



Quantifying the importance of wild bees in apple pollination

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Our Project

Orchard and
Landscape



Bee fauna



Fruit set



Orchard and Landscape

Orchard and
Landscape



Bee fauna



Fruit set



Park et al. 2015 PRSL

Orchard and Landscape



Increasing
Natural
Habitat

HIGH Abundance and
Diversity of Wild Bees

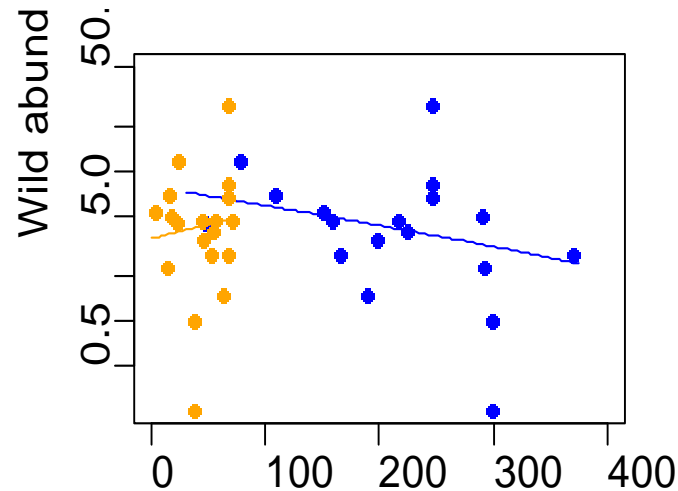


Increasing
Pesticide Use

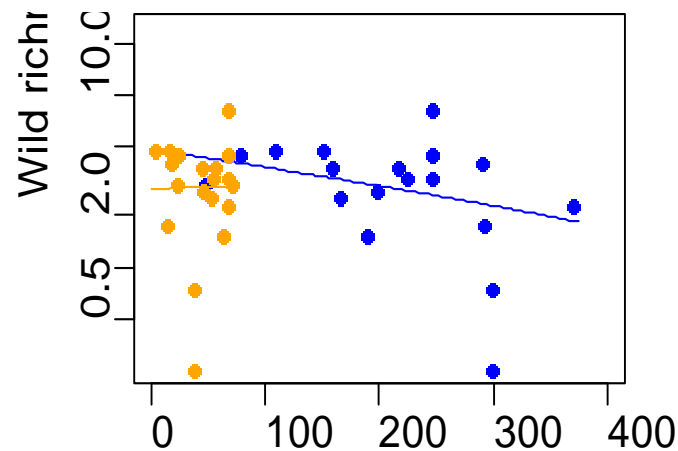
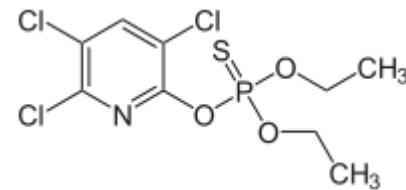
LOW Abundance and
Diversity of Wild Bees

Orchard and Landscape

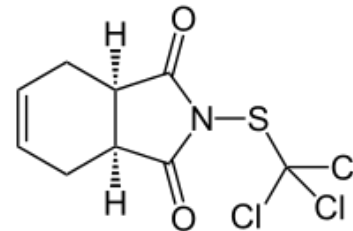
Pesticides: Fungicides vs. Insecticides



—●— Insecticides



—●— Fungicides



Fungicides, not insecticides, impact bee pollinators

Bee Fauna Impact on Fruit Set

Orchard and
Landscape



Bee fauna



Fruit set



?



Laura Russo and EJ Blitzer



Who is doing MOST of the pollination in NY apple orchards?

Honey bees or wild bees?



The existential
question posed by
every apple....who
pollinated me?

A framework for comparing pollinator importance

$$\text{Total pollinator importance} = \text{Pollinator abundance} \times \text{Per visit effectiveness}$$

