Pollinator-Friendly Best Management Practices for Federal Lands

Bumble bee foraging on goldenrod, *Solidago* sp.

Cover photo courtesy of R. Issacs

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Introduction

Honey bees, native bees, butterflies, moths, flies, bats, and beetles contribute substantially to the food production systems of the United States, to the economic vitality of the agricultural sector, and to the health of our environment. Honey bee pollination alone adds more than $15 billion in value to agricultural crops in the United States each year, and pollination by other species adds another $3.3 billion (Losey and Vaughan, 2006; Calderone, 2012). Honey bees and native pollinators (hereinafter referred to as "pollinators") pollinate more than 80% of wild flowering plants in temperate latitudes, thereby enhancing biodiversity and supporting stronger and more resilient ecosystems. The health of pollinator population, has, however, been impacted over recent decades by a variety of factors: the loss, degradation, and fragmentation of habitat; diminished quantity and quality of food sources; reduced availability of sites for mating, nesting, and migration; exposure to pesticides; and increased adverse effects from pathogens, arthropod pests, and parasites. Beekeepers now struggle against annual hive mortalities of 30% or more, and in 2014, a record low population of North American migrating monarch butterflies was reported in their overwintering forests in Mexico, representing a more than 90% reduction in numbers from past decades.

On June 20, 2014, President Obama issued a memorandum (Appendix A) directing the heads of executive departments and agencies to create a Federal strategy to promote the health of pollinators. The Presidential Memorandum directs Federal departments and agencies to evaluate and use their resources, facilities, and land management responsibilities to expand knowledge of pollinator health and to increase habitat quality and availability. By doing so, Federal departments and agencies can inform and inspire the private sector toward similar action and foster partnerships with States and counties, businesses, citizen groups, and philanthropists to advance mutual goals. These actions will build on existing Federal mandates for multiuse lands through emphasizing pollinator needs in managing for diverse native plant communities. Most actions can be taken within existing Federal land management budgets, indeed in many cases offering additional benefits through, for instance, reduced mowing of grasslands and long-term maintenance cost reductions from conversion to self-sustaining, native prairie.

Section 3(e) of the Presidential Memorandum instructs the U.S. Department of Agriculture (USDA) and the Department of the Interior (DOI) to develop best management practices (BMPs) for executive departments and agencies to enhance pollinator habitat on Federal lands. The USDA/DOI Federal lands guidance focuses on the large expanses of managed Federal lands, from forests, prairies, and parklands to grassed spillways and rights-of-way for roads, pipelines, and power lines. The President's Memorandum directs future land management activities, including restoration, rehabilitation, and revegetation projects, to consider the needs of pollinators. Employees of Federal land management agencies are encouraged to become knowledgeable about pollinators and pollination ecology and to make commitments to healthy, resilient pollinator habitats.

As an initial step, the formation of interdisciplinary teams (IDTs) or project teams of biologists and other qualified individuals has proven valuable for evaluating onsite conditions and the potential environmental consequences of management activities. In the National Environmental Policy Act context, if impacts to pollinators are expected, the IDT or project team would describe site-specific prescriptions to prevent those impacts. In other contexts, IDTs or project teams would be convened to enlist local expertise and engage the public, thereby

recognizing the variability of pollinator habitats and needs across the United States and the advantages that local knowledge, resources, and partnerships can bring.

In general, managing for pollinators involves providing these basic habitat elements:

- protecting, enhancing, or restoring wildflower-rich foraging habitat;
- providing hive site locations and nest sites for native bees;
- providing host plants for butterflies; and
- providing overwintering refuge for other insects (Mader et al., 2011).

Once these basic habitat elements are provided, they should be managed to ensure long-term productivity. These general management considerations are incorporated throughout the information presented below about pollinator BMPs.

How To Use this Document

The objective of this document is to consolidate general information about practices and procedures to use when considering pollinator needs in project development and management of Federal lands that are managed for native diversity and multiple uses. As managers implement the BMPs, they will need to look beyond this document for specific information for many of the BMPs. The document does not provide an extensive literature review for each BMP or lists of every resource that may be available for using a BMP locally. For example, for seeding native plant species, managers would research to determine the specific species that are locally available and the amount of seed that would be used, or the seeding equipment available to complete the project. Managers may need to have a clear understanding of the suite of pollinators that occupy a site to develop an extensive list of appropriate plants to use.

This document is intended to assist interdisciplinary teams (IDTs), project teams, project managers, and other Federal land managers by providing them with a range of BMPs appropriate to different resource categories. It is not considered a policy document, but as guidance that agencies can use as they implement management actions tied to specific agency missions. Each BMP is formatted to specify the practice, its objective, a more detailed explanation, and implementation guidance. The BMPs are organized under three subject areas: (1) BMPs to improve pollinator habitat, (2) BMPs to protect pollinators when taking management actions, and (3) BMPs to protect and sustain specific pollinator species.

Selected references are provided, and readers are encouraged to access these as well as additional sources of information on the BMPs that they are interested in implementing.

Common and scientific names used in this report are provided in appendix B. The document includes information on partnerships, programs and initiatives for pollinators (appendix C.) as well as information on services that native plants provide for pollinators (appendix D) and a glossary of terms used in the document (appendix E.). This information, along with the BMPs, provides a starting place for including pollinator considerations in projects and management activities on federal lands.

BMPs To Improve Pollinator Habitat

Key Considerations in Developing BMPs for Conserving Pollinator Habitat

Eight broad considerations are key when evaluating projects for conserving pollinator habitat:

- determining the quality of foraging habitat;
- identifying important pollinator reproduction sites;
- determining important nesting and overwintering sites;
- identifying pollinators of sensitive or at-risk plant species on Federal, State, local, or nongovernmental organization (NGO) (e.g., NatureServe) lists as outlined in the National Academy of Sciences report *Status of Pollinators in North America*.
- identifying and removing invasive species to improve pollinator habitat;
- identifying, collecting, and using local, genetically appropriate native seeds;
- implementing adaptive management; and
- engaging and informing the public.

Determining the Quality of Foraging Habitat

The best pollinator habitat sites for foraging are open landscapes with good sun exposure and many different types of herbaceous plants. Habitat patches that are bigger, rounder, and closer to other patches are generally better than those that are smaller, uneven in shape, and isolated. Habitats with a variety of native flowering plants that have overlapping blooming times and that are adapted to local soils and climates are usually the best sources of nectar and pollen for pollinators (Black et al, 2007). Some pollinators are limited in the distance from their nesting sites they can forage. For example, no bee is likely to travel more than 1.5 kilometer (about 0.9 mile) from its nesting site, and most are likely to fly distances that are significantly less (Gathnann and Tscharntke, 2002). Bumble bees and honey bees, however, provide notable exceptions, easily flying 1 mile in the case of bumble bees and 2–4 miles in the case of honey bees.

Figure 1. Pollinator habitat in an open landscape with good sun exposure and many different types of flowering forbs.

IDTs or project teams should evaluate the suitability of habitat for pollinator forage on the basis of the following criteria:

- which types of foraging pollinators are present in the project area;
- which plant species are present;
- whether the plant species are native;
- whether the flowers are attractive to the target foraging pollinators;

- whether the vegetation provides a continuous bloom from early spring through fall or provides forage at times of nectar and pollen dearth in the surrounding landscape; and
- what effects the proposed project activities have on foraging pollinators and the vegetative features mentioned above.

Site-specific prescriptions are discussed in subsequent sections and should be developed after documentation of National Environmental Policy Act effects.

For additional information on pollination and pollinators, see the on-line material at *http://dx.doi.org/10.2111/RANGELANDS-D-11-00008.s.1*. Associated with the June 2011 special issue of Rangelands Volume 33 Number 3 Pollinators in Rangelands.

Figure 2. A sagebrush plant community with blooming forbs that provides forage for pollinators.

Identifying Important Pollinator Habitat Sites

For nesting and reproduction, native bees require areas that are untilled and unmulched, have some bare ground or woody vegetation, and have nesting materials (Mader, et. al, 2011). Cavity-nesting native bees benefit from standing dead or partly dead trees as well as dried stands of grass. Cavity-nesting bees need open soil (not mulched over) that is well drained and not compacted. Sandy silty soils especially those in stream banks and riparian areas are ideal habitats. Bumble bees nest in small cavities such as abandoned rodent holes, under thick grasses, in brush piles, or in stone walls. It is important to remember that nest sites should be close to foraging sites since many native bees do not range more than a few hundred feet. Butterflies and moths often require specific plant species as larval host plants. Good foraging habitat also will often provide suitable egg-laying sites for a broad range of pollinators, including butterflies, as well as undisturbed areas with potential nest sites for bees (Mader et al., 2011).

IDTs or project teams should evaluate the suitability of project area habitat for pollinator populations on the basis of the following criteria:

- which plant species are present, including whether important larval host plants are present for specific butterfly and moth species;
- whether pollinators, if present, are on Federal, State, local, or NGO (e.g., NatureServe) lists of sensitive or at-risk species;
- whether the project area provides a variety of ground-nesting areas including woody plant stems and twigs with pithy centers, small cavities, abandoned rodent nests, or stands or patches of undisturbed native grass for native bees;
- whether the number of standing dead or partly dead trees, dead limbs, and amount of downed wood is sufficient for cavity nesting pollinators;
- whether sufficient nesting habitat is present for hummingbirds; and
- whether the proposed project activities affect the existing pollinator habitat, with special attention paid to the needs of at-risk pollinators.

  Site-specific prescriptions are discussed in subsequent sections and should be developed after documentation of environmental effects.

Figure 3. A clean, reliable source of water, like this high-elevation meadow with open water, is essential to pollinators. Running water and ponds provide resources for drinking. Water sources that are shallow or have sloping sides allow for easier approach without drowning.

