ELECTRIC POWER RESEARCH INSTITUTE

OVERVIEW OF POWER COMPANIES AND POLLINATORS

June 2018

THE FOLLOWING ORGANIZATIONS PREPARED THIS REPORT:

The Xerces Society for Invertebrate Conservation

The Electric Power Research Institute

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NOTES

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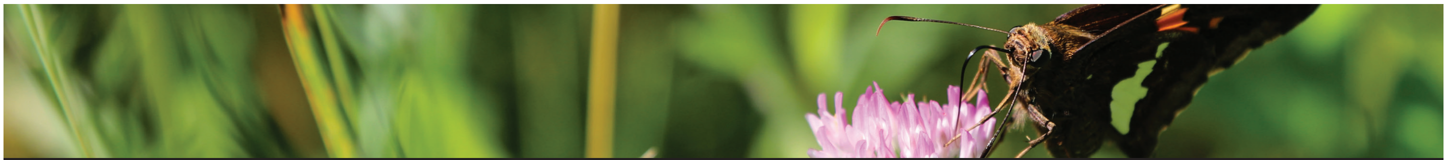

For financial, health, and cultural reasons, serious declines in pollinator populations are causing global alarm. Many electric power companies are concerned about the decline in pollinators and would like to understand more about pollinator science, conservation opportunities, and associated costs and risks. Through management of large real estate assets, there is ecological potential to enhance pollinator habitat through well-designed, ecologically meaningful, and cost-effective actions on property that power companies manage. This technical brief provides an overview of pollinators, considerations for power companies, and an introduction to conservation strategies.

Table 1. Examples of crops with yields dependent upon pollinators

Crop	Crop
Almond	Cocoa
Apple	Coffee
Avocado	Peach
Blueberry	Pumpkin
Canola	Watermelon
Cherry (tart and sweet)	Vanilla

Importance of Pollinators

Pollination is movement of pollen within or between flowers of the same plant species and is critical for seed production, plant reproduction, and food growth. These services provided by pollinators are essential to human well-being and agricultural and ecosystem health. Thirty-five percent of global crop production is dependent on insect and animal pollinators, including 87 of the world's 124 most commonly cultivated crops (Klein et al. 2006). From the coffee you drink to start your day to the apple pie that wraps up dinner, an estimated one out of every three mouthfuls of food and drink that you consume comes from a pollinator-dependent crop. In addition to production of many fruits, vegetables, spices, nuts, and seeds, pollinators are also important to forage plants, such as alfalfa and clover, that provide feed for livestock. Many minerals, vitamins, and nutrients, such as vitamin C, calcium, and folic acid, which are needed to maintain human health, are found in crop plants that rely partially or fully on animal pollinators (Eilers et al. 2011). The value of crops directly dependent on pollination by insects (see Table 1 for examples) was estimated at $15.1 billion annually in the United States, and the value of crops that indirectly rely on pollinators (such as alfalfa hay or onions, harvested crop yield of which is not reliant on pollination but pollinators are required in order to produce seed to grow the crop) was estimated at $12 billion annually (Calderone 2012).

An estimated 85% of the world's flowering plants depend on animals—mostly insects—for pollination (Ollerton et al. 2011). In most terrestrial ecosystems, pollinators are a keystone group necessary for flowering-plant reproduction and important for wildlife food webs (Kearns et al. 1998; Summerville and Crist 2002). Fruits, seeds, and nuts—the result of animal pollination—are

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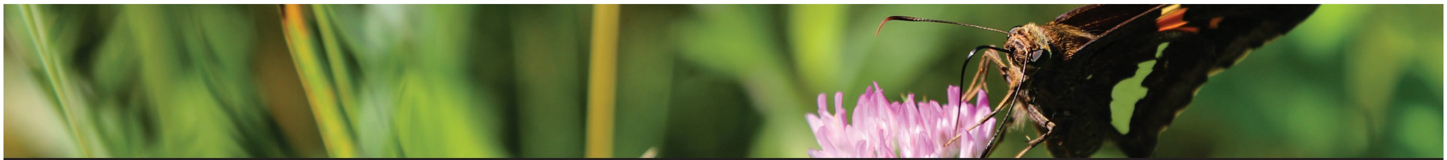


food for many insects, birds, and mammals. Pollinators can also be direct prey for wildlife. For example, pollinator larvae are an important part of the diet of many young birds (Buehler et al. 2002). Healthy habitat that supports pollinators often confers other environmental benefits, such as reduced soil erosion, enhanced rainwater infiltration, improved water quality, reduced wind velocity, carbon sequestration, and habitat for a variety of wildlife, including predator and parasitoid insects that reduce crop pests.

