

Draft

Are Current Management Practices for Brambles Causing Potential Pollination Problems?

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Our central PA farm is thick with native brambles; blackberries, black raspberries and red raspberries (wine berries). For the past three years we have observed, and enjoyed, the various “seasons” of bramble; leafing out, flowering, fruiting, harvesting (and eating) and brilliant senescing fall colors. As entomologists it was not surprising that the interesting variety of native pollinators visiting brambles caught our attention and prompted a series of questions concerning the pollination of wild and cultivated brambles and the possible management of native bees for the pollinators of cultivated brambles.

We designed a study to look at the kinds and numbers of pollinators visiting wild brambles and compare this to the pollinators visiting cultivated raspberries. Our survey of three different organic farms revealed interesting differences in pollinators with potential economic consequences for growers of raspberries.

Singing Creek Farm has no cultivated brambles. Pollinator diversity and abundance data were collected on wild brambles. While we had hoped to survey mainly wild red raspberries (wine berries), a late frost greatly reduced the flowering of these wild berries. We were however able to sample pollinators on blackberries and black raspberries which we felt were representative of pollinators of wild brambles. These wild brambles flowered throughout the month of June. Two other organic farms surveyed had cultivated red raspberries, (variety; Heritage). On both farms these varieties are managed by cutting the canes to the ground early in the season. The canes grow back and delay flowering and fruiting for about one month. The plants then flower and bear continuously from mid-July until frost.

Diversity and abundance of pollinators visiting raspberries on three farms

The **diversity** of pollinators working raspberries at the three different farms was determined by collecting at least one of every type of insects visiting the bramble flowers during each farm visit. Different colored pan traps were also used as a tool to sample pollinators at times when we were not physically at the farms. The **abundance** of pollinators visiting brambles was determined by counting the number of each species visiting a set number of bramble flowers (15 for most counts) during 10-minute periods during each farm visit. This was done six times at two times of the day (mid- morning and early afternoon) on three different visits to each farm. These results were summarized as the Index of visitation rate for each species.



Melissodes bimaculata (Lepeletier)



Augochloropsis spp.

Pollinator diversity varied greatly among the three farms. From the collections and identifications of bees shown in Tables 1-3, several differences can be seen. Bees visiting brambles on Singing Creek Farm during wild raspberry bloom in June included 10 species from 7 genera from 6 families. The majority of the bees were from the family Megachilidae, genus *Osmia*. This includes the two well-known species that are specialists on plants of the Rosaceous family and are widely used as pollinators in Japan and the western U.S, as well as a third *Osmia* species. We had held a group of *Osmia cornifrons* (the Japanese horn-faced bee) under refrigeration for several weeks and pulled them out May 30, 2002. The high number of these bees seen foraging on brambles were undoubtedly these bees. We also found bees of a different genera in each of the families Colletidae and Adrenidae. In both cases, bees of these genera are known to be specialists on Rosaceous plants. Thus at least 4 species from 3 families known to specialize on Rosaceous pollen were found on wild brambles on Singing Creek Farm, that were not seen on the other two farms a month later during cultivated berry blooming. Also, noticeably absent were wild honey bees.

Table 1. Diversity of Bees on Wild Raspberries at Singing Creek Farm in June, 2002.

Family	Genus	species
Megachilidae (leafcutter and mason bees)	<i>Osmia</i>	<i>cornifrons</i>
		<i>lingeria</i>
		?
	<i>Megachile</i>	?
Halictidae	<i>Lasioglossum</i>	?
Anthophoridae	<i>Nomada</i>	?
Andrenidae	<i>Andrena</i>	?
		?

Colletidae	<i>Hylaus</i>	?
		?
Apidae honey & bumble bees	<i>Bombus</i>	?
6 families	7 genera	11 species

Bees visiting red raspberries on the Village Acres Farm during bloom in July included 8 species in 7 genera in 4 families. The majority of the bees observed were honey bees presumably from the hives kept nearby on the farm. We observed none of the solitary bee species known to specialize on Rosaceous plants during the late July to early August blooming period that had been seen on wild raspberries above in June.

