

The conservation and ecology of native bees and other pollinators



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Outline

- Overview of pollination and bee biodiversity
- My research on forest bees at Rutgers University
- What you can do to support native bees
- Bee ID!

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Pollination: Transfer of pollen grains from anther to stigma





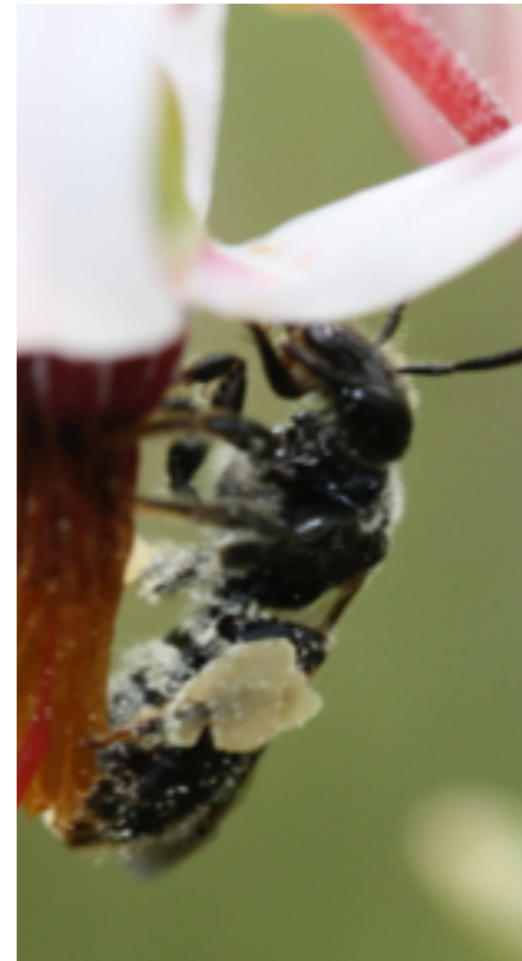


~ 87% of all flowering plants



Ollerton et al. 2011
Oikos

>2/3 crop species use animal-mediated pollination



Klein et al. 2006 J. Applied Ecology





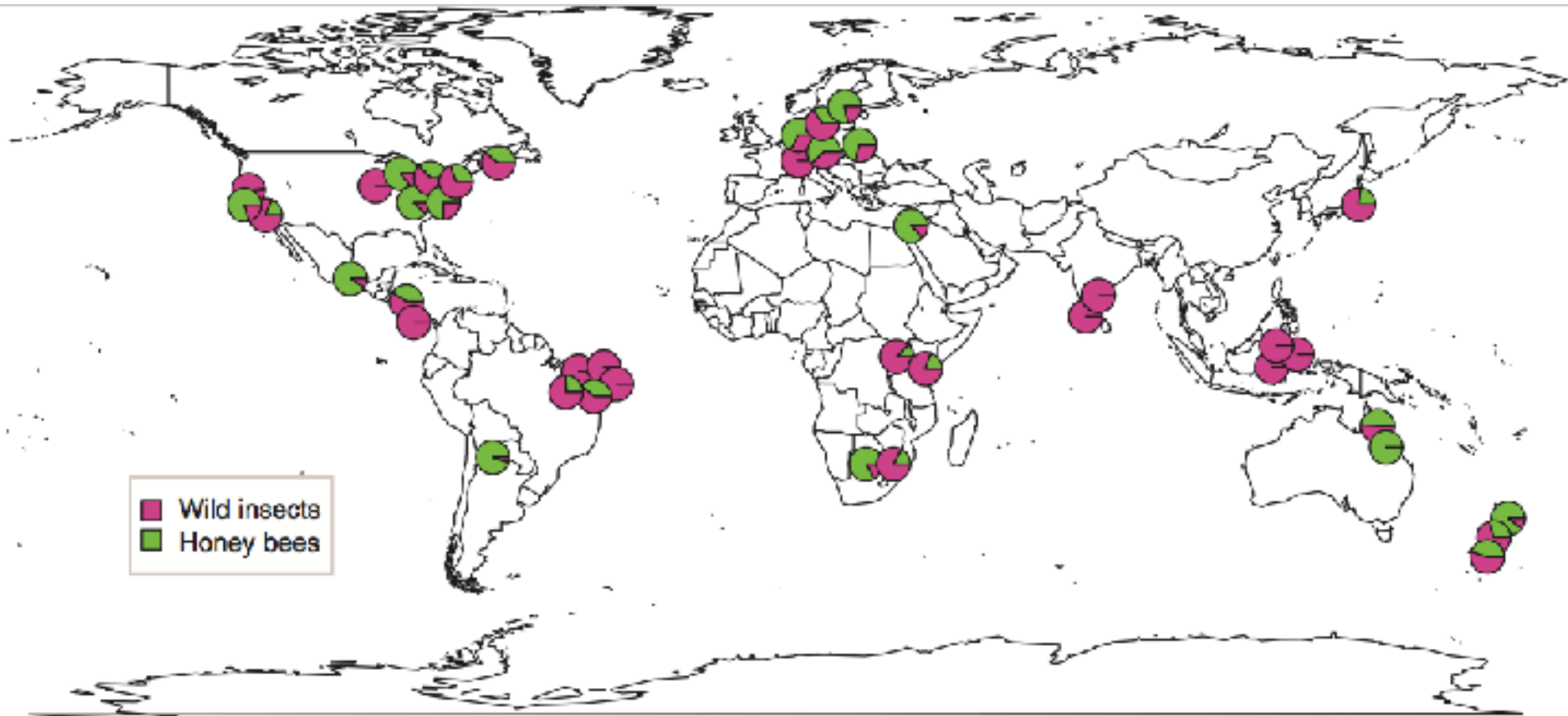
Bees







Native bees are important pollinators for many crops globally



Garibaldi et al 2013 *Science*

3 bee life history strategies

Solitary

- 77% of bee species



Social

- 10% of bee species



Parasitic

- 13% of bee species



3 bee life history strategies

Solitary

- 77% of bee species



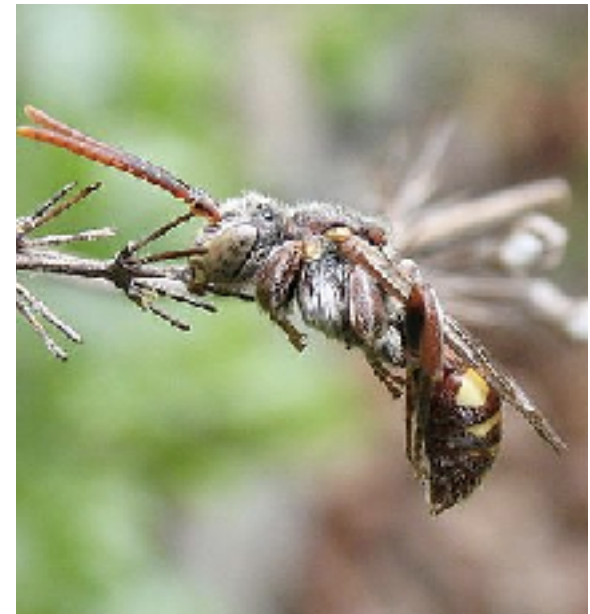
Social

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Parasitic

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Bee life histories: solitary

The vast majority of bees!

