Global Distribution of Bees

About 75% of the crop plants grown worldwide depend on pollinators – bees, butterflies, birds, bats and other animals – for fertilization. Although some species of plants are pollinated by the wind and water, the vast majority (almost 90% of all plant species) need the help of animals to act as pollinating agents. The majority of North American plants are pollinated by bees, and honey bees are still in decline due to varroa mites and associated diseases. This can potentially have a huge impact on food production. The good news is that everyone can help avert this disaster by planting native wildflowers that provide bees with the energy they need to survive.

WHY DO WE NEED BEES & OTHER POLLINATORS?

- Plants that depend on pollination make up 35% of global crop production volume with a value of as much as $577 billion a year.*
- Bees are responsible for pollinating more species of plants than any other animal. The fruits and seeds of these plants, in turn, provide a valuable food source for many other animals. These plants also protect watersheds and contribute to air quality.
- Over 1,000 of the world's most important foods, beverages and medicines are derived from plants that rely on pollination by bees.
- Pollinators are an important food source for other animals in the food chain and ensure the growth of plants that provide food and shelter. The adults and larvae of pollinators including bees, wasps, butterflies, moths, beetles and flies are a major food source for other animals including bats, birds and fish.
- There is evidence worldwide that pollinating animals are suffering from loss of habitat, introduced and invasive species of plants and animals, pesticides, diseases and parasites. In the US alone, 42% of managed honeybee colonies died within a year between 2014/2015.

*New York Times 2/26/16

Measurements denote the height of plants unless otherwise indicated. Illustrations are not to scale.

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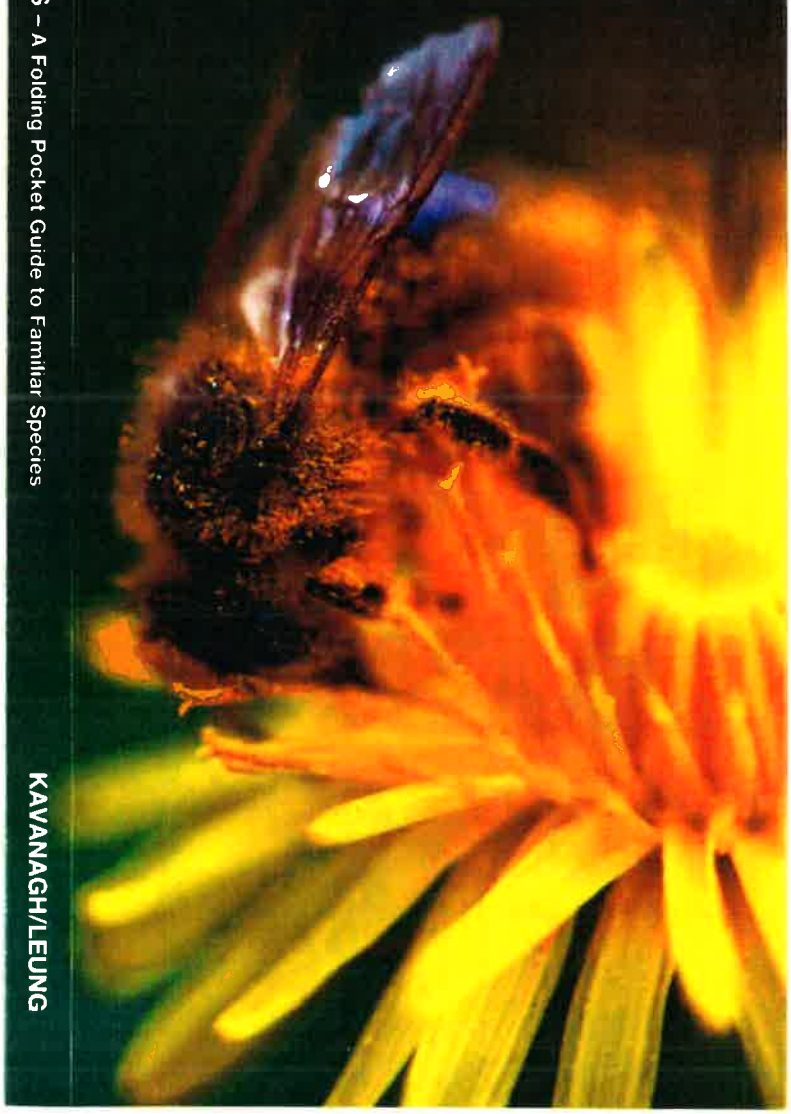
BEES & OTHER POLLINATORS

