

**NCHRP Project 20-44(033):**  
Implementing NCHRP Project 20-119: Evaluating the  
Suitability of Roadway Corridors for Use by Monarch  
Butterflies

**Final Report**

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Prepared for  
**National Cooperative Highway Research Program**

by  
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**SPECIAL NOTE:** This report **IS NOT** an official publication of the National Cooperative Highway Research Program, Transportation Research Board, National Research Council, or The National Academies.

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# DISCLAIMER

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## INTRODUCTION & PROJECT SUMMARY

Our initial National Cooperative Highway Research Program project (NCHRP Project 20-119) developed tools to assess the value of roadway corridors as habitat for monarch butterflies (*Danaus plexippus*) and to aid departments of transportation (DOTs) in preparation for potential regulatory action by the US government. The monarch butterfly (*Danaus plexippus*) is currently a candidate species for listing under the Endangered Species Act (U.S. Fish and Wildlife Service, 2020) and in 2020, the International Union for the Conservation of Nature (IUCN) added the migratory monarch butterfly (*Danaus plexippus plexippus*) to its Red List of Endangered Species (Walker et al., 2022). NCHRP Project 20-119 was designed to enhance the ability for DOTs to plan for and manage habitat for the monarch in transportation rights-of-way, and to evaluate the effectiveness of roadside management projects for monarchs. The tools created assist transportation managers participating in the Nationwide Candidate Conservation Agreement with Assurances (Monarch CCAA) for the Monarch Butterfly on Energy and Transportation Lands as well as any other road corridor managers interested in managing their roadside habitat to benefit monarch butterflies. The work initially identified four Products, two of which were combined into the Roadside Monarch Habitat Evaluator. Hence, three main contributions resulted:

- 1) A [Landscape Prioritization Model of Roadside Habitat for Monarchs](#) for roadside managers to identify locations that are compatible with their road and right-of-way maintenance objectives. Locations are ranked in suitability for monarch habitat conservation based on surrounding land use types and road characteristics. The model is free, downloadable, and runs in standard Esri ArcGIS desktop software.
- 2) A [Roadside Monarch Habitat Evaluator](#) that enables managers to quickly assess the monarch habitat quality of roadside areas. The module is free and runs in *Esri Survey123* software which is linked to the agency's Esri ArcGIS Online enterprise system. Data gathered create an adaptive management feedback loop to track success of efforts and improve future conservation practices.
  - a. Surveyors use a simple **Rapid Assessment** protocol that can be completed on a mobile device or on paper and entered using the Survey123 application. The protocol can be adjusted for a variety of levels of expertise and can be conducted in 10-15 minutes per location.
  - b. Field data are automatically transformed by a **Roadside Monarch Habitat Quality Calculator** into monarch habitat quality scores that can be used to compare sites, characterize habitat across a jurisdiction, compare areas under different management regimes, and inform managers of needed conservation actions. Results are easily tracked and summarized within each state department of transportation.
- 3) [Decision support tools](#) for roadside managers to help align road authority objectives and regulations with conservation goals in a way that is economically and environmentally additive. Materials including a decision tree, milkweed and nectar plant identification guides, weeds and herbicide handout, and a set of frequently asked questions support land managers in their conservation-oriented decisions.

NCHRP Project 20-44(033) provided support for direct implementation of these tools via personnel training, technical assistance, and resource updates and development.

# TASKS & TIMELINE

NCHRP Project 20-44(033) resulted in four primary components, described below:

<b>Tool Customization &amp; Dissemination</b> <i>Feb 2021-June 2022</i>	<ul style="list-style-type: none"><li>• Customized &amp; shared the Roadside Habitat Evaluator and Landscape Prioritization Model tools</li></ul>
<b>Technical Assistance, Training, &amp; Support</b> <i>Feb 2021 - Aug 2023</i>	<ul style="list-style-type: none"><li>• Provided technical assistance, training, and support to DOTs and other roadside managers</li></ul>
<b>Field Data Collection</b> <i>May - Sept 2021</i>	<ul style="list-style-type: none"><li>• Collected roadside field data via the Roadside Habitat Evaluator tool</li></ul>
<b>Resource Development &amp; Updates</b> <i>Jan 2022 - Aug 2023</i>	<ul style="list-style-type: none"><li>• Updated existing resources &amp; developed new materials to support DOT monarch &amp; pollinator conservation efforts</li></ul>

## 1) Tool Customization & Dissemination

Throughout implementation of this project, we provided technical support and tool modification according to the needs and requests of the participating departments of transportation (DOTs). In total, we distributed the Landscape Prioritization Model and Monarch Roadside Habitat Evaluator templates to organizations from 31 U.S. states as well as individuals from Canada and India. 22 of the 31 state organizations were departments of transportation (DOTs). When sharing the tools, we corresponded via email with some and met with others virtually to provide training and technical support.

In addition to sharing the tools, we made upgrades and improvements to the original Roadside Habitat Evaluator template based on feedback and recommendations from DOT users. These changes included significant improvements to the back-end display of data (e.g., developing additional data summaries and outputs), adding new optional data fields, modifying the flow of survey fields and related table structure, and fixing multiple bugs discovered during re-evaluation. Additionally, we made upgrades to align the tool with monitoring requirements of the [Candidate Conservation Agreement for Monarch Butterflies](#) (Monarch CCAA), as many of our DOT collaborators were already enrolled or are considering enrollment in the program. We added new optional fields to record insect pollinators (in addition to monarchs) as well as fields to document the presence or absence of other specific pollinator habitat requirements. We communicated these changes and shared updated templates with all DOTs and organizations who previously requested the tool.

