**Pollinator Habitat Conservation Along Roadways**

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Abstract

As pollinators have declined in the United States, interest has increased in managing existing roadside habitat or creating additional habitat to support them. In particular, state Departments of Transportation (DOT) are seeking strategies to implement voluntary conservation practices to help recover imperiled species and reduce the likelihood that additional species will be listed under the Endangered Species Act (ESA), as well as strategies to comply the ESA if a species becomes listed. This report summarizes findings from a survey to DOT staff from around the country, a survey to leading pollinator and roadside revegetation researcher experts, and information from a peer exchange meeting with DOT staff representing 41 states. The surveys and peer exchange meeting provided information on current roadside management practices used that may benefit pollinators, as well as barriers to implementing particular practices, and other information related to pollinators. This data informed the creation of 16 regional guides, Pollinator Habitat Conservation Along Roadways. These guides cover all 50 states and outline strategies for DOTs for ESA compliance, as well as for creating, enhancing, and maintaining pollinator habitat along roadways.

Chapter 1. Introduction

Animal pollinators are central to the health of terrestrial ecosystems as well as to human wellbeing. Pollinators are essential for the reproduction of about 85% of all flowering plants (Ollerton et al. 2011) and are essential for wildlife food webs (Kearns et al. 1998; Summerville and Crist 2002). Pollinators are also crucial for human nutrition and food production. Many of the nutrients, vitamins, and minerals needed to maintain human health come from insect-pollinated crops (Eilers et al. 2011). Pollinators are required for 35% of global crop production, including 87 of the world’s 124 most commonly cultivated crops (Klein et al. 2007).

The great majority of pollinators in North America are insects, including bees, wasps, flies, beetles, butterflies, and moths (Allen-Wardell et al. 1998; Kearns 2001). Bees are considered to be the most efficient group of pollinators, and there are over 3,600 species of wild native bees just in the United States and over 5,100 species in North America (Ascher and Pickering 2015). Over the last several decades, a number of insect pollinators have undergone population declines. Nearly 30% of all bumble bee species in North America, including species that were formerly among the most common (Grixti et al. 2009; Cameron et al. 2011), face a risk of extinction (Hatfield et al. 2016). Other pollinators are also facing extinction risk, including about 20% of butterflies (NatureServe 2018). Once common and widespread, even the iconic monarch butterfly (*Danaus plexippus*), known for its impressive long-distance migration, has declined by 80% east of the Rocky Mountains and more than 95% west of the Rocky Mountains (Semmens et al. 2016; Pelton et al. 2019).

The Southern Plains bumble bee (*Bombus fraternus*) is one of a number of formerly widespread species of bumble bees that has declined significantly in recent years. Bumble bees are highly efficient pollinators of wild plants and crop plants.

*Photo credit: Jennifer Hopwood/Xerces Society*

Currently (as of December 2022), 47 pollinating insects are listed under the federal Endangered Species Act (ESA)—nine bees, 34 butterflies, two moths, one fly, and one beetle—plus two butterflies that are currently candidates for listing. There are a number of imperiled pollinator species with declining populations that are not currently listed under the federal ESA, so there is a high likelihood that more pollinator species will be listed in the future.

Factors that contribute to insect pollinator declines include:

* the loss, degradation, and fragmentation of habitat (e.g., Kremen et al. 2002; Potts et al. 2010),
* introduced species (e.g., Memmott and Wasser 2002; Tallamy and Shropshire 2009),
* the use of pesticides (e.g., Kevan 1975, 1999; Dover et al. 1990; Baron et al. 2014),
* diseases and parasites (e.g., Altizer and Oberhauser 1999; Cameron et al. 2011; Koch and Strange 2012), and
* climate change (Forister et al. 2010; Warren et al. 2008; IPBES 2016; Glenny et al. 2018).

Threats to pollinator communities affect not only pollinators themselves but also the function of natural ecosystems and overall agricultural productivity in the United States and worldwide.

As pollinators have declined in the United States, interest has increased in managing existing habitat or creating additional habitat to support them (National Research Council 2007). Roadsides are some of the most extensive networks of linear habitats in the United States, and they extend across urban as well as rural landscapes. In some highly altered landscapes, roadsides are or could be managed as the only natural vegetation that remains. Pollinator diversity can be high in roadsides, with communities that include a significant portion of the species found in the region (Ries et al. 2001; Hopwood 2008; Noordijk et al. 2009). Roadsides can be home to rare species as well as common species (Munguira and Thomas 1992; Ries et al. 2001). They can support pollinators through a portion of their life cycles, or species may live their entire lives on roadsides. Specifically, roadsides provide pollinators with a place to find food, reproduce, and take shelter or overwinter. By providing habitat for a part or all of pollinators’ life cycles, roadsides can increase habitat connectivity between larger areas of natural habitat. In addition to supporting pollinators and flowering plants, roadsides also provide a number of other services, including supporting carbon sequestration; regulating air, water, and soil; enhancing aesthetics and safety for drivers; and showcasing regional beauty (Phillips et al. 2020).

Roadsides can be valuable habitat for pollinators and other wildlife, and with appropriate management, they can enhance habitat connectivity between areas of natural habitat. The value of roadsides for the conservation of listed and potentially listed species can be substantially increased by adjusting seed mixes, mowing schedules, herbicide use, and other roadside management strategies.

The purpose of NCHRP Project 25-59 was to create 16 regional guides covering all 50 states to support Departments of Transportation (DOTs) in ESA compliance, as well as in creating and maintaining pollinator habitat along roadways. The project team hosted an interactive, virtual Peer Exchange Workshop for DOT staff and other roadside managers to give them an opportunity to share ideas and also to inform preparation of the guides. The regional guides include profiles of listed species and at-risk, imperiled species that have the potential to become listed, with information on range, life history, key plants, management practices, and more. The guides also include options for ESA compliance, and guidance for roads and roadside planning, maintenance, design, and revegetation. The guides will be available on the National Academies Press website (www.nap.edu).

## 

1. Chapter 2. Research Approach

The content of the guides was derived from a thorough literature review of research, reports, and other relevant information related to the use of roadsides, vegetation management, and restoration to enhance habitat value for pollinators. Literature was researched and summarized within the context of the broader literature on pollinator decline, causes of decline, and conservation actions. Key declining pollinators were given special attention, and what is known about their life histories was summarized in species profiles, which were informed by input from researchers with expertise on these imperiled species.

The guides were also informed by feedback from pollinator experts and DOT practitioners from two sets of surveys and the Peer Exchange Workshop.

* 1. Surveys

The preparation of the guides greatly benefited from input received through two sets of surveys. We first conducted a detailed online survey with leading pollinator and roadside revegetation researcher experts from across the United States to ensure the most current science was considered in the development of the guides. The survey asked experts to identify the relative benefit of specific conservation actions for imperiled pollinators and provide input on the opportunities for DOTs to implement practices that support pollinators. A list of the questions for experts are included in Appendix A, and their responses are in Appendix C. Twenty-nine experts were contacted to participate in the survey; 18 completed the survey, yielding a 62% response rate. Participants included researchers from universities, state agencies, consultants, and non-governmental organizations.

Next, we surveyed DOT staff from around the country about practices used that may benefit pollinators, barriers to implementing particular practices, and other information about roadside management and maintenance related to pollinators. The survey questions were derived from the findings of our literature review of peer-reviewed and technical material on the topic of vegetation management to enhance pollinator habitat value. The literature review found that adjusting vegetation management techniques to accommodate pollinator resource needs, as well as enhancing and restoring native vegetation to roadsides, are key steps toward improving the quality of roadside habitat for pollinators. Additionally, modifications to the frequency, timing, and scale of vegetation management practices and roadside native plant revegetation can help to mitigate some of the threats associated with roads that pollinators face. Revegetation and pollinator expert input also informed the recommended conservation actions and discussions of priority actions included in the survey for DOTs.

We sent the detailed survey to 200 DOT staff from all 50 states, and 70 transportation professionals from DOTs in 33 states completed the survey. See Appendix B for a list of DOT survey questions and the survey results, and see Appendix D for responses. Survey results were used to inform conservation recommendations included in the guides.

* 1. Peer Exchange Workshop

We also solicited feedback from roadside managers through a virtual Peer Exchange Workshop held January 18–20, 2022. This workshop, entitled “Pollinator Habitat Conservation along Roadways,” brought together staff from DOTs around the country, as well as other roadside managers, to share challenges and successes in creating and managing pollinator habitat along roadways.

Our primary goals for the Peer Exchange Workshop were to:

1. solicit specific feedback regarding key topics in the guides, with an aim to identify potential case studies to include in the final guides,
2. discuss relevant opportunities to include pollinator-friendly measures in DOT operations,
3. create connections and spread knowledge among DOTs,
4. facilitate discussion among DOTs on how they have overcome barriers to creating and managing roadside pollinator habitat, and
5. help participants feel engaged and invested in the guides.

A total of 209 people registered for the workshop from 41 states, plus Washington D.C. The majority of attendees were DOT staff, but there were attendees who manage county roads, as well as people from federal agencies, non-profits, consulting firms, and academics.

The workshop consisted of six interactive, non-concurrent sessions facilitated by ICF’s Spark Labs. Spark Labs uses Mural Boards (Figure 1), an online whiteboard tool that allows for real-time collaboration using virtual sticky notes and interactive exercises in a highly visual multi-user digital interface. Mural Boards for each session were saved so that participants can revisit them as needed.

A picture containing timeline

Description automatically generated

Figure 1. Example Mural Board Used for the Endangered Species Act Compliance Workshop Session.

The six workshop sessions and links to the associated Mural Boards are provided below:

* Opening Session and Introduction to Pollinator Biology and Conservation
  + [Mural Board link](https://app.mural.co/t/icfeei4168/m/icfeei4168/1641335986720/2a5a63ce41052b599f60fb72a61326273d88be56?sender=uaba3bec092d6ac3714792013)
* Endangered Species Act Compliance for Pollinator Conservation
  + [Mural Board link](https://app.mural.co/t/icfeei4168/m/icfeei4168/1641336009329/e0a4bdd0262ac64d8cffc06b07b4f3106fcf7779?sender=uaba3bec092d6ac3714792013)
* Maintenance Strategies to Support Imperiled Pollinator Conservation
  + [Mural Board link](https://app.mural.co/t/icfeei4168/m/icfeei4168/1641339863717/3f3a00874fcb971bfdef4721f61598fedcca6652?sender=uaba3bec092d6ac3714792013)
* Revegetation Strategies to Support Imperiled Pollinator Conservation
  + [Mural Board link](https://app.mural.co/t/icfeei4168/m/icfeei4168/1641336282822/084a435f90afa681fbee47fa6778f91612d79e9b?sender=uaba3bec092d6ac3714792013)
* Interacting with the Public and Creating Partnerships
  + [Mural Board link](https://app.mural.co/t/icfeei4168/m/icfeei4168/1641336294296/44bc514b2b1c96fe7b23d9fa3baab313afd8298e?sender=uaba3bec092d6ac3714792013)
* Final Wrap-up
  + [Mural Board link](https://app.mural.co/t/icfeei4168/m/icfeei4168/1642005241572/217da1d144b311177475bd9a076a857f00fc1065?sender=uaba3bec092d6ac3714792013)

“I LIKE... hearing what other DOT are doing and the lessons they have learned in the process.”

“I BELIEVE this platform allowed for more engagement from DOTs. Travel has always been difficult even before Covid.”

“I LIKE... hearing others have the same issues.”

“I WISH we could do this peer exchange again and allow other states to show case projects, successes, challenges from more states.”

“I WISH my upper management heard this!”

“I WONDER if we can do this peer exchange more often to showcase other states.”

“I WONDER... if we are preaching to the choir. How do we get leadership to engage?”

The four topical sessions each consisted of 2 to 3 short talks from DOT staff about work they are engaged in to benefit pollinators in roadside habitat. This was followed by breakout groups where attendees brainstormed practices to benefit pollinators, challenges to implementing those practices, and ways to overcome those challenges. The sessions were highly interactive and encouraged participants to engage in the discussion. As part of the discussions, we asked participants to share case studies and research needs. Some of the case studies were incorporated into the guides, while the research needs were incorporated into the Research Needs Memo.

Feedback about the workshop was very positive. During the final session, we asked people to give feedback on the workshop using “I like…,” “I wish…,” and “I wonder…” as prompts. Many participants expressed an interest in holding similar workshops on a regular basis to continue sharing ideas and to hear examples from more states. Other feedback included the suggestion to get more upper management to engage in similar future workshops.

* 1. The Guides

The primary goal of this project was to develop a series of 16 regional guides that could be used by roadside managers throughout the United States to help them to create and maintain pollinator habitat along roadways and other DOT holdings. Many of the chapters contain regionally specific guidance.

The guides each contain 12 chapters:

* Chapter 1, Introduction;
* Chapter 2, Pollinator Biology and Roadsides;
* Chapter 3, Imperiled Pollinator Profiles;
* Chapter 4, Native Pollinators and the Federal Endangered Species Act: Compliance Strategies for State Departments of Transportation;
* Chapter 5, Considering Imperiled Pollinators in Transportation Planning, Design, and Construction;
* Chapter 6, Roadside Maintenance and Vegetation Management for Pollinators;
* Chapter 7, Revegetation and Pollinators: Design and Implementation;
* Chapter 8, Creating Climate-Smart Pollinator Habitat along Roadsides;
* Chapter 9, Surveys, Monitoring Strategies, and Habitat Assessments;
* Chapter 10, Cost-Benefit Considerations for Pollinator Management on Roadsides;
* Chapter 11, Communication Support; and
* Chapter 12, Conclusion.

1. Chapter 3. Summary of Survey Findings
   1. Revegetation and Pollinator Researcher Expert Survey Findings

As mentioned above, we conducted a detailed online survey with leading pollinator and roadside revegetation researcher experts from across the United States. Twenty-nine experts were contacted to participate in the survey; 18 completed the survey, yielding a 62% response rate. Participants included researchers from universities, state agencies, consultants, and non-governmental organizations. A list of the questions experts were asked are included in Appendix A, and survey responses are in Appendix C.

When asked to describe high quality roadside habitat for pollinators, experts most frequently (88%) noted the need for a diverse plant community, with floral resources available from spring through fall. Reduced mowing frequency and protection from pesticides were the next most common attributes (27% and 25%, respectively), followed by habitat that increases connectivity, habitat that is adjacent to roads with low traffic volume/speed, and habitat that is resistant to weeds (19%). When asked to gauge the impact of management actions on imperiled pollinators, experts ranked the following practices as very positive for pollinators:

*“Systemic changes applied consistently over time are more cost effective than small symbolic plantings.”*

- Revegetation expert

* Train managers, staff, and/or contractors to identify and protect important nectar/host plants. (89%)
* Increase use of native host plant species in seed mixes used in reseeding/restoration efforts. (87%)
* Monitor pollinators and/or native plants on roadside rights-of-way. (84%)
* Increase use of native blooming species in seed mixes used in reseeding/restoration efforts. (79%)
* Increase communication and coordination with private landowners about protecting pollinator habitat (e.g., from insecticide drift). (79%)
* Install new pollinator habitat at a restoration scale (> ¼ acre/11,000 square feet). (78%)
* Outreach to the public, shareholders, and/or customers about the importance of pollinator conservation. (74%)
* Control invasive herbaceous plants that are not known to be floral resources/host plants for pollinators. (68%)
* Limit broadcast herbicide use; use spot spraying for vegetation management. (63%)

*“Herbicides are powerful and useful tools that can be used responsibly for the benefit of native plant/invertebrate communities.”*

- Revegetation expert

* Limit mowing beyond the clear zone to one cut per growing season. (63%)
* Spot mow weeds or undesirable plants to avoid host and/or nectar plants. (63%)
* Mow during the season(s) when pollinators are not present. (56%)

The top three most important actions, in order, were reducing mowing and/or timing mowing to avoid active pollinator seasons, increasing use of native plants and increasing plant diversity, and increasing training of staff/contractors.

*“When it comes to revegetation, “I believe there is no recipe. Every site is different. We need an educated workforce that can plan, implement, and monitor.”*

- Revegetation expert

When asked their opinions about the major challenges for native plant establishment, common themes included (in order from most common to least):

* public education/buy-in,
* agency buy-in/training,
* soil health,
* weeds/invasive plants,
* lack of appropriate seed sources/plant materials/cost,
* biological constraints (planting window, steep slopes, establishment),
* mowing or herbicides by adjacent landowner, and
* lack of compromise among stakeholders.

Using native plants in roadside revegetation projects was widely recognized as important and valuable for helping to make roadsides more resilient to climate change. Revegetation experts were asked to name traits for climate-resilient plants, and they listed drought tolerance, flood tolerance, tolerance of cold and hot temperatures, and genetic diversity. Descriptions of climate-smart plant communities on roadsides included a focus on diversity—both in terms of planting a diverse assemblage of species and in terms of genetic diversity within species. Another common theme was reducing additional stressors, especially mowing, invasive weeds, and pesticides/toxins.

*“Climate change makes it more imperative to use genetically diverse plant stock, since a single genome is very vulnerable to a single stressor/pest/disease etc.”*

- Revegetation expert

* 1. DOT Practitioner Survey Findings

In February and March 2020, we conducted a detailed online survey with DOT practitioners from across the United States. The survey was sent to 200 DOT staff from all 50 states. In total, 70 transportation professionals from DOTs in 33 states responded to the online survey, which was a 35% response rate from individuals, and 66% response rate of state DOTs. A total of 47% of respondents identified their area of expertise within their agency as “Environmental,” 27% as “Maintenance,” 13% as “Landscape Architecture,”, 3% as “Construction,” 1% as “Planning,” and 9% as “Other.”

Questions for the DOT survey were generated based upon the conservation guidance that resulted from the literature review and were informed by the results of the pollinator and revegetation experts survey. Goals were to understand the current state of adoption of pollinator conservation practices and to assess barriers to implementation. See Appendix B for a list of the survey questions and Appendix D for the responses.

The first set of questions posed to DOTs focused on the current implementation of maintenance strategies that could support or reduce harm to pollinators. Conservation maintenance strategies included in the survey focused on adjustments to mowing practices, ways to target herbicide applications, brush management efforts, and other vegetation management techniques. DOTs rated the extent to which the conservation actions were currently being implemented by their agency, selecting one of the following: always, usually, sometimes, not often, and never.

Nearly 50% of DOTs responded that they usually limit mowing beyond the recovery zone to no more than twice a year, and 17% responded that they always limit such mowing. However, it was less common for DOTs to avoid mowing imperiled butterfly host plants during breeding season; only 25% of DOTs reported usually implementing this strategy, with 50% responding sometimes to not often, and 17% responding never. With 50% of respondents selecting sometimes or not often, it appears less common to delay mowing until later in the growing season as well. Rotational mowing was always implemented by only 17% of respondents, and over 50% reported using this strategy not often or never. Raising the mower height was also limited, and cleaning mowing equipment to reduce the spread of weeds was not consistently implemented by most DOTs. The barriers to implementing mowing strategies to support pollinators that were most cited by respondents include the lack of staff training and incompatibility with other goals. Limited staff resources were also noted as a barrier, but financial constraints and equipment limitations were considered minor limitations.

Roadsides with native plants can be important habitat for pollinators, and a number of DOTs are taking steps to adjust maintenance practices to help support them.

*Photo credit: Arizona DOT*

The most commonly used conservation practice for herbicide use was avoiding herbicide use under weather conditions that increase drift; 84% of respondents reported always or usually implementing that practice. Regular calibration of application equipment with drift management in mind was reported by 71% of respondents. A majority of respondents reported applying herbicides during plant life stages when weeds were most vulnerable (13% always, 53% usually). Directing herbicide applications to undesirable plants to avoid non-target plant species was slightly less implemented; 19% always undertook this practice, and 40% usually did. Selective herbicides were prioritized always by 28% of respondents, usually by 32%, and sometimes by 28%, suggesting that selective herbicides are a tool routinely used to varying degrees by DOTs. Staff training to recognize and distinguish noxious and invasive weeds from non-target native plants was implemented by respondents less consistently than other techniques: 40% reported sometimes, and 27% usually, with only 8% reporting always and 25% reporting not often or never. Strategies to identify weed outbreaks and track herbicide uses, such as regular inventories or evaluation of management effectiveness over time, were the least routinely implemented herbicide practices. Weed outbreaks and herbicide usage were usually or sometimes tracked by 35% or 25% of respondents, respectively. Vegetation inventories to identify emerging weed outbreaks were only sometimes used (43%) or not often used (27%); only 8% of DOTs reported always using inventories. Adoption of practices was most often determined by multiple limiting factors, including staff resources, staff training, and costs. For example, 79% and 75% of DOTs cited limited staff resources and trainings for why they were unable to regularly conduct inventories or track weed outbreaks and management outcomes. Staff training sessions in particular were noted as limitations for avoiding sprays during drift-inducing weather conditions (90%), calibrating equipment to reduce drift (79%), and distinguishing problematic plants from native species (71%).

DOTs were also queried about their conservation practices for brush removal. Softening or feathering forest edges to thin the canopy along the forest edge to allow understory plants like shrubs and wildflowers to flourish there was a relatively uncommon practice for DOTs to use consistently. It was never used by 17%, not often used by 39%, sometimes used by 26%, and usually and always used by only 13% and 4%, respectively. Leaving snags that do not pose a safety risk seems to be a practice more common with some DOTs than others; 30% reported usually using it, and 30% reported not often using it. Minimizing soil disturbance was most commonly implemented by DOTs; 45% reported usually using that practice. The two most common barriers for implementation noted were limited staff training and incompatibility with other goals.