Important Groups of Pollinators

In North America the great majority of pollinators are insects, including bees, wasps, flies, beetles, butterflies, and moths (Allen-Wardell et al. 1998; Kearns 2001), though nectar-feeding bat species and hummingbirds pollinate as well (Grant 1994; Valiente-Banuet et al. 2004).

Bees

Bees (order Hymenoptera) are considered the most important group of pollinators for agricultural crops (McGregor 1976; Garibaldi et al. 2013), as well as for many wild plants in temperate climates (Michener 2007).

Domesticated European Honey Bees

The domesticated European honey bee (*Apis mellifera*) is the most widely recognized bee worldwide. Introduced to North America in the 1600s, it is an important managed crop pollinator. It has been estimated that honey bee pollination accounts for more than $15 billion in crop production annually in the United States (Morse and Calderone 2000).

Native Bees

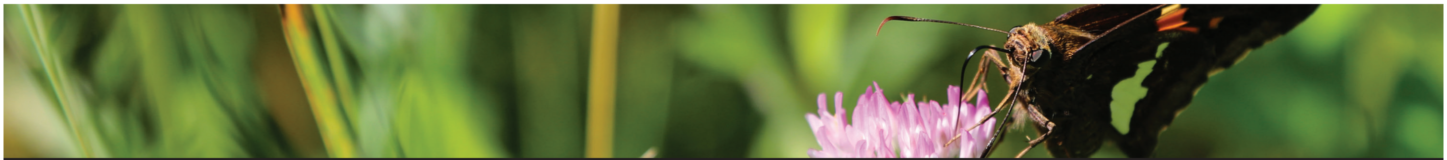
There are a little over 3600 species of native bees in the United States and Canada (Asher and Pickering 2015), many of which are also crop pollinators. In 2006 Losey and Vaughan estimated that $3 billion worth of crops annually was pollinated by native bees in the United States, though this is now thought to be an underestimate of native bee contribution to crop pollination. A recent analysis of 41 crop systems worldwide found that managed honey bees alone do not replace the pollination services provided by a diverse community of native bees (Garibaldi et al. 2013). For example, native bees provide pollination services in colder, windier weather (for example, Brittain et al. 2013) and are more efficient than honey bees on an individual bee basis at pollinating particular crops, such as squash, berries, and tree fruits (for example, Tepedino 1981; Bosch and Kemp 2001; Javorek et al. 2002). To ensure crop pollination, landscapes need to support a large number of native bees (Winfree et al. 2018).

Flies, Wasps, and Beetles

Most other flower visitors play a lesser role in crop pollination, with some exceptions. Flower-visiting flies (order Diptera) provide substantial pollination services (Speight 1978; Kearns 2001; Larson et al. 2001), especially in alpine areas and tundra. Flies also contribute significantly to pollination of crops such as carrots, onions, canola, and cacao. Flower-visiting beetles (order Coleoptera) and wasps (order Hymenoptera) provide pollination services to a lesser extent, although beetles are important pollinators in tropical regions of the world (for example, Frankie et al. 1990; Irvine and Armstrong 1990; Kevan 1999).

Butterflies

Although there are instances where butterflies or moths (order Lepidoptera) have been documented pollinating wild plant species, the contribution of most butterfly and moth species to pollination services is not well-known (Jennersten 1988; Frankie et al. 1990; Allen-Wardell et al. 1998; Westerkamp and Gottsberger 2000; MacGregor et al. 2015). There is limited evidence that butterflies may be important to help move pollen across longer distances. Butterflies are a valuable group, however, because the public generally supports butterfly conservation, and efforts to support butterflies will benefit many other pollinators.



