Enhancing Alternative Pollinators for Orchards and Gardens.

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The Need For "Alternative Pollinators" Honey bee mortality caused by parasitic mites has reduced the number of colonies available for pollination. Now a new pest, the small hive beetle has the potential to create more problems for honey bees. Growers are aware of the need for adequate pollination services to produce good yields and these recent problems with honey bees has stimulated interest in "alternative pollinators."

It has long been known that honey bees are not very effective pollinators of alfalfa and many large scale commercial alfalfa seed producers use alfalfa leafcutter bees instead of, or in addition to, honey bees. The blue orchard bee has been successfully developed for pollinating some fruit trees, and researchers have been working on developing other bees for pollination. More recently we have become aware that honey bees do not pollinate some other crops very well. For example, plants in the blueberry family [blueberry, cranberry, huckleberry, manzanita] keep their pollen enclosed within bags that have a small opening at the tip. These specialized anther sacs are in turn enclosed within urn-shaped flowers which only allow access to pollen and nectar through a small opening at the tip. In order to get the pollen out, a foraging bee must hang under the flower, vibrate the flower using its wing muscles and shake the pollen onto its body where it can be gathered. Honey bees are not capable of buzz pollinating but bumble bees and some other bees are good buzz pollinators. The realization that honey bees are not effective pollinators of some crops and the loss of so many honey bee colonies to diseases has also stimulated interest in developing more alternative pollinators. Tomatoes require buzz pollination and bumble bee colonies are now available year-round for commercial pollination of tomatoes grown in greenhouses.

Should you purchase alternative pollinators from a commercial source and abandon honey bees next year? Well, that would probably not be a wise thing to do for several reasons. The advantages of using honey bees for pollination include the ease of management of huge populations which can easily be moved and manipulated. Honey bees also provide a source of income through honey production and other hive products. Pollination guidelines for crops are generally based on honeybees and specify the appropriate numbers of hives required per acre to maximize yield. Replacing a single pollinator species with another species which may not have pollination guidelines for your crop and that you have no experience with is probably asking for trouble. A few other species of bees have been successfully developed for pollinating certain crops. You might start by purchasing some of these pollinators to supplement your honey bees and beginning to learn how to work with them. As a biologist and native bee specialist, I suggest that you consider developing a diversity of pollinators by taking advantage of the bees available in your area. This option requires a basic understanding of bee biology, awareness of what bees are present in your area and then pursuing cultural practices that will help you build populations to levels you need. Enhancing local populations of native bees essentially new territory, so be prepared to experiment on your own. It will probably take several years to accomplish. Here's what you need to know to get started.

Alternative Pollinators Are Beneficial Insects. Butterflies, flies, beetles, wasps, and bees drink nectar for energy. These active insects need sugars to keep them going just like we do. Some insects also eat pollen, which is rich in proteins and oils. In the process of rummaging around in the flower while foraging, these insects get covered with pollen which, when rubbed off on the appropriate portion of the flower's anatomy, accomplishes pollination. Bees are the most effective pollinators because they regularly visit many flowers of the same species for the express purpose of collecting pollen and nectar, which they feed to their young.

Native Bees. Although honey bees have since become naturalized throughout North America they are not native to the New World, having been introduced from Europe by the colonists. There are more than 20,000 species of other kinds of bees, including bumble bees, carpenter bees, leafcutter bees, digger bees, sweat bees, cellophane bees, mason bees and other groups. Some species are specialists that only visit a few kinds of flowers, while others are generalists and will visit a wide variety of flowers. Some groups have long tongues that allow them to reach into deep tubular flowers to get nectar, while other groups have short tongues and are restricted to foraging on flowers with nectar accessible in a shallow bowl.

Although many bees form colonies of sorts, most bees are solitary, living and constructing their nests by themselves. In some species many nests can be found very close together in aggregations, but nests of other species the nests are widely dispersed. A solitary bee constructs a nest, provisions a brood cell, and seals it after laying an egg. Within this brood cell, the offspring eats the stored provisions (pollen and nectar) and develops on

