Management Recommendations for Washington's Priority Habitats and Species: Riparian Pollinators

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Introduction

Riparian ecosystems are global hotspots of biological diversity, providing habitat for many species of fish and wildlife (Kauffman et al. 2001). Riparian areas in the Pacific Northwest are no exception. Situated at the interface between terrestrial and aquatic environments, riparian areas provide the moisture necessary to sustain diverse ecological communities (Kauffman et al. 2001). These ecosystems generally support a high diversity and richness of native vascular plants compared to surrounding areas with less available moisture (Raedeke 1989, Gregory et al. 1991, Décamps and Tabacchi 1993, Naiman et al. 1993). These rich plant communities are also often varied in their vegetative structure (Gregory et al. 1991), which creates niches for numerous species of fish and wildlife, including pollinators (Kauffman et al. 2001, Cole et al. 2015). The abundance and diversity of plants, and especially flowering plants, supports pollinators by providing them with habitat for foraging, nesting, and overwintering (Roof et al. 2018).

Riparian ecosystems can provide important refuge for wildlife during periods of intense heat and drought (Seavy et al. 2009). The proximity to open water in riparian areas moderates the environmental conditions compared to surrounding landscapes (Kauffman et al. 2001). This often creates microclimates that provide resources and refuge to a variety of species (Seavy et al. 2009). These moderating influences may also result in periods of flowering that differ from the surrounding landscape. This can contribute to increased opportunities for pollinator foraging within a landscape and make riparian areas particularly valuable as habitat (Figure 1). As climate change continues to alter environmental conditions, riparian areas could become important climate-change refugia for invertebrates including pollinators (Seavy et al. 2009, Ramey and Richardson 2017).

Figure 1. In eastern Washington, moisture associated with riparian areas support flowering plants in otherwise arid landscapes. Photo by Molly Martin.

Purpose

This publication provides guidance for incorporating pollinator-friendly management and conservation practices into land use activities in riparian areas. Guidance is provided in the form of scientifically supported management recommendations and best management practices (BMPs).

This publication includes a tool for assessing and scoring a site's function and value as pollinator habitat. This tool can help land managers identify important features on a site and can also help them identify strategies for maintaining and enhancing a site's value as pollinator habitat. Land managers can use the

outcome of this assessment to determine the management recommendations and BMPs with the highest potential to effectively mitigate land use impacts to pollinator habitat.

Scope

These guidelines provide information and support to those interested in maintaining and improving pollinator habitat. The guidelines are also valuable for helping design plans to mitigate the impacts of land use activities on pollinator habitat in riparian areas. Mitigation can be accomplished by integrating the management recommendations and BMPs in this publication into site-specific habitat management plans.

The management recommendations are applicable throughout all of Washington given riparian habitat is widely distributed across the state. Although other animals including flies, wasps, beetles, and hummingbirds contribute to pollination, this publication focuses on taking measures to conserve and maintain habitat for native bees and butterflies. Native bees and butterflies generally serve as the primary pollinators of native plants.

Significance of riparian habitat to pollinators

Riparian areas occur within a variety of landscapes and ecosystems, are hotspots of biodiversity, and have the potential to provide high quality, interconnected habitat for native pollinators when managed appropriately. Riparian areas play an outsized role, particularly in arid landscapes, and during the late summer and fall when most vegetation outside of riparian areas have died back. In Washington, riparian habitats are especially important in eastside landscapes including the Columbia Plateau (Perry et al. 2012, Rentz et al. 2020). In areas where habitat has been fragmented or degraded, including within intensively managed agricultural landscapes, intact habitat associated with riparian areas can support a diversity of native pollinators (Affek et al. 2021, Williams 2011, Cole et al. 2015). While riparian habitat is used by pollinators during all life stages, riparian ecosystems are particularly essential for providing the flowering vegetation that pollinators require for feeding.

Figure 2. Native willows, often associated with riparian areas, provide important early season foraging resources for pollinators. Photo by Matthew Shepherd.

The availability of moisture in riparian areas leads to high levels of floral diversity throughout the spring, summer, and fall, when most pollinators are active, providing the pollen and nectar required by generalist and specialist species of pollinators (Roof et al. 2018, Williams 2011, Cole et al. 2015). Flowering trees and shrubs commonly associated with riparian ecosystems, in particular native willows (Figure 2), are important

sources of forage for pollinators early in the season when few other species are blooming (Williams 2011, Affek et al. 2021, Pendleton et al. 2011).

Riparian areas provide particularly important habitat for pollinators in intensively managed landscapes including areas with high development density, agriculture, and grazing (Affek et al. 2021, Cole et al. 2015, Roof et al. 2018, Williams 2011). As climate change leads to declining precipitation and rising temperatures in arid landscapes, including in portions of eastern Washington, riparian areas will provide increasingly important habitat for pollinators as well as other wildlife (Seavy et al. 2009).

In Washington, five butterflies Species of Greatest Conservation Need (SGCN) are associated with riparian habitat (WDFW 2015; Table 1). The use of the management recommendations in this publication will benefit species such as these and will help keep other more common species of pollinators common.

Table 1. Butterfly SGCNs associated with riparian habitat in Washington.

Common Name	Scientific Name	Closely Associated with riparian habitat	Associated with riparian habitat
Meadow Fritillary	*Boloria bellona toddi*	*x*	
Monarch	*Danaus plexippus*	*x*	
Taylor's Checkerspot	*Euphydryas editha taylori*		*x*
Mardon Skipper	*Polites mardon mardon*		*x*
Valley Silverspot	*Speyeria zerene bremnerii*		x

Characteristics of riparian habitat beneficial to pollinators

The most important characteristics of riparian habitat for pollinators are those directly related to providing pollinators with the floral resources, nesting sites, and overwintering habitat they rely on to complete their life cycle. The following elements of riparian habitats contribute to their role in sustaining a diversity of native pollinators.

