Advocating Native Bee Pollination Services on U S Farms

BY EMILY MCGLYNN

Researchers at Rutgers University and Bryn Mawr College are helping farmers identify the top native pollinators in their area and how to support them.

The Impact of Colony Collapse Disorder

Insect pollination is an essential agricultural input: the world is dependent on insect pollinators for 35% of its food supply and two-thirds of crop varieties require some level of animal-mediated pollination (Klein et al. 2007, Roubik 1995). This pollination service, almost exclusively due to the activity of bees, is highly valuable and generates an estimated $18 billion annually in the US (Morse and Calderone 2000, Losey et al. 2006). Bees efficiently transfer pollen between different plants of the same species. This cross-pollination makes for healthier and more genetically diverse plant populations. It also facilitates reproduction for crops such as watermelon, which have separate pollen providing (male) and fruit producing (female) flowers, or apples, many varieties of which require cross-pollination from a different variety (called self-incompatibility) to produce fruit.

Commercial growers of entomophilic (or insect-pollination dependent) crops depend heavily on rented honeybee colonies to fulfill their pollination service needs. When in 2006 US honeybee populations began to crash in a startling trend now known as Colony Collapse Disorder (CCD), the agriculture industry became deeply concerned. Though the cause of CCD is mysterious, the phenomenon highlighted the risk of relying on a single pollination service provider (honeybees) for commercial crop production. Severe economic losses and food shortfalls could result if pollination service loss is not addressed.

Apples, blueberries, strawberries and various nuts, all crops that generate billions of dollars annually for the US economy, require from one to three honeybee colonies per acre to maximize fruit production (Blossom to Harvest 2005). Almonds, California's top agricultural export, are completely dependent on insect pollination for reproduction due to self-incompatibility, and bring $1.9 billion into the state each year (Kodad 2008, Almond Board of California 2008). In part due to declining honeybee numbers, California honeybee colony rental costs have increased three-fold since 2001 (California Agricultural Statistics Service 2007).

Costs of honeybee hives will continue to rise if CCD and other hive management problems continue, requiring that farmers spend more revenue on a less reliable input. If farmers rely exclusively on honeybees, the availability of pollinator-dependent foods may become more irregular or they may simply become economically inefficient to produce (Allen-Wardell et al. 1998).

Strategies for Addressing the Disorder

Direct investigation of the causes and treatment of Colony Collapse Disorder are crucial. However, an equally important approach to promoting reliable crop pollination is to encourage larger and more robust populations of native, non-managed bees. This may require only investing in the long-term sustainability of their habitat, and would hopefully allow for greater reliability of pollination services into the future. The mitigation strategy outlined here aims to reduce tacit reliance on a single pollinator species and augment native bee populations, simultaneously compensating for lost pollination services and increasing insect biodiversity on farms.

In order to locally promote this strategy, a group of researchers from Rutgers University and Bryn Mawr College quantified the presence and visitation rates of 78 native bee species on 29 farms in Pennsylvania and New Jersey. Their data, along with previous studies, were used to rank native bees according to their importance (here determined by population abundance) for 11 Pennsylvania and New Jersey fruit and vegetable crops. They found that increasing the presence of native bees on farms could compensate completely for lost honeybees in certain geographical areas (Winfree et al. 2008). These results and information on the biological needs of the most important local native bee populations are currently being distributed to PA and NJ farmers through an outreach pamphlet, encouraging local adoption of this strategy (see "Native Bee Benefits").

The Three Strategy Components

There are three components of implementing this strategy on farms:

1. Increasing preferred foraging resources (i.e. food, which for bees is nectar and pollen from flowers);
2. Providing areas and materials to nest so bees will want to come back year after year;
3. Practicing bee-friendly land management where they are active.