Meet the Pollinators

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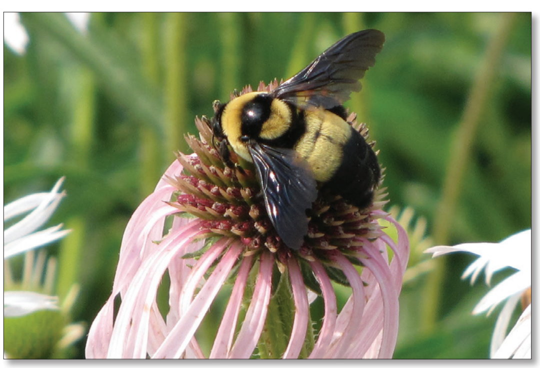
Honey Bee

Order: Hymenoptera
Family: Apidae
Species: Apis mellifera

The European honey bee (native to Europe, Africa, and Asia) is a domesticated species that lives in large social colonies (hives), with division of labor within the colony. Only the queen reproduces, while others gather nectar and pollen to feed brood and store food (honey) for the winter. Feral colonies in the United States are now rare; most hives are managed by beekeepers.

Bumble Bees

Order: Hymenoptera
Family: Apidae
Genus: Bombus



Bumble bees form annual social colonies. Queen bumble bees that mated the previous fall start nests in spring, and by midsummer colonies can have dozens or hundreds of workers. They nest in insulated cavities, such as under clumps of bunch grass or in old rodent nests.

Ground-Nesting Bees

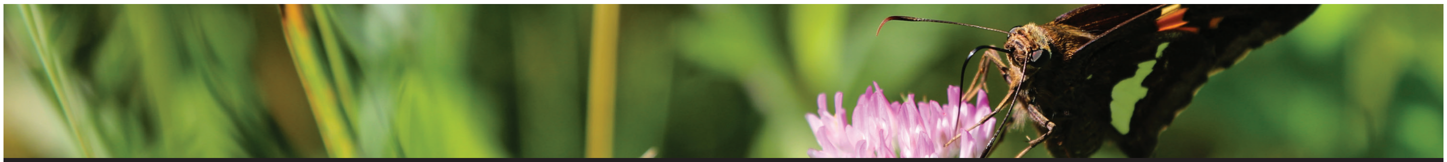
Order: Hymenoptera
Family: Andrenidae, Apidae, Colletidae, Halictidae

Most native bees live solitary lives, with each female working alone to build her nests and collect and provide food for her offspring. About 70% of solitary bee species nest underground, digging slender tunnels off which they build cells for each egg and its provisions.

Tunnel-Nesting Bees

Order: Hymenoptera
Family: Apidae, Colletidae, Halictidae, Megachilidae

Approximately 30% of solitary bee species nest in tunnels, inside already hollow stems or chewing into the pithy center of stems, or in existing holes, sometimes man-made. Most tunnel-nesting bees are solitary species.



Flower-Visiting Flies

Order: Diptera
Family: Syrphidae, Tachinidae, others

Flower-visiting flies consume nectar and sometimes pollen. Many hover flies (in the family Syrphidae) resemble bees or wasps in coloration. Larvae of some species are voracious predators of small insects, such as aphids.

Flower-Visiting Beetles

Order: Coleoptera
Family: Cantharidae, Coccinellidae, Scarabaeidae, others

Flower-visiting beetles consume nectar and pollen and may also chew on flower parts. Larvae of some species are predatory, hunting other insects (including crop pests) as food, while others are herbivorous or are decomposers.

