

Monarch Butterfly Habitat Monitoring Protocol

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1. INTRODUCTION

The Arizona Department of Transportation (ADOT) is coordinating with the U.S. Fish and Wildlife Service (USFWS) and the University of Illinois Chicago (UIC) to develop a Nationwide Candidate Conservation Agreement with Assurances (CCAA) for monarch butterfly (*Danaus plexippus*). As part of this process, ADOT has partnered with WestLand Engineering & Environmental Services (WestLand) to develop this monarch habitat monitoring guidance document for implementation of the annual ADOT monitoring program. The purpose of this program is to monitor suitable monarch habitat (specifically milkweed (*Asclepias* spp.)) throughout Arizona within the ADOT Right of Way (ROW) to aid in pollinator habitat management. The USFWS developed a milkweed model (the latest version) for Arizona using Maxent that identified relative habitat suitability (1=Low, 2=Medium, 3=High) across Arizona highways for low to mid elevation and mid to high elevation milkweed species. WestLand used ADOT's Maxent habitat modeling to prepare this protocol to guide the ADOT annual monitoring for low to mid elevation milkweed species.

This protocol describes the randomization of sample plot locations focused on ADOT ROWs (**Section 2**), the survey timing (**Section 3**), and the field survey protocol using the Pollinator Habitat Assessment (**Section 4**). The purpose of this guide is to provide detail on how to survey for pollinator habitat.

2. LOCATION RANDOMIZATION

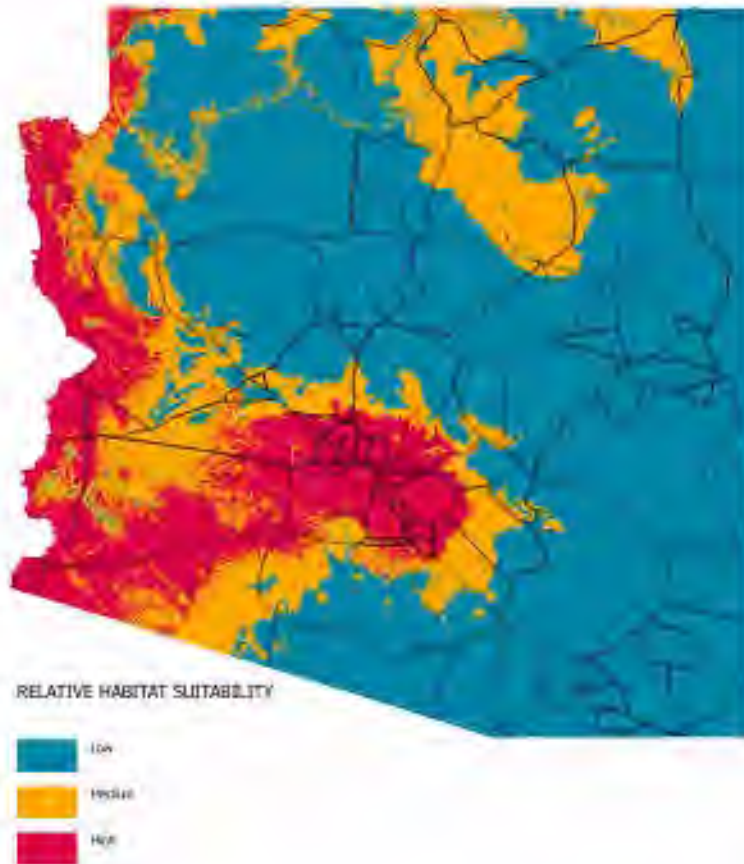
Identification of sampling plot locations is based on the Maxent habitat modeling assessment. Using ArcGIS Pro, all ADOT mile markers are initially selected within the ADOT Southwest, Northwest, and Central Districts that are not Interstate highway markers. A random number generator will be used within excel to assign a random number (0-10,000) for each mile marker. Once a random number has been assigned to each mile marker the random number column will be copied and pasted as a value in a new column to prevent random number regeneration when the file is re-opened. The worksheet is then sorted ascendingly by the pasted values. The lowest 60 mile markers associated with those random numbers are selected for the biology team to review and observer to select 25 plots for ground-truthing. The remaining 35 plots will serve as alternative sample points as needed. Plot selection is then confirmed by ADOT prior to field surveys.

The Maxent model identifies milkweed habitat suitability as:

1. Low
2. Medium
3. High

The screenshot below shows the Maxent model layout for Arizona low to mid elevation milkweed species with low (blue), medium (gold) and high (red) habitat suitability. Detailed maps for each ADOT district are shown in **Appendix B**.

LOW TO MID ELEVATION MILKWEED SPECIES



3. SURVEY TIMING

In order to capture the monarch breeding season surveys will be timed to coincide with the beginning of the monsoon season. Surveys will generally start approximately 3 weeks after the beginning of Arizona's monsoon season (June 15 – September 30); however, start dates will vary geographically and with elevation. Surveys will be conducted on an annual basis to monitor changes in milkweed habitat presence and status over time.

4. FIELD SURVEY PROTOCOL

The field survey protocol will follow the methods outlined in the Rights-of-Way as Habitat Working Group's Pollinator Scorecard (**Appendix B**). The Pollinator Scorecard facilitates the habitat quality data collection and provides ADOT managers with an understanding of which milkweed habitats along specific sections of Arizona highways can be improved. The Pollinator Scorecard includes specific information on the following:

- Definitions of pollinator habitat, site, management area and plot
- Tier 1 – Basic, Tier 2 – Qualitative, and Tier 3 – Detailed metrics for the scorecard
- Instructions for distributing plots (random, systematic, representative)
- Recommended timing of monitoring during ‘peak blooming season’
- Habitat quality ratings system (improvement opportunity, basic quality, moderate quality, high quality, and exemplary)
- Management ratings (needs improvement, some needs met, satisfactory, great, exemplary)

The pollinator scorecard document includes a list of field materials and safety equipment required for plot monitoring.

5. HABITAT SCORING

After data collection is completed, each plot will be scored based on the habitat quality ratings and given a management prescription based on the scoring interpretation. The habitat quality ratings are as follows:

Rating	Tier 2 Point Range	Tier 3 Point Range	Interpretation
Improvement Opportunity	0 - 25	0 - 20	Pollinator habitat is either not present or very limited. Consider creation of habitat for pollinators if opportunities exist.
Basic Quality	26 - 40	21 - 35	Some components of pollinator habitat are present but limited. Consider enhancement through revegetation or changing vegetation management.
Moderate Quality	41 - 55	36 - 50	The habitat is capable of supporting pollinators. Habitat may be enhanced or maintained, depending on opportunities present.
High Quality	56 - 75	51 - 75	High-quality habitat is present. Focus on maintaining habitat quality.
Exemplary	N/A	76 – 110	Habitat is exemplary quality. Congratulations! Share your site as a showcase to educate others about habitat potential.

Management ratings for each site are given after habitat quality ratings. The management ratings are as follows:

P:\Projects\11900s\0000011906\5_Work\Environmental\Task 4 -Monitoring Protocol\20240611_11906_Monarch_Habitat_Monitoring_Protocol.docx

