Draft: July 14, 2008

Economic Indicators Team Report

August 1, 2008

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Economic Indicators Team Mission Statement:

Identify the current protocols/systems used for estimating the value of crop production resulting from native pollinators and compile updated data documenting the value of fruit, nut, vegetable and crop production resulting from pollination services provided by native pollinators. Crops identified for more intensive economic analysis include: watermelons, apples, seed industry (particularly hybrid seed producers), cranberries, squash, soybeans, strawberries, and alfalfa with its connection to dairy and beef production. Detailed results are found in attachments to this report.

Economic Value Information: We reviewed the literature and essentially have found that there is little, if any, new information on the economic value of native or managed pollinators since we prepared the economic values table for Phase I of this project.

In Table 1 we added eight columns to the original table using information contained in the 2006 paper by Klein, et al. titled "Importance of pollinators in changing landscapes for world crops." The Klein paper rated the role of pollinators in crop production as essential (100% of crop production), great (40-90% of crop production), modest (10-39% of crop production), and little (less than 10% of crop production).

Our Phase I report looked at the economic value of pollinators for 43 crops (20 fruit and nuts, 13 vegetable, and 10 field crops). When we applied Klein's rating to these 43 crops we found pollinators "essential" to 5 fruit and nut crops (almond, apple, avocado, blueberry, and cranberry). In addition, the crop impact was rated as "great" to 11 of the remaining 15 fruit and nut crops listed, and "modest" for the four remaining fruit and nut crops on the list.

When Klein's rating is applied to the 13 vegetable crops in the Phase I report, insect pollination is rated as "essential" to 10 of the crops and the remaining three are listed as "great". In terms of field crops listed in the Phase I report, insect pollination is rated as "essential" for 5 of the 10 crops, and "modest" for the remaining 5 crops.

We have also included new information based upon further work by Klein, et al. that shows the impact of insect pollination on fruit set, fruit size, seed production, and breeding characteristics.

We used the figures from Klein et al. on crop pollination requirements to further refine our calculations for the value of production that depends upon pollinators. Using the range of potential losses associated with crops for which pollinators are essential, great or modestly important, we generated a minimum and maximum value of pollinator dependent production. Summing these totals, we find that at a minimum, pollinators are required for $18.15 billion to a maximum value of $27.72 billion. This brackets the earlier total crop value figure of $20 billion for these same crops. Based on these updated figures, native bees are estimated to be responsible

for $2.7 billion to $6.9 billion in production. The contribution of native bees varies significantly depending upon the landscape, diversity of crops being grown, field size, etc. However, even in heavily managed landscapes, such as California's Central Valley around Davis, CA, scientists have documented that wild native bees contribute 10% to 30% of the pollination of watermelon. When you move to the east coast, where field sizes are smaller and landscapes more diverse, native bees provided all watermelon pollination needed for more than 90% of farms studied.

A. Information on Project Target Crops:

1. Alfalfa. Regarding the intensive analysis charge in the mission statement, other than alfalfa, data were not obtainable for vegetable seed or flower seed. We did find estimates, in alfalfa seed production, that leafcutter bees can double the yield of alfalfa seed and shorten the pollination season by several weeks thereby reducing the impacts of harmful insects on seed set and production. A USDA ARS Tucson Bee Laboratory book reports that both alkali bees and leafcutter bees are far more efficient, on a bee for bee basis, than honey bees in pollinating alfalfa.

2. Apples. Various wild bees have been mentioned as important pollinators of apples, including the species in the genera *Andrena, Bombus, Halictus,* and *Osmia*. Some wild bees, for, example *Osmia*, visit flowers at lower temperatures than do honey bees. At times and in some areas, wild bees are sufficiently abundant to set an apple crop. In general, however, wild bees cannot be depended upon to adequately pollinate the blossoms of very large commercial apple orchards in the United States. During the summer of 2008, scientists at Cornell University are starting a project to investigate the role of wild native bees in apple pollination in upstate New York, where orchards are often smaller than those in Washington state's Columbia Basin. There is great potential for managed native bees to provide this service.

