Impact of pollinator gardens on wild bees and yield in cranberry

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Pollinators in cranberry

- Bees are important pollinators in cranberry as they ensure fruit set and increase fruit yield
- 89% of WI cranberry growers use honeybees
- WI cranberry growers spend $140-$210 per acre each year on honeybee rentals for pollination services
- 182 wild bee species documented in cranberry (Gaines Day 2013)

Promoting pollinators

Can we foster native wild bee communities on cranberry marshes by implementing pollinator gardens?

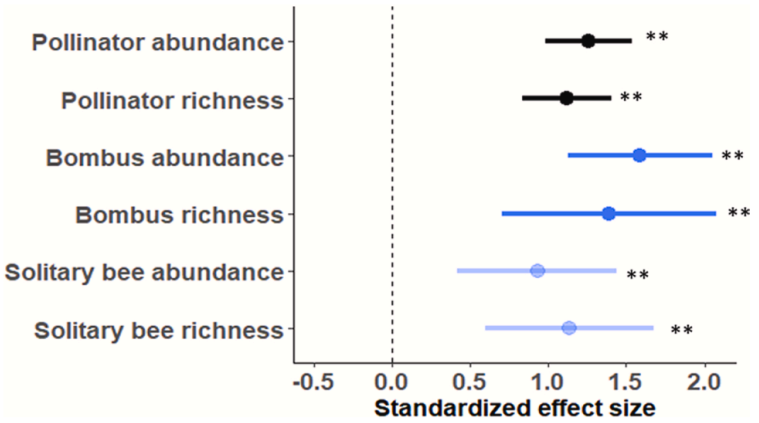


Fig. 1. The effects of field edge pollinator plantings on overall pollinator abundance and richness, Bombus abundance and richness, and solitary bee abundance and richness in field edges. Mean effect sizes (Hedge's *d*) ± 95 % CI are illustrated. Double asterisks denote significance at $\alpha < 0.001$.

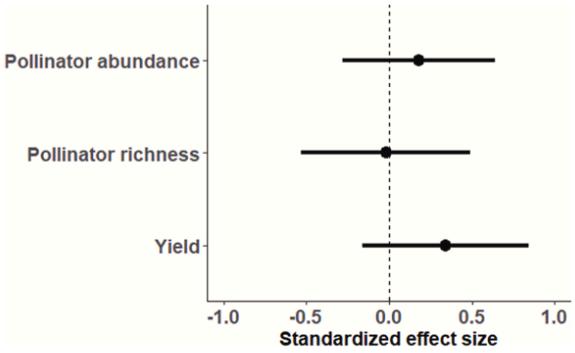


Fig. 2. Effects of field-edge pollinator plantings on pollinator abundance and richness in crop fields (ES provision) and crop yields (ES delivery). Mean effect sizes (Hedge's *d*) ± 95 % CI are illustrated. No groups were significant at $\alpha < 0.05$.

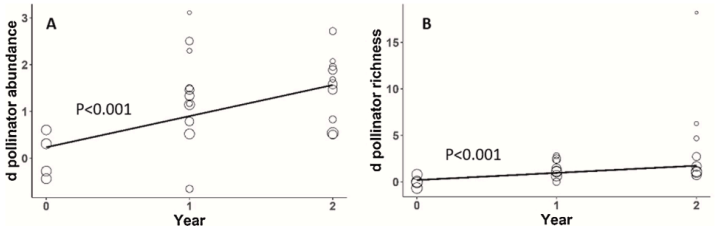


Fig. 3. Relationship between planting maturity and a) pollinator abundance and b) pollinator richness for studies included in meta-regressions. Point size = 1/var. Year 0 represents the year plantings were established.