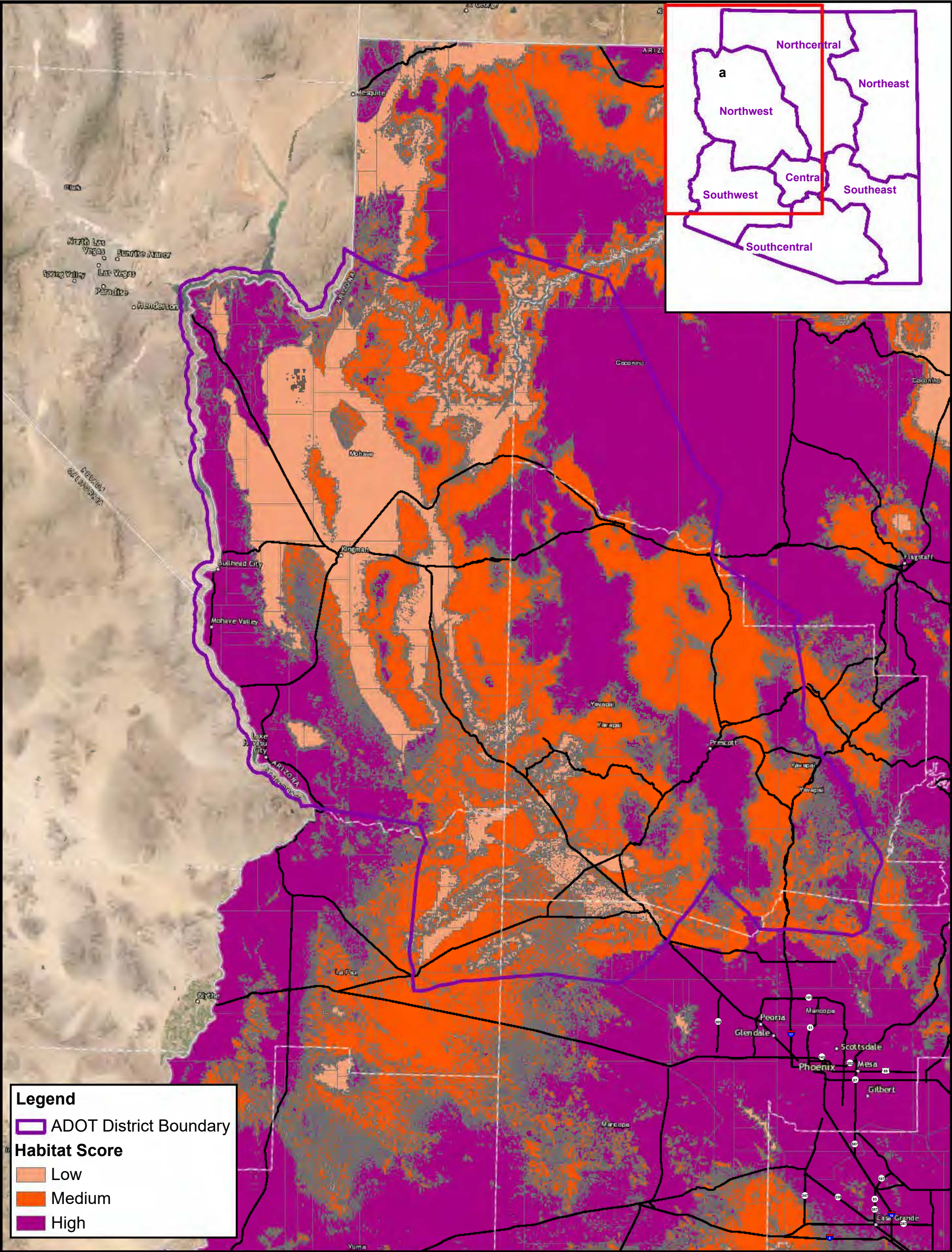
Qualitative Ratings	Score
Needs Improvement	0-18
Some Needs Met	19-30
Satisfactory	31-42
Great	43-54
Exemplary	55-60

Further breakdown of the scoring procedures are described in the *Pollinator Management Module Protocol* and *Description of Scoring* sections in the Pollinator Scorecard (**Appendix B**).

It is important to note the following regarding use of scorecards/surveys for all ADOT projects within monarch habitat:

- Tier 1 Survey = No scorecard required. This is a basic presence/absence survey that can be done in conjunction with the overall biology survey. It is typically recommended for BESFs, projects with limited SOW, and/or projects within low milkweed suitable habitat.
- Tier 2 Survey = Scorecard recommended, but not required. This tier is typically recommended for projects within medium to high milkweed suitable habitat and will be ordered based on the ADOT biologist's discretion and project footprint.
- Tier 3 Survey = Scorecard required. This tier is typically recommended for projects within high suitable habitat and will be ordered based on the ADOT biologist's discretion and project footprint.

APPENDIX A
2024 MONARCH HABITAT MONITORING BY ADOT
DISTRICT



Portions of Southcentral Arizona,
Santa Cruz County, Arizona
Projection: NAD 1983 UTM Zone 12N
Image Source: Maxar 11/25/2018 - 08/04/2024

ARIZONA DEPARTMENT OF
TRANSPORTATION
2024 Monarch
Habitat Monitoring

NORTHWEST DISTRICT BOUNDARY
Figure X.a.