Only 30% of state DOTs reported using other vegetation management strategies, namely prescribed grazing and prescribed burning. When these management strategies were used, they were used on a limited basis, primarily on mitigation sites or on pilot project sites. Barriers include timing and logistics for implementation of prescribed burns or moving livestock to sites, and costs; the work is typically performed by contractors because maintenance staff often do not have the training or certifications needed to conduct prescribed burns or have direct experience with managing grazing animals.

When asked about the type of weed control assistance that would be useful, financial assistance and training for staff and contractors were most cited (29% each). When asked about additional assistance that might be needed, respondents predominately mentioned that support from leadership within their agency was critical (e.g., having weed management recognized by upper management as a priority within the agency). Additional staff was also cited as a critical need, with several people noting that maintenance staff are stretched too thin to treat all the locations that are needed for effective weed management.

*“Both financial assistance and training for staff/contractors. I would also add training/education for managers. Without their support, the other staff have an uphill battle. My experience with several DOTs is that these are the common hurdles.”*

- DOT respondent

The survey also included questions for landscape designers and revegetation planners. These questions focused on the current implementation of practices that could support or reduce harm to pollinators. As with questions about maintenance, DOTs rated the extent to which the conservation actions were currently being implemented by their agency (options were always, usually, sometimes, not often, and never), and also weighed in on barriers to adopting these practices.

Native plants are frequently used by DOTs in new plantings, with 41% responding that they are used always, 37% usually, 5% not often, and 0% never. Whenever possible, DOTs are prioritizing the use of local or regionally sourced native plant material, with 31% selecting always as their frequency of use and 39% selecting usually. Though DOTs are using native plant material, coordination in advance with native plant vendors to allow time to collect additional species or increase availability of stock is not widely adopted on a regular basis; most DOTs reported doing so sometimes (38%). Requiring a seed testing certificate from native seed vendors that describes germination rates and weed contaminants is a much more common practice, with 57% declaring that they always require seed testing. Limitations with staff training were most often cited as the primary barrier for implementing these conservation practices, followed by incompatibility with other goals, limited staff resources, and financial constraints.

*“Our Agency at the local level does many good things. Statewide Maintenance leadership is intransigent and opposed to changing standard practices. Statewide Maintenance leadership needs influence from government to change mindset and policy.“*

- DOT Respondent

*“Most of the DOT staff doesn't seem concerned about the importance of establishing pollinator habitat. Everything that has been done has been because of ONE employee. This employee has been trying to get management to create a pollinator program of some kind, but can't seem to gain any momentum with current management.”*

- DOT Respondent

*“The biggest challenge is agency culture (i.e. “we’ve always done it this way, why change?”) and priorities. Also, there’s a lack of institutional technical knowledge, limited staff (we have 2 landscape architects for entire state), challenges with site preparation and initial weed control, limited capacity or desire to conduct long-term maintenance of new plantings, to name a few.”*

- DOT respondent

Planners reported including plants known to provide pollen and nectar for pollinators at varying rates; 20% of DOTs reported always, 43% usually, 25% sometimes, and 10% not often. Though a majority of DOTs consider the needs of adult pollinators when designing plantings, that is not the case for larval stages. It is less common for DOTs to consistently consider including key host plants for target species of butterflies and moths; the majority include host plants some of the time (35%) or not often (26%). Interseeding, the temporary suppression of existing vegetation in combination with seeding additional native species, is a method that can increase floral abundance and diversity in existing stands of vegetation. It does not appear to be commonly used by DOTs currently; 28% and 28% have used it sometimes or not often, respectively, and only 12% and 6% use it usually or always, respectively. Limitations with staff training was most often cited as the primary barrier for implementing these conservation practices, followed by incompatibility with other goals, limited staff resources, and financial constraints. A lack of institutional knowledge, lack of interest from program directors, and unwillingness of leadership to change standard practices were also noted as barriers to successful native plant establishment.

Not having a long-term maintenance plan for new plantings was the most common challenge for native plant establishment on roadsides. Planners and designers are not consistently collaborating with maintenance to develop a weed management plan for the site preparation and weed control during the establishment period of new native plant revegetation projects, which can dramatically improve the successful establishment of the planting. The majority work with maintenance only some of the time (31%) or not often (31%). Though 11% and 18% coordinate with maintenance always or usually, respectively, 7% of DOTs never use this strategy. Staff resources was cited by 76% of respondents as the main barrier, followed by staff training and financial constraints. Several respondents mentioned the need for leadership to create a dedicated staff position or allocate more resources in order to bridge the gap between design and maintenance staff.

Additional challenges to native plant establishment identified by DOT respondents centered on the difficulty of establishing plants in arid environments. Only 6% of DOTs are always considering resilience to climate change when designing new plantings; most consider it sometimes (33%), not often (22%), or never (18%). Staff training was most often cited as the primary barrier (78%), followed by staff resources (61%).

Several motivations for past pollinator projects by DOTs were reported, such as inclusion of pollinators as part of the agency's sustainability goals, response to a community or collaboration opportunity, cost savings, part of the agency’s permit negotiations, and President Obama’s 2014 Presidential Memorandum. Additionally, the possibility of an imperiled pollinator species becoming listed under the ESA also motivated DOTs. Of the respondents, 40% said they were motivated to take proactive actions to protect pollinators in order to hopefully avert listings, and another 41% were somewhat motivated by this. Additionally, 42% of respondents said that pollinator conservation is an identified priority for their DOT. However, for five states respondents from the same state transportation agency gave opposing answers, suggesting that communications and policies toward pollinators are not equally understood or may be interpreted differently within agencies. DOTs that engage with the public about their pollinator conservation efforts usually do so through information on their website (29%) or interpretive signs at rest areas (12%). Additional outreach methods include social media, webinars, engagement with the news media, brochures, demonstration gardens, and seed packet distribution.

*“The best way to get DOTs and other ROW owners to manage their properties for pollinators is to show cost savings and other operational benefits. I am an ecologist, so I want to save pollinators because I know they are important, but I need to show how it saves the DOT money, time, or regulatory stress in order to convince management that it is important.”*

- DOT Respondent

The final portion of the survey asked DOT practitioners about their experiences with the ESA. Transportation planners and managers recognized compliance with the ESA can present logistical and operational challenges. When responding to the survey, 45% of 47 transportation professionals indicated they need to consult with the United States Fish and Wildlife Service (USFWS) or relevant state agency regarding federally or state-listed pollinator species at least once each year. More than half of those individuals (51%) needed to consult five or more times a year. Furthermore, 75% of 48 respondents to another question recognized the possibility that if an imperiled pollinator species became legally protected under the ESA, it would cause barriers, such as altered project timelines, increased workloads, and higher costs to their agencies. However, survey respondents recognized the cost savings that come from advance planning efforts and 81% of 48 respondents acknowledged that the possibility of an imperiled pollinator species becoming legally protected by the ESA would motivate their agency to proactively protect pollinators in order to avert a listing. Additionally, nine respondents recognized early adoption of compliance strategies as being good for public relations and consistent with identified sustainability goals for their transportation agency.

Many of the transportation planners and managers surveyed were familiar with the range of ESA compliance strategies, and many had used one or more of the strategies. The following percentages indicate the proportion of respondents that have applied each strategy to their work: Habitat Conservation Plan (42%); Safe Harbor Agreement (60%); Candidate Conservation Agreement (27%); Candidate Conservation Agreement with Assurances (CCAA) (36%); Recovery Crediting System (21%); and Prelisting Conservation Agreement (14%).

As of March 2020, only four state DOTs had signed on to the USFWS’s CCAA for the monarch butterfly, and another 13 agencies reported that they had plans to enroll. Agencies that signed on or planned to sign on reported that their reasons for signing on included the desire to avert an ESA listing of monarchs, a desire to save time and costs by reducing Section 7 consultations, and to have regulatory assurances if the monarch does become listed. Twenty-two agencies had decided against signing on to the CCAA by March 2020, and reported it was because the CCAA did not fit the needs and priorities of their agency, it was logistically challenging, or it would have greatly affected operations activities. Several other agencies said they were still in the process of evaluating the merits of signing on to the monarch CCAA. As of November 2022, ten state transportation agencies had enrolled in the USFWS’s CCAA for the monarch butterfly (https://rightofway.erc.uic.edu/national-monarch-ccaa/ccaa-enrollment/)

*“I think we could be doing so much more for pollinators on our roadsides but the administration is unwilling to increase efforts. It will take the listing of the monarch to spur them to do anything else. We plant about 500 acres of forbs each year but post planting management is minimal. We funded research that showed that. We need to actively manage our roadsides better for wildlife. Until there is a listed species, I do not see our administration stepping up efforts.”*

- DOT respondent

2. Chapter 4. Conservation Guidance and Recommended Practices for Pollinators

The guides cover a range of topics related to pollinator conservation. This chapter presents brief conservation guidelines for ESA compliance, planning, design and construction, roadside maintenance, revegetation, and communications. See the guides for more detailed information.

* 1. ESA Compliance Guidance

ESA regulatory permitting programs provide the opportunity to create new habitat and manage existing roadsides for imperiled and listed species. These programs provide a range of ESA compliance options, with many providing regulatory assurances. ESA compliance strategies covered in the guides include:

* Habitat Conservation Plan
* Safe Harbor Agreement
* Candidate Conservation Agreement
* Candidate Conservation Agreement with Assurances
* Recovery Crediting System
* Prelisting Conservation Agreement
  1. Planning, Design, and Construction Recommended Practices

There are several opportunities to integrate pollinator conservation measures into transportation projects during the planning and project development processes. Early stages of project planning provide opportunities to avoid the most sensitive habitats; project design allows for inclusion of pollinator-friendly roadside features; and project construction provides opportunities to minimize construction impacts on pollinators and to integrate pollinator habitat into projects. Incorporating consideration of pollinators early in the planning process will increase the likelihood of effective conservation. Below are some suggestions for incorporating pollinators into the planning, design, and construction phases of transportation projects.

**Planners:**

* Identify partners and stakeholders, along with an understanding of their wants and needs.
* Collaborate and coordinate with partners and stakeholders early and often.
* Develop a detailed local and regional understanding of the ecology, conservation status, and regulatory requirements for pollinators of conservation concern that are potentially affected by the project.
* Identify and prioritize avoidance and minimization measures for potential negative effects on pollinators generally and/or on specific pollinators of concern.

**Designers:**

* Collaborate and coordinate with partners and stakeholders early and often.
* Develop a detailed local and regional understanding of the ecology, conservation status, and regulatory requirements for pollinators of conservation concern.
* Understand pollinator-friendly design elements and opportunities to include them in project design and construction.
* Understand how project implementation may affect pollinators, including pollinators of concern, and conservation objectives; recognize potential positive and negative impacts.
* Identify and prioritize avoidance and minimization measures for potential negative effects on pollinators generally and/or on specific pollinators of concern.
* Develop a pollinator mitigation strategy to offset negative effects of roadside construction and maintenance on pollinators, and a pollinator conservation strategy to enhance pollinator habitat value.
* For federally listed species, develop or use programmatic permits and agreements when appropriate.
* Track environmental commitments to ensure pollinator-friendly conservation measures are implemented and that avoidance, minimization, and mitigation measures are implemented.
* Monitor outcomes to document the actual benefits to pollinators, including focal pollinators, and implement adaptive management to improve outcomes as needed.

**Construction:**

* Identify and prioritize avoidance and minimization measures for potential negative effects on pollinators generally and/or on specific pollinators of concern.
* Understand how project implementation may affect focal species, pollinators generally, and conservation objectives; recognize potential positive and negative impacts.
* Identify and prioritize avoidance and minimization measures for potential negative effects on pollinators generally and/or on specific pollinators of concern.
* Track environmental commitments to ensure pollinator-friendly conservation measures are implemented and that avoidance, minimization, and mitigation measures are implemented.

Implementation of these actions facilitates early inter- and intra-agency collaboration, stakeholder coordination, improved regional conservation outcomes, and increased efficiencies of project development cost and schedule.

Early implementation benefits include:

* improved environmental planning and regulatory predictability,
* streamlined permitting and environmental review processes,
* lower risk to total project cost and schedule, and
* improved project and environmental outcomes.

1. Roadside Maintenance Recommended Practices

Roadside maintenance practices can be harmful or beneficial to pollinators. Listed below are roadside maintenance practices for mowing, herbicide use, and mechanical weed and brush removal that can benefit pollinators generally, as well as specific imperiled species.

Mowing

Conservation practices that benefit pollinators broadly:

* Reduce the frequency of mowing beyond the mown strip to once or less a year.
* Reduce the frequency of mowing beyond the mown strip to no more than twice per year.
* Delay mowing as late as possible during the growing season (e.g., mow after the first frost) so blooming plants are available throughout the growing season.
* Clean mowing equipment after use and between sites to limit the spread of invasive weeds.

Conservation practices for imperiled pollinator species include:

* Aim to mow no more than one-third to one-half of an area beyond the mown strip in the recovery area per year (e.g., rotate mowing sections of a roadside).
* Avoid mowing host plants of imperiled butterflies during butterfly breeding seasons.
* Adjust mowing height to a minimum height of 8 to 10 inches in areas with target butterfly host plants or bumble bee colonies in grass thatch, if mowing during the growing season.
* Explore mitigation efforts if there is a known mortality hot spot for an imperiled pollinator due to vehicle collisions.

Herbicide Application

Conservation practices that benefit pollinators broadly:

* Train staff and contractors to recognize native plants as well as noxious and invasive weeds to reduce unintended damage to nontarget plants.
* Use targeted herbicide applications on undesirable plants to avoid harming non-target species (e.g., spot treatment applications with a backpack sprayer, targeted applications to cut stems).
* Apply herbicides during plant life stages when weeds are most vulnerable (e.g., before blooming or before going to seed).
* Use selective herbicides whenever possible to reduce damage to nontarget plants.
* Avoid herbicide sprays when weather conditions increase drift (e.g., avoid wind speeds above 15 mph, and avoid applications during a temperature inversion).
* Choose and calibrate equipment with drift management in mind (e.g., calibrate equipment regularly, choose spray nozzles that reduce drift, and on boom sprayers, use the lowest effective pressure and largest droplet size possible).
* Avoid broadcast applications of systemic herbicides and persistent herbicides with long residual periods to reduce the exposure to butterfly and moth caterpillars, which can be exposed by consuming contaminated vegetation.
* Whenever possible, prevent conditions that would allow incompatible vegetation or noxious and invasive species to establish or reestablish.
* If necessary (e.g., if the seed bank is depleted of desirable species), replant areas that have been treated with herbicides to remove dense infestations of undesirable vegetation with desirable, competitive low-growing plant species to reduce the need to re-treat the area.
* Avoid the use of pre-emergent herbicides on areas where the seed bank might contain desirable native species.

Conservation practices for imperiled pollinator species include:

* Train staff and contractors to recognize and avoid herbicide applications to key host plants for target imperiled butterflies and moths or key nectar plants for bumble bees.
* Avoid use of products that have toxicity to imperiled species during breeding seasons.
* If treatment cannot be scheduled outside the window when pollinators are present, consider a mechanical control strategy when feasible if in an area where herbicide use might affect imperiled species.

Mechanical Weed and Brush Removal

Conservation actions that support pollinators generally include:

* Feather or soften forest edges adjacent to the recovery area to create a transitional area between forests and grass (e.g., thin portions of the forest canopy along the edge next to grassy areas, removing undesirable or unhealthy trees).
* Leave snags or trees with cavities in areas where they are set back from the road and pose no safety risk.
* Minimize soil disturbance (e.g., disking, tilling, removal of root balls) during brush removal activities to avoid spreading invasive plants and destroying overwintering sites or nests.

Conservation actions that support imperiled pollinators include:

* Time activities to avoid vulnerable times of pollinator life stages.

1. Revegetation Recommended Practices

Revegetation that incorporates native plants can support pollinators while providing many other benefits, including erosion control, carbon sequestration, and weed suppression. Below are some revegetation principles that aid in creating quality pollinator habitat.

Revegetation actions that support pollinators generally include:

* Prioritize native plants in designs.
* Prioritize sourcing native plants locally.
* Increase flowering plant diversity and abundance.
* Include species with overlapping and sequential bloom periods.

Revegetation actions that support imperiled pollinators include:

* Include key host plants for target pollinator species.
* Consider the bloom time of flowering plants within the project area.
* Include key nectar and/or pollen plants for target pollinator species.
* Consider additional specific habitat needs, such as nesting or overwintering habitat.
* Consider the connectivity of planned revegetation sites to existing habitat within the landscape.
* Consider timing of revegetation projects.

1. Prioritizing Sites for Revegetation Efforts to Benefit Imperiled Pollinators

It can be helpful to prioritize sites for roadside revegetation projects that support imperiled pollinators in order to maximize conservation value and use resources effectively. Considerations to guide decisions about prioritization of sites to improve pollinator habitat include:

* presence of target pollinator species,
* landscape connectivity,
* landscape diversity,
* roadside width,
* traffic density,
* road density, and
* visibility to the public.

1. Communications Recommended Practices

Outreach and communication are important parts of the process when taking action for pollinator conservation. Many of the actions necessary to protect pollinators may involve increased up-front costs or require cultural changes in planning or maintenance activities. Outreach and communication with the public and within a agency are important for building support for such actions. The guides contain suggestions and examples for internal communication and for communication with the public.

Outreach to the public can:

* build public support,
* share accomplishments and progress over time,
* educate decision-makers and partners about the impact and reach of a DOT’s work.
* demonstrate responsible use of resources and funding to the public,
* share practices with other DOTs, and
* attract new organizations and partners for collaboration and outreach.

Internal communication can:

* build internal support for actions that benefit pollinators,
* improve understanding of why particular actions are important for pollinator conservation,
* share accomplishments and progress over time, and
* attract new organizations and partners for collaboration and outreach.

2. Chapter 5. Research Needs

The research needs outlined below were compiled based on an evaluation of the current state of the science, and input from the participants in the Peer Exchange Workshop held January 18–20, 2022. The research needs identified are grouped below by topics, which include a focus on ESA compliance, planning and design, roadside vegetation maintenance, roadside revegetation, resilience to climate change through revegetation, and additional research needs that influence all of the above categories.

Each table below includes the identified research need and description of why the research need is important. The “Source of Research Topic” column indicates whether the research need was indicated by the research team, the scientific literature, or from DOT staff attending the 2022 workshop. The “Scale” column indicates whether the research need is national or regional in scope. When national and regional are both listed, it indicates that the research is needed nationally, but that the research outcomes will vary by region. Finally, the “Pollinators Supported” column indicates whether the research need focuses on pollinators in general (multiple species) or specifically on imperiled pollinators.

* 1. Research Needs Related to Endangered Species Act Compliance for Roadside Management and Operations

These research questions center on the need for accessing data that can help in making decisions about approaches.

Table 1. Research Needs for ESA Compliance

| Research Need | Purpose and Importance | Source of Research Topic | Scale | Pollinators Supported |
| --- | --- | --- | --- | --- |
| Determine how to use LIDAR/aerial/drone imagery or other similar technologies effectively to document pollinator habitat. | This would reduce the need for excessive tracking and fieldwork to confirm if and where habitat exists. | Proposed by DOTs | National | Multiple species |
| Synthesize current DOT strategies for ESA compliance with listed or at-risk pollinators. | This summary would help DOTs understand how other states are approaching similar issues, and may provide ideas to address problems. | Proposed by research team | National | Multiple imperiled species |
| Create and share digital maps of the range distributions of pollinator species of interest, along with a summary of resources for previous observations. | Some project areas do not have listed species but could have positive impacts on a listed species if that species is found nearby. Easy to access data on the ranges of sensitive, non-listed species would also be useful in planning roadside management activities. | Proposed by research team | National, regional | Multiple imperiled species |
| Create a database of natural history information of imperiled pollinator species. | This information could be pulled for internal agency use, for example, as part of a decision support tool. | Proposed by research team | National | Multiple imperiled species |
| Recommended practices for management of noxious weeds in sensitive pollinator habitat, so that floral resources remain while revegetation projects take place. | Noxious or invasive weeds are often the dominant source of pollen/nectar in disturbed landscapes, and imperiled pollinator species that are generalists may frequently use resources from these plants (e.g., *Bombus affinis* visits Canada thistle). We need guidance on how to conduct weed management and revegetation practices in a way that will ensure pollinators have access to floral resources during these activities. | Proposed by DOTs | National | Multiple imperiled species |

* 1. Research Needs Related to Planning and Design

Additional research is needed to inform the planning and design process through recommended management practices for improving soil health and on pollinator use of wildlife overpasses and crossings.

Table 2. Research Needs for Planning and Design

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Research Need | Purpose and Importance | Source of Research Topic | Scale | Pollinators Supported |
| Understand how pollinators may use large wildlife overpasses or other structures to aid wildlife road crossings. | Incorporating vegetation and particular plant species may increase the value to pollinators of a highway overpass designed to aid the movement of vertebrates. | Proposed by research team and DOTs | Regional | Multiple species |
| Soil health recommended practices for desirable vegetation establishment, especially during construction activities. | Soil health and its effects on the success of revegetation projects are often overlooked, particularly during the planning phase. It would be helpful to have a compilation of recommended practices to support the retention of soil health throughout a project. This would also support the development of language for construction contract specifications. | Proposed by DOTs | National | Multiple species |

* 1. Research Needs Related to Roadside Vegetation Maintenance

Research needs regarding maintenance practices that can benefit pollinators include understanding how different practices can help promote and maintain habitat, as well as questions about recommended practices to remediate salty fills on roadsides.