Lowe et al 2021 AEE 310: 109290

Objectives

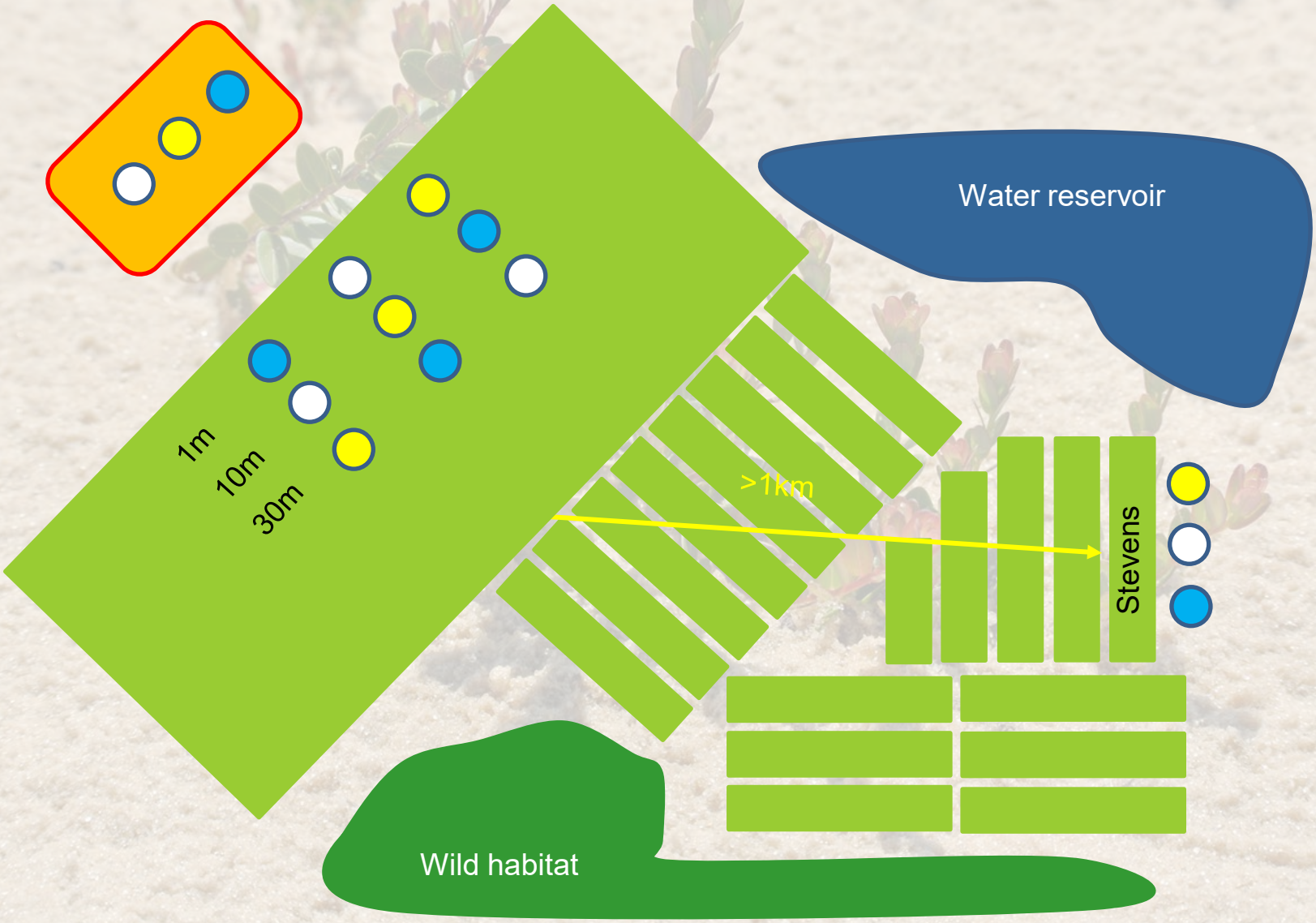
Objective 1: Assess impact of pollinator gardens on

1) wild bee richness
2) wild bee abundance
3) wild bee visitation to cranberry flowers

Objective 2: Assess impact of wild bee richness and abundance and honey bee abundance on yield (berry size and number of berries)

Photo credit: Getty Images

Study design



Bee species richness over time

Number of species increased every year
Over 180 bee species documented with several new state records

Family	2018	2019	2020	2021	# Species
Andrenidae	5	19	21	25	31
Apidae	13	22	31	35	45
Colletidae	0	3	3	3	6
Halictidae	31	44	46	61	74
Megachilidae	5	14	16	21	25
Melittidae	0	0	1	1	2
Total	54	102	118	146	183

USDA ARS, Wikimedia Commons

Apidae

Andrenidae:
Mining bees

Colletidae:
Polyester bees

Halictidae:
Sweat bees

Megachilidae:
Leafcutter bees

Dick Belgers, Waarneming.nl, https://commons.wikimedia.org/w/index.php?curid=20662093

Mellitidae

Bee species abundance over time

Number of individual bees increased every year to perhaps plateau

Family	2018	2019	2020	2021	# Individuals
Andrenidae	6	72	170	216	464
Apidae	85	316	633	713	1747
Colletidae	0	3	10	22	35
Halictidae	261	1432	2497	2523	6713
Megachilidae	15	93	131	185	424
Melittidae	0	0	4	2	6
Total	367	1916	3445	3661	9389

USDA ARS, Wikimedia Commons

Apidae

Andrenidae: Mining bees

Colletidae: Polyester bees

Halictidae: Sweat bees

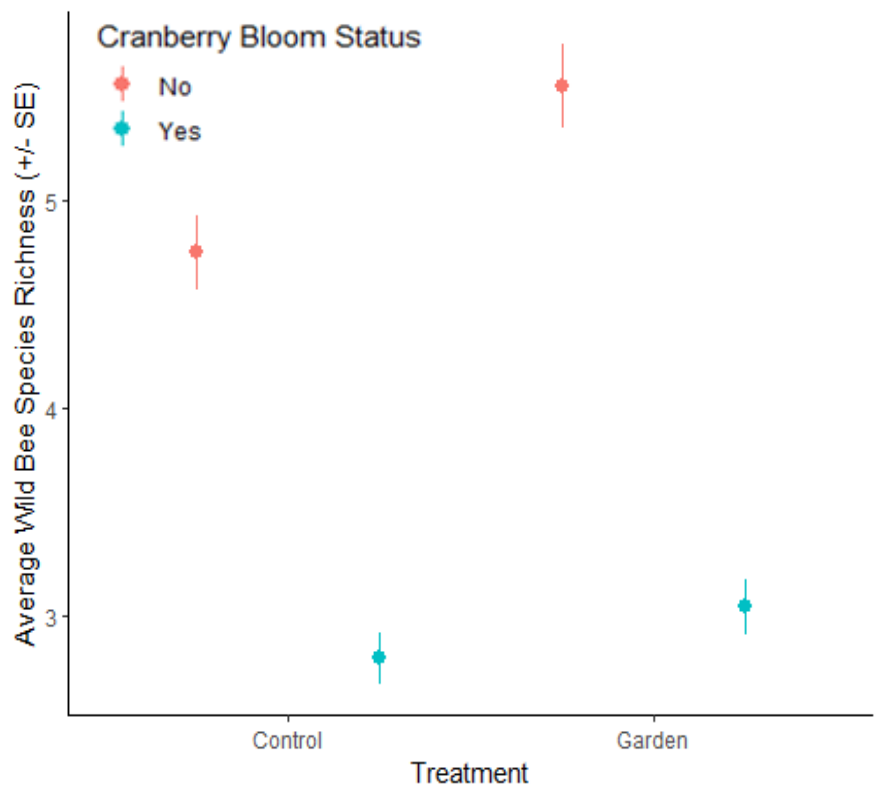
Megachilidae: Leafcutter bees

Dick Belgers, Waarneming.nl, https://commons.wikimedia.org/w/index.php?curid=20662093

