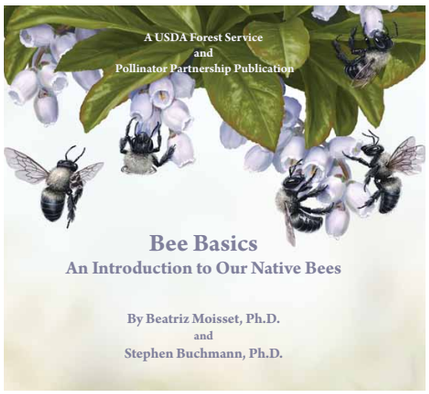
Part 3-B

BEES' NEEDS: Nutrition, Habitat & Reproduction



Two introductory booklets from the US Forest Service provide make a good starting point. Illustrated with handsome watercolors, they provide essential background:

Attracting Pollinators to Your Garden with Native Plants A 14-page booklet that targets plants and *pollinators found in our region; includes bees, flies and other animals.*

Bee Basics: An Introduction to Our Native Bees, by Beatriz Moisset, and Stephen Buchmann. This 39-page booklet distinguishes bees, wasps and flies and describes key members of five bee families.

Food for Bees:[1]

All bee species require both the pollen and nectar from flowering plants.

One of the causes for pollinator decline is a severe lack of plant diversity in their surroundings, such as overly managed lawns, loss of wild fields, fields that are not permitted to flower, lack of native host plants for insect larvae, loss of hedgerows and massive agricultural monocultures. Increasing use of herbicides, thanks to agricultural GMO seeds that resist herbicides, has removed native flowering plants from edges of large agricultural operations. Some plants have little pollen or nectar to offer bees. Some have low quality pollen or nectar.

Pollinator Plants: Plants that have high quality and quantities of essential nutrients are considered 'pollinator' plants.

Bees are very important, but are not our only pollinators. Other pollinators include certain beetles, flies, wasps, humming birds, bats and other small mammals, butterflies and moths. One plant that doesn't need bees is red *Trillium,* which smells like rotten meat and attracts a specific carron-eating fly for pollination!

Non-native Honeybees and native bumblebees have much in common. Both have worker bees to help build nest or feed larvae, both are generalists and forage on a wide range of plant species in different families and both are social, living in colonies with cooperative brood care and overlap of generations.

However, roughly 90% of our native bee species are *solitary*: The queen lays eggs and provisions her brood. And most of these solitary bees are *oligolectic*: They make use of just one plant family or genus.

Floral Habitat: How Bees Use Plants in Order to Thrive

Nutrition Values From Flowers:

- *Nectar provides carbohydrates for the energy used in foraging*. Bees get water from plant nectar, but the nectar[2] also provides three types of sugars in varying quantities: sucrose, glucose, and fructose. Certain bees prefer certain plants for the type of sugar provided.
- *Pollen supplies protein and lipids (essential fatty acids and sterols).* The protein content of pollen varies from 2-60%, and the concentration affects larval health. The lipids range from 1-20% and contribute to physiological processes such as egg production, secondary energy source, healthy growth, worker productivity, overwintering and general health.
- *Bees can resist diseases* by using the nutrients, phytochemicals with anioxidant properties (carotenoids, flavonoids, alkaloids etc) and micronutrients (vitamins and minerals) found in pollen or nectar. Bees fight pathogens, 'self-medicating' by locating certain plants that contain the needed micronutrients that help them to resist disease. For example, *thymol* is a micronutrient found in the nectar of *Monarda* (bee balm) and other members of the mint family; it has anti-fungal and anti-bacterial qualities.
- *Certain bees gather resins and oils from plants.* These compounds are anti-microbial and are used to build nests for larvae.

- *Plant diversity impacts bees' health*. "Large-scale land-use that reduces floral abundance and species richness will negatively affect bee species through nutritional shortage in both quantity and quality of resources".[3]
- *Bee Bread feeds larvae*. Native bees make bee bread by mixing pollen and nectar into a ball, on which a single egg is laid. Upon hatching, the larvae eat the bee bread, pupate and emerge from the nest as an adult.
- *Bees need plants with high levels of protein in pollen,* to rear their young. Some plants' pollen has very little protein.
- *Reproduction success depends on high-quality sources* of both nectar and pollen that are available at the time of year when that particular species is making nests for their eggs[4].

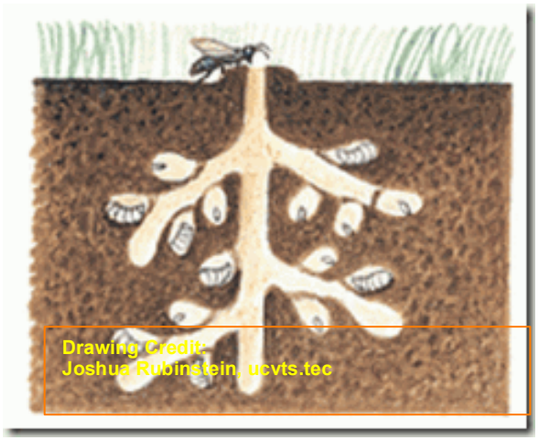
Other Bee Properties:

- *Bees will travel back and forth to the same clump of plants* when foraging, until the nectar and pollen supplies are greatly reduced.
- *Bees can't see red*. Unlike humans, bees can see ultraviolet colors; they prefer plants with white, yellow or blue flowers. Some petals are ultraviolet, and detected by bees as a 'landing pad'.
- *Bee species differ in the length their tongues*. To collect nectar, some pollinators have short tongues, others have long tongues, so a variety of plants such as sunflowers are preferred by short-tongued pollinators, while plants with tubular flowers are used by the long-tongued pollinators (includes humming birds, butterflies, moths and certain bees).
- *Cultivars with dense centers are problematic*. They don't supply essential pollen and nectar because they have little resources and what is there is hard to reach.

