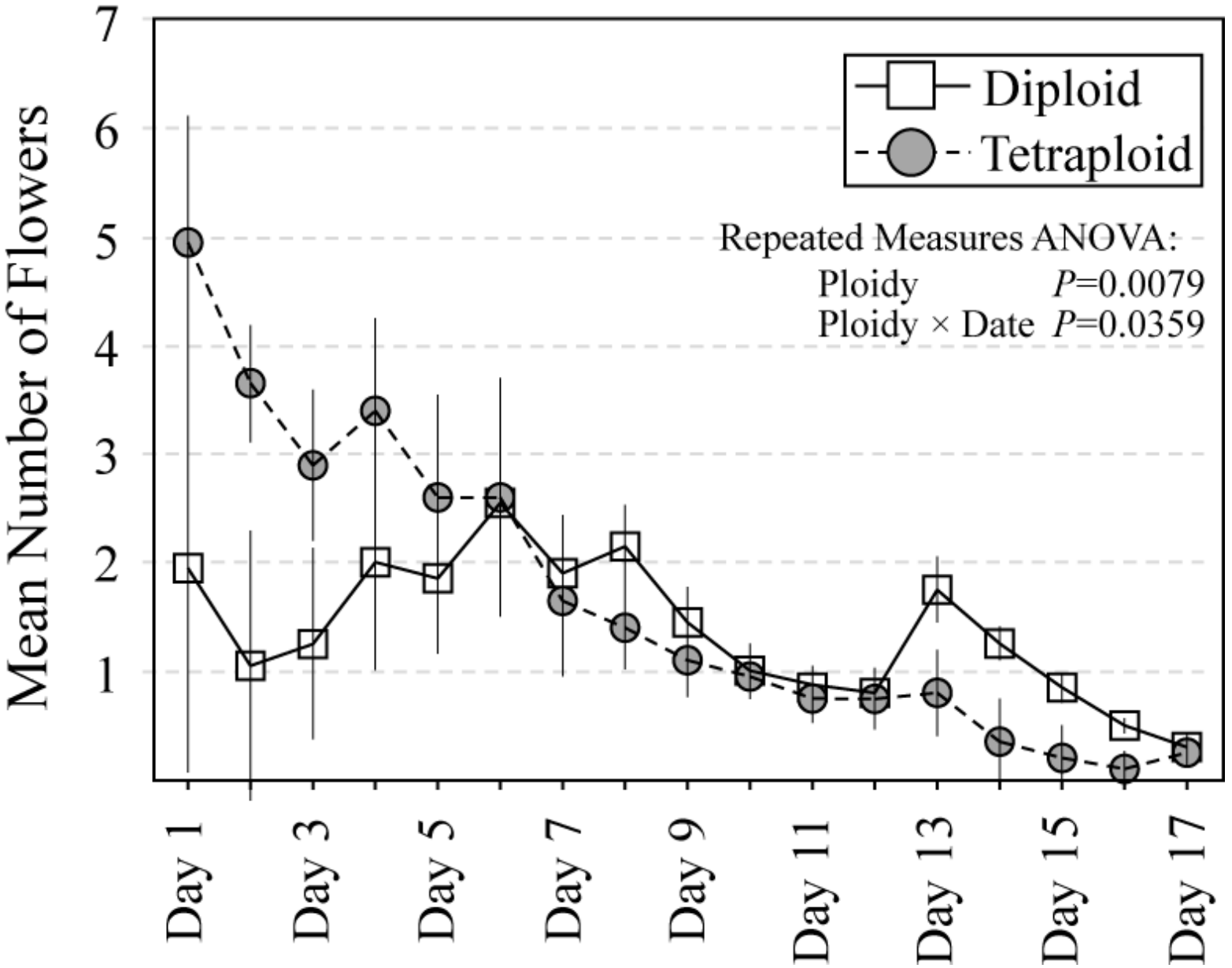
Flower Phenology



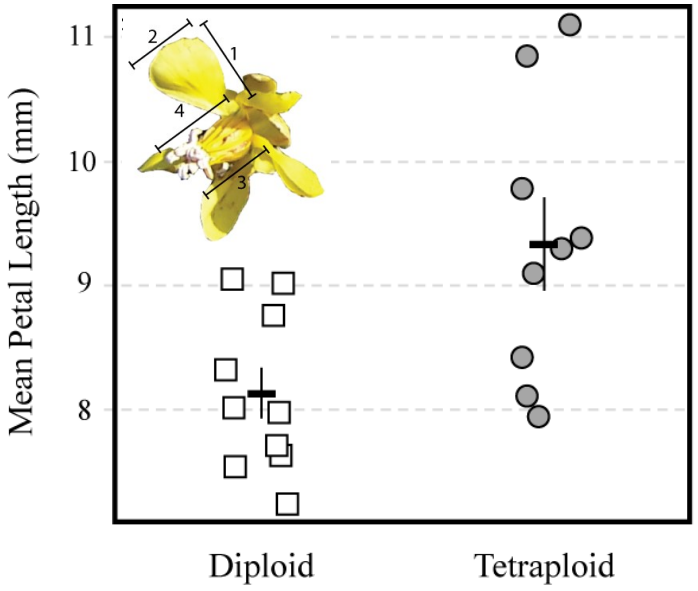
Floral Display & Resources

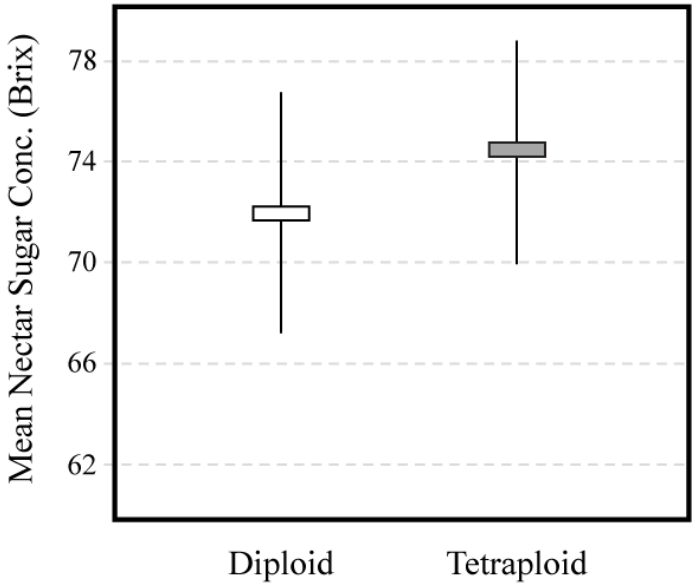
Pollinator Discrimination