Table 3. Research Needs for Roadside Vegetation Maintenance

| Research Need | Purpose and Importance | Source of Research Topic | Scale | Pollinators Supported |
| --- | --- | --- | --- | --- |
| Methods to find and document rare plant populations or existing natural plant remnants (e.g., prairie remnants) in rights-of-way. | Roadsides may host remnant vegetation that is no longer found within the landscape, and likewise may host other species that depend on that vegetation. Understanding and tracking where this habitat occurs can reduce negative impacts on the vegetation and help maintenance crews manage the vegetation properly. | Proposed by DOTs | National | Multiple species |
| How to best remediate salty fills on roadsides and reduce salt use on roads, with a review on the effects of remediation techniques and deicing alternatives to salt. | Years of salt use impairs soil and hinders vegetation establishment and maintenance. Research is needed on remediation techniques to reduce the impacts of salt on roadside vegetation. | Proposed by DOTs | Regional | Multiple species |
| How to conduct vegetation management after wildflowers are well established. | It is important to have research that explores ways to maintain diverse stands of vegetation over time because the timing or frequency of vegetation maintenance can favor grasses that will outcompete wildflowers. Some DOTs have been able to get wildflowers established but then maintenance activities unintentionally reduce them over time | Proposed by DOTs | National, regional | Multiple species |
| Understand if reduced mowing influences the incidence of wildlife-vehicle collisions. | Agency leaders have expressed concern that reduced mowing that benefits pollinators may increase vehicle collisions with large mammals like deer, thereby reducing driver safety. Though there is research on this topic that indicates that collisions do not increase and reduced mowing does not compromise driver safety, it is limited in scope and geography. It would be useful to design a multi-state study to address this question. | Proposed by DOTs; research team | National, regional | Multiple species |
| Synthesis of how DOTs are measuring the success of maintenance practices that improve habitat for pollinators and conducting follow-up monitoring to inform adaptive management. | A synthesis of existing practices would help DOTs determine which practices are most effective. | Proposed by research team | National | Multiple species |
| Timing of mowing to promote wildflower diversity by region. | This will help refine mowing BMPs so that they can be fine-tuned by ecoregion and topography. | Proposed by research team; scientific literature | National, regional | Multiple species |
| Conduct trials of haying of roadsides in regions where appropriate. | The removal of plant biomass through haying can increase flowering plant diversity in some settings by allowing more sunlight to reach new seedlings and reduce grass dominance. Haying is not currently a common maintenance technique used on roadsides by DOTs (however, in some states, adjacent landowners are allowed to hay roadsides); however, if timed well, haying could increase roadside plant diversity and aesthetics, and benefit pollinators. | Proposed by research team; scientific literature | Regional | Multiple species |

* 1. Research Needs Related to Roadside Revegetation

DOT staff identified many research needs related to revegetation along roadsides. Most of these research needs focus on appropriate plant selection, recommended practices for establishment and weed control, and safety.

Table 4. Research Needs for Revegetation

| Research Need | Purpose and Importance | Source of Research Topic | Scale | Pollinators Supported |
| --- | --- | --- | --- | --- |
| Compile guidance for how to create different native seed mixes for different roadside areas and uses. | Generic native seed mixes often have too much grass or contain species that are not appropriate for a given site (e.g., include species that require dry soil for a site with moist soil). It would be useful to synthesize known recommended practices to support DOTs in developing native seed mixes and adapting them for particular circumstances. | Proposed by DOTs; research team | National, regional | Multiple species |
| Determine native seed mixes that best provide erosion control as well as support pollinators. | The focus of revegetation for erosion control is on quick establishment and green up, often with aggressive species that outcompete plants that support pollinators. Regional native seed mixes that will provide erosion control and address Environmental Protection Agency sediment compliance while also supporting pollinators are needed. | Proposed by DOTs | National, regional | Multiple species |
| Develop a list of native species that have a lower fire risk. | Currently, many agencies prefer to use non-native species for 'fire wise' plantings. Identification of native species that can also reduce fire risk is needed. | Proposed by DOTs | Regional | Multiple species |
| Understand the effect of increasing herbaceous vegetation on deer-vehicle collisions along both primary and secondary roads, accounting for landscape-level factors. | Agency leadership have expressed concern that revegetation with native plants may increase vehicle collisions with large mammals like deer. Some DOTs have focused on installing non-palatable plants in high crash areas, or palatable plants near wildlife overpass crossings. It would be useful to work with those DOTs to understand if those planting practices influence vehicle collisions. | Proposed by DOTs | National, regional | Multiple species |
| Strategies for weed control in newly seeded or newly established plots. | What combination of practices—such as mowing, spot treatment with herbicide, etc.—is most efficient and effective in weed control in newly planted areas? | Proposed by DOTs | National, regional | Multiple species |
| Compile guidance on management during plant establishment (e.g., mowing strategies, weed control) for effective native plant revegetation. | Many recommendations for management during the plant establishment phase are scaled for residences or commercial projects; scale practices up to the DOT level. | Proposed by DOTs | National, regional | Multiple species |
| Synthesize how DOTs are measuring successful plant establishment and follow-up monitoring of revegetation. | A synthesis of existing evaluation measures and monitoring would help DOTs determine which practices are most effective. | Proposed by research team | National | Multiple species |
| Strategies for effective interseeding to increase wildflower diversity in existing roadside vegetation. | Interseeding (also known as overseeding) can increase flowering plant diversity in grass-dominated stands of vegetation but has rarely been used on roadsides. Research is needed to better understand how to temporarily suppress existing vegetation in cost-effective ways. | Proposed by research team | National, regional | Multiple species |
| Strategies for transplanting into existing stands of vegetation. | Some species of butterfly host plants can be difficult to establish via seed and need to be established through the installation of bare root or transplants (e.g., milkweeds west of the Rockies). Research is needed to inform optimal sowing dates and management of existing vegetation to aid establishment. | Proposed by research team | National, regional | Multiple species |
| Improve establishment of wildflowers in arid regions. | Test and refine new innovative revegetation methods on roadsides to aid in plant establishment in arid regions. For example, experiment with the timing of seeding, or working with bare roots or native soil inoculum. | Proposed by DOTs | Regional | Multiple species |
| Synthesis of weed control strategies for the most difficult weeds, and an analysis of cost and labor for the top strategies. | Weed control prior to revegetation can influence the success of a revegetation project. Some perennial invasive weeds are particularly challenging to control. A synthesis of control practices used for challenging weeds (e.g., reed canary grass, Canada thistle, crested wheatgrass) would help highlight effective strategies and identify knowledge gaps. | Proposed by DOTs | Regional | Multiple species |

* 1. Research Needs Related to Revegetation and Resilience to Climate Change

Research needs related to climate change primarily center around the need to understand how plant communities will respond to climate change, so that successful, resilient revegetation projects that also support pollinators can be implemented.

Table 5. Research Needs for Climate Change Resilience through Revegetation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Research Need** | **Purpose and Importance** | **Source of Research Topic** | **Scale** | **Pollinators Supported** |
| Which plant species are more resilient to increased weather variability? | Extreme weather events will become more frequent and more intense with climate change. Understanding how different plant species will respond to this variability will help in the selection of plants for revegetation projects in different regions. | Proposed by research team | National, regional | Multiple species |
| How will climate change shift competitive interactions between native and key invasive plants? | In many regions (e.g., the southeast and the northeastern United States), invasive plants are expected to expand their ranges. Understanding competitive interaction between native and noxious or invasive weeds under future climate scenarios will aid in weed management, as well as in maintaining pollinator habitat. | Proposed by research team | National, regional | Multiple species |
| Understanding how provenance of plant material may influence longevity of planting and resilience to the impacts of climate change. | One tactic to increase climate resilience of revegetation projects may be to include a small percentage of seed from more southern ecotypes, which may be better adapted to future climate conditions. Understanding when this is appropriate—and how much seed from other ecotypes to use—would be beneficial, as well as understanding when such practices should be avoided. | Proposed by research team | National, regional | Multiple species |
| Develop “climate-ready” restoration systems that can persist under stress and unstable conditions. | Guidance is needed on how to conduct stable, resilient revegetation projects that will persist under climate change while also providing habitat for sensitive pollinators. | Proposed by research team | National, regional | Multiple species |

* 1. Additional Research Needs

Other research needs that have been identified focus on more information about perception of roadside management by the public, how pollinators use roadsides to move, and the scale and impacts of possible threats to pollinators using roadsides.

Table 6. Additional Research Needs

| Research Need | Purpose and Importance | Source of Research Topic | Scale | Pollinators Supported |
| --- | --- | --- | --- | --- |
| Understand the public perception of reduced roadside mowing. | Conducting a stakeholder engagement analysis could help DOTs to better understand how the public views reduced mowing schemes, and would inform future public relations and messaging about reduced mowing. | Proposed by DOTs; research team | National, regional | Multiple species |
| Measuring the levels of roadside vegetation contamination and potential impacts on key pollinators. | Data on levels of salt and heavy metals in roadside vegetation is not well known across regions of the United States (most data comes from Minnesota, where Dr. Snell-Rood is studying similar questions). Additionally, data on potential impacts on pollinators is limited to several species. A larger-scale study of roadside surveys would identify pollution levels across regions and explore whether pollinator densities are mediated by traffic volume and contamination. In addition, such a study should consider potential effects on pollinators that have higher levels of exposure than foraging pollinators, such as those species that reproduce or overwinter in roadsides, and so are more vulnerable. | Proposed by research team; scientific literature | National, regional | Multiple species |
| Do medians planted with flowering vegetation increase vehicle collisions with pollinators? | It is not currently understood if medians planted with flowering plants influence pollinator movement across roads or mortality due to vehicle collisions. If flowering medians are found to cause higher levels of pollinator-vehicle collisions, DOTs could invest money for diverse plantings in other locations. | Proposed by research team; scientific literature | National | Multiple species |
| Increased understanding of traffic volume and road density on pollinator mortality due to vehicle collisions. | While some studies have shown that higher volumes of traffic correspond to higher rates of pollinator mortality, others have found that moderate levels of traffic have highest levels of mortality. More studies are needed to understand where to prioritize high quality roadside habitat to reduce vehicle mortality. | Proposed by research team; scientific literature | National | Multiple species |
| Understanding how nitrogen deposition may alter roadside plant communities over time. | Vehicle exhaust can cause nitrogen deposition, and nitrogen can favor certain types of plants (e.g., dominant grasses). | Proposed by research team | National | Multiple species |
| Development of a comprehensive cost-benefit decision support tool. | Cost-benefit information is very hard to obtain and summarize to provide consistent and applicable guidance. Research into how this information can be obtained and used across regions is needed. | Proposed by research team; DOTs | National, regional | Multiple species |
| For key imperiled pollinator species, identify if roadkill hotspots exist and test and apply possible reduction measures. | Some imperiled pollinators may live their whole lives on roadsides, and some species may be more susceptible to the impacts of vehicles. There may be hot spots of mortality, due to landscape features or other factors, and it is important to understand if and where hotspots are located and if their impacts can be reduced. | Proposed by research team; scientific literature | Regional | Species specific (e.g., monarch butterflies) |
| Investigate how pollinators use roadsides for movement and dispersal. | Better understand how pollinators use roadsides for movement within landscapes or to disperse to new habitats. | Proposed by research team; scientific literature | National | Multiple species |
| Does revegetation for pollinators increase bat and bird mortality due to collisions with vehicles? | Hummingbirds and nectar-feeding bats that visit flowering plants, as well as birds and bats that rely on insects as a food source, may be more abundant in roadsides that support more insect pollinators. It would be useful to know if birds and bats are subject to increased rates of collisions with vehicles as a consequence of increasing pollinator habitat. | Proposed by DOTs | National, regional | Vertebrate pollinators (hummingbirds, nectar-feeding bats) |

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1. List of Abbreviations, Acronyms, and Initialisms

CCAA Candidate Conservation Agreement with Assurances

DOTs Departments of Transportation

ESA Endangered Species Act

USFWS United States Fish and Wildlife Service

1. Appendices
   1. Appendix A. Survey Questions for the Pollinator and Revegetation Expert Survey
2. Intake Questions

* Name
* Affiliation and position/title
* Contact information (email, phone)
* General description of pollinator research/expertise
* Do you want to be acknowledged by name as a contributor to the guidelines developed through this project? (Yes, I want to be attributed by name/No, please make my contribution anonymous).
* Would you be willing to answer some follow-up questions? We may reach out to a small group of respondents to answer some additional questions, so you may or may not be contacted if you respond “Yes”. (Yes/No)

1. Survey Questions

1. What is your area of expertise? Pick all that apply

* Butterflies/Moths
* Bees
* Roadside habitat

2. How would you describe high-quality roadside habitat for bees/butterflies?

3. What do you think would be the impact of the following management actions in areas (habitats & geographic regions) which support imperiled bees/butterflies? Please rate the following actions either very positive, somewhat positive, neutral, somewhat negative, or very negative (or N/A) from the perspective of the action’s overall impact on bee/butterfly populations. Use the notes section below to add any caveats or additional details about your rankings. Do not consider feasibility in answering this question.

3a. Control woody plant encroachment

3b. Control invasive herbaceous plants which **are not** known to be floral resources/host plants for bees/butterflies

3c. Control invasive herbaceous plants which **are** known to be floral resources/host plants for bees/butterflies

3d. Limit broadcast herbicide use; using spot spraying for vegetation management

3e. Limit mowing beyond the clear zone to one cut per growing season

3f. Limit mowing beyond the clear zone to two cuts per growing season

3g. Mow during the season(s) when pollinators **are not** present

3h. Mow during the season(s) when pollinators **are** present

3i. Spot mow weeds or undesirable plants to avoid host and/or nectar plants

3j. Install new pollinator habitat at a restoration scale (> ¼ acre/11,000 square ft)

3k. Install new pollinator habitat at the garden scale (< ¼ acre/11,000 square ft)

3l. Increase use of native blooming species in seed mixes used in reseeding/restoration efforts

3m. Increase use of native host plant species in seed mixes used in reseeding/restoration efforts [butterfly only]

3n. Train managers, staff, and/or contractors to identify and protect important nectar /host plants

3o. Increase communication & coordination with private landowners about protecting pollinator habitat (e.g. from insecticide drift)

3p. Outreach to the public, shareholders, and/or customers about the importance of pollinator conservation

3q. Monitor pollinators and/or native plants on roadside rights-of-way (ROW)

3r. Optimize other management practices. Please specify if you have specific examples: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. What do you think are the 3-5 most important conservation actions (from the list in question 3) that roadside managers can take to help imperiled bees/butterflies?

5. How would you prioritize potential sites for roadside habitat for the conservation of imperiled pollinators? Please rate each of the following on a scale of 1 to 5 with (1) being low priority and (5) being highest priority:

* Width of available roadside habitat beyond the clear zone (the greater the width, the higher the value as habitat)
* Location strategic to conservation (e.g. pollinator diversity hotspot)
* Location strategic to public outreach goals
* Site amenable to high quality revegetation (e.g. low weed pressure)
* Increases habitat connectivity
* Low probability of pesticide drift from adjacent lands
* Road type (traffic volume, speed limit, number of lanes)
* Site has existing survey data of pollinator diversity/abundance
* Site has high existing plant diversity
* Site has low weed/invasive species pressure and establishing native vegetation may be easier
* Other\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. What do you think DOT’s in your region are doing well right now in terms of pollinator habitat? Please describe.

7. What do you think DOTs in your region are missing right now in terms of roadside pollinator habitat? Are there obvious opportunities or low-hanging fruit for DOTs to change their practices to better support pollinators?

8. What is your region of expertise? Pick all that apply (show map)

* Alaska
* Hawaii
* Maritime Northwest
* Inland Northwest
* California
* Great Basin
* Rocky Mountains
* Southwest
* Northern Plains
* Southern Plains
* Florida
* Southeast
* Mid-Atlantic
* Great Lakes
* Midwest
* Northeast

The remaining survey questions were bifurcated based on expertise. Revegetation experts had slightly different questions than pollinator experts.

Questions for Revegetation Experts

9. What traits would make plants more climate resilient in your region?

10. How could roadside plant communities be made more resilient as climate changes?

11. In your opinion, how important is it to use local ecotype plant materials in revegetation, given future climate shifts?

12. What are the major challenges for native plant establishment on roadsides in your region?

13. Have you been involved with, or are aware of examples of successful vegetation management approaches along roadsides that protect listed or imperiled pollinators? If so, please describe.

14. What information do you think you would need in order to tailor revegetation efforts for listed or declining pollinators?

15. What are the priority research needs in terms of roadside habitat for listed or imperiled pollinators? Please specify if this relates to a particular species.

16. Is there any additional information that relates to roadside design or management of pollinator habitat that you would like to share with us (e.g. white papers, research in progress)?

Questions for Pollinator Experts:

9. We are interested in any insights you may have on imperiled pollinators that occur in the region(s) you have selected, including:

* management timing windows,
* specific management recommendations,
* important plants,
* potential negative consequences of creating roadside habitat for these species,
* whether the costs of roadside habitat outweigh the benefits.

This list includes all pollinators in the region that are listed under the Endangered Species Act, species on the USFWS work plan, and some additional pollinators known to be declining. Please click on any species you are familiar with to provide insight on any/all of these topics. You can also choose “bees/butterflies” to provide general guidance.

* List of bees/butterflies for chosen regions, also include bees/butterflies as an option
* Under each species:
  + - What would be the optimal time of year for roadside vegetation management to reduce impacts on this species?
    - Do you have any specific recommendations to manage roadside habitat for this species?
    - Are there negative consequences for creating roadside habitat for this species?
    - Do the benefits of roadside habitat for this species outweigh potential risks associated with roadside habitat (e.g. exposure to heavy metals, mortality from vehicle collisions)?
    - Do you expect this species will be affected by climate change? If so, how?
    - Do you think general efforts to support pollinators on roadsides would be beneficial to this species?
    - Are you willing to be listed as an expert source for DOTs for this species?

10. Are there additional species that should be included on this list?

11. Are there species not on this list for which roadside habitat is valuable?

12. What are the priority research needs in terms of roadside habitat for pollinators? Please specify if this relates to pollinators in general or a particular species.

13. Have you been involved with, or are you aware of examples of successful vegetation management approaches along roadsides that protect listed or imperiled pollinators? If so, please describe.

14. Is there any additional information that relates to roadside design or management of pollinator habitat that you would like to share with us (e.g. white papers, research in progress)?

***Thank you for contributing to this survey!***

* 1. Appendix B. Survey Questions for the DOT Practitioner Survey

1. Part 1. Intake Questions (Questions 1-5)

* Name
* Affiliation and position/title
* Contact information (email, phone, address)
* What is your area of expertise within your agency? Pick one or more categories that best fits your expertise.
* Environmental
* Maintenance
* Design
* Planning
* Construction
* Landscape Architecture
* Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Would you like to be included in the acknowledgements by name as a contributor to the guidelines developed through this project? (Note: your name will not be directly tied in the document to your responses provided in this survey.)
* (Yes, I want to be attributed by name/No, please make my contribution anonymous).
* Would you be willing to answer some follow-up questions? We may reach out to a small group of respondents to answer some additional questions, so you may or may not be contacted if you respond “Yes”. (Yes/No)

1. Survey Questions

Please respond to questions to the best of your ability. If you do not have expertise in an area, feel free to skip a question or answer N/A. If you feel like a colleague might contribute responses to questions, please share the survey link with them.

1. Part 2. Feasibility of Conservation Actions for Imperiled Pollinators

We would like to better understand the potential and current implementation of DOT practices that can support or reduce impacts to imperiled pollinators.

Below we list conservation actions that can support imperiled pollinators. Please rate the extent to which conservation actions are currently being implemented by your agency, and select possible barriers to the implementation of these practices.