Quantifying Diversity & Abundance

orchard surveys

- Collect (aerial netting)
- Identify to species
- ~3000 specimens per year



Quantifying Diversity & Abundance

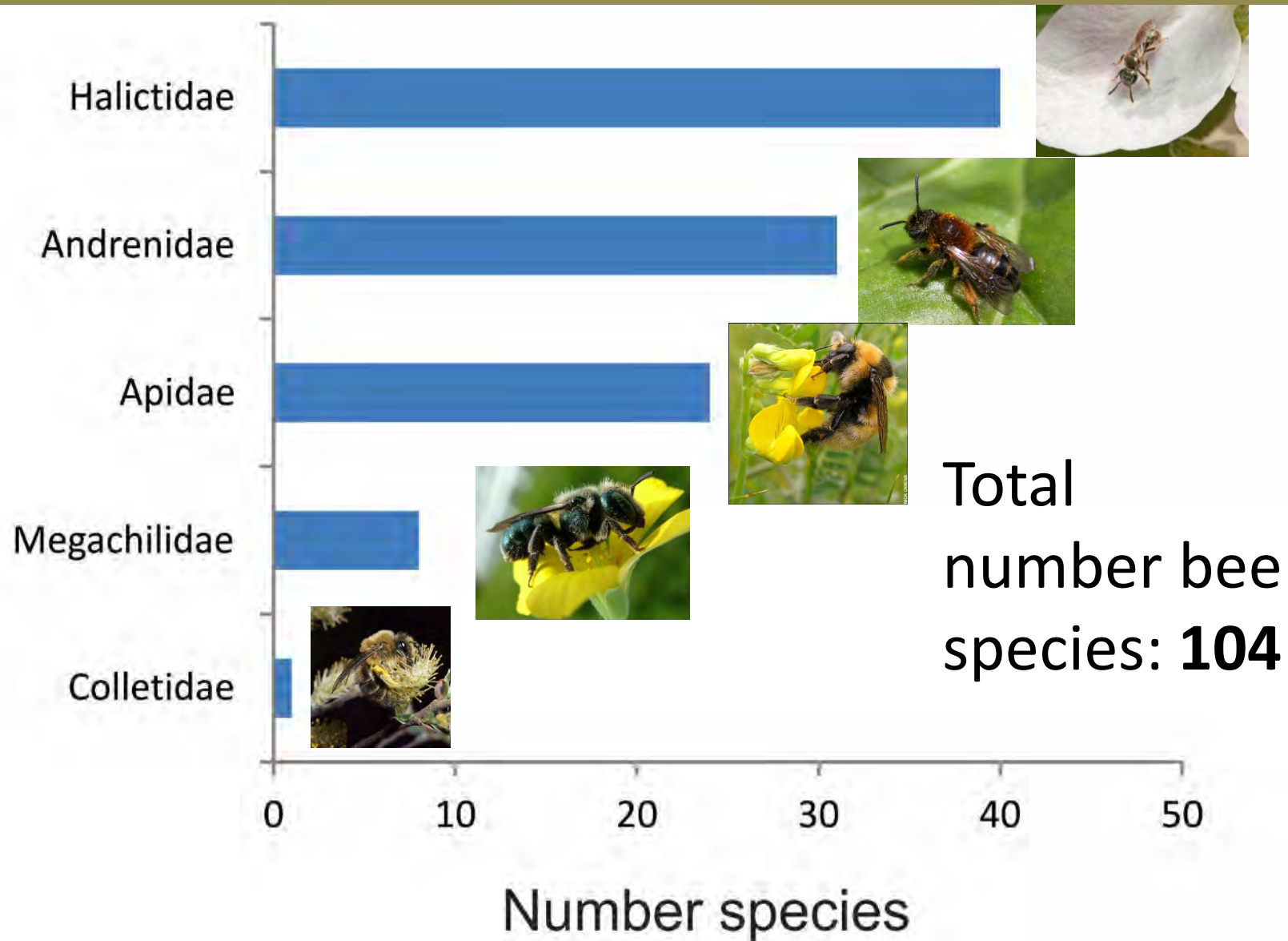


Collections permanently stored in the CUIC

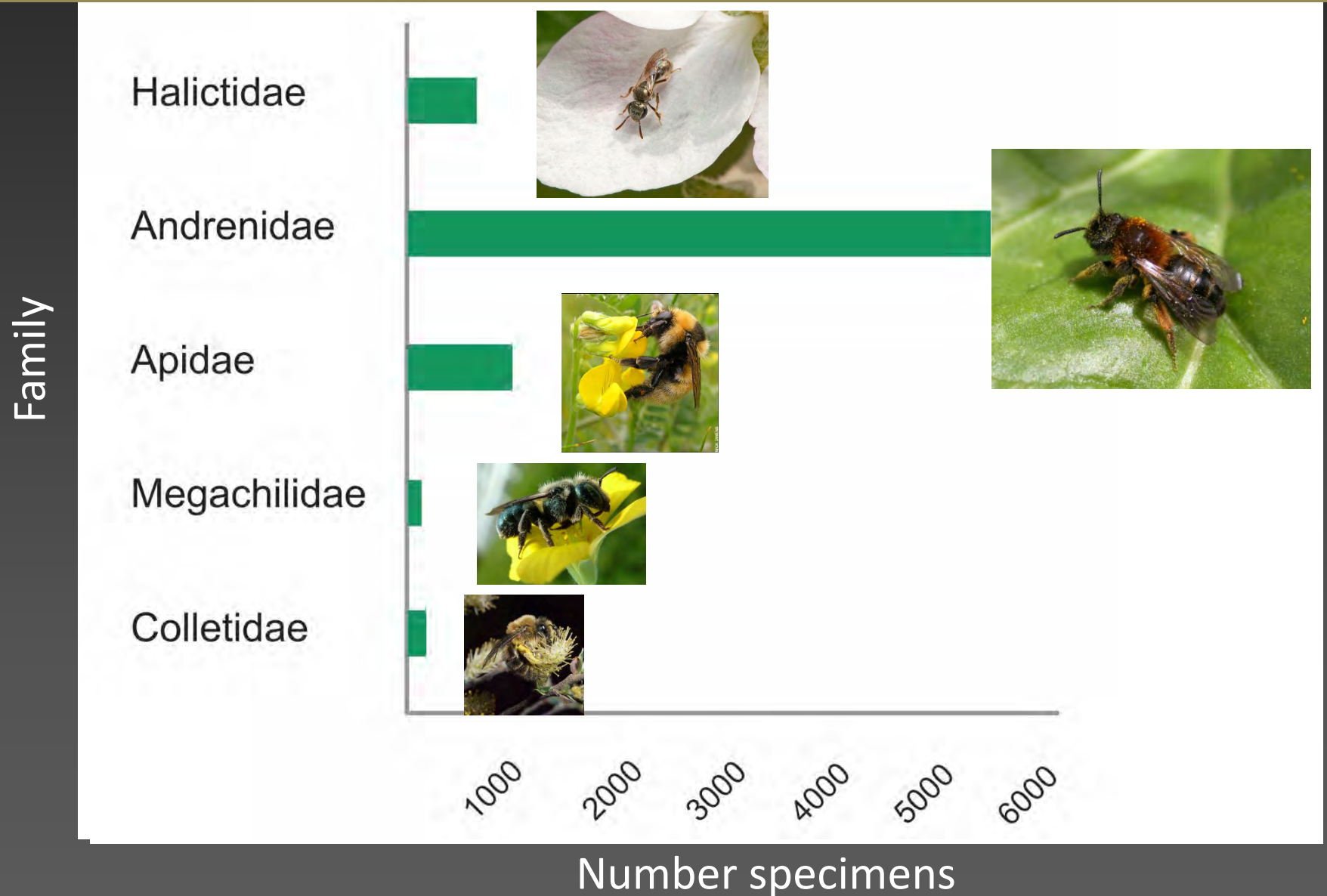
Quantifying Diversity & Abundance



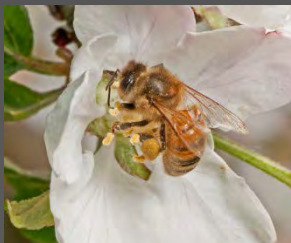
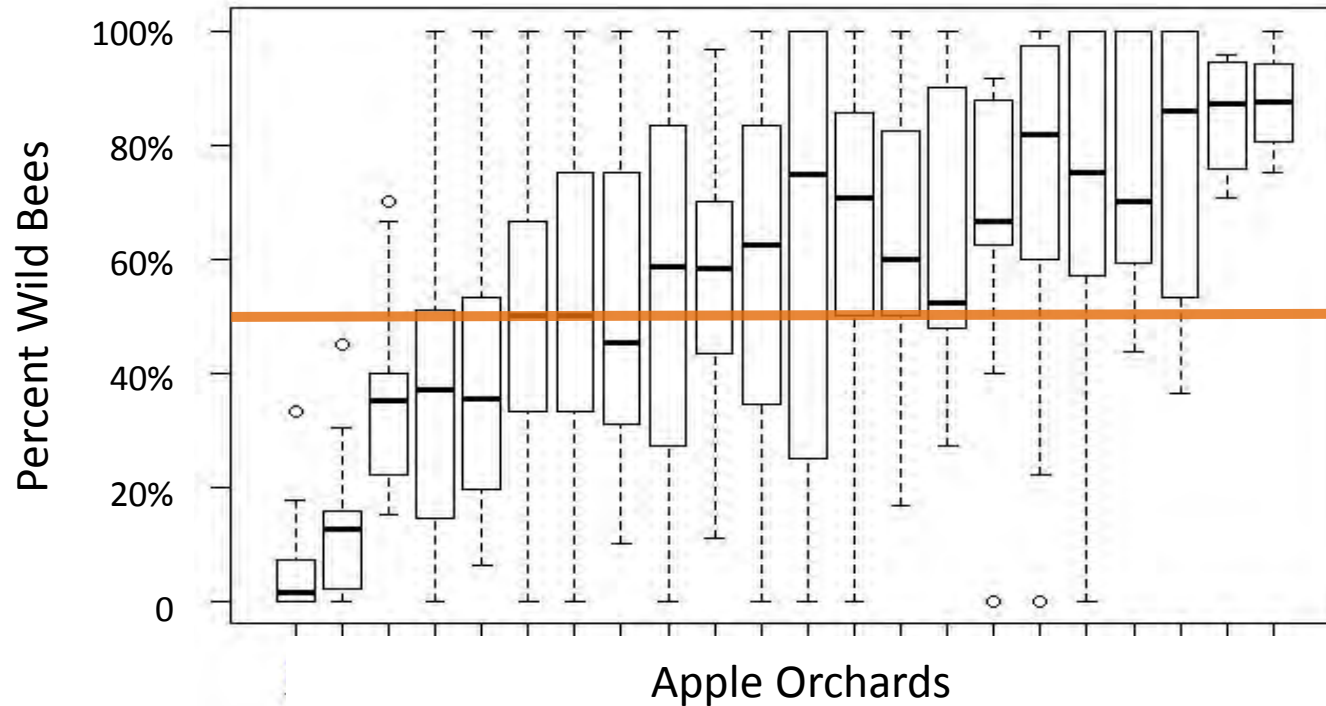