Determining Important Nesting and Overwintering Sites

Pollinators need protection from severe weather and predators and require sites for nesting and roosting. About 70% of North America's native bee species are ground-nesters. (Mader et. al 2011). Most bees overwinter in the nest. Cavity-nesting bumble bees provide an important exception, with queens needing soft humus, loose soil, or protected underground holes and tunnels within which to overwinter.

Project managers should determine whether specific project areas are important pollinator nesting/overwintering sites on the basis of the following criteria:

- whether the site has patches of undisturbed grass for rodents (future nest sites for bumble bees), existing nest sites of ground-nesting bees, shrubs with pithy or hollow stems, and/or areas of bare sandy soil in sunny locations. For bumblebees, nesting habitat should be in proximity (500–800 meters, or 0.3 to 0.5 miles) to foraging habitat (Schweitzer et al., 2012).

Site-specific prescriptions should be developed to enhance or protect the habitat elements necessary for a particular pollinator or group of pollinators to successfully nest or overwinter. For example, deep-soil disturbance near nest sites should be minimized, shrubs with pithy or hollow stems should be planted/protected, dead limbs, logs, and snags should be maintained whenever possible, some areas of bare soil for ground-nesting bees should be left, and/or disturbing larval host plant areas should be avoided.

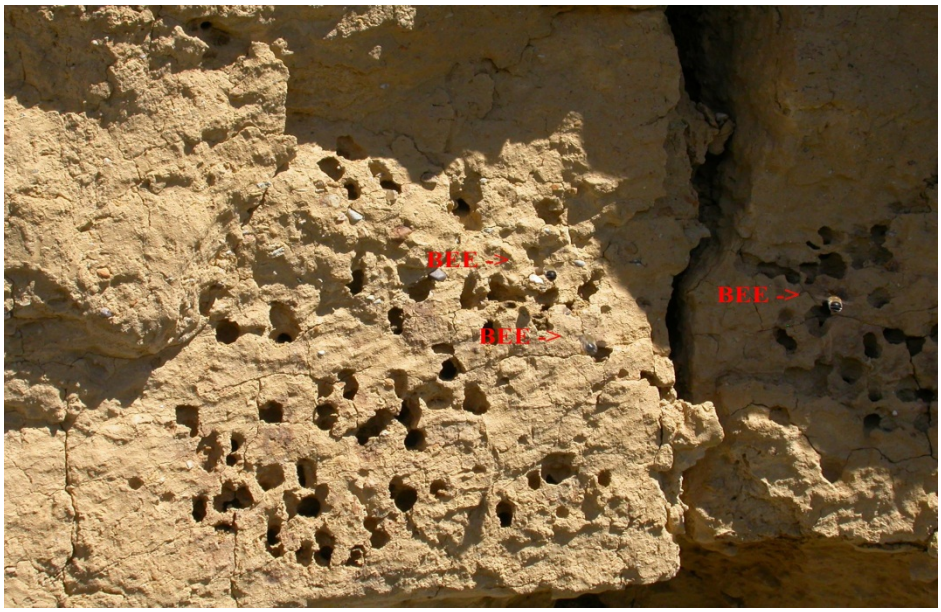

Figure 4. Bee nesting aggregation in an arroyo wall in the Carrizo Plain National Monument.

Identifying Pollinators of Special Status Plant Species

Consistent with the National Academy of Sciences report *Status of Pollinators in North America* (Committee on the Status of Pollinators in North America, National Research Council, 2006), project managers should survey and document the species and abundance of pollinators of

endemic plants and special status (rare, threatened, and endangered) plant species on public lands. When pollinators of special status plant species are found in the project area, the following actions should be considered:

- Create partnerships with local and State governments, universities, and NGOs to provide expertise and additional support in identifying and surveying pollinator species.
- Include managing and monitoring of pollinators in all special status plant conservation planning efforts.
- Implement recovery actions in the plans of Endangered Species Act listed plant species for pollinators. See http://www.fws.gov/endangered/species/recovery-plans.html to search for recovery plans and actions.
- Create information sheets for use by field unit specialists that picture the pollinator and outline its history, distribution, habitat, and ecology, as well as conservation priorities for pollinators of all special status plant species.
- Use qualified entomologists, botanists, ecologists or wildlife biologists to design mitigation measures to ensure that pollinators at all life stages, associated insects, and flowers are not impacted by the project design.
- Minimize the use of pesticide and herbicide in special status plant habitat, or monitor pollinator species diversity and abundance both before and after application, if use of insecticides is necessary.
- Avoid aerial applications of herbicides if special status plant species or habitat must be sprayed with herbicides.
- Ensure that monitoring programs include measurements of the presence and abundance of pollinators of rare plants at regular intervals.
- Monitor pollinator populations for at least 5 years at both donor sites and recipient sites when translocating pollinators of rare plants.
  Site-specific prescriptions are discussed in subsequent sections and should be developed after documentation of environmental effects.

Figure 5. A bee fly (left) and a sweat bee (right) pollinating slickspot peppergrass, a rare listed plant species from Idaho. Flowers of this species that are insect pollinated produce more seed than those that are self-pollinated (photographs by Ian Robertson).

Identifying and Removing Invasive Species

Invasive plant species have been implicated worldwide in the disruption of native pollinator processes and alteration of habitats that support native pollinators.[1] Nonnative invasive plants often form dense monocultures that inhibit growth of native plant species or compete with native plant species for pollination services. Removing invasive grasses, vines, shrubs, and trees is an effective way to increase pollinator abundance and diversity. Consistent with Federal guidance on invasive species management[2], implementation actions should include the following:

- Consult experts to develop individual strategies to manage or eradicate a given species. In general, focusing effort on management of the invasive species with dominant monocultures that exclude most other plant species will provide the greatest benefit to pollinators.
- Use adaptive management approaches to try various techniques on small plots to determine what works best for a given species and area. Management of invasive species may include felling by hand or machine, machine mulching, applying spot treatments of herbicide to bark, cut stumps, or leaves, controlled burning, mowing, or combinations of the approaches. Follow-up treatments may be necessary to prevent growth of new seedlings or plants that survived the initial treatment.
- Clean all equipment before moving to new sites to ensure that invasive species are not transported to new areas.

Figure 6. A West Virginia White butterfly laying eggs on nonnative garlic mustard. Toxins in garlic mustard can kill the larvae when they hatch (photograph by Keri Leaman).

[1] This objective is featured in the U.S. Forest Service report *National Strategy and Implementation Plan for Invasive Species Management* (2004; http://www.fs.fed.us/invasivespecies/documents/Final_National_Strategy_100804.pdf).
[2] National Invasive Species Council. http://www.invasivespecies.gov/.

Identifying, Collecting, and Using Local Native Seeds

Priority should be given to identifying, collecting, and using seed from local native forbs, grasses, and other plant species beneficial to local pollinators for use in restoration projects. A high-quality, accurately identified seed collection of those plant species that benefit pollinators should be maintained to provide seeds that are currently unavailable in the seed market for restoration projects. Regular purchasing of such seeds would also serve the purpose of generating and supporting a private industry and market place, thereby serving Federal, State, local, and citizen needs.

When developing local native seed inventories, the following actions should be considered:

- Consult a botanist familiar with local plant species to identify the most suitable populations for collecting genetically appropriate seed.
- Collect seeds at times when they would naturally fall from the plant.
- Monitor seed maturation, insect damage, and other damage levels throughout the population before making the seed collection.
- Document seed collections with standardized location data and herbarium specimens.
- Collect a sample of seed from more than 50 individuals from within a single large population equally and randomly across the extent of the population while maintaining a record of the number of individuals sampled. This method will maximize the genetic diversity within a seed collection. Collect no more than 20% of the viable seed on any plant.
- Collect no more than 20% of the viable seed available on the day of collection for those species that are common in the plant community.
- Ensure that seed collections do not overheat (e.g., avoid leaving seeds in a vehicle). Ventilation around the seed collections should be maintained. Use paper or cloth bags for collection; avoid plastic bags.
- Spread moist seed collections on newspaper to dry naturally, either outside in the shade or in a well-ventilated room.
- Clean the seeds, and place them in a proper storage facility to maintain their viability until they are used in a restoration project.
- Test the seeds for germination and viability prior to use.
- Work with native plant growers or farmers to increase seed availability for future needs through native plant grow-out projects (to increase seed available for use in restoration of pollinator habitat).

For more information on collecting native seeds, see considered (see http://www.blm.gov/wo/st/en/prog/more/fish__wildlife_and/plants/seeds_of_success/protocol.html

Figure 7. Botanists near Bishop, California, determine if a population of lupine is ready for seed collection.

Deploying well-adapted and ecologically appropriate plant materials is a core component of a successful restoration project. Seed transfer zones are areas within which plant materials can be transferred with minimal risk of maladaptation. Using the provisional seed transfer zones (Bower et. al. 2012) will increase restoration success and ensure that plant materials are compatible with the needs of local and migratory pollinators. These zones are based on multiple factors including temperature, precipitation, elevation, and ecoregion. While seed transfer zones are most successful when created for a specific species and its needs, the U.S. Forest Service has developed generalized seed transfer zones that can be applied to any native plant species. Maps of these generalized seed transfer zones should be considered a starting point for seed transfers and should be used in conjunction with appropriate species-specific information, as well as local knowledge of environmental differences. Once the project site and targeted pollinators are chosen, a list of plants can be developed and sourced by referring to seed transfer zone maps. The U.S. Forest Service's Western Wildland Environmental Threat Assessment Center (WWETAC) Seed Zone Mapper Web site (*http://www.fs.fed.us/wwetac/threat_map/SeedZones_Intro.html*) is one source of such maps. Seed transfer zone layers can be added to any geographic information system (GIS) project early in the planning phase. Once seed transfer zone is determined, all plant material used for the pollinator habitat project should originate from the same zone.

Figure 8. A native seed production field.