A Folding Pocket Guide to Familiar Species



BEES & OTHER POLLINATORS – A Folding Pocket Guide to Familiar Species

KAVANAGH/LEUNG

ATTRACTING BEES & POLLINATORS

Everyone can contribute to the success of pollinators. It takes little time or money to provide for their primary needs of food, water and a place to rest/nest.

1. Food – Cultivate pollen and nectar producing plants. For butterflies, also plant larval host plants (many insect larvae – caterpillars, grubs – feed on specific plants. Many monarch larvae, for example, feed exclusively on milkweed).

2. Water – Like all living organisms, pollinators require water to survive. Bees also use water for evaporative cooling in their hives. Before adding a water feature, consider that butterflies like to drink in shallow mud puddles and birds prefer shallow water sources no more than 2 in. (5 cm) deep. If you soak the soil in your garden to create puddles, they will provide bees and butterflies with a source of water and minerals. If space is limited, a saucer of muddy water will work.

3. Shelter/Refuge – Create areas, out of the sun, where they can rest and avoid predation while foraging.

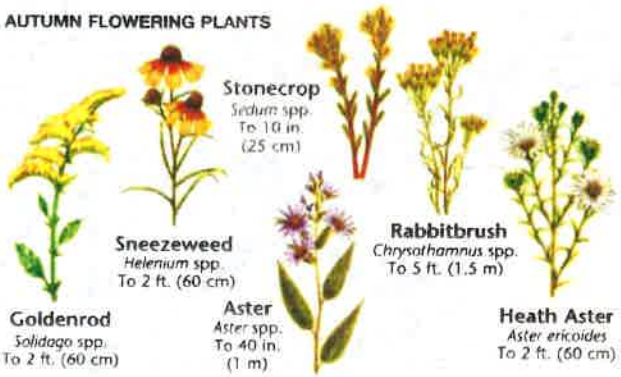
Create a Bee Hotel – Nests for many species of bees can be made by filling coffee cans with sections of bamboo. Be sure to leave one end closed. Include openings from 1/8-3/8"

4. Nesting Areas – Create nesting boxes or brushy areas that provide protection from predation and are suitable for pollinators to raise their young. Bumble bees will nest in abandoned bird houses or upturned plant pots. Most bees (70%) nest underground, so leave some areas uncultivated with soft soil that is easy for them to burrow.

Planting Tips

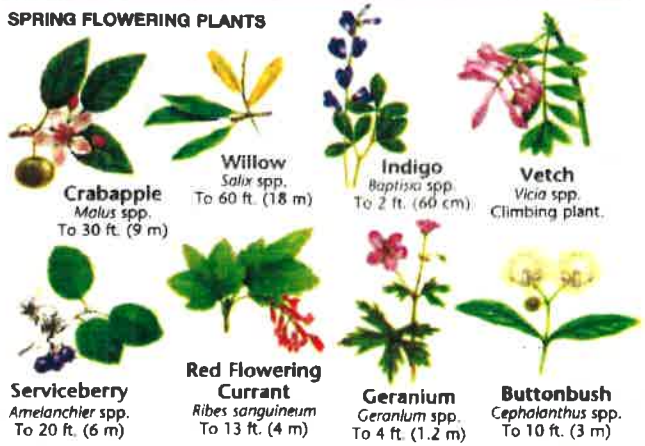
- Cultivate native pollen and nectar-producing plants that bloom at different times throughout the growing season. Ensure the species you select will thrive with the amount of sunshine and moisture at the site. Note that blooming periods are highly variable depending on the weather and the growing region.
- Plants should be grown in clusters of diverse species in different parts of the yard. Plant in patches measuring at least 3 ft. (90 cm) square if possible, but even a single pot on the porch can provide a lot of resources for bees.
- Include a selection of larval host plants in your landscape.
- Create a muddy salt lick for butterflies and bees. Moisten the soil and mix some sea salt into the mud.
- Don't use pesticides. If you must, use organic repellents. Also, ensure the plants you purchase are free of harmful pesticides like neonicotinoids; many garden stores have their seedlings and plants pre-treated prior to sale.