Quantifying Diversity



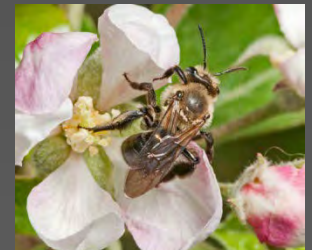
Quantifying Abundance



Quantifying Abundance



Increasing Wild Bee Abundance



But are these wild bees **EFFECTIVE** pollinators?

$$\textit{Total pollinator importance} = \textit{Pollinator abundance} \times \textit{Per visit effectiveness}$$

Abundance is easy to measure...

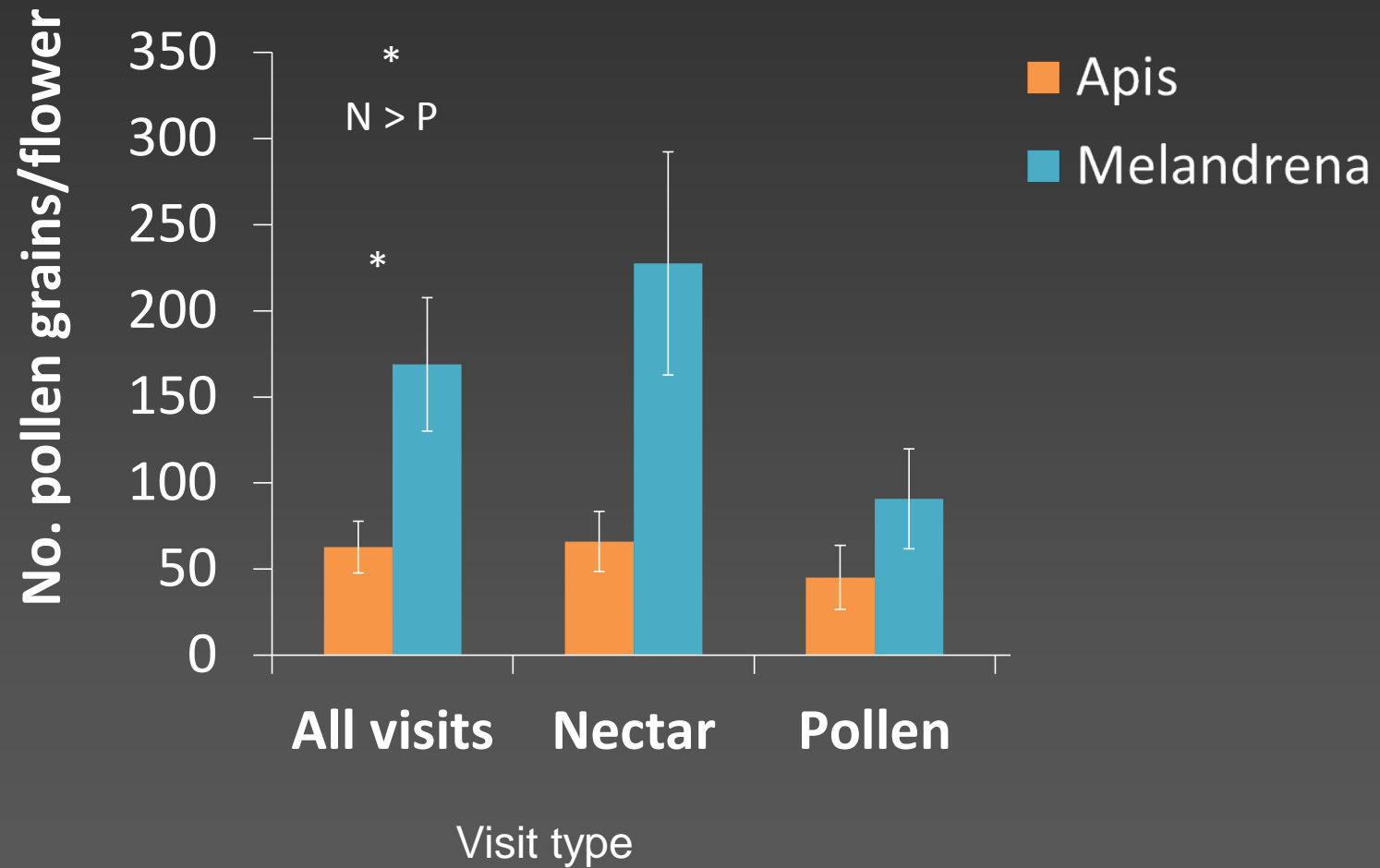
but per-visit effectiveness is not.