The first component involves planting a mix of native flowering plants around the farm, especially in marginal land such as in ditches, along the sides of roads and paths, or on steep hills near the crops needing pollination. Increasing suitable habitat in these areas is highly successful at encouraging bee nesting, with a 135% increase on average in number of bees found in restored roadsides from those found in non-restored sites (Hopwood 2008).

The second component entails providing preferred nesting substrates near foraging resources. Depending on the bees one is trying to attract, three different kinds of nesting substrates will need to be provided: wood, suitable ground areas, and pre-existing cavities. It is important to keep in mind that foraging resources should be planted within the flight range of the bees' nesting sites, which varies from as little as a few hundred yards for small sweat bees such as Lassioglossum to over four miles for large bees like Bombus (bumble bees).

The third component requires that farmers know how different land management strategies can affect bee populations, including which pesticides and herbicides (if any) to use on their crops. These chemicals can negatively impact bees, both when sprayed directly on them, and when collected by bees from sprayed flowers. The former can kill a bee immediately, but the latter contaminates the food supply of the entire hive if brought back by foragers, killing many bees or the brood over a period of weeks (Delaplane 2000). Highly targeted application is more likely to limit bee exposure. In general, granules and solutions are safer than powders, which certain bees may confuse with pollen and collect as food (Delaplane 2000). Insecticides with sugary baits are likely to attract bees and therefore should be avoided.

Conclusion

The current outreach efforts mentioned above are based on locally obtained data and are relevant mainly to growers in the Pennsylvania and New Jersey region. Similar efforts are going on in Michigan, California and elsewhere. Nationwide implementation of this strategy requires replication of the research done on Pennsylvania and New Jersey pollinator communities (see Winfree et al. 2008) throughout the US such that farmers in all parts of the country can benefit from knowing the top native pollinators in their area and how to support them. Researchers can help by carrying out these studies and farmers have a role in implementing targeted bee habitat restoration based on the studies' results. These efforts can help ensure secure, sustainable and affordable production of a huge variety of cash crops including apples, watermelon, peppers, tomatoes, berries, nuts, and even soy.

About the Author

Emily McGlynn is a Research Assistant with the Ecology Lab at Bryn Mawr College in Pennsylvania.

Author's Picks for Further Reading

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Author's Picks for Further Reading (con't)

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"Native Bee Benefits" pamphlet: beebiology.ucdavis.edu/NATIVEBEES/index.html

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The most efficient native bees for top regional fruits and vegetables.[12,13]

All these bees are good pollinators, but three stars (***) indicates a key pollinator for that crop. Supporting a variety of bee species will help maintain reliable pollination of crops season after season. A good goal would be to attract as diverse a collection of bees as possible.

Bee Species	Crops	Apple	Blueberry	Cranberry	Cucumber	Muskmelon	Pepper	Squash	Strawberry	Tomato	Watermelon
ndrena (multiple species)		*	**						*		
gochlora pura						***	**			**	**
Augochlorella striata						***	**		*	**	**
Bombus (multiple species)			*	*		***	*	**		**	***
Bombus impatiens			*	**	**	***	*	**		**	***
Ceratina (multiple species)						*					
Colletes inaequalis		*	**								
Habropoda laboriosa			***								
Halictus confusus							***		*	**	**
Lasioglossum (Dialictus)			*			**	***		**	***	***
Peponapis pruinosa						*		***			*
Xylocopa virginica			**								

Bee importance for crop pollination	
*	**Good**
**	**Better**
***	**Best**

How do I attract these bees to my farm?

There are two key things that would likely increase support for native bees on PA and NJ farmland:

- Grow recommended native plants that studies have shown are preferred by bees in order to attract more pollinators to your property (see page 6).
- Establish areas of suitable pollinator habitat around the farm. This will allow more bees to nest on your property and encourage their return year after year (see page 7).

The rest of this pamphlet provides guidelines for what you can do to make your farm a bee haven.

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Excerpt from "Native Bee Benefits" pamphlet. Available for download at beebiology.ucdavis.edu/NATIVEBEES/index.html