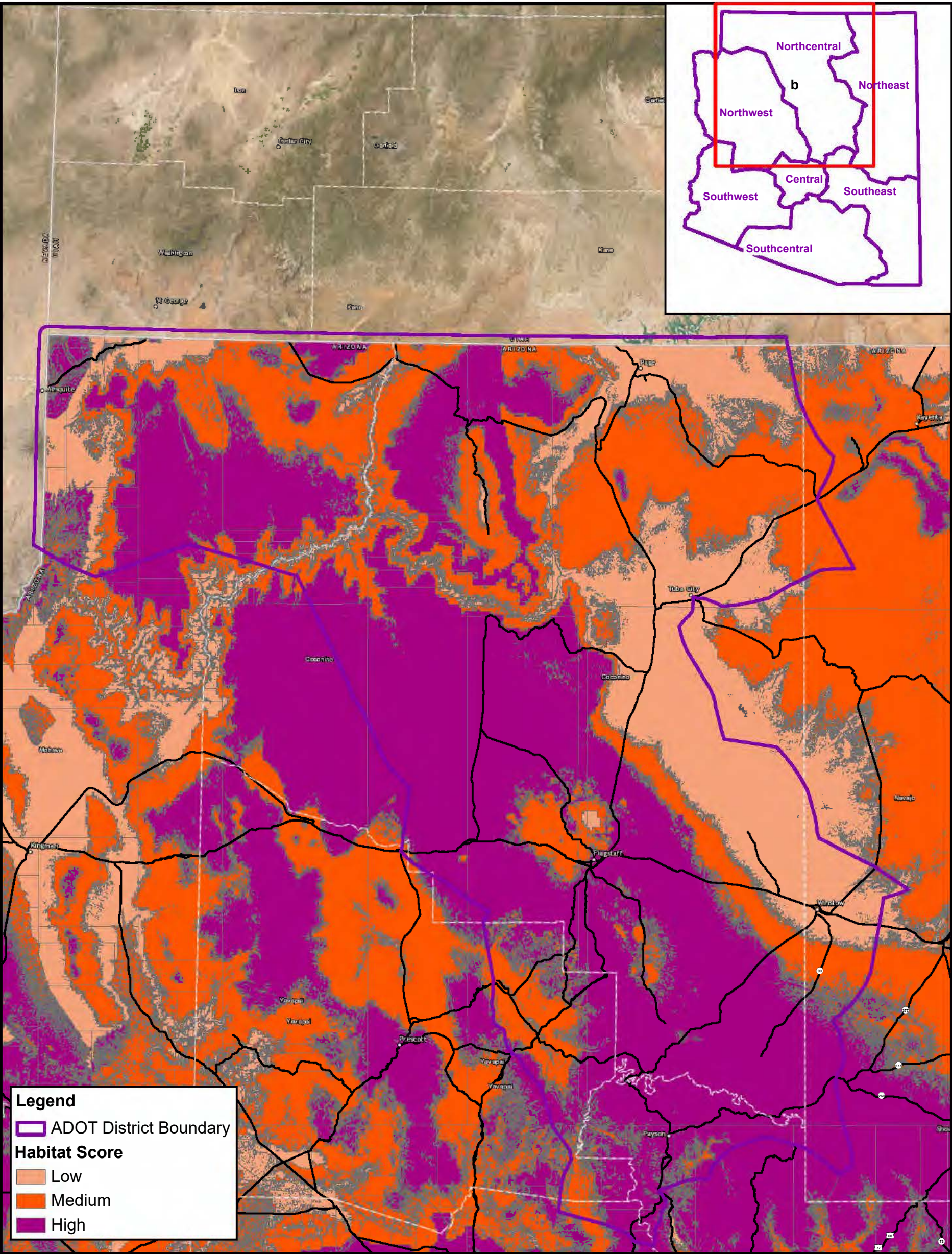


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0 12 24 Miles

0 20 40 Kilometers



Legend

ADOT District Boundary

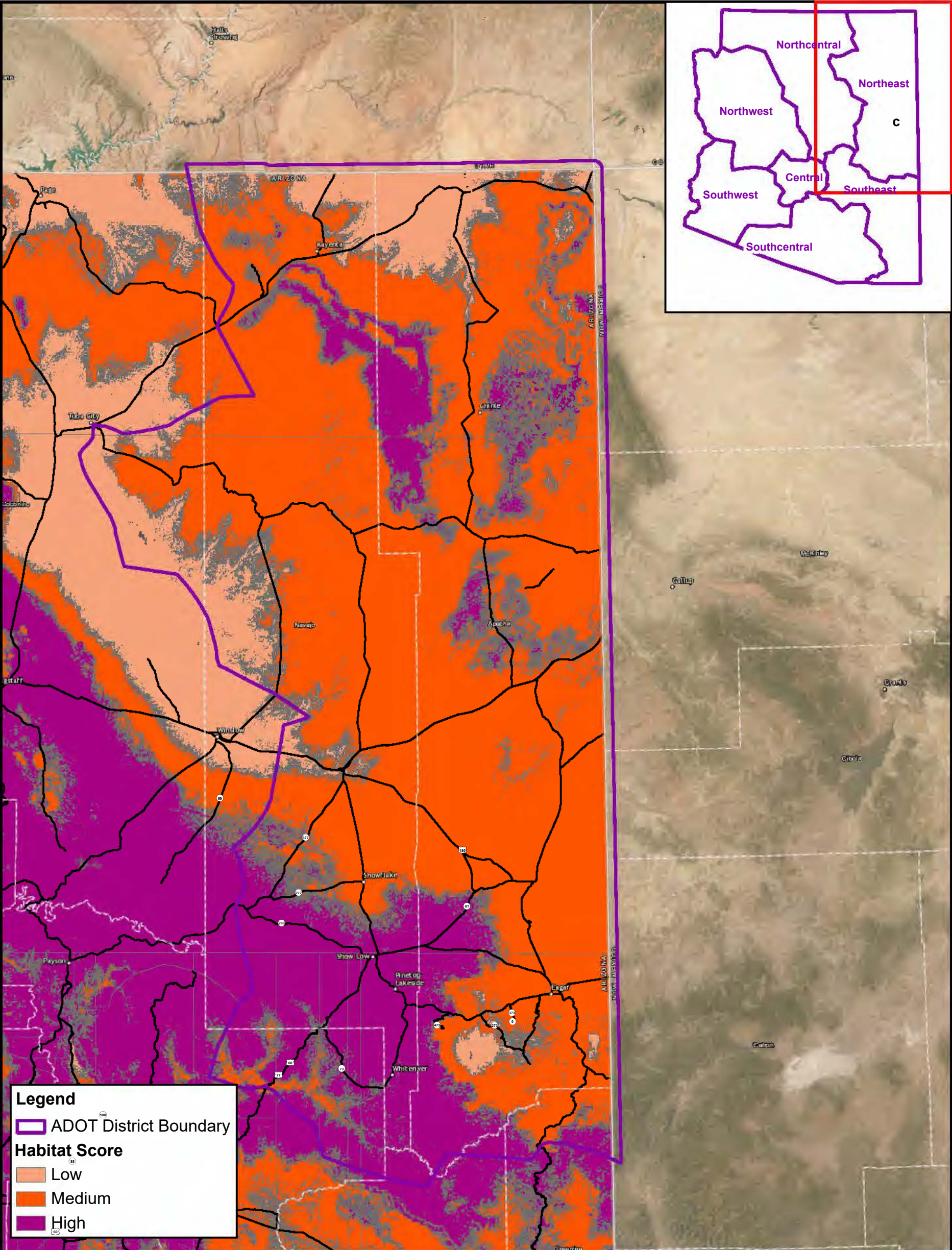
Habitat Score

- Low
- Medium
- High

Portions of Southcentral Arizona,
Santa Cruz County, Arizona
Projection: NAD 1983 UTM Zone 12N
Image Source: Maxar 11/25/2018 - 08/04/2024

ARIZONA DEPARTMENT OF
TRANSPORTATION
2024 Monarch
Habitat Monitoring

NORTHCENTRAL DISTRICT BOUNDARY
Figure X.b.



Portions of Southcentral Arizona,
Santa Cruz County, Arizona
Projection: NAD 1983 UTM Zone 12N
Image Source: Maxar 11/25/2018 - 08/04/2024

ARIZONA DEPARTMENT OF
TRANSPORTATION
2024 Monarch
Habitat Monitoring

NORTHEAST DISTRICT BOUNDARY
Figure X.c.

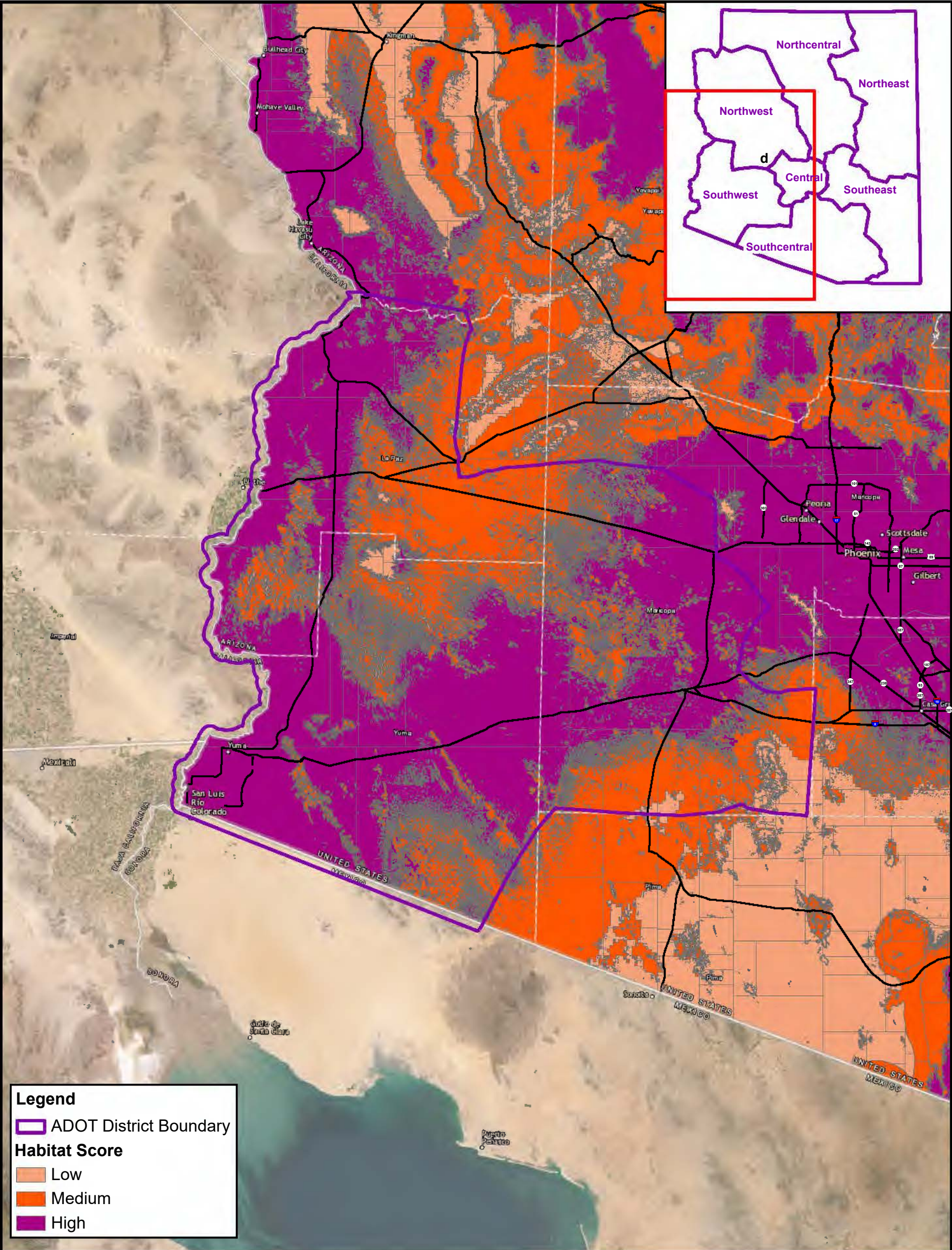


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0 12 24 Miles

0 20 40 Kilometers



Portions of Southcentral Arizona,
Santa Cruz County, Arizona
Projection: NAD 1983 UTM Zone 12N
Image Source: Maxar 11/25/2018 - 08/04/2024

ARIZONA DEPARTMENT OF
TRANSPORTATION
2024 Monarch
Habitat Monitoring

SOUTHWEST DISTRICT BOUNDARY
Figure X.d.