Feeding Habitat

- Feeding habitat is particularly important given the strong positive relationship between floral resources and the abundance and species richness of native bee and butterfly communities in riparian areas (Figure 3; Cole et al. 2015).
- The ideal feeding habitat is generally comprised of a diverse community of native plants that provide continuous floral resources throughout the spring,

Figure 3. Many pollinators, including native bees and butterflies, rely on floral resources found in riparian areas. Photo by Molly Martin.

summer, and fall. In arid landscapes, the floral vegetation associated with riparian habitat is particularly important in the late summer and fall when a lack of moisture leads to few other flowering plants in the broader landscape. Riparian areas with high diversity of plant family, flower shape, size, and color, and blooming period attract and support a broad range of pollinators (Roof et al. 2018, Williams 2011, Cole et al. 2015, Affek et al. 2021, Pendleton et al. 2011).

Nesting and Overwintering Habitat

- The availability of nesting and overwintering habitat are important factors influencing populations of native bees and other pollinators (Foltz Jordan et al. 2018). Specific characteristics of riparian ecosystems that contribute to the availability of nesting and overwintering habitat include:
    - Dead wood, hollow stems, and brush piles that provide cavities for cavity nesting species (about 30% of native bee species).
    - Cavities, including abandoned rodent burrows and hollow logs, as well as grass tussocks, for bumble bee nests.
    - A variety of natural habitat elements including tree litter (both deciduous and coniferous), moss, and dead wood for overwintering.

Constraints and limits to pollinator populations

Research has shown significant declines in native pollinator population sizes and ranges globally (Figure 4). Up to 40% of pollinator species on earth may be at risk of extinction due to habitat loss and fragmentation, exposure to pesticides, climate change, diseases and pathogens, and competition with non-native species (IPBES 2016). Threats of particular concern to pollinators in riparian ecosystems include direct and indirect impacts from grazing, non-native plants outcompeting native flowering vegetation, competition from non-native bees, exposure to pesticides, and impacts of climate change.

Figure 4. Monarch butterflies, a species of conservation concern in areas including eastern Washington, require milkweed as a food source for larval development. Milkweed plants are often associated with riparian areas. Photo by Emma Pelton.

Livestock frequently graze in riparian habitats in arid landscapes. This impacts pollinator communities both through direct competition over vegetative resources as well as through trampling of nest sites and larval caterpillars, and by compacting soil. While dietary preferences of grazers vary by

species, vegetation community, and season, these herbivores consume flowering plants, thereby competing with native pollinators for resources (DeBano et al. 2016, Averett et al. 2017). Grazing near flowing water often also causes erosion, leading to incised channels, lowering of water tables, decreasing moisture in surface soil, which can reduce the vegetative resources for pollinators (Platts 1979, Kauffman and Krueger 1984, Manning et al. 1989, Kleinfelder et al. 1992, Micheli and Kirchner 2002, Dwire et al. 2004, Norton et al. 2011). Limited grazing may be compatible with pollinator conservation when a plan is designed that incorporates best management practices (McKnight et al. 2018).

Multiple studies have found that non-native plants have significant negative impacts on pollinator communities in riparian ecosystems. Specifically, exotic woody shrubs directly compete with native plants for light, water, and nutrients, resulting in a reduction of flowering herbaceous plant cover (Ghazoul 2004, Hanula and Horn 2011a, Ebeling et al. 2012, Hudson et al. 2013, Morris et al. 2002). The exclusion of herbaceous plants in the understory may reduce both the diversity of plant species as well as the timing of resource availability, thereby reducing the presence of bee species that require certain species of plants (Tepedino et al. 2008, Baskett et al. 2011) as well as butterflies whose larvae feed on specific species of native plants (Tallamy and Shropshire 2009). Research suggests that invasive plant removal in riparian habitat positively impacts native bees and butterflies (Baskett et al. 2011, Hanula and Horn 2011b, Fiedler et al. 2012, Tonietto and Larkin 2018, Goodell and Parker 2017).

While honeybees are essential pollinators in our agricultural environment, they can negatively influence native pollinators. The majority of research examining the effects of honeybees on wild bee and plant communities suggest that honeybees can negatively alter plant and native bee communities through their foraging habits, relatively high level of pathogen loads, degree of resource (pollen and nectar) removal, and their interactions and competition with native bees (Hatfield et al. 2018).

A variety of pesticides can pose risks to pollinators even when following legal application requirements. Herbicides can remove floral resources and fungicides are linked with subtle harm such as decreased offspring (Gabriel and Tscharntke 2007, Power and Stout 2011, Bernauer et al. 2015, May et al. 2019). Broad spectrum insecticides often are the most obvious risk to pollinators. Of particular concern are the widely used neonicotinoids, a class of systemic insecticides that can be expressed in the nectar and pollen of plants and are therefore actively collected by bees and butterflies. These insecticides can persist in the environment at toxic levels for months to years after an application and exert both lethal and sublethal effects on pollinators (Baskaran et al. 1999, EPA 2003, Whitehorn et al. 2012, Hopwood et al. 2016). Other systemic insecticides, increasingly in use and less studied, likely pose similar risks. Pesticide exposure may result from direct application to a site, drift from an adjacent area, or through planting seeds or starts that have been treated with systemic insecticides.

The impact of climate change on pollinator communities in riparian areas, particularly in arid and semiarid regions of the western United States, is projected to continue increasing (Perry et al. 2012). As temperatures rise and droughts become more intense and frequent, the amount and timing of available moisture will change. With altered hydrology resulting from earlier snow melt as well as altered precipitation patterns, the hydrology of water bodies will change, leading to increased flood magnitudes and decreased summer and base flows. The combination of increased heat and decreased moisture will alter the timing and distribution of plant communities. This will lead to mismatches that will impact pollinators that rely on the presence of certain flowering plants (Parmesan 2006, Perry et al. 2012).