Andrena erigeniae



Colletes inaequalis



Augochlora pura



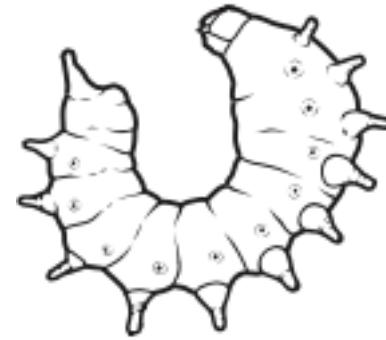
Pupa



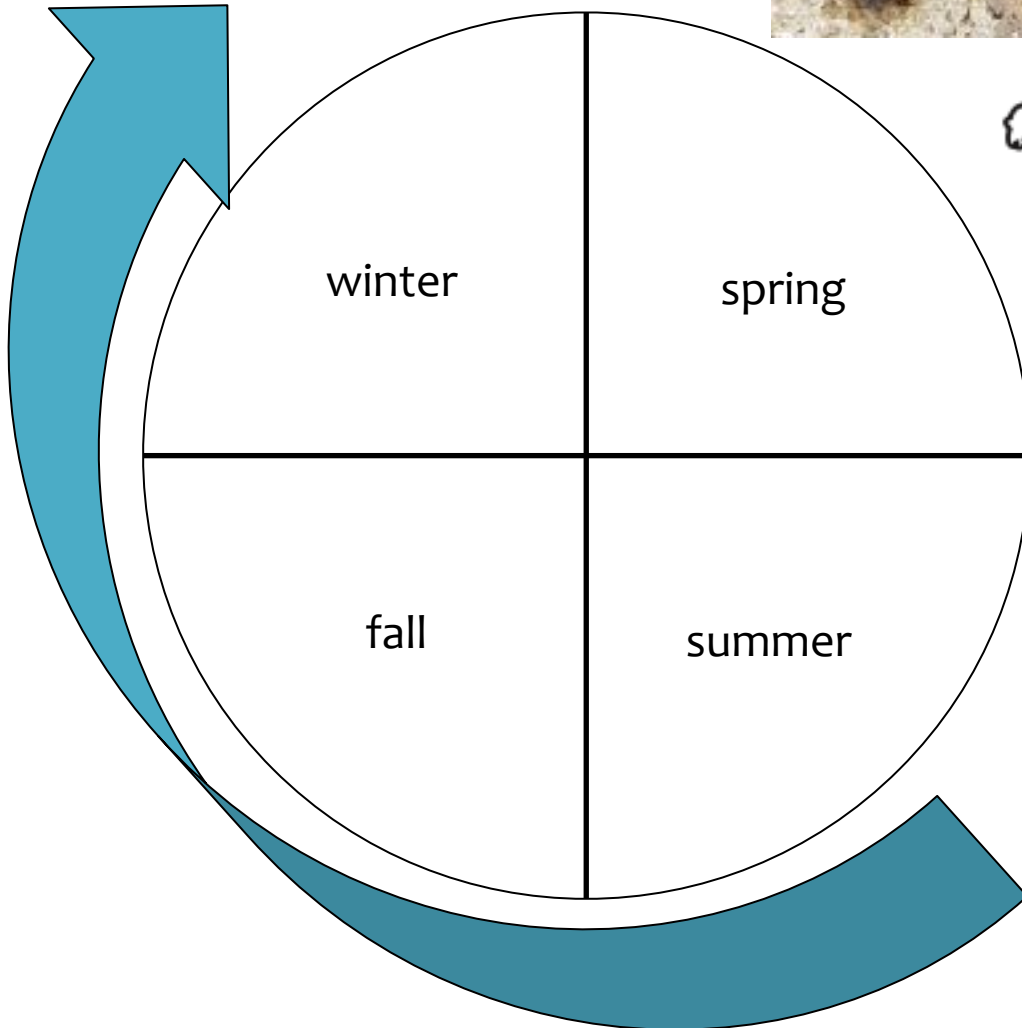
Adult bee



Egg



Pre-pupa



winter

spring

fall

summer

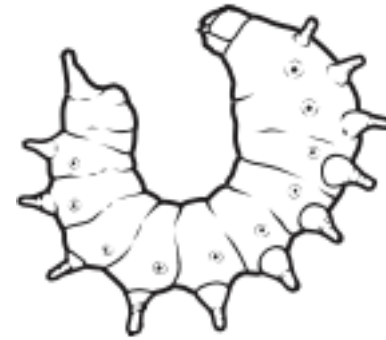
Pupa