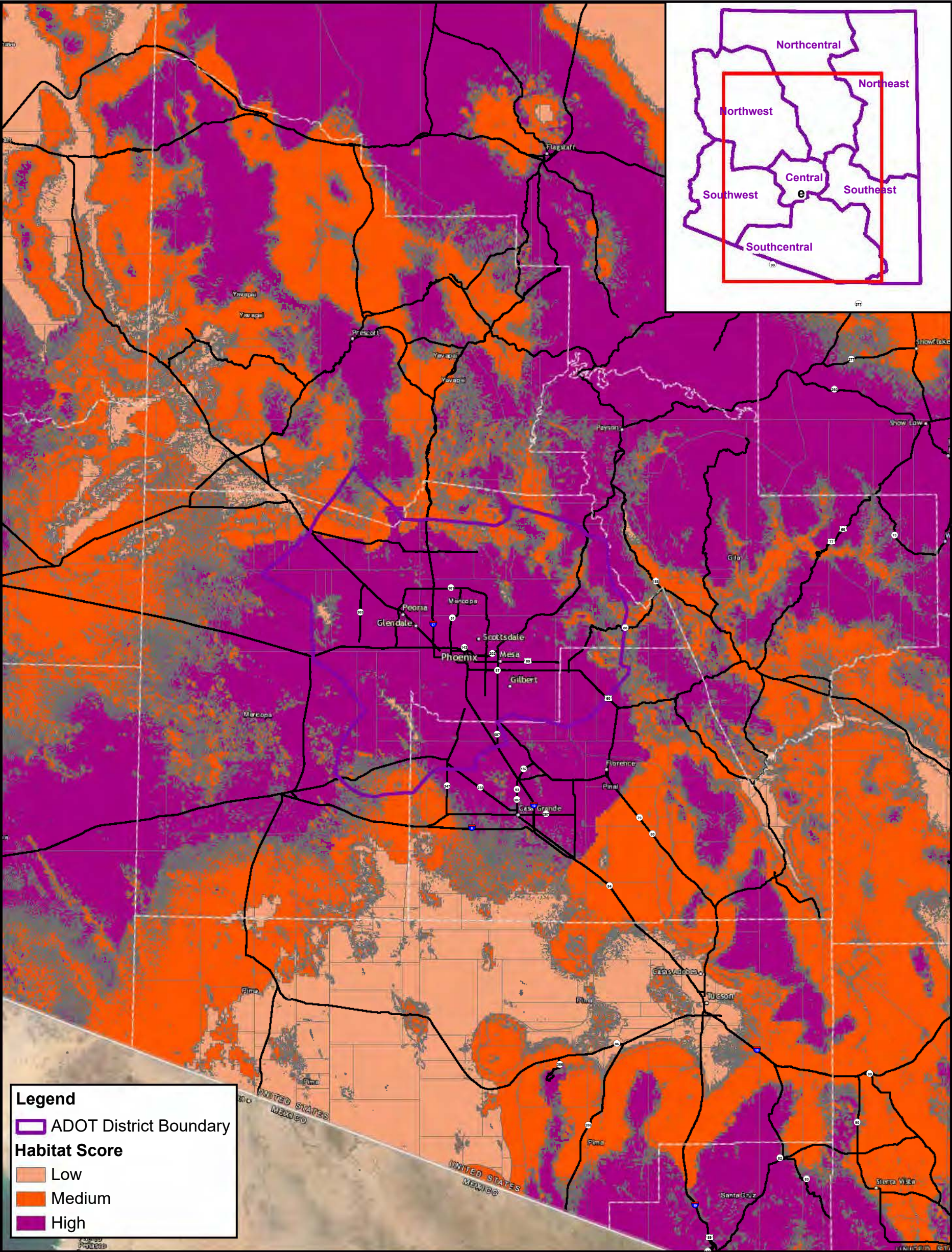


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Services



0 12 24 Miles

0 20 40 Kilometers



Legend

ADOT District Boundary

Habitat Score

Low

Medium

High

Portions of Southcentral Arizona,
Santa Cruz County, Arizona
Projection: NAD 1983 UTM Zone 12N
Image Source: Maxar 11/25/2018 - 08/04/2024

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TRANSPORTATION
2024 Monarch
Habitat Monitoring

CENTRAL DISTRICT BOUNDARY
Figure X.e.