AUTUMN FLOWERING PLANTS



VERY IMPORTANT POLLINATOR FOOD PLANTS

SPRING FLOWERING PLANTS



SUMMER FLOWERING PLANTS

THREATS & CONSERVATION

Loss of Habitat

The destruction of forests, meadows and natural habitats removes undisturbed areas where flowers and insects can thrive. This also exposes these sensitive ecosystems to contaminated water and polluted air which further jeopardizes plants and insects' ability to survive. Introduced and invasive plants are replacing native plants that pollinators have relied on for centuries, and are often inferior food sources that will take over the habitat.

Pesticides

Aerial spraying targeting nuisance plants or insects affects all species eventually. Since many of these pesticides remain in the environment before degrading, these noxious products are washed by rains into our groundwater which creates a future hazard for all of us.

Human Conflicts

People are afraid of bees and unnecessarily kill them or destroy their hives on sight, for fear of being stung. Bees are territorial and will only sting when their colonies (nests) are threatened. If you need to have a hive removed, contact a professional who can relocate the bees rather than kill them.

Non-native Species & Diseases

Introduced species of invasive plants can quickly degrade a natural habitat by overtaking native species and preventing them from germinating. Introduced plant species can also introduce diseases and parasites that have a major negative impact on native insects.

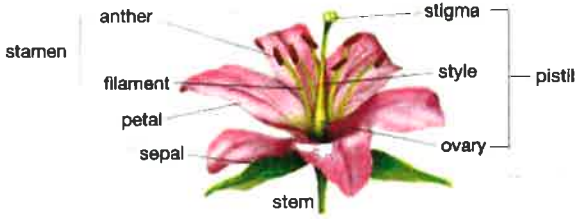
WHAT CAN YOU DO?

- Recognize the pollinators in your area and plant a pollinator garden to support the larvae and adults of different species. Add nectar resources like hummingbird feeders before/after plants bloom.
- Create nesting areas or structures for pollinators to raise their young.
- Reduce/eliminate use of pesticides. If you use any type of repellent, ensure it is organic and pesticide free.
- Plant wildflowers instead of grass in your yard and reduce mowing.
- If there is a hive on your property you need to have removed, contact a local beekeeper who will relocate it to a safe, permanent location.
- Protect local wildlife habitat, especially riparian corridors and wetlands that provide nectar and pollen during droughts.
- Join a conservation organization or volunteer where something is being done to protect pollinators. Leading organizations include the North American Pollinator Protection Campaign, the Xerces Society and the National Wildlife Federation. Federal agencies include the US Fish & Wildlife Service, Park Service, Natural Resources Conservation Service, and Geological Survey.

WHAT IS A POLLINATOR?

Pollinators are animals that transfer pollen between flowers including bees, birds, bats, butterflies, moths, beetles, and many others.

FLOWER ANATOMY



WHAT IS POLLINATION?

Plants are pollinated by animals who collect nectar and pollen for food, or who move pollen as a result of incidental contact while feeding on plants.

Pollination results when the pollen from the male part of the plant (stamen) is transferred to the female part (pistil) of another plant or a different part of the same plant by a pollinator while it feeds. Eventually pollen grains reach the female ovary where fertilization occurs, which results in the production of seeds and/or fruit.