These impacts pose a particularly significant threat to specialist pollinator species that may not be able to change the plant species they rely on (Mitchell et al. 2009).

Management recommendations for pollinators in riparian habitats

These recommendations will help land managers incorporate strategies to retain or improve the habitat for pollinators in riparian ecosystems. These recommendations can be used to develop a plan specifically for pollinators in riparian ecosystems or to incorporate pollinator conservation strategies into habitat management plans with a broader focus. For example, plans for enhancing riparian instream functions could include native plant species more likely to attract pollinators. Certain species of plants can be selected that benefit both instream and pollinator habitat.

The most effective way to support pollinators is by conserving and restoring the habitat they need for feeding, nesting, and overwintering, and by protecting that habitat from pesticides, pathogens, changes in land use, as well as other negative influences. This section provides land managers with tools to assess pollinator habitat function as well as management recommendations and BMPs to effectively implement management practices that benefit pollinators. These management recommendations and BMPs are derived from currently available peer-reviewed literature, are adapted from Hatfield et al. (2021), and are designed to benefit a wide variety of pollinator species. Used in conjunction, the habitat assessment, BMPs, and other recommendations can aid in developing a habitat management plan tailored to the site as well as to the needs of the local pollinator community. The following guidance supports the development of a site plan to protect the habitat functions necessary to benefit pollinators within riparian management zones. Additional management guidance can be found in Appendix 1. Guidance for delineating the riparian management zone can be found in WDFW's *Riparian Ecosystems, Volume 2: Management Recommendations* (Rentz et al. 2020).

Assessing riparian condition and pollinator habitat functions

A habitat assessment helps land managers evaluate what characteristics of a particular riparian area will support pollinators. Habitat assessments provide key information for tailoring the habitat management plan to the features and functions of a site.

A tool for assessing pollinator habitat is available in Appendix 2. This assessment was designed by The Xerces Society for Invertebrate Conservation to characterize a site's value to pollinators. The Xerces Society is a leader in invertebrate conservation, focusing primarily on the conservation of pollinators. The full assessment guide with detailed instructions can be found on the Xerces Society website (Foltz Jordan et al. 2014). The assessment requires collecting quantitative and qualitative data to determine a site's potential to provide habitat for pollinators. It can be administered in a variety of ecosystem types including riparian ecosystems.

The assessment requires gathering information to help determine the characteristics of a site that pollinators can use for foraging, nesting, and overwintering. The outcome of a completed assessment is a set of scores, including an overall score of pollinator habitat quality as well as individual scores for key habitat components.

These scores are useful for selecting conservation measures and tailoring them to the conditions of a given site. The selected measures can then be incorporated into a habitat management plan to either conserve pollinator habitat or to mitigate potential negative impacts of a land use proposal.

The habitat assessment should be conducted by an expert trained in identifying native plants as well as regionally established non-native plants. An understanding of the ecology of native pollinators is also useful for conducting a habitat assessment.

Integrating pollinator conservation into riparian management

This section provides guidance to help land managers conserve, protect, and enhance the elements of riparian management zones that provide habitat for pollinators. Here we provide considerations and best management practices for creating and maintaining quality habitat for pollinators in riparian management zones. The results of the habitat assessment described earlier will guide management strategies used to develop a plan, often referred to as a habitat management plan (HMP), to conserve high quality pollinator habitat or to mitigate habitat impacts. An HMP is a document that describes proposed management actions to protect habitat functions on a site, as well as the strategies for implementing them.

In developing an effective HMP, one should first assess the site to identify the characteristics important for providing pollinator habitat. For example, if the site contains a diverse and abundant community of flora, it likely also provides high-quality pollinator foraging habitat. The habitat assessment described earlier can help land managers and property owners gather this type of information. It uses a scoring system that can then help users determine the overall value of a site to pollinators. It can also help determine if key features of pollinator habitat are either present or lacking.

We recommend conserving important features of pollinator habitat present on a site while restoring or enhancing features that are absent or lacking. For example, a low score for foraging habitat can indicate a need to enhance foraging habitat as part of the HMP.

The score generated from the habitat assessment is also useful for gauging the potential outcome of an HMP. Specifically, it can be used as a benchmark to help determine if the actions outlined in the HMP will result in a net gain in habitat function for pollinators. That gain can be measured by conducting a habitat assessment before and after implementing an HMP. A higher score after implementation likely indicates a gain in habitat function due to the actions of the HMP. Conversely, a lower score likely shows that more work is needed to adequately conserve habitat or to mitigate land use impacts. When developing an HMP, it is beneficial to consider the potential outcomes before taking steps to implement the plan. This may include getting an outside and impartial expert to review the HMP to identify areas where the plan can be improved.

Post implementation monitoring is another important step that should be outlined in an HMP to assess the long-term outcome of a project. This type of monitoring provides an opportunity for adaptive management. Adaptive management is the systematic acquisition and application of reliable information to improve management over time. As with earlier steps, land managers and planners can use the habitat assessment as a tool to measure both success over time as well as areas for improvement and aspects of the project that did not work out as anticipated. The latter should be addressed by implementing new strategies to offset any setbacks.

The next section provides considerations for developing an HMP as well as BMPs that can be incorporated into a plan to conserve habitat or to mitigate impacts to pollinator habitat in riparian management zones. These considerations and BMPs are derived from The Xerces Society's "Best Management Practices for Pollinators on Western Rangelands" (McKnight et al. 2018) unless cited otherwise.

Considerations for creating and maintaining high quality habitat

Feeding Habitat

Many of the following considerations for feeding habitat require careful selection of plants. See the "Habitat Installation" section in Appendix 1 for a list of useful plant selection reference guides.