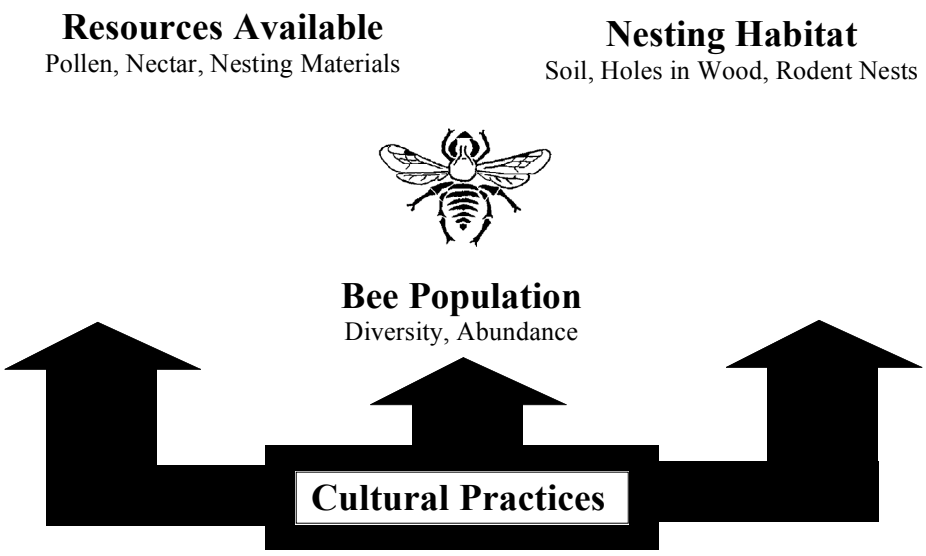
its own. In most cases, that bee will not emerge from the nest until the following year. Adults usually live only a few weeks. Therefore, although each bee lives a year, most of the their life is spent developing or dormant inside the nest. Many solitary bees have a short flight season, but some are active for many months as new individuals continue to emerge. The flight season of many species is synchronized with the floral resources that they depend on. and many different species are active during the spring, summer and fall.

There are distinct behavioral and often distinct physical differences between males and females. While females are primarily engaged in constructing nests and foraging to provision their nests, the primary activity of males is mating and they spend a great deal of time searching for females. Unlike honey bee drones, males can be seen actively foraging in flowers for nectar to fuel their mating activities. While they do not collect pollen, males are often covered with pollen and are effective pollinators.

Evaluating Your Own Local Pollinators. Just as you must keep an eye out for pests in your crops, you should be looking for beneficial insects, including pollinators. By examining flowers you can learn which insects are visiting those flowers and which insects appear to be important pollinators by seeing which are transferring pollen to the stigma. In addition to bees, butterflies, flies, wasps and beetles are all potential pollinators. Flower flies [also called hover flies] are very abundant in the early spring and can be very effective pollinators. These flies hover like tiny humming birds around flowers. After bees, flower flies are probably the most important pollinators you will have.

Identifying Bees. Not all insects look like the pictures presented in most field guides. In order to determine the general types of insects and groups of bees, I prefer the Peterson *Field Guide to Insects* because it provides descriptive characteristics that assist in identification. Many bee species look alike, can only be identified to species by specialists, and species identification may not be possible because there are no specialists or keys available for some groups. However, in most cases just identifying the group (taxonomic family) the bee belongs to will provide enough information. Extension entomologists should be able to assist with identifying insects to the level needed.

Enhancing Your Local Pollinators. If you have some bees present, you can generally increase their numbers by providing them the resources they need to proliferate. In Integrated Pest Management this approach to increasing numbers of beneficial insects is known as augmentation. The smaller the size of your operation, it is more likely that such a strategy will be successful, and in a shorter time.



Keep in mind that your local Bee Population (abundance and diversity) will be influenced by Nesting Habitat (an appropriate place to build nests) and Resources Available (flowers that supply nectar and pollen, possibly water and nest construction materials). In order to build a population that can do an adequate job of pollinating, you want to be sure that these needs are met. You will also need to pay attention to the ways that your cultural practices effect these critical elements.

Cultural Practices can have an impact on foraging resources, nesting habitat and nesting materials. Take care not to destroy adults or developing brood with pesticides or flooding. Take care not to till up nesting sites because it can destroy brood. Modify your weed control activities so you provide abundant foraging resources. Remember that if you reduce the availability of the resources they require you won't be able to depend on these bees to provide adequate pollination.

In order to build a good crop of bees, it is important that food is available throughout their nesting season. Orchard blooms are typically short, on the order of a few weeks. If no other foraging resources are available before, during or after the bloom, and you saturate the orchard with honey bees, then the local bees will have little food available to allow them to build up strong populations and they will have to compete with honey bees for the available bloom. To build native bee populations you will need to provide resources before and after the crop blooms because you want large numbers of those bees actively foraging by the time your crop begins to bloom and you want new recruits to be emerging throughout that bloom.