Table 2. Diversity of Bees on Cultivated Raspberries “Heritage” at Village Acres Organic Farm in July, 2002

Family	Genus	species
Megachilidae (leafcutter and mason bees)	<i>Megachile</i>	?
Halictidae	<i>Augochloropsis</i>	?
	<i>Lassioglossum</i>	?
Apidae (honey and bumble bees)	<i>Bombus</i>	?
		?
	<i>Apis</i>	<i>mellifera</i>
Anthophoridae	<i>Melissodes</i>	<i>bimacula?</i>
	<i>Nomada</i>	
4 families	7 genera	8 species

Bees visiting red raspberries on the New Morning Farm during bloom in July included at least 12 species in 10 genera in 4 families. The great majority of bees were bumble bees. While we saw a greater diversity of bees here than on the other farm, there were very few honey bees, and none of the species known to specialize on Rosaceous plants seen on wild berries in June.

Table 3. Diversity of Bees on Cultivated “Heritage” Raspberries at New Morning Farm during July-August, 2002.

Family	Genus	species
Megachilidae	<i>Megachile</i>	?

(leafcutter and mason bees)	<i>Chelostoma</i>	?
Halictidae	<i>Lasioglossum</i>	?
	<i>Nomada</i>	?
	<i>Augochloropsis</i>	?
	<i>Agopostemon</i>	?
Apidae (honey bee and bumble bees)	<i>Bombus</i>	<i>perplexus</i>
		<i>impatiens</i>
		?
	<i>Apis</i>	<i>mellifera</i>
Anthophoridae	<i>Xylocopa</i>	<i>virginica</i>
	<i>Melissodes</i>	<i>bimacula</i>
4 families	10 families	12 species

Pollinator Abundance

Pollinator abundance also varied greatly among the three farms. While flower visitation counts were not made on wild raspberries due to late frost that appeared to reduce flowering, pollinators were collected on wild blackberries and wild black raspberries on Singing Creek Farm. We collected a high number of *O. cornifrons*. These bees originated from a population that we had overwintered from 2001, held in refrigeration and placed in the field May30th. We also collected a number of *O. lignaria* (horn-faced bees) and another *Osmia* species that were naturally occurring.

The initial visit to the Village Acres Farm was at the beginning of raspberry bloom (July 10). Flowers and pollinators were few. During the second two visits, the number of flowers increased. While the numbers of bumble bees and solitary bees remained about the same, the number of honey bees foraging increased significantly. A calculation of the index of visitation shows that honey bees were providing the highest visitation to flowers on the second two dates compared to all solitary bees and all bumble bees seen. This index shows that honey bees were visiting flowers 1-2 times per hour during the later dates.

Table 4. Abundance of Bees Visiting Raspberries “Heritage” Blooms on Village Acres Farm, July, 2002

Date and Time	Bee Group ^a	No. of visits/ No. of flowers observed	Index of visitation ^d	Total Bees Observed	Notes
7/10; AM counts made between 10:00-10:40 ^b	BB	32/82	0.4	10	light bloom
	HB	15/82	0.2	5	4 colonies on site
	SB	9/82	0.1	6	
7/10; PM counts made between	BB	41/82	0.5	10	light bloom
	HB	13/84	0.2	4	4 colonies on site

2:30-3:00	SB	11/84	0.1	7	
7/17; AM counts made between 9:00- 9:30	BB	45/90	0.5	15	4 colonies on site
	HB	95/90	1.1	38	
	SB	10/90	0.1	6	
7/17; PM counts made between 1:00-1:30	BB	13/90	0.1	6	4 colonies on site
	HB	83/90	0.9	36	
	SB	7/90	0.1	5	
7/24;AM counts made between 10:00–11:00 ^c	BB	19/90	0.2	12	4 colonies on site
	HB	208/90	2.3	92	
	SB	15/90	0.2	10	
7/24; PM counts made between 1:00-2:00	BB	18/90	0.2	9	4 colonies on site
	HB	154/90	1.7	76	
	SB	14/90	0.2	11	

a BB= bumble bee; HB= honey bee; SB=solitary bee

b six counts-15 minute counts were made by two individuals

c six count-15 minute counts were made by one individual

d index of visitation = # of visits/flower/hr.

