Native Pollinators and...

Apples and Peaches

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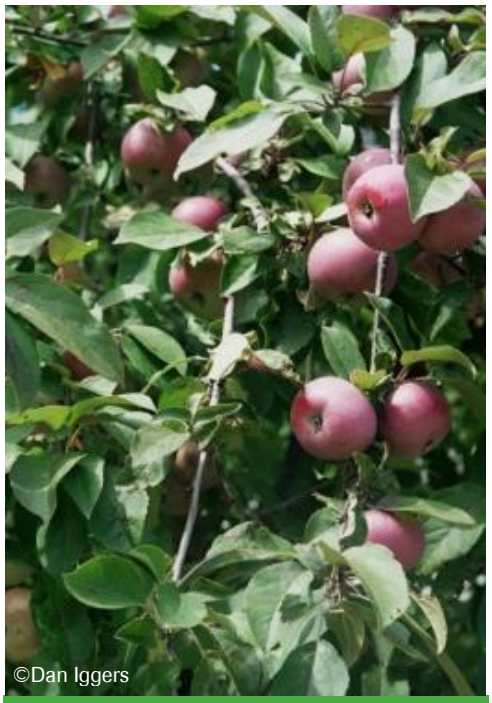
Analysis of Native Pollinator Benefits to New Jersey Farms

Apples and peaches are the major tree fruits produced in New Jersey, adding about $57.2 million each year to the state's economy. Peaches cover about 5,900 acres and apples almost 2,000 acres, with a combined production of over 52,000 tons a year in New Jersey (USDA NASS 2012).

More than one-third of the world's agricultural output depends on animal pollination. Crop yields are impacted by two categories of pollinators: 1) managed honey bees, which were initially imported from Europe; and 2) native insect pollinators (also called wild pollinators) such as bumblebees, sweat bees, and squash bees. Research shows that native insect pollinators can increase yields above what honey bees alone can provide. Native bees are twice as effective as managed honey bees at pollination, demonstrated by a large team of researchers testing a wide array of crops and cropping systems across the globe (Garibaldi *et al.* 2013). And not all pollinator habitat is the same: the quality of habitat is correlated with higher bee abundance and higher pollinator species diversity (Kennedy *et al.* 2013).

Tree fruit production relies heavily upon honey bees. Apple production requires the rental of more honey bee hives than any other crop, after almonds (Morse and Calderone 2000). Yet native pollinators are more efficient than honey bees, with one female orchard mason bee pollinating as much as 60 - 80 honey bees (Xerces 2010). Although peaches are partially self-fertilizing, both peaches and apples see higher yields and quality when pollinated by native insects.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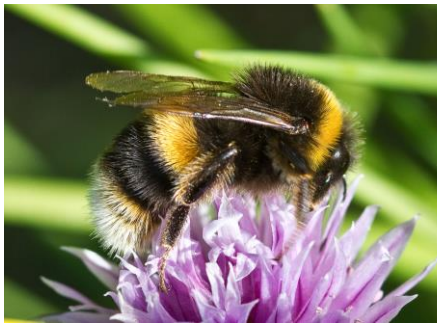
Economic Value of Pollination

Pollinators, such as bees, wasps and flies, contributed approximately **$29 billion to farm income** in the United States in 2010 (Calderone 2012). Yet the **loss of honey bee populations** in New Jersey has ranged from **21% to 35% each winter** from 2009 – 2012 (Schuler 2013). Perhaps more concerning, however, is that there has been a steadily declining trend since the 1940's in managed honey bee populations (Ellis, Evans, and Pettis 2010).

Tree fruit production and native pollinators



Bumble bee ©Richard Towell

Native pollinators contribute $5.2 million to the value of apple and peach production annually in New Jersey. This figure is based upon New Jersey production data from 2009-2011 (USDA NASS 2012); please refer to the full report for details on how this value was calculated by emailing njpollinators@tnc.org.

Given recent trends, it would be risky to assume that existing pollinator habitat will still be around ten years from now, or even next year. A comprehensive analysis of the state of New Jersey reported a rate of over 16,000 acres of new development per year. This 27% increase in urban areas and urban sprawl in just over 20 years has led to a corresponding decrease in agricultural lands, wetlands, and forest (Hasse & Lathrop 2010). Without sufficient habitat, the full benefits of pollination will not be obtained for agricultural production. In some regions of New Jersey where habitat loss is higher, individual tree fruit farmers may already be experiencing negative impacts on profitability.

Common selfheal (Prunella vulgaris) is a favorite of native pollinators ©M.M. Rekenitr

Native pollinators and the benefits for agricultural risk management

Agricultural crop yields vary each year and are affected by many types of risk, including drought, pests, frost, and extreme weather conditions. A common risk management tool used by farmers is the diversification of farm revenue. Diversification strategies include combining crops and livestock, a mix of wholesale and direct marketing, or planting a mixture of crops. The goal is to reduce the variability in household income. Farmers may also rely upon crop insurance or on household members obtaining off-farm employment.