6. How frequently does your DOT currently implement the following **mowing** practices that can support imperiled pollinators?

|  |  |
| --- | --- |
| Limit mowing beyond the clear zone to no more than twice per year. | Always, Usually, Sometimes, Not often, Never |
| Avoid mowing imperiled butterfly host plants during butterfly breeding season in your area (e.g., avoid mowing Lupine spp., which support Karner blue butterfly). | Always, Usually, Sometimes, Not often, Never |
| Delay mowing to as late as possible during the growing season (e.g. mow in autumn). | Always, Usually, Sometimes, Not often, Never |
| Adjust mowing height to a minimum height of 8–10 inches in areas with target butterfly host plants if mowing during the growing season. | Always, Usually, Sometimes, Not often, Never |
| Aim to mow no more than 1/3-1/2 of an area beyond the clear zone per year (e.g. rotate mowing sections of a roadside. | Always, Usually, Sometimes, Not often, Never |
| Clean mowing equipment after use and between sites to limit the spread of invasive weeds. | Always, Usually, Sometimes, Not often, Never |

7. What are the barriers for your DOT to implement these **mowing** practices that can support imperiled pollinators?

|  |  |
| --- | --- |
| Limit mowing beyond the clear zone to no more than twice per year. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Avoid mowing imperiled butterfly host plants during butterfly breeding season in your area (e.g., avoid mowing Lupine spp., which support Karner blue butterfly). | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Delay mowing to as late as possible during the growing season (e.g., mow in autumn). | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Adjust mowing height to a minimum height of 8–10 inches in areas with target butterfly host plants. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Aim to mow no more than 1/3-1/2 of an area beyond the clear zone per year (e.g. rotate mowing sections of a roadside. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Clean mowing equipment after use and between sites to limit the spread of invasive weeds. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |

8. How frequently does your DOT currently implement the following **herbicide** practices that can support imperiled pollinators?

|  |  |
| --- | --- |
| Conduct roadside vegetation inventories to identify emerging weed or hazard tree issues, or to identify high quality vegetative communities. | Always, Usually, Sometimes, Not often, Never |
| Track weed outbreaks and herbicide usage over time to evaluate the effectiveness of herbicide treatments and inform future management decisions. | Always, Usually, Sometimes, Not often, Never |
| Train staff and contractors to recognize native plants as well as noxious and invasive weeds to reduce unintended damage to nontarget plants. | Always, Usually, Sometimes, Not often, Never |
| Use selective herbicides whenever possible to reduce damage to non-target plants. | Always, Usually, Sometimes, Not often, Never |
| Herbicide applications are directed on undesirable plants to avoid harming non-target species (e.g. spot treatment applications with a backpack sprayer, targeted applications to cut stems, etc.). Broadcast treatments or pellet dispersal are used only for dense infestations of weeds or for safety zone or guardrail treatments. | Always, Usually, Sometimes, Not often, Never |
| Apply herbicides during plant life stages when weeds are most vulnerable (before blooming or before going to seed). | Always, Usually, Sometimes, Not often, Never |
| Choose and calibrate equipment with drift management in mind. (e.g., Calibrate equipment regularly; choose spray nozzles to reduce drift; on boom sprayers, use the lowest effective pressure and largest droplet size possible). | Always, Usually, Sometimes, Not often, Never |

9. What are the barriers for your DOT to implement these **herbicide** practices that can support imperiled pollinators?

|  |  |
| --- | --- |
| Conduct roadside vegetation inventories to identify emerging weed or hazard tree issues, or to identify high quality vegetative communities. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Track weed outbreaks and herbicide usage over time to evaluate the effectiveness of herbicide treatments and inform future management decisions. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Train staff and contractors to recognize native plants as well as noxious and invasive weeds to reduce unintended damage to nontarget plants. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Use selective herbicides whenever possible to reduce damage to non-target plants. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Herbicide applications are directed on undesirable plants to avoid harming non-target species (e.g. spot treatment applications with a backpack sprayer, targeted applications to cut stems, etc.). Broadcast treatments or pellet dispersal are used only for dense infestations of weeds or for safety zone or guardrail treatments. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Apply herbicides during plant life stages when weeds are most vulnerable (before blooming or before going to seed). | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Choose and calibrate equipment with drift management in mind. (e.g., Calibrate equipment regularly; choose spray nozzles to reduce drift; on boom sprayers, use the lowest effective pressure and largest droplet size possible). | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |

10. How frequently does your DOT currently implement the following **brush removal** practices that can support imperiled pollinators?

|  |  |
| --- | --- |
| Feather or soften forest edges adjacent to clear zones to create a transitional area between the forest and grass (e.g. thin portions of the forest canopy along the edge next to grassy areas, removing undesirable or unhealthy trees). | Always, Usually, Sometimes, Not often, Never |
| Leave snags or trees with cavities in areas where they are set back from the road and pose no safety risk. | Always, Usually, Sometimes, Not often, Never |
| Minimize soil disturbance (disking, tilling) during brush removal activities to avoid spreading invasive plants. | Always, Usually, Sometimes, Not often, Never |

11. What are the barriers for your DOT to implement these **brush removal** practices that can support imperiled pollinators?

|  |  |
| --- | --- |
| Feather or soften forest edges adjacent to clear zones to create a transitional area between the forest and grass (e.g. thin portions of the forest canopy along the edge next to grassy areas, removing undesirable or unhealthy trees). | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Leave snags or trees with cavities in areas where they are set back from the road and pose no safety risk. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Minimize soil disturbance (disking, tilling) during brush removal activities to avoid spreading invasive plants. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |

12. How frequently does your DOT currently implement the following **landscape design and revegetation** practices that can support imperiled pollinators?

|  |  |
| --- | --- |
| When designing new plantings, include plants known to provide floral resources that attract pollinators. | Always, Usually, Sometimes, Not often, Never |
| Increase the abundance and diversity of flowering plants whenever possible by including 3 or more species in bloom at any time between spring and fall so that there is an overlapping succession of bloom throughout the growing season. | Always, Usually, Sometimes, Not often, Never |
| Include host plants for key target species of butterflies and moths. | Always, Usually, Sometimes, Not often, Never |
| Native plants are used in new plantings. | Always, Usually, Sometimes, Not often, Never |
| Prioritize using locally (or regionally if local is unavailable) sourced native plant materials. | Always, Usually, Sometimes, Not often, Never |
| Coordinate with native plant vendors early about plant material needs to allow them to collect foundation seed or grow out plant materials. | Always, Usually, Sometimes, Not often, Never |
| When planting seed, require seed testing certificates from seed vendors that describe germination rates and any weed seed or contaminants in the order. | Always, Usually, Sometimes, Not often, Never |
| Develop, in collaboration with maintenance staff, a weed management plan for site preparation in advance of planting and a plan for weed control during the establishment period. | Always, Usually, Sometimes, Not often, Never |
| Irrigate for early plant establishment when needed. | Always, Usually, Sometimes, Not often, Never |
| Interseed to increase flowering plants in existing stands of low-diversity vegetation. | Always, Usually, Sometimes, Not often, Never |
| Create new pollinator habitat gardens at rest areas or offices that include plants and host plants. | Always, Usually, Sometimes, Not often, Never |
| To what extent is your DOT considering resilience to climate change when designing new plantings? | Always, Usually, Sometimes, Not often, Never |

13. What are the barriers for your DOT to implement these **landscape design and revegetation** practices that can support imperiled pollinators?

|  |  |
| --- | --- |
| When designing new plantings, include plants known to provide floral resources that attract pollinators. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Increase the abundance and diversity of flowering plants whenever possible by including 3 or more species in bloom at any time between spring and fall so that there is an overlapping succession of bloom throughout the growing season. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Include host plants for key target species of butterflies and moths. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Native plants are used in new plantings. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Prioritize using locally (or regionally if local is unavailable) sourced native plant materials. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Coordinate with native plant vendors early about plant material needs to allow them to collect foundation seed or grow out plant materials. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| When planting seed, require seed testing certificates from seed vendors that describe germination rates and any weed seed or contaminants in the order. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Develop, in collaboration with maintenance staff, a weed management plan for site preparation in advance of planting and a plan for weed control during the establishment period. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Irrigate for early plant establishment when needed. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Interseed to increase flowering plants in existing stands of low-diversity vegetation. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| Create new pollinator habitat gardens at rest areas or offices that include plants and host plants. | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |
| To what extent is your DOT considering resilience to climate change when designing new plantings? | [Select all that apply]  ● staff training  ● financial constraints  ● equipment limitations  ● incompatibility with other goals  ● staff resources  ● Not relevant to this region  ● Other. Please explain: [Comment box] |

14. Which weeds are the most problematic to control on roadsides in your region? [comment box]

15. What type of assistance would be most useful to your DOT in controlling these weed problems? [multiple choice]

* Financial assistance
* Regional technical guidance on weed control strategies
* Training for staff and contractors
* Other: [comment box]

16. Does your DOT use prescribed fire or prescribed grazing? If yes, please describe how your DOT uses these management strategies. [comment box]

17. What are the major challenges for native plant establishment on roadsides in your region?

* Lack of native plant materials
* Lack of institutional technical knowledge
* Timing of planting not ideal for establishment
* Lack of necessary equipment
* Weed control (either prior to planting or during establishment phase)
* Long-term maintenance plan for new plantings
* Other. Please explain further: [Comment box]

18. How does your DOT most commonly engage the public about their pollinator conservation efforts?

* N/A
* Interpretive signage at rest areas
* Printed publications
* Workshops or events
* Information on website
* Other. Please explain further: [Comment box]

1. Part 3. Imperiled Pollinators and Your Work

16. In your transportation work, have you encountered pollinators that are protected through the Endangered Species Act?

If yes, please check the species you have encountered (or add to the comment box) and describe the situation/s. [checklist of ESA species and then a space for comments to describe]

20. How have the listed species you have encountered affected your **project planning workflow?**

* N/A
* No effect
* Delays
* Increased Costs
* Project redesign or modifications to operations
* Other

21. How have the listed species you have encountered affected your **design workflow**?

* N/A
* No effect
* Delays
* Increased Costs
* Project redesign or modifications to operations
* Other

22. How have the listed species you have encountered affected your **operations workflow**?

* N/A
* No effect
* Delays
* Increased Costs
* Project redesign or modifications to operations
* Other

23. What protocol changes would you recommend to improve workflow while still maintaining compliance with endangered species regulations?

* ESA compliance guidebook providing options and decision support.
* Programmatic ESA permits in place to cover all future actions/projects.
* Both (a) and (b).
* None of the above, my workflow for ESA compliance is fine as it is.

24. What information do you need about listed or declining pollinators to support your work? [multiple choice]

* Natural history information (e.g. host plants, distribution, adult flight times)
* ESA compliance guidance
* State-level protection
* List of listed and imperiled pollinator species to be aware of
* Background on management impacts
* Reasons for species decline/risk factors
* Species description/ identification tools
* Other: [comment box]

25. Approximately how many times per year do you need to consult with the United States Fish and Wildlife Service (USFWS) or your state Department of Wildlife (or similar agency involved in the recovery of at-risk species) regarding Federal or state listed **pollinator** species? [multiple choice]

* >10
* 5-10
* 1-5
* <1

26. Approximately how many times per year do you need to consult with the United States Fish and Wildlife Service (USFWS) or your state Department of Wildlife (or similar agency involved in the recovery of at-risk species) regarding Federal or state listed **non-pollinator** species? [multiple choice]

* >10
* 5-10
* 1-5
* <1

27. Does the possibility of an imperiled pollinator species (e.g. monarch butterflies) becoming legally protected by the Endangered Species Act cause barriers (e.g. alters project timeline) to your agency? Yes, Somewhat, No, No Opinion/Don’t Know

* If yes, please describe: [COMMENT BOX]

28. Does the possibility of an imperiled pollinator species becoming legally protected by the Endangered Species Act motivate your agency to proactively protect pollinators in order to avert a listing? Yes, Somewhat, No, No Opinion/Don’t Know.

* If yes, please describe: [COMMENT BOX]

29. Are you familiar with any of the following listed ESA Compliance Strategies? [Please answer yes or no.] If yes, have you ever applied the strategy to your work?

* Safe Harbor Agreements Yes, No
  + - Applied the strategy to your work? Yes, No
    - Recovery Crediting System Yes, No
    - Applied the strategy to your work? Yes, No
* Habitat Conservation Plans Yes, No
  + - Applied the strategy to your work? Yes, No
* Candidate Conservation Agreements Yes, No
  + - Applied the strategy to your work? Yes, No
* Candidate Conservation Agreements with Assurances Yes, No
  + - Applied the strategy to your work? Yes, No
* Pre-listing Conservation Agreements Yes, No
  + - Applied the strategy to your work? Yes, No

30. Has your DOT signed on to the USFWS’s Candidate Conservation Agreement with Assurances (CCAA) for the monarch butterfly (<https://www.fws.gov/savethemonarch/CCAA.html>)?

* Yes, No, Not yet but has plans to enroll, Don’t Know

31. If yes: Why did your DOT decide to enroll in the CCAA? [multiple choice]

* Complemented other goals
* Good for public relations
* To help avert a listing
* Other: [comment box]

32. If no: Why did your DOT decide against enrolling in the CCAA? [multiple choice]

* Too costly
* Too logistically challenging
* Doesn’t fit with current priorities
* Not concerned about a potential ESA listing of monarchs
* Other: [comment box]

33. To the best of your knowledge, do you think your DOT is interested in signing on to potential future CCAAs, if they become available for additional imperiled pollinators (e.g. the western bumble bee, *Bombus occidentalis*)? Yes, No, No Opinion/Don’t Know

34. Has your DOT identified pollinator conservation as a priority? Yes, No, I don’t know

35. If yes: What were the primary motivations for your DOT’s past pollinator conservation projects? [multiple choice]

* Part of agency sustainability goals
* Responding to a community request or collaboration opportunity
* Part of a larger agency permit negotiation/approval
* Effort to avert a species listing
* Other: [fill in]

1. Part 4. Wrap-up

36. DOT efforts to support pollinators (imperiled or otherwise) may be useful to highlight conservation examples to other agencies. Do you have conservation stories /case studies /photos that you would like to highlight in the regional guidebooks (currently in development)?

* Yes, Maybe, No.
* If yes or maybe, we will follow-up to collect more details and photos.

37. Please provide any other comments, perspectives, or concerns related to pollinators that you feel are important.

* [COMMENT BOX]

***Thank you for your time and knowledge!***

* 1. Appendix C. Survey Responses for the Pollinator and Revegetation Expert Survey

1. Part I. Survey Questions

Q2: How would you describe high-quality roadside habitat for pollinators?

* 18 respondents
* Plant diversity (and flowering phenology): 16
* Reduced mowing frequency: 5
* Protected from pesticides: 4
* Low traffic volume or speed: 3
* Adjacent to habitat/increases connectivity: 3
* Resistant to weeds: 3
* Bare soil for nesting bees: 1
* Self-replicating and long-lived: 1
* Mitigates toxins from automobiles and management: 1
* Productive soils, hydrologically stable: 1

Q3: What do you think would be the impact of the following management actions in areas (habitats & geographic regions) which support imperiled pollinators?

Weed Management

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Action | Very Positive | Somewhat Positive | Neutral | Somewhat Negative | Very Negative | Total Responses |
| Control woody plant encroachment | 6 (33%) | 9 (50%) | 3 (17%) | 0 | 0 | 18 |
| Control invasive herbaceous plants which are not known to be floral resources/host plants for pollinators | 13 (68%) | 5 (26%) | 1 (5%) | 0 | 0 | 19 |
| Control invasive herbaceous plants which are known to be floral resources/host plants for pollinators | 2 (11%) | 3 (16%) | 3 (16%) | 9 (47%) | 2 (11%) | 19 |
| Limit broadcast herbicide use; using spot spraying for vegetation management | 12 (63%) | 7 (37%) | 0 | 0 | 0 | 19 |

Mowing

| Action | Very Positive | Somewhat Positive | Neutral | Somewhat Negative | Very Negative | Total Responses |
| --- | --- | --- | --- | --- | --- | --- |
| Limit mowing beyond the clear zone to one cut per growing season | 12 (63%) | 2 (11%) | 2 (11%) | 2 (11%) | 1 (5%) | 19 |
| Limit mowing beyond the clear zone to two cuts per growing season | 3 (16%) | 10 (53%) | 3 (16%) | 2 (11%) | 1 (5%) | 19 |
| Mow during the season(s) when pollinators are not present | 10 (56%) | 4 (22%) | 3 (17%) | 1 (5%) | 0 | 18 |
| Mow during the season(s) when pollinators are present | 1 (5%) | 0 | 2 (11%) | 7 (37%) | 9 (47%) | 19 |
| Spot mow weeds or undesirable plants to avoid host and/or nectar plants | 12 (63%) | 4 (21%) | 3 (16%) | 0 | 0 | 19 |

New Habitat

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Action | Very Positive | Somewhat Positive | Neutral | Somewhat Negative | Very Negative | Total Responses |
| Install new pollinator habitat at a restoration scale (> ¼ acre/11,000 square ft) | 14 (78%) | 4 (22%) | 0 | 0 | 0 | 18 |
| Install new pollinator habitat at the garden scale (< ¼ acre/11,000 square ft) | 5 (26%) | 13 (68%) | 1 (5%) | 0 | 0 | 19 |
| Increase use of native blooming species in seed mixes used in reseeding/restoration efforts | 15 (79%) | 4 (21%) | 0 | 0 | 0 | 19 |
| Increase use of native host plant species in seed mixes used in reseeding/restoration efforts | 13 (87%) | 2 (13%) | 0 | 0 | 0 | 15 |

Education, Training, and Outreach

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Action | Very Positive | Somewhat Positive | Neutral | Somewhat Negative | Very Negative | Total Responses |
| Train managers, staff, and/or contractors to identify and protect important nectar /host plants | 17 (89%) | 2 (11%) | 0 | 0 | 0 | 19 |
| Increase communication & coordination with private landowners about protecting pollinator habitat (e.g. from insecticide drift) | 15 (79%) | 4 (21%) | 0 | 0 | 0 | 19 |
| Outreach to the public, shareholders, and/or customers about the importance of pollinator conservation | 14 (74%) | 4 (21%) | 1 (5%) | 0 | 0 | 19 |
| Monitor pollinators and/or native plants on roadside rights-of-way | 16 (84%) | 2 (11%) | 1 (5%) | 0 | 0 | 19 |

Additional Actions Listed by Respondents

* Monitor pollinators and habitat in conjunction with these efforts to determine their effectiveness and adjust accordingly. Integrate training, seeding, management across stakeholders.
* Educate the public as well as private non-profit activists that herbicides are not all bad. Herbicides are powerful and useful tools that can be used responsibly for the benefit of native plant/invertebrate communities.
* Evaluate roadkill of pollinators along various roadsides (interstates, state highways, twolanes, etc.) to see which are the roadsides that have the least roadkill and use those as emphasis areas for roadside plantings of poll. habitat.
* Reduce traffic speed and/or flow.
* Some questions are hard to answer as they are system and context specific. I'm not sure what the best # of times to mow is - depends on what is impacted and when. Likewise - some herbicides can reduce invasive weeds and have little impact on some of the insects - but that is context and chemical specific; monitoring would also be useful

Q4: What do you think are the 3-5 most important conservation actions (from the list in question 3) that roadside managers can take to help imperiled pollinators?

|  |  |
| --- | --- |
| Number of Responses | Action |
| 12 | Reduce mowing and/or time mowing to avoid active pollinator season |
| 11 | Increase use of native plants and increase plant diversity |
| 6 | Increased training of staff |
| 6 | Limit broadcast herbicide use; using spot spraying for vegetation management |
| 5 | Increased public outreach |
| 4 | Install new habitat (especially at restoration scale) |
| 4 | Control invasive plants, including woody species |
| 1 | Work with adjacent land owners |
| 1 | Proper site preparation, maintenance and design |
| 1 | Monitoring |
| 1 | Don’t remove non-native species that are used by pollinators |
| 1 | Reduce traffic speed |
| 1 | Map restoration efforts and existing habitat along roadsides |
| 1 | Use artificial nests that are protected from ants |

Q5: How would you prioritize roadside habitat for the conservation of imperiled pollinators? Please rank each of the following on a scale of 1 to 5 with (1) being lowest priority and (5) being highest priority:

Number of responses in each category. Shaded rows show the highest rated action.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Action | 5 (highest) | 4 | 3 | 2 | 1 (lowest) | No. responses | Average |
| Width of available roadside habitat | 5 | 6 | 2 | 2 | 2 | 17 | 3.59 |
| Location strategic to conservation (e.g. hotspot region) | 10 | 7 | 0 | 0 | 0 | 17 | 4.59 |
| Location strategic to public outreach goals | 0 | 5 | 6 | 4 | 3 | 18 | 2.72 |
| Site amenable to high quality revegetation (e.g. low weed pressure) | 8 | 6 | 4 | 0 | 0 | 18 | 4.22 |
| Increasing habitat connectivity | 10 | 6 | 2 | 0 | 0 | 18 | 4.44 |
| Low probability of pesticide drift from adjacent lands | 9 | 3 | 4 | 1 | 0 | 17 | 4.18 |
| Road type (traffic volume, speed limit, number of lanes) | 3 | 4 | 6 | 1 | 3 | 17 | 3.18 |
| Surveys of pollinator diversity/abundance | 2 | 8 | 3 | 5 | 0 | 18 | 3.39 |
| Existing plant diversity | 7 | 6 | 2 | 3 | 0 | 18 | 3.94 |
| Weed/invasive species pressure | 4 | 10 | 3 | 1 | 0 | 18 | 3.94 |

Additional actions suggested/ additional comments:

* Depending on landscape context and natural history of each pollinator, priorities might be different. For pollinators in ag zones, avoidance of pesticide drift would disqualify most habitat on the landscape. For other species this might be feasible.
* Besides diversity, take into account presence of endangered, threatened, and conservation concern species.
* As above, the priorities will depend on details of the at-risk species.

