



**USDA NRCS MONARCH  
BUTTERFLY HABITAT  
EVALUATION GUIDE (WHEG),  
AND DECISION SUPPORT TOOL:  
GREATER APPALACHIAN  
MOUNTAINS REGION EDITION 1.0  
(SEPTEMBER 2018)**

Greater Appalachian Mountains Region Monarch Butterfly WHEG:  
Version 1.0

**ABSTRACT**

The Greater Appalachian Mountains region of the U.S. is a mosaic of forest, pasture, cropland and old-field habitats. Many of these habitats lack the forb species richness and abundance required by breeding and foraging monarch butterflies. This monarch wildlife habitat evaluation guide is applied by conservation planners when monarch butterfly habitat is identified as a resource concern. This planning guide includes a quality assessment protocol that rates the habitat as either poor, fair, good, or excellent.

**USDA**

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**USDA NRCS MONARCH BUTTERFLY WILDLIFE HABITAT EVALUATION GUIDE (WHEG) AND DECISION SUPPORT TOOL; *Greater Appalachian Mountains Edition: Version 1.0***

**EXECUTIVE SUMMARY**

In response to the decline in the monarch butterfly population, USDA Natural Resources Conservation Service (NRCS) is providing technical and financial assistance to agricultural producers and other landowners to assist in the establishment of new monarch butterfly habitat and to assist with the enhancement of existing habitat. In the Greater Appalachian region of the United States, the effort is focused on improving monarch habitat, primarily on NRCS landuses of Crop, Farmsteads, and Associated Agricultural Land as defined by NRCS Field Office Technical Guides<sup>1</sup>.

When working with decision-makers on the nation's private agricultural lands, the NRCS uses a 9-step conservation planning process (USDA 2013). During the planning process, if wildlife is identified as a resource concern, NRCS policy requires the use of an approved Wildlife Habitat Evaluation Guide (WHEG) to identify habitat deficiencies (USDA 2010), and to present alternatives to the client. When the monarch butterfly (*Danaus plexippus*) is the target species, NRCS staff in the Greater Appalachian Mountains region of United States will utilize this guide (*USDA NRCS Monarch Butterfly Wildlife Habitat Evaluation Guide and Decision Support Tool; Greater Appalachian Mountains Region 1.0*). The minimum criteria is a planned habitat rating of *good* or *excellent*.

Monarch butterflies prefer a mid-successional (seral stage) plant community, rich and abundant in high-nectar forbs. These conditions are seldom static, but rather require regular monitoring to identify the need to implement periodic disturbance actions (e.g. mowing, burning, disking, grazing or application of herbicides). In the Greater Appalachian Mountains region, the consideration of rapid woody encroachment can add complexity to the conservation planning process.

This Monarch Butterfly Wildlife Habitat Evaluation Guide (WHEG) and Decision Support Tool is designed to assess current monarch habitat condition (benchmark conditions) on different portions of an agricultural operation, provide habitat development alternatives for each assessment area<sup>2</sup>, predict/plan future outcomes (planned conditions), and to provide a mechanism to quantify gains in habitat quality (applied conditions). Unique to this guide, quantitative scores for each assessment area is converted to a qualitative monarch butterfly habitat rating of *poor*, *fair*, *good* or *excellent*. Thus, an agricultural operation (project area), is not provided a monarch rating for the entire operation, but rather a different rating is provided to each assessment area. The user of this WHEG will discover that it is constructed to be applied in a flexible approach depending on the objectives of the conservation planner and decision maker. This conservation planning tool includes the body of the WHEG (commonly referred to as the "instructions"), an excel field data sheet (data sheet), and the supporting document titled *Important Plants of the Monarch Butterfly*, which provides a planting list, and plant inventory list and plant identification guides.

This conservation planning tool includes the body of the WHEG (commonly referred to as the "instructions"), a data-sheet, and technical support documents (planting lists, plant identification guides) contained in the appendices.

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<sup>1</sup> Land use terms are from USDA-NRCS NPPH Circular 180-14-1, 10-1-2013

<sup>2</sup> *Assessment Area* is a portion of the larger monarch butterfly habitat development project that has unique abiotic (soils, slope, or wetness) or vegetative conditions.

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## INTRODUCTION

The portion of the North American monarch butterfly (*Danaus plexippus*) population that winters in Central Mexico highlands, has suffered significant declines over the past two decades. For more specific information on the monarch butterfly population decline and biology, users of this WHEG are encouraged to read the document titled *NRCS Monarch Butterfly Habitat Development Project* (USDA 2015)<sup>3</sup> and the Appendix to this WHEG. NRCS conservation practices installed to benefit the monarch butterfly will typically benefit other grassland wildlife species that occupy periodically disturbed mid-successional (seral plant community stage) habitats. Any monarch butterfly habitat project must target forbs.

Monarch Butterfly and Habitat in the Greater Appalachian Region: In the absence of natural wildfires, periodic artificial disturbances (e.g. prescribed burning, treatments with herbicides, brush management, prescribed grazing, or light disking) are required to obtain and/or sustain the target habitat condition of a seral forb-rich grassland plant community. Without such disturbance, the forb component will reduce in both richness and abundance (Figure 1), and woody species will invade the site. These habitats also require periodic management actions to control encroachment of trees and shrubs (Figure 2).



*Figure 1: Without periodic disturbances, even native grassland habitats in the Greater Appalachian Mountains region can become monotypic stands of grass, of poor value to monarch butterflies.*

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<sup>3</sup> <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/plantsanimals/pollinate/?cid=nrcseprd402207>. For more detailed information on the biology of the monarch and its habitat, staff can access monarch webpages sponsored by Monarch conservation organizations, such as the Monarch Joint Venture <http://www.monarchjointventure.org/>, Monarch Watch <http://www.monarchwatch.org/>, Xerces <http://www.xerces.org/>, and Journey North's citizen observational data <https://www.learner.org/inorth/>.



*Figure 2 Active management (e.g. disking, burning, brush management, and/or herbaceous herbicide treatments) is required to maintain a forb-rich serral herbaceous plant community.*

This region of the U.S. is dominated by forestlands. In much of the region, arable soils are limited to narrow bands along rivers and streams (Figure 3). In these situations, economics often necessitate intensive cultural practices (cropland, hayland, and managed pasture) on the non-forested portions of the agricultural operation. The extensive use of introduced or “improved” cool season forage grasses (fescue, smooth brome, timothy, orchard grass, and Kentucky bluegrass) contributes to the lack of forb-rich herbaceous habitats (Figure 4). Old-field habitat is commonly dominated by grass early in the growing season, with goldenrod (*Solidago* spp.) dominating late in the season. Goldenrod is an excellent monarch forage, but is in bloom during late summer and fall only (Figure 5).



*Figure 3: The Greater Appalachian Mountains region is dominated by forests. In some portions of the region, agricultural lands are positioned along streams and rivers. Much of the early successional habitat common in the region in the early and mid-1900’s, now supports forest habitats of little value to monarch butterflies.*



*Figure 4: Pastures supporting cool-season forage grasses providing little value as either breeding or foraging habitat to monarch butterflies.*



*Figure 5: “Old-field” habitat where goldenrod (Solidago sp.) dominates the plant community. These systems have low species richness and provide little monarch habitat except late in the growing season.*

## Evaluating Monarch Habitat

Most NRCS wildlife evaluation guides determine the quality of habitat at the farm/ranch scale and provide a cumulative habitat score for the entire farm or ranch. The objective of these type of wildlife habitat guides is to identify the most limiting habitat factor (USDA 2003). The habitat needs for the target species are typically well understood. These type of WHEGs include the consideration of proximity and interrelationships to adjacent habitats, including habitats not within the conservation planning unit. This approach is particularly appropriate for resident species with limited mobility (e.g. gopher tortoise, sage grouse, lesser prairie chicken). Identifying limiting factors for a highly mobile, multi-generational, migratory, invertebrate species, mandates a different approach.