Measuring per visit effectiveness



Park et al. 2015
Apidologie

Results per visit effectiveness



Scaling up effectiveness to the larger wild bee community of apple orchards

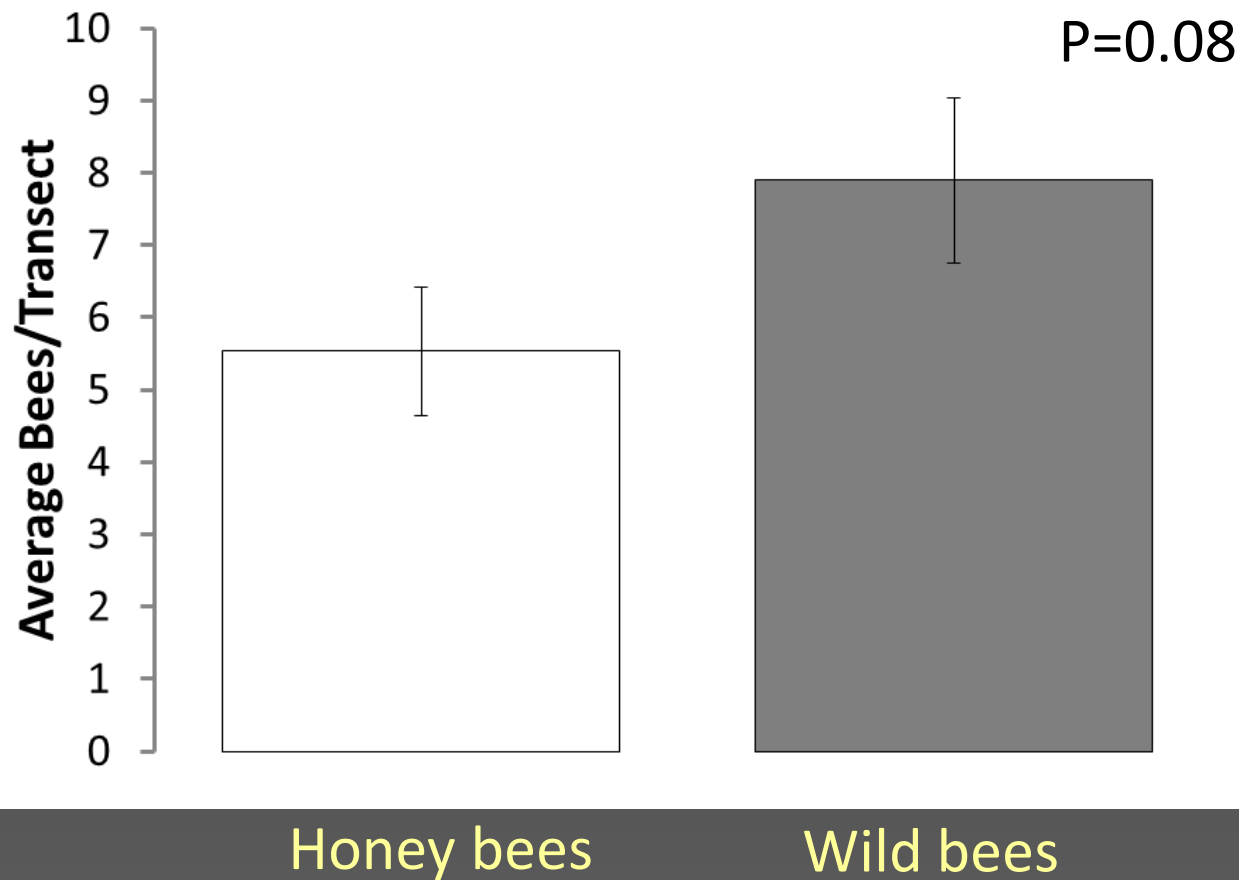
- ☐ Bee body size
- ☐ Pollen purity
- ☐ Flower handling



$$\textit{Total pollinator importance} = \textit{Pollinator abundance} \times \textit{Per visit effectiveness}$$