Q6: What do you think DOT’s in your region are doing well right now in terms of pollinator habitat? Please describe.

| Survey | Answer | Region(s) |
| --- | --- | --- |
| Reveg | Incorporating native seed mixes that include native wildflowers into some of their regrading work. | NP, MW |
| Reveg | Outreach and education, sub-contractor and staff knowledge building [training]. | GL, MW |
| Reveg | NA | MN, IN, CA, GB, RM |
| Reveg | Reduced mowing; preservation of naturally occurring stands of wildflowers/native grasses | FL |
| Reveg | MDOT in Central MD (Carroll and Frederick Counties) is supporting pollinators in a number of ways; including, seeding new construction w/ native sedges, grasses and flowering species, encouraging district shops to adopt a reduced mow regime, enabling meadows to regenerate naturally (albeit slowly in many areas) and they have initiated public outreach efforts. | MA, NE |
| Reveg | Systemic approach (integrated roadside vegetation management, supported by a trust fund for research and technical assistance. Combination of local (county) and state involvement. [multiple stakeholders] | MW |
| Reveg | Supporting research and assessment to establish best methods (for monarchs, rusty-patch bumblebees and other species). Using native seed mixes when budgets allow post-construction. Discouraging frequent mowing (but battling rural haying). Prioritizing invasive controls for low frequency, spreading species instead of spraying everywhere for species that are a lost cause. | MW |
| Reveg | They are thinking about it and considering what to do! | NE |
| Reveg | Funding some low-level research on implementable solutions and installation of demonstration projects that improve habitat and that preserve the needs of the motoring public for infrastructure preservation, affordability and public safety. | SP |
| Pollinator | Supporting research, developed good seed mixes | NP, GL, MW |
| Pollinator | Not mowing quite as much as they used to | NP, SP, SE, FL, GL, MW |
| Pollinator | So far unaware of any DOT pollinator initiatives in Hawaii | HI |
| Pollinator | reduced mowing, spot treatments for invasive non-bee plants, and developing plans for planting bee forage | NE |
| Butterfly west | For Fender's blue/Kincaid's lupine - there is signage along some roads about when to mow/not mow relative to flowering times of the native plants | PNW |
| Butterfly plains | In Iowa there are already roadside managers that work in many of the 99 counties. In some of the counties they have re-established native vegetation and they have maps of where they have seeded. These activities are not all being conducted by DOT employees, but the DOT has the advantage of these positions and activities already existing. | RM, MW |
| Butterfly plains | Delayed mowing in spring Reduced mowing in some locations | SP |
| Butterfly plains | Attempting to identify and maintain areas with higher native diversity. Conducting some insect/pollinator inventories, particularly for rusty patched bumble bee | CA, PNW, NP |

Q7: What do you think DOTs in your region are missing right now in terms of roadside pollinator habitat? Are there obvious opportunities or low-hanging fruit for DOTs to change their practices to better support pollinators?

| Survey | Answer | Region(s) |
| --- | --- | --- |
| Reveg | Better education and monitoring of the quality of contractors work so they are not spraying native plants. | NP, MW |
| Reveg | Reduced mowing, spot spraying | GL, MW |
| Reveg | All I know is that you have to begin with productive soils otherwise you can't grow healthy plants which support pollinators. The low hanging fruit is to start improving the soils on our roadside, which would improve water quality and a bunch of other resources including pollinators. It's a long view but what do you expect from an old guy. Young guys plant gardens, old guys plant trees. Haha! | MN, IN, CA, GB, RM |
| Reveg | Increase number of surveys to find economically and ecologically sustainable naturally occurring habitat | FL |
| Reveg | Training roadside maintenance crews is key. Offering bi-lingual classes on the importance of pollinators, their habitat needs and the role of roadsides in conservation efforts would be a good starting place. Also, construction/development projects offer obvious opportunities to select plants and woodies rich with floral rewards. | MA, NE |
| Reveg | Current use of contractors for seeding and maintenance does not have enough safeguards for ensuring best practices. | MW |
| Reveg | Hopefully research will inform some best practices (E.g., slopes, mowing widths) for reducing collisions; and current research on revegetation techniques. I think most of the low hanging fruit areas need more info. | MW |
| Reveg | There appear to be long-ingrained methods of treating roadsides which are sometimes incompatible with pollinator habitat, for example, frequent mowing beyond the safety clear zone. Less frequent mowing of backslopes would be beneficial. | NE |
| Reveg | Private landowners in rural areas are often old-school and often see little value in preservation of native plant communities. However, these folks are cost-conscious and is perhaps feasible to develop compromise solutions to roadside vegetation management that wins their support and endorsement and will create a win-win for all parties involved. | SP |
| Pollinator | Not enough maintenance, establishment of seeded plantings. More bee habitat being established, prioritized. | NP, GL, MW |
| Pollinator | Totally --- DOT supervisors should sit down with pollinator biologists or their ilk incl. state conservation biologists, , and prioritize areas for poll. planting/conservation emphasis. A huge task for certain, but otherwise it will be a hit/miss operation. Having a plan would be good | NP, SP, SE, FL, GL, MW |
| Pollinator | Native plants, artificial nest sites- yes, plenty of ideas that I'd be happy to discuss. | HI |
| Pollinator | reducing traffic speed in areas where pollinators are ion low abundance and species richness | NE |
| Butterfly west | I don't know these details well enough to answer | PNW |
| Butterfly plains | One of the issues is understanding how much mortality of pollinators occurs on roads with high volume and high traffic speed. More research needs to be conducted to understand whether pollinator habitat on roads with high volume and speed of traffic are sources or sinks for pollinators. Smaller unpaved roadways may be more beneficial to pollinators, but we don't really have enough data to understand these relationships. Similarly, roadside width may affect the value of the habitat. | RM, MW |
| Butterfly plains | Divisions make different decisions | SP |
| Butterfly plains | Mowing indiscriminately and more than necessary | CA, PNW, NP |

1. Part II. Questions from Revegetation Survey Only

Q9 and Q10: Climate change: plant traits and plant communities.

| Q9. What traits would make plants more climate resilient in your region? | Q10. How could roadside plant communities be made more resilient as climate changes? | Region(s) of expertise |
| --- | --- | --- |
| Ability to withstand extreme rain events. | Plant the most diverse seed mixes affordable. Ensure there are at least a few species within each functional group (perennial C4 grasses, perennial C4 forbs, etc.) to ensure at least some species within each group will adapt to climate change. | MW |
| Genetically diverse seed sources. Try to keep a large gene pool | Encourage a suite of native perennial species. If using seed mix, have professionals compose and obtain. | CA, IN, MN, GB, RM |
| Drought tolerance | Reduce mowing | FL |
| Plants w/ deep roots to withstand extreme weather swings from major flooding events to droughts | By designing and managing roadside vegetation to support and an abundance and diverse native flora. While some species might not be able to adapt other species will thrive. Thus ensuring a continuity of vegetative cover and function. Also, minimizing stressors that might compromise plant fitness, i.e., excessive toxins (road salt and pollution) and competition from invasive plants. | MA, NE |
| Increased intense rainfall events and flooding in our region; marginally longer growing seasons and warmer nights/cooler days. Not sure - tolerance for saturated soils. | Increase use of sedges and early spring/late fall species for better coverage across the lengthening growing season. | MW |
| Not sure about this one... planting a diversity of species and genotypes and including generalists with broad climate tolerance. | Diversity of species/genotypes. Have also noticed some of the more competitive roadside species tend to be clonal species. | MW |
| Ability to withstand late-season moisture stress. Ability to be resilient to more frequent, intense precipitation events. Tolerance for a wide temperature band (summers here are getting hotter and winter will be more variable, warmer overall but still with some cold nights). [flooding and drought] | Using a variety of wild-collected, native plants for restoration or planting sites (increase genetic diversity within plants on roadsides). Reduce stress on desired plants by reducing mowing frequency so plants are allowed to go to seed, spread naturally either by seed or clonally, etc. Reduce competition from invasive plants, especially ones known to not be used by pollinators. However, overall wildlife habitat value and biodiversity will benefit from removal of all damaging invasive plants, when they can be spot-treated and replaced with suitable native plants, which are co-evolved with native insects and provide better overall habitat. It's not just pollinators we need to think about on roadsides, many insects can benefit from improved management practices. | NE |
| Drought resistant, cold tolerant, low growing and tolerant of herbivory so as to be able to be mowed yet still flower. This would create a suitable compromise between the mow vs don't mow groups. We need compromise solutions for all parties involved. | By having diverse plant communities that are allowed to go to seed, I believe that the plant communities can adapt over time due to climate change. Diverse populations to start with generally have high heritability in a number of performance traits. If that plant community is allowed to set seed, tubers, mature, etc it will most likely be able to experience the proper change in frequency of gene expression as needed and thereby as a population adapt to climate change. In some cases, introduction of germplasm from outside the region may help diversify and fortify the population and help it adapt as a population to changing climate. We can employ classic concepts of plant breeding discovered in crop production to native plant populations and help those native plant communities adapt. | SP |

Q11: In your opinion, how important is it to use local ecotype plant materials in revegetation? Does climate change change the importance of using local ecotypes?

|  |  |
| --- | --- |
| Respondent | Answer |
| 1 | It is very important to maintain the genetic integrity of local ecotype plant materials. I don't think climate change alters the importance of using local ecotypes, although the ranges of recommended local ecotypes for a given location may shift. |
| 2 | very important for improved resilience through natural solutions |
| 3 | very important |
| 4 | If economically practical, use plant material from same EPA level III ecoregion. Climate change - IMHO, need to have more genetic diversity within a species to facilitate adaptation to climate change over the long term; and include germplasm from outside the ecoregion |
| 5 | I'm not really sure but in theory it seems logical to use local ecotype plant materials. |
| 6 | Compared to what alternative? Most cultivars were selected for particular traits and are less genetically diverse. Non-cultivar, non-local ecotype had to come from somewhere but we don’t know where, Local eco types are in theory more genetically diverse than cultivars and therefore more able to adapt over time. We may be able to use southern eco types further north on a case by case basis. If we don’t know the genetic origin of the non-cultivar non-eco types materials, we can’t try that. So more information, and less deliberate (and unconscious) selection is better. |
| 7 | "Local" to a certain extent (e.g., by region, but not by county). Diverse populations and communities are resilient. |
| 8 | It is a best practice to use local ecotype plant materials in revegetation, and even with climate change, I believe using plants from the existing ecoregion and perhaps the one next door/in a slightly warmer plant zone is still a good practice at this time. Perhaps select plants from the ecotype list(s) with characteristics that allow for increased resilience, like ability to tolerate late season moisture stress. However, we cannot let the perfect be the enemy of the good. The reality is that often, local ecotype plant materials are not available. At a minimum, using native plants known to provide the full suite of resources needed by insects (forage including leaves and stems and roots, not just nectar and pollen) will be beneficial, and whenever possible, using diverse genomes of these plants, NOT cloned stock. Climate change makes it more imperative to use genetically diverse plant stock, since a single genome is very vulnerable to a single stressor/pest/disease etc. |
| 9 | While local ecotype plants are preferred, sometimes their lack of availability, impracticality or expense means that it is only feasible to use ecotypes from other regions. In theory, diversity exists in every population and therefore a population brought in from another area, give opportunity over time it will adapt to the conditions present. |

Q12. What are the major challenges for native plant establishment on roadsides in your region?

|  |  |
| --- | --- |
| Respondent | Answer |
| 1 | Interference with the plantings by adjacent landowners who like the mowed look, and convincing counties to have a program to use an integrated approach to managing their roadsides that includes planting native plants when it is voluntary. |
| 2 | Public buy-in, funding |
| 3 | Creating healthy soils! |
| 4 | - Weeds! - Lack of seed sources adapted to the ecoregion of planting |
| 5 | - Invasive species, specifically Japanese honeysuckle and Canada thistle - Urban aesthetics, people including DOT maintenance crews are used to and often prefer neat and tidy verges, which leads maintenance crews and adjacent land owners to mow despite 'meadow in progress' signs - Lack of experienced practitioners to prep and maintain sites |
| 6 | Short planting windows and intense rainfalls; steep ditch slopes; landowner mowing and spraying/interference; intrinsically low levels of seedling establishment (0.1 to 5%) for native species even with PLS seed. |
| 7 | Being outcompeted by annual invasives in the seed bank. Soil compaction and methods of seeding. Establishment rate of native perennials relative to rates DOTs need to reduce soil erosion. Seed mix cost. |
| 8 | Mowing, exposure to salt from winter ice, probably moisture stress in the planting stage. I am not really sure as I don't have direct experience with this. |
| 9 | Changing the attitude of some of the public, some legislators and some private landowners that it is not desirable nor necessary to keep the areas outside the clear/safety zone mowed down year-around. There is cost-benefit to allow restoration or preserve high-quality existing native habitat outside the clear/safety zone. Also a challenge is to educate the well-meaning environmental activist that alienates significant numbers of people with extreme and inflexible views on ecosystem restoration and management. Environmental extremists regularly shoot themselves in the foot with their inability to compromise and create win-win solutions with all members of the public. |

Q13. Have you been involved with, or are aware of examples of successful vegetation management approaches along roadsides that protect listed or imperiled pollinators? If so, please describe.

|  |  |
| --- | --- |
| Respondent | Answer |
| 1 |  |
| 2 | Ohio, Virginia, North Carolina, illinois and others |
| 3 | Need to define what successful vegetation management means. I have planned, implemented, and monitored dozens of large scale projects. Go to http://resources.nativerevegetation.org/ and type in Steinfeld in the search field and there are some examples you can find. |
| 4 | Work of Jaret Daniels (Univ. of Fla.) in cooperation with Fla. DOT; please contact him |
| 5 | In an effort to improve roadside habitat for pollinators I conducted a three year field study that had two main goals: to determine which vegetation management tactics best maximize quality floral resources for pollinators in the Northeast, and to assess how those different regimes affect regional bee populations. Three roadside vegetation tactics were evaluated in this study: selective herbicide use (SH), annual fall mow (fall mow), and the traditional mowing (turf) regime. The first major conclusion was that treatment is a significant predictor of floral abundance and diversity, expressed via the Shannon’s biodiversity index. The second finding is that the sole significant predictor of bee species diversity is site or surrounding landscape, while treatment is a significant predictor of bee abundance. Data from this study supports the hypothesis that MDOT SHA’s transition from frequent mowing to a fall mow and/or SH regime can benefit bees and other pollinators. While the focus of this study was bees, we observed dozens of monarchs foraging on roadside wildflowers. |
| 6 | No. A species specific approach doesn’t make much sense here for a widespread species (monarch) and dominant crops are not pollinator dependent (23 million acres of corn and soybeans, plus some cattle pasture) |
| 7 | Not more than in above questions (e.g., focus on native vegetation and controlling mowing) |
| 8 |  |
| 9 | yes, on a very limited scale. We have had multi-year demonstration plots that show the importance of preservation of high-quality native habitat and also we have shown that by reducing or eliminating mowing of habitat that is highly invaded by invasive species such as johnsongrass does nothing to improve that habitat. Habitat that has been invaded by invasive species must be assertively and aggressively rehabilitated and generally this involves the use of herbicide. In particular, glyphosate, the active ingredient in Roundup herbicide is a friend and not a foe, when used responsibly, in plant community restoration! |

Q14. What information do you think you would need in order to tailor revegetation efforts for listed or declining pollinators?

|  |  |
| --- | --- |
| Respondent | Answer |
| 1 | Information on their host and nectaring plants. |
| 2 | Plant lists and species they support, sourcing information for seeds and plugs, site prep needs, maintenance plans, time to establishment |
| 3 | I believe there is no recipe. Every site is different. We need an educated workforce that can plan, implement, and monitor. This starts in the college I suppose but is supported in the agencies. |
| 4 | - Documented examples that reveg. will stop decline of listed/declining species - Documented support from high-ranking officials |
| 5 | Seasonality: when is the species active as an adult? And for butterflies, one would need to know of the species various stages Food requirements: this ties in w/ the above and also needed for plant selection; If a bee, is it a pollen specialist? Reproductive/nesting needs: Is a host plant required for caterpillars? Where does the pollinator nest (in cavities or underground)? |
| 6 | More specifics on rusty patch bumble bee, and more systematic surveys to inform managers. Habitat, pesticide sensitivity, locations of existing populations. For monarchs, the conditions under which common milkweed recruits from seed or rhizome, without active revegetation efforts. We should be able to increase abundance of this plant through management more cost-effectively than seeding. |
| 7 | What species are regionally competitive in roadside conditions (E.g., with local invasives, and the unique environment of roadsides) .Could be informed in part by surveying what natives are effectively competing in roadside habitat in a given region and increasing the frequency of those species in seed mixes. |
| 8 |  |
| 9 | Data from regular monitoring of restored areas is important and this data must show that the effort to restore actually produces a benefit in terms of stopping further population decline of the species in question or hopefully actual increase in the species of concern. |

Q15. What are the priority research needs in terms of roadside habitat for listed or imperiled pollinators? Please specify if this relates to a particular species.

|  |  |
| --- | --- |
| Respondent | Answer |
| 1 | When promoting the idea about planting native plants to benefit pollinators, the public and county officials first concern is safety, and how having native plants in the roadsides affects deer movement and deer vehicle collisions. Any research needs I can think of have to address safety since that is a major barrier to counties even wanting to plant roadsides to natives, no matter what the purpose is for. |
| 2 | Minimum distance between habitat patches by species, road traffic impacts on migrating species mortality, minimum habitat size to be viable, |
| 3 | NA |
| 4 | Location of naturally occurring suitable habitat |
| 5 | I think one of the biggest challenges is getting public and organizational buy-in. More research is needed on how to best engage all stakeholders and how to form lasting partnerships w/ adjacent landowners and communities in general. |
| 6 | Given the extremely large area in conventional agriculture in the Midwest, efforts in roadsides to increase milkweed abundance will have negligible impact on monarch numbers. Farm policy research and action (more diverse, perennial cropping systems integrated with livestock, and restricted use of pesticides, would be much more effective than anything we can do with the current patches of habitat for monarch reproduction and migration. |
| 7 | Recent estimates of roadside collision rates (e.g., 2% of eastern monarch population annually) suggest the top priority is reducing collisions, otherwise we may be creating habitat that is effectively creating a sink. Altering mowing buffer and/or slope may be one strategy. Second, methods for revegetation that are cost effective and managers will actually use. Third, pesticide residue, which our research is suggesting is all over the place, and not just with adjacent agriculture. |
| 8 |  |
| 9 | We find that data from roadsides is "very noisy" in terms of variability in plant species counts both within and across years. Finding clear and statistically significant trends that the actions taken resulted in improvements in species is elusive and problematic. Often one must reduce the stringency of statitsical significance due to the noise. Plots need to be large but the funds available are small so we have trouble securing enough area yet also finding enough dollars to sample enough areas to have reasonable certainty that a change in managing is leading to an improvement in species number or improvement in condition. Also, it takes time for change to have an impact, perhaps 5 years as a minimum. Getting grants that last long enough to elucidate change over time is problematic. So, a constant and significant funding source for adequate duration is important. |

Q16. Is there any additional information that relates to roadside design or management of pollinator habitat that you would like to share with us (e.g. white papers, research in progress)?

|  |  |
| --- | --- |
| Respondent | Answer |
| 1 |  |
| 2 |  |
| 3 | www.nativerevegetation.org. Specifically the work the Jennifer Hopwood was involved with. |
| 4 |  |
| 5 | The data collection portion of my roadside research w/ MDOT is complete. Preliminary findings are available online: https://www.roads.maryland.gov/OPR\_Research/MD-19-SHAUM438-Pollinator\_Report.pdf. In addition to the study goals mentioned previously, we're quantifying toxin levels in the floral resources of two common roadside wildflowers (common milkweed and goldenrod) to see if they are potential exposure routes to foraging insects. And digital photo analysis of how different IRVM tactics effect vegetation cover coming soon! |
| 6 |  |
| 7 | We have so much research in progress! On the nutritional side of things, we are somewhat concerned with toxic levels of salt and sodium in roadside plants on very high traffic roads, or at the road edge, but most low to moderate traffic roads have non-toxic levels. |
| 8 | The Wild Seed Project published a book titled "Maine Native Plants for Roadside Restoration" which is available as a PDF online. It might be a useful resource. |
| 9 | Not at this time but perhaps in the future. |

* 1. Appendix D. Survey Responses for the DOT Practitioner Survey

Q2: What is your area of expertise within your agency? Pick one or more categories that best fits your expertise.

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| Environmental | 47.14% | 33 |
| Maintenance | 27.14% | 19 |
| Design | 0.00% | 0 |
| Planning | 1.43% | 1 |
| Construction | 2.86% | 2 |
| Landscape Architecture | 12.86% | 9 |
| Other (please specify) | 8.57% | 6 |
| **TOTAL** |  | **70** |

Q3: In what state do you work?

| Answer Choices | Responses (percent) | Responses (number) |
| --- | --- | --- |
| Alabama | 0.00% | 0 |
| Alaska | 1.47% | 1 |
| Arizona | 4.41% | 3 |
| Arkansas | 1.47% | 1 |
| California | 20.59% | 14 |
| Colorado | 1.47% | 1 |
| Connecticut | 4.41% | 3 |
| Delaware | 0.00% | 0 |
| District of Columbia | 0.00% | 0 |
| Florida | 1.47% | 1 |
| Georgia | 0.00% | 0 |
| Hawaii | 0.00% | 0 |
| Idaho | 2.94% | 2 |
| Illinois | 1.47% | 1 |
| Indiana | 1.47% | 1 |
| Iowa | 1.47% | 1 |
| Kansas | 5.88% | 4 |
| Kentucky | 2.94% | 2 |
| Louisiana | 0.00% | 0 |
| Maine | 0.00% | 0 |
| Maryland | 0.00% | 0 |
| Massachusetts | 0.00% | 0 |
| Michigan | 1.47% | 1 |
| Minnesota | 2.94% | 2 |
| Mississippi | 0.00% | 0 |
| Missouri | 2.94% | 2 |
| Montana | 0.00% | 0 |
| Nebraska | 4.41% | 3 |
| Nevada | 4.41% | 3 |
| New Hampshire | 0.00% | 0 |
| New Jersey | 1.47% | 1 |
| New Mexico | 4.41% | 3 |
| New York | 1.47%  0.00% | 1  0 |
| North Carolina | 2.94% | 2 |
| North Dakota | 2.94% | 2 |
| Ohio | 2.94% | 2 |
| Oklahoma | 1.47% | 1 |
| Oregon | 2.94% | 2 |
| Pennsylvania | 0.00% | 0 |
| Rhode Island | 0.00% | 0 |
| South Carolina | 0.00% | 0 |
| South Dakota | 1.47% | 1 |
| Tennessee | 1.47% | 1 |
| Texas | 1.47% | 1 |
| Utah | 0.00% | 0 |
| Vermont | 0.00% | 0 |
| Virginia | 1.47% | 1 |
| Washington | 4.41% | 3 |
| West Virginia | 0.00% | 0 |
| Wisconsin | 2.94% | 2 |
| Wyoming | 1.47% | 1 |
| **TOTAL** |  | **70** |

Q6: How frequently does your DOT currently implement the following mowing practices that can support imperiled pollinators?