- Maintain a diversity of flowering plants. Carefully select plant species to ensure continuous blooming from spring through fall. Also, choose plants that will provide a diverse range of flower colors, shapes, sizes, and plant structures. Pay particular attention to maintaining ample foraging resources (i.e., plants in flower) during early spring for colony initiation and late summer when landscapes dry out and resources are more limited.
- Prioritize the conservation and/or selection of host plants for butterfly species of conservation concern (Appendix 3).
- Select native plants appropriate to your region, and not horticultural varieties that may not produce as plentiful or high-quality nectar and pollen. In riparian ecosystems, willow and other native flowering plants should not be replaced with woody non-native plants. Woody non-native plants can negatively impact the pollinator community, especially bees (Pendleton et al. 2011, Hudson et al. 2013). Non-native, invasive plants directly compete with native plants for light, water, and nutrients (Morris et al. 2002), compete for visits from pollinators, further limiting propagation and biodiversity (McKinney and Goodell 2010), and produce shade which reduces the presence of bees and butterflies (McKinney and Goodell 2010; Hanula and Horn 2011a, 2011b; Fiedler et al. 2012).
- When creating foraging habitat in arid landscapes, choose plants that tolerate heat and drought.
- Exclude grazing or implement conservation grazing practices to avoid competition for floral resources (see Best Management Practices section, 'Grazing,' below).
- Avoid applying pesticides to pollinator habitat (see Best Management Practices section, 'Invasive Plants and Pesticides,' below).

Nesting Habitat

- Preserve structural complexity including downed wood, rock piles, and tall grasses.
- Preserve undisturbed ground in the broader landscape.
- Exclude grazing and avoid mowing and burning on and around known or potential nesting habitat to avoid impacts to ground-nesting bees. See the 'Nesting and Overwintering Habitat' section above for characteristics of potential nesting habitat.
- Extend habitat management/conservation for bees at least 100 meters into habitats (e.g., woodlands and forests) beyond what might traditionally be considered high quality pollinator habitat (e.g., areas of abundant flowering resources (Hatfield et al. 2021)).

Overwintering Habitat

- Maintain undisturbed microhabitat features including rodent burrows, moss, leaf litter (both broad leaves and evergreen needles), and loose organic material in the vicinity of feeding and nesting habitat.

Best Management Practices

Invasive Plants and Pesticides

- Prevention is the best cure—use native plants in restoration when practical, and avoid moving soil, hay, or other sources of seed long distances.
- Whenever possible, avoid the use of insecticides in or around riparian management zones.
- Evaluate the range of management techniques (e.g., chemical, physical, and mechanical) to select the most effective and feasible management method for removing target pests or plants.
- When available, choose targeted pesticide and minimize pesticide exposure to non-target organisms.
- Consider a phased removal and revegetation plan to avoid removing major floral resources.
- Create a revegetation plan. Pollinators have likely been dependent on the floral resources provided by invasive plants for several years. Those floral resources need to be replaced as soon as possible to avoid local population declines.
- When using herbicides:
    - Use selective herbicides targeted toward the invasive plant(s).
    - Avoid broadcast applications whenever possible and control spray drift.
    - Train staff and/or contractors in plant identification to reduce unintended damage to non-target plants.
    - Avoid treating native plants (especially native thistles!)
    - Do not spray when targeted plants are flowering.

Plant Selection

- The following BMPs require careful plant selection. See the "Habitat Installation" section in Appendix 1 for a list of useful plant selection reference guides.
- Maximize herbaceous cover, particularly following the removal of non-native shrub cover. A higher percentage of herbaceous cover has been shown to correspond with a positive response of pollinator communities (Hudson et al. 2013).
- Plant a diversity of flowering species with multiple species blooming throughout the spring, summer, and fall. A diversity of floral morphology (the shape of the flower) also can increase pollinator diversity in riparian management zones (Roof et al. 2018).
- Prioritize important riparian restoration species of plants. Some examples that occur broadly across the western US include native willow (*Salix* spp.), rose (*Rosa* spp.), elderberry (*Sambucus* spp.), currant (*Ribes* spp.), and goldenrod (*Solidago* spp.) (McKnight et al. 2018).
- Prioritize planting native species of willows. Willows provide essential resources to pollinators in

riparian ecosystems, particularly in the spring when few other plants are flowering (Pendleton et al. 2011).

- Plant species that the larvae of butterflies of conservation concern (Table 1) rely on as a food source (Appendix 3).

Grazing

- Install fences or cages to protect riparian plantings from livestock until plants are established to the point that they will survive grazing (DeBano et al. 2016, Averett et al. 2017). Fenced buffer strips over 5 meters in width lead to more abundant and species rich pollinator communities compared to narrower buffer strips (Cole et al. 2015). Fenced riparian management zones exclude large herbivores, which also supports more diverse communities of wild bees and butterflies than when herbivores are allowed to graze (Cole et al. 2015).
- For additional best management practices for grazing see McKnight et al. (2018).

Prescribed Fire

- Avoid high-intensity fire. Since nests and overwintering sites are generally below the surface of the ground, work to minimize peak soil temperatures.
- Burn in cool, humid conditions to the greatest extent possible.
- When burning, leave some areas skipped by fire and unburned to maintain habitat diversity.
- Burning is likely to affect overwintering, nesting, and feeding habitat, so there is no perfect time to conduct controlled burns. However, the best time to conduct burns is when bees are dormant (roughly October to February, depending on elevation, latitude, and species).
- Take advantage of the post-burning period to introduce additional floral resources.
- For additional best management practices for prescribed fire see McKnight et al. (2018).

Mowing/Haying

- Limit mowing to no more than 2 times per year in riparian areas.
- Delay harvesting in hayfields bordering riparian habitat until after most plants have bloomed.
- Fall mowing after the first frost is best.
- Set the mower at its highest level.
- Use a flushing bar and mow in the middle of the day at slow speeds (< 13 kph / 8 mph) when temperatures are high enough (> 16ºC / 60ºF) to avoid killing pollinators.
- Avoid mowing during early spring and mid-late summer if there are flowering plants present.
- If you must mow during the flight season (late spring through early fall) for most pollinators:
    - Try to leave islands of habitat unmowed (ideally two–thirds of the site during each mowing event) to create a mosaic pattern with refuge sites;
    - Leave some large areas (complete fields, or large field boundaries) entirely unmowed for the entire year, if possible.