When mature, the seeds are dispersed by the wind, water, or by animals that eat the fruits and seeds. Seeds eventually fall to the ground and germinate to become a new plant.

FOODS RESULTING FROM ANIMAL POLLINATION

Fruits & Berries


Apples


Blackberries


Blueberries


Raspberries

Nuts & Seeds


Sunflower Seeds


Pumpkins


Almonds


Buckwheat

Vegetables


Peppers


Squash


Tomatoes


Potatoes

Pollinator Insect Life Cycles

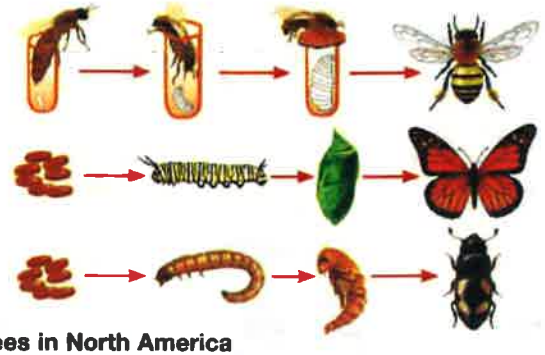
The life cycles of some of our most common insect pollinators – bees, butterflies (and moths), and beetles – have four developmental stages.

1. Eggs – Bees lay eggs in individual cells. Butterflies and beetles lay eggs singly or in clusters on vegetation or on the ground.

2. Larval Stage – Worm-like larvae hatch from eggs. Bee larvae eat pollen and nectar and are fed in their cells by worker bees. Butterfly and beetle larva – caterpillars and grubs – feed primarily on plants.

3. Pupal Stage – Bee larvae pupate within their cells, transforming into adults. Caterpillars and grubs attach themselves to plants before creating pupal cases within which they transform into adults.

4. Adult – Bees, butterflies and beetles emerge from the pupal stage as adults (with wings). Most insect adults can reproduce.



Bees in North America

There are about 4,000 native bees in North America. Most are solitary species, unlike the European honey bee, which is colonial. Only bumble bees and a few other native species live in colonies. Most of our bees emerge, mate, and provision their nests alone. As solitary bees, they are especially efficient pollinators, collecting nectar and pollen every trip (honey bee forages often collect only pollen or nectar). Solitary bees are not defensive since they do not have live young or stores of honey to defend, so never sting, even when you are close to their nests. About 70% nest in the ground and you can sometimes see aggregations of mining bees in early spring because only certain soils make good nest sites.

Life of a Honey Bee

Honey bees live in large colonies (managed hives) of three types of individuals:

Queens – The queen's purpose is to reproduce by laying eggs. Each hive usually has a single queen who is much larger than the other bees and lives up to four years. She is fertilized by drones from other colonies and then lays eggs singly in comb cells. The eggs are nurtured by workers who feed each larva until it pupates. The queen lays fertilized eggs (virgin queens, female worker bees) or unfertilized eggs (drones).

Drones (Males) – Drones are male bees that make up 10-15% of the colony. They exist to find and mate with a queen. They die after mating or are expelled from the hive before winter.

Worker Bees (Females) – They are responsible for most tasks including constructing cells, gathering food (nectar and pollen) and feeding the larvae. There are typically about 50,000 worker bees that live 4-6 weeks during the busy spring and summer and 4-9 months during winter.

Honey bees will occasionally swarm when their hives become too crowded. They will not sting when swarming. Notify local beekeepers immediately if you spot a swarm.

How a Beehive Works

Worker bees create a nest structure called a comb, made of thousands of hexagonal waxy cells for larvae, honey and pollen. The wax used to create cells is excreted from their abdominal glands. The comb is attached to an external structure (e.g., a tree or building). They expand comb over time.

Man-made beehives are artificial structures that make is easier to manage colonies and extract honey. They are dry and predator-proof. The interior of the hive consists of a number of frames (racks) on which bees can build their waxy comb.