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Always | Usually | Sometimes | Not Often | Never | Total | Weighted Average |
| Limit mowing beyond the clear zone to no more than twice per year. | 17.02% | 48.94% | 21.28% | 10.64% | 2.13% | **47** | **2.32** |
| 8 | 23 | 10 | 5 | 1 |
| Avoid mowing imperiled butterfly host plants during butterfly breeding season in your area (e.g. avoid mowing Lupine spp., which support Karner blue butterfly). | 8.33% | 25.00% | 25.00% | 25.00% | 16.67% | **48** | **3.17** |
| 4 | 12 | 12 | 12 | 8 |
| Delay mowing to as late as possible during the growing season (e.g. mow in autumn). | 6.12% | 22.45% | 26.53% | 26.53% | 18.37% | **49** | **3.29** |
| 3 | 11 | 13 | 13 | 9 |
| Adjust mowing height to a minimum height of 8–10 inches in areas with target butterfly host plants if mowing during the growing season. | 8.33% | 12.50% | 14.58% | 41.67% | 22.92% | **48** | **3.58** |
| 4 | 6 | 7 | 20 | 11 |
| Aim to mow no more than 1/3-1/2 of an area beyond the clear zone per year (e.g. rotate mowing sections of a roadside). | 16.67% | 10.42% | 20.83% | 31.25% | 20.83% | **48** | **3.29** |
| 8 | 5 | 10 | 15 | 10 |
| Clean mowing equipment after use and between sites to limit the spread of invasive weeds. | 12.77% | 29.79% | 21.28% | 29.79% | 6.38% | **47** | **2.87** |
| 6 | 14 | 10 | 14 | 3 |

Q7: What are the barriers for your DOT to implement these mowing practices that can support imperiled pollinators? Please check all that apply.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Staff Training | Financial Constraints | Equipment Limitations | Incompatibility with Other Goals | Staff Resources | Total Respondents |
| Limit mowing beyond the clear zone to no more than twice per year. | 66.67% | 11.90% | 11.90% | 64.29% | 23.81% | **42** |
| 28 | 5 | 5 | 27 | 10 |
| Avoid mowing imperiled butterfly host plants during butterfly breeding season in your area (e.g. avoid mowing Lupine spp., which support Karner blue butterfly). | 69.57% | 4.35% | 13.04% | 63.04% | 32.61% | **46** |
| 32 | 2 | 6 | 29 | 15 |
| Delay mowing to as late as possible during the growing season (e.g. mow in autumn). | 48.94% | 6.38% | 14.89% | 68.09% | 34.04% | **47** |
| 23 | 3 | 7 | 32 | 16 |
| Adjust mowing height to a minimum height of 8–10 inches in areas with target butterfly host plants if mowing during the growing season. | 61.70% | 2.13% | 23.40% | 53.19% | 29.79% | **47** |
| 29 | 1 | 11 | 25 | 14 |
| Aim to mow no more than 1/3-1/2 of an area beyond the clear zone per year (e.g. rotate mowing sections of a roadside). | 61.36% | 9.09% | 9.09% | 56.82% | 29.55% | **44** |
| 27 | 4 | 4 | 25 | 13 |
| Clean mowing equipment after use and between sites to limit the spread of invasive weeds. | 75.56% | 13.33% | 17.78% | 11.11% | 37.78% | **45** |
| 34 | 6 | 8 | 5 | 17 |

Q8: How frequently does your DOT currently implement the following herbicide practices that can supportimperiled pollinators?

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Always | Usually | Sometimes | Not often | Never | Total | Weighted Average |
| Conduct roadside vegetation inventories to identify emerging weed or hazard tree issues, or to identify high quality vegetative communities. | 8.16% | 12.24% | 42.86% | 26.53% | 10.20% | **49** | **3.18** |
| 4 | 6 | 21 | 13 | 5 |
| Track weed outbreaks and herbicide usage over time to evaluate the effectiveness of herbicide treatments and inform future management decisions. | 8.16% | 34.69% | 24.49% | 20.41% | 12.24% | **49** | **2.94** |
| 4 | 17 | 12 | 10 | 6 |
| Train staff and contractors to recognize native plants as well as noxious and invasive weeds to reduce unintended damage to non-target plants. | 8.33% | 27.08% | 39.58% | 14.58% | 10.42% | **48** | **2.92** |
| 4 | 13 | 19 | 7 | 5 |
| Use selective herbicides whenever possible to reduce damage to non-target plants. | 27.66% | 31.91% | 27.66% | 12.77% | 0.00% | **47** | **2.26** |
| 13 | 15 | 13 | 6 | 0 |
| Herbicide applications are directed on undesirable plants to avoid harming non-target species (e.g. spot treatment applications with a backpack sprayer, targeted applications to cut stems, etc.). Broadcast treatments or pellet dispersal are used only for dense infestations of weeds or for safety zone or guardrail treatments. | 19.15% | 40.43% | 23.40% | 8.51% | 8.51% | **47** | **2.47** |
| 9 | 19 | 11 | 4 | 4 |
| Apply herbicides during plant life stages when weeds are most vulnerable (before blooming or before going to seed). | 12.77% | 53.19% | 23.40% | 4.26% | 6.38% | **47** | **2.38** |
| 6 | 25 | 11 | 2 | 3 |
| Avoid herbicide sprays when weather conditions increase drift (e.g. avoid wind speeds >15 mph, avoid applications during a temperature inversion). | 56.52% | 28.26% | 10.87% | 2.17% | 2.17% | **46** | **1.65** |
| 26 | 13 | 5 | 1 | 1 |
| Choose and calibrate equipment with drift management in mind. (e.g., Calibrate equipment regularly; choose spray nozzles to reduce drift; on boom sprayers, use the lowest effective pressure and largest droplet size possible). | 35.56% | 35.56% | 20.00% | 6.67% | 2.22% | **45** | **2.04** |
| 16 | 16 | 9 | 3 | 1 |

Q9: What are the barriers for your DOT to implement these herbicide practices that can support imperiledpollinators? Please check all that apply.

|  | Staff Training | Financial Constraints | Equipment Limitations | Incompatibility with Other Goals | Staff Resources | Total Respondents |
| --- | --- | --- | --- | --- | --- | --- |
| Conduct roadside vegetation inventories to identify emerging weed or hazard tree issues, or to identify high quality vegetative communities. | 57.45% | 46.81% | 6.38% | 19.15% | 78.72% | **47** |
| 27 | 22 | 3 | 9 | 37 |
| Track weed outbreaks and herbicide usage over time to evaluate the effectiveness of herbicide treatments and inform future management decisions. | 65.96% | 38.30% | 8.51% | 23.40% | 74.47% | **47** |
| 31 | 18 | 4 | 11 | 35 |
| Train staff and contractors to recognize native plants as well as noxious and invasive weeds to reduce unintended damage to non-target plants. | 71.11% | 31.11% | 2.22% | 20.00% | 66.67% | **45** |
| 32 | 14 | 1 | 9 | 30 |
| Use selective herbicides whenever possible to reduce damage to non-target plants. | 67.44% | 20.93% | 13.95% | 27.91% | 44.19% | **43** |
| 29 | 9 | 6 | 12 | 19 |
| Herbicide applications are directed on undesirable plants to avoid harming non-target species (e.g. spot treatment applications with a backpack sprayer, targeted applications to cut stems, etc.). Broadcast treatments or pellet dispersal are used only for dense infestations of weeds or for safety zone or guardrail treatments. | 68.18% | 27.27% | 15.91% | 22.73% | 56.82% | **44** |
| 30 | 12 | 7 | 10 | 25 |
| Apply herbicides during plant life stages when weeds are most vulnerable (before blooming or before going to seed). | 71.74% | 17.39% | 6.52% | 19.57% | 56.52% | **46** |
| 33 | 8 | 3 | 9 | 26 |
| Avoid herbicide sprays when weather conditions increase drift (e.g. avoid wind speeds >15 mph, avoid applications during a temperature inversion). | 90.00% | 10.00% | 10.00% | 10.00% | 36.67% | **30** |
| 27 | 3 | 3 | 3 | 11 |
| Choose and calibrate equipment with drift management in mind. (e.g., Calibrate equipment regularly; choose spray nozzles to reduce drift; on boom sprayers, use the lowest effective pressure and largest droplet size possible). | 78.79% | 12.12% | 30.30% | 9.09% | 27.27% | **33** |
| 26 | 4 | 10 | 3 | 9 |

Q10: How frequently does your DOT currently implement the following brush removal practices that cansupport imperiled pollinators?

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Always | Usually | Sometimes | Not Often | Never | Total | Weighted Average |
| Feather or soften forest edges adjacent to clear zones to create a transitional area between the forest and grass (e.g. thin portions of the forest canopy along the edge next to grassy areas, removing undesirable or unhealthy trees). | 4.35% | 13.04% | 26.09% | 39.13% | 17.39% | **46** | **3.52** |
| 2 | 6 | 12 | 18 | 8 |
| Leave snags or trees with cavities in areas where they are set back from the road and pose no safety risk. | 10.64% | 29.79% | 17.02% | 29.79% | 12.77% | **47** | **3.04** |
| 5 | 14 | 8 | 14 | 6 |
| Minimize soil disturbance (disking, tilling) during brush removal activities to avoid spreading invasive plants. | 12.77% | 44.68% | 23.40% | 12.77% | 6.38% | **47** | **2.55** |
| 6 | 21 | 11 | 6 | 3 |

Q11: What are the barriers for your DOT to implement these brush removal practices that can supportimperiled pollinators? Please check all that apply.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Staff Training | Financial Constraints | Equipment Limitations | Incompatibility with Other Goals | Staff Resources | Total Respondents |
| Feather or soften forest edges adjacent to clear zones to create a transitional area between the forest and grass (e.g. thin portions of the forest canopy along the edge next to grassy areas, removing undesirable or unhealthy trees). | 67.44% | 23.26% | 23.26% | 37.21% | 55.81% | **43** |
| 29 | 10 | 10 | 16 | 24 |
| Leave snags or trees with cavities in areas where they are set back from the road and pose no safety risk. | 68.29% | 2.44% | 14.63% | 60.98% | 24.39% | **41** |
| 28 | 1 | 6 | 25 | 10 |
| Minimize soil disturbance (disking, tilling) during brush removal activities to avoid spreading invasive plants. | 82.05% | 5.13% | 12.82% | 25.64% | 35.90% | **39** |
| 32 | 2 | 5 | 10 | 14 |
| skip | 37.50% | 0.00% | 12.50% | 50.00% | 12.50% | **8** |
| 3 | 0 | 1 | 4 | 1 |
| skip | 25.00% | 0.00% | 0.00% | 50.00% | 25.00% | **8** |
| 2 | 0 | 0 | 4 | 2 |
| skip | 57.14% | 14.29% | 0.00% | 14.29% | 42.86% | **7** |
| 4 | 1 | 0 | 1 | 3 |

Q12: How frequently does your DOT currently implement the following landscape design and revegetationpractices that can support imperiled pollinators?

|  | Always | Usually | Sometimes | Not Often | Never | Total | Weighted Average |
| --- | --- | --- | --- | --- | --- | --- | --- |
| When designing new plantings, include plants known to provide floral resources that attract pollinators. | 19.61% | 43.14% | 25.49% | 9.80% | 1.96% | **51** | **2.31** |
| 10 | 22 | 13 | 5 | 1 |
| Increase the abundance and diversity of flowering plants whenever possible by including 3 or more species in bloom at any time between spring and fall so that there is an overlapping succession of bloom throughout the growing season. | 17.65% | 33.33% | 25.49% | 17.65% | 5.88% | **51** | **2.61** |
| 9 | 17 | 13 | 9 | 3 |
| Include host plants for key target species of butterflies and moths. | 17.65% | 17.65% | 35.29% | 25.49% | 3.92% | **51** | **2.80** |
| 9 | 9 | 18 | 13 | 2 |
| Native plants are used in new plantings. | 41.18% | 37.25% | 15.69% | 5.88% | 0.00% | **51** | **1.86** |
| 21 | 19 | 8 | 3 | 0 |
| Prioritize using locally (or regionally if local is unavailable) sourced native plant materials. | 31.37% | 39.22% | 19.61% | 9.80% | 0.00% | **51** | **2.08** |
| 16 | 20 | 10 | 5 | 0 |
| Coordinate with native plant vendors early about plant material needs to allow them to collect foundation seed or grow out plant materials. | 8.00% | 24.00% | 38.00% | 20.00% | 10.00% | **50** | **3.00** |
| 4 | 12 | 19 | 10 | 5 |
| When planting seed, require seed testing certificates from seed vendors that describe germination rates and any weed seed or contaminants in the order. | 56.86% | 17.65% | 9.80% | 11.76% | 3.92% | **51** | **1.88** |
| 29 | 9 | 5 | 6 | 2 |
| Develop, in collaboration with maintenance staff, a weed management plan for site preparation in advance of planting and a plan for weed control during the establishment period. | 11.76% | 17.65% | 31.37% | 31.37% | 7.84% | **51** | **3.06** |
| 6 | 9 | 16 | 16 | 4 |
| Irrigate for early plant establishment when needed. | 13.73% | 19.61% | 25.49% | 19.61% | 21.57% | **51** | **3.16** |
| 7 | 10 | 13 | 10 | 11 |
| Interseed to increase flowering plants in existing stands of low-diversity vegetation. | 6.00% | 12.00% | 26.00% | 38.00% | 18.00% | **50** | **3.50** |
| 3 | 6 | 13 | 19 | 9 |
| Create new pollinator habitat gardens at rest areas or offices that include plants and host plants. | 12.00% | 16.00% | 32.00% | 26.00% | 14.00% | **50** | **3.14** |
| 6 | 8 | 16 | 13 | 7 |
| To what extent is your DOT considering resilience to climate change when designing new plantings? | 6.00% | 16.00% | 38.00% | 22.00% | 18.00% | **50** | **3.30** |
| 3 | 8 | 19 | 11 | 9 |

Q13: What are the barriers for your DOT to implement these landscape design and revegetation practices that can support imperiled pollinators? Please check all that apply.

|  | Staff Training | Financial Constraints | Equipment Limitations | Incompatibility with Other Goals | Staff Resources | Total Respondents |
| --- | --- | --- | --- | --- | --- | --- |
| When designing new plantings, include plants known to provide floral resources that attract pollinators. | 60.00% | 40.00% | 4.44% | 46.67% | 35.56% | **45** |
| 27 | 18 | 2 | 21 | 16 |
| Increase the abundance and diversity of flowering plants whenever possible by including 3 or more species in bloom at any time between spring and fall so that there is an overlapping succession of bloom throughout the growing season. | 58.70% | 41.30% | 4.35% | 45.65% | 41.30% | **46** |
| 27 | 19 | 2 | 21 | 19 |
| Include host plants for key target species of butterflies and moths. | 63.04% | 39.13% | 6.52% | 41.30% | 36.96% | **46** |
| 29 | 18 | 3 | 19 | 17 |
| Native plants are used in new plantings. | 65.12% | 34.88% | 6.98% | 32.56% | 30.23% | **43** |
| 28 | 15 | 3 | 14 | 13 |
| Prioritize using locally (or regionally if local is unavailable) sourced native plant materials. | 51.11% | 44.44% | 6.67% | 31.11% | 31.11% | **45** |
| 23 | 20 | 3 | 14 | 14 |
| Coordinate with native plant vendors early about plant material needs to allow them to collect foundation seed or grow out plant materials. | 54.55% | 31.82% | 4.55% | 20.45% | 61.36% | **44** |
| 24 | 14 | 2 | 9 | 27 |
| When planting seed, require seed testing certificates from seed vendors that describe germination rates and any weed seed or contaminants in the order. | 68.97% | 24.14% | 6.90% | 17.24% | 51.72% | **29** |
| 20 | 7 | 2 | 5 | 15 |
| Develop, in collaboration with maintenance staff, a weed management plan for site preparation in advance of planting and a plan for weed control during the establishment period. | 61.54% | 48.72% | 5.13% | 23.08% | 76.92% | **39** |
| 24 | 19 | 2 | 9 | 30 |
| Irrigate for early plant establishment when needed. | 36.11% | 58.33% | 25.00% | 25.00% | 58.33% | **36** |
| 13 | 21 | 9 | 9 | 21 |
| Interseed to increase flowering plants in existing stands of low-diversity vegetation. | 51.35% | 62.16% | 10.81% | 27.03% | 56.76% | **37** |
| 19 | 23 | 4 | 10 | 21 |
| Create new pollinator habitat gardens at rest areas or offices that include plants and host plants. | 56.76% | 62.16% | 10.81% | 24.32% | 62.16% | **37** |
| 21 | 23 | 4 | 9 | 23 |
| To what extent is your DOT considering resilience to climate change when designing new plantings? | 77.78% | 30.56% | 5.56% | 22.22% | 61.11% | **36** |
| 28 | 11 | 2 | 8 | 22 |

Q14: Which weeds are the most problematic to control on roadsides in your region?