Total pollinator importance = Pollinator abundance



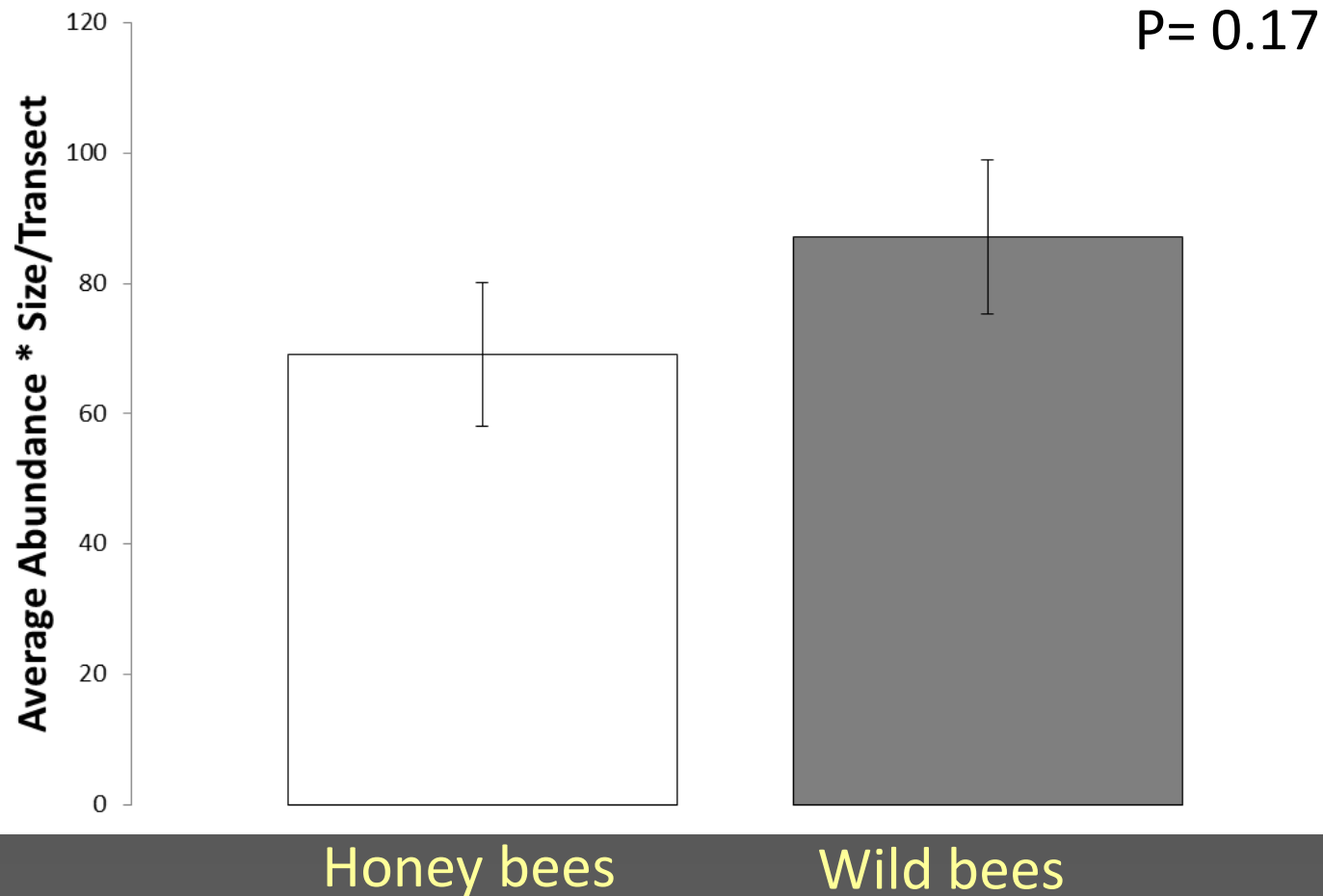
Effectiveness: Body size

$$\text{Total pollinator importance} = \text{Pollinator abundance} \times \text{Body size}$$

Rationale: larger bees are likely to deposit more pollen than smaller bees

Methods: measured body length for all bee species

Total pollinator importance = *Pollinator abundance* X *Body size*



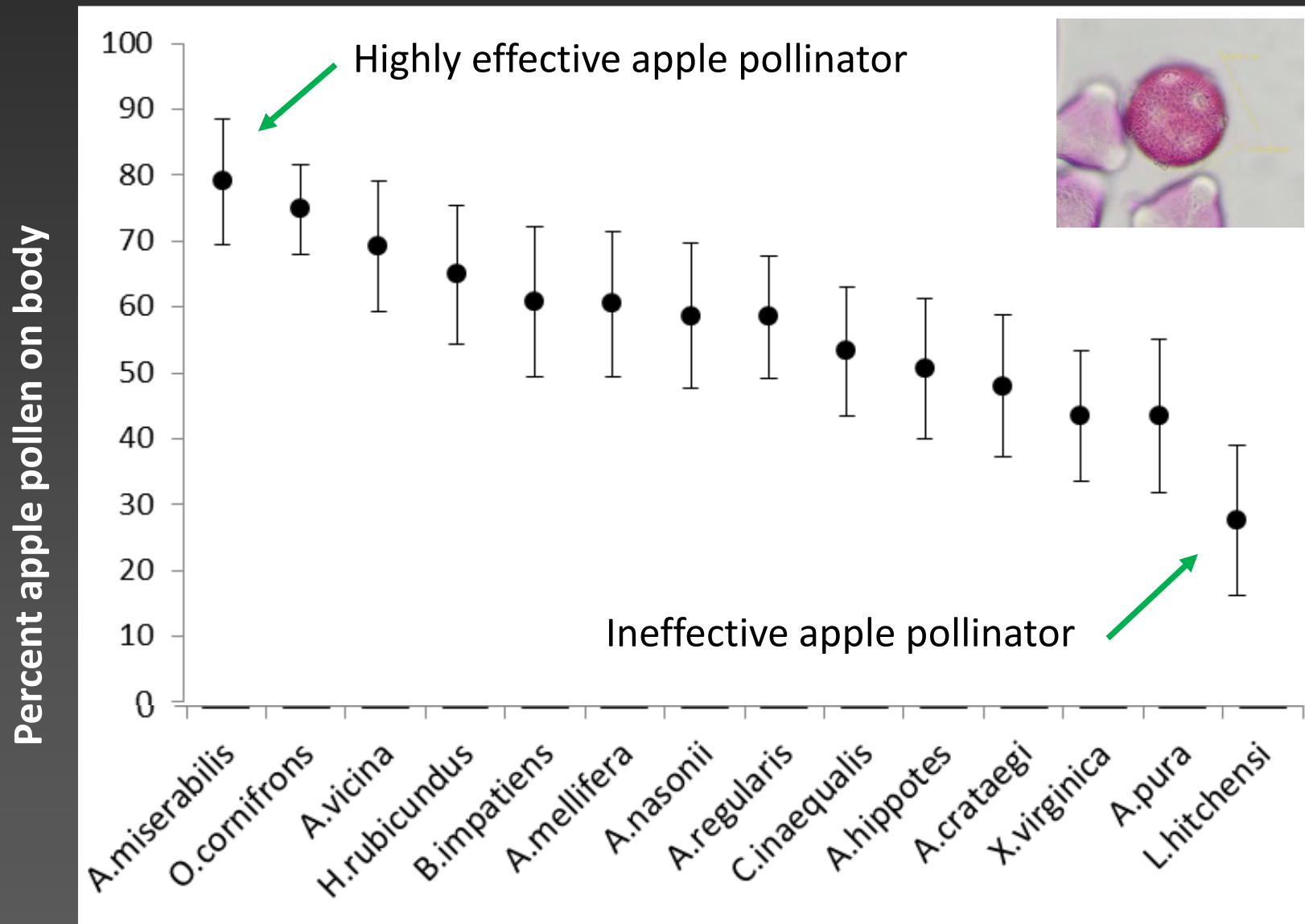
Effectiveness: Proportion of apple pollen

$$\text{Total pollinator importance} = \text{Pollinator abundance} \times \text{Pollen purity}$$