Making Honey

1. A worker bee visits flowers to collect nectar and pollen. She uses a straw-like tongue (proboscis) to slurp up nectar into her second 'honey' stomach. Pollen grains from the plant anthers cling to her body and these are moved to pollen combs on her legs before she flies away.

2. When she returns to the hive, she transfers the nectar and pollen to other workers who store it in the honeycomb. To make honey, workers add enzymes and use their wings to reduce water content to 18% then cap cells with wax.

3. Beehive owners harvest honey when the cells in the hive frames are full. If flowers are abundant and rainfall is adequate, a beehive can produce up to 100 lbs. (45 kg) of honey each year.

Bumble bees and some other 'stingless' bees also produce honey. Stored honey and pollen provide food reserves. High-energy honey provides them with sugar and carbohydrates and pollen is a source of protein and vitamins.

Cool Fact: A single honeybee would need to visit two million plants to make one pound (0.45 kg) of honey.

Ongoing Bee Decline

In 2007, North American bee-keepers noticed unprecedented drastic die-offs of 30-70% in colonies of European honey bees. Called 'colony collapse' the cause of the decline remains uncertain, many attribute it to a combination of insecticides and parasites. Diseases associated with the varroa mite continue to affect honey bee colonies and have moved into native bee populations.

Hunting & Feeding – Honey bees, bumble bees and many species of wasps feed primarily on nectar and pollen. Many species of wasps are primarily carnivorous when young and kill prey by stinging it. They feed their young by regurgitating pre-masticated food. Others will kill a large food source like a caterpillar, lay their egg on it and seal it into an area where the larva can feed on it as it matures. Predatory pollinators are beneficial since they feed on crop pests.

Sleeping – Many species sleep largely at night, although they may nap during the day in flowerheads. You can tell if an insect is sleeping when its antennae hang down and the legs are curled under the body. In winter, many species in temperate regions hibernate but honey bees do not. They form a cluster to keep warm and feed on stored honey until spring.

Honey bee colonies are perennial. Wasps and bumble bee colonies are annual, and the entire population of adults dies off each year except for new queens that overwinter and will start new colonies in spring.

Bees & Wasps

HONEY BEE ANATOMY

North America is home to more than 3,300 species of bees. Of these, the most important crop pollinators are wild native solitary bees, bumble bees, and managed honey bees.

Bumble Bee
Bombus spp.
To .9 in. (2.3 cm)
Stout, black-and-yellow, furry bees are large and noisy. The US has about 45 species. Feeds on nectar and pollen, they live in colonies with 50 to 400 individuals.

Bee Fly
Family Bombyliidae
To .7 in. (1.7 cm)
Furry flies are brown to black above and have a long, rigid proboscis and dangling hairy legs. Typically hovers when feeding on nectar.

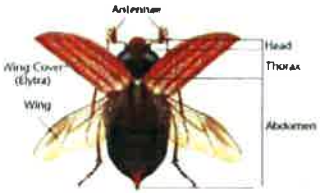
Honey Bee
Family Apinae
To .75 in. (1.9 cm)
Shiny black-and-yellow bee has pollen baskets on its rear legs. Introduced to America from Europe in the 17th century, they are the most common species of pollinator raised in managed colonies worldwide.

Wasp
Vespula spp. To .8 in. (2 cm)
Wasps are carnivorous for most of their young lives. When older, they feed on plant nectar and the sugars of rotting fruits.

Beetles

The living jewels of the bug world, beetles are the dominant life force on earth and account for one quarter of all animal species (about 400,000 species). They can be found throughout the world in every habitat except polar regions and the oceans.

BEETLE ANATOMY



Most have two pairs of wings. Armor-like forewings (elytra) cover the membranous hindwings (sometimes absent) used in flight. All beetles have a straight line down their back which marks where the wing covers meet. The 3-part body consists of a head, thorax and abdomen. Most have chewing mouthparts and feed on plants.