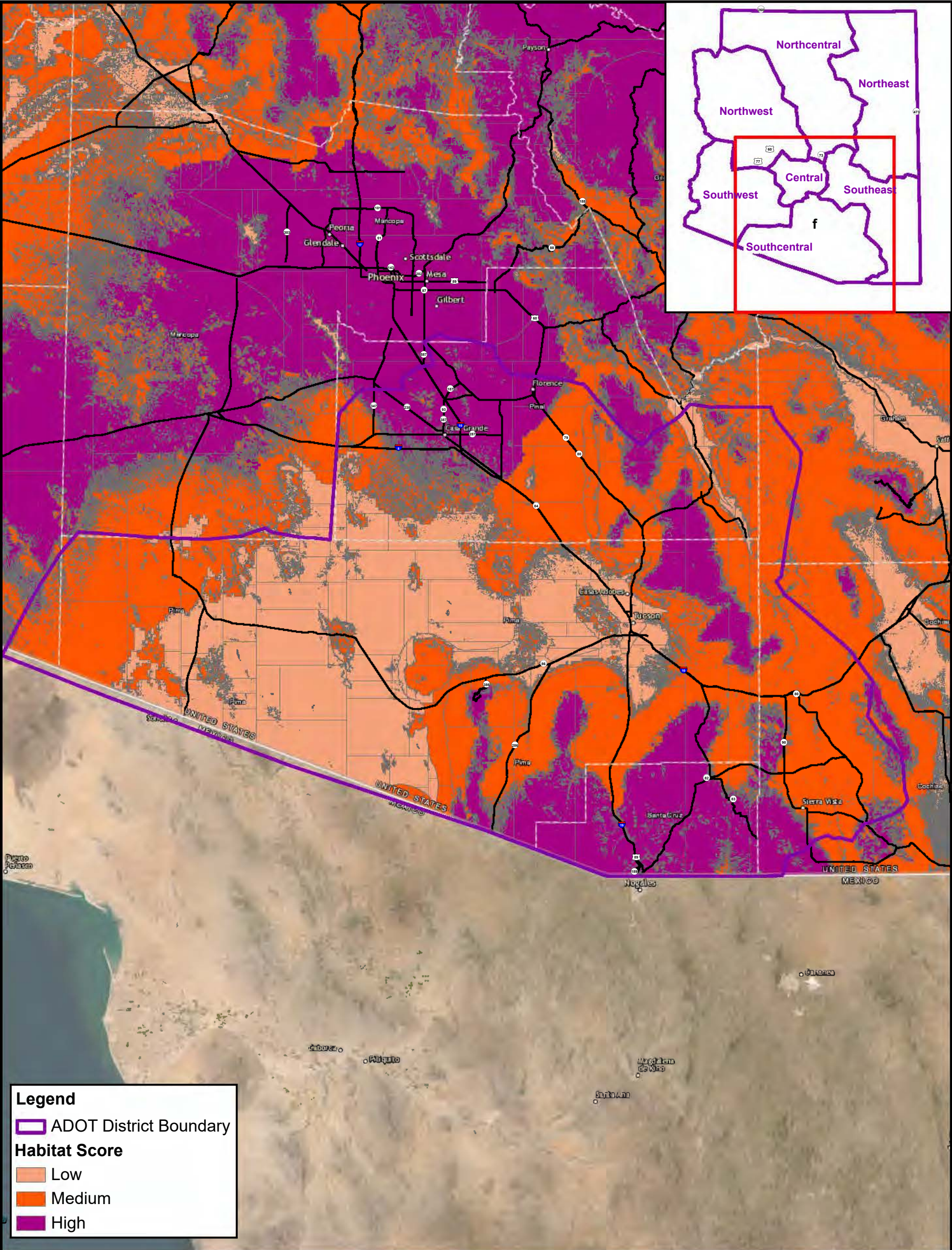


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0 12 24 Miles

0 20 40 Kilometers



Legend

ADOT District Boundary

Habitat Score

Low

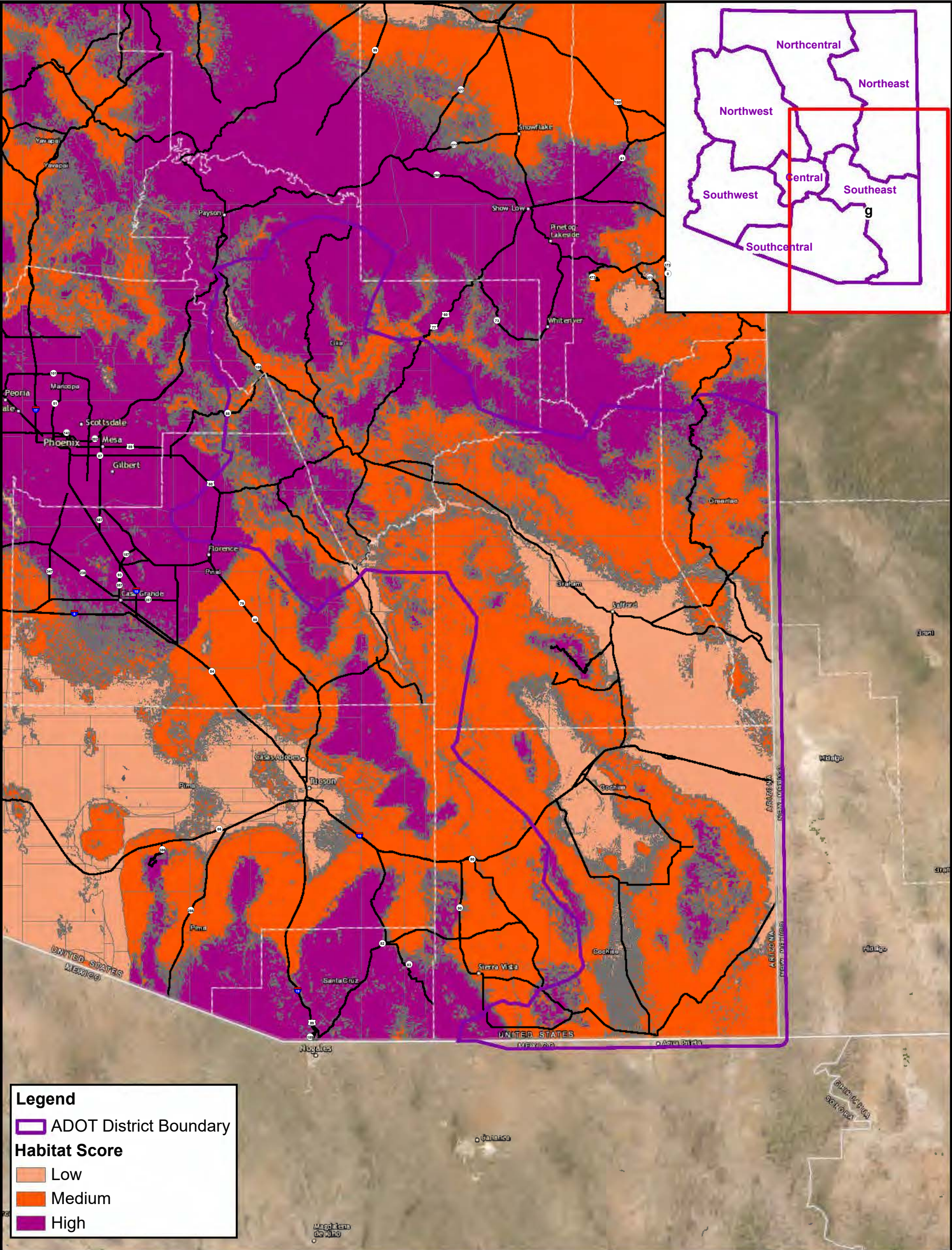
Medium

High

Portions of Southcentral Arizona,
Santa Cruz County, Arizona
Projection: NAD 1983 UTM Zone 12N
Image Source: Maxar 11/25/2018 - 08/04/2024

ARIZONA DEPARTMENT OF
TRANSPORTATION
2024 Monarch
Habitat Monitoring

SOUTHCENTRAL DISTRICT BOUNDARY
Figure X.f.



Portions of Southcentral Arizona,
Santa Cruz County, Arizona
Projection: NAD 1983 UTM Zone 12N
Image Source: Maxar 11/25/2018 - 08/04/2024

ARIZONA DEPARTMENT OF
TRANSPORTATION
2024 Monarch
Habitat Monitoring

SOUTHEAST DISTRICT BOUNDARY
Figure X.g.



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Environmental
Services



0 12 24 Miles

0 20 40 Kilometers

APPENDIX B
RIGHTS-OF-WAY AS HABITAT WORKING GROUP
POLLINATOR SCORECARD V2.1 2020 EDITION

RIGHTS-OF-WAY AS HABITAT WORKING GROUP

POLLINATOR SCORECARD

V 2.1 – 2020 EDITION



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Introduction

The Rights-of-Way as Habitat Working Group Metrics & Targets Task Force proudly presents the Pollinator Scorecard. The Pollinator Scorecard allows rights-of-way (ROW) managers to describe the pollinator habitat on the lands they manage. A common definition of pollinator habitat, coupled with a consistent methodology for evaluating pollinator habitat and management, will allow collaboration between Rights-of-Way as Habitat Working Group members to support pollinator habitat on ROWs and other energy and transportation lands.

The purpose of the Pollinator Scorecard is to:

- Provide a **common language** to talk about habitat on energy and transportation lands in order to facilitate industry learning and collaboration
- Establish a **consistent valuation** method across ROW sectors that aligns with existing habitat assessments and reporting
- Provide a **flexible, multi-tiered approach** that encourages improved monitoring over time
- Support **shared reporting** of habitat metrics across industries

The Pollinator Scorecard may also be used to meet the monitoring requirements for organizations participating in the Nationwide Candidate Conservation Agreement for the Monarch Butterfly on Energy and Transportation Lands (i.e., Monarch CCAA).

What is Pollinator Habitat?

For the purposes of the Pollinator Scorecard, pollinator habitat is defined as:

Pollinator habitat contains native flowering plants, host plants, and nesting sites, throughout the growing season.

Pollinator habitat may be remnant natural habitat, habitat enhanced through management, or newly created habitat. Flowering plants are important because they provide floral resources including nectar and pollen to pollinators. A greater diversity of (or dominance by) native plants provides a greater diversity of floral resources and host plants (such as for butterflies) and nesting sites (such as for native bees). While non-native plants may provide some resources for pollinators, native plants provide other ecosystem services including soil stabilization, water quality improvements, and habitat for birds and other wildlife, and are persistent and typically less costly to maintain for long-term sustainability. A healthy pollinator habitat is commonly defined as having **three or more** native plant species in bloom during each of the spring, summer, and fall periods, as applicable by region.

What Does the Pollinator Scorecard Do?

The Pollinator Scorecard evaluates habitat quality and the compatibility of management on pollinator habitat. The Pollinator Scorecard includes two components:

- (1) **Pollinator Habitat Assessment Protocol:** used to collect data on pollinator habitat attributes in the field
- (2) **Pollinator Management Module:** used to evaluate the extent to which management protects pollinator habitat from threats and leverages opportunities to promote pollinator habitat.



The Pollinator Scorecard is designed for flexibility with an understanding that energy and transportation organizations may have different objectives for using the Pollinator Scorecard and varying levels of access to resources and expertise for pollinator habitat assessment. Therefore, the Pollinator Scorecard was designed with a multi-tiered approach to support a range of users in evaluating habitat (Table 1).

Table 1. Overview of the multi-tiered approach of the Pollinator Scorecard

	Tier 1: Basic	Tier 2: Qualitative	Tier 3: Detailed
Information Gained	Is habitat for pollinators present?	What is the quality of pollinator habitat?	What is the composition (by plant species) of the pollinator habitat?
Metrics	<ul style="list-style-type: none"> ▪ Flowering nectar plant cover ▪ Milkweed presence ▪ Pollinators observed 	<ul style="list-style-type: none"> ▪ Flowering nectar plant cover ▪ Abundance of milkweed ▪ Currently blooming nectar plants ▪ Additional habitat resources ▪ Pollinators observed ▪ Threats and opportunities 	<ul style="list-style-type: none"> ▪ Flowering nectar plant cover ▪ Abundance of milkweed ▪ Flowering nectar plant richness (native and non-native) ▪ Additional habitat resources ▪ Invasive/noxious weed cover ▪ Pollinators observed ▪ Threats and opportunities
Level of Effort	5 – 10 minutes per plot	10 – 20 minutes per plot	20+ minutes per plot
Qualifications Needed	Some familiarity with pollinator habitat or minimal training	Ability to distinguish nectar plants and count milkweed	Ability to identify plants to species level
Outcome	“Yes/No” habitat determination	Qualitative rating of pollinator habitat and management score	Qualitative rating of pollinator habitat; list of species present and metrics per species for nectar plants, milkweed, and invasive/noxious weeds; and management score

In both Tier 2 and Tier 3, information is collected on the threats and opportunities for use in the Pollinator Management Module. See the *Pollinator Management Module Protocol* for instructions on using the management module.

Who Uses the Pollinator Scorecard?