In addition to sharing the tool templates, we worked individually with six state DOTs to customize the Roadside Habitat Evaluator and Landscape Prioritization Model to meet their information needs and interests.

- **California:** During 2021-2022, we held multiple meetings with Caltrans District 5 staff (Central California Coast region) to aid them in implementing a district-level pilot program to monitor monarch butterflies and habitat along their roadways, and to test the existing [Milkweed Habitat Suitability Model](#) for the state. To do so, we customized the Roadside Habitat Evaluator (both paper datasheets and ESRI Survey123 forms) to create a comprehensive but efficient monitoring protocol for assessing baseline habitat suitability at project sites. Customization involved tailoring noxious weed, milkweed, and nectar plant lists to be California-specific; adding custom fields for overwintering habitat documentation; removing immature monarch data fields and replacing with more general fields to record presence/absence of caterpillars and number observed (incidental sightings); adding photo and associated text fields; and modifying the mowing and herbicide data fields.

During the middle of the project, there was a staff change at Caltrans District 5 which resulted in new training for District 5 staff as well as Caltrans Headquarters Division of Environmental Analysis. We reviewed prior Roadside Habitat Evaluator customizations, discussed their enrollment in and planned activities for the [Candidate Conservation Agreement for Monarch Butterflies](#) (Monarch CCA), and explored additional customizations of the Roadside Habitat Evaluator.

- **Georgia:** We provided technical assistance and support to Georgia DOT (GDOT) regarding use of the Landscape Prioritization Model and ground verification of its results. We shared the Roadside Habitat Evaluator and Georgia-specific plant lists to aid this process and provided support to GDOT in generating roadside timing and frequency schedules that minimize adverse impacts on monarchs during their breeding and migration periods.
- **Illinois:** We worked with the Illinois DOT (IDOT) over the course of the project to discuss their Monarch CCA enrollment and current pollinator conservation efforts, provide training on use of the Roadside Habitat Evaluator, and to discuss potential modifications of the tool. We customized the tool per IDOT's requests, including adding a field for mile marker, grass percent cover, additional mowing fields, and management /prescribed burn frequency, as well as modifying certain terminology. We also narrowed the noxious weed list associated with the threats category of the assessment scoring to include those IDOT manages for or considers to be noxious or otherwise undesirable. Afterward, IDOT tested the tool with their roadside managers and planned to deploy the tool for monitoring during 2022.
- **Minnesota:** We collaborated with the Minnesota Department of Transportation (MnDOT) over the course of two years (2020-2022) to customize the Landscape Prioritization Model and to use the Roadside Habitat Evaluator for collecting baseline data on US highway sites in Minnesota (described in more detail in *Field Data Collection*, page 8). MnDOT provided state-specific data layers in which we incorporated into the Landscape Prioritization Model to refine the model for the state of Minnesota. These included a shapefile of native prairie and natural habitat across the state and road-specific data layers. We provided virtual technical assistance and training to MnDOT's staff team on use of both the Landscape Prioritization Model and Roadside Habitat Evaluator.

- **Pennsylvania:** During 2021-2022, we provided tool training, customization, and technical assistance to the Pennsylvania Department of Transportation (PennDOT). We worked with PennDOT staff to refine the Landscape Prioritization Model, incorporating Pennsylvania-specific road data with updated speed limits and traffic volumes. Per PennDOT's request, we also removed roads within municipal areas and identified clusters of high-ranking roads where further investigation may be warranted. We provided the updated model and associated files for their exploration and explored potential tweaks to the model, such as increasing the milkweed weight for wetland landcovers. In the future, they plan to use the Pennsylvania Landscape Prioritization Model in combination with PennDOT conservation mowing practices to increase the effectiveness of the conservation mowing applications in those identified regions.

We also joined meetings with PennDOT and Pennsylvania State University staff who implemented two different monitoring tools on PennDOT roadways (the MJV's Roadside Habitat Evaluator and Rights-of-Way as Habitat Working Group's [Pollinator Habitat Scorecard](#)). During these meetings, we discussed the efficacy of each monitoring tool and compared their survey results.

- **Wisconsin:** We convened two meetings with Wisconsin DOT (WisDOT) during 2021 to discuss use of the Roadside Habitat Evaluator, Landscape Prioritization Model, and potential customizations. We provided training on use of the tools and discussed their monitoring needs for potential Monarch CCAA enrollment. After the meeting, we ran the Landscape Prioritization Model for the state of Wisconsin, shared data outputs with WisDOT, and provided recommendations for improving the model with state-specific data layers from WisDOT. We also shared the Habitat Evaluator Guide and data forms for their review.

**Roadside Monitoring Survey:** In addition to directly customizing tools for the states described above, we drafted and distributed a survey to collect information about current DOT monarch and pollinator monitoring efforts, preferences, and needs, in hopes of enhancing our tools and resources to best support roadside managers. We collaborated with the Rights-of-Way as Habitat Working Group to develop the survey and to compile a contact list of DOT representatives. We distributed the survey to DOTs across the US, receiving 32 responses from individuals across 21 states and provinces (25 of which were Departments of Transportation with others representing local or state road authorities or nonprofit organizations working with roadside managers). After receiving responses, we summarized responses and shared key takeaways with Rights-of-Way as Habitat Working Group collaborators.