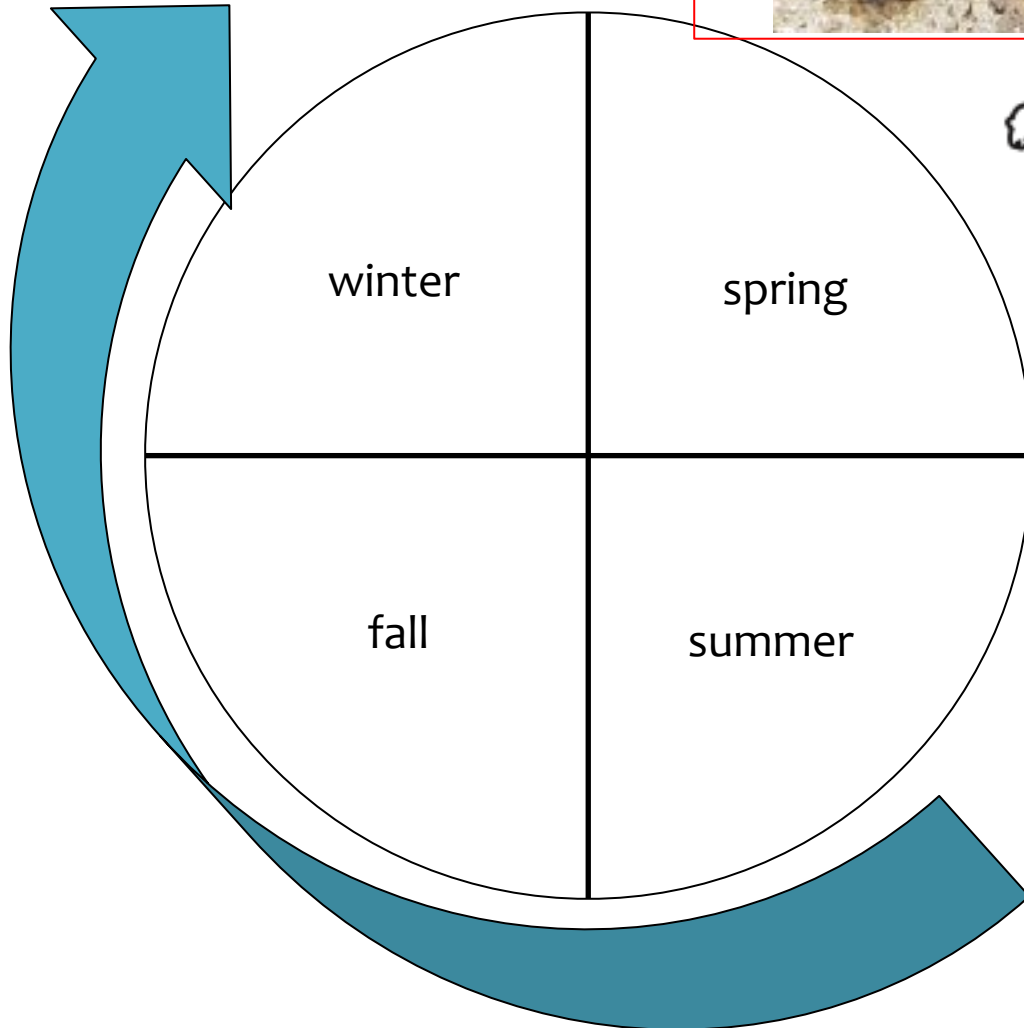
Adult bee



Egg



Pre-pupa



winter

spring

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Pupa

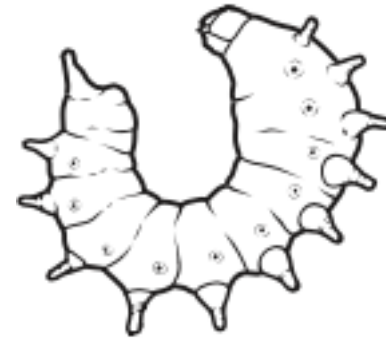


Adult bee

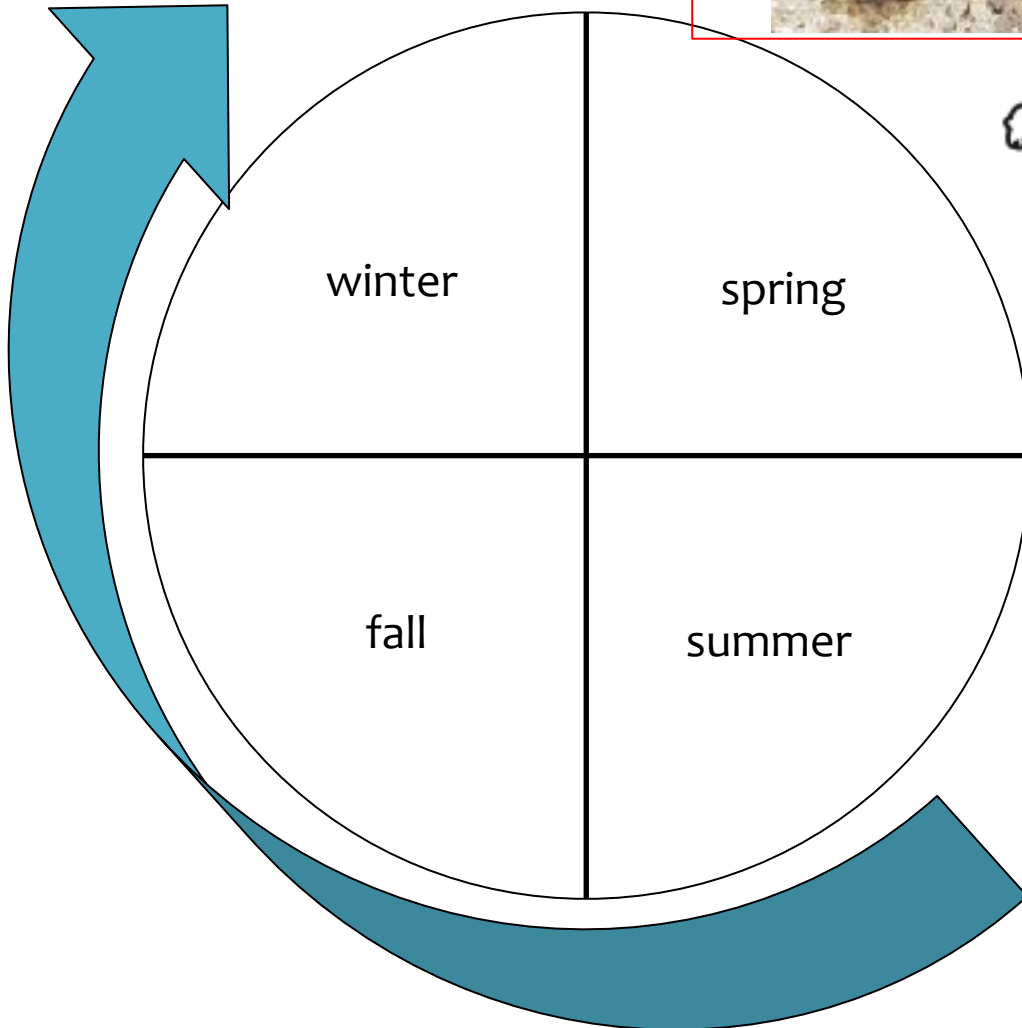
Only 2 to 3 weeks of
a solitary bees' life!