The Pollinator Scorecard includes multiple tiers to allow users of differing training and experience levels to evaluate pollinator habitat (see Table 1, above). The Pollinator Scorecard, as a package, is primarily



intended for organizations that manage energy or transportation ROWs and related lands. Different users may use different components of the Pollinator Scorecard for a single site or management area. For example, a transportation agency may use student interns to complete the Pollinator Habitat Assessment Protocol across their system, while the Pollinator Management Module may be completed by the local vegetation management departments. The Pollinator Management Module must be used by someone familiar with the management practices on the particular site or land area (see the *Pollinator Management Module Protocol* section for more specific requirements). The qualifications required to use the Pollinator Habitat Assessment Module will differ by tier:

- **Tier 1:** Tier 1 is intended for anyone with minimal training. Required qualifications include the ability to:
 - recognize potentially flowering nectar plants (e.g., wildflowers and shrubs);
 - estimate percent cover of potentially flowering nectar plants sufficiently to distinguish between plots with greater than 10% cover and less than 10% cover; and
 - recognize milkweed plants.
- **Tier 2:** with some training, Tier 2 may be used by most users. Required qualifications include the requirements of Tier 1 users as well as the ability to:
 - estimate percent cover within broad bins (e.g., 6 – 10% cover, 10 – 25% cover, etc.);
 - recognize flowering plants currently in bloom;
 - recognize habitat resources used by pollinators (e.g., brush piles, bare ground); and
 - identify management threats and opportunities (if using the Pollinator Management Module).
- **Tier 3:** Tier 3 is intended for more advanced users. Required qualifications include the requirements of Tier 2 users as well as the ability to:
 - Identify most plants to species, especially native and non-native nectar plants.

Tiers 1 and 2 are intended to be used by anyone, but note that successfully completing a Tier 2 assessment requires more training and time than a Tier 1 assessment. Tier 3 should only be used by those with some botany experience.

Where Can the Pollinator Scorecard Be Used?

The Pollinator Scorecard may be used to evaluate pollinator habitat and management on ROWs and other lands for multiple sectors within the contiguous United States. Users may use the Pollinator Scorecard anywhere they wish to describe pollinator habitat, whether or not there is known pollinator habitat present. The scorecard may also serve as a tool in areas being considered for enhancement by management. Or users may like to use the scorecard when they encounter pollinator habitat while monitoring ROW corridors for routine vegetation management, stopping periodically to characterize a segment of corridor.



To evaluate a specific site or management area, the user must first delineate the boundaries of the assessment area. A **site** is an individual area in which the user is interested in characterizing habitat. The user may also wish to characterize habitat across a larger **management area**, or a system of lands or sites managed through similar practices. A **plot** is a 1,500 square foot rectangle or circle in which pollinator habitat data are collected. Multiple plots are used to characterize a site or management area.

The number and frequency of plots used will be dictated by the user's objectives. The more plots used, the greater the 'resolution' of data on pollinator habitat and thus the more useful the assessment will be in characterizing the site or management area and informing future management actions. In general, as the assessment area increases, the number of plots sampled should also increase. Higher variability within the site or management area will require more plots to have confidence that the assessment area was accurately characterized. Also consider the spacing between plots—the less distance between plots, the less uncertainty in the habitat quality between the plots, in general. Statistical methods can be used to more accurately calculate the number of plots required for any site¹.

Detailed instructions for distributing plots are provided in the *Pollinator Habitat Assessment Protocol* section. In most cases, plots should be distributed in a random or systematic way to eliminate bias in characterizing habitat. However, in some circumstances, users may wish to use a 'representative' plot to characterize a site. Representative plots are placed subjectively in a place that best represents the habitat according to the judgement of the assessor. Representative plots can provide a rapid characterization of a specific, small site, but are generally not appropriate for larger sites (e.g., greater than 1 acre in size). Data from representative plots should not be pooled with data from randomly or systematically placed plots to characterize larger areas. If using the Pollinator Scorecard to meet the monitoring requirements of the Monarch CCAA, please note that plot locations **must be randomly selected** (see Section 14.2 of the Monarch CCAA for more details).

Alternative Assessment Protocols

The Pollinator Scorecard was developed after careful review of many similar assessment methods for pollinator habitat. It's important to note that the Pollinator Scorecard may not be the best method for assessing pollinator habitat in all circumstances. Users should consider their objectives and the specific

Definitions

Site – An individual area over which habitat will be characterized. Sites may consist of a single pollinator planting or a section of right-of-way corridor.

Management Area – A system of lands on which similar management practices are implemented and for which habitat will be characterized. Management areas may consist of an entire right-of-way corridor or collection of sites.

Plot – A 1,500 square foot area within which an assessment is conducted. A plot is typically a 150 x 10 foot rectangle or 22 foot radius circle. Multiple plots are used to characterize a site or management area.

¹ See the reference [Measuring & Monitoring Plant Populations](#) published by the Bureau of Land Management, U.S. Department of Interior for an approachable treatment of this topic.



attributes of the site. For example, state solar scorecards may be better suited for assessing pollinator habitat in solar facilities and the [Integrated Monarch Monitoring Protocol](#) may be best for detailed evaluation of monarch habitat specifically.

When Should the Pollinator Scorecard Be Used?

The Pollinator Scorecard was designed with an understanding that ROW managers are generally unable to visit assessment areas multiple times per year due to resource constraints. Thus, the Pollinator Scorecard is designed to provide a reasonable representation of the assessment area with a single visit during the growing season. However, to best understand the value of a site for pollinators, information is needed regarding the availability of nectar for pollinators throughout the year. Therefore, we collect information for all ‘Potentially Flowering Nectar Plants,’ which include wildflowers (forbs) and flowering shrubs (i.e., excluding grasses), that could provide nectar to pollinators, regardless of whether or not those plants are blooming on the date of assessment and whether the plants are considered weedy. ‘Potentially Flowering Nectar Plants’ are defined as:

Potentially flowering nectar plants include all flowering plants that can provide available nectar for pollinating insects at some point throughout the growing season, including primarily forbs that (at the time of monitoring) have already, are currently, or not yet bloomed.

For best results, the site should be evaluated during peak blooming season, which will vary by region. Some regions, especially hotter and drier regions of the U.S., will experience two peak blooms per year, in which case users may wish to evaluate a site twice per year. Ideally, all plots will be collected within a brief window of time (e.g., within a few weeks), which will allow better comparisons of habitat across sites. The Pollinator Scorecard may be used multiple times per year on the same site if desired.

To evaluate changes over time, users may wish to revisit specific plots in subsequent years. In this case, the same plot locations should be revisited if possible. If use of permanent markers is not feasible, collect plot location information as accurately as possible, either with a GPS unit or through clear description of the plot location in reference to permanent landmarks.

The Pollinator Management Module may be completed at any time of year following the site assessments.

How Long Does It Take?

The length of time required for site assessments depends on the size of the assessment area and the number of plots sampled. Time to collect data within each plot depends on the protocol tier, and ranges from less than five minutes to 20 minutes or more. Also consider the time required to travel between plots when collecting multiple plots.

As an example, evaluating a one-mile length of right-of-way (ROW) with vehicle access using five plots and the Tier 2 protocol may require 75 minutes of assessment time (15 minutes per plot) plus 50 minutes of driving time (10 minutes between plots) for a total of approximately 3 hours. Note that total times may vary significantly based on a number of factors—with some experience users will better understand the time required for their needs and will become faster at data collection.



What Information Does the Pollinator Scorecard Provide?

The Pollinator Scorecard will provide information on the location and abundance of pollinator habitat as well as the suitability of management practices to promote pollinator habitat.

Habitat Quality Ratings

After completing the Pollinator Habitat Assessment Protocol for Tier 2 and 3, a habitat quality rating is provided for each plot. The habitat quality rating is associated with the score received and the tier used. The Tier 3 protocol will provide more accurate habitat quality ratings than the Tier 2 protocol due to the additional information available for scoring with the Tier 3 protocol. In addition, the total number of points possible for Tier 3 is greater than Tier 2 to emphasize the level of effort and accuracy of using the Tier 3 protocol. However, in general, Tier 2 and Tier 3 should provide similar habitat quality ratings for the same site. If evaluating both tiers at a particular site, some exceptions may occur for sites scoring at the margins of scoring ranges. These variations are expected as a result of the differing tiers of information required. If both Tier 2 and Tier 3 have been evaluated at a site, the Tier 3 score is generally considered as being more accurate as a result of the increased understanding of site conditions.