Implementing Adaptive Management

Adaptive management is a decision process that promotes flexibility as outcomes from management actions and other events become better understood (Williams et. al, 2009). Careful monitoring of these outcomes advances scientific understanding and helps inform adjustments to policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a "trial and error" process but rather one that emphasizes learning while doing; further, it does not represent an end in itself but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals; increases scientific knowledge; and reduces tensions among stakeholders.

As the scope and complexity of resource problems grow, it will be increasingly important to make resource decisions in a structured and transparent way that is based on science and that accounts for uncertainty. Adaptive management meets these conditions, and it can be a valuable template for effective decision making by land managers.

In recent years, engagement of stakeholders in decision making has steadily increased (Williams et. al, 2009). Active stakeholder engagement helps involved parties learn from each other, find areas of common ground, and build trust in developing management strategies collaboratively. This arrangement offers an incentive to stakeholders to agree on an initial strategy that involves compromise on all sides. In the context of adaptive management, negotiations to establish strategies allow parties to be more flexible because they recognize that the outcome of negotiations can be changed as understanding improves and conditions change.

Engaging and Informing the Public

Public engagement and education are critical components for achieving pollinator habitat objectives. Large expanses of prime pollinator habitat may appear unkempt to the untrained eye, and efforts must be made to inform the public, in advance, of the benefits of maintaining this type of habitat. Ways to engage and educate the public include the following:

- Engaging federal department and agency staff and the public early in the goals of a pollinator habitat activity;

- Posting signs indicating the intent of the habitat project, as well as the species of plants and pollinators that may be found there;
- Clearly indicating that pollinator habitat is being prioritized, such as with obvious markings and lines between mowed areas and pollinator habitat on rights-of-way;
- Attending to factors known to elicit adverse public comment, such as the presence of certain nonnative "weed" species that are well recognized locally. Such species may be viewed by the public as evidence of inadequate maintenance and should be spot treated with herbicide to prevent these types of adverse public comments.

Pollinator BMPs for Common Managed Habitat Types

Six common managed habitat types are highlighted here. These habitats occur across the country in many different plant communities and can often be managed similarly.

- Forests: Thinning and understory shrub control
- Roadsides: Promoting native plant communities for pollinators
- Arid and semiarid Western shrublands: Seeding native forb species
- Grasslands: Conversion to native meadows and prairies
- Riparian areas: Maintaining forb diversity
- Wildlife openings: Managing to improve and sustain pollinator habitat

Thinning and Understory Shrub Control in Forests

Objective: To improve forest stand health and increase pollinator abundance and diversity.

Explanation: Dense, shrubby forest stands are poor habitat for pollinators. Thinning is a common forest management practice used to promote the health of trees, stands, and forests. Forest stands with open canopies through which sunlight reaches the forest floor are beneficial for a wide variety of pollinators, including bees and butterflies. Thinning alone, however, is not adequate if stands have a dense understory shrub layer or midstory. A combination of thinning overstory trees and controlling shrubs with fire, mechanical cutting, and/or targeted herbicide applications promotes herbaceous plant growth and flowering and exposes soil, providing nesting habitat for ground nesting bees. See Grundel et al, 2010 for more information.

Implementation: Removing woody vegetation can prevent meadows from being overrun by woody species and create openings in canopies that allow for pollinator friendly plants as a component in understory vegetation.

- Evaluate stands for thinning and shrub control on the basis of guidelines already established for bark beetle management (e.g., Southern Pine Beetle Prevention and Restoration Program) or the U.S. Forest Service Healthy Forest Initiative.
- Thin stands in a manner that minimizes wounding of residual trees and at appropriate times to reduce the risk of disease.
- Clean equipment to prevent movement of invasive species between sites. Roadsides along treatment blocks or stands infested with invasive plant species should be treated beforehand to minimize spread into the forest.

- Shrub and midstory tree control will be dictated by region, forest type, site, and species and might include a combination of prescribed fire, mechanized cutting, shrub felling followed by herbicide stump treatment, or herbicide injection or basal bark application.
- Evaluate the site after restoration to determine if seeding of native plants beneficial to pollinators is needed.

Figure 9. Successful thinning project in a southeastern pine savanna that now provides excellent pollinator habitat.

Figure 10. Poor pollinator habitat invaded by an understory shrub (left) and good pollinator habitat providing open areas for forbs and small shrubs to bloom. (right).

Promoting Native Plant Communities Along Roadsides for Pollinators

Objective: To increase pollinator abundance and diversity by managing roadsides to provide larval host plants, food plants for caterpillars, as well as nectar, pollen, and nesting habitat for ground-nesting bees. Since most solitary bee species have limited foraging ranges, roadsides can provide all of their habitat needs.

Explanation: Roadsides in forests, woodlands and shrublands are significant opportunities to provide habitat for many bees and butterflies. Roadsides also serve as corridors for movement between habitat patches for some pollinator species. Most bees and butterflies prefer open habitats and benefit from some disturbance that prevents shrub and tree encroachment and maintains flowering herbaceous plants. Roadsides are openings that receive some disturbance, usually in the form of mowing, and can be managed to provide bee and butterfly habitat.

Implementation: Include considerations for pollinators in integrated roadside vegetation management.

- Use an adaptive management approach to test various techniques on a small scale to determine what works best in a given area.
- Select sections of roads with exposure to good sunlight for extended periods, accessibility, and ease of management. Some tree removal along roads to increase sunlight will favor both plant growth and bee nesting and butterfly habitat.
- Native pollinators evolved with and are adapted to native plants. Roadsides that contain monocultures of nonnative plant species can be managed to provide canopy openings for native species to establish.
- If necessary, initially mow closely, and possibly couple with light soil disturbance, to prepare a seedbed, and expose soil for seed germination and seedling growth. Eliminating nonnative species with herbicide application may be necessary after light soil disturbance or close mowing.
- With permission, collect seeds from forest openings with diverse native wildflower populations as a source of material for roadside plantings.

- Select areas for tree removal to provide more sunlight to promote herbaceous plant growth and flowering in places where subsequent management to maintain the roadside (e.g., mowing) will be possible. Select trees that flower at different times of the year to provide pollen and nectar throughout the growing season. Removing wind-pollinated trees and favoring animal-pollinated ones will provide more flower resources.
- Remove additional trees at the edges of intersections and other large forest openings to provide additional sunlight and better growing conditions for herbaceous flowering plants.

Figure 11. Dense roadside trees and overhanging canopy result in poor pollinator habitat.

Figure 12. Roadside management results in canopy openings for good pollinator habitat.

Arid and Semiarid Western Shrublands—Seeding Native Forb Species in Restoration, Rehabilitation, and Revegetation Efforts

Objective: To increase the cover and diversity of essential habitat components for native pollinators when restoring or rehabilitating native plant communities.

Explanation: Using the seeds of native plants, especially after fires in arid rangelands, is a relatively new concept but can provide important sources of food for pollinators because native plants and their pollinators evolved together.

Implementation: The following actions should be considered in restoration and rehabilitation on arid and semi-arid western rangelands:

- When planting seeds, use minimum till drills.
- Use small seed boxes on drills specifically built to deliver small forb seeds.
- Seed native plants according to their species level requirements, as guided by locally-knowledgeable native plant experts.
- Avoid seeding forbs and grasses at the same time to limit competition between the forbs and grasses.
- Seed forbs in separate rows from where grasses are seeded.
- Seed native grass species in amounts to allow native forbs to establish successfully.
- Avoid seeding native forbs in mixes with nonnative forbs that may establish more quickly and out compete natives.
- Seed forbs in fall, although some legumes are more successful when seeded in spring.
- Seed forbs with different flowering times in patches so that pollinators can find them.

- Where practicable, cover seed with weed-free hay to capture moisture.
- Include in seed mixes annual and short-lived perennial native forb species; these seeds will bloom in the first year and provide forage for native bees.
- Seed several different species of forbs with different colored flowers and shapes to provide forage throughout the growing season for a variety of pollinators.
- Consult regionally relevant sources of knowledge for information on wildflower species mixes suitable for the soil type and moisture conditions.

Figure 13. A minimum till drill.

Grasslands—Conversion to Native Meadows and Prairies

Objective: To increase the extent of native vegetation and pollinator habitat in grasslands, prairies, and federally maintained rights-of-way, particularly cost-effective ways to increase the quality of flowering resources on existing grassed areas, and longer term means to restore native prairie and meadow habitat from nonnative grasslands.

Explanation: The Federal Government manages large expanses of open grassed areas, from parks and wild lands to road, rail, and pipeline rights-of-way and to spillways and recreational areas. In addition to their intended uses, these open areas offer valuable opportunities for enhanced pollinator habitat.

Implementation: The following actions should be considered when seeking to improve pollinator habitat on grasslands and converting nonnative grasslands to native meadows and prairies:

- Consider the specific region, local botanical expertise, and adopting an adaptive management approach, testing various techniques on a small scale to determine what works best in a given area.
- Appraise the existing flora for the presence of prairie or native meadow species, which can be encouraged through cessation of mowing accompanied by spot treatment or removal of undesirable or invasive species.

- Increase flowering of many native and clover species by reducing frequency of mowing, along with timing of mowing to follow blooming.
- Initiate conversion to native meadows and prairies by eliminating undesirable grass and weed species, usually through herbicide application or controlled burning.
- Plan ahead to remove the undesirable seed bed and roots, an essential first step, as surviving weed species will out compete native seed mixes. In some areas, herbicide and/or fire application will need to be repeated, especially in the presence of persistent weeds, such as Canada thistle.
- Spray-apply or drill-plant a very diverse seed mix of native grasses and forbs, cold and warm season species, legume and non-legume to fill a wide variety of local ecological niches and maintain a floral resource for pollinators throughout as much of the year as possible. These seeds should preferably be locally derived phenotypes, where such seeds are anticipated to out-compete nonnative species.
- Mow revegetated areas with high cuttings (6 inch) for the first season to reduce weed reproduction and thereafter spot treat for invasives. Native seeds will form strong roots and will survive drought and fire application yet remain susceptible to inappropriate herbicide application, which will favor reemergence of invasive nonnative species.