Table 5. Abundance of Bees Visiting Raspberry Flowers “Heritage” on New Morning Farm, July, 2002.

Date and Time	Bee Group ^a	No. of visits/ No. of flowers observed	Index of visitation ^d	Total Bees Observed	Notes
7/20; AM counts made between 10:30-11:00 ^b	BB	172/90	1.9	67	
	HB	7/90	0.08	4	
	SB	80/90	0.9	40	
7/20; PM counts made between 1:30-2:00	BB	240/90	2.6	93	
	HB	10/90	0.1	5	
	SB	70/90	0.8	42	
7/24; AM counts made between 10:00- 11:15 ^c	BB	173/90	1.9	58	Temp. low 70's
	HB	2/90	0.02	2	
	SB	41/90	0.5	33	
7/17; PM counts made between 1:00-2:15 ^c	BB	129/90	1.4	64	
	HB	11/90	0.1	7	
	SB	78/90	0.9	50	
7/31; AM counts made between 10:00–11:00	BB	93/90	1.0	45	
	HB	11/90	0.1	7	
	SB	63/90	0.7	43	
7/31; PM counts made between 1:00-2:00 ^{***}	BB	137/90	1.5	79	
	HB	30/90	0.3	14	
	SB	44/90	0.5	32	

a BB= bumble bee; HB= honey bee; SB=solitary bee

b six counts-15 minute counts were made by two individuals

c six count-15 minute counts were made by one individual

d index of visitation = # of visits/flower/hr.

Bumble bees were by far the most abundant pollinators of raspberries on the New Morning Farm. This farm had the greatest diversity and density of pollinators and the highest visitation rates to flowers. The index of visitation shows that bumblebees were visiting flowers much more frequently than either honey bees or solitary bees.

From the data above a conservative estimate of the number of bee visits per day can be made by averaging the number of morning and afternoon visits per hour and multiplying

by six (conservative estimate of the number of hours per day that bees forage on brambles). For instance the index of visitation for bumble bees on 7/24 (from Table 6) was 1.9 in the morning and 1.4 in the early afternoon. The average visitation per hour was 1.7 visits x 6 (hrs. of foraging per day) = 10.2 visits/flower/day by bumble bees. This can be done for individual bee groups, such as bumble bees or for two or more bee groups combined. Published rates for adequate pollination of raspberries by honey bees recommended 5-15 visits/flower over 3 days.

Conclusions

In central PA, wild brambles flower at the end of May- beginning of June. At this time there are a number of active, native (and a few introduced) bee pollinators including those that specialize on Rosaceous plants, particularly in the genus *Osmia* (mason bees). However raspberry growers in this project routinely cut back red raspberry canes in spring to delay flowering and fruit production) until July (through frost). Some of the wild solitary pollinators specialize on Rosaceous, such as *Osmia spp.*, have completed their adult lives and are no longer active by the time these domestic brambles are blooming. Consequently, the effective pollinators of domestic brambles appeared to be somewhat different from wild brambles. The absence of these wild pollinators that normally specialize on Rosaceous plants has the potential to cause pollination problems for bramble growers, especially since wild honey bees are no longer common.

However, both cooperating farms appeared to have good bee visitation. The Village Acres Farm had four colonies of honey bee colonies which appeared to be critical given the lack of bumble bees and other native pollinators found visiting raspberry flowers. Without the addition of honey bee pollinators this farm would have most likely suffered a loss in fruit quality and yield. The New Morning Farm did not have honey bee colonies and very few honey bees were seen visiting raspberry flowers indicating a lack of wild colonies. However, the high numbers and kinds of pollinators, especially bumble bees, resulted in higher bee visitation rates than occurred at the Village Acres Farm. Given this scenario, if New Morning Farm had opted to rent honey bee colonies for raspberry pollination, the expense would have been money wasted .

We propose that observing the visitation rate to raspberry flowers holds the potential to make a conservative estimate of the adequacy of pollination by honey bees, bumble bees, or solitary bees individually or in combination. This method combines published honey bee pollination rates with the current observations, and allows the grower to make immediate adjustments if needed. Some additional testing is required to confirm this potential and with the help of SARE we hope to complete another 2 years of study making this a practical tool for growers.

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