Table 2. Habitat Quality Ratings and Interpretation

Rating	Tier 2 Point Range	Tier 3 Point Range	Interpretation
Improvement Opportunity	0 - 25	0 - 20	Pollinator habitat is either not present or very limited. Consider creation of habitat for pollinators if opportunities exist.
Basic Quality	26 - 40	21 - 35	Some components of pollinator habitat are present but limited. Consider enhancement through revegetation or changing vegetation management.
Moderate Quality	41 - 55	36 - 50	The habitat is capable of supporting pollinators. Habitat may be enhanced or maintained, depending on opportunities present.
High Quality	56 - 75	51 - 75	High-quality habitat is present. Focus on maintaining habitat quality.
Exemplary	N/A	76 – 110	Habitat is exemplary quality. Congratulations! Share your site as a showcase to educate others about habitat potential.

While ROWs and other energy and transportation lands provide an important opportunity for supporting pollinators, habitat on these lands may not be as high in quality as on remnant prairie, prairie restorations, or similar areas. Thus, the ratings are tailored to provide meaningful information based on the range of habitat qualities expected in ROWs and related lands.

Tier 1 does not yield a habitat quality score. The results of Tier 1 are intended to verify that the basic elements of habitat are present, and to align with the required monitoring variables for the Monarch



CCAA. While this provides an important tool for compliance with requirements of that agreement, the information gained cannot be used to infer habitat quality.

Management Ratings

The management module evaluates the suitability of management for pollinator habitat if present on each plot or site. After completing the Management Module, a management suitability rating is provided. Management suitability ratings are described in Table 3.

Table 3. Management Ratings and Interpretation

Qualitative Ratings	Score
Needs Improvement	0-18
Some Needs Met	19-30
Satisfactory	31-42
Great	43-54
Exemplary	55-60

Combining Habitat Quality and Management Ratings

The Pollinator Scorecard provides ratings for habitat quality and management separately so that users can understand each component and interpret the results both individually as well as collectively when appropriate. Targeted management of low-quality habitat may result in improved habitat quality over time and may be the best that a manager can do. Conversely, unsuitable management of high-quality habitat may minimize the benefits that the habitat provides to pollinators. Both the habitat quality and management ratings should be considered together when evaluating current and potential habitat onsite.

Pollinator Habitat Assessment Protocol

This section provides step-by-step instructions for setting up and completing the Pollinator Scorecard in the field.

Materials Required

The habitat assessment may be completed with just the datasheet, a clipboard, and pen/pencil in most cases. The datasheets are also available in electronic format, either as a fillable PDF file or using the Survey123 application (see below). Ensure you have permission, documented as required, and safety equipment depending on the type of right-of-way to be assessed. Other items, including a GPS, measuring tape, clicker counter, and guidebooks are helpful but not required.

1. Permit or permission for access to the right-of-way from proper authority
2. Safety clothing (Type 3 vest in some states), helmet (required in some states or if desired)
3. Revolving or flashing light for top of car, if required
4. Datasheets (in paper or electronic format)
5. Clipboard and pen/pencil, if using paper datasheets
6. GPS unit, GPS enabled tablet, or smartphone* (for navigating to plots or collecting plot locations)
7. Measuring tape*
8. Clicker counter* (for tallying milkweed)
9. Pin flags* (for marking plot corners)
10. Plant identification guidebook or aides*
11. Pollinator identification guidebook or aides*
12. Hand lens or magnifying glass* (for identifying plant parts)

* Optional items



Habitat Assessment Instructions

Follow the instructions below to complete a habitat assessment using the Pollinator Scorecard.

H-1. Set Up Site Assessment

- H-1.1. **Define the boundaries of the assessment area:** The assessment area (i.e., site or management area) is the area within which the user is interested in characterizing habitat. It may range in size from a single pollinator planting to an entire ROW corridor.

For linear ROWs, note the beginning and ending points of the assessment area. For non-linear features, define the polygon representing the area of interest on an aerial map of the site. If using the Rights-of-Way as Habitat Geospatial Database, the details and



geographic boundary for sites and management areas can also be defined electronically using the Collector for ArcGIS app.

Plots will be distributed within the assessment area boundaries.

- H-1.2. **Estimate the assessment area:** The area of the site or management area will inform the number of plots required as well as permit calculation of other parameters, such as milkweed density, from plot-scale data. Using best estimates, note the total assessment area; it will be recorded on the datasheet.
- H-1.3. **Determine the number of plots required:** The number of plots required will depend on the objectives of the assessment and resources available.
- H-1.4. **Distribute the plots over the assessment area:** First, determine whether plots will be distributed randomly, systematically, or representatively:
- **Random** plot locations are best for large, non-linear sites or management areas. Use a GIS or random number generator to generate point locations within the site or management area that will serve as the starting corner locations for plots. Load those plot locations into a GPS unit, if available, or mark on an aerial image. Random plot locations allow for characterization of very large sites or management areas.
 - **Systematic** plot locations—in which plots are taken at set intervals along a site or management area—are ideal for long, linear ROWs. Simply specify a starting location along the ROW, a distance from the feature to begin the plots, and a distance to travel between plots such that the number of plots desired will be collected (e.g., start at mile marker 8, 12 feet from the centerline, and collect plots every quarter mile). Systematic plot locations also allow for characterization of very large sites or management areas.
 - **Representative** plots may be used when a specific, small patch of habitat is being assessed. Note that representative plot data generally should not be used for large sites (greater than 1 acre in size) and should not be pooled with random/systematic data to characterize larger sites or management areas. Representative plot locations may not be used for the purposes of monitoring for the Monarch CCAA (see section 14.2 of the Monarch CCAA).

H-2. Record Site Data

- H-2.1. **Record site data on the datasheet:** Record the Site (or Management Area) Name, ROW Organization, Assessor Name, Assessor's Affiliation, Total Area of Site or Management Area (in acres), Monitoring Type and Survey Type on the top of the datasheet. If step H-1 was completed in the office and multiple plots will be collected across the assessment area, you may wish to pre-fill this information before printing field datasheets.



H-3. Collect Plot-Scale Data

- H-3.1. **Navigate to the first plot:** Using the plot location information created during step H-1.3, navigate to the first plot location. If using a representative sample, plot location will not be provided. Instead, identify an area that represents the site and begin the plot there.
- H-3.2. **Record plot data on the datasheet:** Observe the plot from the starting point and record the plot number and plot corner location (as latitude/longitude coordinates (*preferred*) or in relation to permanent landmarks). Provide a brief description of the plot, including the type of ROW (if applicable) and ownership status (i.e., owned or easement).
- H-3.3. **Take photos:** Take photos of the plot and record the photo number or other identifying information on the datasheet such that photos may be matched with the corresponding plots in the office. This step is optional but highly recommended.
- H-3.4. **Establish the plot:** The plot will be a 1,500 square foot area. Use a rectangular plot if possible; 150 x 10 ft is recommended. If the site is too small, or configuration does not allow for a rectangular plot, a 22 ft radius circle may be used. Regardless of plot shape, it is important to maintain a consistent sampling area of 1,500 square feet.

If using a rectangular plot on a ROW corridor, orient the long side of the plot parallel, perpendicular, or diagonal to the ROW (or spin a pen/pencil to obtain a random direction if the site is not a linear ROW). Consider orienting the long axis of the plot across the width of the corridor to encompass the greatest expected variation in the vegetation. Note your starting position (use a pin flag if desired) and walk the length of the plot along its edge to the opposite end. When first beginning assessments, observers should use a measuring tape to measure the length of the plot; once calibrated, observers can pace. Re-calibrate at the beginning of a new field season and occasionally throughout.

- H-3.5. **Record the primary adjacent land uses (Tier 2 & 3 only):** Record the land use type directly adjacent to the site or management area that borders the majority of the length of the plot. If different land use types are located on either side of the site or management area, select up to two adjacent land uses per plot (one for each side). If multiple land uses are adjacent to the plot on one side of the site or management area, select the dominant land use type. See Table 5 for land use definitions.
- H-3.6. **Record habitat attribute scores:** Return to the starting point of the plot using a meandering or zig-zag pattern, observing habitat attributes within the plot (Figure 1). Attributes will vary by tier. See Table 4 *Attribute Definitions* (below) for definitions of each attribute. Note that Tier 3 also includes a Plant Species Worksheet that should be completed.