Flower-Visiting Wasps

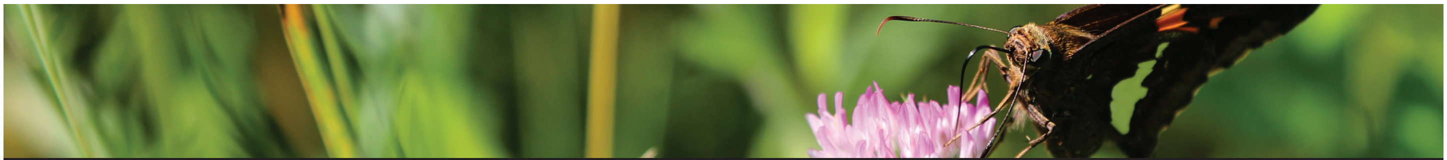
Order: Hymenoptera
Family: Sphecidae, Vespidae, Tiphiidae, Scoliidae, others

Predatory wasps, most of which are solitary, hunt for prey to bring back to their nest as food for their young. They build nests in cavities or in the ground and may use pieces of grass, mud, or resin in construction of their nest. Adults maintain their energy by consuming nectar and in the process may also transfer pollen between flowers.

Flower-Visiting Moths

Order: Lepidoptera
Family: Sphingidae, Noctuidae, Arctiidae

Moths, which are often subdued in color and tend to fly at dusk or night, are less visible than other groups, but several are important specialist pollinators of wild plants. Moths as a group form a critical food source for wildlife.



Butterflies

Order: Lepidoptera
Family: Papilionidae, Hesperiidae, Pieridae, Lycaenidae, Nymphalidae

With their striking transformation from a chubby plant-chewing caterpillar to a delicate pupa to a graceful nectar-drinking adult, butterflies are some of the most beloved insects. Some species have narrow host plant needs for their caterpillars, and others feed on a wide variety of plants.

Pollinator Status and Threats

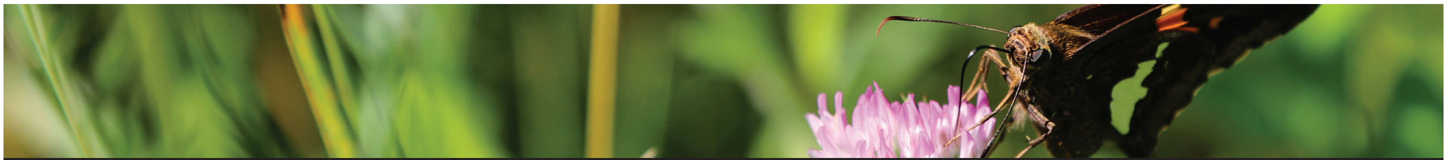
Globally, pollinators are in decline (Biesmeijer et al. 2006; Potts et al. 2010), with some scientists estimating that 40% of invertebrate pollinator species may be at risk of extinction worldwide in the coming decades (IPBES 2016).

Pollinators have been in the news since colony collapse disorder was identified in honey bees more than a decade ago. Although the number of managed European honey bee hives is increasing at the global scale (IPBES 2016), since 2006, honey beekeepers in the United States have experienced record high annual hive losses of 29% or more; an average of 33% of managed colonies were lost in 2016–2017 (Bee Informed Partnership 2017). Colony losses may be mitigated somewhat by beekeepers splitting colonies, but repeated loss at this level is not sustainable for beekeepers.

Much less is known about the status of most of North America's native pollinators, though what data that do exist suggest that numerous species are experiencing declines. One-quarter of North America's bumble bees have experienced significant declines (Hatfield et al. 2014), including declines in species that were formerly among the most common (Grixti et al. 2009; Cameron et al. 2011).The populations of hummingbirds and nectar-feeding bats throughout the southwestern United States have also experienced declines (National Research Council 2007).

In the United States, some butterflies are also in decline. NatureServe assessed all of the country's roughly 800 butterfly species and found that 19% are at risk of extinction (NatureServe 2018). A number of generalist butterfly species have seen significant declines in recent years (Forister et al. 2011). In particular, the population of monarch butterflies (*Danaus plexippus*) has dropped by over 80% east of the Rocky Mountains (Semmens et al. 2016) and by over 95% to the west (Schultz et al. 2017). The loss of milkweeds, the monarch's larval host plants, has been significant, particularly within agricultural fields (Pleasants and Oberhauser 2012; Hartzler 2010).