Managed Honeybees

- Apiaries should not be placed within any area managed for biodiversity, including:
    - Habitats of special value for biodiversity and/or pollinators such as riparian areas, wet meadows, montane and high-elevation meadows.
    - Known locations of sensitive species, including bees, butterflies, and other pollinators, as well as plants with specific and important native pollinator relationships that could be disrupted by honeybees.
    - Protected natural lands including designated wilderness, national parks and monuments, state preserves, etc.
- If an apiary must be placed within an area managed for biodiversity, all hives should be more than 6.4 km (4 miles) from the areas listed above. Each apiary should have no more than 20 hives and apiaries should be separated by at least 6.4 km (Hatfield et al. 2018).

Policy Guidance

Local governments can play an important role in helping to conserve and maintain functional riparian habitat for pollinators through both regulatory and non-regulatory measures and strategies. On lands owned and managed by jurisdictions, this can include policies requiring that city/county funded landscaping and land maintenance programs (e.g., city parks, rights-of-way, stormwater bioswales) include meaningful measures to improve pollinator habitat in riparian areas as well as in other ecosystems. These measures include Integrated Pest Management practices that ensure the careful selection and use of invasive species control measures following best management practices for pollinators. Jurisdictions can also create strategic plans that identify priority areas for pollinator-friendly practices and lay out plans for implementing those practices on a city-wide scale.

As for regulations, jurisdictions and homeowner associations can amend rules requiring that homeowners maintain “tidy” landscaping, including manicured yards and vegetation that does not exceed a certain height. These types of rules and regulations limit the ability of landowners to implement pollinator friendly landscaping on their properties. As for riparian habitat, cities and counties can adopt measures in their codes that protect riparian areas and the habitat they provide for pollinators. These measures can include requiring that project proponents use pollinator-friendly BMPs when mitigating impacts to riparian management zones as a condition of a land use approval. These types of requirements can also be written into local land use code including in GMA development regulations, such as critical areas ordinances.

Local communities can also incentivize the use of pollinator conservation measures. This can include adopting incentive-based strategies to encourage homeowners and homeowner associations to change landscaping practices to benefit local pollinator populations. Jurisdictions can do this by adopting and funding incentive programs, including cost sharing for installation of pollinator-friendly features in yards and gardens. Other local programs can also incentivize protection of pollinator habitat. An example of this is the City of Seattle’s Conservation Futures Program which includes habitat for pollinators as a part of their scoring process. This process gives properties with features supporting pollinators a better chance of being selected for acquisition and protection under the program.

Many municipalities in the Pacific Northwest have also become certified in the Bee City USA program. To become a Bee City USA affiliate, your city or county council will need to make a series of commitments and adopt those as a resolution. The commitments include the creation and enhancement of pollinator-friendly habitat on public and private lands, the formation of an Integrated Pest Management Plan, as well as a commitment to consider pollinators whenever local plans or policies are proposed for adoption. Cities annually apply for renewal and report to the Bee City USA program on the previous year's activities.

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Appendicies

Appendix 1. Additional resources for pollinator habitat management.

Habitat Assessment

Habitat Assessment Guide for Pollinators: Natural Areas and Rangelands

https://xerces.org/publications/hags/pollinators-farms-and-agricultural-landscapes

This pollinator habitat assessment guide is designed for natural areas and rangelands.

Habitat Assessment Guide for Pollinators in Yards, Gardens, and Parks

https://xerces.org/publications/habitat-assessment-guides/habitat-assessment-guide-for-pollinators-in-yards-gardens

Landscaping for pollinators can help urban, suburban, and rural residents to directly benefit local pollinators.

Pollinators: Farms and Agricultural Landscapes

https://xerces.org/publications/hags/pollinators-farms-and-agricultural-landscapes

This pollinator habitat assessment guide is designed for a single site on a farm to an agricultural landscape.

Habitat Installation

Organic Site Preparation for Wildflower Establishment

https://xerces.org/publications/guidelines/organic-site-preparation-for-wildflower-establishment

Site preparation is one of the most important and often inadequately addressed components for successfully installing pollinator habitat. These guidelines provide step-by-step instructions, helpful suggestions, and regional timelines and checklists for preparing small and large sites.

Pollinator Plants: Maritime Northwest Region

https://xerces.org/publications/plant-lists/pollinator-plants-maritime-northwest-region

This fact sheet features regionally native plants that are highly attractive to pollinators and are well-suited for small-scale plantings in gardens, urban greenspaces, and farm field borders, and on business and school campuses.

Western Oregon and Washington Conservation Cover for Pollinators

https://www.xerces.org/publications/western-oregon-washington-conservation-cover-327-for-pollinators

These region-specific guidelines provide in-depth practical guidance on how to install and maintain nectar- and pollen-rich habitat for pollinators in the form of wildflower meadow plantings/conservation cover. Seed mixes and plant recommendations are included in the appendix.

Western Oregon and Washington Hedgerow Planting for Pollinators

https://xerces.org/publications/education-resources/western-oregon-washington-hedgerow-planting-422-for-pollinators

These region-specific guidelines provide in-depth practical guidance on how to install and maintain nectar- and pollen-rich habitat for pollinators in the form of linear rows of native flowering shrubs/hedgerow plantings. Seed mixes and plant recommendations are included in the appendix.

Establishing Pollinator Meadows from Seed

https://xerces.org/publications/guidelines/establishing-pollinator-meadows-from-seed

Establishing wildflower habitat for pollinators is the most effective course of action to conserve pollinators that can be taken by anyone at any scale. These guidelines provide step-by-step instructions for establishing pollinator meadows from seed in areas that range in size from a small backyard garden up to areas around an acre.