Consider integrated vegetation management (IVM) approaches, managing for the desired species through the focused use of control measures and plant-specific herbicides to control undesirable species. More information on IVM approaches is available on line through many federal and state agencies.

Riparian Areas: Maintaining Forb Diversity

Objective: To improve and maintain riparian resources needed by pollinators and to develop guidance for managing these key areas for pollinator conservation.

Explanation: Riparian areas contain a high diversity of herbaceous plants, including many of the forb or wildflower species needed by pollinators for nectar and pollen. Riparian areas occur throughout the landscape as wet meadows, streamside zones, swales, fens, seeps, and springs. They are dominated by wetland and riparian grasses and herbaceous species that are often quite different from species that occur in adjacent habitat. Riparian habitats are usually small areas interspersed within more widespread habitats; however, they provide a rich diversity of species despite their size. Depending on elevation, riparian wildflowers and shrubs provide a source of food and habitat throughout the growing season beginning in early spring in the valley bottoms and continuing with snowmelt into higher elevation riparian areas. Many riparian plants are dependent on native bees, moths, bumblebees, and hummingbirds for pollination.

Implementation: Consider the following management options to conserve and protect pollinators within these sites:

- Maintain hydrologic function within watersheds to enhance water-holding capacity and maintain water-dependent native plant communities.
- Reduce wetland drainage and conversions that reduce the size and extent of riparian plant communities.
- Use site-adapted native seed in riparian restoration to promote pollinator-preferred plant species.

- Maintain vegetative structure in riparian areas including grass and herbaceous structure for pollinator nesting and cover needs.
- Control the introduction and spread of nonnative invasive species.
- If grazed, develop grazing regimes that maintain species structure and plant diversity.
- Minimize the use of broad-spectrum insecticides and herbicides within riparian communities.

Figure 14. Riparian areas, including those around spring and seeps (left) and those around streams (right), can provide diverse pollinator habitat.

Managing Wildlife Openings To Improve and Sustain Pollinator Habitat

Objective: To create and manage wildlife openings with a wide variety of native plants, including forbs, trees and shrubs to provide forage, seeds, and fruit to support a diverse pollinator community and other wildlife.

Explanation: Even-aged management of forests and fully stocked forest stands has led to more closed canopy forests, which are less beneficial to pollinators. To combat this, wildlife managers create artificial gaps, or wildlife openings (originally created with game species in mind), to stimulate a more natural mosaic of habitats. These wildlife openings were often sewn with seeds of nonnative plants; some of these are now invasive species that displace beneficial native plant species, many of which are important to pollinators. Wildlife openings are ideal for bees and butterflies because these pollinators thrive in sunny habitats with diverse native plant communities that bloom from spring through fall. This is important since many bee species are active for only a short time each year and because others require access to flowers throughout the season. These sunny openings provide both foraging and nesting habitat for bees and can include larval host plants of butterflies. By providing flowering herbaceous plants, shrubs, and trees, wildlife openings can support both pollinators and other wildlife.

Implementation: Game and nongame wildlife as well as pollinators thrive in forest gaps and meadow openings. Manage wildlife openings to include a mix of native annual and perennial forbs, including legumes, grasses, shrub thickets and sparse patches of bare ground

- Remove undesirable woody species to create sunny, meadow-like openings, replacing nonnative trees, shrubs, grasses, or herbaceous plants with native species. Fire (when possible), in combination with mowing, may be needed to maintain wildlife openings.
- Seed, as needed, to establish native plant communities. Seed in strips or patches if seeding whole openings is not feasible. Native wildflower mixes that bloom during different times of the year and in different flower colors should be given the highest preference.
- Select plants, when possible, that serve as butterfly larval host plants.
- Select a diversity of native woody species suited to the site, and avoid those already common in a forest (e.g., rhododendron, mountain laurel, etc.). Examples of trees or shrubs that provide resources to bees include Carolina laurel cherry, Chickasaw plum, black cherry, American plum, hawthorn, American holly, Carolina silverbell, serviceberry, blackgum, sourwood, basswood, persimmon, chinquapin, crabapple, black locust, honey locust, willow, eastern redbud, and sumac.
- Plant animal-pollinated trees along field margins, which can provide long-term stable floral resources for pollinators and require less management. These trees also provide flowers at different heights.
- Use repeated disturbance to maintain wildlife openings and keep woody species from encroaching. Mowing is simple and often effective, but timing (winter, spring, and fall) and frequency (annual, biennial) should be varied to determine the optimum method to benefit both pollinators and wildlife in different regions.

Figure 15. Wildlife opening in sagebrush habitat with structure and diversity that can benefit pollinators.

BMPs To Protect Pollinators When Taking Management Actions

Pesticide Use

Objective: To minimize the risk of pesticides to pollinators.

Explanation: Minimize the use of pesticides toxic to pollinators or that will remove useful floral resources is best for conserving local pollinators. When use of pesticides harmful to pollinators cannot be avoided, managers should engage in practices that reduce exposure to pollinators. Determine the types of pollinators in the project area and their vulnerability to pesticides, taking into consideration pesticide chemistry, toxicity, and mode of action, can lead to more informed pesticide application. Consult local Cooperative Extension or state departments of agriculture for more information.

Implementation: Minimize the direct contact that pollinators might have with pesticides that can cause harm and the contact that they might have with vegetation sprayed with pesticides that are toxic to pollinators. Try to keep portions of pollinator habitat free of pesticide use.

- Plan timing and location of pesticide applications to avoid adverse effects on pollinator populations. Apply pesticides that are harmful to pollinators when pollinators are not active or when flowers are not present.
- Place buffers around important pollinator foraging, reproduction, nesting, and overwintering areas.
- Limit the amount of pesticide use only to that which is absolutely necessary. Follow the label instructions; the pesticide label is the law.
- Reduce the risk of drift by operating standard boom sprayers at the lowest effective pressure and with nozzles set as low as possible and/or by using nozzles that are capable of operating at low pressures (15–30 pounds per square inch).
- Avoid aerial spraying whenever possible. Limit spray applications to times when wind speed is low (i.e., less than 10 miles per hour).
- Adopt integrated pest management principles (find more information at *http://www.epa.gov/pesticides/factsheets/ipm.htm* or state-wide IPM programs).
- Use pesticides judiciously to avoid development of pesticide resistance in target pest populations and to protect pollinators.

Prescribed Burning

Objective: To reduce the impact of prescribed fires on pollinators.

Explanation: Many plant communities need periodic fire. Without it, trees can be stressed by overcrowding, fire-dependent forbs and grasses can disappear, and flammable fuels build up and become hazardous. The right fire at the right place at the right time reduces hazardous fuels, protects human communities from extreme fires, minimizes the spread of pest insects and

disease, removes unwanted species, provides forage for game, recycles nutrients back to the soil; and promotes the growth of trees, wildflowers (forbs), and other plants.

Implementation: Prescribed fire can play an important role in the long-term maintenance of pollinator habitat, but it can have negative effects on pollinator populations in the short term, unless the needs of pollinators are considered in project design.

- Conduct prescribed burns in a manner that protects pollinator health. Fires that are too frequent, widespread, or intense can eliminate pollinator populations.
- Determine the types of pollinators using the project area, and assess potential impacts. Consider specific needs of pollinators that are at-risk or of concern at a site to determine if other management techniques should instead be implemented to reach goals.
- Burn only 30% of a site during one prescribed burn. If possible leave small unburned patches within the burned areas (Gilgert and Vaughan, 2011) (Black et. al, 2007).
- Allow adequate recovery of pollinator populations between controlled burns in one area (dependent on the ecosystem and specific management goals).
- Implement prescribed burns outside the blooming period in foraging habitat (i.e., burn in late fall to early spring and early or late in the day).
- Post fire monitoring of pollinators is encouraged.

Figure 16. Many pollinators can survive infrequent, low intensity prescribed burns which promote long term maintenance of pollinator habitat.

Livestock Grazing

Objective: To reduce the impact to pollinators from livestock grazing.

Explanation: Livestock grazing alters the structure, diversity, and growth pattern of vegetation, which affects the associated insect community. Grazing during a time when flowers are already scarce may result in insufficient forage for pollinators. Grazing when butterfly larvae are active on host plants can result in larval mortality and high intensity grazing can cause local loss of forb abundance and diversity.

Implementation: The following actions should be considered in rangelands when livestock grazing is present:

- Determine which types of pollinators and which pollinator habitat elements are affected by grazing livestock.
- Assess if grazing is compatible with the specific needs of target pollinator species on site, including targeted butterfly species.
- Prevent trampling ground-nesting sites by implementing practices to minimize hoof action of grazing animals, which causes soil compaction or erosion in pollinator nesting and shelter patches.
- Minimize livestock concentrations in one area by rotating livestock grazing timing and location to help maintain open, herbaceous plant communities that are capable of supporting a wide diversity of butterflies and other pollinators.
- Protect the current season's growth in grazed areas by striving to retain at least 50% of the annual vegetative growth on all plants.
- Enhance the growth of forbs to ensure their ability to reproduce and to provide nectar and pollen throughout the growing season by setting grazing levels to allow forbs to flower and set seed.
- Leave nearby ungrazed areas to provide reserves for pollinator populations.
- Prevent grazing during periods when flowers are already scarce (e.g., midsummer) to maintain forage for pollinators, especially for bumble bee species.
- In important butterfly areas, avoid grazing when butterfly eggs, larvae, and in some cases pupae are on host plants.
- Consider the needs of pollinators when placing range improvements and structures on the landscape.
- Ensure that fencing is adequate and well maintained.
- Include protection of pollinator species in grazing management plans.