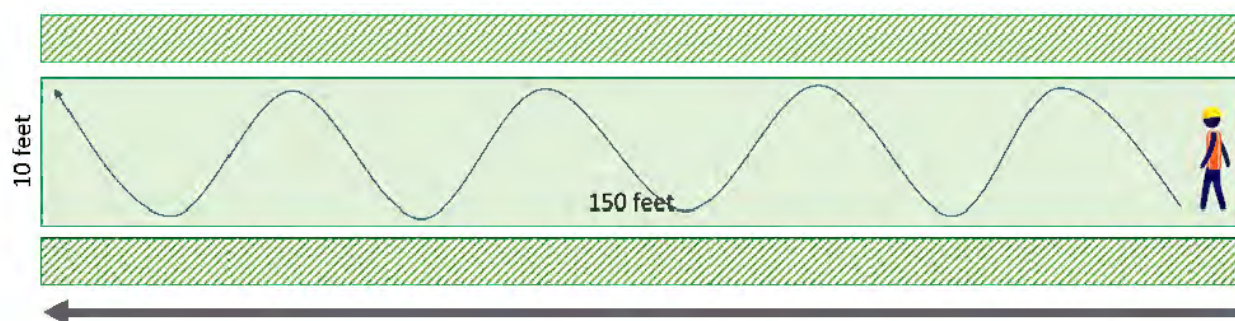


Figure 1. Illustration of a meandering walk through 150 x 10 ft plot (plot not drawn to scale).

- H-3.7. **Calculate a plot score (Tier 2 & 3 only):** Each habitat attribute is associated with a number of points (in curly braces '{ }'). Record the points for each attribute, then total the points to calculate Total Points. The total points can be translated to a qualitative rank for the plot, see guidance on the datasheet.
- H-3.8. **Repeat for additional plots:** Repeat the above process, navigating to the plot, recording plot data, taking photos, establishing the plot, recording habitat attributes, and scoring the plot for each plot assessed.

Table 4. Attribute Definitions

		Tier 1	Tier 2	Tier 3
Site Information				
Site Name	A unique identifying name for the site or management area	•	•	•
ROW Organization	The organization responsible for managing the site or management area	•	•	•
Assessor	The name of the assessor(s) (i.e., your name(s))	•	•	•
Assessor's Affiliation	The organization name(s) of the assessor(s)	•	•	•
Site Area (acres)	The size in acres of the site or management area (see step H-1.2)	•	•	•
Date	The date of the assessment	•	•	•
Monitoring Type	Indicate whether monitoring is occurring before conservation measures are in place (i.e., Baseline) or after (i.e., Post-Activity).	•	•	•
Survey Type	Indicate whether plots were distributed in a random/systematic or representative way		•	•
Plot Information				
Start Time	The start time for plot assessment	•	•	•

		Tier 1	Tier 2	Tier 3
Plot Number	A unique identifier for the plot	•	•	•
Plot Location	The coordinates of the plot and/or sufficient information to re-identify the plot in subsequent visits	•	•	•
Plot Description	A general description of the plot, including the type ROW it is located in, the ownership status (owned or easement), etc.	•	•	•
Photos	Photo names, numbers or other identifying information	•	•	•
Adjacent Land Uses	The land use type directly adjacent to the of site or management area that borders the majority of the length of the plot. If different land use types are located on either side of the of site or management area, select up to two adjacent land uses per plot (one for each side). If multiple land uses are adjacent to the plot on one side of the of site or management area, select the dominant land use type. See Table 4 for adjacent land use definitions.		•	•
Habitat Attributes				
More than 10% cover potentially flowering nectar plants?	Indicate 'yes' if the plot contains more than 10% cover of potentially flowering nectar plants (e.g., wildflowers and shrubs), whether flowering or not.	•		
Numerous milkweed stems present?	Indicate 'yes' if the plot contains the target defined for milkweed stems based on your region. ²	•		
Potentially Flowering Nectar Plant Cover	Estimate the percent cover of potentially flowering nectar plants (e.g., wildflowers and shrubs), whether flowering or not; select the appropriate category.	○	•	•
Additional Habitat Resources	Check any habitat resources that are present. If unsure, note what was observed.		•	•
Number of Flowering Nectar Plant Species Currently in Bloom	Count the number of distinct types of flowers observed in the plot which are in bloom. Distinct types of flowers means flowers of different wildflower or shrub species.		•	
Abundance of Milkweed	Count the number of milkweed stems observed in the plot. In addition to <i>Asclepias</i> species, also	○	•	•

² The minimum target needed will vary depending on which part of the U.S. you are sampling within. The West and South regions of the U.S. have a minimum target of 2 or more milkweeds per plot. The Midwest and Northeast have a target of 6 or more milkweeds per plot. Verify your region using the inset maps included in each Tier 1 scorecard version, or within the Monarch CCAA, or by selecting the appropriate geographic region on the Survey123 form.



		Tier 1	Tier 2	Tier 3
	include honeyvine, <i>Cynanchum laeve</i> . For Tier 3 only, use the Plant Species Worksheet, which optionally includes plant count in addition to stems. Count a plant as a single stem (e.g., common milkweed, <i>Asclepias syriaca</i> , ignoring possible below ground connections); or a plant may be multiple stems originating from the same central location in the soil (e.g., green antelope horn, <i>A. asperula</i> , or butterfly weed, <i>A. tuberosa</i>).			
Actual Milkweed Stem Count	Record the exact count of milkweed stems (<i>Asclepias spp.</i> and <i>Cynanchum leave</i>). This information is especially useful for plots with high milkweed stem counts (greater than 50 stems). For Tier 3, stem counts per species are recorded in the Plant Species Worksheet.	o	o	•
Number of Nectar Plant Species	Count the number of unique nectar plant species identified in the plot; select the appropriate category. Use the Plant Species Worksheet.			•
Number of Native Nectar Plant Species	Count the number of unique native nectar plant species identified in the plot; select the appropriate category. Use the Plant Species Worksheet and note how the status of a plant as native was determined (e.g., USDA plant lists).			•
Invasive Species & Noxious Weed Cover	Estimate the percent cover of invasive species and noxious weeds in the plot. Use the Plant Species Worksheet and note how the status of a plant as noxious or invasive was determined (e.g., county noxious weed list).			•
Pollinators Observed	Check for any pollinators observed while surveying the plot. Pollinators need not be located within the plot to be counted.	o	•	•
Threats	Check for any threats identified on or adjacent to the plot. If other, describe.		•	•
Opportunities	Check for any opportunities identified on or adjacent to the plot. If other, describe.		•	•
Additional Notes and Observations/Recommendations	Capture other relevant information to inform the habitat assessment and/or future work (e.g., vegetation management, assessments, etc.)	o	o	o

Key: • required; o optional



Table 5. Adjacent Land Use Descriptions

Cropland	Currently or recently used for agricultural production. Will vary by region. Excludes Conservation Reserve Program and other agricultural set-asides.
Developed	Includes pavement, buildings, lawn, landscaping and other features associated with urban, suburban, or ex-urban development.
Woodland	Woody or brush-dominated.
Wetland	Areas characterized by standing water during parts of the year and associated with wetland vegetation (e.g., cattails, rushes).
Grassland (Diverse)	Includes native or restored grassland or prairie remnant, wildlife areas, etc., and CRP with bunchgrasses and forbs present.
Grassland (Non-diverse)	Includes open space, heavily grazed lands, hayfields, recreation fields, golf courses, and CRP dominated by a single grass species.

Table 6. Additional Habitat Resources

Native bunch grasses	Group of grass species in <i>Poaceae</i> family that grow in a single, dense tuft of vegetation (e.g. purple three-awn, blue grama).
Brush piles	Mound or pile of woody vegetation, including brush and loose branches, on top of a base comprised of larger logs or other natural materials.
Undisturbed thatch	Loosely interwoven layer of dead and living shoots, stems, and roots.
Dead wood/snags	A standing, dead, or dying tree, often missing a top or most of its smaller branches.
Rock piles	A pile of rocks or boulders in which the largest rocks are on the bottom of the stack, which provides opportunities for shelter.
More than 1 sq. ft bare ground	More than 1 sq. ft. of bare ground that provides sunning area important for warming pollinator bodies in preparation for flight. These areas may also serve as habitat for ground-nesting wild bees.
Plants with hollow pithy stems	Pollinators may use cavities as nesting habitat (e.g. sumac, box elder, elderberry).
Larval host plants (<i>e.g., milkweed</i>)	A specific plant species upon which butterfly larvae subsist, which is dependent on butterfly type. For example, Milkweeds, a latex-secreting flowering plant in the genus <i>Asclepias</i> , and honeysuckle (<i>Cynanchum leave</i>) are the only host plants on which Monarch caterpillars can grow. Some other larval host plants include Queen Anne's lace, clovers, thistles and violets.

Questions

Questions regarding the Habitat Assessment Protocol? Contact ROWHWG@uic.edu.