When not migrating, the movement of individual monarchs is not well understood, though adults appear to move very long distances to acquire life requirements (Brower 1995, Brower et al 2011). Additionally, little is known about the importance of the spatial connectivity of habitats. What is known, is that the eastern population of the North American monarch butterfly is at-risk. Increasing the abundance, quality and distribution of habitat across its summer range is considered paramount to recovery of the species (Flockhart et al. 2013, Inamine et al. 2016, and Throgmartin et al. 2017). In consideration of the above statements, this monarch butterfly habitat guide recognizes that monarch butterflies are highly mobile, and that the importance of connectivity and adjacency is unknown<sup>4</sup>. Thus, this WHEG is applied independently to different portions of the project area. Each unique area within the project area, is referred to as an *assessment area*. Any single agricultural operating unit (project area) will commonly have multiple assessment areas, including narrow linear habitats (Figure 4). Following independent implementation of the protocols to each assessment area.



*Figure 4: Common milkweed (Asclepias syriaca) is often found growing adjacent to drainage ways, hayfields, and woodlands. Economics limit the opportunities for large scale habitat restoration in the Greater Appalachian Mountain Region.*

Based on best available science (Pleasants and Oberhauser 2012; Brower et al 2011), one limiting factor for monarchs in the eastern U.S. is the availability of quality reproductive habitats (a significant milkweed component). Others suggest that the lack of foraging habitat, particularly during the fall migration, is a population stressor, particularly for monarchs in the Northeast and Mid-Atlantic region (Agrawal 2017,

<sup>4</sup> Within the monarch conservation community, many suspect that the lack of somewhat evenly distributed habitats across the migration path, may be as limiting to the wintering population as is total acres of habitat. Hence one population stressor might be inadequate distribution of habitat acres, rather than total acres.

Agrawal 2018, Inamine et al. 2016). Accordingly, the target habitat conditions in this WHEG identify and consider both breeding habitat/milkweed (*Asclepias* spp.) and foraging (nectar) habitat as significant critical components. This WHEG provides for three scores. One score for reproductive (breeding) habitat, another for foraging (nectaring) habitat and a composite score.

The ratings derived from this WHEG are not designed to be used as a ranking mechanism for Farm Bill conservation programs. Maintaining the integrity of this WHEG as a planning tool and not a Farm Bill program ranking tool, allows the conservation planner the opportunity to apply the WHEG in a flexible approach, incorporating professional judgments deemed necessary for unique site conditions, varying financial resources and objectives. With the decision to limit the WHEG as a planning tool, the scoring process is not encumbered with concern of consequences of the rating related to Farm Bill program eligibility.

#### Time Requirements to Apply the WHEG

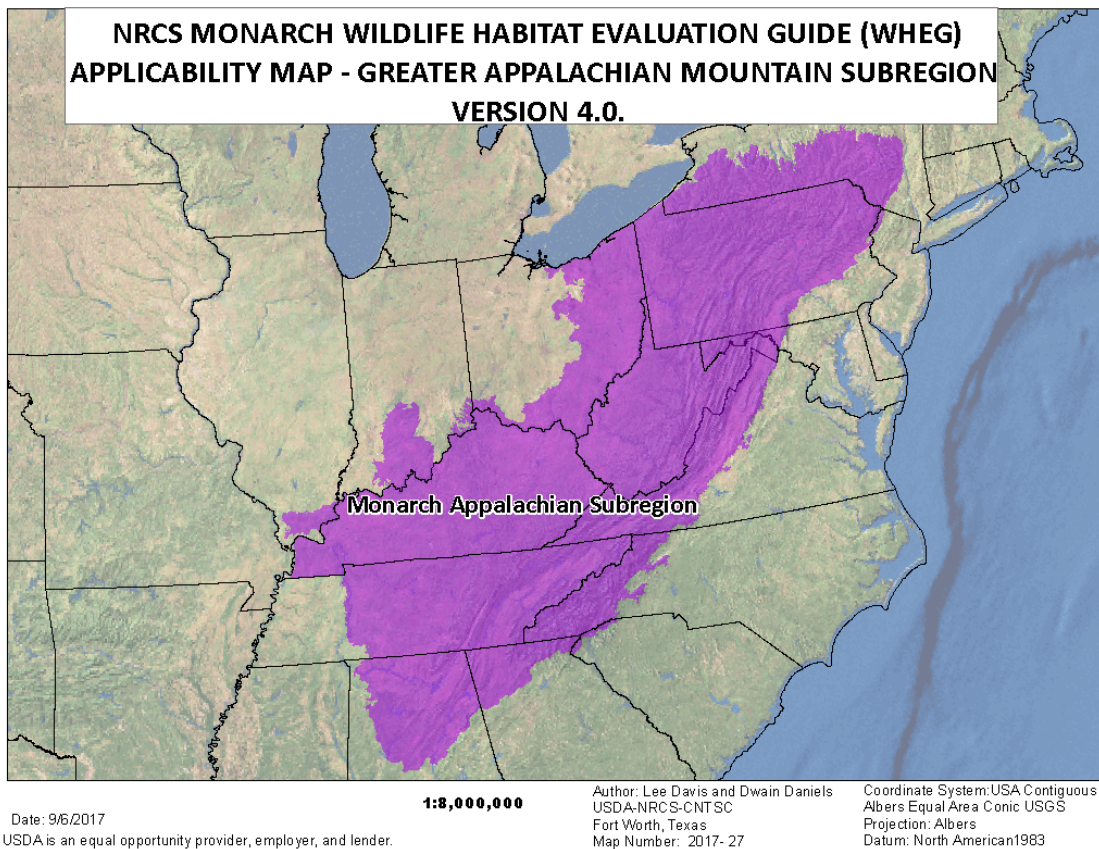
This WHEG is designed to allow for application of Rapid Methods for most projects. It is anticipated that application of the rapid approach will only add less than one hour to the traditional conservation planning process. Application of the vegetative sampling methods required in the comprehensive method will add approximately 2-3 additional hours to the conservation planning process.



## REFERENCE DOMAIN

Figure 6 provides the reference domain (area of applicability) for the NRCS Monarch WHEG; Greater Appalachian Mountain edition. The reference domain includes all, or portions four Land Resource Regions (LRR) (USDA 2006).

- (i) All Major Land Resource Regions (MLRA) in the eastern LRR N – East and Central Farming Region
- (ii) MLRA’s 139 and 140 in LRR R – Northeastern Forage and Forest Region
- (iii) MLRA 147 in LRR S – Northern Atlantic Slope Diversified Farming Region
- (iv) The Kentucky portion of MLRA 133A in LRR P – South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock LRR



*Figure 6: Applicability region for the NRCS Monarch WHEG; Greater Appalachian Mountains Edition.*

The application of this WHEG on lands located in LRR’s immediately adjacent to the reference domain may be appropriate if approved by the NRCS State Conservationist.

## Exclusions

The WHEG will not be applied to current forested areas (forested swamps, riparian forested areas or forested uplands)<sup>5</sup> or any other rare and declining habitats that are currently providing other important ecosystem services. Such areas contained within the project area will be rated as “N/A”.

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<sup>5</sup> Old-field habitat recently invaded by early-successional woody species are not considered forested for the purpose of this exclusion.

## MONARCH BUTTERFLY: QUICK FACTS

Most key wildlife species in North America have been studied extensively for centuries. Life requirements of these species are well understood and well documented. This is not true for the monarch butterfly, as the science remains very dynamic. With the loss of habitat in the Corn Belt, habitats in the Greater Appalachian Mountains Region of the U.S. has increased in importance to monarch butterflies that winter in Mexico.