Figure 17. Cattle grazing in a meadow with pollinator habitat.

Prescribed Mowing Along Roadsides

Objective: To reduce the impacts to pollinators from mowing.

Explanation: The differences between an ultimately beneficial mowing regime and a detrimental one are timing, technique, and scale. Although mowing is not a frequent management activity in natural areas on most public lands, it is used by many agencies to maintain roadside safety, pull-off areas, and road shoulders and as a roadside fuels management practice for fire prevention. Prescribed mowing plans can be developed to create vegetation of various heights, thereby improving structural diversity that provides potential nesting sites for bumble bees and other pollinating insects. Also, mowing removes almost all flowers, reducing nectar and pollen availability to pollinators. Prescribed mowing can be planned to ensure that blooms are present all season long and to ensure that the host plants of butterflies and moths are not mowed while they are being used, which can lead to direct mortality.

Implementation: The following actions should be considered when mowing is applied:

- Determine the pollinators using the area proposed for mowing and evaluate the current safety and other needs that the roadside provides.
- Review the current vegetation complex of the roadside to determine if it can or should be adjusted to provide or enhance pollinator habitat for foraging, reproduction, and shelter.
- Mow during non-blooming seasons.
- Allow pollinators to escape mower blades by using a flushing bar on the mower and by mowing at reduced speeds (less than 8 miles per hour). Cut high (a minimum of 12-16 inches) and/or mow in patches to ensure that some pollinator habitat is left intact.

Figure 18. A dry meadow that was mowed for yellow star thistle control.

Agricultural Practices for Wildlife Management

Objective: To minimize the impacts of agricultural practices on pollinators and their foraging and nesting resources.

Explanation: Agricultural practices on Federal lands provide food resources for target wildlife species and include growing and harvesting of crops, as well as mowing and haying pastures. Short-term agricultural practices are also utilized to prepare poor-quality habitats for planned restoration projects. Agricultural programs often require soil tillage for weed removal and crop planting, along with pesticides to control weeds and crop-depredating insects. While these practices can limit pollinator foraging and nesting resources in the short term, some crops provide foraging opportunities and/or bare soil for ground-nesting bees. Agricultural crop production impacts pollinators to varying extents depending on the pollinators present within the area, crop type, site location, field size, weed species present, and the practices implemented. Field sizes on Federal lands are relatively small and may be surrounded by, or in proximity to, more natural landscapes, and the overall impact to pollinator communities may be localized. Some crops require annual tillage and replanting (corn), while other crops such as alfalfa may only require replanting once every few years.

Implementation: Best practices to reduce crop-related impacts to pollinators include the following:

- Evaluate the scope of the agricultural production program in the context of its potential effects on pollinators within the surrounding landscape.
- Provide a diversity (25 species or more) of native plants that provide nectar, nesting, shelter, and larval host plants throughout the season (including shrubs, forbs, and grasses) around fields when native habitats are less than 50 meters from field edges.
- Evaluate the timing of field or crop mowing and haying to ensure that breeding, egg, and larval stages are not impacted for key moths and butterflies.

- Incorporate buffer strips along fence rows to provide a diversity of native plants.
- Use no-till seed drilling to reduce destruction and disturbance of ground-nesting bees while also minimizing the growth of weeds.
- Lengthen crop rotation cycles to limit impacts to ground-nesting bees.
- Minimize the use of seed treated with insecticides. Use all insecticides, including seed treated with insecticide, as a component of an integrated pest management program, and only when necessary.
- Minimize exposure of pollinators to pesticides by following long-standing integrated pest management principles:
    - Notify nearby beekeepers before spraying a product formulation that may be harmful to bees.
    - Provide a buffer between crops and adjacent pollinator forage and/or host plants.
    - Use pesticides only when needed rather than on the basis of a predetermined schedule.
    - Select pesticides with the lowest effective toxicity.
    - Use the minimum application rate.
    - Reduce pesticide use during the larval stage for butterflies.
    - Apply pesticides an hour after sunset when feasible to avoid pollinator activity. (The presence of nocturnal flying pollinators should be assessed prior to implementing this technique.)
    - Minimize or avoid pesticide applications when dew is present or forecasted to be present on vegetation.
    - Minimize or eliminate pesticide applications when flowers are in bloom.
    - Use backpack sprayers or other feasible application methods to reduce spray drift.
    - Avoid weather conditions (e.g., windy conditions) that promote spray drift.
    - Operate spray equipment with nozzles set just above plant height and at the lowest pressures (15–30 pounds per square inch) to increase spray droplet size to reduce drift.

Figure 19. Abundant wildlife including snow geese (left) and elk (right) rely on public lands for habitat, as do pollinators.

Mulching for Landscaping and Gardens

Objective: To mulch for landscaping and in gardens in a manner that conserves native ground-nesting pollinators.

Explanation: There are benefits to using mulch in landscaping and gardening. Organic mulches (such as wood chips and compost) can control erosion, limit weeds, preserve soil moisture, and moderate soil surface temperature. Considerations such as where to mulch, how much mulch to use, and type of mulch, however, are very important regarding the conservation of native ground-nesting pollinators. There are more than 4,000 species of native bees in North America, many of which nest in the ground (Mader et. al 2011). These valuable native pollinators need open patches of soil, preferably in proximity to the plants they pollinate.

Implementation: Consider the following practices regarding mulching to protect ground-nesting pollinators:

- Do not apply mulch to all areas; keep some bare dirt exposed. A few small open patches of soil between planting beds will provide habitat for ground-nesting bees.
- Preserve a mulch-free zone of 6–12 inches around the bases of plants to enable ground-nesting bees to construct nests in proximity to the plants they pollinate.
- Install pots of soil buried 8- to 10-inches deep within mulched areas for use by ground-nesting bees.
- Maintain patches thinly top-dressed with less than 1 inch of compost to provide habitat for digging bees while also offering some of the benefits associated with mulch.
- Remove all plastic mulch (of any color). Plastic is detrimental to digging bees and also smothers soil.

Managing Lawns for Pollinators

Objective: To decrease lawn mowing frequency to protect lawn flowers for increased foraging opportunities and to reduce compaction to support ground-nesting bees.

Explanation: Weekly lawn mowing practices suppress flower growth, leading to a decline in flower density. Flowers provide pollen and nectar sources for pollinators in urban and intensively managed areas. In combination with raising the mowing height to 2.5 inches and minimizing pesticide use, mowing only every 2 or 3 weeks has the potential to increase flower abundance by 70–300%.

Implementation: The following actions should be considered when developing a landscaping plan for managing lawns at Federal facilities:

- Mow every 2 weeks in high-traffic areas and every 3 weeks in low-traffic areas.
- Develop a mowing rotation plan for each site to ensure that lawn flowers persist throughout the growing season.
- Minimize the use of insecticides and fertilizers.

- Create patches of bare soil for nesting sites.
- Install signs in high-traffic areas to inform the public about the benefits of less frequent mowing.
- Consider increasing land allocated to flowering plants and reducing land allocated to grass.

Hayland Management and Harvesting

Objective: To reduce the impact to pollinators from hay harvesting.

Explanation: Haying, like mowing and to an extent grazing, creates vegetation of uniform heights, reducing structural diversity that provides potential nesting sites for pollinators. Haying abruptly removes almost all flowers, and haying during a time when flowers are already scarce may result in insufficient forage available for pollinators. Haying when butterfly larvae are active on host plants could result in larval mortality.

Implementation: To reduce the detrimental effects to pollinators from haying operations, the following actions should be considered:

- Form an IDT to determine the types of pollinators using the project area, which habitat elements are important to them, and which habitat elements are affected by hay harvest and management activities. An IDT can also address potential effects to pollinators that are associated with haying and describe methods to prevent unacceptable effects to pollinator foraging, reproduction, and shelter.
- Assess if haying is compatible with the specific needs of target pollinator species on the site.
- Harvest hay during non-blooming seasons if practical, considering hay quality.
- If the hay field includes large amounts of flowering plants beneficial to target pollinators, consider delaying hay harvest until after peak bloom.
- Consider incorporating pollinator-beneficial forage plants into hay fields, if appropriate.
- Consider rotational haying to help maintain open, herbaceous plant communities that are capable of supporting a wide diversity of pollinators.
- If the entire hay field must be harvested within a short time period, harvest from one end of the field to another, rather than harvesting the perimeter and inward, to allow insects—and other wildlife—a route to escape the field.
- Leave nearby unharvested areas to provide habitat for pollinator populations.
- Avoid spraying harmful insecticides on the hay field at any time but especially during bloom times or when pollinators are foraging in the field.
- In important bumble bee areas, avoid haying during periods when flowers are already scarce (e.g., midsummer) to maintain forage for pollinators.
- In important butterfly areas, avoid haying when butterfly eggs, larvae, and—in some cases—pupae are on host plants.

Row Cropping

Objective: To reduce the impact to pollinators from row cropping operations.

Explanation: Row cropping (which is infrequent on federally managed lands) is typically a highly managed process that limits diversity. Soil disturbance, crop harvesting, and pesticide use may result in insufficient nesting sites, lack of foraging resources, and adverse conditions for pollinators.