3. Soybeans. There are no recommendations for the use of bees in pollination of soybeans. The subject is reviewed, however, because of the interest in hybrid soybeans and the possibility of using pollinating insects in hybrid soybean production. At this time, a variety of studies yield mixed results about the benefits of pollinators to soybean production. A general rule of thumb is that soybean does not need pollinators to be productive. However, some studies and anecdotal evidence suggest that pollinators do increase yields in some soybean varieties and some studies have documented that native bees, such as leaf-cutter bees and sweat bees, play a role. Because of these mixed findings, Klein et al rate pollinators as modestly (10% to 40% of production) important for soybean production. Furthermore, scientists are working to develop hybrid lines of soybeans. When these techniques are worked out, pollinators will play a very significant role in pollen transfer between male sterile and male fertile plants.

4. Squash. Squash, like watermelon, are highly pollinator dependant and have a suite of native pollinators (for example, squash bees) that are specifically adapted to visit these flowers, including male squash bees that spend the night in the flowers. Research has also demonstrated that farming practices that minimize tillage can lead to tripling of squash bee populations, as it is not unusual for these bees to nest at the base of the plants they pollinate. Anecdotal evidence from conversations with Ray Vincent (workgroup member and squash grower in Delaware) suggests that on a year when Mr. Vincent could not get honey bee colonies, he still had a full crop due to pollination from the bees living around his farm.

5. Strawberry. A 2002 Study by Ohio State leader of small fruit entomology with the Ohio Agricultural Research and Development Center in Wooster, OH found that while insects like ants and beetles help pollinate strawberries, the primary pollinators are native bees. After three years of identifying bee species that were visiting strawberry fields in Wooster and Moreland, OH, researchers recorded 19 different species, all of which were native except the honey bee. Bee species included carpenter bees, leaf cutting bees, orchid bees, bumble bees, digger bees, cuckoo bees and small, metallic bees of the family Halictidae.

6. Watermelon. Native pollinator references were most often Claire Kremen of the U. of California and Mace Vaughan of *The Xerces Society* and speak to the importance of native pollinators to this important summer crop in many parts of the U.S. More than twenty different species of native bee pollinators have been associated with watermelon in California. Of twenty-nine watermelon farms studied in New Jersey and Pennsylvania, almost all could receive all of their pollination from wild native bees.

B. Honey Bee Hive Rental Rates: The most recent paper we could find on honey bee hive rental rates was by Daniel A. Sumner and Hayley Boriss titled "Bee-conomics and the Leap in Pollination Fees" (http://aic.ucdavis.edu/research/bee-conomics-1.pdf). Hive or colony rental rates are highest for California's almond crop, where honey bees are essential to almond production and approximately 700,000 acres come into bloom all within a concentrated two to three week period. Colony rental rates are generally lower for crops with flowering periods that are more widely distributed in their bloom time and location (e.g. apples, blueberries, cranberries, melons) and are likely even less for those crops that produce significant amounts of honey (e.g. canola and clover). Sumner and Boriss report that recent honey bee pests and other problems have reduced the supply of available colonies, while expansion of almond acreage has increased peak-season colony demand. Honey bee rental rates in 1990-2000 were around $40.00 per colony, increasing to $50.00 in 2003, $75.00 in 2005 and doubled to $140.00 in 2006. In 2009 rental rates are expected to increase to $170-$195. Anecdotal evidence from Dan Weaver (task force member and honey bee hive producer) indicates that colony rental rates have doubled for watermelon and cantaloupe in Texas in the last three years (now at $90.00 per colony). If CCD problems continue, and gas prices stay high, colony rental rates can be expected to increase for all pollinator dependent crops with attendant potential negative impacts on the profit margins of the producers involved.

Recommendations:

- **Increase research investments on the role of native bees in crop pollination.**
- **Develop regional and crop specific data on importance of native bees to agriculture.**
- **Prepare and distribute case studies (e.g. Wind Dancer Farms) about grower experiences on the role of pollinators on their farms and estimates of the economic contribution to their bottom line.**
- **With assistance from state apiarists develop regional and crop specific data on what growers are paying for honeybees.**
- **Conduct more crop specific research on importance of bee habitat.**