Answered: 49

| Scientific Name | Common Name | Number | State |
| --- | --- | --- | --- |
| *Arundo donax* | giant cane | 1 | California |
| *Acroptilon repens* | Russian knapweed | 1 | New Mexico |
| *Ailanthus altissima* | Tree of heaven | 5 | Arizona, California, Indiana, New Mexico, Virginia |
| *Alhagi maurorum* | Camelthorn | 1 | Arizona, New Mexico |
| *Alliara petiolata* | garlic mustard | 1 | Oregon |
| *Amaranthus palmeri* | Palmer's amaranth | 1 | Arizona |
| *Artemisia absinthium* | absinthe wormwood | 1 | North Dakota |
| *Artemisia vulgaris* | mugwort | 2 | Connecticut, New Jersey |
| *Arundo donax* | giant reed | 1 | Ohio |
| *Bassia scoparia* | Burningbush | 1 | Arizona |
| *Bothriochloa bladhii* | Caucasian Bluestem | 1 | Kansas |
| *Bothriochloa ischaemum* | yellow bluestem | 1 | New Mexico |
| *Brassica tournefortii* | African mustard | 2 | Arizona, Nevada |
| *Bromus inermis* | smooth brome | 1 | Minnesota |
| *Bromus rubens* | red brome | 1 | California |
| *Bromus tectorum* | Cheat grass | 5 | California, Colorado, Nevada, New Mexico, Oregon |
| *Buddleia davidii* | butterfly bush | 1 | Washington |
| *Carduus nutans* | Musk Thistle | 2 | Kansas, Kentucky |
| *Centaurea solstitaialis* | Yellow star thistle | 1 | California |
| *Centaurea spp.* | Knapweeds | 1 | Arizona, Nevada, Wyoming |
| *Chondrilla juncea* | rush skeletonweed | 1 | Washington |
| *Cirsium arvense* | Canada thistle | 9 | Alaska, Illinois, Indiana, Kentucky, Minnesota, Nebraska, New Mexico, North Dakota, Ohio |
| *Conium maculatum* | poison hemlock | 1 | Ohio |
| *Convolvulus arvensis* | bindweed | 1 | Kansas |
| *Conyza canadensis* | mares tail | 3 | California, Kentucky, Ohio |
| *Coronilla varia* | Crown Vetch | 2 | Kansas, Minnesota |
| *Cortaderia selloana* | pampas grass | 1 | California |
| *Cynodon dactylon* | bermuda grass | 1 | Texas |
| *Cytisus scoparius* | Scotch broom | 2 | Oregon, Washington |
| *Dipsacus fullonum* | Teasel | 6 | Illinois, Indiana, Kansas, Kentucky, Nebraska, Ohio |
| *Elaeagnus umbellata* | autumn olive | 2 | Indiana, Ohio |
| *Euphorbia esula* | leafy spurge | 4 | Colorado, Minnesota, Nebraska, North Dakota |
| *Fallopia japonica* | Japanese knotweed | 6 | Connecticut, Kentucky, New Jersey, New York, Ohio, Virginia |
| *Foeniculum vulgare* | fennel | 1 | California |
| *Genista monspessulana* | French broom | 1 | California |
| *Halogeton glomeratus* | halogeton | 1 | California |
| *Heterotheca subaxillaris* | Camphorweed | 1 | Arizona |
| *Hieracium aurantiacum* | orange hawkweed | 1 | Alaska |
| *Imperata cylindrica* | cogon grass | 1 | Florida |
| *Kochia scoparia* | kochia | 4 | Colorado, Idaho, Texas, Washington |
| *Lepidium latifolium* | pepperweed | 1 | California |
| *Lespedeza cuneata* | Chinese lespedeza | 4 | Arkansas, Illinois, Missouri, Oklahoma |
| *Lonicera maackii* | bush honeysuckle | 5 | Indiana, Kentucky, Missouri, New Jersey, Ohio |
| *Lotus corniculatus* | birds foot trefoil | 1 | Minnesota |
| *Lythrum salicaria* | purple loosestrife | 2 | Iowa, Ohio |
| *Melilotus officinalis* | White sweetclover | 1 | Alaska |
| *Microstegium vimineum* | Japanese stiltgrass | 1 | New Jersey |
| *Oncosiphon piluliferum* | Stinknet | 2 | Arizona, California |
| *Onopordum acanthium* | scotch thistle | 1 | Arizona |
| *Oxalis corniculata* | yellow clover | 1 | Wyoming |
| *Pastinaca sativa* | wild parsnip | 3 | Minnesota, New York, Wisconsin |
| *Peganum harmala* | African rue | 1 | New Mexico |
| *Pennisetum ciliare* | Bufflegrass | 1 | Arizona |
| *Pennisetum setaceum* | crimson fountaingrass | 1 | Arizona |
| *Persicaria perfoliata* | mile-a-minute | 1 | New Jersey |
| *Phalaris arundinacea* | reed canary grass | 1 | Oregon |
| *Phragmites australis* | Common reed | 8 | Illinois, Indiana, Iowa, Nebraska, New Jersey, New York, Ohio, Wisconsin |
| *Prosopis spp.* | Mesquite | 1 | Texas |
| *Pueraria spp* | Kudzu | 2 | Kentucky, Ohio |
| *Pyrus calleryana* | callery pear | 3 | Indiana, Missouri, Ohio |
| *Rosa multiflora* | Multiflora Rose | 3 | Kentucky, Ohio, New Jersey |
| *Rubus armeniacus* | Himalayan blackberry | 2 | Oregon, Washington |
| *Salsola tragus* | Russian thistle | 5 | Arizona, California, Idaho, Texas, Washington |
| *Setaria faberi* | Giant Foxtail | 2 | Kentucky, Ohio |
| *Sorghum halepense* | Johnson grass | 10 | Arizona, Arkansas, Illinois, Indiana, Kansas, Kentucky, Ohio, Oklahoma, Tennessee, Texas |
| *Spartium junceum* | Spanish Broom | 1 | California |
| *Taraxacum* | dandelion | 1 | Alaska |
| *Typha spp.* | cattails | 1 | Indiana |
| *Vachellia erioloba* | Camelthorn tree | 1 | Arizona |
| *Vicia cracca* | bird vetch | 1 | Alaska |
| *Washingtonia robusta* | Mexican Palm | 1 | California |
|  | mustards | 2 | California, Idaho |
|  | Thistles | 6 | Arizona, Nebraska, Nevada, Oregon, Tennessee, Wyoming |

Q15: What type of assistance would be most useful to your DOT in controlling these weed problems?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| Financial assistance | 28.85% | 15 |
| Regional technical guidance on weed control strategies | 11.54% | 6 |
| Training for staff and contractors | 28.85% | 15 |
| Other (please specify) | 30.77% | 16 |
| **TOTAL** |  | **52** |

Answers Given for “Other”

* **Financial** is most important, but **training** and **guidance** are also needed
* The priority needs to be recognized within the agency at a level that can create programs to accomplish these ideas. [**management/leadership**]
* Finding species that can handle the difficult highway roadside is a challenge. The native **soil** was not protected when the highway system was developed so much of the roadside is built on fill as opposed to topsoil. Finding plants that grow well but are not invasive is a challenge for us. Additionally, recognizing rural vs urban requirements is helpful.
* Required direction. **Money, guidance, and training** are not enough to get people here to change their ways of doing things.
* Additional **staff**. Our maintenance staff is stretched too thin to spot spray all of the locations that need it
* Financial assistance, training staff and contractors
* **Educating** the public and legislators about the interactions between vegetation management practices and control of these species. For example- infrequent (2-5 cycles a year) mowing will not control/eliminate phragmites, johsongrass, Canada thistle, teasels or woody plants.
* More staff and equipment
* **Financial** assistance and staff/contractor **training**. If we had a budget for this we could train and enforce properly.
* Directive from upper **management** needed to make it a priority. **Financial** assistance would also be helpful for staffing and equipment.
* Our department contracts with county weed boards with control of noxious weeds. Our staff does not control noxious weeds via chemical application. Mowing occasionally for problem areas to slow spread.
* All of the above plus stronger executive **leadership** on non-roadway issues
* **Legal** requirements
* It's a matter of **prioritization**, maintaining the roadsides for protection of the roadway itself and safety is first priority.
* All of the above.
* Both **financial** assistance and **training** for staff/contractors. I would also add training/education for **managers**. Without their support, the other staff have an uphill battle. My experience with several DOTs is that these are the common hurdles.

Q16: Does your DOT use prescribed fire or prescribed grazing? If yes, please describe how your DOT uses these management strategies.

Comments

* ADOT uses prescribed burning in northern Arizona areas in conjunction with the US Forest Service (only areas within or adjacent to National Forest land).
* In some regions prescribed grazing is being introduced on a pilot project basis.
* No, grazing is prohibitively expensive.
* Occasional prescribed grazing but only on a case by case basis. Prescribed fire is not used, to the best of my knowledge.
* Prescribed fire is an issue with the ARB's (Air Resources Boards) in California. We use goats for vegetation control throughout the State. Critical to make sure they don't escape containment and end up on the highway.
* Yes, but rarely, usually done only as a specific treatment for a specific area.
* No we do not use either of these methods. Historically prescribed fire was used to maintain certain areas of native vegetation- until a traffic accident happened. Establishing a prescribed fire program for roadsides in the majority of the eastern US will likely be nearly impossible.
* We have recently used prescribed fire to prepare the acreage at several rest areas for native grass and wildflower planting projects.
* Yes. https://www.dot.state.mn.us/policy/operations/op001.html
* Very seldom uses prescribed fire. Used only on a native planting on the Northeast District complex grounds. Never uses prescribed grazing.
* NDOT has used fire and goat grazing at selected wetland mitigation sites, but not on roadsides.
* We graze and burn our state owned mitigation sites. We need to increase our efforts on those sites as well as roadsides
* No, fire is not a reasonable control option. Prescribed grazing seems to spread noxious weeds through hoof action and feces distribution
* We have at time and would do more if the program were better funded.
* We have used prescribe fire in past and recently started again. Currently only used in wetland mitigation sites and on roadside remnant prairies.
* Yes, we use prescribed very in very limited circumstances. This work is typically done through consultant contracts because routine maintenance staff are not experienced or equipped for this type of work. We have never actively explored prescribed grazing.
* My only experience with prescribed fire is with Wisconsin DOT. Some of the barriers there are timing and logistics, qualifications required, and costs.

Q17: What are the major challenges for native plant establishment on roadsides in your region?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| Lack of native plant materials | 5.77% | 3 |
| Lack of institutional technical knowledge | 9.62% | 5 |
| Timing of planting not ideal for establishment | 3.85% | 2 |
| Lack of necessary equipment | 1.92% | 1 |
| Weed control (either prior to planting or during establishment phase) | 5.77% | 3 |
| Long-term maintenance plan for new plantings | 23.08% | 12 |
| Other (please specify) | 50.00% | 26 |
| **TOTAL** |  | **52** |

Answers Given for “Other”

* You ask a plural question and I can only select one answer. Knowledge, timing, maintenance, and weed control.
* Support of Administration Engineers for technically and biologically correct and environmentally sound practices with an understanding of plant succession and su8stainable landscapes.
* Balancing fire reduction goals with having enough trained maintenance staff to properly manage the roadside with our limited equipment availability.
* Combination of funding, equipment, and resource issues along with fire danger. Natives are costly and so is the eradication of weed seed bank in areas to be rehabilitated. Equipment restrictions by Governor's Office, and vegetation management to address fire risk does not allow for implementation of converting roadside easily.
* weed control, long-term maintenance, and management of invasives
* dry climates (not enough precip at the right time), inadequate soil nutrients, lack of appropriate equipment, weed control or pressure (outcompetes natives), and long term maintenance plans
* Native vegetation establishes on it's own quite well- often times too well but so does non-native/undesirable vegetation. Maintaining species diversity within a narrow, linear corridor that meets safety requirements and the expectations of the public while being economically achievable is the biggest challenge to native vegetation establishment within the ROW.
* Lack of institutional technical knowledge and training, and long-term maintenance plans for new plantings. We also rely on obtaining grants to secure money to buy native wildflower plugs.
* Mainly the long germination and establishment period of grasses. Viability and longevity of forbes
* Lack of funding.
* I would say that lack of interest from program directors to take the next step to increase efforts for pollinators. Unless there is a federal compliance element to the management, the administration is not interesting in changing the program.
* Roadside seeding site damage by sheet flow, traffic, snow removal ops, seed loss (blowing, washing).
* Irrigation, not enough precipitation.
* Soil type along roadsides is not ideal for plant establishment in dry desert environments, so weeds tend to come in prior to seedings.
* Lack of locally adapted native plant materials, weed control, drought.
* Lack of moisture!
* North Dakota Century Code allows for adjacent landowners to hay right of ways so it is hard to manage vegetation.
* There are concerns with attracting pollinators to roadsides due to future potential restrictions on roadway projects/maintenance, and haying for the ag community which is allowed through our states century code. A big hurdle which would face big pushback should it tried to be changed legislatively.
* financial resources
* Lack of institutional support
* willingness to change standard practices by senior leadership within Maintenance business line
* we are just beginning a research project to look at what natives are already on our roadsides and result will be native seed mixes that can be used on ROWs - right now the biggest issue is meeting erosion control requirements and with the longer establishment time of natives and lack of germination standards, our agency has not developed standard approved native seed mixes There has been much increased interest in this and so this survey is very timely!
* Staff resources for monitoring and applying needed aids to survival of the natives.
* Lack of political support, institutional technical knowledge, establishment challenges due to the way construction projects are run, and lack of expertise and support in maintenance.
* There are many! The biggest challenge is agency culture (i.e. “we’ve always done it this way, why change?”) and priorities. Also, there’s a lack of institutional technical knowledge, limited staff (we have 2 landscape architects for entire state), challenges with site preparation and initial weed control, limited capacity or desire to conduct long-term maintenance of new plantings, to name a few.
* Timing not being ideal, suitable timing allowed for weed control, and long-term maintenance.

Q18: How does your DOT most commonly engage the public about your pollinator conservation efforts?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| N/A | 21.15% | 11 |
| Interpretive signage at rest areas | 11.54% | 6 |
| Printed publications | 3.85% | 2 |
| Workshops or events | 1.92% | 1 |
| Information on website | 28.85% | 15 |
| Other (please specify) | 32.69% | 17 |
| **TOTAL** |  | **52** |

Answers Given for “Other”

* News releases blogs.
* interpretive signs at rest area, workshops and training, attend conferences, and information on website
* KDOT Pollinator Habitat signs erected at rest areas, webpage dedicated to pollinator habitat projects and efforts, celebrating National Pollinator Week at Headquarters office in June.
* We have an outdated brochure and a website. We are working on creating more materials and I have done a webinar and several talks this year. This is an increased effort that just started to engage more with the public on roadsides and pollinators
* Webinars, currently re-developing the roadside veg brochure to include pollinator info, guest speaker
* Signage in the area of seeding
* Public presentations to interest groups. Starting soon, also a social media and signage campaign.
* We have not done a lot of public outreach as our state is in its infancy for pollinator conservation efforts.
* Signage, media, outreach events, website, seed packets, demonstration gardens, public-private partnerships, partnerships across sectors (energy, transportation), local governments
* News media
* tri-fold brochure in rest area. efforts are negligible
* we use any and all methods mentioned and many more.
* Podium presentations at conferences, butterfly and bug societies, radio shows and other invitations to speak.
* Mostly through limited (two people) staff participation in statewide efforts and providing outreach and education.
* This is an area for improvement. The agency is not good at telling our story, and generally prefers not to share environmental-related stories for fear of public and lobby group perceptions. We have a few things in place, including a public-facing website, signage at demonstration sites within rest areas, and a dated brochure (probably from the 80s or 90s).
* They don't, but they should...staff resource issue.
* Most DOTs I see conducting outreach are through signage and social media.

Q19: Have you encountered pollinators that are protected through the Endangered Species Act (ESA) in your transportation work? Please check all that apply.

| Answer Choices | Responses (percent) | Responses (number) |
| --- | --- | --- |
| I have not encountered ESA listed pollinators as part of my work | 59.57% | 28 |
| Anthricinan yellow-faced bee (*Hylaeus assimulans*) | 0.00% | 0 |
| Assimulans yellow-faced bee (*Hylaeus assimulans*) | 0.00% | 0 |
| Bartram's hairstreak butterfly (*Strymon acis bartrami*) | 0.00% | 0 |
| Bay checkerspot butterfly (*Euphydryas editha bayensis*) | 0.00% | 0 |
| Behren's silverspot butterfly (*Speyeria zerene behrensii*) | 0.00% | 0 |
| Blackburn's sphinx moth (*Manduca blackburni*) | 0.00% | 0 |
| Callippe silverspot butterfly (*Speyeria callippe callippe*) | 0.00% | 0 |
| Carson wandering skipper (*Pseudocopaeodes eunus obscurus*) | 2.13% | 1 |
| Dakota Skipper (*Hesperia dacotae*) | 6.38% | 3 |
| Easy yellow-faced bee (*Hylaeus facilis*) | 0.00% | 0 |
| El Segundo blue butterfly (*Euphilotes battoides allyni*) | 0.00% | 0 |
| Fender's blue butterfly (*Icaricia icarioides fenderi*) | 4.26% | 2 |
| Florida leafwing butterfly (*Anaea troglodyta floridalis*) | 0.00% | 0 |
| Franklin's bumble bee (*Bombus franklini*) | 0.00% | 0 |
| Hawaiian yellow-faced bee (*Hylaeus kuakea*) | 0.00% | 0 |
| Hawaiian yellow-faced bee (*Hylaeus longiceps*) | 0.00% | 0 |
| Hawaiian yellow-faced bee (*Hylaeus mana*) | 0.00% | 0 |
| Hermes copper (*Lycaena hermes*) | 0.00% | 0 |
| Hilaris yellow-faced bee (*Hylaeus hilaris*) | 0.00% | 0 |
| Island marble butterfly (*Euchloe ausonides insulanus*) | 0.00% | 0 |
| Karner blue butterfly (*Lycaeides melissa samuelis*) | 12.77% | 6 |
| Kern primrose sphinx moth *(Euproserpinus euterpe*) | 2.13% | 1 |
| Laguna Mountains skipper (*Pyrgus ruralis lagunae*) | 0.00% | 0 |
| Lange's metalmark butterfly (*Apodemia mormo langei*) | 0.00% | 0 |
| Lotis blue butterfly (*Lycaeides argyrognomon lotis*) | 0.00% | 0 |
| Miami blue butterfly (*Cyclargus thomasi bethunebakeri*) | 0.00% | 0 |
| Mission blue butterfly (*Icaricia icarioides missionensis*) | 0.00% | 0 |
| Mitchell's satyr butterfly (*Neonympha mitchellii mitchellii*) | 2.13% | 1 |
| Mount Charleston blue butterfly (*Icaricia shasta charlestonensis*) | 4.26% | 2 |
| Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*) | 0.00% | 0 |
| Oregon silverspot (*Speyeria zerene hippolyta*) | 2.13% | 1 |
| Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdesensis*) | 0.00% | 0 |
| Pawnee montane skipper (*Hesperia leonardus montana*) | 2.13% | 1 |
| Poweshiek skipperling (*Oarisma poweshiek*) | 8.51% | 4 |
| Quino checkerspot butterfly (*Euphydryas editha quino*) | 4.26% | 2 |
| Rusty patched bumble bee (*Bombus affinis*) | 19.15% | 9 |
| Saint Francis' satyr butterfly (*Neonympha mitchellii francisci*) | 0.00% | 0 |
| San Bruno elfin butterfly (*Callophrys mossii bayensis*) | 0.00% | 0 |
| Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*) | 0.00% | 0 |
| Smith's blue butterfly (*Euphilotes enoptes smithi*) | 2.13% | 1 |
| Taylor's checkerspot (*Euphydryas editha taylori*) | 0.00% | 0 |
| Uncompahgre fritillary butterfly (*Boloria acrocnema*) | 0.00% | 0 |
| **Total Respondents:** |  | **47** |

Q20: How have the listed species you have encountered affected your project planning workflow

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| N/A- I have not encountered listed species as part of my work | 51.11% | 23 |
| No effect | 8.89% | 4 |
| Delays | 0.00% | 0 |
| Increased Costs | 0.00% | 0 |
| Project redesign or modifications to operations | 20.00% | 9 |
| Other (please specify) | 20.00% | 9 |
| **TOTAL** |  | **45** |

Other

* Delays, increased costs, timing restrictions, and modifications to work plans, re-vegetation, and monitoring efforts.
* In a few instances, delays/increased costs in order to work through the Section 7 process.
* increased coordination and commitments to move host plants. No delays.
* increased costs and project redesign or modifications to operations and delays
* project redesign or modifications to operations, delays sometimes, and increased costs
* Project-specific impacts, from no effect to delays and/or modification to design.
* There are a number of reviews and evaluations that must occur for each project.
* This section should be completed by ODOT's Megan Michael. Megan.Michael@dot.ohio.gov
* Would need to interview environmental staff but to my knowledge it has not affected planning

Q21: How have the listed species you have encountered affected your design workflow

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| N/A- I have not encountered listed species as part of my work | 52.27% | 23 |
| No effect | 6.82% | 3 |
| Delays | 2.27% | 1 |
| Increased Costs | 0.00% | 0 |
| Project redesign or modifications to operations | 27.27% | 12 |
| Other (please specify) | 11.36% | 5 |
| **TOTAL** |  | **44** |

Other

* increased costs and project redesign or modifications to operations
* It is not more costly to do things right that benefit the project areas. Our seeding specifications include from 20 to 25 native plant grasses and forbes.
* Minimization of ground clearing/impacts in areas with host plants. No major redesign or modifications to operations. No delays.
* Typically no effect because this is included in the process already. Unless it's a new species with new unexpected requirements, the delays, increased costs and possibly redesign
* Would need to interview environmental staff but to my knowledge it has not affected design

Q22: How have the listed species you have encountered affected your operations workflow?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| N/A- I have not encountered listed species as part of my work | 46.67% | 21 |
| No effect | 11.11% | 5 |
| Delays | 0.00% | 0 |
| Increased Costs | 13.33% | 6 |
| Project redesign or modifications to operations | 13.33% | 6 |
| Other (please specify) | 15.56% | 7 |
| **TOTAL** |  | **45** |

Other

* Assuming "operations" = construction -increased costs and project redesign or modifications to operations and delays
* If the Department enters into the CCAA for Monarchs then it could potentially alter vegetation management in those areas with monarch activity.
* Modifications to usual mowing. Mowing in late autumn or winter.
* No effect. Off site mitigation is established.
* Project redesign or modifications to operations, delays sometimes, and increased costs.
* We deal with listed species all the time, just not the pollinators listed.
* Would need to interview environmental staff but to my knowledge it has not affected operations

Q23: What protocol changes would you recommend to improve workflow while still maintaining compliance with endangered species regulations?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| ESA compliance guidebook providing options and decision support. | 13.95% | 6 |
| Programmatic ESA permits in place to cover all future actions/projects. | 11.63% | 5 |
| All of the above. | 46.51% | 20 |
| None of the above, my workflow for ESA compliance is fine as it is. | 13.95% | 6 |
| Other (please specify) | 13.95% | 6 |
| **TOTAL** |  | **43** |

Other

* Agreements will have a lot of value, like the CCAA or KBB agreements
* Encourage more upfront planning at a project level.
* Flexibility and ability to engage in discussions and determine best practices for addressing the situation rather than being told or inability to alter vegetation management techniques to resolve the concerns.
* Generally our ESA compliance is fine. There is concern with attracting pollinators (which may become listed in the future) to roadsides and creating more burden on project development and maintenance operations as well as haying from the ag community.
* We already have Programmatic ESA permits for construction and maintenance. Maintenance follow-through following construction is the biggest challenge.
* Would need to interview environmental staff

Q24: What information do you need about listed or declining pollinators to support your work?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| Natural history information (e.g. host plants, distribution, adult flight times) | 52.17% | 24 |
| ESA compliance guidance | 47.83% | 22 |
| List of species receiving state-level protection | 30.43% | 14 |
| List of listed and imperiled pollinator species to be aware of | 43.48% | 20 |
| Background on management impacts | 39.13% | 18 |
| Reasons for species decline/risk factors | 30.43% | 14 |
| Species description/ identification tools | 39.13% | 18 |
| Other (please specify) | 21.74% | 10 |
| **TOTAL** |  | **46** |

Other

* All this information is available from USFWS and state regulatory agencies, but having the information in one place on the web is always helpful.
* An easy to use field guide/brochure to identify listed and imperiled species for non-biological staff. Need information to distribute to help field staff know what is good and what is bad and common practices to use when.
* Cost effective mitigation strategies
* ESA guidance is very tricky when it comes down to insects. Surveys can be very difficult and there are short timeframes in which surveys can be conducted. If it comes down to take, it is hard to quantify.
* Frequent status efforts or results of surveys.
* individual species websites are very helpful
* Map showing species in our area, and compatible planting suggestions.
* Need legislation or governmental direction to influence Agency decision makers
* Public education about vegetation management methods and the impacts that these methods and timing have on the pollinators.
* The others that are not checked are needed but are readily available and are being used.