Threats that contribute to insect pollinator declines include the loss, degradation, and fragmentation of habitat (for example, Kremen et al. 2002; Potts et al. 2010); introduced species (for example, Memmott and Wasser 2002; Tallamy and Shropshire 2009); the use of pesticides (for example, Kevan 1975, 1999; Dover et al. 1990; Baron et al. 2014); and diseases and parasites (for example, Altizer and Oberhauser 1999; Cameron et al. 2011; Koch and Strange 2012). Hummingbirds face disruption of migratory routes and loss of habitat (Calder 2004), while nectar-feeding bats face disturbance of their roost sites and removal of foraging habitat and nectar sources (USFWS 2006).



Why Do Power Companies Care?

Threats to pollinators may have profound consequences for ecosystem health, as well as our food systems (Kearns et al. 1998; Spira 2001; Steffan-Dewenter and Westphal 2008). Concerns about pollinator decline and its repercussions have led to increased efforts to reduce threats to pollinators.

Electric power companies own and/or manage substantial land and associated natural resources across North America. This land management responsibility includes millions of miles of transmission and distribution rights-of-way, buffer acres surrounding power plants and substations, separately owned parcels ranging from 5 to 10,000 acres, property leased to farmers, and solar fields. These acres hold the potential to create a network of habitats to support pollinators in urban and rural areas. Power companies have an opportunity to make a huge difference for pollinators and their valuable role in agriculture and the environment by considering the needs of pollinators when managing habitat or revegetating land.

Additionally, several species of pollinators, including the regal fritillary butterfly (*Speyeria idalia*), the monarch butterfly (*Danaus plexippus*), and the western bumble bee (*Bombus occidentalis*), are under consideration for listing under the U.S. Endangered Species Act. Contributions to species recovery efforts in advance of decisions about listings can be investments toward helping a species rebound and averting a listing.

Pollinator-Friendly Strategies

Managing existing habitat for pollinators and restoring additional habitat can increase wild pollinator abundance and diversity (for example, Fiedler et al. 2012; Klein et al. 2012; Morandin and Kremen 2013). Diverse habitat can also support the health of managed honey bees (for example, Di Pasquale et al. 2013). Principles for pollinator conservation include the following:

Support Flowering Plant Diversity

Diverse plant communities sustain more species and numbers of pollinators. Some species of pollinators fly for just a few weeks during the growing season, while others are out the entire season. Diverse plantings include flowering plants with sequential and overlapping bloom times, which in turn will support pollinators from spring through fall. In addition to the many native wildflowers such as wild hyssop, purple coneflower, bee balm, cup plant, prairie clovers, and asters that will attract pollinators, native flowering trees and shrubs, such as willows, New Jersey tea, hawthorn, serviceberry, and spirea, are also valuable.

Support Nesting and Overwintering Habitat

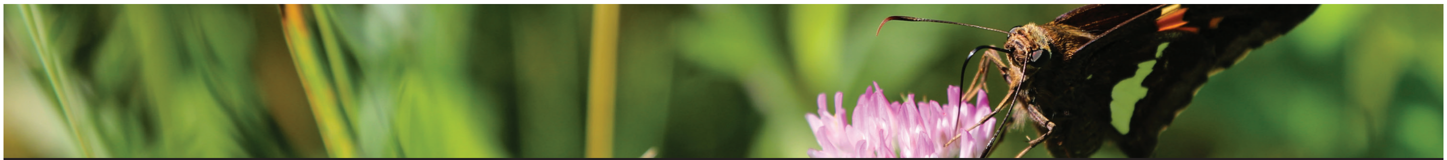
Pollinators also need shelter and overwintering sites. Undisturbed tall grassy areas can be nesting habitat for bumble bees and overwintering sites for numerous other pollinators. Shrubs can serve as nest sites for tunnel-nesting bees and wasps. Many ground-nesting bees prefer to locate their nests in well-drained soil, often in small patches of exposed ground in sunny locations.