Increased attention is going towards incorporating both native insects and honey bees for agricultural pollination as a way to manage risk. Investing in native pollinator habitat could be an appealing option for a risk-averse farmer to increase the probability of maintaining a steady net income from tree fruit production. A diversified approach to pollinating—one that includes wild insects in addition to managed honey bees - will increasingly become an essential tool in a farmer's risk management tool kit.

A growing amount of research is showing that the inclusion of native pollinators in an agricultural production system can benefit agricultural risk management in the following ways:

- Maintain higher yields
- Improve yield quality
- Serve as a form of crop insurance

Economic Evidence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Overview

The available evidence suggests that planting native pollinator habitat can lead to multiple benefits for farmers. We conducted an economic analysis to assess the change in gross revenues after new native pollinator habitat is implemented. The analysis is based upon varying levels of habitat loss, since we expect that the land surrounding each agricultural field varies substantially in terms of land use types. Our two scenarios are based on actual prices and yields from New Jersey, to calculate the following: What would the difference in gross revenues be, had farmers implemented native pollinator habitat during the time period?

Methods and Scenarios

Ideal choices for land for pollinator habitat include backyards, poor quality fields where crop yields are already low, or areas in hedgerows and between fields. In these cases, the cost of implementation of native pollinator habitat is just the cost of materials, labor, and maintenance, or $1,074 per acre in the first year and significantly less in each subsequent year. Costs are provided by the USDA's Natural Resources Conservation Service (NRCS) of New Jersey and adjusted for inflation. However, additional production costs will be incurred if a farmer were to choose to retire one acre of either apple or peach production in order to plant the native pollinator habitat. Therefore, the costs in the analysis are a function of production costs *and* lost revenues from retiring one acre of tree fruit. In most cases, the costs will be substantially **lower**, as other land will be available and retiring an acre of apples or peaches will be unnecessary. Data on crop yields and prices are from New Jersey from 2009-2011 (USDA NASS 2012). Please refer to the full report for details on the economic analysis and for long-term benefits and costs by emailing njpollinators@tnc.org.

Gross revenues from apples or peaches ($/acre) =	Price ($ per unit) **x** Yield (per acre)
Change in gross revenues ($/acre) after habitat implementation =	Initial Gross Revenues ($/acre) + Production Boost ($/acre) – Costs of implementation

Table 1. Explanation of terms used in the economic analysis

The economic analysis includes a range of values, based upon the proximity of apple or peach orchards to native pollinator habitat and the quality of that habitat. On one end of the spectrum, we theorize that in certain areas of New Jersey, all native pollinator habitat has already been lost. The loss of habitat may be due to development and lack of permeable surfaces associated with areas with high amounts of pavement. Or this situation may also occur in areas where a large percentage of land is fully covered by agricultural production, as fields of a single monoculture are not typically high quality habitat for native pollinator species. On the opposite end of the spectrum is the situation where no pollinator habitat has been lost or has decreased in quality.

Below are two more moderate scenarios of focus that we hope will be a realistic representation of the range of on-the-ground possibilities for most farmers.

Scenario 1

Areas of New Jersey where only a small percentage of native pollinator habitat has been lost, though the remaining habitat may not be of the highest quality. We use an estimated yield boost of 15% as the percentage increase in productivity resulting from planting new native pollinator habitat.

The yield boost is only applied to the 9% of yields attributable to native pollinators, which gives us the following: **15% x 9% = 1.4%**. Thus, the resulting 1.4% increase in productivity is a conservative estimate used in the analysis.

Scenario 2

Areas of New Jersey where 50% of the benefits of native pollinators have already been lost. In this situation, the increase in gross revenues will be slightly higher than scenario 1 once new native pollinator habitat is implemented.

This is calculated by assuming that the portion of yields attributed to native pollinators is currently at 50% of the total potential.

Results of economic analysis - Apples

Table 2 presents the net economic benefits for apples of planting an acre of native pollinator habitat. Before habitat is planted, gross revenues average $11,251/acre (yield is in pounds/acre). In areas where more pollinator habitat still remains (scenario 1), gross revenues decrease by just $348/acre, though that number switches to a net increase of $102/acre if one acre of apples is not retired from production. In areas where native pollinator habitat is further degraded (scenario 2), even when subtracting the full costs of production and retired apple production, we see gross revenues per acre increase by $37. It is important to reiterate that these calculations do not include total production costs and are not a measure of profitability; they show the expected change in ***gross revenues***.