The following are well understood about the individuals wintering in Central Mexico:

- Adult monarchs leaving the wintering grounds in Mexico move primarily north and northeast.
- Gravid females from Mexico, cease their northern migration, to lay eggs, primarily in Texas, but also in northern Mexico and other southcentral and southeastern states. Monarchs (1<sup>st</sup> Generation) born in these regions migrate north and northeast to lay eggs (2<sup>nd</sup> Generation), some reaching as far north as Canada.
- The Mid-Atlantic and northeastern states are primarily populated by monarchs raised in the eastern Midwest. After birth in the Midwest, many 2<sup>nd</sup> generation monarchs migrate across the Appalachian Mountains Region to access habitat in the Mid-Atlantic and New England Regions. A much smaller percentage migrate from the southeast (Miller et al. 2011)
- Depending on the climate, there are 3-5 generations of monarch butterflies each year.
- Gravid females lay eggs (200-400 eggs) almost exclusively on plants in the genus *Asclepias*.
- The most important plant family for nectaring is the Composite family (Asteraceae).
- Monarchs with a natal origin in the eastern U.S. contribute significantly to the total wintering population in Mexico (Flockhart et al 2016; Flockhart et al. 2017). Note: The percent contribution from any one region of the U.S. varies each year, depending on reproductive success/climate (Flockhart et al. 2017).
- Gravid females are selective of the digestibility of individual plants (Baum and Sharber 2012; Fischer et al. 2015). Young milkweed plants resulting from disturbance (e.g. mowing) are heavily utilized if available during late summer (Fischer et al. 2015).
- Recent data demonstrates some sensitivity to stand density (Kasten et al. 2016), where stands in excess of 2000 stems/acre are utilized at a lower rate per plant than stands less than 2000 stems per acre.

The following are not well understood:

- individual monarch movements of gravid females, particularly during egg laying
- the movements (distance traveled) of wild gravid females during egg laying<sup>6</sup>
- preferred or importance of spatial scale and/or configuration of patterns of the monarch butterfly habitats for either migration or reproduction

The WHEG is based on the best available science with the anticipation of future modifications.

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<sup>6</sup> Female monarchs lay 400+/- eggs over many weeks, but the vast majority of the eggs are laid within a 7-10 day period (Edson 2007).

## TIMING OF THE EVALUATION

For most situations, this WHEG can be applied using the rapid approach during any time of the year with the use of remote sensing and/or a field visit without herbaceous vegetative data collection. However, for some situations, the comprehensive approach is applied, requiring an inventory of forbs and milkweed (*Asclepias* spp.). Ideally, this vegetative inventory is applied when species richness of the forb component is at its highest level, and when conditions are suitable for plant identification.



*Figure 7: Late summer is an ideal time of the year to inventory a site for species richness and abundance.*

## RECOMMENDED SUPPLIES AND EQUIPMENT

If the assessment area supports enough *Asclepias* and other forbs to warrant vegetative sampling of the herbaceous community (as explained in the Instructions section), the following may be needed to conduct this assessment.

- Backpack
- GPS
- 100-foot measuring tape
- Pin flags or stakes
- Compass
- Clipboard
- WHEG, supporting documents and data sheets
- Plant ID field guide (optional)

## INSTRUCTIONS

### STEP 1: DEVELOP A PROJECT BASE MAP (FIGURES 8 AND 9)

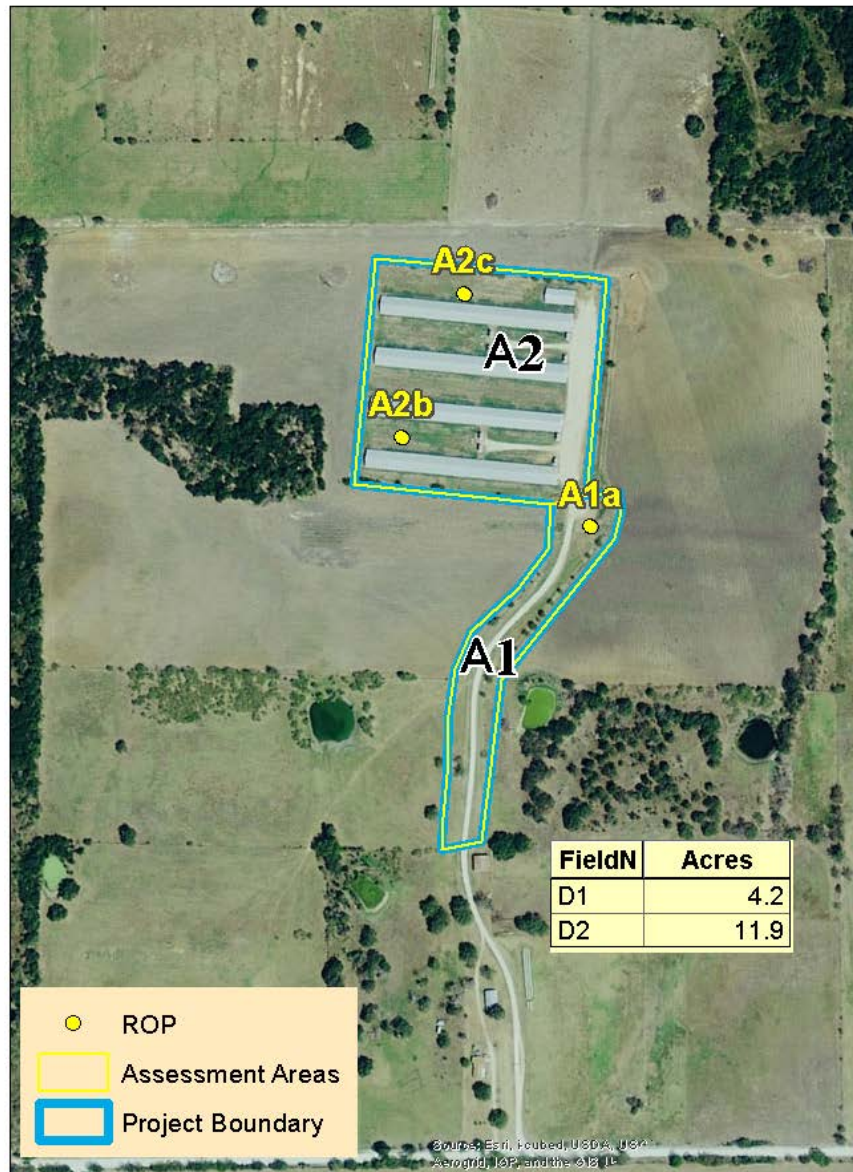
- a. Delineate the entire area to be evaluated on aerial imagery. The area to be considered for monarch habitat improvements is referred as the “*project area.*” *Note: Commonly, the project area will be the USDA Tract boundaries, but not always. In some situations it may be a single field or a portion of field. The decision of the project area boundary is left to the discretion of the conservation planner and client (decision-maker).*
- b. Identify areas within the project area that will *not* be evaluated. Within the project area, identify and delineate those areas where the decision-maker has no interest in development of monarch habitat. For example, the client might not be interested in converting a cropland field into monarch habitat. Identify such areas by placing the word “OUT” on the base map.
- c. Identify all assessment areas with the monarch WHEG land-type<sup>7</sup> of *Forested.* These areas include narrow zones of woody vegetation (riparian areas) and blocks of forested species such as ash (*Fraxinus spp.*), oaks (*Quercus spp.*), and hickory (*Carya spp.*). These assessment areas are excluded from the application of this WHEG. If determined to be the *forested* monarch WHEG land-type, document a rating of “N/A” and end the assessment.