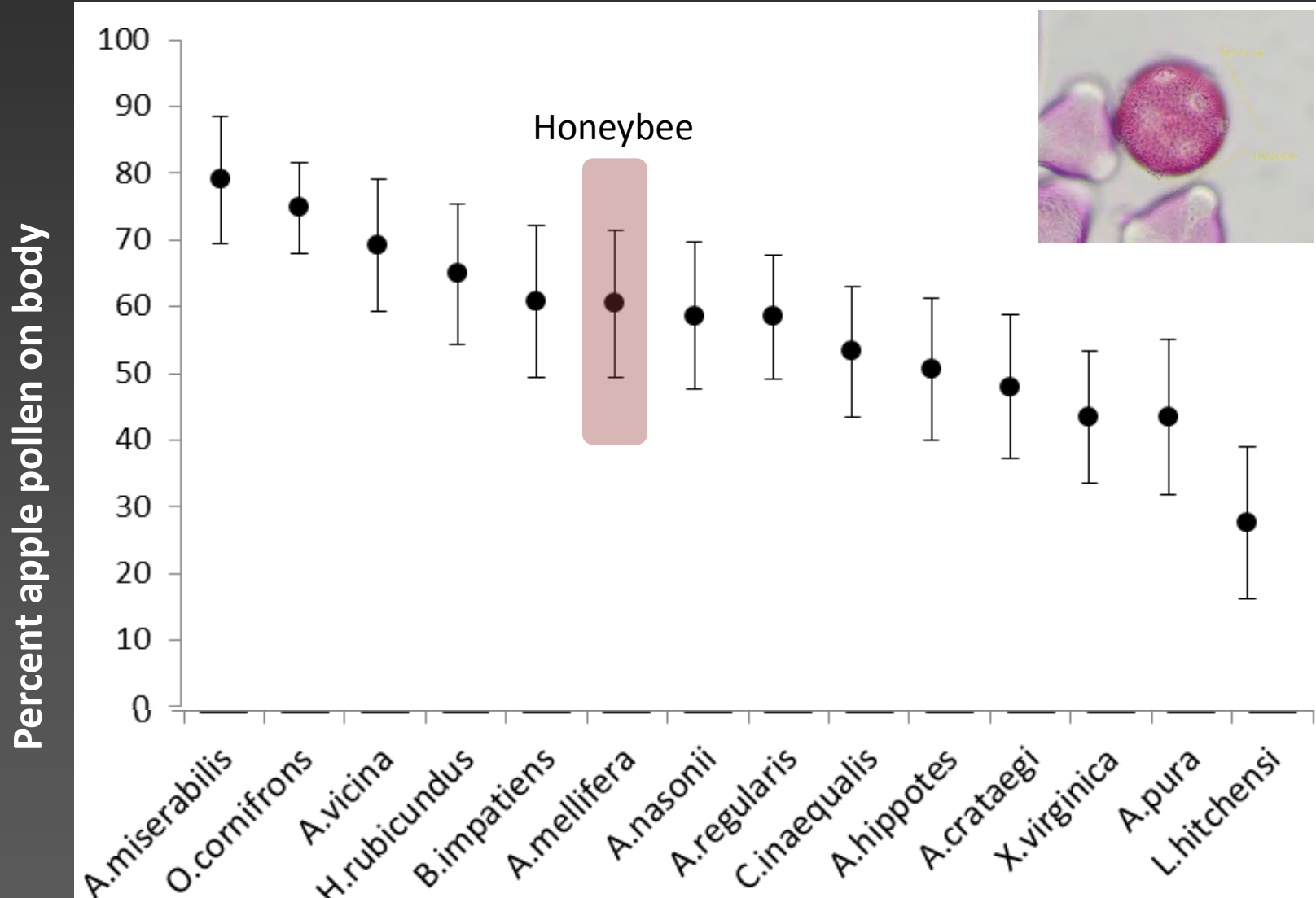
Rationale: bees that carry a larger proportion of apple pollen are likely to deposit more apple pollen grains/visit

Methods: quantified the percent apple pollen carried by the most common bees across our surveys that represented all size groups equally.

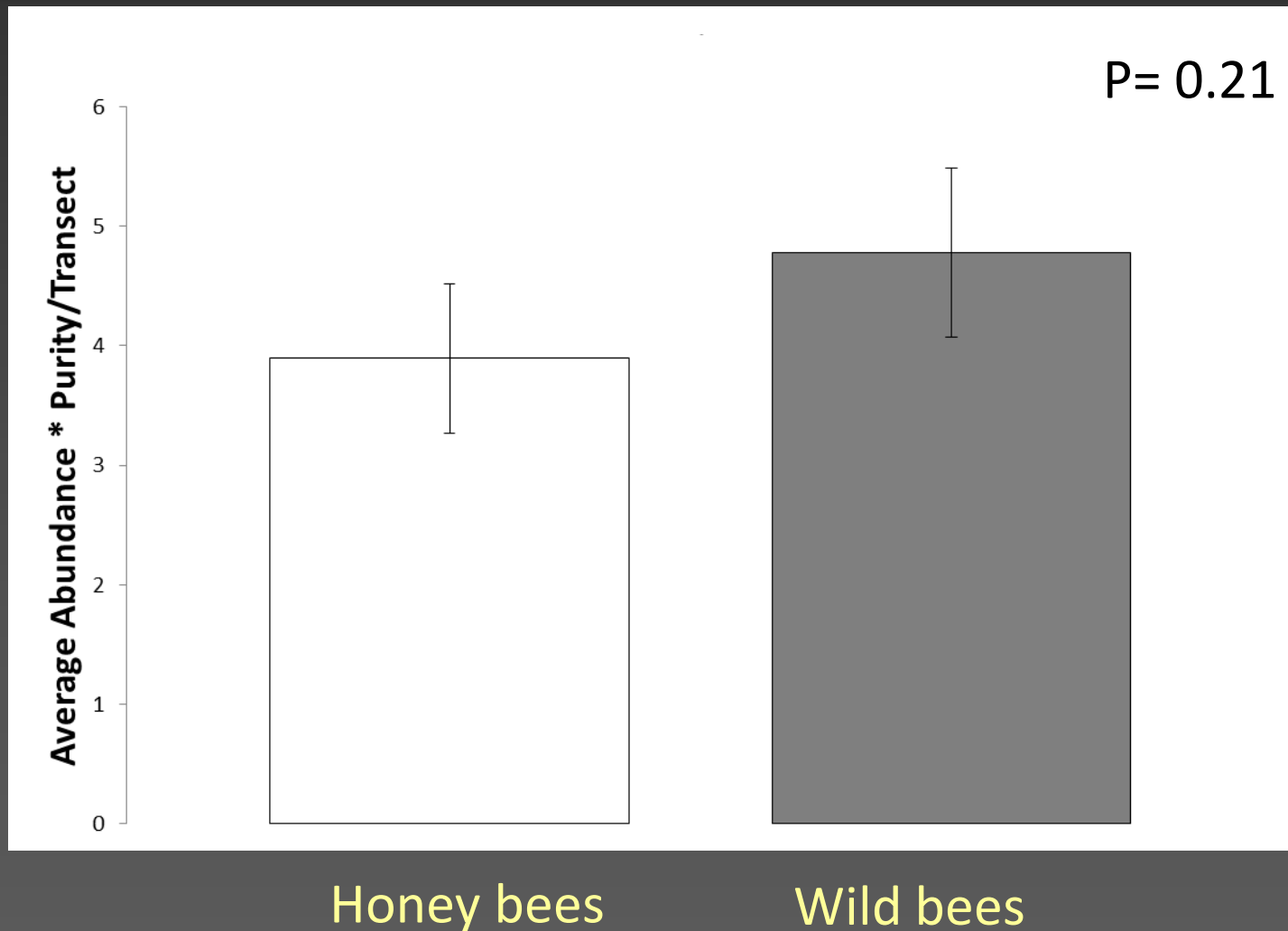
Effectiveness: Proportion of apple pollen