Egg



Pre-pupa



winter

spring

fall

summer

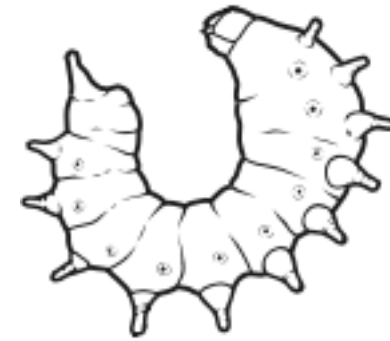
Pupa



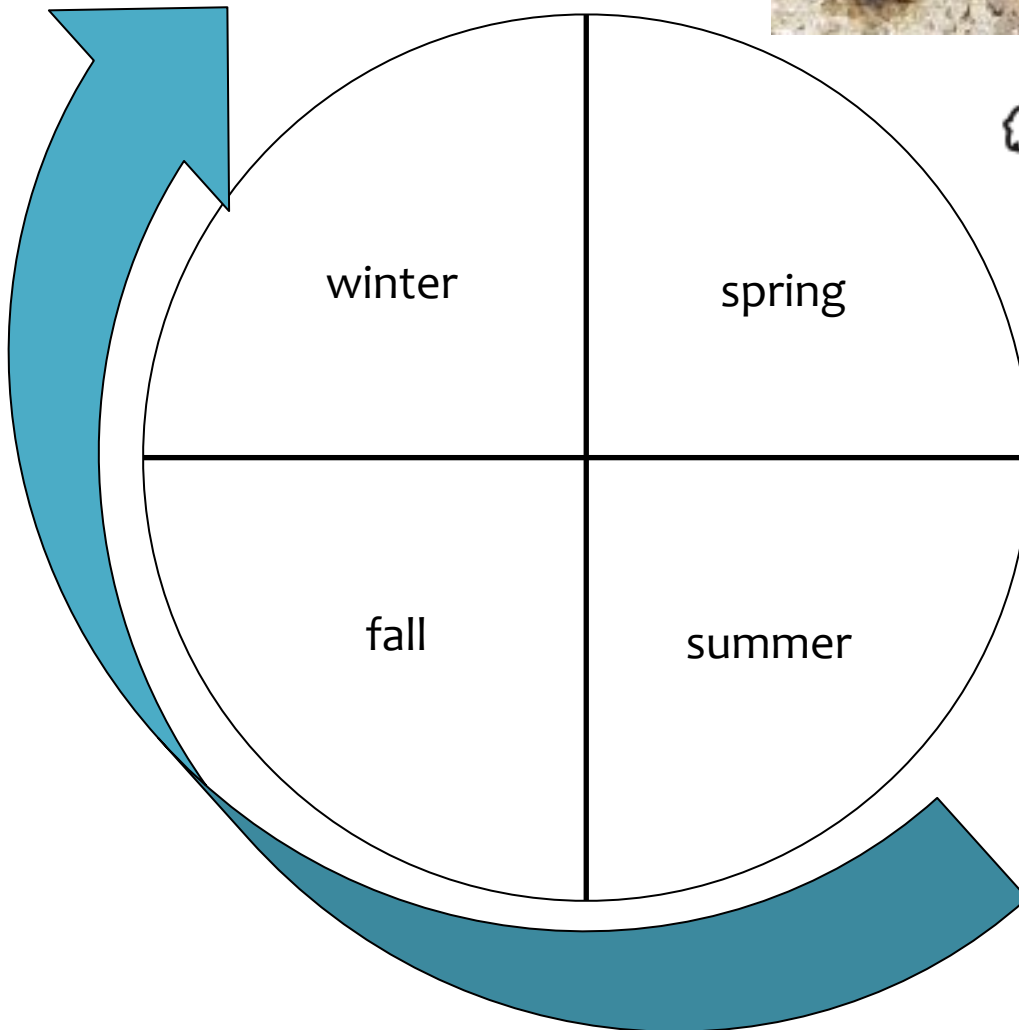
Adult bee



Egg



Pre-pupa



How a solitary bee spends most of its life

3 bee life history strategies

Solitary

- 77% of bee species



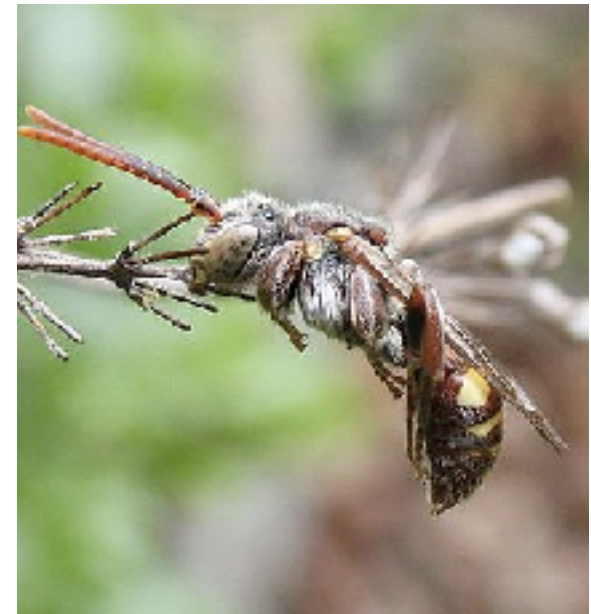
Social

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Parasitic

- 13% of bee species



Cuckoo bees



Nomada bee

3 bee life history strategies

Solitary

- 77% of bee species



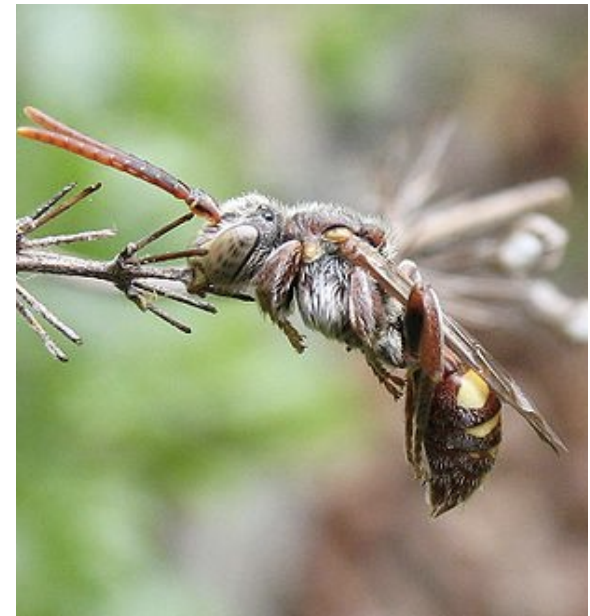
Social

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Parasitic

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Bombus, Lasioglossum, Halictus

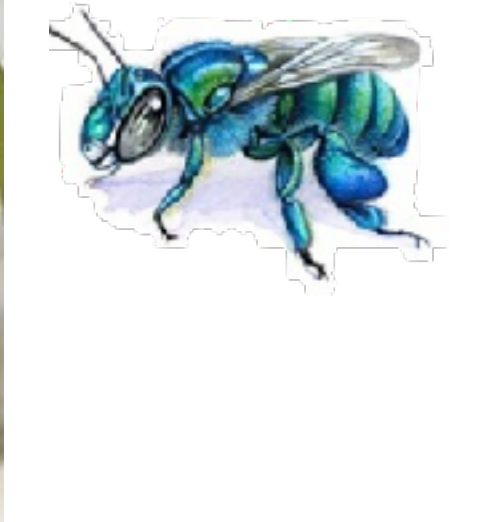




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- **My research on forest bees at Rutgers University**
- What you can do to support native bees
- Bee ID!