Mellitidae

Obj 1.1: Wild bee richness in relation to bloom

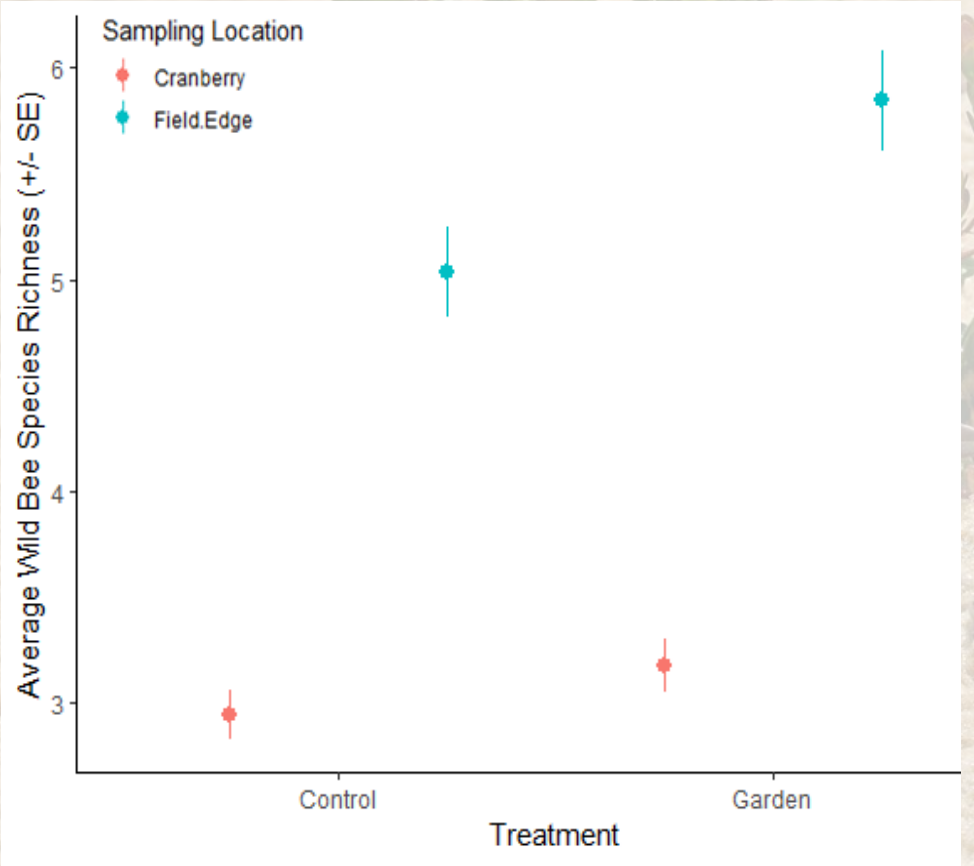
Pollinator gardens increase wild bee richness, regardless of whether or not cranberry is blooming, with greater richness outside of cranberry bloom compared to during bloom



Treatment: $F(1,70) = 8.06$; $P = 0.0046$
Bloom $F(1,1718) = 199.12$; $P < 2 \times 10^{-16}$

Obj 1.1: Wild bee richness in relation to sampling location

Pollinator gardens increase wild bee richness within cranberry and on marsh edge, with higher richness on marsh edge