Monarch Fact: Narrow forested riparian areas and edges of larger blocks of land supporting trees often provide important resting cover (micro-climates) for migrating monarchs, particularly during the fall migration.
- d. Subdivide the remainder of the project area into unique assessment areas. As appropriate, subdivide the remainder of the project area into areas that have similar characteristics, such as ecological sites, vegetation, soils, slope, and management. These unique areas are referred to as *assessment areas* (AA). Identify each AA on the base map. To not conflict with Common Land Units (CLU) and USDA field numbering, choose an alphabetical notation (A, B, and C). An assessment area need not be fully contained in a contiguous polygon. For example, if more than one portion of the project area supports similar characteristics such as a dense stand of cool season grass, then each polygon supporting these conditions will be assigned the same AA label. For these situations, follow a sequential numeric notation (A1, A2, A3, etc.) to denote that a group of non-contiguous areas (“sub-assessment areas” or “sub-areas”) have similar characteristics and will be considered as one assessment area.
- e. Determine size of each area. Determine and denote the acres in each assessment areas (including each sub-area) on the base map.

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<sup>7</sup> This monarch butterfly WHEG requires the identification of a “Monarch Butterfly WHEG Land-type” for each Assessment Area. Monarch habitat development options and decisions are provided for each monarch land-type. There are 5 Monarch Butterfly WHEG Land-Types in this WHEG: *FORESTED*, *CROP*, *MONOTYPIC GRASS OR LEGUMES*, or *OTHER PRIMARILY HERBACEOUS COMMUNITIES*. The *FORESTED* Monarch WHEG Land-type is unique as the WHEG prohibits consideration of conversion of AA meeting the *FORESTED* monarch WHEG land-type to monarch habitat.

### Monarch Butterfly Habitat Base Map

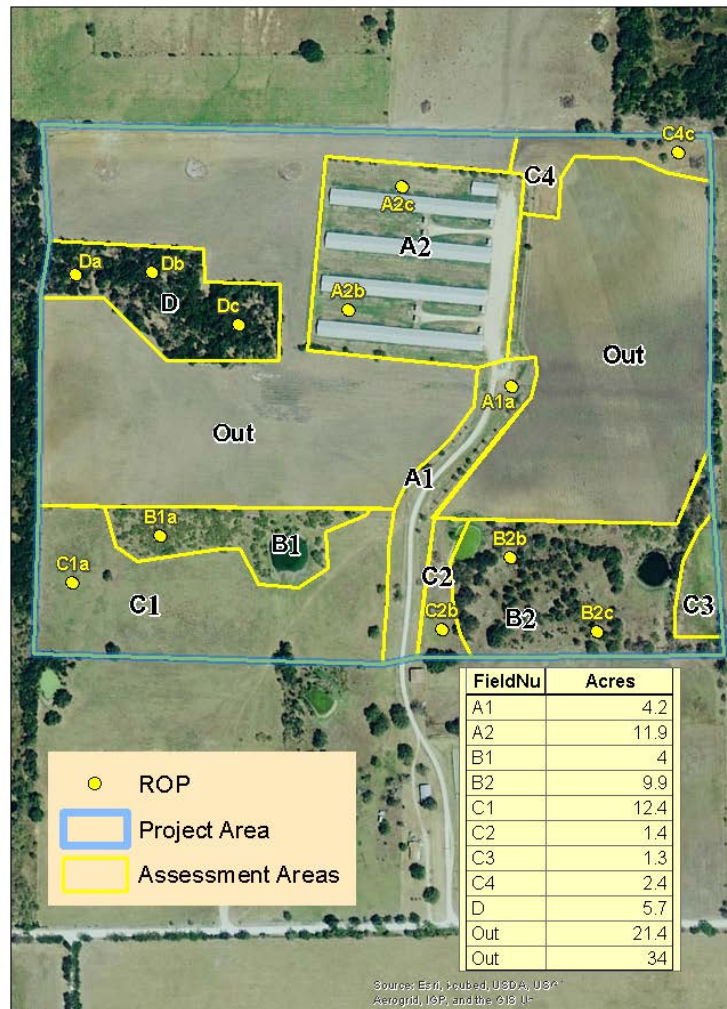


1:4,800

Map created: February 19, 2016  
 Central National Technology Support Center  
 USDA-NRCS, Fort Worth, Texas  
 Map No. 2016- 25

Figure 8: Example of a monarch habitat development base map for a less complex project. Note the concept that an assessment area need not be contiguous. This assessment area (A) is divided into two subareas (A1 and A2). ROP denotes Representative Observation Point.

### Monarch Butterfly Habitat Base Map



1:4,800  
 Map created: February 29, 2016  
 Central National Technology Support Center  
 USDA-NRCS, Fort Worth, Texas  
 Map No. 2016-28

Figure 9: Example of a monarch habitat development base map for a complex project. Note the concept that an assessment area need not be contiguous. As an example, the open herbaceous assessment area C has four subareas (C1, C2, C3, and C4). ROP denotes Representative Observation Point.

**USER NOTE:** To save staff time, this WHEG allows the planner to screen AAs that will not require the full application of the WHEG protocols, based on the plant community. For example, vegetative sampling to determine the density of milkweed and/or nectaring species has no value for a cropland area under consideration of conversion to monarch habitat. This screening process, and the presentation of conservation planning alternatives, are based on four monarch WHEG Land-types<sup>8</sup>. Each type is defined

<sup>8</sup> Monarch WHEG Land-types are related specifically to this WHEG and should not be confused with the term “landuse” in the NRCS National Conservation Planning Manual or program guidance. The WHEG’s rapid method is

in steps 2 (Rapid Methods) and 3 (Comprehensive Methods). To support the screening concept, no vegetative sampling or numeric scoring will occur in Step 2. Rather, the WHEG will direct the user to the appropriate monarch butterfly quality rating of *poor*.

## STEP 2: RAPID METHOD

Identify Monarch WHEG Land-types that have low species richness or abundance. These Monarch Land-types allow for a rapid decision on monarch butterfly habitat quality.

- a. Determine the Monarch WHEG Land-type and document the decision on the data sheet(s) for the assessment area.
  - i. *FOREST* - As is provided in the Exclusions within the Reference Domain section, this WHEG will not be applied to current forested areas (forested swamps, riparian forested areas or forested uplands)<sup>9</sup> or any other rare and declining habitats that are currently providing other important ecosystem services. Such areas contained within the project area will be rated as “N/A”.
  - ii. *CROP* – Any area that (i) is being annually planted for harvest of a product, or (ii) is planted to alfalfa (*Medicago sativa*).
    - A. Document a benchmark condition rating of *poor* and end the assessment.
    - B. If the planning consideration below are an objective of the decision maker, continue to Step 4; otherwise, identify the AA as OUT on the base map per step 1b and end the assessment<sup>10</sup>.
      - Alternatives and Planning Considerations:
      - Plant monarch habitat using Conservation Cover (327), Restoration of Rare or Declining Natural Communities (643), Field Border (386) or Riparian Herbaceous Cover (390), with an additional criteria to enhance wildlife, pollinator and beneficial organism habitat, with the monarch butterfly as the target wildlife species.
  - iii. *MONOTYPIC GRASSES or LEGUMES (including pasture, managed hay, farmsteads, and other frequently-managed areas, OR areas with low forb richness or abundance)* - These areas support primarily monotypic non-native or native grass species. Forb species richness is low, particularly related to the forb species on the Monarch WHEG Plant List in the appendix to this WHEG. Examples are reed canary grass (*Phalaris arundinacea*), Kentucky bluegrass (*Poa pratensis*), smooth brome (*Bromus inermis*), fescue (*Schedonorus* spp.), orchard grass (*Dactylis glomerata*), bluestems (*Andropogon and Schizachyrium* spp.), switch grass (*Panicum virgatum*), and clover (*Trifolium* spp.). *User Note: If the plant community supports low milkweed densities and low species richness and abundance of forbs used by monarchs for nectaring ( as provided on the Monarch WHEG Inventory List in the appendix), then the AA is best considered in the MONOTYPIC GRASSES OR LEGUMES monarch land*

used to determine monarch habitat quality ratings for CROP, MONOTYPIC GRASS or LEGUMES and BRUSH types. A more rigorous protocol is used for the Land-type of OTHER PRIMARILY HERBACEOUS COMMUNITIES.