Threats to wild bees









© Jon Rapp



©Terry Tho

Forest Bees

- Small
- Solitary/ Parasitic
- Emerge in the spring



Agricultural/ Urban Bees

- Large-bodied
- Social
- Emerge in the summer



Harrison et al. 2018





Forest loss



Forest loss



Forest regrowth

Forests are younger and smaller than they were historically



Forest loss



Forest regrowth





Forest age



How does forest bee diversity change with

Forest area?



Forest age?



How does forest bee diversity change with

Forest area?

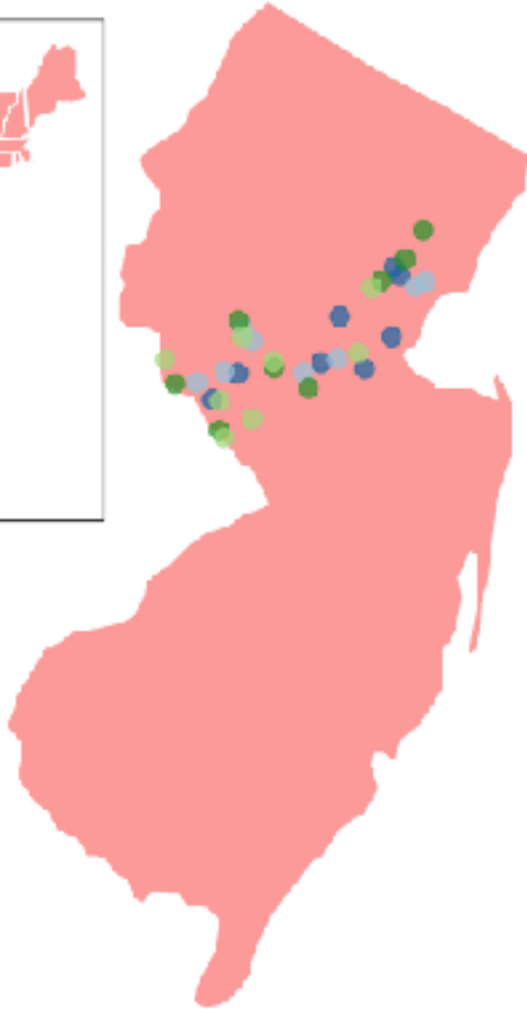
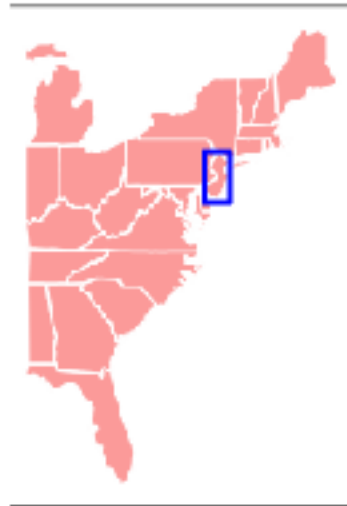


Forest age?



Time?

1870  2011



Category

- Large, mature
- Small, mature
- Large, young
- Small, young



	Large	Small
Mature	8 sites	8 sites
Young	8 sites	8 sites





Results

5,381 forest bees of 31 species



Lasioglossum subviridatum

- Most common forest bees:
 - *Osmia pumila* (a mason bee)
 - *Lasioglossum subviridatum* (a sweat bee)
 - *Andrena carlini* (a digger bee)



Osmia pumila



Andrena carlini

How does forest bee diversity change with

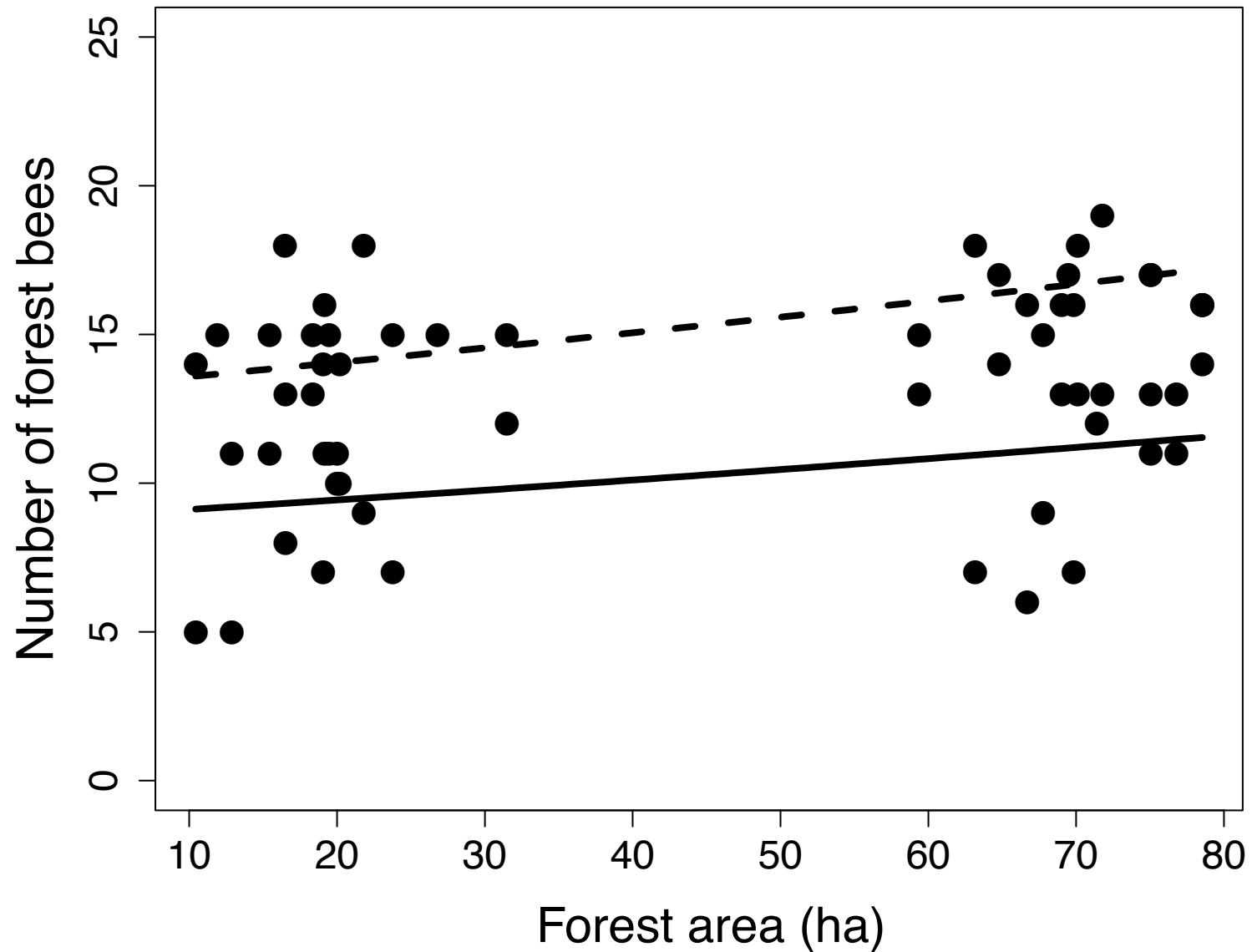
Forest area?