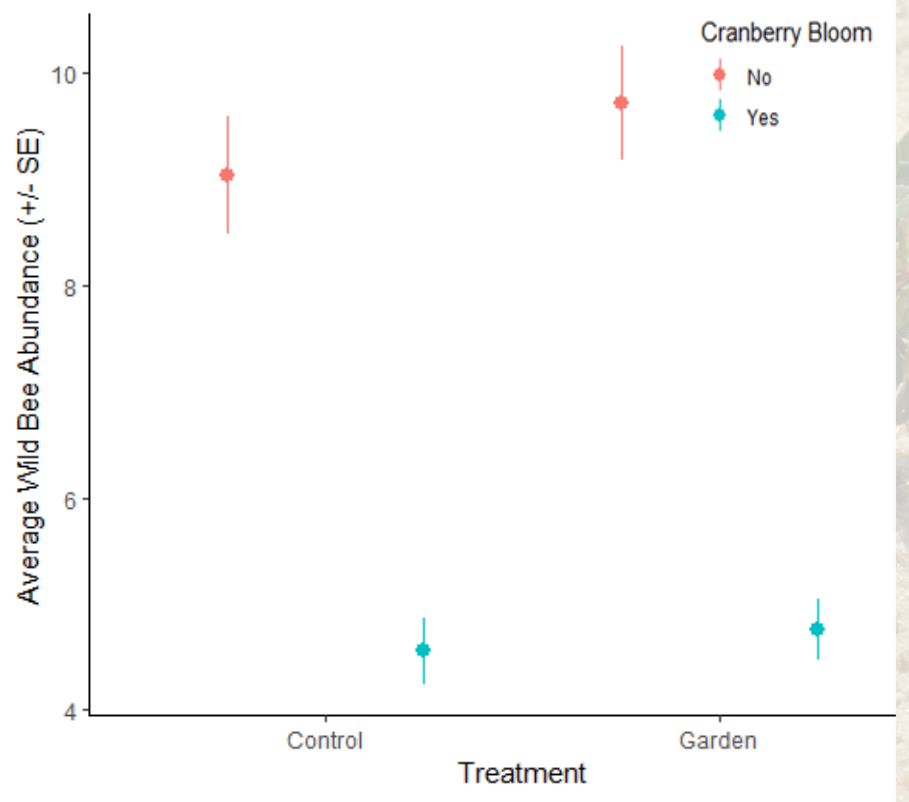


Treatment: $F(1,70) = 8.06$; $P = 0.0045$

Bloom $F(1,1718) = 199.12$; $P < 2 \times 10^{-16}$

Obj 1.2: Wild bee abundance in relation to bloom

Pollinator gardens did not increase wild bee abundance, but higher wild bee abundance outside of cranberry bloom compared to during cranberry bloom

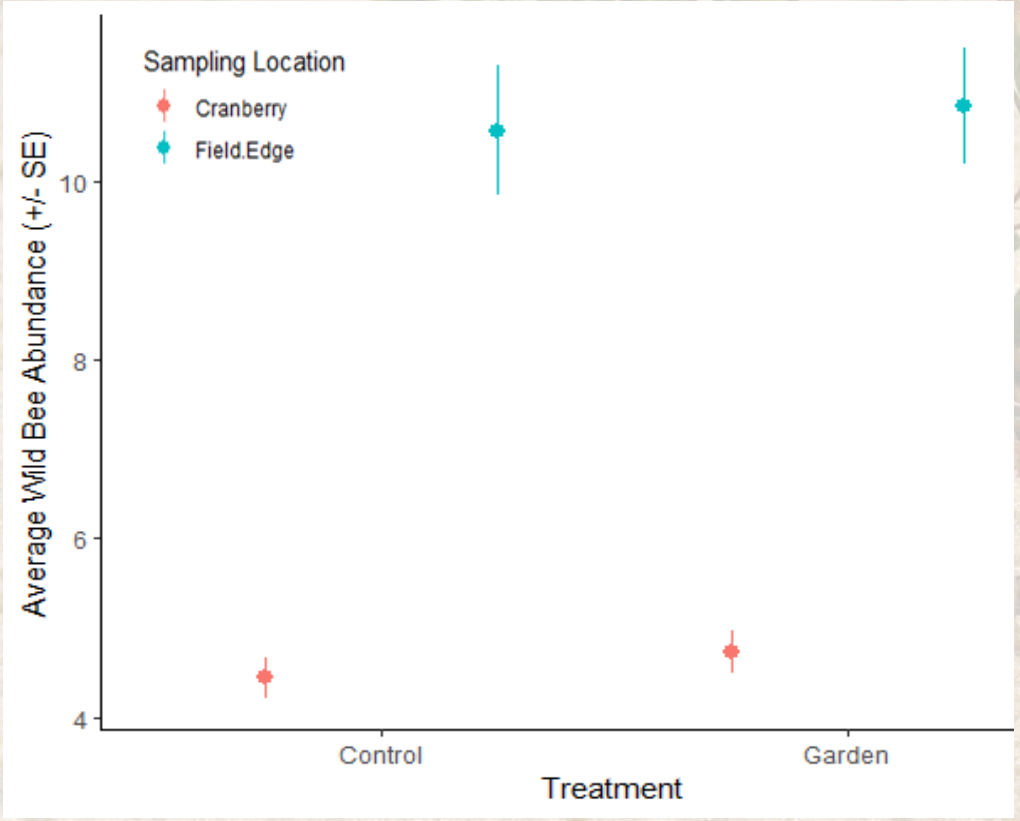


Treatment: $F(1,38) = 0.64$; $P = 0.43$

Bloom $F(1,17684) = 130.06$; $P < 2 \times 10^{-16}$

Obj 1.2: Wild bee abundance in relation to sampling location

Pollinator gardens did not increase wild bee abundance, but wild bee abundance was higher on marsh edge compared to cranberry