Implementation: To reduce the detrimental effects to pollinators from row cropping operations, the following actions should be considered:

- Form an IDT to determine the types of pollinators using the project area, which habitat elements are important to them, and which habitat elements are affected by row cropping activities. An IDT can also describe methods to prevent unacceptable effects to pollinator foraging, reproduction, and shelter.
- Assess if growing the desired row crop is compatible with the specific needs of target pollinator species on the site.
- Use untreated crop seed to avoid adverse impacts on forage resources.
- Consider diversifying crop production in different parts of the site; for example, if corn is the predominant crop, use part of the site to grow more beneficial flowering species such as canola, alfalfa, or vegetable crops.
- Strategically place alternate crops that are beneficial to pollinators in proximity to nesting sites and other desirable pollinator habitat.
- Establish field borders planted with a diverse mix of flowering species and grasses. Field borders may also help trap sediment and nutrients from the crop field.
- Use adjacent lands to crop fields to plant high-quality perennial flowering species and grasses. Consider planting species that will benefit rare or at-risk pollinators if they are present at the site.
- Use appropriate flowering cover crops in between row crop cycles, or planted as an understory crop that can mature after row-crop harvest, to reduce soil erosion, recycle cropland nutrients, improve soil quality, and provide additional habitat for pollinator species. To provide pollinator benefit, choose species that have documented benefit for pollinators and allow cover crop to bloom before termination.
- Use integrated pest management techniques to minimize the need for pest treatments to the extent possible.
- Avoid spraying harmful insecticides during bloom times or when pollinators are active in the field. Avoid overspray or drift from crop spraying to field borders, natural areas, or other areas with high-quality habitat.
- Plant habitat for predatory insects that may help control pests of row crop species.
- Use no-till cropping methods to limit disturbing habitat for ground-nesting bees, as well as to reduce erosion and protect soil quality.

BMPs To Protect and Sustain Specific Pollinator Species

Restoration and Rehabilitation of Monarch Habitat in the United States

Objective: To restore and rehabilitate monarch butterfly habitat for both the eastern and western populations of this species.

Explanation: During spring and summer, monarch butterflies (hereafter "monarchs") breed throughout the United States and southern Canada. In fall, adults of the eastern population migrate to Mexico and adults of the western population migrate to scattered groves along the coast of California. The following spring, these butterflies leave their overwintering sites and fly northward in search of host plants on which to lay their eggs. Monarchs are threatened by the loss and degradation of habitat and the ongoing decline in milkweed availability, their obligate host plant for egg laying and caterpillar growth.

Implementation: To determine those lands best suited for restoration and rehabilitation of monarch habitat, the following actions should be considered:

- Ensure that native wildflowers are available, diverse, and abundant to provide nectar for monarchs.
- Ensure that milkweed species (preferred by female monarchs for egg laying) are available; if not, implement a planting program for milkweeds:
  - In the Eastern United States, plant swamp milkweed, butterfly milkweed, and common milkweed.
  - In the Southern United States, plant butterfly milkweed, swamp milkweed, aquatic milkweed, white milkweed, pinewoods milkweed, and swamp milkweed.
  - In the Northern Great Plains, plant showy milkweed, common milkweed, plains milkweed, green comet milkweed, and whorled milkweed.
  - In the Southern Great Plains, plant showy milkweed, butterfly milkweed, whorled milkweed, swamp milkweed, spider milkweed, and green antelopehorn milkweed.
  - For the California population, plant California milkweed, heartleaf milkweed, woollypod milkweed, Mexican whorled milkweed, also known as narrowleaf milkweed and woolly milkweed.
  - For the intermountain west and desert southwest plant butterfly milkweed, cor kernel milkweed, spider milkweed and pine needle milkweed.
  - In the Pacific Northwest, consider using showy milkweed or narrowleaf milkweed.

Figure 20. A monarch butterfly caterpillar on flowering narrow leaf milkweed.

Placement of Honey Bee Hives on BLM and U.S. Forest Service Lands

Objective: To determine appropriate sites for placement honey bee hives (apiaries) on Bureau of Land Management (BLM) and U.S. Forest Service managed lands and to document environmental impacts that need to be considered in the National Environmental Policy Act evaluation process.

Explanation: Placement of honey bee hives (apiaries) is allowed on Federal lands managed by BLM and the U.S. Forest Service. The decisions about where to place apiaries can have significant ecological and natural resource implications. Assessing the ecological and natural resource impacts of apiary placement is an integral part of both the planning and decision making processes.

Implementation: To determine if placement of hives on Federal land is appropriate and will not have significant adverse effects on natural resources or land management goals, it is necessary to evaluate each request on a case by case basis by conducting the necessary environmental analysis:

- When determining whether to allow an apiary on public land, the first consideration is to assess the infrastructure requirements of the apiary. All apiary sites need the following:
  - Sufficient road infrastructure. Beekeepers deliver hives by using a range of vehicles from flatbed trucks to semi-tractor trailers. Access roads must be appropriate for the required transport and must not result in excess erosion, road damage, or other infrastructure challenges.

- Access to the apiary site at night and on a regular basis afterwards. Beekeepers move honey bee hives at night, and they will need to be able to get into a site at night regularly to manage the hives.
- Limit travel through areas infested with invasive plant species and/or ask beekeepers to clean vehicles to ensure that invasive plants are not spread across public lands unintentionally.
- A relatively flat open space to accommodate the proposed hives, as well as enough space for turning a vehicle around, and the apiary site will need to have firm flat ground that is not prone to erosion.
- A source of clean water that does not impact wildlife or ranching. Honey bees will congregate in large numbers at the nearest source of clean water, which can interfere with livestock access to drinking water.
- Pesticide-free areas. Place hives on lands that have not been, and will not be, managed with pesticides while the bees are present. Consider terms and conditions in permits to allow beekeepers to control mites, nematodes or other pests within the hives while they are occupying public lands.
- Animal deterrents around the hives. Honey bee hives are very attractive to bears. Beekeepers frequently erect electric fences around apiaries where bears are an issue. Managers should require electric fencing and maintenance of that fencing to prevent intrusion from wildlife and bear damage to apiaries.

- The second consideration when determining whether to allow an apiary on public land is the potential impact of honey bees to native species and natural resources. Specific considerations include the following:
  - Are species of conservation concern present within 2–5 miles of a proposed apiary location? If rare species of bee, butterfly, or other pollinator—including threatened or endangered species—are known to exist within the honey bee flight range from where hives are to be placed, the potential risks to these populations must be assessed. If it is unknown whether rare species are found in the area, efforts should be made to determine if they are present; consultation with scientists with expertise in pollinator survey and species identification is recommended. In cases where native bees are critically imperiled, every remaining population and individual may be essential to the immediate and long-term survival of the species, and the potential threats that high concentrations of honey bees may pose to native bees from disease transmission and competition may be substantial.
  - Are unique sensitive ecosystems (e.g., high-elevation meadows) with abundant native pollinators present within 2–5 miles of a proposed apiary location? If unique sensitive ecosystems are known to exist within the honey bee flight range from where hives are to be placed, assessment of potential risks to these ecosystems should be undertaken. For unique high elevation or wet meadows, bumble bees and other native pollinators are often present in abundance. There is evidence that honey bees can spread disease (such as deformed wing virus) to bumble bees and therefore pose significant risk to wild pollinator populations. Where possible, this risk to native biodiversity should be avoided.
  - Are there invasive plant populations, or ongoing efforts to eradicate invasive plant species, that would be affected by the inclusion of honey bees? Honey bees may not

be compatible with invasive plant species management. If honey bees will contribute to the pollination of the invasive species in question, land managers may want to exclude honey bees during periods of bloom.

- Are there bears in the area that will be attracted to the apiary as a food source? As stated above, bee hives are attractive to bears; therefore, land managers need to assess whether placement of an apiary will increase the potential for human-bear conflicts and discuss with the beekeeper their plans to prevent this risk. This will also help to prevent bears from being killed because they have damaged private property or become habituated to people. If there are known bear travel routes, these should be avoided in placement of apiaries.

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Appendix A –Memorandum—Creating a Federal Strategy To Promote the Health of Honey Bees and Other Pollinators

MEMORANDUM FOR HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES
SUBJECT: Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators

Pollinators contribute substantially to the economy of the United States and are vital to keeping fruits, nuts, and vegetables in our diets. Honey bee pollination alone adds more than $15 billion in value to agricultural crops each year in the United States. Over the past few decades, there has been a significant loss of pollinators, including honey bees, native bees, birds, bats, and butterflies, from the environment. The problem is serious and requires immediate attention to ensure the sustainability of our food production systems, avoid additional economic impact on the agricultural sector, and protect the health of the environment.

Pollinator losses have been severe. The number of migrating Monarch butterflies sank to the lowest recorded population level in 2013-14, and there is an imminent risk of failed migration. The continued loss of commercial honey bee colonies poses a threat to the economic stability of commercial beekeeping and pollination operations in the United States, which could have profound implications for agriculture and food. Severe yearly declines create concern that bee colony losses could reach a point from which the commercial pollination industry would not be able to adequately recover. The loss of native bees, which also play a key role in pollination of crops, is much less studied, but many native bee species are believed to be in decline. Scientists believe that bee losses are likely caused by a combination of stressors, including poor bee nutrition, loss of forage lands, parasites, pathogens, lack of genetic diversity, and exposure to pesticides.

Given the breadth, severity, and persistence of pollinator losses, it is critical to expand Federal efforts and take new steps to reverse pollinator losses and help restore populations to healthy levels. These steps should include the development of new public-private partnerships and increased citizen engagement. Therefore, by the authority vested in me as President by the Constitution and the laws of the United States of America, I hereby direct the following:

Section 1. Establishing the Pollinator Health Task Force. There is hereby established the Pollinator Health Task Force (Task Force), to be co-chaired by the Secretary of Agriculture and the Administrator of the Environmental Protection Agency. In addition to the Co-Chairs, the Task Force shall also include the heads, or their designated representatives, from:

(a) the Department of State;

(b) the Department of Defense;

(c) the Department of the Interior;

(d) the Department of Housing and Urban Development;

(e) the Department of Transportation;

(f) the Department of Energy;

(g) the Department of Education;

(h) the Council on Environmental Quality;

(i) the Domestic Policy Council;

(j) the General Services Administration;

(k) the National Science Foundation;

(l) the National Security Council Staff;

(m) the Office of Management and Budget;

(n) the Office of Science and Technology Policy; and

(o) such executive departments, agencies, and offices as the Co-Chairs may designate.