Forest age?



Forest area increases forest bee diversity



How does forest bee diversity change with

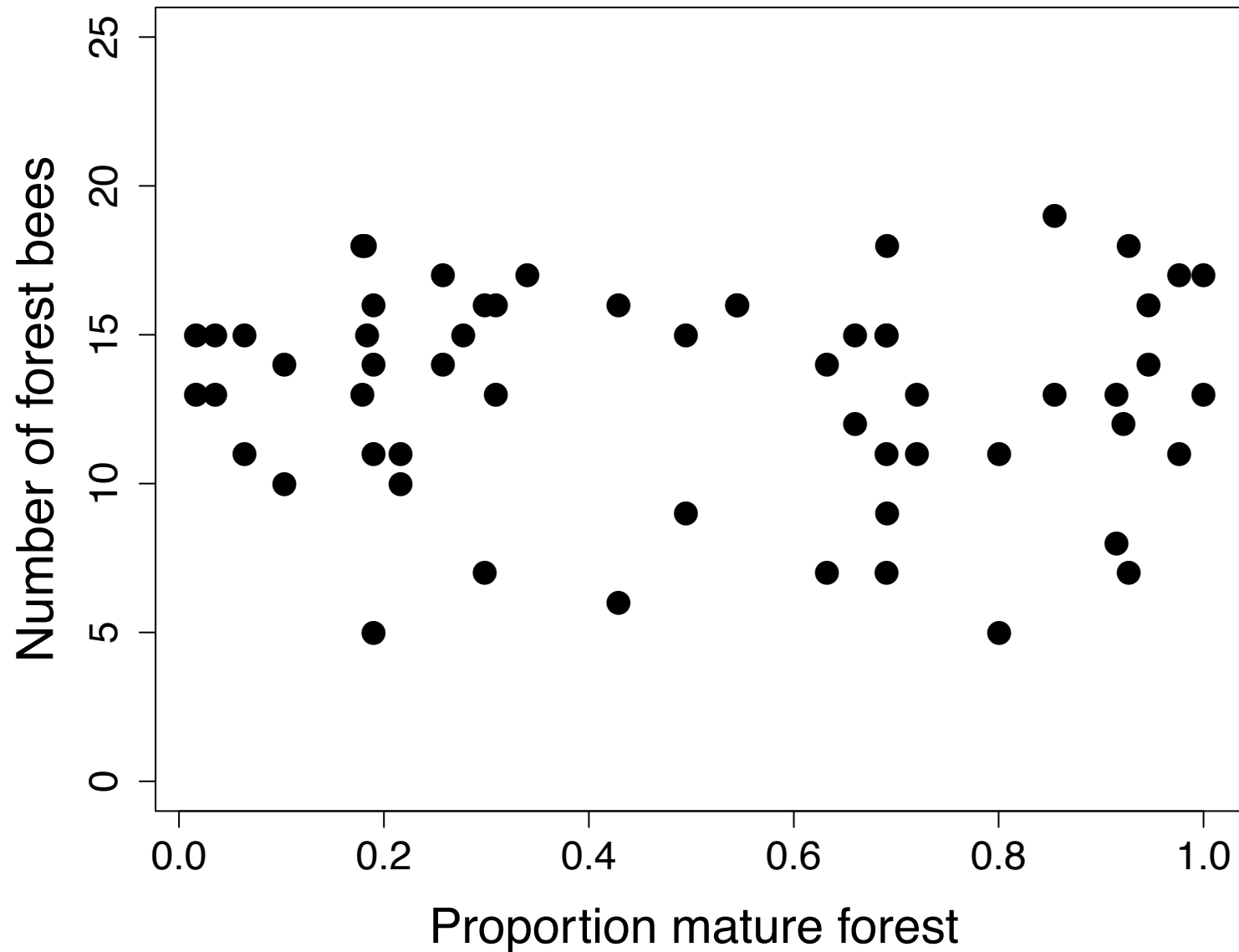
Forest area?



Forest age?



Forest age does not affect forest bee diversity



How does forest bee diversity change with

Forest area?