<sup>9</sup> Old-field habitat recently invaded by early-successional woody species are not considered forested for the purpose of this exclusion.

<sup>10</sup> If the CROP AA is immediately adjacent to monarch habitat, consider pesticide drift risks to the adjacent habitat..



- type*. There may be some woody encroachment, but not to such a level to warrant a land-type of *Brush*.
- A. Document a benchmark condition rating of *poor* and end the benchmark condition assessment.
  - B. If any of the planning considerations below are an objective of the decision maker, continue to Step 4; otherwise, identify the AA as OUT on the base map per step 1b and end the assessment for this AA.
    - Alternatives and Planning Considerations:
      - Plant monarch habitat using Conservation Cover (327), Restoration of Rare or Declining Natural Communities (643), Field Border (386) or Riparian Herbaceous Cover (390), with an additional criteria to enhance wildlife, pollinator and beneficial organism habitat, with the monarch butterfly as the target wildlife species.
      - Implement strategic disturbance to increase milkweed and/or monarch nectaring plant species richness, abundance and cover by applying Prescribed Burning (338), Early Successional Habitat Development / Management (647) or Brush Management (315) or Herbaceous Weed Control (314).
- iv. **BRUSH** – These are old-field habitats that have been recently invaded by early successional woody species, but not so much as to be a fully stocked stand of trees (FORESTED monarch community type). Herbaceous vegetation currently growing in the old-field habitat is being impacted (or soon will be impacted) by shading. Without control of the young woody vegetation, the area will soon have minimal value for monarch butterflies. The planner and decision-maker agree that the brush must be addressed prior to implementation of any other monarch habitat efforts. This monarch land-type does not include early successional forested habitat. Mid-stage “old-field habitats” are the most common BRUSH monarch land-types in the Greater Appalachian Mountains region.
- A. Document a benchmark condition rating of *poor* and end the assessment of benchmark habitat conditions on the datasheet.
  - B. If any of the planning considerations below are an objective of the decision maker, continue to Step 4; otherwise, identify the AA as OUT on the base map per step 1b and end the assessment.
    - Alternatives and Planning Considerations: Monarch habitat would require Brush Management (314), often followed by :
      - Prescribed Burning (338), Early Successional Habitat Development / Management (647), Herbaceous Weed Control (315),
      - If the seed bank is lacking preferred native forbs, including milkweed, following control of brush, the decision-maker will consider planting the AA with a monarch mix using Conservation Cover (327), Restoration of Rare and Declining Natural Communities (643), or other plant establishment national conservation practices.

### STEP 3: COMPREHENSIVE METHOD

Assign ratings for the subset of the other AAs with a monarch WHEG land type of *Other Primarily Herbaceous Communities*

- i. *OTHER PRIMARILY HERBACEOUS COMMUNITIES* – These areas support grass with a fair number of milkweeds or forbs on the monarch WHEG Plant Inventory List provided in the appendix<sup>11</sup>. They commonly have past cropping history, or have been managed as pasture or hayland. There may be some woody encroachment, but not to the level to warrant a land-type of *Brush*.
  - A. **Document the benchmark habitat conditions on the datasheet.**
  - B. If any of the planning considerations below are an objective of the decision maker, continue to Step 4; otherwise, identify the AA as OUT on the base map per step 1b and end the assessment.

Determine the monarch habitat scores for the assessment areas identified as the Monarch land-type *OTHER PRIMARILY HERBACEOUS COMMUNITIES*, by considering the following monarch habitat variables:

- Insecticide Risk Condition  $V^{IR}$
- Weed Management Risk Condition  $V^{WMR}$
- Average Milkweed Stem Density  $V^{MWD}$
- Forb Cover  $V^{FC}$
- Forb Richness  $VRI$

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<sup>11</sup> If the milkweed and monarch friendly forbs are of such low density that the AA would score low for the Milkweed Density, Forb Cover, and Forb Richness, it is recommended to consider the AA as Monotypic Grass or Legume monarch land-type.

### Insecticide Risk Condition

V <sup>IR</sup> Insecticide Risk condition <sup>12</sup>	Benchmark Score	Planned Score	Applied Score
A portion of the AA is treated with insecticides, including insecticidal seed treatments.	0.0	0.0	0.0
(stop the assessment and provide a rating of <i>poor</i> )			
A portion of the AA is located within 100 feet of areas treated with insecticides, AND no insecticide drift techniques are assured.	0.2	0.2	0.2
A portion of the AA is located within 100' of areas treated with insecticides, AND the AA is either (a) located where it is not downwind of the areas treated with insecticides (seed treatment or foliar), based on prevailing wind direction during the growing season <sup>13</sup> , or (b) insecticides are not applied (seed treatment or foliar) when wind is blowing towards the AA.			
If above is met	0.5	0.5	0.5
AND > 25% of the AA is within 100' of treated areas.	.7	.7	.7
AND <25% of the AA is within 100' of treated areas.	.7	.7	.7
The AA meets conditions for a score of 0.5 above, AND offsite pesticide drift mitigation techniques from Table 3 of TN-190-AGR-9 <sup>14</sup> are implemented to meet a target index score of at least 20 points.	.8	.8	.8
The AA meets conditions for a score of 0.7 above, AND offsite pesticide drift mitigation techniques from Table 3 of TN-190-AGR-9 are implemented to meet a target index score of at least 20 points.	.9	.9	.9
The entire AA is greater than 100' from any area treated with insecticides (including seed treatment).	1.0	1.0	1.0

<sup>12</sup> V is used for the term “variable”. Variables scores are used to calculate the final score for the assessment area.

<sup>13</sup> Wind Rose Data will be used to determine prevailing winds

<https://www.wcc.nrcs.usda.gov/climate/windrose.html>

<sup>14</sup> NRCS Agronomy Technical Note 9 – *Preventing or Mitigating Potential Negative Impacts of Pesticides on Pollinators Using IPM and Other Conservation Practices*, is only used to support the Monarch WHEG when the client is fully committed to reducing pesticide drift. Otherwise, the conservation planning considerations associated with pesticide drift is limited to: (1) locate habitat away from fields treated with pesticides, and when that is not possible (2) locate habitat upwind of prevailing wind to minimize exposure.