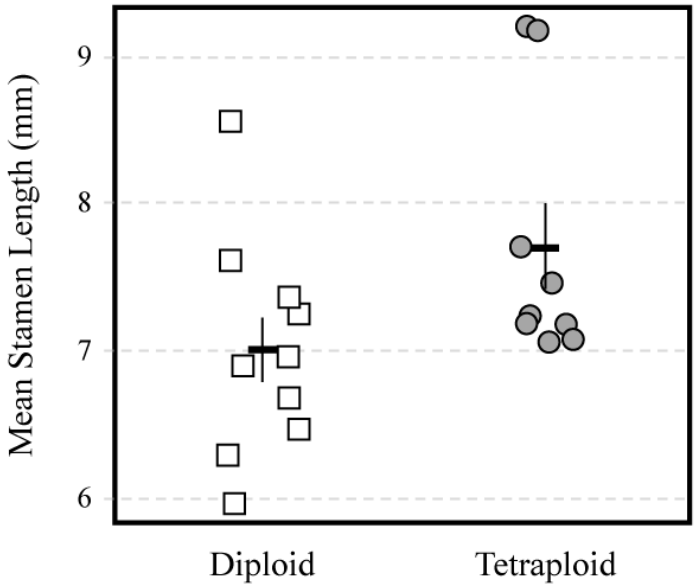
Flower Phenology

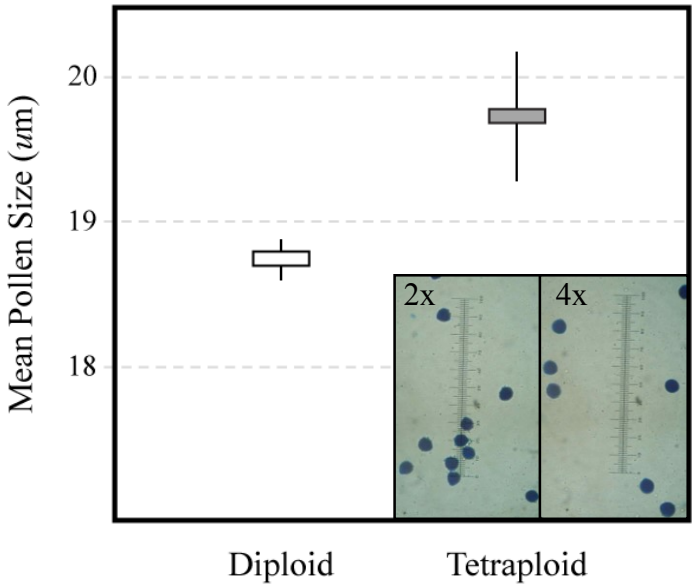


Floral Display & Resources

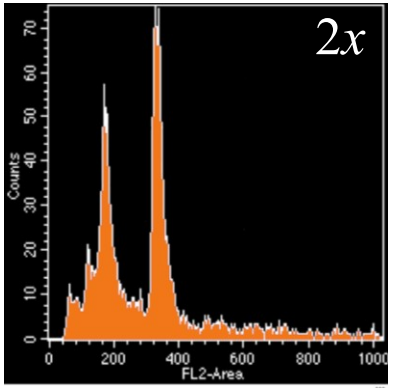


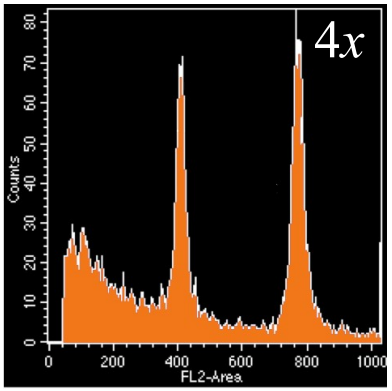