Habitat Management

Maintaining Diverse Stands of Wildflowers

https://xerces.org/publications/guidelines/maintaining-diverse-stands-of-wildflowers-planted-pollinators

High quality pollinator meadows sometimes experience a decline in wildflower diversity or abundance as they age. This guide provides recommendations on how to bring declining meadows back into a high-quality condition.

Nesting and Overwintering Habitat for Pollinators and Other Beneficial Insects

https://xerces.org/publications/fact-sheets/nesting-overwintering-habitat

This guide focuses on a variety of natural nesting habitat features that can be readily incorporated into most landscapes. Compared to artificial nesting options such as bee blocks and bee hotels, natural nesting habitat features often better mimic the natural nest site density of insects, and also break down naturally with time, limiting disease and parasite issues.

Best Management Practices for Pollinators on Western Rangelands

https://xerces.org/publications/guidelines/best-management-practices-for-pollinators-on-western-rangelands

The Xerces Society developed these guidelines to help land managers incorporate pollinator-friendly practices into rangeland management. This publication is focused on federally managed rangelands that span the following western states: Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, Oregon, Washington, and Wyoming.

Pesticide Protection

Guidance to Protect Habitat from Pesticide Contamination: Creating and Maintaining Healthy Pollinator Habitat

https://xerces.org/publications/fact-sheets/guidance-to-protect-habitat-from-pesticide-contamination

This Xerces Society guidance document was designed to help growers, land managers, and others safeguard pollinator habitat from harmful pesticide contamination. It includes information on selecting habitat sites, as well as ways to maintain clean habitat by limiting and carefully managing pesticide use.

Assistance and Incentive Programs

Bee City USA

https://beecityusa.org/

The Xerces Society's Bee City USA program provides city governments and planners with support to adopt pollinator-friendly policies and practices. Participating cities commit to follow best management practices for pollinators by adopting a resolution and reporting annually on their accomplishments.

For additional information visit the Xerces Society's Pollinator Conservation Resource Center. This webpage of pollinator conservation resources for the Pacific Northwest includes information about habitat assessment, installation, and management, selecting and sourcing native plants, and pesticide protection.

Appendix 2. The following habitat assessment guide is adapted from Xerces' Natural Areas and Rangelands Pollinator Habitat Assessment Guide[1].

Instructions:

Below are measurements for assessing pollinator habitat on a site. Most measurements in this survey can be collected on a single site visit. However, measurements for feeding habitat are best done on three separate dates. For *Section 3. Feeding Habitat*, survey for "B," "C," and "D" in the spring, summer, and fall, respectively. Circle the multiple-choice that best applies to the site you are assessing for each question. Then sum up the total scores in the table at the end of the survey form.

As part of the habitat assessment, identify on a map any areas largely void of floral resources. Do this mapping during each of three seasonal visits to the parcel(s). Create a map using geographical information system (GIS) software to show where these places are. Make sure that the GIS coverage shows which areas are lacking plants in flower during the spring, then summer, and then again in the fall. Using GIS, identify these locations by season and use that to identify locations on the parcel that are largely lacking floral resources year-round.

For more details on conducting this assessment, see *Pollinator Habitat Natural Areas and Rangelands Assessment Form and Guide* at https://www.xerces.org/publications/hags/natural-areas-and-rangelands

[1] Xerces Society. 2014. Pollinator Habitat Assessment Form and Guide. Natural Areas and Rangelands.

Owner/Operator:		Planner:	
Address (if applicable):			County:
Township:	Range:		Section(s):
Parcel Numbers (all that apply):			
Dates	Assessment **before** implementation of Habitat Management Plan:		
	Assessment **after** implementation of Habitat Management Plan:		
Define and describe the project area (attach annotated maps; including Ecological Classification System information, if known):			

Total Score for Habitat Assessment

The figures entered into this summary table will be calculated during completion of the assessment.

	Before	After
Section 1. Landscape Features (max. score 20)		
Section 2. Site Features (max. score 20)		
Section 3. Feeding Habitat (max. score 40)		
Section 4. Nesting & Overwintering Habitat (max. score 30)		
Section 5. Management Practices (max. score 25)		
OVERALL SCORE		

Section 1. Landscape Features

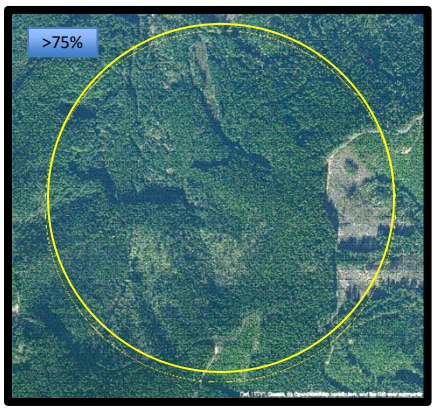
Characteristics of the broader landscape have a significant influence on wild bee populations and pollination services on adjacent sites. Natural areas in the landscape can also increase the likelihood that new habitat will be colonized by bees. Native plants, especially, are critical for supporting overall pollinator and wildlife diversity.

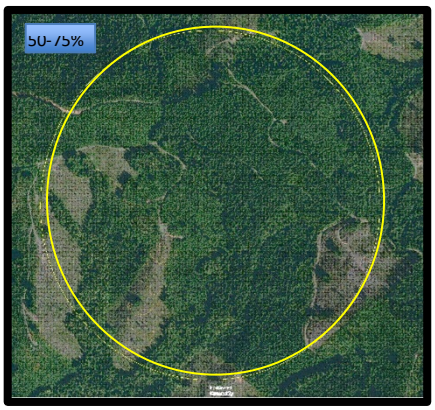
1a. Percent of natural or semi-natural vegetation within ½ mile of from. This land use cover includes prairie, shrub lands, woodlands, grasslands, riparian habitat, and wetlands. It does NOT include lawn grass, invasive or weedy vegetation, or overgrazed pasture (areas where flowers are scarce).