### Weed Management Condition

$V^{WMR}$ Weed Management Risk Condition	Benchmark Score	Planned Score	Applied Score
Either of the following (i) AA is treated with herbicides, or (ii) Weed management of the AA is NOT consistent with Monarch Best Management Practices <sup>15</sup> . Stop, AA is rated as <i>poor</i> .	Stop	Stop	Stop
A portion of the AA is located within 30' of areas treated with herbicides, AND (ii) Weed management of the AA is consistent Monarch Best Management Practices.	0.3	0.3	0.3
The entire AA is located more than 30' from areas treated with herbicides, AND (ii) Weed management of the AA is consistent Monarch Best Management Practices.	0.5	0.5	0.5
The criteria for a score of 0.3 is met, AND off-site drift mitigation efforts from Table 3 (NRCS Agronomy T.N. 9) provide an index value of at least 20 points.	0.6	0.6	0.6
The AA meets conditions above (score of either 0.5), AND off-site drift mitigation efforts from Table 3 (NRCS Technical Note 9) provide an index value of at least 20 points.	0.85	0.85	0.85
The entire AA is greater than 100' from any area treated with herbicides, and (ii) Weed management of the AA is consistent with Monarch Best Management Practices.	1.0	1.0	1.0
<p><i>Do not consider Individual Plant Treatments (IPT) for plants deemed undesirable such as spot treatments of brush, noxious weeds, invasive plants, and other undesirable plant species.</i></p> <p><i>Do not consider treatments, such as NCP 314 – Brush Management or 315 - Herbaceous Weed Control, when required for establishment of milkweed or nectaring habitat.</i></p>			

### **SAMPLE VEGETATION TO DETERMINE MILKWEED DEINSITY AND FORB COVER AND RICHNESS**

– use the following process for variable factors  $V^{MWD}$ ,  $V^{FC}$ , and  $V^{FR}$

- *Locate Representative Observation Points (ROP's):* Within the assessment area, locate at least three observation points that best represent the vegetative conditions (e.g. species, density, richness) that occur in the AA. If the assessment area supports subareas (noncontiguous areas with similar vegetation, soils, slopes, etc.) the determination of the location of the ROP's will be based on locations that best represent the assessment area, without the need in having a ROP in each subarea. *Note: If the AA is small and/or the*

<sup>15</sup> The Monarch BMP Guidance is provided in the Appendix section of this document.

*community is ecologically diverse (species are evenly distributed within the AA), then selection of a single ROP, or inventorying the entire AA would be suitable.*

- At each ROP, locate the direction of a 72.6' X 6' foot belt transect<sup>16</sup> that would include vegetation that is most representative of the community in the assessment area. If the plant community within a 72.6 foot radius from the ROP is fairly homogeneous, then use a north, south, east, or west direction.
- Denote the vegetative transect geo-location and direction on the data sheet or base map.
- Sample vegetation within each assessment area using the following: *Note: There will be one data sheet for each assessment area.*
  - **Milkweed:** Walk the full distance of the belt transect carefully noting the presence of *Asclepias* plants<sup>17</sup> emerging from ½ of the belt transect (3' X 72.6'). Return to the ROP (starting point) while inventorying the other ½ of the belt transect. Document the findings on the data sheet for this assessment area.
  - **Monarch Nectaring Forbs:** Collect monarch nectaring forb data within three 6' x 6' plots. The first plot will be between 10 – 16 feet; the 2<sup>nd</sup> between 34 – 40 feet; and the 3<sup>rd</sup> between 60 and 66 feet. Visually estimate the absolute percent cover<sup>18</sup> of monarch nectaring forbs<sup>19</sup> in each plot. Document the findings on the data sheet.
- Repeat this sampling approach at each transect within the assessment area.

V <sup>MWD</sup> : Average milkweed stem density per acre	Benchmark Score	Planned Score	Applied Score
Milkweed absent in belt transects and the AA.	0.10	0.10	0.10
Milkweed absent in belt transects; however, individual milkweed stems present in the AA.	0.15	0.15	0.15
100 – 200	0.30	0.30	0.30
201 – 300	0.50	0.50	0.50
301 – 500	0.80	0.80	0.80
> 500	1.00	1.00	1.00

- Alternatives and Planning Considerations:
  - If the score is 0.15 or less consider planting milkweed with the use of Conservation Cover (327).
  - If the score is 0.3 – 0.5, consider using the following Conservation Practice Standards to increase milkweed densities.

<sup>16</sup> A 72.6' X 6' belt transect is equal to 0.1 acre. Multiplication of the data by 10 rapidly converts it to acre data.

<sup>17</sup> A milkweed “plant” is a stem emerging from the ground, surrounded by soil. The most common milkweeds in the Greater Appalachian Mountain region (common and swamp milkweeds) are rhizomatous with above ground stems having a common root system. To count in this tally, the stem must originate from the soil within the belt transect. Each stem emerging from the soils is considered a plant for tallying purposes, regardless of the origination point under the soil surface.

<sup>18</sup> Absolute cover is the percent shading that would occur if the sun was directly over the plot. Absolute cover for a single species would never exceed 100 percent, but cumulative (many species) would commonly exceed 100 percent in an herbaceous plant community.

<sup>19</sup> Nectaring forbs are included on the Monarch WHEG Plant List in the appendix. *Asclepias* spp. serve as preferred nectaring species. As such, they are included in the monarch nectaring forb inventory.

- Early Successional Habitat Management (647) to increase milkweed densities
- Prescribed Burning (338), with wildlife habitat as the purpose and milkweed and forbs being the target conditions.
- If the score is 0.8 - 1.0, consider the practices 647 and 338 to maintain milkweed densities.

V <sup>FC</sup> : Forb Cover: Average monarch nectaring forb cover within the AA	Benchmark Score	Planned Score	Applied Score
Absent ( $\leq 2.0\%$ )	0.10	0.10	0.10
Rare (2.1-5.0%)	0.20	0.20	0.20
Uncommon (5.1 – 15.0%)	0.30	0.30	0.30
Moderately abundant (15.1 – 25.0% cover)	0.60	0.60	0.60
Abundant (25.1% – 35.0% cover)	0.80	0.80	0.80
Very Abundant ( $> 35.0\%$ )	1.00	1.00	1.00
V <sup>FR</sup> : Forb Richness: Average number of monarch nectaring forb-species within the AA	Benchmark Score	Planned Score	Applied Score
< 1	0.10	0.10	0.10
1 -2	0.30	0.30	0.30
2.1 – 3.5	0.50	0.50	0.50
> 3.5	0.80	0.80	0.80
> 3.5 and two or more species of <i>Asclepias</i> represented in V <sup>MWD</sup>	1.00	1.00	1.00

- Alternatives and Planning Considerations:
  - If the score is 0.3 or less for either V<sup>ForbC</sup> or V<sup>ForbR</sup>, consider planting nectaring species with the use of Conservation Cover (327)
  - If the score is 0.3 – 0.5 consider the following to increase monarch nectaring species.
    - Early Successional Habitat Management (647), with an improvement in monarch nectaring habitat being the target conditions.
    - Conservation Cover (327), with the additional criteria to “enhance wildlife, pollinator and beneficial organism habitat”, and monarch nectaring habitat as being the target conditions
    - Prescribed Burning (338), with wildlife habitat as the purpose and monarch nectaring habitat as the target conditions.
  - If the score is > 0.5 consider the use of practices 647 and 338 to maintain or enhance current conditions.

**APPLY THE FOLLOWING FORMULA(S) TO DETERMINE MONARCH HABITAT CONDITION RATING (BENCHMARK, PLANNED, OR APPLIED RATING) FOR THE**

**TARGET HABITAT OBJECTIVES (BREEDING, NECTARING, OR BOTH BREEDING AND NECTARING).**

**Breeding Habitat Formula:**

$$BH\ Score = (2V^{IR} + V^{WMR} + 6V^{MWD})/9$$

**Nectaring Habitat Formula:**

$$NH\ Score = (V^{IR} + 2V^{WMR} + 4V^{FC} + 3V^{FR})/10$$

**Composite Habitat Formula**

$$WHEG\ Score = (BH + NH)/2$$

Monarch Habitat Condition Score	Benchmark Score	Planned Score	Implemented Score
0.00 – 0.25	<i>poor</i>	<i>poor</i>	<i>poor</i>
0.26 – 0.49	<i>fair</i>	<i>fair</i>	<i>fair</i>
0.50 – 0.74	<i>good</i>	<i>good</i>	<i>good</i>
0.75 – 1.00	<i>excellent</i>	<i>excellent</i>	<i>excellent</i>

**STEP 4: DETERMINE PLANNED MONARCH HABITAT CONDITION RATING**

Monarch Habitat Success Criteria: The minimum criteria to meet conservation practice standard Upland Wildlife Habitat Management (645) for the monarch butterfly is a rating of *good* for the limiting factor (breeding, nectaring or a composite score). In addition to a determination of a benchmark habitat condition rating, planners will need to produce planned condition ratings for those AAs where the client is considering a monarch butterfly habitat development alternative. This is accomplished by using best professional judgement to plan future conditions (based on implementation of conservation practices) and inputting those planned future conditions into the WHEG. If planned conditions are rated *poor* or *fair* and the monarch remains a resource concern for that AA, then the plan does not meet a Resource Management System (RMS) (NRCS 2013). Determine if monarch habitat remains a resource concern for the AA. Continue the progressive planning process.