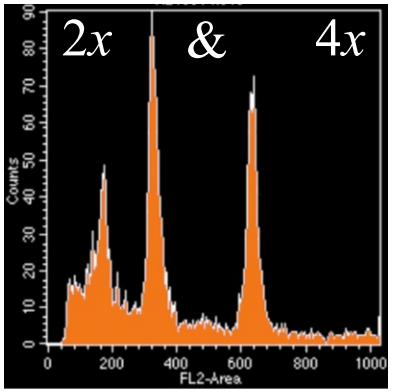




Pollinator Discrimination

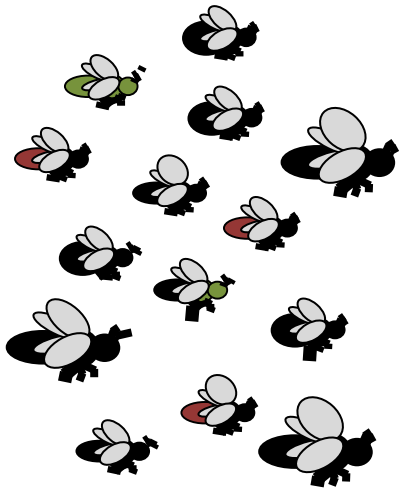






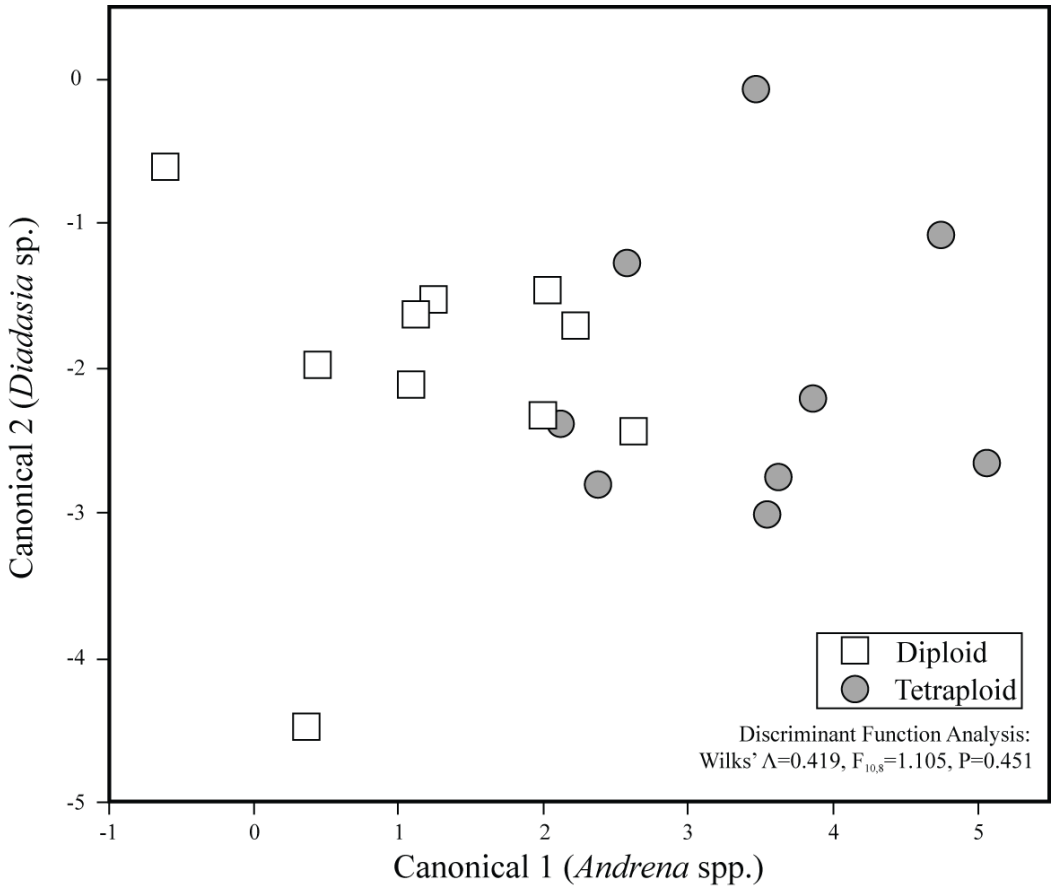
Pollinator Discrimination

Diploid