Treatment: $F(1,38) = 0.67$; $P = 0.41$

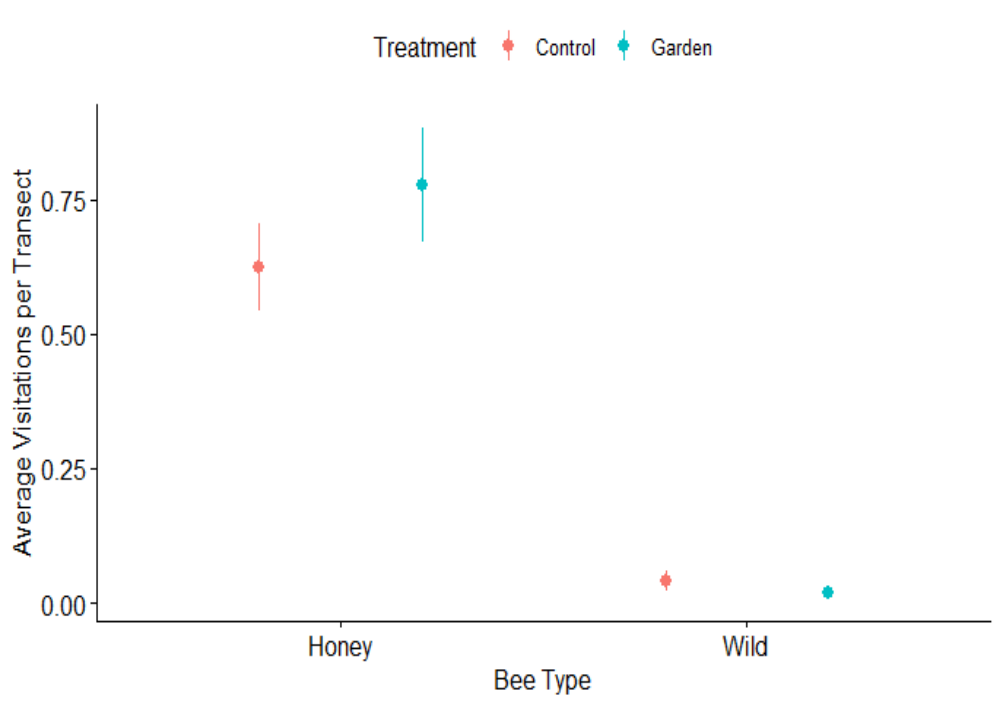
Bloom $F(1,11930) = 212.8$; $P < 2 \times 10^{-16}$

Obj 1.3: Bee visitation to cranberry flowers

Honey bees visit cranberry flowers more frequently than wild bees

No impact of pollinator gardens on honey bee visitation to cranberry flowers

Wild bees visited more often cranberry flowers near control plots than garden plots



Bee type: $P < 2.2 \times 10^{-16}$

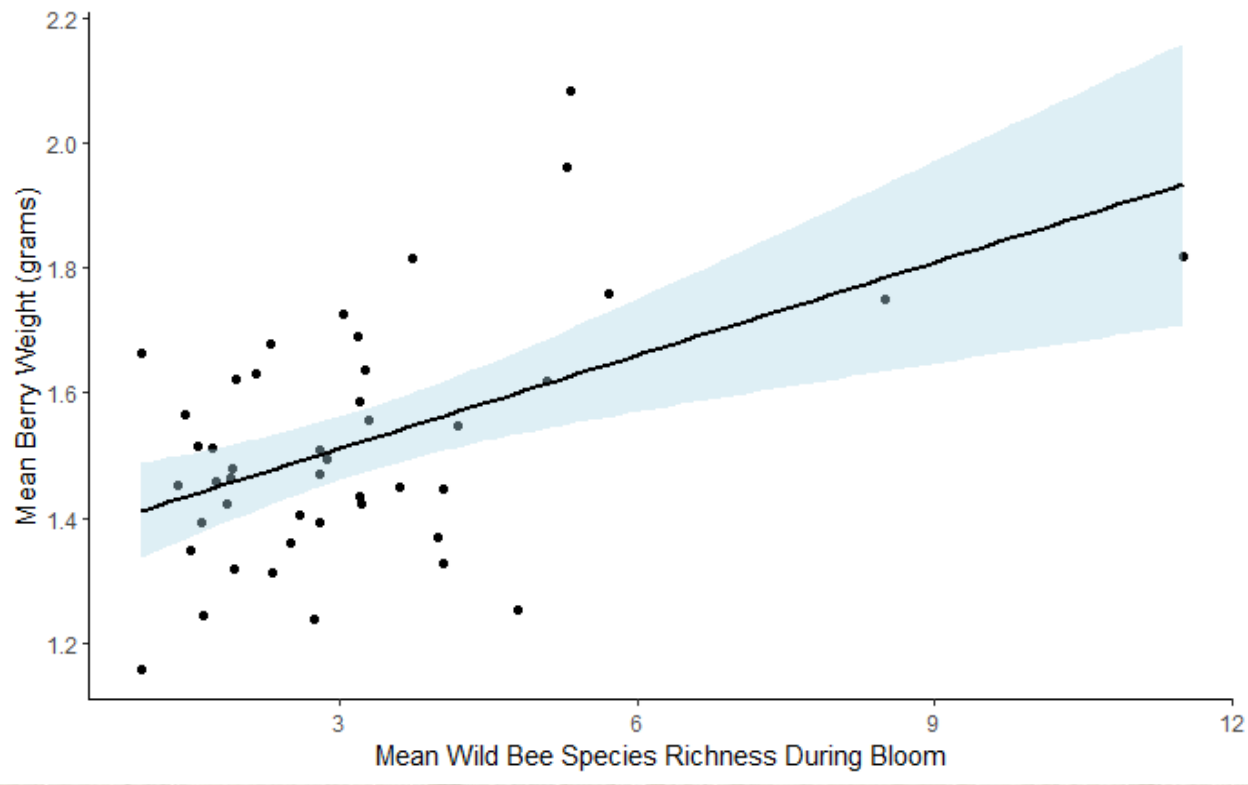
Treatment: P = 0.59

Bee type*treatment: P = 0.018

2.1: Wild bee richness and berry weight

Increasing wild bee richness during bloom correlated with increasing berry weight