**STEP 5: DOCUMENT DECISIONS**

Following consideration of the findings and presentation of alternatives, incorporate monarch butterfly habitat decisions in the conservation plan for those AA’s where the monarch butterfly remains an objective. Provide plan implementation assistance, as needed.

**STEP 6: FOLLOW UP**

Seldom can any conservation practice be installed with confidence without the need to revisit the site to determine the post implementation conditions and identify adaptive management needs that would benefit the conservation effort. As mentioned in the executive summary, the NRCS National Planning Procedures Handbook (NPPH) explains that conservation planning by its nature “is both progressive and adaptive” (USDA 2013). This statement is particularly true for wildlife habitat efforts on grasslands. Progressive and adaptive planning requires follow up, monitoring and flexibility. It is anticipated that this WHEG may be used in subsequent years to not only measure gains in monarch habitat quality (applied conditions ratings), but also to continue the progressive and adaptive planning process.



## DEFINITIONS

*Assessment area (AA):* A portion(s) of a planning unit of a project area that differ from other portions of the project area. This subdivision/delineation of AA's is based on differences in soils<sup>20</sup>, slope, vegetation, current or future landuse, etc. Delineations are made when the differences between two areas are significant enough to result in either (i) a different rating or (ii) a different habitat development recommendation. The purpose of delineation of an AA is to allow for input (data collection) and output (alternatives for treatment). Unique areas contained within a larger AA that are too small for application of a different conservation practice, should be included in a larger AA; however, they will not be sampled. An AA may include non-contiguous sub-assessment areas (subareas). An example would be if a project contained three non-contiguous areas on steep slopes with shallow soils, and each area is dominated by juniper. The characteristics (and treatments) of these three subareas are so similar that they are considered a single AA.

*Base map:* A map of the entire project area with delineations and notations of assessment areas, sizes of assessment areas and/or subarea, representative observation points, transects, other notations. The final map will denote the baseline condition rating, or the rating may be provided in another format (e.g. tabular)

*Benchmark habitat condition rating (benchmark rating):* A qualitative rating (e.g. poor, fair, good, or excellent) that reflects the current habitat conditions or value. This rating is often derived from cumulative quantitative scoring of different habitat condition variables.

*Habitat condition variable (V):* A non-static habitat characteristic (e.g. vegetation, size, connectivity) that can be changed with the implementation of conservation practice standards. Static conditions or characteristics (e.g. soil type) fail to meet the definition of a variable. Variables are assigned scores from 0.1 – 1.0 based on the matrix being measured or planned within the assessment area. A score of 1.0 reflects the range of conditions for that variable that would occur if the habitat is in excellent condition. Similarly, a score of 0.4 reflects the range of conditions (matrix being measured) that would occur for that variable when at 40% of the value needed to reach 1.0. The final habitat condition rating (*poor, fair, good* or *excellent*) is based on a single habitat condition variable, or a subset of variables applied to a mathematical formula. In a habitat assessment rating formula, variables are often mathematically weighted by importance. A score of 0.0 is reserved for conditions that are not salvageable or restorable.

*Planned habitat condition rating (planned rating):* In consideration of habitat development alternatives, the WHEG can be re-applied to plan future conditions or results. If the rating remains as *poor* or *fair*, additional alternatives are needed to meet the criteria of National Conservation Practice Standard 645. If the rating is *good*, additional alternatives are presented for consideration. If the rating is *good* or *excellent*, the requirements of operation and maintenance is presented to the decision maker.

*Project area:* A single polygon (outside boundaries) that delineates the entire area being evaluated for potential monarch habitat. Most commonly the project area will follow common land unit or field

boundaries, but not always. There will commonly be areas within the project area where monarch habitat is not identified as a resource concern (e.g. cropland field, hay field, bottomland hardwood forest).

*Reference domain:* From Smith et al. (1995). The furthest-most geographic reach, range, scope of the applicability of the WHEG. The reference domain delineates the outside boundary of the area (single polygon) that contains all sites (reference sites) used to build, test, or calibrate the WHEG. The reference domain establishes a boundary of applicability of the WHEG. There may be areas, within the reference domain, where the WHEG is not applicable. For example, in application of an early successional upland grassland WHEG, it would be prohibited to apply the WHEG on mature forested swamp community. Those areas are typically assigned a rating of N/A. These situations are described in the Exclusions section of the WHEG.

*Representative observation point (ROP):* Concept derived from the Corps of Engineers Wetland Delineation Manual (1987). A point contained within an assessment area that represents the average conditions (e.g. soils, vegetation, disturbance, slope, and wetness) that are occurring within the AA. Proper selections of ROP's allow for sampling intensities to be less than what would be required under random sampling strategies.

*Applied habitat condition rating (applied rating):* After full implementation of the selected national conservation practice standard(s), the WHEG can be re-applied to the assessment area to determine results. If the rating remains as *poor* or *fair*, additional alternatives are needed to meet the criteria of National Conservation Practice Standard 645. If the rating is *good*, additional alternatives may be presented for consideration. If the rating is *good* or *excellent*, consideration of actions required to maintain the habitat are presented.

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## APPENDIX

### Appendix A: Monarch WHEG Data Sheet

- The data sheet can be accessed at the NRCS Monarch Butterfly Webpage, under the Greater Appalachian Mountain Region heading.

### Appendix B: Important Plants of the Monarch Butterfly – Greater Appalachian Mountain Staff Guide, Ver. 2.0

- The data sheet can be accessed at the NRCS Monarch Butterfly Webpage, under the Greater Appalachian Mountain Region heading.

### Appendix C: Commonly Applied Conservation Practices

- Provided on page 27

### Appendix D: Monarch Butterfly Best Management Practices

- Provided on page 29

## Appendix C: Commonly Applied Conservation Practices for the Development or Management of Monarch Butterfly Habitat in the Greater Appalachian Mountain Region.

Conservation Practice Standard	Code	Category (CR) <sup>21</sup>	Practice Type <sup>22</sup>
Access Control	472	Supporting <sup>23</sup>	Management
Brush Management	314	Core	Management
Conservation Cover	327	Core	Establishment
Critical Area Planting	342	Supporting	Establishment
Early Successional Habitat	647	Supporting	Management
Fence	382	Supporting	Management
Field Border	386	Core	Establishment
Fire Break	394	Supporting	Management
Forage Harvest Management	511	Core	Management
Hedgerow Planting	422	N/A	Establishment
Herbaceous Weed Treatment	315	Supporting	Management
Integrated Pest Management	595	Supporting	Management
Prescribed Burning	338	Core	Management
Prescribed Grazing	528	Core	Management
Restoration of Rare or Declining Natural Communities	643	Supporting	Establishment

<sup>21</sup> NRCS and the USFWS developed a Monarch Butterfly Conference Report (CR) in 2016. A CR serves as part of the consultation requirements of Section 7 of the Endangered Species Act (ESA), in the event of a positive listing decision under the ESA. Table 1 of the CR provides a list of conservation practice standards covered by the Conference Report. Table 1 is much more extensive than the list provided in the Monarch WHEG. The CR identifies 645 as the Umbrella practice, and designates all other practices as either Core or Supporting. A Core practice can stand alone, while a supporting practice most commonly is implemented in support of a Core Practice.