- *Bees need plants that flower during the parts of the year when they are active*. Bee species have different schedules - some have a short lifetime (even just a few weeks), while others, such as certain bumblebees, are active from early spring into late fall. Some emerge early in the spring, others emerge later when more flowers are blooming. Pussy willow plants (left) flower very early in spring, attracting early queen bees that emerge from hibernation.

Reproduction - Nesting Habitat

Besides high quality floral resources, bees need sites very close to their foraging space that provide habitat for nests - materials for cavity-nesting bees and bare ground or sand for ground-nesting bees.



The photo above is a cross-section of the cavity-nesting blue orchard bee, and shows the cells the queen makes and the white egg that is laid on bee bread (a mixture of pollen and nectar). This bee uses mud to separate cells.

Ground-nesting bees comprise roughly 70% of bee species. The drawing illustrates the tunnels made by some of these bees. Each cell contains one egg, along with the ball of bee bread that will nourish the larva when it emerges. Note the mound of dirt around the entrance.

Bee Habitat: greater floral diversity leads to increased bee diversity

In short, based on the above facts about bees, their habitat has several key elements;

- A diverse variety of plants that bloom at assorted times in the growing season.
- A diverse variety of plants that provide high quality nutrients during growing season.
- A diverse variety of plants to suit both long-tongued and short-tongued bees.
- Large clumps of flowering plants to help bees locate them and make repeated visits; this will also benefit plants with more thorough pollination.
- Nesting sites for ground-nesting bees such as bare ground near pollinator plants and hollow stems or logs with holes for cavity-nesting bees.
- Shelter from severe weather or predators, wind breaks and protection for nests can be provided by shrubs, trees, or bunch grasses.
- ***Pesticides and herbicides shouldn't be used where bees are foraging.*** Practice Integrated Pest Management[5], an approach that avoids the need for chemicals. Certain pesticides are systemic and poison all parts of a plant, even the pollen and nectar that bees need and should be totally avoided. See section 6-B [need LINK to 6-B] for more information about these chemicals.

For more detail:

To learn more about promoting pollinator friendly land use practices link to USFS guidelines and the Xerces Society's guidelines for establishing and maintaining bee habitat.

What about Honey Bees?

Chart compares differences.

HONEY BEES	NATIVE BEES
Don't like cold or wet	Do not mind cold or wet
Get up late	Get up early
Neat	Messy
Can travel long distance [2 + miles]	Like to stay close to home [0.5 mile]
Need many trips to pollinate	Efficient as a pollinator
Social, thousands in colony	90% are solitary
Non-native	Native
Require humans to survive	Don't require special care

Honeybees are a major industry:

With the intensification of agriculture and the huge fields associated with them, honeybees are essential for pollination because they can fly for great distances - as compared with native bees. To pollinate crops in large fields and orchards, honeybees are transported to farms all over the country. The stress of constant moving can weaken the bees, and their focus on plants in the monocultures of large fields can contribute to lack essential nutrients that would be provided by a varied diet.

Bee hives are transported hundreds of miles

Honeybees can spread pathogens[6]:

Because honeybees are imported and raised on such a large scale, they can carry exotic pathogens, such as the *Nosema* parasite, that have spilled over to native bees that live nearby.

Honeybees - a threat to native bees?[7]

Recent research suggests that the farmed honeybees are competing for food resources with native bees, thus contributing to the decline in native bees. A related National Public Radio story (Jan 2018) suggests that 'honeybees help farmers, but don't help the environment'.

[1] Vaudo, Anthony et al. *Bee nutrition and floral resource restoration* *Current Opinion in Insect Science* 2015, 10:133–141. This document synthesizes results from a list of 145 references, and highlights key documents.
[2] Vaudo: 'there are three relatively constant characteristics that influence bee host-plant choice for nectar: sugar composition, nectar volume, and nectar concentration'. References #18 and 39.
[3] Vaudo, reference #115: Potts S, Biesmeijer K, Bommarco R, Breeze T, Carvalheiro L, Franze´ n M, Gonza´ lez-Varo JP, Holzschuh A, Kleijn D, Klein AM et al.: Status and Trends of European Pollinators. Key Findings of the STEP Project. Pensoft Publishers; 2015. "This report of the multi-institutional partnership STEP (Status and Trends of European Pollinators) reviews the research and policy in Europe defining the impact of interacting factors of land-use on pollinator decline and associated agri-environmental schemes and ecological intensification used to support pollinator populations. "
[4] Vaudo reference #27: Vanderplanck M, et al: How does pollen chemistry impact development and feeding behaviour of polylectic bees? PLoS ONE 2014, 9:e86209:
'Using bumble bee microcolonies confined to monofloral pollen diets of varying protein and sterol quality, bumble bees collected all pollen equally, but increases in protein/amino acid and sterols lead to higher larval weight, indicating healthier offspring that could lead to more productive adults.'
[5] IPM: https://en.wikipedia.org/wiki/Integrated_pest_management
[6] Fürst, MA et al. *Disease associations between honeybees and bumblebees as a threat to wild pollinators. Nature.* 2014 Feb 20;506(7488):364-6
Graystock, P et al. *Do managed bees drive parasite spread and emergence in wild bees*? International Journal for Parasitology:Parasites and Wildlife 5 (2016) 64e75 67
[7] Geldmann, J; González-Varo, JP. '*Conserving honeybees does not help wildlife*' . *Science,* 26 Jan 2018:Vol. 359, Issue 6374, pp. 392-393 This article has links to supporting research literature.
See also related NPR story