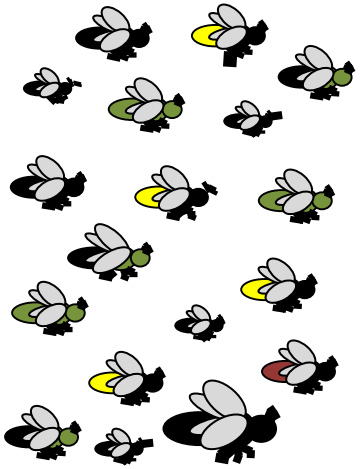


$S_{2x} = 24$

$H'_{2x} = 1.6$



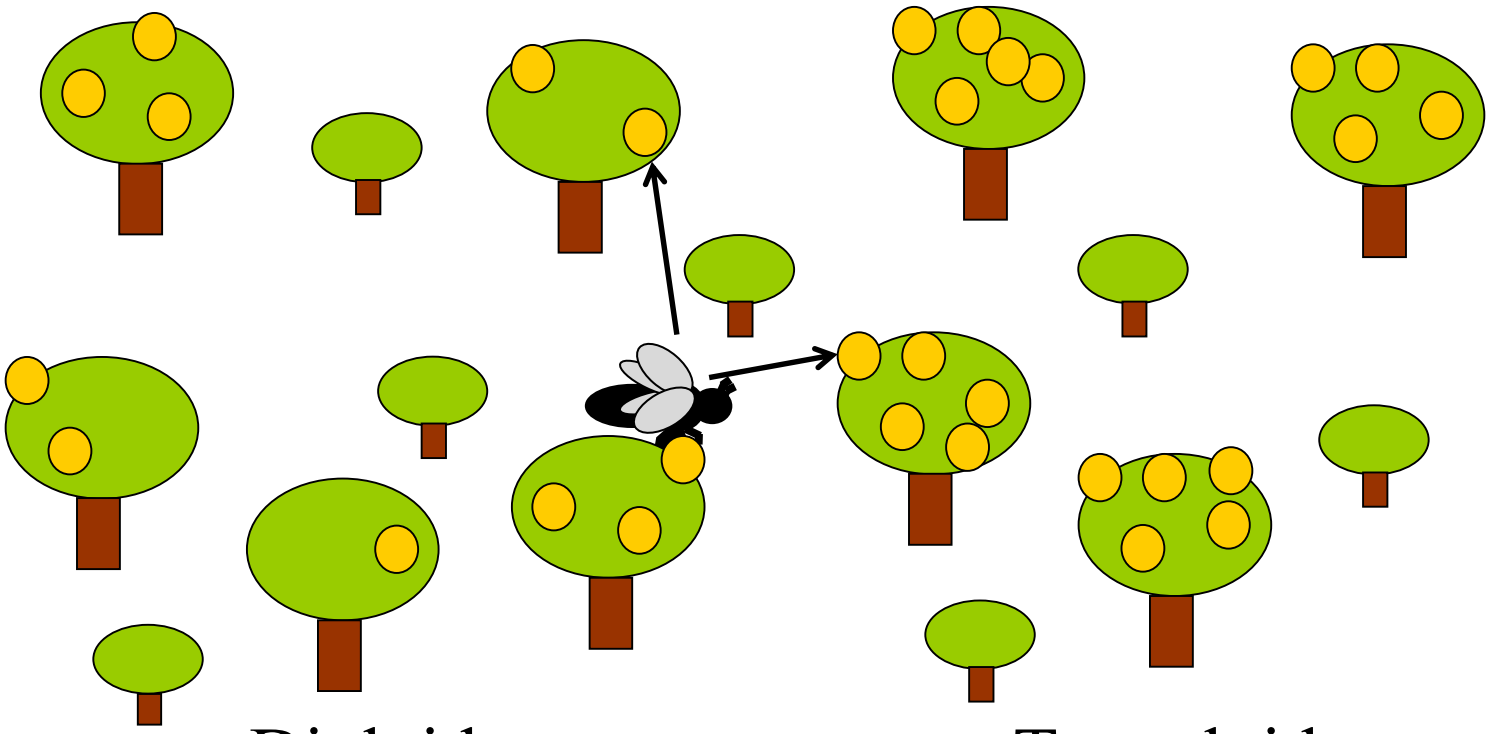
Tetraploid



$S_{4x} = 22$

$H'_{4x} = 1.3$

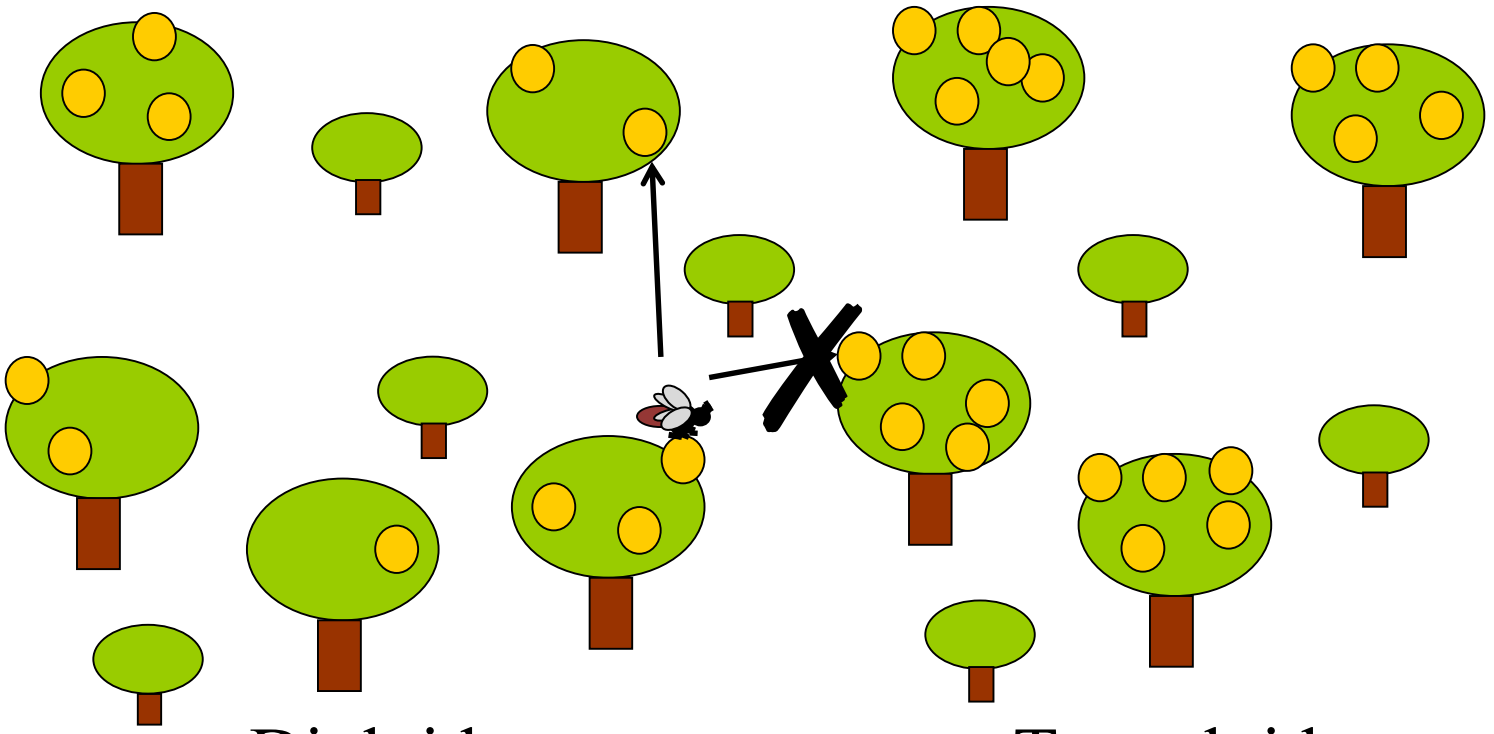
Pollinator Discrimination