Q25: Approximately how many times per year do you need to consult with the United States Fish and Wildlife Service (USFWS) or your state Department of Wildlife (or similar agency involved in the recovery of at-risk species) regarding Federal or state listed pollinator species?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| >10 | 19.15% | 9 |
| 5-10 | 4.26% | 2 |
| 1-5 | 21.28% | 10 |
| <1 | 55.32% | 26 |
| **TOTAL** |  | **47** |

Q26: Approximately how many times per year do you need to consult with the United States Fish and Wildlife Service (USFWS) or your state Department of Wildlife (or similar agency involved in the recovery of at-risk species) regarding Federal or state listed non-pollinator species?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| >10 | 55.32% | 26 |
| 5-10 | 10.64% | 5 |
| 1-5 | 14.89% | 7 |
| <1 | 19.15% | 9 |
| **TOTAL** |  | **47** |

Q27: Does the possibility of an imperiled pollinator species (e.g. monarch butterflies) becoming legally protected by the Endangered Species Act cause barriers (e.g. alters project timeline) to your agency?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| No Opinion/Don’t Know | 8.33% | 4 |
| No | 16.67% | 8 |
| Somewhat | 22.92% | 11 |
| Yes (please describe) | 52.08% | 25 |
| **TOTAL** |  | **48** |

Other

* If we do not participate in the monarch CCAA, we would have Section 7 consultations on many more projects, including many that would not require Section 7 consultation otherwise. We also would not have take coverage for maintenance activities in monarch habitat unless we completed a Habitat Conservation Plan or other ESA Section 10 take permit. It would increase costs and timeline for project and maintenance activity approval dramatically.
* Listed monarch would require consultation on most highway construction projects
* Depending on whether entering into the CCAA for Monarchs agreement it could severely impact vegetation management activities for the roadside if the Department is not a part of the CCAA and the Monarch becomes listed. If we are part of the CCAA then we would be have some slight impacts but mostly able to perform our routine activities with little impact hopefully.
* Increase resource needs and liability.
* Section 7 Consultation would be required, thus mitigation for impacts and extended project schedule to received Biological Opinion
* Will need to know how many ROW acres and suitable habitat acres; identify and implement statewide plan for protecting or increasing habitat for pollinator species; incorporating host and nectar species in all seed mixes, regional weed control plans/operation plans to include reduced or modified mowing and herbicide use.
* Any restriction such as this causes a barrier. These barriers can be overcome, but a great deal of resources will be necessary.
* It should alter our current maintenance practices for vegetation management.
* Impacts construction and maintenance activities as milkweed has the potential to grow everywhere in MN
* Listing a pollinator like monarch butterflies could significantly alter mowing practices and timelines for both construction projects and routine maintenance.
* All of our roadsides would be habitat therefore all of our projects would need to be compliant with ESA for monarchs.
* As potential habitat is considered any flowering plant in arid regions, it has huge potential to create barriers.
* It's another species that would require consultation with USFWS that may affect the project schedule.
* This would constitute a significant change in business, as monarchs and their larval host plants (milkweeds) are common along the highways here. More inventories, more avoidance measures, more consultation, more time, more money.
* Routine mowing practices could be affected. We are looking into the CCAA for the Monarch; Defining and adopting new procedures is expected.
* Yes. Monarchs are widespread in our state and can be found in many areas. It would cause a great shift in how we develop projects, conduct maintenance, and potentially place liability on the ag community for haying within our ROW.
* We are entering into the Monarch CCAA to programmatically handle maintenance projects and projects with no or minimal new ROW. Larger projects that impact pollinator habitats, especially with milkweed, will either require at least a portion of the construction to occur in winter or formal consultation (either individual or programmatic).
* It will alter all operations on our land system and without a programmatic agreement we would have to consult every time we performed agency activities on our lands. This could cause delays in project implementation.
* It will until the monarch gets incorporated into our programmatic ESA permits.
* World require identification of host plants, geo-locating and signage at locations to direct maintenance staff, could require off site mitigation, could result in non-operational Rights of Way being managed by crews trained in best management practices
* With approximately 5,000 construction jobs currently underway and the whole state as potential habitat, this would be a major item to implement and costly.
* VDOT has joined the Monarch CCAA. We already have a pollinator habitat program so this is in line with our environmental stewardship goals but we also we realize the listing of the monarch has the potential to alter project timelines as well as hamper our regular maintenance activities
* Listings can have widespread implications, depending on the species. Generalist species seem to be more challenging than specialists, particularly for assessing suitability of habitat and/or presence/absence. New listings tend to cause a flurry of concern and activity. We comply with the ESA on most roadway design projects through the Section 7 consultation process. Maintenance activities are handled different because there is no federal nexus. These are handled ad hoc as we’re made aware of the proposed activity.
* Sometimes we need to perform surveys or wait for responses
* My conversations with DOTs indicate that all foresee some level of impact from a monarch listing.

Q28: Does the possibility of an imperiled pollinator species becoming legally protected by the Endangered Species Act motivate your agency to proactively protect pollinators in order to avert a listing?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| No Opinion/Don’t Know | 8.33% | 4 |
| No | 10.42% | 5 |
| Somewhat | 41.67% | 20 |
| Yes (please describe) | 39.58% | 19 |
| **TOTAL** |  | **48** |

Other

* We are working on a voluntary pre-listing conservation agreement
* California DOT has signed on to the advanced regional plan to try and prevent the Monarch from being listed.
* California DOT is participating the Monarch CCAA
* Caltrans is working on joining the Monarch CCAA
* If we knew what needed to be done to help protect these species we would certainly do that. We are working closely with our biologists to become educated, but they do not stay with the agency very long.
* We want to be sure not to adversely impact our day-to-day operations. We have policies in place in Design for pollinator species and also do not to adversely impact the project development/delivery process or construction activities.
* Joined the CCAA Task Force to ID areas to help protect and conserve nectar producing flowers or mitigating the decline of the butterfly.
* Although we do not know how many ROW acres we have, how many acres of suitable habitat,
* We are participating in the monarch butterfly CCAA and would potentially participate in another such agreement for additional pollinator species.
* Funded bumblebee research, RPBB surveys, participation in Monarch CCAA
* Agency is not only sharing more about efforts we've been making for supporting pollinator life cycles, but also is participating in development of the Monarch CCAA.
* We were interested in the CCAA but due to our level of NEPA assignment it did not work out for us. We are exploring other options at the moment.
* Yes, but due to limited staffing, we just don't have the resources to dedicate to efforts that are not required. Staff are stretched thin, so anything that is not essential is not something we can integrate.
* We have already started to minimize mowing of areas beyond the clear zone and planting pollinator plots in larger areas of ROW. We will also join the Monarch CCAA.
* We would take any necessary steps to ensure full compliance with the ESA.
* We are joining the CCAA, but TxDOT has always maintained the right of way for pollinator/native wildflower species. This will increase the amount of paper work tremendously and with no additional personnel.
* See above - we are working to calculate our conservation efforts already occurring and working to increase through more staff training and compliance tracking.
* The monarch butterfly is an excellent example of this. Partly over fear of the impending listing decision, many entities banded together to develop proactive conservation approaches to prevent a listing. However, the concern over creating risk is always raised when discussing habitat restoration on rights-of-way.

Q29: Are you familiar with any of the following listed ESA Compliance Strategies? If so, have you ever applied the strategy to your work?

|  |  |  |  |
| --- | --- | --- | --- |
| Are you familiar with this ESA compliance strategies? | Yes | No | Total |
| Safe Harbor Agreements | 60.00% | 40.00% | 40 |
| 24 | 16 |
| Recovery Crediting System | 31.58% | 68.42% | 38 |
| 12 | 26 |
| Habitat Conservation Plans | 90.24% | 9.76% | 41 |
| 37 | 4 |
| Candidate Conservation Agreements | 77.50% | 22.50% | 40 |
| 31 | 9 |
| Candidate Conservation Agreements with Assurances | 79.07% | 20.93% | 43 |
| 34 | 9 |
| Pre-listing Conservation Agreements | 53.85% | 46.15% | 39 |
| 21 | 18 |
| **If yes, have you applied this strategy to your work?** | **Yes** | **No** | **Total** |
| Safe Harbor Agreements | 3.70% | 96.30% | 27 |
| 1 | 26 |
| Recovery Crediting System | 20.83% | 79.17% | 24 |
| 5 | 19 |
| Habitat Conservation Plans | 42.42% | 57.58% | 33 |
| 14 | 19 |
| Candidate Conservation Agreements | 26.67% | 73.33% | 30 |
| 8 | 22 |
| Candidate Conservation Agreements with Assurances | 36.36% | 63.64% | 33 |
| 12 | 21 |
| Pre-listing Conservation Agreements | 14.29% | 85.71% | 28 |
| 4 | 24 |

Q30: Has your DOT signed on to the USFWS’s Candidate Conservation Agreement with Assurances (CCAA) for the monarch butterfly [(https://www.fws.gov/savethemonarch/CCAA.html)?](http://www.fws.gov/savethemonarch/CCAA.html))

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| Yes | 8.70% | 4 |
| No | 47.83% | 22 |
| Not yet, but has plans to enroll | 28.26% | 13 |
| Don't know | 15.22% | 7 |
| **TOTAL** |  | **46** |

Q31: Why did your DOT decide to enroll in the CCAA?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| Complemented other goals | 15.00% | 3 |
| Good for public relations | 5.00% | 1 |
| To help avert a listing | 15.00% | 3 |
| Other (please specify) | 65.00% | 13 |
| **TOTAL** |  | **20** |

Answers Given for “Other” (Yes - Enrolling)

* If we do not participate in the monarch CCAA, we would have Section 7 consultations on many more projects, including many that would not require Section 7 consultation otherwise. We also would not have take coverage for maintenance activities in monarch habitat unless we completed a Habitat Conservation Plan or other ESA Section 10 take permit. It would increase costs and timeline for project and maintenance activity approval dramatically.
* All the above
* To be proactive and possibly avert a listing.
* reduce costs, workload, regulatory assurance.
* It helps reduce risk to the agency and is consistent with other goals.
* All the above, adds regulatory certainty to future construction and maintenance activities
* Agency hasn't yet enrolled. NDOT has been part of the CCAA development
* We are not 100% committed in enrolling at this time, but we are actively investigating this. It comes down to limited staff resources and funding, so we have to look at all options right now.
* To have a mechanism for completing our maintenance work without having to do a HCP or section 7 consultation every time that ODOT needed to mow or replace guardrail. We also hoped that it would avert a listing, but that wasn't our main goal.
* To help avert listing, yes but if it is listed to have those assurances.
* All of the above
* I'm still working to convince WSDOT this is the right thing to do.

Q32: Why did your DOT decide against enrolling in the CCAA?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| Too costly | 9.52% | 2 |
| Too logistically challenging | 9.52% | 2 |
| Doesn’t fit with current priorities | 9.52% | 2 |
| Not concerned about a potential ESA listing of monarchs | 9.52% | 2 |
| Other (please specify) | 61.90% | 13 |
| **TOTAL** |  | **21** |

Answers Given for “Other” (Not Enrolling)

* We are monitoring the situation and working with the group by providing staff resources.
* We don't have time to change our maintenance practices, establish survey transects and achieve managerial approval prior to the expected listing decision. Without those in place, the number of acres we could commit too are too few to justify the cost.
* Still unclear on all the details of the CCAA; not sure it is finalized yet
* It does not seem to fit our agencies needs. Not sure what it would accomplish if we did.
* Most of the DOT staff doesn't seem concerned about the importance of establishing pollinator habitat. Everything that has been done has been because of ONE employee. This employee has been trying to get management to create a pollinator program of some kind, but can't seem to gain any momentum with current management.
* Kentucky developed it own Pollinator Habitat Conservation Plan.
* The federal action of issuing a take permit through the CCAA would establish a federal nexus on state fund only construction projects and maintenance activities. This would require a NEPA review (106 is a large issue) for all maintenance activities that are not currently being reviewed. The impact to project delivery by Environmental Section would likely be substantial. NDOT Operations activities would be greatly impacted.
* The currently version of the CCAA does not include discussion for projects that received an effect determination of “may affect, but is not likely to adversely affect” as it relates to ESA Section 7 consultation for Federal-Aid projects. This was discussed in a phone call between NDOT, Nebraska FHWA, FHWA in Washington DC, other DOTs, and the CCAA administrators. The CCAA administrators have promised to address this topic within the CCAA.
* The CCAA only applies to State owned ROW and would not apply to Local Projects. This will create issues for T&E review of Local Projects and could require a separate matrix for State and Local Projects.
* We are not aware of the details of it yet.
* Did not receive support from upper management. No reason given.
* Was not aware of it
* Because ODOT has an ESA Section 7 programmatic take agreement for STIP projects and a Section 10 take permit for routine maintenance. We will add the monarch to both if the species is listed. Adding the monarch to our existing ESA coverage avenues will keep ODOT in control; ODOT control would be relinquished in the CCAA.
* Too logistically challenging AND does not fit current priorities
* WisDOT is still evaluating

Q33: To the best of your knowledge, do you think your DOT is interested in signing on to potential future Candidate Conservation Agreements with Assurances, if they become available for additional imperiled pollinators (e.g. the western bumble bee, Bombus occidentalis)?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| Yes | 33.33% | 16 |
| No | 14.58% | 7 |
| No opinion/don't know | 52.08% | 25 |
| **TOTAL** |  | **48** |

Q34: Has your DOT identified pollinator conservation as a priority?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| Yes | 41.67% | 20 |
| No | 43.75% | 21 |
| Don't know | 14.58% | 7 |
| **TOTAL** |  | **48** |

Q35: What were the primary motivations for your DOT’s past pollinator conservation projects?

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| Part of agency sustainability goals | 33.33% | 7 |
| Responding to a community request or collaboration opportunity | 14.29% | 3 |
| Part of a larger agency permit negotiation/approval | 4.76% | 1 |
| Effort to avert a species listing | 9.52% | 2 |
| Other (please specify) | 38.10% | 8 |
| **TOTAL** |  | **21** |

Answer for “Other”

* All of the above
* All of the above plus cost savings.
* I've heard all of the above expressed as reasons for DOTs to get involved in pollinator conservation. Averting a listing and public interest being the two most common.
* Legislature passed law to use native plants for pollinators in 2018.
* Obama's 2014 letter
* President Obama's Presidential Memorandum, 2014
* Previous Agency director had strong interest in issue. We do want to avert species listing.
* We have only completed one past pollinator conservation project and it was to promote awareness to public and staff

Q36: DOT efforts to support pollinators (imperiled or otherwise) may be useful to highlight conservation examples to other agencies. Do you have conservation stories /case studies /photos that you would like to highlight in the regional guidebooks (currently in development)? If you answer yes or maybe, we will follow-up for more information.

|  |  |  |
| --- | --- | --- |
| Answer Choices | Responses (percent) | Responses (number) |
| Yes | 23.40% | 11 |
| No | 42.55% | 20 |
| Maybe | 34.04% | 16 |
| **TOTAL** |  | **47** |

Q37: Please provide any other comments, perspectives, or concerns relatedto pollinators that you feel are important.

Answers Given

* Although our DOT has not made pollinators a priority, it has been increasing efforts to do better but including more pollinator friendly species in our seed mixes as well as adding some brief education components into other education programs.
* Because WSDOT is large (6,000 employees) and responsibilities widely distributed among staff with many difference work habitats and points-of-view, it is very difficult to know how often the direction on pollinators is being implemented.
* CDOT currently has one highway (I-76) where we have a pollinator pilot project. If successful, we hope to eventually expand that statewide. Guidance such as you are developing would be very useful. Thanks!
* I think the issue with insect mortality next to busy highways has been overlooked or glossed over. While roadside pollinator habitat makes sense in rural areas, I am not sure that roads with high speeds and heavy traffic are appropriate for pollinator habitat. In this urban area it makes more sense for pollinator habitat efforts to be focused on individual people's properties (ie backyard habitat).
* I think we could be doing so much more for pollinators on our roadsides but the administration is unwilling to increase efforts. It will take the listing of the monarch to spur them to do anything else. We plant about 500 acres of forbs each year but post planting management is minimal. We funded research that showed that. We need to actively manage our roadsides better for wildlife. Until there is a listed species, I do not see our administration stepping up efforts.
* Kentucky is reviewing its vegetation management practices with hopes of being more accommodating for pollinator species within the near future.
* ODOT has a Special Management Area (SMA) Program where ESA species are protected along the roadside. SMAs are the foundation for ODOT's Routine Maintenance HCP for butterflies and plants.
* One of WisDOT's biggest challenges is we contract/partner with our county highway departments for maintenance activities. This is unique to our state DOT, making unique education an enforcement issues.
* Our DOT is undergoing management changes and it is uncertain whether they will continue conservation efforts. The state is one of the original I-35 Monarch Highway partners and it is hoped that we will continue to build upon that work. The message from working with other state agencies is connectivity is important to state hunting interests and helps to get the benefits of pollinator rights of way habitat in front of a larger audience.
* Our first pollinator conservation project has mixed reviews due to the pressure of weeds. Need to find a way to promote pollinator conservation while managing or reducing weeds.
* Several questions within the survey suggested that I select all that apply, but this was not possible. Mowing outside of clear zone is not occurring until noxious weeds, invasive plants and woody stems are treated. We won’t avoid an area in the clear zone due to nectar resources- not an option. We currently only mow 2-5 times a year, dependent on road classification and only within the first 15-30 feet of road, depending on road class. The focus is to mow for maintaining sight distance and to capture the seed head formation on cool season grasses and again for warm season grasses. We will mow the clear zone to a height of 6 inches. Currently not mowing beyond the clear zone. Contract specifications require cleaning at the end of each day and prior to moving onto job site. We recently started a monitoring/mapping process for invasive species and tree risk. We track herbicide utilization and location it is placed but currently don’t have a well-defined feedback look for QA/QC of these activities. Question #9 is all about mowing and not herbicide as the heading states- as such, I did not answer this question. Question #11 is the same as #9 and # 7. As such, I did not answer this question. Question #13 is the same as #11, #9, and #7. As such, I did not answer this question. General comments: It would benefit the Xerces Society and other pollinator focused groups to attend utility and DOT vegetation management seminars and conferences. Many states have a “XXX Vegetation Management Association”. There are also some regional and nationwide conferences that are focused on this arena. Not all states manage all roadsides in the same manner i.e. some states have multiple jurisdictions for the various levels of roads while other states have a centralized system in place for all roads within the state’s network- e.g. INDOT maintains about 12,000 centerline miles of Interstate, US and State Routes while there are 66,000+ centerline miles roads that are maintained by other entities (in this case 92 counties and countless municipalities). I bring this up as the vast majority of miles within a state network is largely roads with little-to-no right-of-way outside of what would be considered a “clear zone” if that analysis were to be conducted.
* Since I do not represent a specific DOT, I have left some of my responses to those questions as blank. To the extent practical, I've responded based on my experience with multiple DOTs working through the CCAA and other conservation projects.
* Stephanie Dobbs of the Bureau of Operations contributed to the operations-related portion of this survey.
* The best way to get DOTs and other ROW owners to manage their properties for pollinators is to show cost savings and other operational benefits. I am an ecologist, so I want to save pollinators because I know they are important, but I need to show how it saves the DOT money, time, or regulatory stress in order to convince management that it is important.
* The general public sometimes complains that unmowed areas look unsightly. An educational program for the general public as well as maintenance staff would be useful.
* Traffic collisions with pollinators is an important metric to sites which attract these organisms.
* We are not utilizing stormwater detention and retention ares to create long term benefits for pollinizers. There is little interest to implement good practices to accomplish this benefit.
* We are preparing to launch more pollinator-friendly IVM practices statewide, and also a pollinator conservation license plate to fund habitat enhancement. But these aren't in effect yet. The answer choices in this survey often didn't match our situation. For instance, we mostly don't mow at all (ever) beyond the clear zone on many highways, but this wasn't an answer choice. Similarly, there are many highways that don't use herbicides at all, or if used, just along the edge of pavement. So we are probably doing more for pollinators than the answers above indicate, but there wasn't a way to reflect this in the answers.
* We have many mitigation and roadside projects that are not "managed" by Agency maintenance that are excellent. Our Agency at the local level does many good things. Statewide Maintenance leadership is intransigent and opposed to changing standard practices. Statewide Maintenance leadership needs influence from government to change mindset and policy.
* WSDOT is also coordinating with other states nationally, to study the use of roadsides for pollinator forage and habitat.
* Your questions on the barriers are not correct and if they are pose no reason for response. All of these are really not a pick one answer. There are many factors that come into play.