Support Butterfly and Moth Host Plants

A wide variety of plants are host plants for butterflies and moths, including trees, grasses, shrubs, and wildflowers. If a goal is to support a particular butterfly or moth species, it is important to foster growth of the host plants that the species requires. For example, encouraging milkweed whenever feasible is important to support the recovery of monarch butterflies.

Thoughtful Chemical Use

Power companies are responsible for managing large amounts of land, which can involve the use of herbicides for weed and brush control. Thoughtful application of these chemicals can minimize impacts on pollinators and the plants on which they depend. Steps to reduce impacts to nontarget plants include using selective herbicides where possible, carefully targeting applications of nonselective herbicides, regularly calibrating equipment, and applying herbicides under proper weather conditions to reduce offsite movement. Herbicide applications timed during the stage of growth when the target weed is most vulnerable or based on the herbicide's mode of action will be most effective.



Support Habitat Connectivity

Habitats that are connected allow pollinators to travel more safely between patches to find resources, disperse to new habitat, and encounter potential mates. Some pollinators, such as tiny bees or butterflies that are poor fliers, have limited dispersal capacity and may need corridors that connect directly to habitat to aid their dispersal across otherwise inhospitable landscapes. Other larger-bodied, strong fliers, such as bumble bees, may be able to colonize new habitat patches using noncontiguous corridors as stepping stones.

The linear shape of rights-of-way may act as corridors to help pollinators move through the landscape, either for daily foraging or for dispersal between larger habitat patches. Additionally, rights-of-way corridors are likely to be particularly beneficial in agricultural landscapes, where the natural or seminatural habitat they provide benefits pollinator populations (Menz et al. 2011; Klein et al. 2012; McKechnie et al. 2017)—and, therefore, crop yields, as well (Morandin and Winston 2006; Blaauw and Isaacs 2014; Klatt et al. 2014).

Power companies may have opportunities to collaborate with neighboring landowners, states, or nonprofit conservation organizations that will elevate conservation opportunities beyond what could be done as a single organization.

Allow Time for Habitat to Take Hold

As vegetation management practices, such as the use of selective herbicides to remove weeds, are implemented to enhance existing plant diversity, some positive results will be noted immediately while others may take several years. Recolonization of pollinators can also take time and will vary depending on the surrounding landscape, habitat quality, and other factors. When revegetating a site, it can take several years for perennial plants to establish and bloom. The first year after planting, new seedlings are still quite short and the vegetation may look relatively unattractive. If partnering landowners are aware of the restoration process and time involved to see results, their expectations will be realistic. It can take three or more years before a habitat planting project may look attractive to the average observer.

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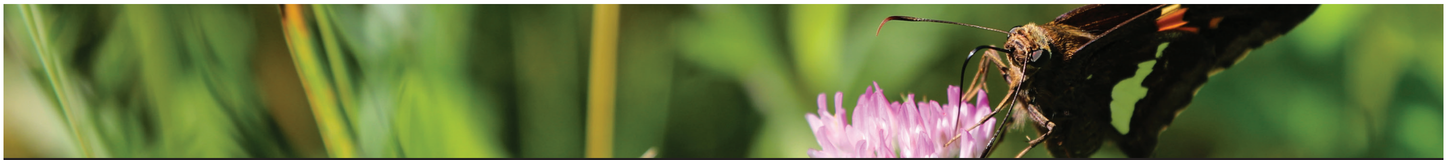

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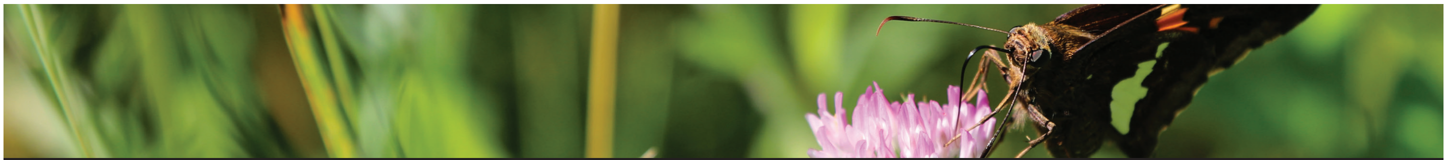

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