Honeybees

22%: Only 2*x* Pollen	47%: Mixed Loads	31%: Only 4*x* Pollen

Pollinator Discrimination



Diploid

Tetraploid

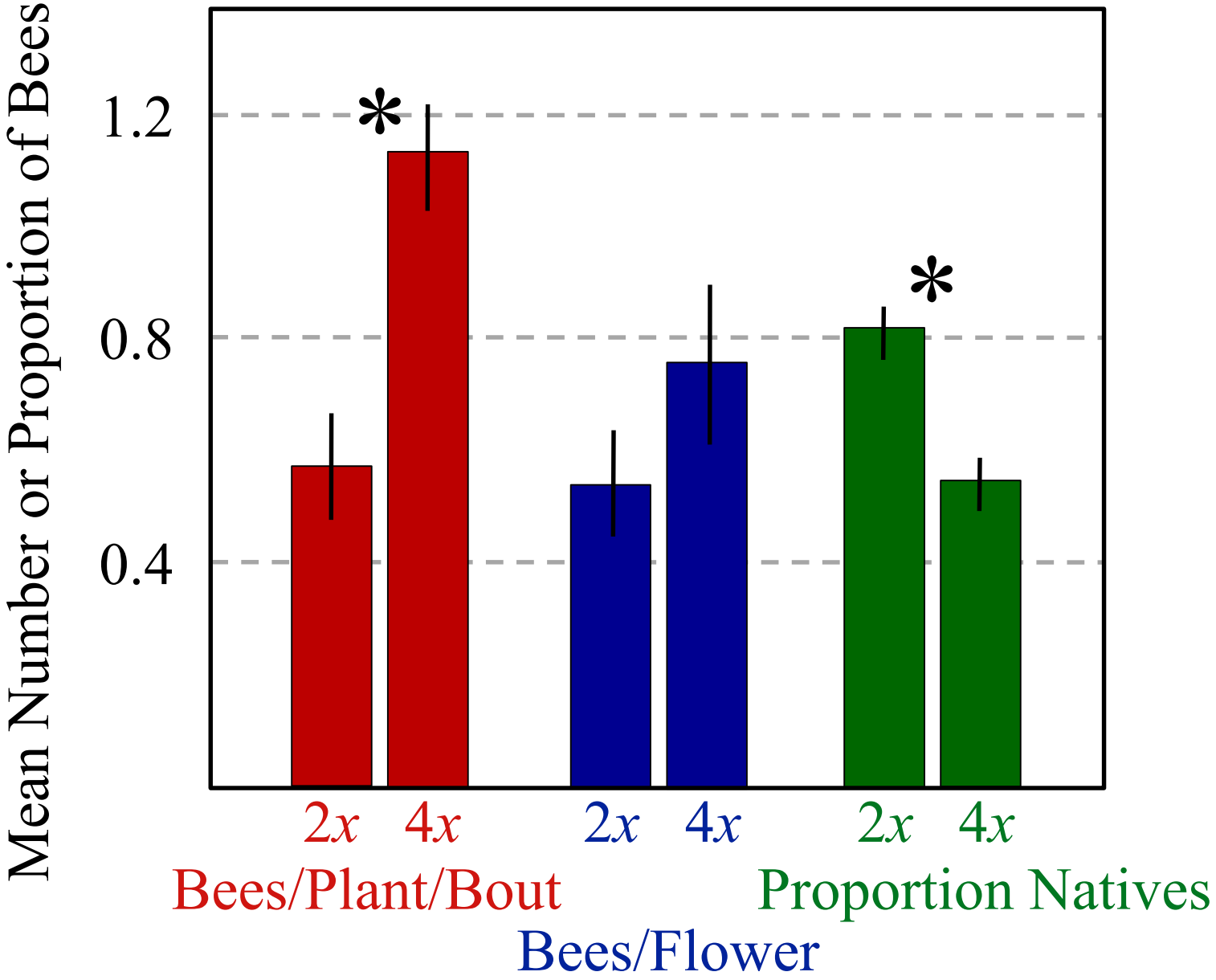
Honeybees

22%: Only 2*x* Pollen	47%: Mixed Loads	31%: Only 4*x* Pollen

Native Bees

90%: Only 2*x* Pollen	0%: Mixed Loads	10%: Only 4*x* Pollen

Pollinator Discrimination



Conclusions & Future Directions

Polyploidy Alters Plant Attributes:

- unique flowering responses over time
- $4x > 2x$ flowers, pollen, nectar sugar

Polyploidy Influences Pollinators

- bee assemblages differ slightly
- more bees overall on $4x$ plants
- honeybees don't seem to care
- native bees exhibit $2x$ pollen bias, show up more on $2x$

Extend to $4x$/$6x$; Polyploidy Reduces Gene Flow

Advising & Collaboration:

Diana Pilson (Univ. of Nebraska)
Stacey Smith (Univ. of Colorado)
Justin Ramsey (Black Hills State Univ.)
Bob Minckley (Univ. of Rochester)
Brian Husband (Univ. of Guelph)
Tara Ramsey (Black Hills State Univ.)
Paul Kron (Univ. of Guelph)
Adam Green (Colgate Univ.)
Daven Presgraves (Univ. of Rochester)
Carmala Garzione (Univ. of Rochester)

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Undergraduates:

Carter Kennell
Haydar Hasan
Purity Muhia
Margaret Ball
Aviv Brockman
Julia Cosgrove
Erin Fox
Owen Hardy
Layla Hatem
Dana Hilfinger
Annalise Kjolhede
Adam Mattison
Colleen McHale
Olivia Morgan
Hannah Pullman
Emily Reiss
Caitlin Smigelski
Tim Tsai
Michael Wallis
Laney Widener


Sarah Laport


Michael Laport


Julienne Ng


Maria Strangas


Matt Deveney


Adrian Minckley

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Why so many different flowers?

Diversity of Size, Shape, Color, and Rewards









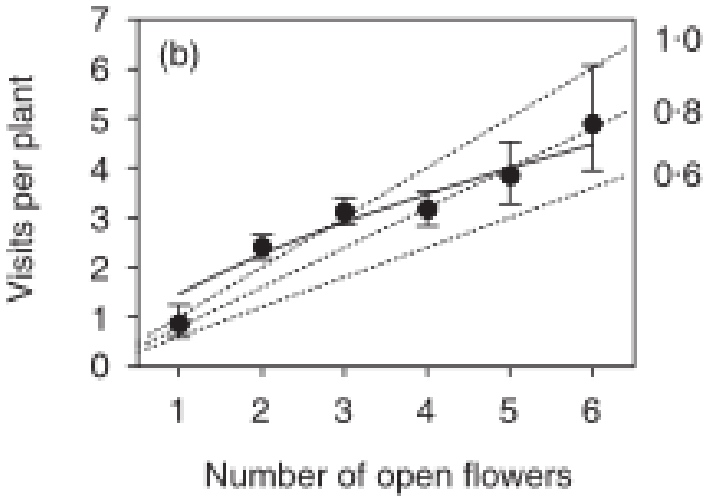
Mutation, Defense, Stress…

Attract New, More, Better Pollinators

Why so many different flowers?

Changes in Size of Floral Display

Delphinium spp.



Ishii & Harder 2006

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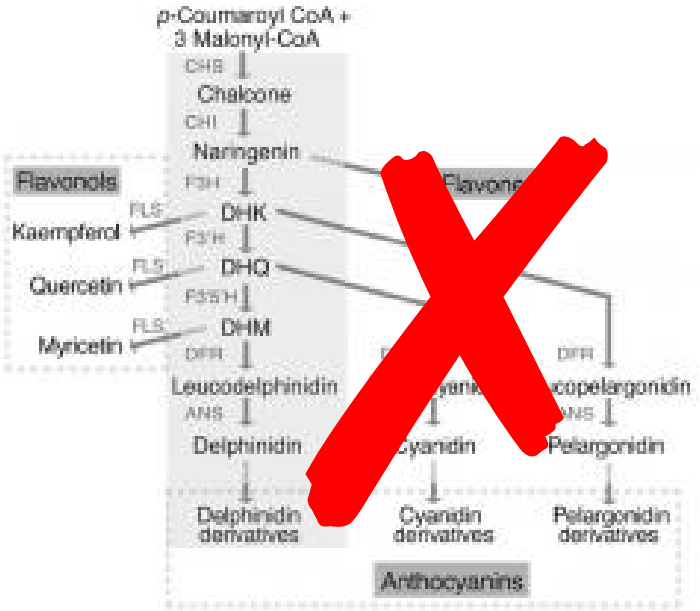
Attract New, More, Better Pollinators?

Why so many different flowers?

Changes in Color



Iochroma spp.