<sup>22</sup> Conservation Practice Standards can be used to support monarch habitat by creating new habitat, or as a management tool to improved conditions of existing habitat.

<sup>23</sup> This WHEG uses 3 practice categories:

Practice Categories:

1. Umbrella: Serves as the foundation for the conservation planning process for the monarch butterfly. Though required in the conservation plan, the umbrella practice is not required in a financial assistance contract.
2. Core: Can be planned and implemented as a standalone practice.
3. Supporting: Is not a standalone practice, but rather is used to support a core practice.

Riparian Forest Buffer	391	Supporting	Establishment
Riparian Herbaceous Cover	390	Core	Establishment
Upland Wildlife Habitat Mgmt.	645	Umbrella	Management
Wetland Enhancement	659	Supporting	Management
Wetland Restoration	657	Supporting	Management
Wetland Wildlife Habitat Mgmt.	644	Supporting	Management

## Appendix D: Best Management Practices for the Monarch Butterfly: Greater Appalachian Mountain Region



### Use Approved Decision Support Tools

Use the monarch butterfly wildlife habitat evaluation guide (Monarch WHEG) as a decision-support tool to inform the planning process, and to implement a monarch butterfly habitat plan.

- **Why?** The WHEG is the decision-support tool used by NRCS planners and their clients to identify habitat deficiencies, and then to identify alternatives available for monarch butterfly habitat improvement.

### Use Time-of-Year Restrictions

Implementing and managing the plan consistent with an applicable time-of-year restriction ensures best outcomes. Journey North animation maps (<https://journeynorth.org/monarchs>) are excellent predictors of when monarch butterflies will be in the area.

Lands Identified as *Good* or *Excellent* Monarch Habitat: The use of habitat rated as *good* or *excellent* is expected to be high. Thus, the risk of mortality associated with disturbance is high in these areas. Minimize monarch mortality associated with normal farm and ranch management activities by minimizing disturbance during the period of the year when the habitat is in use by monarchs.

- **Why?** Curbing activities during peak breeding and migration periods is paramount to achieving best outcomes. Adhering to all applicable best practices in *good* or *excellent* habitat during a time-of-year restriction period helps avoid and minimize larval and adult mortality. Research suggests that some land management activities (mowing or burning) within the time-of-year restriction period can be beneficial to monarchs if conducted strategically to assure that all habitat is not being impacted. For example, a midsummer burn or mowing on a portion of the habitat, will result in younger milkweed plants with higher digestibility. These plants are sought after for egg laying by late season gravid females.



Lands Identified as Poor or Fair Monarch Habitat: Adherence to time-of-year restrictions should not preclude activities being implemented to increase habitat quality on areas rated as *poor* or *fair*.

- **Why?** Activities related to plan implementation or management in habitat with a WHEG rating of *poor* or *fair* will have long-term beneficial effects that will more than replace any short-term monarch mortality resulting from the habitat improvement activities.

## Look Before Acting

To the extent practicable, monitor the habitat for the presence of eggs and larvae before undertaking management activities. The Monarch Larva Monitoring Project provides an excellent monitoring protocol and online training (<https://monarchlab.org/mlmp>). It is especially important to conduct monitoring before undertaking activities within the time-of-year restriction period.

- **Why?** It is not difficult to perform a rapid assessment to detect the presence of monarch eggs and larvae. Foregoing activities (plan implementation or management) until eggs and larvae are absent or in low abundance can greatly minimize mortality and thereby balance short-term adverse with long-term beneficial effects. Monitoring for such adaptive management is an option under NRCS Conservation Practice Standard (645): Upland Wildlife Habitat Management.

## Coordinate Activities with Neighbors

To the extent practicable, use an adaptive, landscape approach by coordinating plan implementation and management activities with neighbors.

- **Why?** Coordinating activities with neighbors may allow for a more effective approach to habitat development and management by staggering disturbances (e.g. mowing or burning) which will better assure successful monarch production in the immediate area.

## Burning

When possible, implement prescribed burning on no more than 1/3 of the habitat, unless suitable monarch habitat exists nearby, or the WHEG rating is *poor* or *fair*.

- **Why?** Prescribed burning is a common management technique used to set back ecological succession and increase the abundance of milkweed and nectaring forbs. Restricting burning to a fraction of the habitat retains suitable habitat, promotes ecological heterogeneity, and promotes abundant breeding and nectaring resources.

When possible, allow fires to burn in a patchy, finger-like pattern within units.

- **Why?** Unburned patches of suitable habitat promote ecological heterogeneity and long-term benefits important to the monarch's life cycle.

## Grazing

Monarch habitat should be fenced from grazed areas. Short-term grazing can be used to target grasses, which can benefit forbs. Monitor the area and move cattle when they begin to forage extensively on the forbs.

- **Why?** Many excellent monarch nectaring forbs are of higher digestibility than are grasses. In these situations, livestock will target these high-quality forbs. Conversely, milkweed is avoided by livestock, and grazing stands of milkweed will have little impact on reproductive habitat. Through a prescribed grazing plan, with monarch butterflies as a consideration, higher quality habitat may be achieved.

## Herbicide Applications

Herbicides are often an essential tool when establishing new monarch habitat. Additionally, herbicides can be a viable management tool following planting and to manage established monarch habitat.

- **Why?** Broadcast application of herbicides is often the most cost-effective and efficient way to prepare existing stands to high quality, species-rich monarch habitat. Depending on the existing cover, aggressive treatment may be necessary. After establishment, individual plant treatment (IPT) can be used to control noxious and invasive species. If grass becomes too dense, the use of grass specific herbicides (graminicides) can be used to release the forb component.

## Mowing and Haying

Do not mow any area more than once every 4-5 years. Mow or hay no more than 1/3 of the habitat per year, and when possible leave patches. The use of individual plant treatment (IPT) to control invasion of woody plants may be required between mowing intervals.

- **Why?** Mowing and haying are common management techniques used to set back ecological succession and control invasion of woody plants. Mowing too often (more than once every 4-5 years) will favor the grass component in the habitat and will reduce monarch nectar plants (forbs). Limiting this activity to no more than 1/3 of the monarch habitat in the area, promotes ecological heterogeneity, and promotes abundant breeding and nectaring resources each year.

Mow at 12-16 inches, but not less than 8 inches. When practical defer mowing until after fall migration.

- **Why?** Mowing benefits monarch habitat because it somewhat replicates disturbance and stimulates new plant growth. Increasing mowing height retains more standing biomass and reduces temporal loss of milkweed and nectar resources. If the objective is to control woody species, mowing lower than an 8-inch height should be considered.

## Tillage

Shallow-till no more than 1/2 of the habitat per year, if possible. Leave patches of untilled habitat for the entire year.

- **Why?** Use of a tillage tool such as a disk to break the sod and stir the soil surface to a shallow depth is a common management technique used to set back ecological succession. Tilling a limited portion of the site retains some suitable habitat, promotes ecological heterogeneity, and promotes abundant breeding and nectaring resources. Mowing, burning, grazing or haying may be needed prior to tillage if equipment is not heavy enough to penetrate existing sod. For habitat with the primary purpose of providing reproductive habitat (milkweed), late-season tillage is an excellent tool to increase the density of common milkweed (*Asclepias syriaca*) the following year.

## Useful Resources:

### [Journey North Interactive Maps](#)

- Real-time peak migration tracking.

### [Integrated Monarch Monitoring Program](#)

- Monitoring protocol, [online-training](#) and datasheets