Effectiveness: Proportion of apple pollen



Total pollinator importance = *Pollinator abundance* X *Pollen purity*



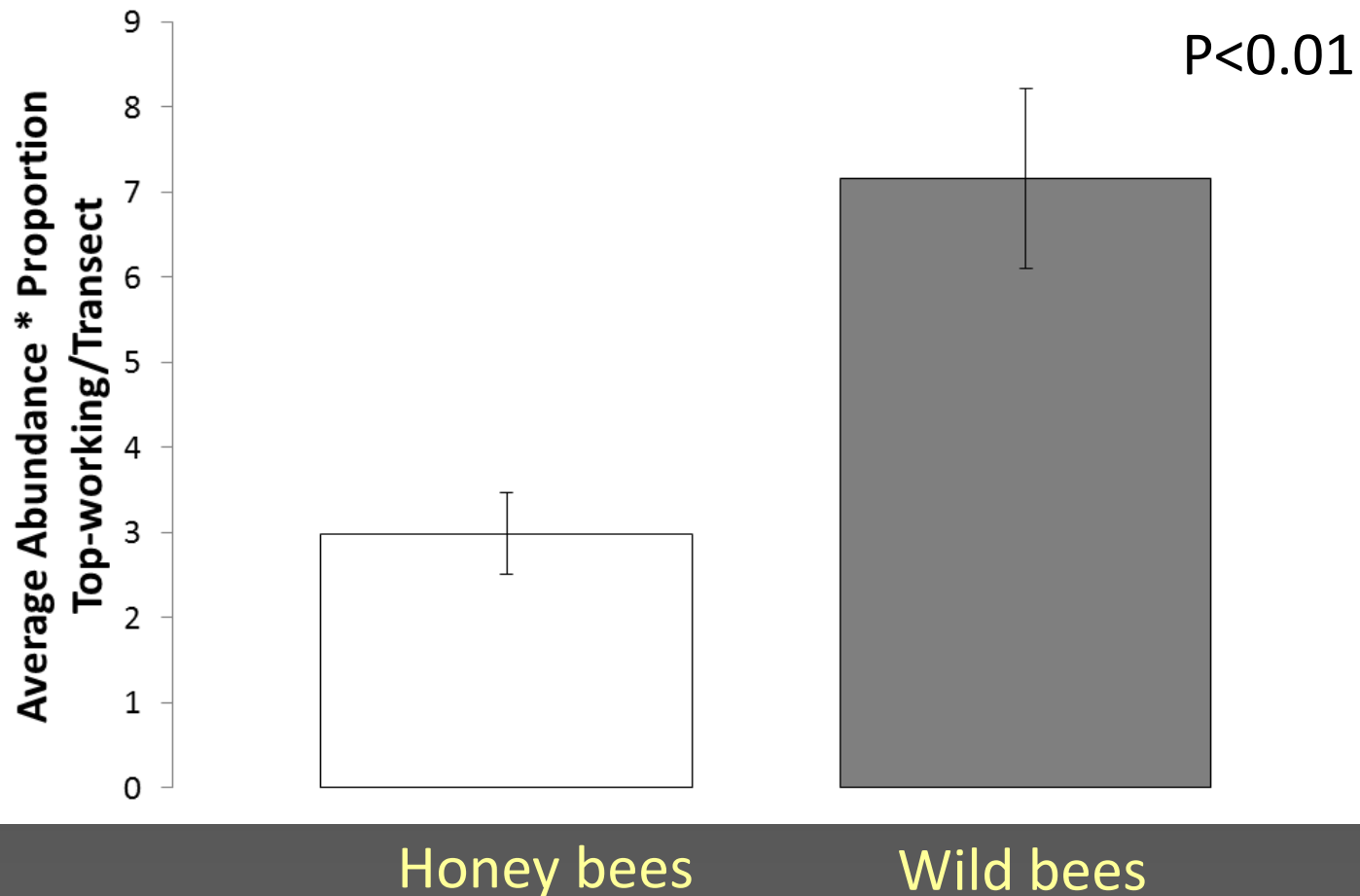
Effectiveness: Flower Handling

$$\text{Total pollinator importance} = \text{Pollinator abundance} \times \text{Flower handling}$$