Nesting habitat includes soil, sand, holes in wood or dead trees, artificial nest holes and rodent nests. Some species such as the alfalfa leafcutter and the blue orchard bee nest in pre-existing cavities such as nail holes or worm holes in dead wood. The nests are very difficult to find even for an expert. You can assess cavity nesters by providing nest opportunities with "trap nests" made of sticks with holes drilled about four inches deep in them. Different species have preferred hole sizes, so you will want to place out several sizes ranging from 1/8 to 3/8 inch in diameter to determine which is best for your site. You will find that earwigs, wasps, spiders and other insects will also take advantage of the free housing, so you may not actually be able to do much good for your bees with trap nests. Paper straws and directions for their use are available from suppliers of blue orchard bees. Other species will excavate their own holes in solid or rotting wood or in stems of plants such as goldenrod. The nests of ground-nesting bees are often hidden in the vegetation and only appear as a pile of "mine tailings" on the surface around the nest entrance. Ants and other ground-burrowing insects generate similar holes, making it difficult to tell if the hole is a bee nest or not. The only way to tell for sure is to watch the suspected nest entrance to observe bees returning with pollen loads. This may require considerable time and patience.

Nesting materials include leaves, mud and rodent nests. Leafcutter bees tend to favor certain species of plants for nest construction materials and some species use flower petals. Mason bees, including the blue orchard bee, use mud for nest construction and will require access to sources of mud. These sources should be relatively close to nesting sites to reduce the energy and time required to collect mud. Bumble bees generally use old gopher and rodent nests, so you might encourage bumble bee populations by providing nest boxes with cotton, dry grass or other nest material for mice in a barn and then placing these nest boxes out as bumble bee "trap nests" in the early spring. These nest boxes should be protected from animals that like to eat bees (skunks, opossums) and from rain by a plastic covering. You might placed some under a pile of brush or tree prunings that you won't burn. While you may be reluctant to increase rodent nest habitat in your orchard, it could be worth attempting a few since commercial bumble bee nests cost about $200 each. Also, be aware that some rodents carry human diseases, and take precautions not to contaminate yourself.

The large bumble bees you see in the early spring are queens that have come out of hibernation and are establishing new colonies. They are often seen flying around the ground and in barns searching for places to build a nest. The queen will forage for a few weeks and raise the first batch of brood which becomes worker bees. After workers are available, the queen takes control of egg-laying and does not leave the nest again. The number of foragers in the nest will increase as more batches of eggs are raised until the colony has about 100-200 workers. The mature colony then raises only new queens and males, which forage and mate. Eventually all the bees die except the inseminated queens, which hibernate and renew the cycle by emerging and establishing new nests the following year. These queens often hibernate in holes in the ground, or the old nest, so you don't want to destroy those sites.

Providing adequate forage is probably the most important and easiest thing to do. A good way to find out if you have any "alternative pollinators" in your neighborhood and to encourage them to proliferate is to provide them food by planting a "butterfly garden." Base your plantings on what your local bees are doing: observe which bees are potential pollinators, then which other flowers they also visit – before, during, and after your crop blooms. These are the bees and plants you want to work with and encourage to proliferate. Obviously, you will prefer to use plant species that are not obnoxious weeds.

Being a biologist, I would encourage you to use native plants and turn your "bee garden" into a wildflower patch. Protecting pollinators of native plants is also a goal of many plant conservation programs that can provide information or assistance in determining what to plant and where you can get native plants. The Kentucky Department of Fish & Wildlife Resources has two programs that encourage the use of native plants for landscaping and wildlife enhancement: the Backyard Wildlife Program and the Habitat Improvement Program.

Potential Problems With Native Bees. Most people are concerned about bee stings. Honey bees defend their nest or sting when they get stepped on as they forage on flowers in the grass. Some bumble bee species are rather pugnacious if their nest is disturbed so an unsuspecting intruder can expect a response similar to disturbing

a honey bee colony. Some sweat bees are bothersome because they are prone to bite or sting [or both] when they land on arms or legs to drink up salty perspiration. In general however, most native bees are very docile, do not defend their nests, and should arouse no cause for concern. During twenty years of digging nests, collecting, and handling these bees I have been stung only twice. In general the sting is much milder than that of a honey bee, more like a pin prick that burns for a short time. Of course, the larger the bee the more potent the sting because of the size of the stinger and the amount of poison injected. People who are allergic to honey bee and wasp stings are probably allergic to all bee stings and should have a healthy respect for all bees.

Carpenter bees can cause structural damage to timbers and rafters that they nest in. These bees can live several years so the nests are continually used and expanded. Alfalfa leafcutter bees can create problems by cutting leaf materials from flower gardens. Sometimes they cut flower petals and may do major esthetic damage to a rose garden. They also can build up to such numbers that they become a nuisance in some areas, nesting in every conceivable nook and cranny. I have even heard reports of damage to equipment from nests constructed inside air compressors and engine distributors. However, alfalfa leafcutters develop unusually large populations and most leafcutters do not cause such problems.