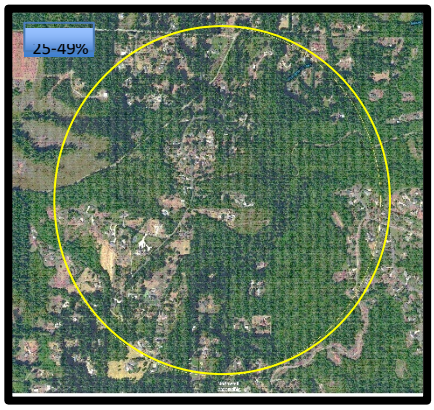
Max score of 10.

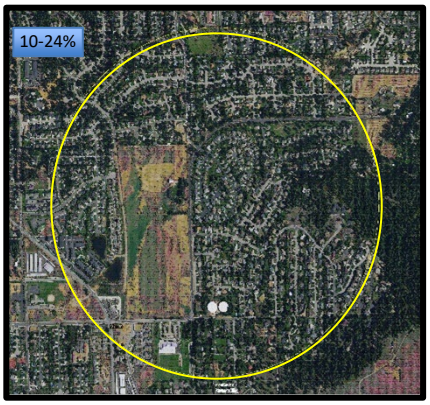
SELECT ONLY ONE	Score	Before	After	Treatment to increase score (no treatment if off-site)
>75%	10			
50-74%	7			
25-49%	5			
10-24%	3			
<10%	0			
Subtotal (*1a*)				

(1a)









1b. Dominant vegetation in non-cropped area within ½ mile of site.

Max score of 10.

SELECT ONLY ONE	Score	Before	After	Treatment to increase score (no treatment if off-site)
Native plants	10			
Mix of native and naturalized (non-invasive) plants	7			
Naturalized flowering species (e.g., clover or alfalfa)	5			
Mix of native, naturalized, and weedy / invasive species	3			
Invasive flowering weeds and / or sod-forming grasses	0			
Subtotal (1b)				
Landscape Features Total				

(1a)

(1b)

(1a + 1b)

Section 2. Sites Features

On-site natural areas and other features have a significant influence on pollinator abundance and diversity.

2a. Percentage of target site that is in natural or semi-natural habitat (see 1a for examples).

Max score of 10.

SELECT ONLY ONE	Score	Before	After	Treatment to increase score (no treatment if off-site)
>75%	10			
50-74%	7			
25-49%	5			
10-24%	3			
<10%	0			
Subtotal (*2a*)				

(2a)

2b. Additional site features that are present.

Max score of 10.

SELECT ONLY ONE	Score	Before	After	Treatment to increase score (no treatment if off-site)
>75%	10			
50-74%	7			
25-49%	5			
10-24%	3			
Subtotal (*2b*)				
Site Feature Total				

(2b)

(2a + 2b)

Section 3. Foraging Habitat

High flower abundance and season long bloom positively influence bee abundance and diversity.

2a. Percentage of target site that is in natural or semi-natural habitat (see 1a for examples).

Max score of 10.

SELECT ONLY ONE	Score	Before	After	Treatment to increase score (no treatment if off-site)
>50% cover	10			
30-50% cover	7			
20-30% cover	5			
10-20% cover	3			
<10% cover	1			
Subtotal (3*a*)				

(3a)

Section 3. Foraging Habitat *continued*

3b. Number of species of forbs, flowering shrubs, or pollinator-friendly trees on site that bloom in **spring** and support bees. In rangelands, this includes some forage legumes and cover crops, but does not include invasive or noxious species (see references for examples).

Max score of 10.

SELECT ONLY ONE	Score	Before	After	Treatment to increase score (no treatment if off-site)
10+ species	10			
5-9 species	5			
1-4 species	3			
0 species	0			
Subtotal (*3b*)				(3b)

3c. Number of species of forbs, flowering shrubs, or pollinator-friendly trees on site that bloom in **summer** and support bees. In rangelands, this includes some forage legumes and cover crops, but does not include invasive or noxious species (see references for examples).

Max score of 10.

SELECT ONLY ONE	Score	Before	After	Treatment to increase score (no treatment if off-site)
10+ species	10			
5-9 species	7			
1-4 species	3			
0 species	0			
Subtotal (*3c*)				(3c)

3d. Number of species of forbs, flowering shrubs, or pollinator-friendly trees on site that bloom in **Fall** and support bees. In rangelands, this includes some forage legumes and cover crops, but does not include invasive or noxious species (see references for examples).

Max score of 10.

SELECT ONLY ONE	Score	Before	After	Treatment to increase score (no treatment if off-site)
10+ species	10			
5-9 species	7			
1-4 species	5			
0 species	0			
Subtotal (*3d*)				(3d)
Foraging Habitat Total				(3a + 3b + 3c + 3d)

(3a)

Section 4. Native Bee Nesting and Overwintering Habitat

Native bees have a variety of nesting requirements. About 70% of native bee species in North America nest in the ground, 30% nest in cavities in wood or stems.

4a. Percentage of target site that is in natural or semi-natural habitat (see 1a for examples).

Max score of 15.

Score options that apply A=Abundant, M=Moderate, S=Scarce	Score	Before	After	Treatment to increase score (no treatment if off-site)
Areas of site with undisturbed, well-drained bare ground A= >20%, M= 20%-5%, S= <5%	A= 5 M=3 S=1			
Areas with well-drained sandy to sandy / loam soil. A= >20%, M= 20%-5%, S= <5%	A= 5 M=3 S=1			
Areas of undisturbed (e.g., ungrazed) native bunch grasses (clump-forming). A= >20%, M= 20%-5%, S= <5%	A= 5 M=3 S=1			
Subtotal (3*a*)				→ (4a)

The photos below illustrate some ground nests and typical habitat.