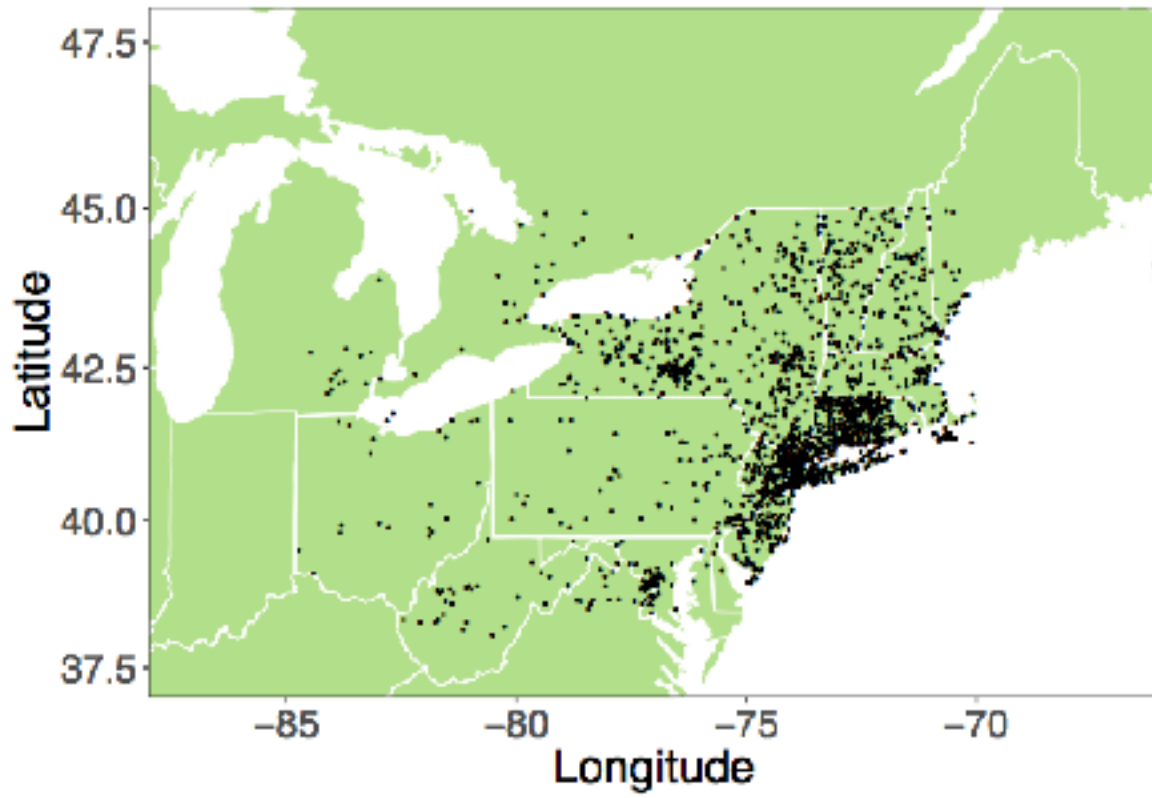
Forest age?



Time?

1870  2011

Museum dataset: 1872-2011



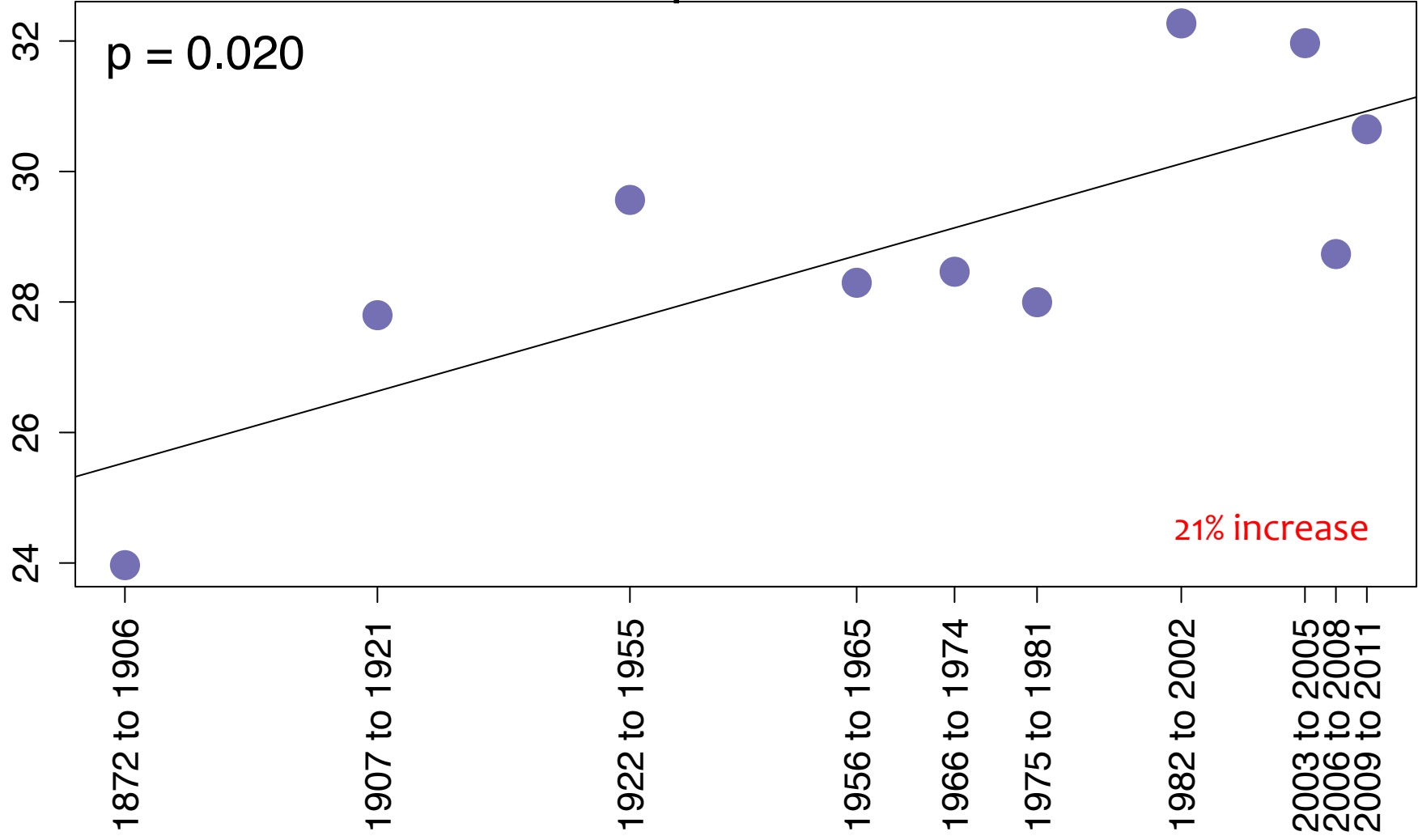
30,135 individuals of 449 bee species



Native forest bees:

- 4,137 individuals
- 29 species

Number of forest bees



Time period

1872 to 1906

1907 to 1921

1922 to 1955

1956 to 1965

1966 to 1974

1975 to 1981

1982 to 2002

2003 to 2005

2006 to 2008

2009 to 2011

$p = 0.020$

21% increase

1880s



2010



Large forests, of any age, are important for forest bee conservation

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Plant bee-friendly plants

www.xerces.org



Bloom Period	Common Name	Scientific Name	Flower Color	Max. Height	Water Needs
	Forbs			(Foot)	L, M, H Low, Medium, High
Early	1 Lanceleaf coreopsis	<i>Coreopsis lanceolata</i>	yellow	2	M
	2 Smooth penstemon	<i>Penstemon digitalis</i>	white	2	M
Early-Mid	3 Wild indigo	<i>Baptisia tinctoria</i>	yellow	3	L
	4 Butterfly milkweed	<i>Asclepias tuberosa</i>	orange	3	L
	5 Great blue lobelia	<i>Lobelia siphilitica</i>	blue	3	H
Mid	6 Joe Pye weed	<i>Eurochium fistulosum</i>	pink	7	H
	7 Mountain mint	<i>Pycnanthemum</i> spp.	white	3	M
	8 Purple coneflower	<i>Echinacea purpurea</i>	purple	4	M
	9 Wild bergamot	<i>Monarda fistulosa</i>	purple	4	M
Mid-Late	10 Field thistle	<i>Cirsium discolor</i>	purple	6	M
	11 Marsh blazing star	<i>Liatris spicata</i>	purple	4	M
	12 Wingstem	<i>Verbesina alternifolia</i>	yellow	6	H
	13 Bottle gentian	<i>Gentiana andrewsii</i>	blue	2	M
Late	14 New England aster	<i>Symphoricaricum novae-angliae</i>	purple	6	M
	15 New York ironweed	<i>Vernonia noveboracensis</i>	purple	7	H
	16 Seaside goldenrod	<i>Solidago sempervirens</i>	yellow	6	L
	17 Sneezeweed	<i>Helenium autumnale</i>	yellow	2	H
	18 Whiteleaf goldenrod	<i>Solidago rugosa</i>	yellow	4	M

How to Help Pollinators

- Plant bee-friendly plants
 - www.xerces.org
- Reduce pesticide (especially insecticides)
- Provide nest sites: nest boxes, bare soil, dead wood



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- Reduce pesticide (especially insecticides)
- Provide nest sites: nest boxes, bare soil, dead wood
- **Mow your lawn every other or every three weeks**

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- **Bee ID!**

Bees



Flies



Wasps



Bees vs Flies



Bees vs Wasps



Bee, wasp or fly?





Salvador Vitanza, Ph.D.







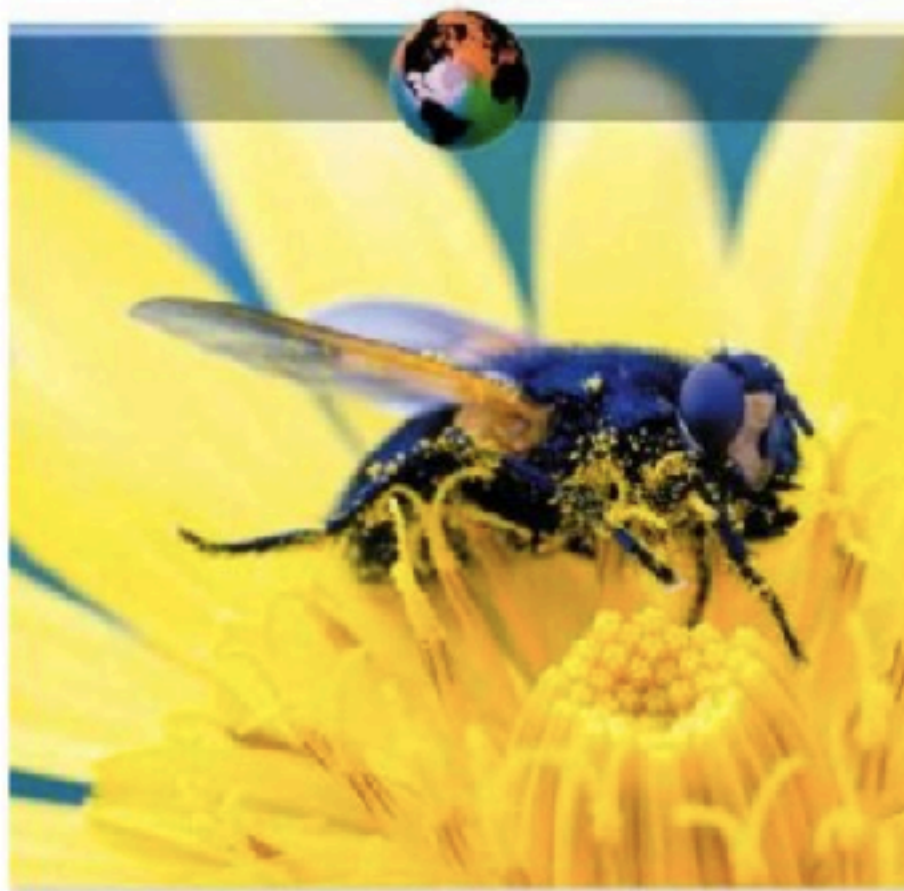






BEEES

OF THE WORLD



CHRISTOPHER O'TOOLE & ANTHONY RAW

Green bees: *Augochlora*, *Augochlorella*,
Augochloropsis



Bumble bees: *Bombus*



Digger bees: *Andrena*



Honey bees: *Apis*



Large carpenter bees: *Xylocopa*



Small carpenter bees: *Ceratina*



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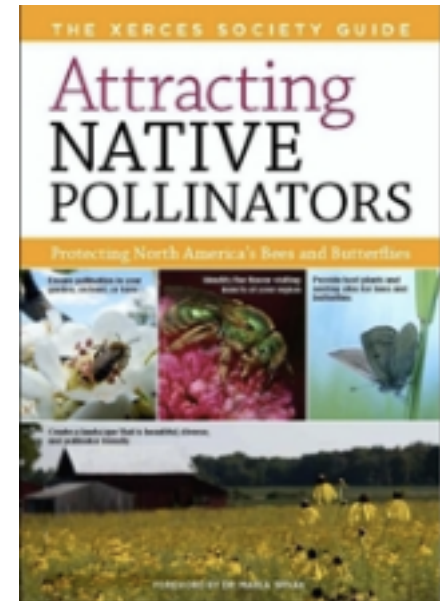
Large carpenter bees: *Xylocopa*



Learn more



- Check out Xerces Society website: xerces.org
- *Attracting Native Pollinators*, the Xerces Society
- winfreelab.rutgers.edu/outreach
- *Bees of the World* by Christopher O'Toole and Anthony Raw



Thank you

- Private landowners and parks department
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- Funding: USDA



United States Department of Agriculture
National Institute of Food and Agriculture

Questions?