Baseline scenario for apple production in New Jersey			
GROSS REVENUES ($/ACRE) *before new native pollinator habitat implemented*	$11,251	PRODUCTION COSTS *$/acre of habitat implemented (benefitting 24 acres of cropland)*	$1,074
Scenario 1: What is the change in gross revenues in situations where minimal habitat surrounding agricultural fields has been lost, and a 15% yield boost is expected from native pollinators?			
Gross revenues ($/acre) after habitat implementation:	$10,903	**Change in gross revenues ($/acre) after habitat implementation:**	**-$348**
Scenario 2: What is the change in gross revenues in situations where due to some habitat loss surrounding agricultural fields, there has been a 50% reduction in yield benefits from native pollinators?			
Gross revenues ($/acre) after habitat implementation:	$11,287	**Change in gross revenues ($/acre) after habitat implementation:**	**$37**

Table 2. Results for apples: Changes in gross revenue following implementation of one additional acre of native pollinator habitat

Results of economic analysis – Peaches

Table 3 presents the net economic benefits for peaches of planting an acre of native pollinator habitat. Before habitat is planted, gross revenues average $6,097/acre (yield is in tons/acre). In areas where more pollinator habitat still remains (scenario 1), gross revenues decrease by just $208/acre, though that number switches to a net increase of $35/acre if one acre of peaches is not retired from production. In areas where native pollinator habitat is further degraded (scenario 2), even when subtracting the full costs of production and retired peach production, we see gross revenues per acre remain the same. It is important to reiterate that these calculations do not include total production costs and are not a measure of profitability; they show the expected change in ***gross revenues***.

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Baseline scenario for peach production in New Jersey			
GROSS REVENUES ($/ACRE) *before new native pollinator habitat implemented*	$6,097	PRODUCTION COSTS *$/acre of habitat implemented (benefitting 24 acres of cropland)*	$1,074
Scenario 1: What is the change in gross revenues in situations where minimal habitat surrounding agricultural fields has been lost, and a 15% yield boost is expected from native pollinators?			
Gross revenues ($/acre) after habitat implementation:	$5,889	**Change in gross revenues ($/acre) after habitat implementation:**	**-$208**
Scenario 2: What is the change in gross revenues in situations where due to some habitat loss surrounding agricultural fields, there has been a 50% reduction in yield benefits from native pollinators?			
Gross revenues ($/acre) after habitat implementation:	$6,097	**Change in gross revenues ($/acre) after habitat implementation:**	**$0**

Table 3. Results for peaches: Changes in gross revenue following implementation of one additional acre of native pollinator habitat

Discussion of economic analysis – Apples and Peaches

The economic analysis clearly shows for both apples and peaches that the most profitable scenario is where additional land is available and one acre of orchard does not need to be retired from production. As mentioned earlier in this fact sheet, backyards, poor quality fields where crop yields are already low, or areas in hedgerows and between fields are recommended. Removing one acre of tree fruit from production is a good investment in areas where at least 50% of the native pollinator benefits have already been lost. However, long-term planning is important and investing in native pollinator habitat *before* a majority of pollinator populations are lost is expected to be more cost-effective.

Management Options

The results in this economic analysis demonstrate that the range in benefits for tree fruit production is wide. The costs and benefits are largely influenced by the following:

- The type and quantity of habitat surrounding a given field;
- The crop's dependency on native pollinators (each crop has a different level of dependency);
- The net income received from that crop; and
- The net income received from other crops grown in the same year; instead of removing one acre of tree fruit from production, a crop with lower profitability could be targeted for removal from production.

The analysis gives decision makers a sense of the baseline scenario and the tradeoffs involved in implementing native pollinator habitat. Other crops analyzed as part of this native pollinator project include tomatoes, squash, blueberries, cucumbers, bell peppers, melons and soybeans. Additional fact sheets are posted on The Nature Conservancy's website, at: www.nature.org/njpollinators.

Native pollinators: nature's crop insurance

Dedicating areas to native pollinators as part of your farm's long-term plan can reduce risk and potential income fluctuations associated with land conditions beyond your property's borders changing over time.

Conclusion

Native pollinators contribute to agricultural production in terms of increased yields and quality. Given that New Jersey has seen a rapid decrease in agricultural lands, wetlands, and forest over just 20 years, focusing on long-term planning is important. Implementing an acre of native pollinator habitat per 25 acres of agricultural production is a beneficial strategy for managing agricultural risk, and an investment in habitat can be viewed as a form of crop insurance against future losses in productivity. The return on investment varies across the state, depending upon the exact rate of loss of native pollinator habitat in that region. Location-specific maps of pollinator habitat in New Jersey are also posted on The Nature Conservancy's website to give you a general sense of the quality of habitat near your agricultural production area.

If cases were to exist where native pollinator habitat is of such high quality that no immediate yield boost were possible from implementing additional habitat, investment in native pollinator habitat is the annual cost of insurance, buffering household income in the future, as habitats continue to decline and honey bee populations continual to fall. In cases where native pollinator habitat is already depleted, the increase in gross revenues for apples is about $37/acre; for peaches, gross revenues do not change. In all cases, farmers will benefit from thinking about the costs and benefits of including native pollinator habitat in their long-term management plan.

For more information

For more information about the agricultural benefits of wild pollinators in New Jersey, visit www.nature.org/njpollinators or contact njpollinators@tnc.org.

For information about planting pollinator habitat on your farm, visit the Natural Resources Conservation Service at http://www.nj.nrcs.usda.gov/technical/biology/pollinators.html.

For more information from the Rutgers New Jersey Agricultural Experiment Station website on native pollinators, please refer to http://njsustainingfarms.rutgers.edu/nativepollinators.html.

The Xerces Society also provides information on native pollinators in the northeastern United States, at http://www.xerces.org/pollinator-conservation/.

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