59 percent (19/32) of individuals reported that they are currently monitoring roadside habitat, with 16 percent (5/32) planning to do so in the future. The majority of respondents (63%; 20/32) indicated that they spend 11-50 days conducting surveys of monarchs, pollinators, and/or habitat along roadways each year (Figure 1), and that they typically monitor each site just one time within a year. We learned that staff biologists, maintenance staff, and contractors/consultants are often the individuals conducting field surveys at most organizations. Their primary purposes for monitoring included meeting Monarch CCAA monitoring requirements, collecting baseline habitat data, and evaluating the impacts of their vegetation management. This information was used to enhance existing tools, training materials, and resources, such as adjusting habitat calculator scoring and providing additional training and support via live webinars and research roundtables.

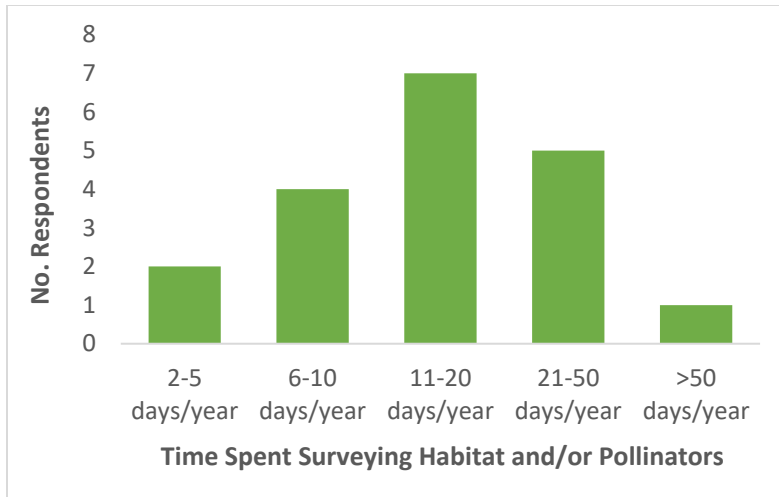


Figure 1. Time spent surveying roadside habitat and/or pollinators reported by roadside managers or related entities during 2022.

## 2) Technical Assistance, Training, & Support

During phase one of the project, we found that providing hands-on training and support to the personnel who will be using the tools is instrumental in gaining interest and comfort implementing them. Our initial proposal was to conduct in-person training workshops for each state DOT, tailored to their specific needs and wishes for using and/or customizing the tools. We budgeted for these trainings to include lecture-style presentations as well as hands-on field activities targeted for management, landscape architects, GIS experts, and vegetation managers. However, we were limited in our ability to fulfill original plans and provide in-person training due to the COVID-19 pandemic. Instead, we provided training and support to DOTs virtually throughout the implementation period.

In total, we held virtual meetings with and/or trainings for 13 departments of transportation throughout the implementation project (AZ, CA, CO, IL, OH, OK, WI, MN, NE, NJ, GA, PA, TX). We met with state departments of transportation to learn about their pollinator initiatives, consult on their activities, management, and programming, to provide information about MJV's and other external tools for roadside managers, and to identify opportunities for collaboration.

One in-person meeting was held during February 2023 with Nebraska DOT (NDOT), Nebraska Game and Parks Commission, and USFWS staff to discuss monarch habitat on roadsides and implications for managing monarchs in these spaces. During the meeting, NDOT staff emphasized the need for decision making tools such as those being created through the NCHRP grant working groups. NDOT environmental leads expressed the need for data-driven resources such as the extensive literature review (pg. 10) that MJV has created as well as summarized information (e.g., fact sheets) to better communicate with vegetation management staff and public stakeholders.

**Research Roundtable Meetings - Monarch Roadside Mortality:** In addition to direct training and support, MJV and UIC Energy Resources Center organized and facilitated two virtual roundtable meetings during 2023 to address needs communicated by DOTs regarding the topic of monarch roadside mortality. One of the most common questions DOTs receive from the public is whether roadside habitat increases mortality of monarchs and pollinators due to vehicle collisions. DOTs have repeatedly expressed the need for additional information and resources that summarize the latest science and

communicate the risks and benefits associated with roadside habitat. To help achieve this, we convened two meetings with subject matter experts, researchers, and DOT representatives, with 19 attendees participating in total. (Agendas with detailed meeting topics for each meeting are provided in Appendix A.) The specific objectives of the meetings were to:

1. Understand the current state of knowledge on monarch roadside mortality;
2. Determine if existing research is sufficient to provide recommendations for roadside managers to mitigate roadside mortality risks; and to
3. Identify who and what would be needed to identify BMPs (e.g., future research needs, project ideas, funding opportunities).

MJV and the UIC Energy Resources Center met multiple times over the course of 2022 and early 2023 to plan for and debrief from the meetings. Prior to each meeting, we compiled and shared reading material for the group including a literature review (pg. 10) of more than 50 roadside and pollinator related research papers. The meetings resulted in the group identifying two products that would aid DOTs and other relevant stakeholders in communicating with the public about monarch roadside mortality: the literature review summary compiled by MJV and a new fact sheet that would outline the conservation value of roadside habitat as well as associated risks. MJV then finalized and formatted the literature review for sharing publicly and is developing a fact sheet on the conservation value and risks of roadside habitat in collaboration with the UIC Energy Resources Center (both described in more detail on page 10).