No impact of honey bees on berry weight



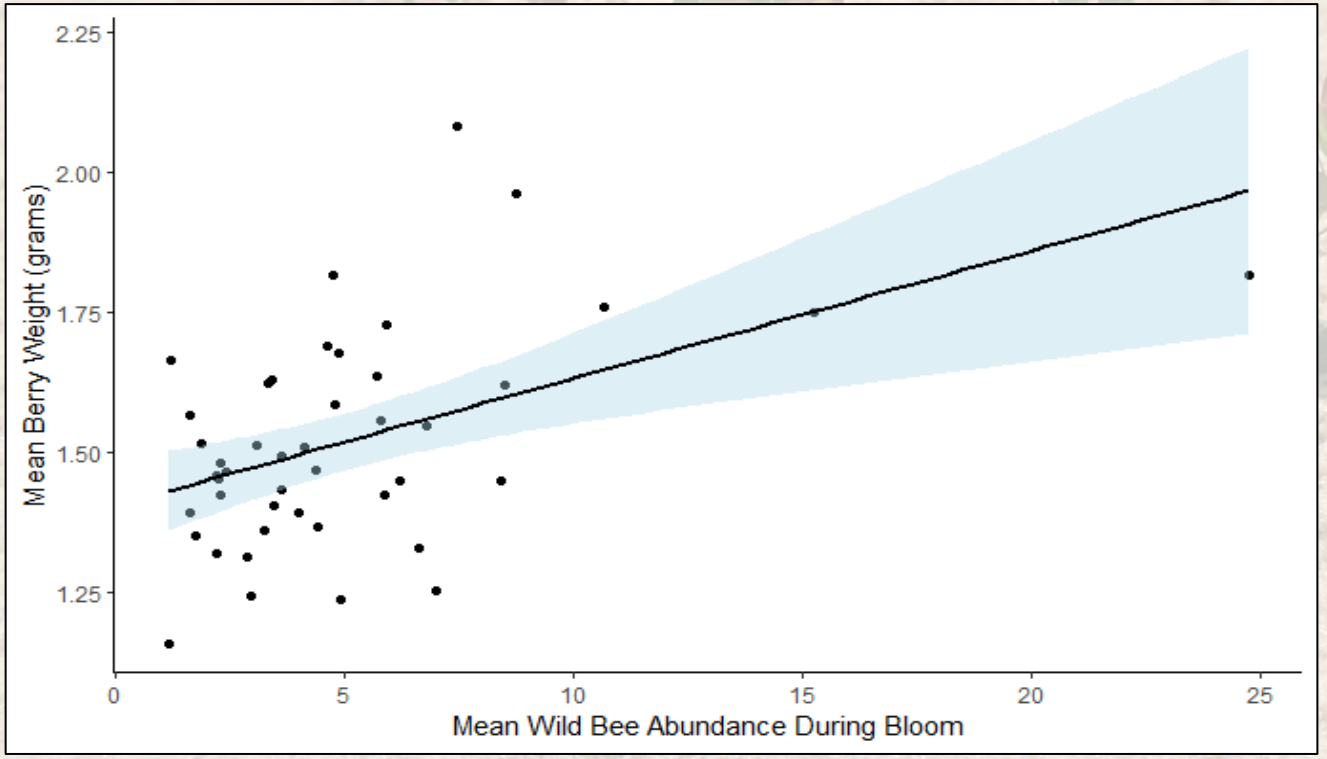
Richness: p = 0.0002

Honeybee: p = 0.35

2.1: Wild bee abundance and berry weight

Increasing wild bee abundance during bloom is correlated with increasing berry weight