Sec. 2. Mission and Function of the Task Force. Within 180 days of the date of this memorandum, the Task Force shall develop a National Pollinator Health Strategy (Strategy), which shall include explicit goals, milestones, and metrics to measure progress. The Strategy shall include the following components:

(a) Pollinator Research Action Plan. The Strategy shall include an Action Plan (Plan) to focus Federal efforts on understanding, preventing, and recovering from pollinator losses. The Plan shall be informed by research on relevant topics and include:

(i) studies of the health of managed honey bees and native bees, including longitudinal studies, to determine the relative contributions of, and mitigation strategies for, different stressors leading to species declines and colony collapse disorder, including exposure to pesticides, poor nutrition, parasites and other pests, toxins, loss of habitat and reduced natural forage, pathogens, and unsustainable management practices;

(ii) plans for expanded collection and sharing of data related to pollinator losses, technologies for continuous monitoring of honey bee hive health, and use of public-private partnerships, as appropriate, to provide information on the status and trends of managed hive losses;

(iii) assessments of the status of native pollinators, including the Monarch butterfly and bees, and modeling of native pollinator populations and habitats;

(iv) strategies for developing affordable seed mixes, including native pollinator-friendly plants, for maintenance of honey bees and other pollinators, and guidelines for and evaluations of the effectiveness of using pollinator-friendly seed mixes for restoration and reclamation projects;

(v) identification of existing and new methods and best practices to reduce pollinator exposure to pesticides, and new cost-effective ways to control bee pests and diseases; and

(vi) strategies for targeting resources toward areas of high risk and restoration potential and prioritizing plans for restoration of pollinator habitat, based on those areas that will yield the greatest expected net benefits.

(b) Public Education Plan. The Strategy shall include plans for expanding and coordinating public education programs outlining steps individuals and businesses can take to help address the loss of pollinators. It shall also include recommendations for a coordinated public education campaign aimed at individuals, corporations, small businesses, schools, libraries, and museums to significantly increase public awareness of the importance of pollinators and the steps that can be taken to protect them.

(c) Public-Private Partnerships. The Strategy shall include recommendations for developing public-private partnerships to build on Federal efforts to encourage the protection of pollinators and increase the quality and amount of habitat and forage for pollinators. In developing this part of the Strategy, the Task Force shall consult with external stakeholders, including State, tribal, and local governments, farmers, corporations, and nongovernmental organizations.

(d) Task Force member agencies shall report regularly to the Task Force on their efforts to implement section 3 of this memorandum.

Sec. 3. Increasing and Improving Pollinator Habitat. Unless otherwise specified, within 180 days of the date of this memorandum:

(a) Task Force member agencies shall develop and provide to the Task Force plans to enhance pollinator habitat, and subsequently implement, as appropriate, such plans on their managed lands and facilities, consistent with their missions and public safety. These plans may include: facility landscaping, including easements; land management; policies with respect to road and other rights-of-way; educational gardens; use of integrated vegetation and pest management; increased native vegetation; and application of pollinator-friendly best management practices and seed mixes. Task Force member agencies shall also review any new or renewing land management contracts and grants for the opportunity to include requirements for enhancing pollinator habitat.

(b) Task Force member agencies shall evaluate permit and management practices on power line, pipeline, utility, and other rights-of-way and easements, and, consistent with applicable law, make any necessary and appropriate changes to enhance pollinator habitat on Federal lands through the use of integrated vegetation and pest management and pollinator-friendly best management practices, and by supplementing existing agreements and memoranda of understanding with rights-of-way holders, where appropriate, to establish and improve pollinator habitat.

(c) Task Force member agencies shall incorporate pollinator health as a component of all future restoration and reclamation projects, as appropriate, including all annual restoration plans.

(d) The Council on Environmental Quality and the General Services Administration shall, within 90 days of the date of this memorandum, revise their respective guidance documents for designed landscapes and public buildings to incorporate, as appropriate, pollinator-friendly practices into site landscape performance requirements to create and maintain high quality habitats for pollinators. Future landscaping projects at all Federal facilities shall, to the maximum extent appropriate, use plants beneficial to pollinators.

(e) The Departments of Agriculture and the Interior shall, within 90 days of the date of this memorandum, develop best management practices for executive departments and agencies to enhance pollinator habitat on Federal lands.

(f) The Departments of Agriculture and the Interior shall establish a reserve of native seed mixes, including pollinator-friendly plants, for use on post-fire rehabilitation projects and other restoration activities.

(g) The Department of Agriculture shall, as appropriate and consistent with applicable law, substantially increase both the acreage and forage value of pollinator habitat in the Department's conservation programs, including the Conservation Reserve Program, and provide technical assistance, through collaboration with the land-grant university-based cooperative extension services, to executive departments and agencies, State, local, and tribal governments, and other entities and individuals, including farmers and ranchers, in planting the most suitable pollinator-friendly habitats.

(h) The Department of the Interior shall assist States and State wildlife organizations, as appropriate, in identifying and implementing projects to conserve pollinators at risk of endangerment and further pollinator conservation through the revision and implementation of individual State Wildlife Action Plans. The Department of the Interior shall, upon request, provide technical support for these efforts, and keep the Task Force apprised of such collaborations.

(i) The Department of Transportation shall evaluate its current guidance for grantees and informational resources to identify opportunities to increase pollinator habitat along roadways and implement improvements, as appropriate. The Department of Transportation shall work with State Departments of Transportation and transportation associations to

promote pollinator-friendly practices and corridors. The Department of Transportation shall evaluate opportunities to make railways, pipelines, and transportation facilities that are privately owned and operated aware of the need to increase pollinator habitat.

(j) The Department of Defense shall, consistent with law and the availability of appropriations, support habitat restoration projects for pollinators, and shall direct military service installations to use, when possible, pollinator-friendly native landscaping and minimize use of pesticides harmful to pollinators through integrated vegetation and pest management practices.

(k) The Army Corps of Engineers shall incorporate conservation practices for pollinator habitat improvement on the 12 million acres of lands and waters at resource development projects across the country, as appropriate.

(l) The Environmental Protection Agency shall assess the effect of pesticides, including neonicotinoids, on bee and other pollinator health and take action, as appropriate, to protect pollinators; engage State and tribal environmental, agricultural, and wildlife agencies in the development of State and tribal pollinator protection plans; encourage the incorporation of pollinator protection and habitat planting activities into green infrastructure and Superfund projects; and expedite review of registration applications for new products targeting pests harmful to pollinators.

(m) Executive departments and agencies shall, as appropriate, take immediate measures to support pollinators during the 2014 growing season and thereafter. These measures may include planting pollinator-friendly vegetation and increasing flower diversity in plantings, limiting mowing practices, and avoiding the use of pesticides in sensitive pollinator habitats through integrated vegetation and pest management practices.

Sec. 4. General Provisions.

(a) This memorandum shall be implemented consistent with applicable law and subject to the availability of appropriations.

(b) Nothing in this memorandum shall be construed to impair or otherwise affect:

(i) the authority granted by law to any agency, or the head thereof; or

(ii) the functions of the Director of the Office of Management and Budget relating to budgetary, administrative, or legislative proposals.

(c) Nothing in this memorandum shall be construed to require the disclosure of confidential business information or trade secrets, classified information, law enforcement sensitive information, or other information that must be protected in the interest of national security or public safety.

(d) This memorandum is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person. OBJ OBJ OBJ

(e) The Secretary of Agriculture is hereby authorized and directed to publish this memorandum in the Federal Register.

BARACK OBAMA

http://www.whitehouse.gov/the-press-office/2014/06/20/presidential-memorandum-creating-federal-strategy-promote-health-honey-b

Appendix B – Common and Scientific Names Used in Report

[spp., unspecified species of the preceding genus]

Common name	Scientific name
Kingdom Animalia	
bark beetle	Family Scolytidae
bee fly	Family Bombyliidae
bumble bee	*Bombus* spp.
digger bee	*Anthophora occidentalis*
elk	*Cervus elaphus*
honey bee	Family Apidae
leaf-cutter bee	*Megachile addenda*
miner bee	Family Andrenidae
monarch butterfly	*Danaus plexippus*
snow geese	*Chen* spp.
sweat bee	Family Halictidae
West Virginia White butterfly	*Pieris virginiensis*
Kingdom Plantae	
alfalfa	*Medicago* spp.
American holly	*Ilex opaca*
American plum	*Prunus americana*
aquatic milkweed	*Asclepias perennis*
basswood	*Tilia* spp.
black cherry	*Prunus serotina*
blackgum	*Nyssa sylvatica*
black locust	*Robinia pseudoacacia*
butterfly milkweed	*Asclepias tuberosa*
California milkweed	*Asclepias californica*
Canada thistle	*Cirsium arvense*
canola	*Sinapis arvensis*
Carolina laurel cherry	*Prunus caroliniana*
Carolina silverbell	*Halesia carolina*
Chickasaw plum	*Prunus angustifolia*
chinquapin	*Chrysolepis* spp.
common milkweed	*Asclepias syriaca*
corn	*Zea mays*
corn kernel milkweed	*Asclepias latifolia*
cow parsnip	*Heracleum maximum*
crabapple	*Malus* spp.
garlic mustard	*Alliaria petiolata*
green antelopehorn milkweed	*Asclepias viridis*
green comet milkweed	*Asclepias viridiflora*
hawthorn	*Crataegus* spp.
heartleaf milkweed	*Asclepias cordifolia*
honey locust	*Gleditsia triacanthos*

lupine	*Lupinus* spp.
Mexican whorled milkweed	*Asclepias fascicularis*
milkweeds	*Asclepias* spp.
mountain laurel	*Kalmia latifolia*
mountain monardella	*Monardella odoratissima*
narrow leaf milkweed	*Asclepias fascicularis*
persimmon	*Diospyros* spp.
pine needle milkweed	*Asclepias linaria*
pinewoods milkweed	*Asclepias humistrata*
plains milkweed	*Asclepias pumila*
rhododendron	*Rhododendron* spp.
sagebrush	*Artemisia* spp.
serviceberry	*Amelanchier* spp.
showy milkweed	*Asclepias speciosa*
slickspot peppergrass	*Lepidium papilliferum*
sourwood	*Oxydendrum arboreum*
spider milkweed	*Asclepias asperula*
swamp milkweed	*Asclepias incarnata*
sumac	*Rhus* spp.
white milkweed	*Asclepias verticillata*
whorled milkweed	*Asclepias verticillata*
willow	*Salix* spp.
woolly milkweed	*Asclepias vestita*
woollypod milkweed	*Asclepias eriocarpa*
yellow star thistle	*Centaurea solstitialis*

Appendix C – Partnerships, Programs, and Initiatives for Pollinators

Federal agencies are active in several partnerships that have developed programs and initiatives designed to help promote pollinators. The following is not a comprehensive list but provides good sources of information.