**March 2023 Monarch Meeting:** The Monarch Joint Venture and UIC Energy Resources Center co-hosted a national meeting for rights-of-way managers and monarch conservation stakeholders during March 6-8 in Phoenix, Arizona. 175 individuals from 105 organizations attended, representing partners of the MJV, partners of the nationwide Monarch CCAA program administered by the University of Illinois Chicago, and other invited stakeholders. MJV and UIC Energy Resources Center staff planned and facilitated the meeting which included a series of presentations on pollinator conservation and transportation topics, panel discussions, and breakout group sessions on various topics. MJV staff presented on monarch roadside habitat suitability, recent efforts to generate refined best management practices, and highlighted resources currently available to roadside managers.

**Research Roundtable Webinar – Rare Plant & Biodiversity Monitoring on ROWs:** In 2022, Monarch Joint Venture facilitated a virtual, break-out session discussion as part of UIC Energy Resources Center’s Research Roundtable with DOTs who are monitoring rare plants, pollinators, and biodiversity on rights-of-way. During the break-out session, participants discussed and identified research, monitoring, and information needs and shared relevant resources with each other.

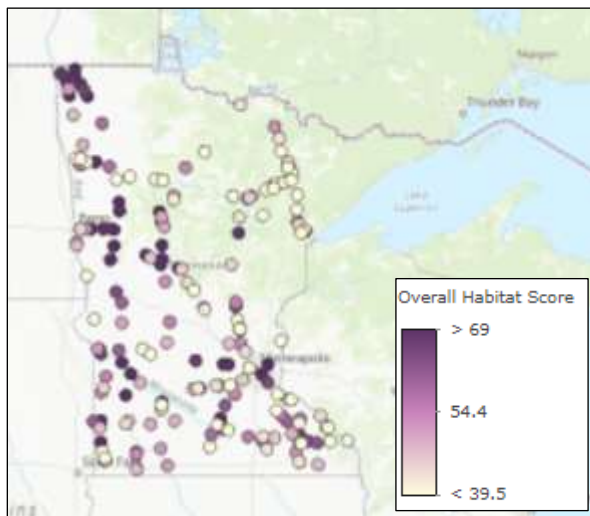
### 3) Field Data Collection

During June — August 2021, we utilized the Roadside Habitat Evaluator to collect field data that would aid in refining and ground-truthing the Minnesota Landscape Prioritization Model, informing Minnesota DOT’s (MnDOT) conservation management decisions, and fulfilling their monitoring requirements for the Monarch CCAA. The Monarch Joint Venture hired, trained, and supervised two field technicians who together conducted 265 surveys of roadside habitat (milkweed density and species richness, floral resource composition) and use by monarch butterflies across the state (Figure 2). Sites were selected in collaboration with MnDOT and included a portion of sites already enrolled in the Monarch CCAA along

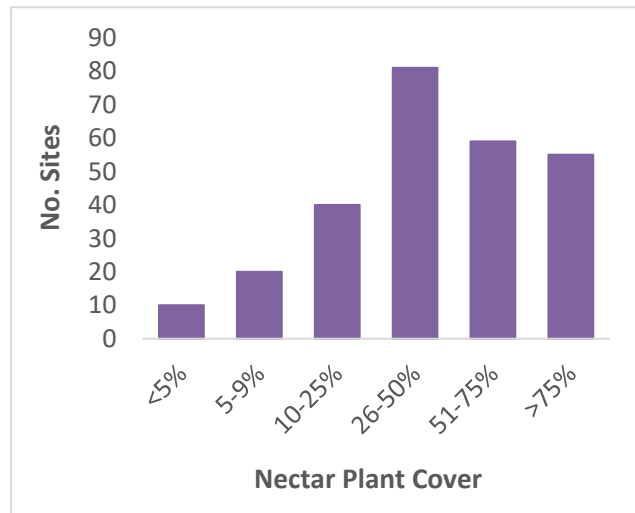


with a set of varying quality sites to ground-truth and refine the Landscape Prioritization Model. Once the field season was complete, we packaged and shared the field data with MnDOT’s team.

The mean monarch habitat quality score calculated by the Roadside Monarch Evaluator across surveys was 57.26 (median = 54.69, range = 19.61-89.75, SD = 14.87). The score incorporates various components of monarch habitat including breeding resources (milkweed), foraging resources (nectar plants), threats (e.g., noxious weeds), and management (e.g., mowing). Milkweed (*Asclepias* spp.) was present on 207 of 265 surveys, with 75 stems present at a site on average (median = 18; range = 0-4,028; SD = 268). (Note that the maximum density of 4,028 stems observed was an outlier due to the clonal growth form of the species *Asclepias verticillata*; the next highest stem count totaled 1,066.) Nectar plant cover was variable across sites with the largest number of surveys (81/265) documenting 26-50 percent cover (Figure 3). Monarch reproduction was documented on 83 surveys, with a total of 389 eggs and 126 larvae counted throughout the season.



**Figure 2.** US highway site locations (265) surveyed by Monarch Joint Venture in 2021 and their associated monarch habitat quality scores calculated via the Roadside Habitat Evaluator.



**Figure 3.** Percent cover of nectar plants at sites surveyed (n=265).

#### 4) Resource Updates & Development

Throughout the project we developed various resources to support departments of transportation in evaluating monarch habitat, creating and/or maintaining habitat, prioritizing conservation efforts, and communicating with the public.