All bees have diseases, pests and predators. Alfalfa leafcutter bees can have major problems with parasitic wasps, chalk brood fungus, and beetles that destroy nests when they eat the pollen that has been provisioned. Some parasitic bees sneak into other bees nests and lay their own egg. The offspring of these "cuckoo bees" destroy the host's offspring and consume the provisions. Such parasites have caused problems with alkali bees used for alfalfa pollination. Other parasites include various species of flies which lay eggs in adult bees and larvae. Adult bees are attacked and eaten by robber flies, and some wasps. Since parasites and diseases can be problems, alfalfa leafcutters and blue orchard bees may require special management techniques to keep mortality to acceptable levels.

Commercial Sources Of Alternative Pollinators. If you do not have the right species, or enough native bees in your area, you can purchase bees from commercial suppliers and release them in your orchard. Bumble bees and blue orchard bees [mason bees] are probably the most common alternative pollinators available commercially. Blue orchard bees pollinate a few orchard crops such as apples and almonds. Another mason bee, the horn-faced bee, is also available for pollinating some orchard crops. Bumble bees are used for pollination of tomatoes grown in glass-houses and colonies are available year-round. These buzz-pollinators are generalists and will visit many different kinds of flowers. The alfalfa leafcutter bee is used for large-scale alfalfa seed production in California and the Pacific Northwest. Commercial sources and information regarding these and other bees are available through the Logan Bee Lab website. Additional information sources include the AAPA web site, and a new pollination book that will be available in July, 2000.

Diversify Your Pollinators. What can you do? First, the goal should not be to eliminate honey bees, but to diversify and to reduce dependence on them. If your operation is very large, you may always require honey bees. In some cases, there simply not adequate kinds or numbers of native bees present. Purchasing commercially available bees will involve new investments. Developing and enhancing local populations will require long-term commitment and changes in cultural practices. You may want to begin introducing some of the commercially available alternative pollinators while you begin to assess and enhance your local pollinators. If you don't have any local bees, that may be the only option available. Remember that the bee's flight season must coincide with the flowering season of your crops, and you want bees that will forage on (and pollinate) those crops. Introducing bees will provide a source of alternative pollinators, but enhancing populations of local species adapted to your environment will help reduce the need to purchase more each year. The best way to do this is to become better informed about alternative pollinators, to being to enhance foraging resources, set aside habitat for nesting, and adjust your cultural practices to reduce negative impacts they might have on pollinators. Remember that this is new territory, so be prepared to experiment on your own.

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Valuable References. Check your local library, many of these are available there.

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Buchmann, Stephen & Gary Nabhan. ***The Forgotten Pollinators.*** Island Press, 1996. An informative story about the need for paying attention to native pollinators.

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O'Toole, Christopher, & Anthony Raw. ***Bees Of The World.*** Facts On File, New York. 1991. Excellent background on the different types of bees and their natural histories, and nests. Many color photos.

Proctor, Michael, Peter Yeo & Andrew Lack. ***The Natural History of Pollination.*** Timber Press, Portland Oregon. 1996. An excellent textbook on pollination, addressing all types of pollinators.

Seeley, Thomas D. ***Honeybee Ecology.*** Princeton University Press. Princeton, New Jersey. 1985. Good basic information about honey bees and how they forage.

World Wide Web Resources. Using a search engine such as the Web Crawler to search the key words *Alternative Pollinators* will result in many interesting sites, including several of the following:

The Forgotten Pollinators Campaign
http://www.desertmuseum.org/fp
Provides information on alternative pollinators and plants that attract alternative pollinators.

University of California at Davis
http://entomology.ucdavis.edu/faculty/mussen/news.html
The latest news about honey bees from the California State Apiculturist.

University of Minnesota
http://www.ent.agri.umn.edu/AAPA/aapapubs.htm
Source of pamphlets from the American Association of Professional Apiculturists, including information on alternative pollinators.

U.S. Department of Agriculture Agricultural Research Service
http://gears.tucson.ars.ag.gov U.S.D.A. Carl Hayden Bee Lab, Tucson, AZ
Provides an on-line version of Insect Pollination of Cultivated Crop Plants and honey bee info.
http://www.LoganBeeLab.usu.edu U.S.D.A. Bee Research Lab at Utah State University
Lists commercial sources of alternative pollinators and links to other sites of interest.