- **Butterfly Conservation Initiative (Florida Museum of Natural History):** The Butterfly Conservation Initiative is dedicated to the conservation of threatened, endangered, and vulnerable North American butterflies and the habitats that sustain them, with a focus on recovery, research, and education.
- **The Monarch Joint Venture:** The Monarch Joint Venture (MJV) is a partnership of Federal and State agencies, nongovernmental organizations, and academic programs that are working together to support and coordinate efforts to protect the monarch migration across the lower 48 United States. The MJV is committed to a science-based approach to monarch conservation work, guided by the *North American Monarch Conservation Plan* (2008). The monarch migration was listed by the International Union for Conservation of Nature as an endangered phenomenon in 1983. In 2010, the World Wildlife Fund included monarchs on its list of the "Top 10 To Watch" in 2010: species that are thought to be in need of close monitoring and protection. The U.S. Forest Service has been active in the North American Monarch Institute and the PollinatorLive program under the MJV:
  - **North American Monarch Institute:** The "Monarchs in the Classroom" program seeks to provide teachers with the information they need to create, plant, and use a schoolyard garden with their students. A specialized Web site keeps participants, their students, and the instructors communicating and learning about monarchs and science from each other during the school year.
  - **PollinatorLIVE:** The PollinatorLIVE program, a collaborative effort between the U.S. Forest Service, other USDA agencies, Prince William County School District, and many other Federal, State and local agencies and organizations, seeks to promote pollinator education and to provide opportunities to schools and communities for the implementation of pollinator gardens throughout the Nation.
- **North American Butterfly Association:** The North American Butterfly Association (NABA) is a nonprofit organization dedicated to increasing public awareness and conservation of butterflies and their habitats.
- **People's Garden Initiative:** The USDA, under Secretary Tom Vilsack's People's Garden Initiative, seeks to establish gardens at USDA facilities worldwide and also to help communities create gardens by providing information about pollinators and how to protect them while simultaneously creating valuable pollinator habitat for monarchs and a diverse suite of other pollinator species. The U.S. Forest Service has registered many of their facility gardens in the international register of People's Gardens.
- **Pollinator Partnership and the North American Pollinator Protection Campaign:** The Pollinator Partnership (P2) works to protect the health of managed and native pollinating animals vital to our North American ecosystems and agriculture. As one of its many projects, P2 manages the North American Pollinator Protection Campaign (NAPPC), a collaborative group of more than 130 organizations and individuals that promote and implement a continent-wide action plan to encourage activities to protect the numbers and health of all pollinating animals. *www.pollinator.org*

- **Xerces Society for Invertebrate Conservation:** The Xerces Society is a nonprofit organization that protects wildlife through the conservation of invertebrates and their habitat. *http://www.xerces.org/bumblebees*

  Other sources for information about pollinator ecology:
- Downloadable information about pollinators is also available from the U.S. Forest Service at *http://www.fs.fed.us/wildflowers/pollinators/index.shtml* and from the USFWS Pollinator Portal at *http://www.fws.gov/pollinators.*
- Web sites with pollinator BMPs include the following:
  - *http://www.mda.state.mn.us/protecting/bmps/pollinators.aspx*
  - *http://umaine.edu/agriculture/files/2014/11/Best-Management-Practices-For-Pollinator-Safety-David-Epstein.pdf*
  - *http://www.nd.gov/ndda/files/resource/NorthDakotaPollinatorPlan2014.pdf*

Appendix D – Services Native Plants Provide for Pollinators

Plant communities containing a variety of plants species that bloom over a long season support an abundant and diverse pollinator population. Blooming plants are needed throughout the growing season to provide forage for pollinators over their adult life. A variety of different types of plants provide nectar and pollen for pollinators. Pollinators come in a variety of shapes and sizes allowing some pollinators to reach the nectar or pollen in flowers that others cannot reach. Many pollinators have morphological features specific to foraging on certain types of flowers. For example, there are short-, medium-, and long-tongued bumble bees that prefer to forage on flowers that have short, medium, or long corolla tube lengths.

Pollinators participate in sexual reproduction of many plants, ensuring cross-pollination and/or genetic diversity. Plants are the primary food source for animals, so reductions in the number of pollinators are of concern. Pollination services are valuable both for direct production of human-utilized plant products and for reproduction of plants that contribute to other ecosystem services. It is estimated that 60–90% of all flowering (wild) plant species require an animal pollinator for reproduction. No studies have measured increases in ecosystem services provided by wild plants due to animal pollination; however, impacts to pollinator communities that change pollen delivery ultimately change plant communities and the ecosystem services they provide.

A variety of **native** plants that have overlapping blooming times and are adapted to local soils and climates are usually the best sources of nectar and pollen for native pollinators.

Native plant communities are also important for nesting and overwintering pollinators. Protecting or providing nest sites for native bees is as important as providing native plants for foraging. About 70% of North America's native bee species are ground-nesters, and about 30% are wood-nesters. Ground-nesting bees require bare soil in order to excavate or tunnel. Ground-nesting bees rarely nest in rich soils so poor quality sandy or loamy soils may provide good sites. Most wood-nesting bees are solitary. They live in abandoned beetle tunnels in logs, stumps and snaps. Some can chew out the soft pith of the stems of plants such as elderberry to make nests. Most native bees overwinter in the nest. Butterflies also need native plants to overwinter. Depending on the species, butterflies may overwinter in any of four life stages: egg, caterpillar, pupa, or adult. It is important, therefore, to retain undisturbed native plant sites. Some flies and beetles also pollinate native plants. Having a variety of native plant species provides sites for many diverse egg-laying flies and beetles.

Table title.

Native Plant Food	Pollinator Type	Shelter
Nectar, pollen	Solitary bees	Most nest in bare or partially vegetated well-drained soil. Others nest in narrow tunnels in dead standing trees or excavate nests within the pith of plant stems and twigs. Some construct nests out of mud, plant resins, saps, or gums on the surface of rocks or trees.
Nectar, pollen	Bumble bees	Most nest in small cavities, often underground in abandoned rodent nests or under clumps of grass. Nests can also be in hollow trees, bird nests, or walls.
Nectar, pollen	Honey bees	Feral colonies nest in hollow trees.
Leaves of larval host plants	Butterflies and moths – larva	Larval host plants.
Nonfeeding	Butterflies and moths	Protected sites such as a shrub, tall grass, a pile of leaves or sticks, or underground.
Nectar; some males obtain nutrients, minerals, and salt from rotting fruit, tree sap, animal dung/urine, carrion, clay deposits, and mud puddles.	Butterflies and moths – adult	Protected areas.

(Adapted from Yolo Natural Heritage Program Pollinator Conservation Strategy, which adapted it from "Native Pollinators," Natural Resources Conservation Service Fish and Wildlife Habitat Management Leaflet No. 34, 2006.)

Appendix E – Glossary

Best management practice: A practice, or a combination of practices, that is determined by the designated area-wide planning agency to be the most effective, practicable means of preventing or reducing impacts to pollinators in high-quality foraging, reproduction, nesting, and/or overwintering habitats.
Foraging: The adult insect action of gathering food or nesting materials for itself or its offspring.
Forb: Another term for "herbaceous plant" (as opposed to woody plants or grasses).
Ground-nesting: A term referring to bees that excavate nests in the ground.
Host plant: A species of plant that a butterfly or moth caterpillar will eat. The female must lay her eggs on or close to this plant.
Insect: An invertebrate animal that, as an adult, has three major body regions (head, thorax, and abdomen), three pairs of jointed legs attached to the thorax, and usually two pairs of wings.
Interdisciplinary team (IDT): A team of resource specialists that typically work together to complete assessments or projects. For pollinator conservation, a team approach including botanical and entomological expertise is recommended.
Invasive species: A species that can crowd out, displace, or otherwise harm native species of plants and animals.
Nectar: A sugar-rich fluid produced by flowers, which attracts pollinating animals.
Pesticide: A general term applied to a variety of chemical pest controls, including insecticides for insects, herbicides for plants, fungicides for fungi, and rodenticides for rodents.
Pollen: Microscopic, hard capsules containing the male gametes (reproductive cells) of a plant.
Pollination: The transfer of pollen grains from an anther (the pollen-bearing part of a stamen, the pollen-producing reproductive organ of a flower) to a receptive stigma (the pollen-receiving reproductive part of a flower). Self-pollination is movement within a flower or between flowers on the same plant; cross-pollination is between flowers on separate plants. Pollination can occur through movement of pollen by wind, water, or animals.
Pollinator: An animal that moves pollen and can affect pollination.
Pollinator decline: The reduction in abundance of pollinators in many ecosystems worldwide during the end of the 20th century.
Queen: The egg-laying female in a social bee colony.
Wood-nesting: A term referring to bees that construct nests in or on woody stems, twigs, and snags.
Worker: A female bee in a social colony that forages, constructs nests, and tends the larvae. A worker does not lay eggs.