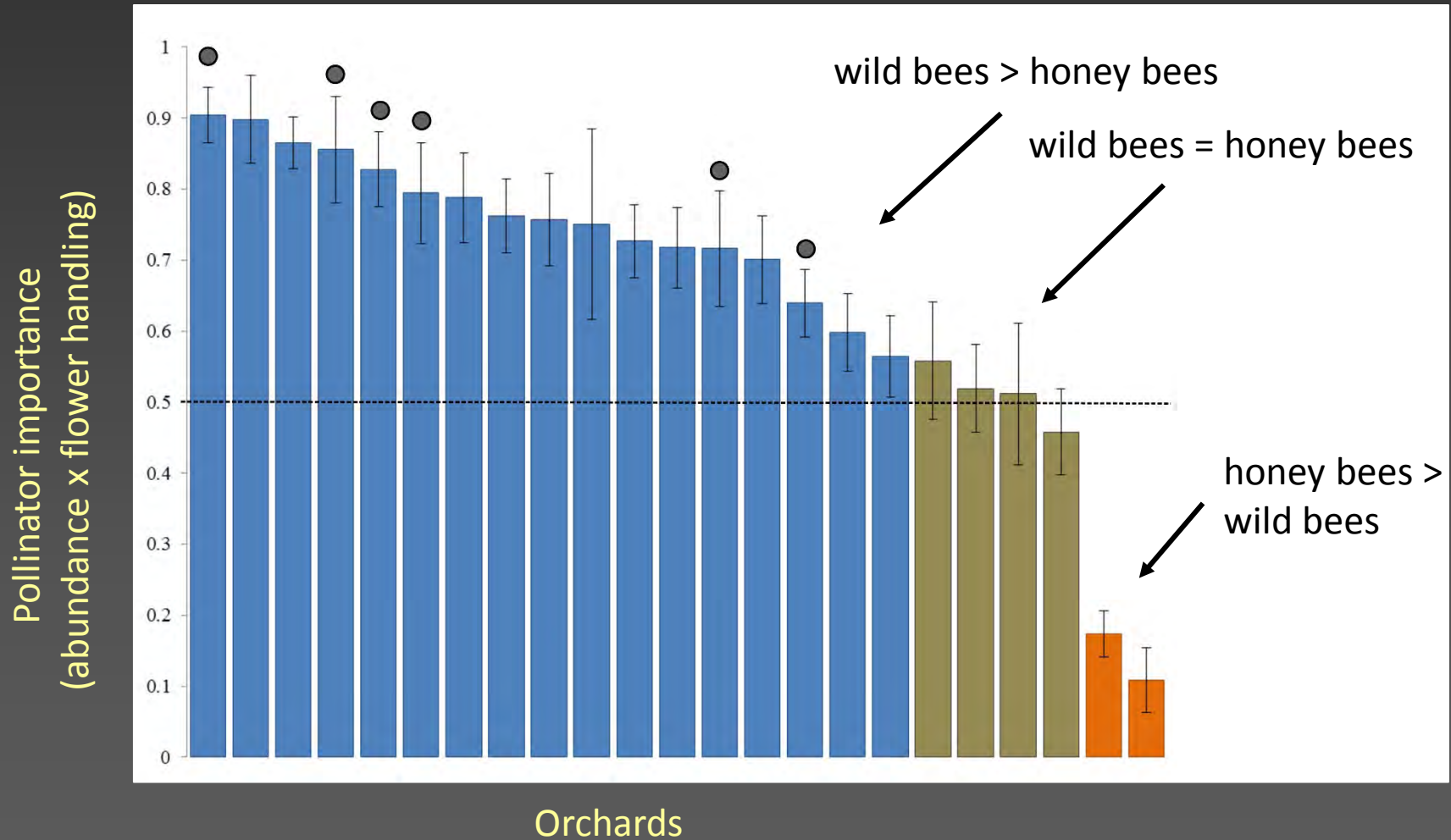
Rationale: bee species that do more “top working” than “side working” are likely to deposit more pollen per visit

Methods: quantified the proportion of “top” and “side” working for the most common bee species in our surveys

Total pollinator importance = *Pollinator abundance* X *Flower handling*



Total pollinator importance = *Pollinator abundance* × *Flower handling*





**Do these pollinator importance measures
ACTUALLY
translate into increased fruit set?**

Bee Diversity and Seed Set



2000 apples later...



Measuring Impact of Wild Bees on Seed Set



Wild Bee
Abundance

Increased seed set

Wild Bee
Diversity

Increased seed set

Honey Bee
Abundance

No significant effect
on seed set

Conclusions 1

Orchard and
Landscape



Bee fauna



Fruit set



Wild bees have a greater
importance than honey bees



Conclusions 2

Orchard and
Landscape



Bee fauna



Fruit set



Flower handling is the best
measure for per-visit effectiveness.

Wild bees are **more than twice** as
important as honey bees

Conclusions 3

Orchard and
Landscape



Bee fauna



Fruit set



Seed set as a proxy for fruit production **is driven by an** abundant and diverse **wild bee population.**



**But HOW DO YOU KNOW
if you have enough wild bees in your orchard?**

www.northeastpollinatorpartnership.org



THE NORTHEAST POLLINATOR PARTNERSHIP

A partnership between scientists and apple growers that will lead to:

- more informed orchard pollination and savings.
- long-term monitoring of wild bee populations in regards to climate change.
- more sustainable pollinator management.



www.northeastpollinatorpartnership.org



THE NORTHEAST POLLINATOR PARTNERSHIP

Participants

Data
collection

Apple growers
Extension professionals
Scientists

Data
analysis

Scientists (our lab)

Data
visualization

Apple growers
Extension professionals
General public
K-12 classrooms
Scientists
Policy makers

Recommendations





Wild bee



Honey bee



Data Collection

- Count native bees and honey bees.
- 5 minutes
- 1 sq meter area.

Training Materials

- Video: Teach protocol and use of survey app
- Online pictures of apple bees with a quiz



THE NORTHEAST POLLINATOR PARTNERSHIP



What **YOU** could do with the data:

1. Make more informed decisions about how many hives to rent.
2. Determine if you are susceptible to honey bee declines
3. Manage for native bees to fulfill certain biodiversity requirements for out of country export.



THE NORTHEAST POLLINATOR PARTNERSHIP



What **RESEARCHERS** could do with the data:

1. Detect declines in wild pollinators across the Northeast
2. Understand the impact of climate change on apple flowering and pollination
3. Understand more about what factors drive wild pollinator communities

Other products arising from this research:

On-line pollen reference library:

<http://blogs.cornell.edu/pollengrains/>

Guide to wild pollinators in eastern apple orchards:

<http://entomology.cals.cornell.edu/extension/wild-pollinators>

Northeast Pollinator Partnership:

<http://www.northeastpollinatorpartnership.org/>

Download the app:

<http://app.northeastpollinatorpartnership.org/>



Acknowledgements

Growers:

28 orchard owners in central
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END