- [Literature Review Summary - Roadside Habitat Conservation Value & Risks](#): We conducted a review of scientific research papers related to monarch butterflies, pollinators, and roadside habitat to provide roadside managers and practitioners with the latest science. We summarized each study and topic, and organized the review into three main sections as follows. The document is available for download on the MJV website.
  - a. Roadside Mortality and Threats
    - i. Vehicle Collisions
    - ii. Road Noise
    - iii. Road Salts and Heavy Metals

- iv. Parasites and Parasitoids
    - v. Light Pollution
  - b. Conservation Value of Roadside Habitat
  - c. Roadside Habitat Management
    - i. Mowing
    - ii. Native Plant Establishment
    - iii. ROW Habitat Prioritization
- [\*\*\*Monarchs & Roadsides Frequently Asked Questions\*\*\*](#): We updated our frequently asked questions resource developed during phase one of the grant, utilizing information acquired from the literature review and Monarch CCAA. We shared the modifications with original co-authors at the Xerces Society for Invertebrate Conservation, incorporated their edits, and re-published the resource on our website.
- ***Roadside Habitat Assessment Tool Comparison (Appendix B)***: Since there are now multiple habitat assessment tools available, we created a comparison chart to aid DOTs in selecting a tool or protocol that best suits their data collection needs.
- ***Social Media Toolkit: Roadside Habitat (Appendix C)***: We created a social media toolkit for DOTs and relevant stakeholders to use when communicating with the public about roadside habitat. The toolkit provides engaging content with facts about roadside habitat for monarch butterflies, including text and images for a series of Facebook, Instagram, and Twitter posts.
- ***Fact Sheet: Conservation Value of Roadside Habitat (in progress)***: Many DOTs have expressed the need for resources and materials that communicate the conservation value of pollinator habitat along roadways. Thus, in collaboration with the UIC Energy Resources Center and National Wildlife Federation, we are in the process of developing a fact sheet geared toward both the general public and DOT staff that communicates the benefits of roadside habitat and addresses questions DOTs often receive. We have gathered input on the content from DOTs and relevant stakeholders throughout development.
- [\*\*\*Mowing & Management – Best Practices for Monarchs Fact Sheet \(updates in progress\)\*\*\*](#): We met with the University of Illinois-Chicago Energy Resources Center to plan additional subgroup meetings with relevant stakeholders and researchers to refine our mowing guidance, per the recommendations of DOTs (e.g., Oklahoma) and researchers. We are planning to convene multiple regional meetings in summer 2023 to discuss current research and DOT practices and will update the fact sheet accordingly.
- [\*\*\*Roadside Habitat for Monarchs Webpage\*\*\*](#): We maintained and regularly updated our roadside habitat webpage with resources and links throughout the course of the project.

## COVID-19 Impact & Project Modifications

Our proposed tasks and timelines were altered due to the COVID-19 pandemic. We revised our initial proposal, tasks, and timelines and received approval from the project committee in October 2022. The

pandemic prevented us from conducting a significant component of the initial proposal – to provide in-person training and data collection field events for departments of transportation. Because of travel restrictions and safety concerns, we instead conducted all training, support, and technical assistance virtually during 2021 and 2022. This eliminated significant costs associated with travel (i.e., flights, mileage, lodging), leaving remaining funding in the budget. We re-allocated these funds for the development of new resources, existing resource and training material updates, continued technical assistance, as well as a subcontract to the University of Illinois-Chicago’s Energy Resources Center. We received a no-cost extension for the project to accommodate these changes and allow for these new tasks to be completed.

## CONCLUSIONS & PROJECT IMPACTS

This project advanced pollinator conservation along US roadways via the implementation of tools developed via NCHRP Project 20-119. Throughout the project, we supported departments of transportation in assessing habitat via the Roadside Habitat Evaluator and prioritizing habitat for conservation via the Landscape Prioritization Model. We provided technical support and training to more than ten departments of transportation as well as other entities managing or evaluating roadside habitat. We facilitated collaboration and information sharing among organizations working in the transportation sector, including the UIC Energy Resources Center, Xerces Society for Invertebrate Conservation, National Wildlife Federation, many departments of transportation, and more. Through working group meetings and webinars, we identified future research and training needs and began filling those needs through working group activities and the development of new materials and resources.

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# APPENDIX A – Research Roundtables: Monarch Roadside Mortality

## Goals & Objectives:

1. Summarize the current state of knowledge on monarch roadside mortality
2. Determine if existing research is sufficient to provide recommendations for roadside managers to mitigate roadside mortality risk
3. Identify who and what would be needed to identify best management practices for roadside managers to mitigate roadside mortality risk
  - a. Identify future research needs (and/or project ideas, funding opportunities)
  - b. Identify methods and formats for sharing BMPs

## Roundtable Participants:

The following researchers, topic experts, and DOT representatives participated in the meetings: Dr. Robert Coulson, Texas A&M University; Caroline Hernandez, University of Illinois-Chicago Energy Resources Center; Catherine Liller, US Fish & Wildlife Service; Chris Smith, Minnesota DOT; Dan Salas, Cardno/Stantec; Dr. Emilie Snell-Rood, University of Minnesota; Glenn Gingras, Vermont DOT; Iris Caldwell, University of Illinois-Chicago Energy Resources Center; Dr. James Tracy, Texas A&M University; Jennifer Hopwood, Xerces Society; Dr. Katy Prudic, University of Arizona; Kris Gade, Arizona DOT; Dr. Kristen Baum, Oklahoma State University; Dr. Kristine Nemecek, Tallgrass Prairie Center; Laura Lukens, Monarch Joint Venture; Luz Quinnell, CalTrans; Mercy Manzanares, Monarch Joint Venture; Dr. Rebeca Quinones-Pinon, National Wildlife Federation; Sam Glinsky, Texas DOT; Sean Sweeney, US Fish & Wildlife Service; Tegha Obire, University of Illinois-Chicago Energy Resources Center; Vonceil Harmon, Oklahoma DOT.