Section 4. Native Bee Nesting and Overwintering Habitat *continued*

4b. Sites for wood- amd cavity-nesting bees. The majority of wood- or cavity-nesting bees nest in pre-existing tunnels or cavities in snags, brush, or the centers of pithy-stemmed shrubs, and large-statured prairie plants.

Max score of 5.

Score options that apply A=Abundant, M=Moderate, S=Scarce	Score	Before	After	Treatment to increase score (no treatment if off-site)
Site has dead wood, snags, brush piles, shrubs with hollow or pithy stalks (e.g., elderberry, cane fruit, sumac) and/or large, sturdy prairie plants with hollow or pithy centers (e.g., Silphium, Solidago, Amorpha). Note: all of these features may not be appropriate for each habitat type.	A= 5 M=3 S=1			
	Subtotal (*4b*)			

(4a)

(4b)

The photos below illustrate some ground nests and typical habitat.

Section 4. Native Bee Nesting and Overwintering Habitat *continued*

4c. Are there habitat features for pollinators to use as overwintering habitat?

Max score of 10.

Score options that apply A=Abundant, M=Moderate, S=Scarce	Score	Before	After	Treatment to increase score (no treatment if off-site)
Site has stems and branches of trees, shrubs, and wildflowers; leaf litter; undisturbed ground; bare ground; dead wood; brush piles; and rock piles.	A= 10 M=5 S=1			
Subtotal (*4c*)				
NESTING AND OVERWINTERING TOTAL				

(4a + 4b)

(4c)

(4a + 4b + 4c)

Section 5. Management Practices

Management practices in and around habitat areas have a significant influence on bee populations.

5a. Is the area protected from pesticide use, including herbicides that result in loss of flowering plants as well as pollinator-toxic insecticides?

Max score of 10.

Site features Score all options that apply	Score	Before	After	Treatment to increase score (no treatment if off-site)
No use of herbicides or insecticides on site.	10			
Buffer of at least 30 feet between any herbicide or insecticide application and habitat areas, either on- or off-site.	2			
Invasive weed control, if any, carried out with targeted herbicide applications, rather than broadcast.	1			
If insecticides are used, spray drift is carefully controlled.	1			
If insecticides are used, spray equipment calibrated annually, as per state regulations	1			
Subtotal (*5a*)				

(5a)

Section 5. Management Practices *continued*

5b. Are land management techniques used in the area beneficial to pollinators?
Max score of 5.

Grazing (Select only one)	Score	Before	After	Treatment to increase score (no treatment if off-site)
The site will not be grazed.	5			
This site will be grazed with a conservation grazing plan in place and includes prescribed grazing practices to encourage wildflower diversity/abundance, (e.g., low intensity grazing, or short duration grazing with long recovery periods).	2			
Conventional grazing practices will happen on the site.	0			
Subtotal (*5b*)				(5b)

Burning (Select only one)	Score	Before	After	Treatment to increase score (no treatment if off-site)
The site will not be burned or burned specifically to enhance floral resources.	5			
If burning is not carried out to encourage floral resources, then entire disturbed area is limited to 1⁄3 of habitat per year, and a patchy burn approach is used, leaving numerous skips and unburned patches. A 3 to 10 year burn rotation period is used, and the time of year when burning occurs is varied. Rare invertebrate species and their specific needs are considered.	2			
Burning will occur on more than a 1/3 of the parcel in a given year.	0			
Subtotal (*5c*)				(5c)

Mowing / haying (Select only one)	Score	Before	After	Treatment to increase score (no treatment if off-site)
The site will not be mowed or hayed.	5			
If mowing/haying occurs, then entire disturbed area is limited to 1⁄3 of habitat per year. Haying or mowing is done patchily, at reduced speeds (<8 mph), with high mower height (12–16"), and in late summer (after peak bloom).	2			
Habitat will be mowed/hayed with conventional practices.	0			
Subtotal (*5d*)				(5d)
MANAGEMENT PRACTICES TOTAL				(5a + 5b + 5c + 5d)

(5a)

Appendix 3. Washington butterfly species of conservation concern that utilize riparian habitat and their associated host plant(s). A star (*) before a species' scientific name indicates that riparian habitat is particularly important for the species.

Common Name	Scientific Name	General Distribution in Washington	Washington State Conservation Status[1]	Host Plant(s)
Sachem	*Atalopedes campestris*	Eastern Washington	Vulnerable	Poaceae: *Cynodon dactylon, Digitaria sanguinalis, Eleusine indica, Festuca rubra, Stenotaphrum secundatum*
Meadow Fritillary	*Boloria bellona toddi	Northeastern Washington	Imperiled	Violaceae
Monarch	**Danaus plexippus*	Statewide	Critically Imperiled	Apocynaceae: *Asclepias, Calotropis, Matelea, Sarcostemma*
Taylor's Checkerspot	*Euphydryas editha taylori*	Olympic Peninsula and South Puget Sound	Critically Imperiled	Scro*phulariaceae:* Castilleja hispida, Veronica scutellate, V. beccabunga, V. serpyllifolia ssp. Serpyllifolia, Plantago lanceolata, *P. major*
Nevada skipper	*Hesperia nevada*	Eastern Washington	Vulnerable	Poaceae: *Stipa occidentalis,* perhaps *Elymus elymoides*
Sandhill skipper	**Polites sabuleti*	Eastern Washington	Vulnerable	Poaceae: *Agrostis scabra*, *Cynodon dactylon*, *Distichlis spicata var. stricta*, *Eragrostis trichodes, Festuca brachyphylla, Festuca idahoensis*, *Poa pratensis*
Mardon skipper	Polites mardon mardon	South Puget Sound and southcentral Washington	Critically Imperiled	Poaceae

[1] Washington Natural Heritage Program Conservation Rank