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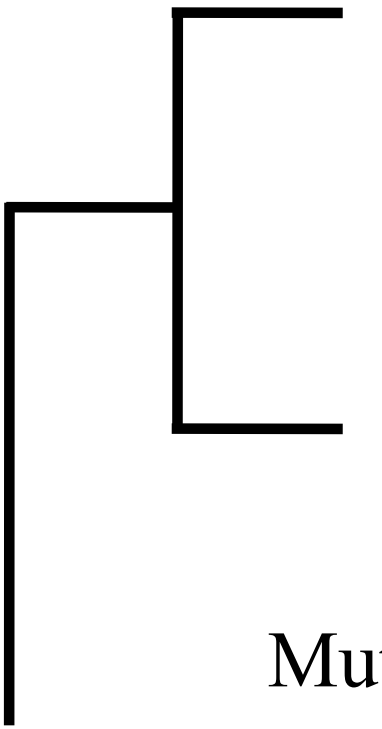
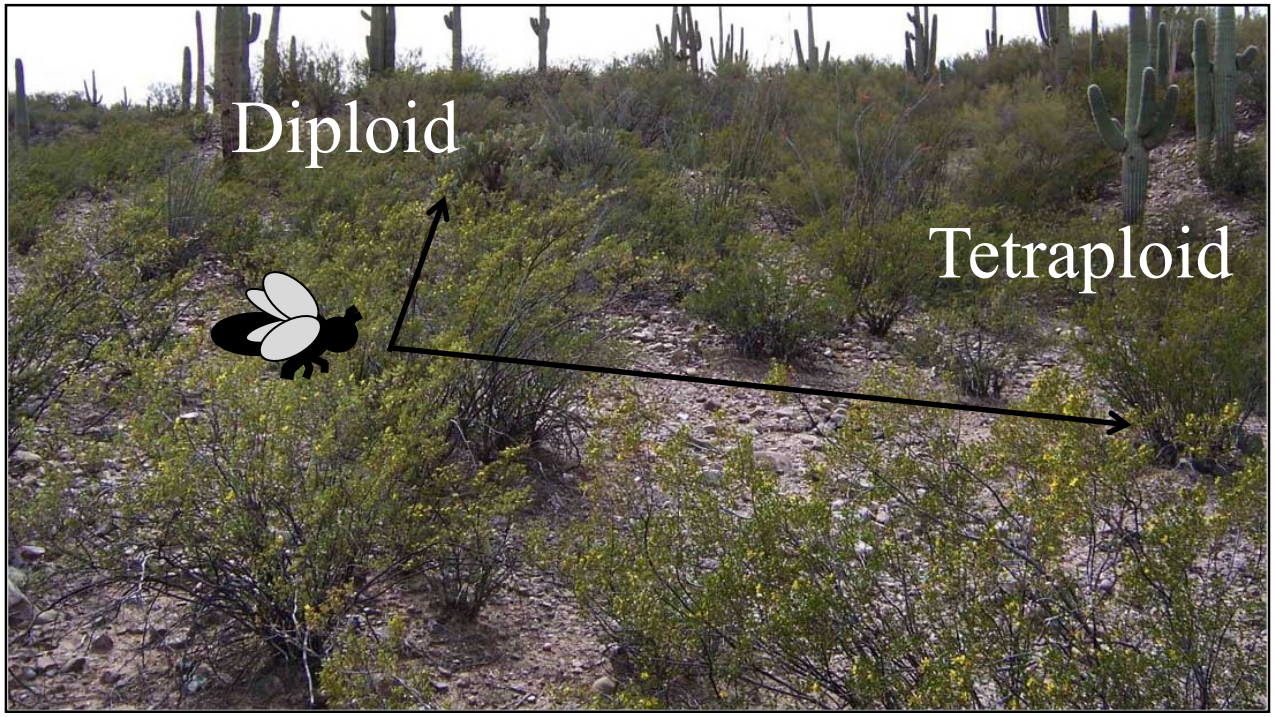
Alterations to Size, Shape, Color, Rewards…



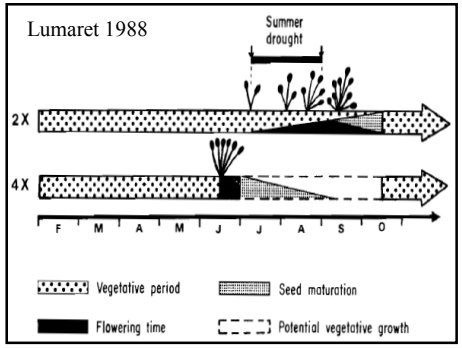
Mutation, Defense, Stress…

Attract New, More, Better Pollinators?

Does polyploidy influence pollinator visitation?



Flower Phenology



Floral Resources

Pollinators

Genetic Structure