## Agenda – Meeting #1, January 26, 2022

1. **INTRODUCTIONS**
2. **RECAP & LIT REVIEW**
  - a. Recap of last year’s discussion and work on roadside mortality, objectives, meeting goals
    - i. Summarize the current state of knowledge on monarch roadside mortality
    - ii. Determine if existing research is sufficient to provide recommendations
  - b. Review of current research key takeaways, knowns & unknowns
3. **GUIDED DISCUSSION**
  - a. Do you know of any additional studies (or ongoing research) that were not covered in our literature review summary?
  - b. Do you think the existing research is sufficient to generate recommendations for mitigating roadside mortality risk? Considerations may include:
    - i. *Outer roadside habitat vs medians*
    - ii. *Traffic speed & volume*
    - iii. *ROW width*
    - iv. *Road type*
    - v. *Adjacent habitat (ag, natural areas, forest) (studies of ag habitat in Midwest suggest habitat is beneficial overall)*
    - vi. *Proximity to other habitat patches*
    - vii. *Management (and timing)*

- c. What are the research gaps and future needs? What are the priorities / greatest unknowns / potential collaborations?
- d. Would a published literature review / white paper on the current state of knowledge on monarch roadside mortality be helpful?
- e. What form would they like the review to take? How in depth? Level of detail?
- f. Who wants to help figure out what it should look like, etc.
- g. What types of recommendations or best management practices do you think would be most helpful to roadside managers? What are their priority needs? (e.g., selecting locations for roadside habitat, adjusting routine maintenance, seeding/planting, etc.)

#### **4. NEXT STEPS**

- a. Take a close look at the literature on management practices
- b. Recap discussion topics we didn't get to
- c. Query peers/roadside managers you work with to come to the meeting with more clarity on what some of the needs (bring those ideas back for the second meeting)

## **Agenda – Meeting #2, February 13, 2022**

### **1. RECAP & OBJECTIVES**

- a. Review of first meeting discussion - summarize what we heard during first meeting
  - i. Two types of resources (longer and shorter)
  - ii. Mowing guidelines
  - iii. Risk-assessment tool
- b. Is there anything additional that comes to mind / that you learned in terms of recommendations or BMPs that would be most helpful to roadside managers?
- c. Objective for this meeting: Identify who and what would be needed to identify BMPs

### **2. GUIDED DISCUSSION**

- a. Overview of management-related literature
- b. POLLS: Do we have sufficient information to generate basic recommendations for mitigating monarch roadside mortality, in relation to the considerations below?
  - i. Distance from road edge
  - ii. Road type (traffic volume, speed, # lanes, medians, cloverleaf areas)
  - iii. Adjacent land use
  - iv. Habitat composition & width/area
  - v. Management type & timing
- c. Which of the above would be the easiest to modify current practices around?
- d. In what ways do current DOT practices differ from (or even contradict) research findings?
- e. How should we go about creating the proposed BMPs? What else is needed?
- f. Who should be involved in creating the proposed BMPs and guidance?

### **3. NEXT STEPS**

- a. Update literature review document
- b. Convene additional work group meetings
- c. Opportunities for high-level review from full group
- d. Longer term: Facilitate data sharing and track future research opportunities