Longhorn Flower Beetle
Brachyleptura rubrica
To .8 in. (2 cm)

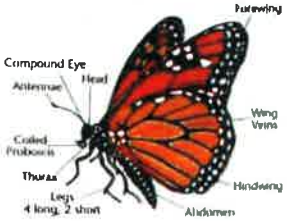
Eyed Click Beetle
Alaus oculatus
To 1.75 in. (4.4 cm)
Makes a clicking noise when it jumps.

Four-spotted Sap Beetle
Glischrochilus quadrisignatus
To .13 in. (.3 cm)

Black Blister Beetle
Epicauta pennsylvanica
To .5 in. (1.3 cm)

Butterflies & Moths

BUTTERFLY ANATOMY



Butterflies and moths belong to the second largest order of insects (next to beetles) with approximately 170,000 species worldwide. All have two pairs of wings covered with overlapping layers of fine scales. They feed by uncoiling a long feeding-tube (proboscis) and sucking nutrients from flowers, puddles, etc. When not in use, the tube is coiled under the head.

The two groups differ in several ways:

BUTTERFLIES

- Active by day
- Brightly colored
- Thin body
- Rests with wings held erect over its back
- Antennae are thin and thickened at the tip

MOTHS

- Active at night
- Most are dull colored
- Stout body
- Rests with wings folded, tent-like, over its back
- Antennae are usually thicker and often feathery

Monarch
Danaus plexippus
To 4 in. (10 cm)

Cabbage White
Artogeia rapae
To 2 in. (5 cm)
One of the most common butterflies.

Tiger Swallowtail
Pterourus spp.
To 6 in. (15 cm)
Note tail-like projection on hind wings.

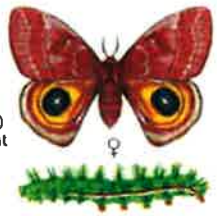
Mourning Cloak
Nymphalis antiopa
To 3.5 in. (9 cm)
Emerges during the first spring thaw.

Luna Moth
Actias luna
To 4.5 in. (11 cm)

White-lined Sphinx
Hyles lineata
To 3.5 in. (9 cm)
Active at all hours, it hovers like a hummingbird.

Woollybear

Isabella Tiger Moth
Pyrrharctia isabella
To 2 in. (5 cm)
Also called woollybear caterpillar moth. Caterpillar is distinctive.



Io Moth
Automeris io
To 3 in. (8 cm)
Note prominent eyespot on hindwings.

Birds

Though 50+ species of North American birds occasionally feed on plant nectar and blossoms, it is a primary food source for hummingbirds and orioles. Sugar water feeders are a good way to supplement the energy of nectar-drinkers, but it is far better to plant flowers and shrubs that provide native sources of nutrient-rich nectar.

Ruby-throated Hummingbird

Rufous Hummingbird

Baltimore Oriole

Bullock's Oriole

Black-chinned Hummingbird

Calliope Hummingbird

Orchard Oriole

Bats & Other Animals

While very common in tropical climates around the world, nectar-feeding bats are rare in North America; only three species are found in the southwestern U.S. They are important pollinators of large cacti (including the organ pipe and saguaro) and agaves including the century plant. Bats roost in colonies during the day and feed at night; they are notorious for draining hummingbird feeders. All three species are Threatened.

Rodents, lizards and small mammals like mice pollinate plants when feeding on nectar and flowerheads.

Long-nosed bat
Leptonycteris spp.
To 3 in. (8 cm)

Gray Squirrel
Sciurus griseus
To 23 in. (58 cm)

Deer Mouse
Peromyscus maniculatus
To 8 in. (20 cm)

Flying Fox (Fruit Bat)
Bats, especially the flying foxes, are one of the most important pollinators in warm climates in the Eastern Hemisphere. In addition to feeding on pollen and nectar, they play a crucial role in seed dispersal and reforestation of clear cut areas.

Flying Fox
Family Pteropidae
Length – To 16 in. (40 cm)
Weight – To 4 lbs. (1.8 kg)