No impact of honey bees on berry weight

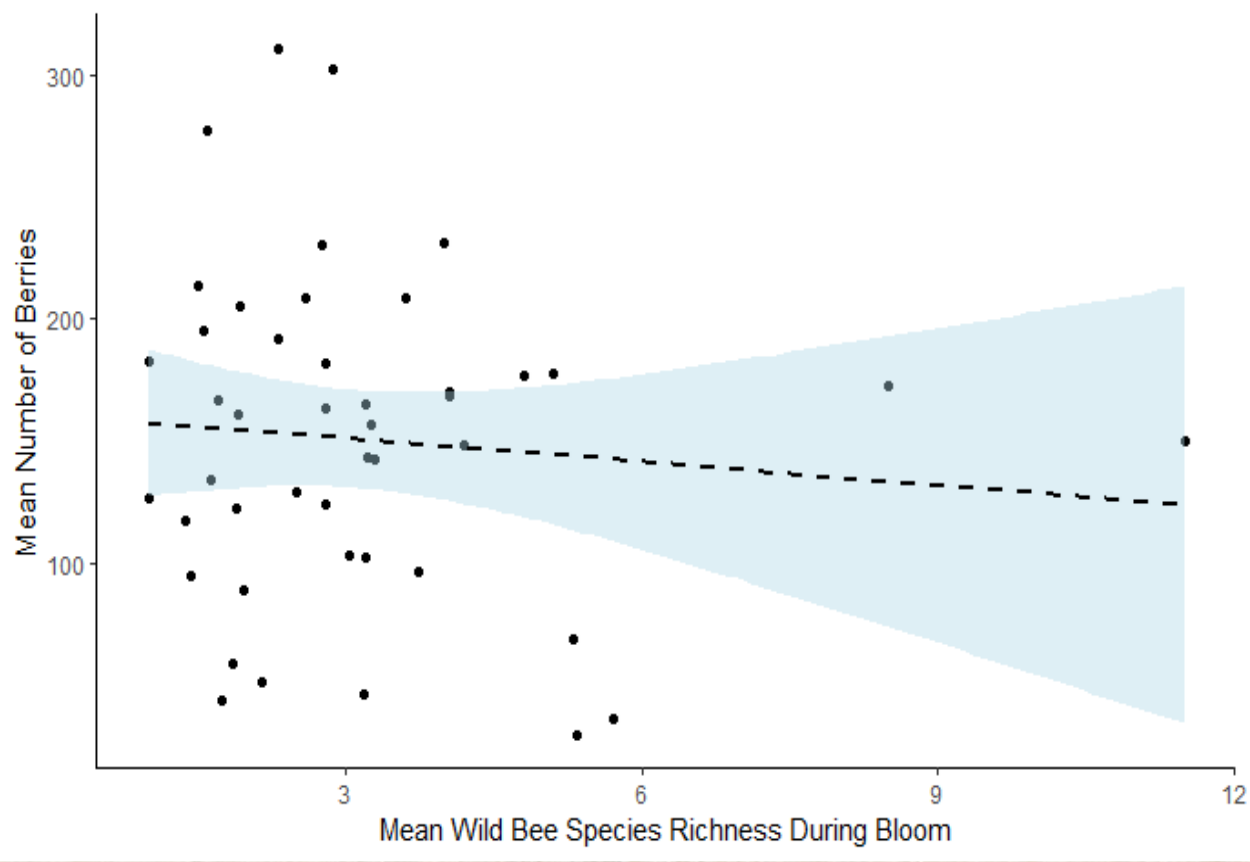


Abundance: p = 0.003

Honeybee: p = 0.207

2.2: Wild bee richness and number of berries

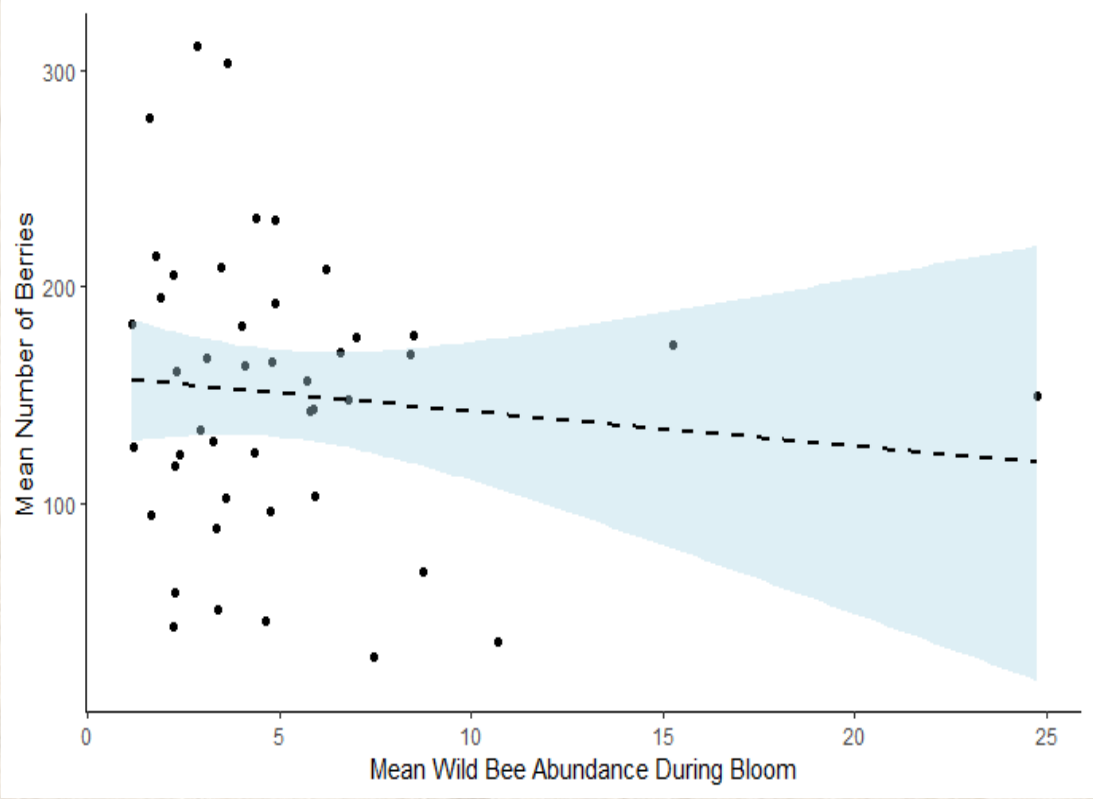
No impact of wild bee richness on number of berries
Marginal impact of honey bee abundance on number of berries