## APPENDIX B – Roadside Habitat Assessment Tool Comparison

<b>Tool Name &amp; Developer</b>	<a href="#">Rapid Roadside Monarch Habitat Evaluator</a> Monarch Joint Venture	<a href="#">Pollinator Habitat Scorecard</a> Rights-of-way as Habitat Working Group	<a href="#">Integrated Monarch Monitoring Program: Activity 1</a> Monarch Joint Venture
<b>Purpose</b>	To help transportation rights-of-way organizations and land managers evaluate monarch habitat and management practices	To help energy and transportation rights-of-way (ROW) organizations and land managers evaluate pollinator habitat and management practices	To inform monarch conservation efforts by collecting spatially & temporally representative data on monarchs and their habitat in various landscape types
<b>Best Use</b>	For the evaluation of roadside habitat for monarchs where organization would like to own/manage collected data	For the evaluation of pollinator habitat on a range of energy or transportation lands.	For the evaluation of monarch habitat in a variety of landscape types. Rights-of-way are one of six landscape types that can be evaluated with this protocol
<b>Data Collection Method</b>	ArcGIS Survey123 form	Fillable PDF form, printable paper form, or ArcGIS Survey123 form (if registered with the <a href="#">Rights-of-Way as Habitat Geospatial Database</a> )	Collection on paper datasheets and entered into an <a href="#">online web portal</a>
<b>Data Storage Method</b>	User's own ArcGIS Online (AGOL) data repository	User's own paper or electronic data files. If user is registered with the <a href="#">Rights-of-Way as Habitat Geospatial Database</a> , data from Survey123 forms is stored in an AGOL data repository managed by the Univ. of Illinois Chicago's Energy Resources Center (ERC). Raw data and summary reports can be downloaded from the database.	MySQL database managed by the Monarch Joint Venture
<b>Data Sharing Method</b>	Users are owners of the data and choose how and with whom to share it	If user is registered with the <a href="#">Rights-of-Way as Habitat Geospatial Database</a> , data is aggregated at the county level and shared on a public dashboard. Users can also choose to share more detailed data with other database users.	Users can view data summaries (such as milkweed density, flowering plant frequency, species richness) after submitting data to the IMMP Data Portal, and export their data as Excel or CSV files ( <i>coming in November 2021</i> ).
<b>Levels</b>	Fully customizable while retaining the core metric outputs. Standard form equivalent to Tier 3 of the Pollinator Habitat Scorecard	Three tiers of data collection. Tier 1: Is habitat for pollinators present? Tier 2: What is the quality of pollinator habitat? Tier 3: What is the composition of the pollinator habitat?	There are two options for identifying blooming plants – to species (Option A) or just noting presence/absence. portion of activity (Option B). Milkweed identification is required for both options.
<b>Customization</b>	Fully Customizable	Not customizable (but can choose from three tiers)	Not customizable
<b>Evaluation</b>	Monarch habitat quality is scored	Pollinator habitat quality is scored.	Monarch habitat quality is not scored but outputs habitat metrics (e.g. milkweed density and richness, blooming plant frequency and richness, diversity index).
<b>User Guide / Protocols</b>	<a href="https://monarchjointventure.org/images/uploads/presentations/MonarchHabitatEvaluatorGuide.pdf">https://monarchjointventure.org/images/uploads/presentations/MonarchHabitatEvaluatorGuide.pdf</a>	<a href="http://rightofway.erc.uic.edu/wp-content/uploads/Pollinator-Scorecard-Users-Guide-V2.1.pdf">http://rightofway.erc.uic.edu/wp-content/uploads/Pollinator-Scorecard-Users-Guide-V2.1.pdf</a>	<a href="https://monarchjointventure.org/images/uploads/documents/Activity1_2021.pdf">https://monarchjointventure.org/images/uploads/documents/Activity1_2021.pdf</a>
<b>Can be used to meet monitoring requirements of the Monarch CCAA*</b>	Yes, if noted "optional" fields are completed. These fields can be set to "required" with simple customization. Users may bulk upload data to the Rights-of-Way as Habitat Geospatial Database to meet Monarch CCAA requirements.	Yes, all three tiers are compatible with Monarch CCAA monitoring requirements	No

## APPENDIX C – Roadside Habitat Social Media Toolkit



# Social Media Toolkit: Roadside Habitat

*This material was created by staff of the Monarch Joint Venture. It does not represent the positions of all of our partners and has not been pre-approved for use by our government partners. Where necessary, all organizations should work with their internal communications team and leadership before posting content. Any questions about this resource may be directed to [science@monarchjointventure.org](mailto:science@monarchjointventure.org).*

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## PURPOSE

The **purpose** of this social media toolkit is to provide engaging content with basic facts about roadside habitat for monarch butterflies. Please feel free to use and share these resources as you see fit. *You are welcome to share this content outside of the MJV partnership!*

## VISUAL ASSETS

- Images taken by Monarch Joint Venture staff are available in the visual assets folder.
- The images do not specifically align with posts, but instead are a collection of some of our favorite photos of monarchs, roadside pollinator habitat, and community science. Feel free to mix and match, using MJV photos from this folder or your own!
- In each file name, you will find the organization name, photographer name, and an image description.
  - *Example:* "Monarch Joint Venture/Wendy Caldwell\_monarch caterpillar on milkweed leaf.JPG"

- If you use any of MJV's photos, **please credit MJV using "Monarch Joint Venture / Photographer Name"**.
  - *Example:* Monarch Joint Venture / Wendy Caldwell

## HASHTAGS

Hashtags can be used across all social media platforms to allow users to search for posts with similar content. While not required, hashtags could include #RoadsideHabitat #MonarchConservation #MonarchButterfly #MoreThanMonarchs.

## TIMING

These posts can be used at any time throughout the year and have no order. Please feel free to mix and match and use at your convenience!

## SAMPLE POSTS

- Below are sample posts adjusted for Facebook, Instagram, and Twitter.
  - **NOTE:** In this toolkit, the draft posts for Facebook and Instagram are combined. **Instagram does not support links in image descriptions so you will need to adjust these sample posts for Instagram.** A simple modification could be: *For more information, check out the link in our bio.*
- You can copy and paste these posts as is, or adjust the message/update the links. If there are resources/messaging important to your community, please adjust accordingly!

### 1. Roadsides as Monarch Habitat

#### FACEBOOK & INSTAGRAM Posts

From the seat of a vehicle, a roadside ditch may look like nothing more than a blur of weeds. But to a monarch butterfly, it is an oasis of nectar and milkweed needed for survival.

The loss of suitable habitat has been one of the biggest factors in the decline of the monarch population over the last several decades. Many roadsides contain abundant breeding and foraging resources for monarchs and span millions of acres across North America.