Richness: p = 0.26
Honeybee: p = 0.07

2.2: Wild bee abundance and number of berries

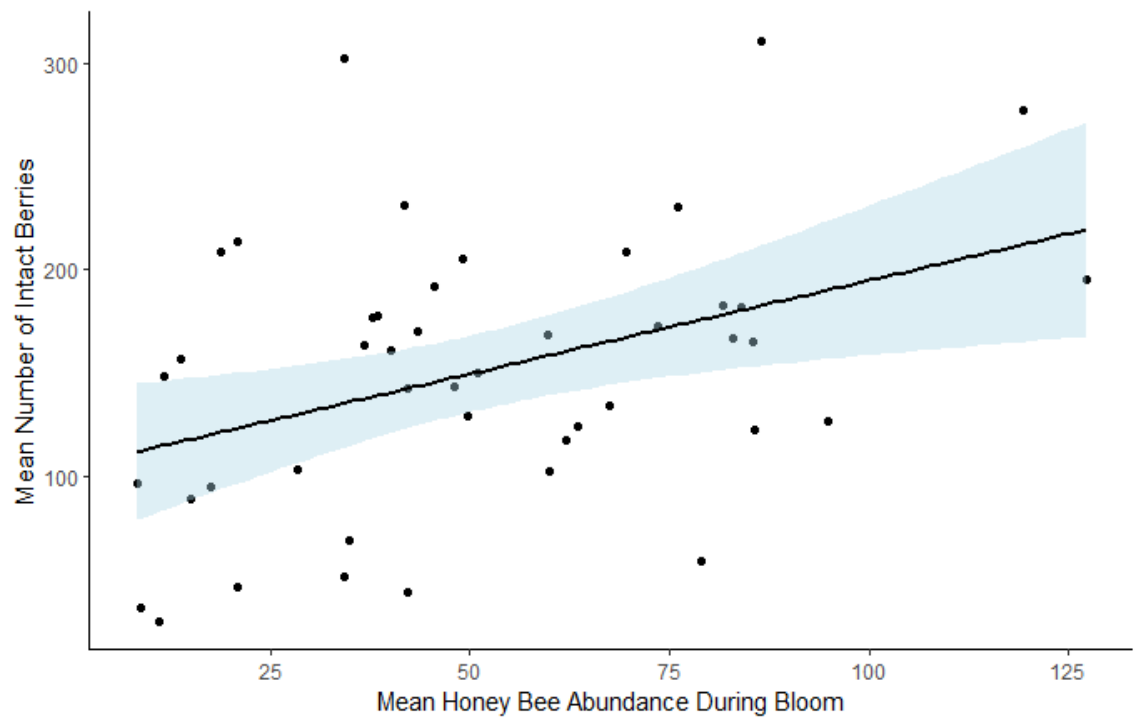
No impact of wild bee abundance on number of berries
Marginal impact of honey bee abundance on number of berries



Abundance: p = 0.45
Honeybee: p = 0.063

2.3: Honey bee abundance and number of berries

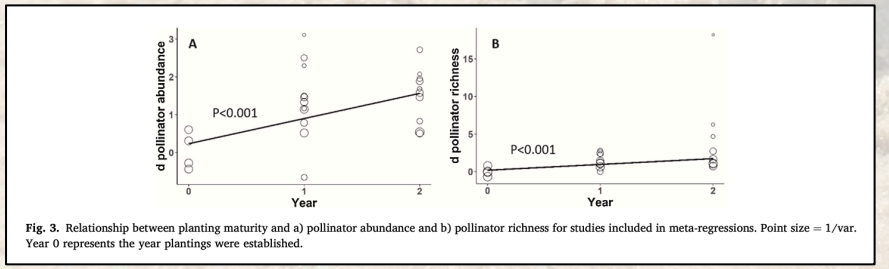
Honey bee abundance positively correlated with number of berries



Honey bee abundance:
p = 0.019

Summary

- Increases in wild bee richness and abundance over time
- Pollinator gardens led to increase in wild bee richness inside and on marsh edges of cranberry but not in wild bee abundance
- Honey bees visit cranberry flowers more often than wild bees, not surprising considering >89% WI growers rent honey bees
- Wild bees visited cranberry flowers more often in control than garden plots, could be drawn away from cranberry by gardens?



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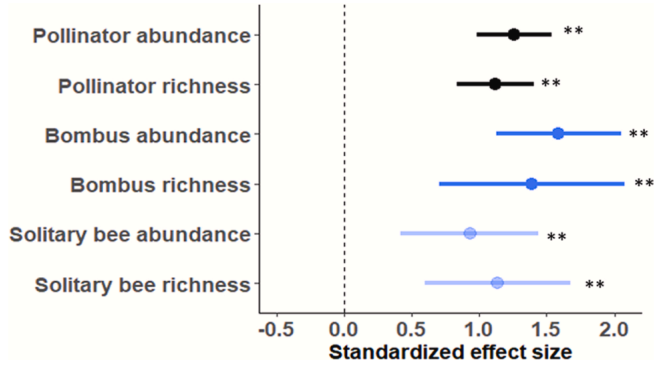

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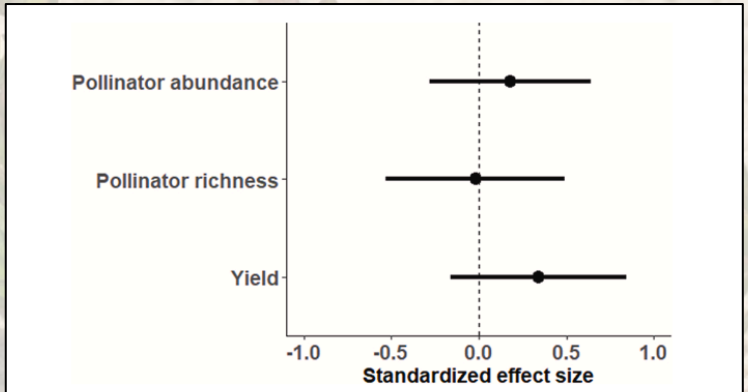
Summary and Conclusions

- Wild bee richness and abundance both correlated with berry weight but not with number of berries
- Honey bee abundance positively correlated with number of berries but not berry weight



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Wild bees may visit fewer flowers but deposit more pollen

Honey bees may visit more flowers but deposit less pollen

Wild bees and honey bees could provide complementary pollination services

Acknowledgements

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