Learn more about roadside habitat, management, and assessment tools on the @MonarchJointVenture blog: [monarchjointventure.org/blog/roadside-habitat-for-monarchs](https://monarchjointventure.org/blog/roadside-habitat-for-monarchs)

#### TWITTER Post

A roadside ditch may look like a bunch of weeds, but to a monarch, it is an oasis of nectar and milkweed needed for survival. Learn more about roadside habitat, management, and assessment tools: [monarchjointventure.org/blog/roadside-habitat-for-monarchs](https://monarchjointventure.org/blog/roadside-habitat-for-monarchs)

### 2. CCAA for Energy and Transportation Lands

#### FACEBOOK & INSTAGRAM Posts



The U.S. Fish and Wildlife Service (USFWS) decided in 2020 that the monarch butterfly would not yet be listed under the Endangered Species Act, but the monarch is a candidate species for future ESA protections. If enough people and organizations take voluntary action, the monarch may never have to be listed.

Many managers from the energy and transportation sector are acting proactively to protect monarchs by entering into a nationwide Candidate Conservation Agreement with Assurances (CCAA). This agreement with the USFWS encourages transportation and energy organizations to take steps to create monarch habitat now, so that even if the monarch becomes a threatened or endangered species, quality habitat will already be in place to help the monarch recover.

It's like a down payment on an investment, if the investment were a healthy ecosystem! Learn more about the CCAA at [www.fws.gov/savethemonarch/CCAA.html](http://www.fws.gov/savethemonarch/CCAA.html)

#### **TWITTER Post**

When managers from the energy and transportation sectors enter a Candidate Conservation Agreement with Assurance (CCAA), they commit to taking action today to prevent the monarch butterfly from becoming endangered tomorrow. Learn more: [www.fws.gov/savethemonarch/CCAA.html](http://www.fws.gov/savethemonarch/CCAA.html)

### **3. Monarch Mortality**

#### **FACEBOOK & INSTAGRAM Posts**

Why create more roadside habitat when monarchs die in collisions with vehicles each year? Research suggests that mortality is highest during particular time periods and in specific geographies, such as during the fall migration in Texas and northeastern Mexico. During the breeding season, the benefits typically outweigh the risks, as roadsides can provide and connect thousands of acres of milkweed and nectar plants to support a healthy monarch population. Prioritizing habitat restoration along roadways with lower speeds and traffic volume may minimize adverse impacts on monarchs and pollinators. Learn more and explore frequently asked questions about monarchs and roadsides here: [bit.ly/3rmfd4G](https://bit.ly/3rmfd4G)

#### **TWITTER Post**

Why create more roadside habitat when monarchs die in collisions with vehicles each year? In most cases, the benefits outweigh the risks. Learn more: [bit.ly/3rmfd4G](https://bit.ly/3rmfd4G)

### **4. Monarch Highway**

#### **FACEBOOK & INSTAGRAM Posts**

I-35 is the "Monarch Highway," traversing the eastern monarch migration corridor across six states from Minnesota to Texas. Since 2015, a coalition of state transportation agencies and other partners have been working to promote awareness of monarch conservation and provide resources for roadside vegetation management along the central flyway, one of the most important habitat corridors in North America. Learn more about the Monarch Highway initiative at: [bit.ly/3NDhf8h](https://bit.ly/3NDhf8h)

#### **TWITTER Post**

Traveling from MN to TX, I-35 is the “Monarch Highway”. Since 2015, a coalition of partners have been working to provide resources for roadside vegetation management along one of North America’s most important flyways. Learn more: [bit.ly/3NDhf8h](https://bit.ly/3NDhf8h)

## **5. Roadside Mowing**

#### **FACEBOOK & INSTAGRAM Posts**

Mowing roadside vegetation is necessary to maintain roadway visibility and vehicle safety. When vegetation is mowed too frequently or at the wrong time, important nectar sources and milkweed availability may be reduced, and it can result in direct mortality of butterfly eggs and larvae. Many departments of transportation are considering the impacts of mowing on pollinators and habitat, and many follow the guidelines on MJV’s “[Mowing and Management: Best Practices for Monarchs](#)” handout in order to limit adverse impacts. Handout here: [bit.ly/3JlYaF1](https://bit.ly/3JlYaF1)

#### **TWITTER Post**

Many DOTs are considering how mowing roadside vegetation impacts pollinators, and many follow MJV’s guidelines to limit adverse impacts. Learn about our recommendations for mowing timing on our handout here: [bit.ly/3JlYaF1](https://bit.ly/3JlYaF1)

## **6. What are roadside managers doing to support monarchs and pollinators?**

#### **FACEBOOK & INSTAGRAM Posts**

Departments of Transportation (DOTs) must manage roadside vegetation to maintain visibility and ensure vehicle safety. While doing so, many DOTs keep monarchs and pollinators in mind in order to achieve multiple benefits. Current pollinator efforts include altering mowing practices to maximize pollinator resources, restoring or enhancing native plant communities along roadways, and eliminating invasive species. Learn more about DOT efforts here: [rightofway.erc.uic.edu/resources/case-studies/](https://rightofway.erc.uic.edu/resources/case-studies/)

#### **TWITTER Post**

Departments of Transportation manage roadside vegetation to maintain visibility and ensure vehicle safety. Many DOTs also keep monarchs and pollinators in mind to achieve multiple benefits. Learn more about their efforts to protect pollinators here: [rightofway.erc.uic.edu/resources/case-studies/](https://rightofway.erc.uic.edu/resources/case-studies/)