Eastern regal fritillary butterfly reintroduction: site guidelines

Developed by Department of Military and Veterans Affairs (DMVA) Wildlife Office, Updated February 2026

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One-page summary, followed by expanded sections below

Fort Indiantown Gap (FIG), National Guard Training Center, Annville, PA is home to the only remaining population of eastern regal fritillary butterflies (*Argynnis idalia idalia*). DMVA wildlife biologists are attempting to reintroduce the butterfly (which was proposed for listing as an endangered species in August 2024) outside of FIG. Captive rearing takes place at ZooAmerica (Hershey, PA) and reared individuals are released to selected PA Game Commission (PGC) sites. By clearly defining habitat requirements, and management and monitoring goals, it is the hope that the project can expand to additional sites in the future. Standards for this project serve as an excellent opportunity to promote grassland conservation in the eastern United States. The work is ecosystem based and provides habitat for a variety of non-target species such as pollinators, birds, and game species. Note: reintroduction site locations are not currently disclosed to the public to prevent harvesting of this rare species.

General Initial Site Requirements:

- Large scale (native) grasslands (minimum: 250 acres)
  - 100+ acres core habitat (thin/poor soils able to support violets and native bunch grass)
  - 150+ acres open habitat (grasses and forbs, some shrubs and trees acceptable, but non-forested)
- Partner site management goals are compatible with goals to reach regal vegetation requirements (see **1.**)
- Partner commitment for multiple years
- Partner implements grassland management recommendations (see **2.**)
- Partner assists in determining long term responsibility of monitoring (see **3.**), management, and training

1. Regal Vegetation Requirements:

- **Caterpillar Host Plants**: ≥5,000 violets/acre (1 violet/yard^2), arrow-leaved violet (*Viola sagittata*)
- **Adult Nectar Sources**: throughout the flight period (Jun-Oct)
  - Primary species: 100-150 blooming stems/acre, common milkweed (*Asclepias syriaca*), butterfly milkweed (*A. tuberosa*), pasture thistle (*Cirsium pumilum*), field thistle (*C. discolor*)
  - Secondary species: wild bergamot, swamp milkweed, mountainmint, dogbane, others
- **Native Warm Season Bunch Grasses (WSG)**: ~30-40% cover little bluestem (*Schizachyrium scoparium*)
- **Bare ground**: ~10% cover

2. Habitat Management Recommendations:

- **Disturbance: Prescribed Fire**: ~1/3 of habitat burned every 3 years; possibly more or less based on goals and results; **mowing, removal of larger woody vegetation, herbicide, topsoil removal**
- **Meeting regal vegetation requirements:** warm season grasses (separate than other species-prepare site, seed, control other species until established), violets (disturbance, seeding, transplants), nectar plants (seeding, transplants)

3. Monitoring goals:

- **Staffing and data management**
- **Habitat monitoring**
- **Butterfly work**

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Expanded sections

1. Regal Vegetation Requirements:

a. Larval Host Plants (native): caterpillar food (Mar/Apr-Jun)

- **≥5,000 violets/acre, (1 violet/yard²)**
- Primarily arrow-leaved violet (*Viola sagittata*) (Fig. 1)
- Disturbance-dependent species
- No commercial seed source
- Other violet species used elsewhere

b. Adult Nectar Sources (native): throughout the flight period (Jun-Oct)

- **Primary species (Fig. 2): 100-150 blooming stems/acre**
  - **(Jun) Common milkweed (*Asclepias syriaca*)** – 30 stems/acre
  - **(Jun-Jul) Butterfly milkweed (*A. tuberosa*)** – 33 stems/acre
  - **(Jul) Pasture thistle (*Cirsium pumilum*)** – 7 stems/acre
    - No commercial seed source
  - **(Aug-Oct) Field thistle (*C. discolor*)** – 47 stems/acre
    - No commercial seed source
- **Secondary species (native) (Fig. 3):** wild bergamot, swamp milkweed, dogbane, mountainmint, others

c. Warm Season Bunch Grasses (WSG) (native) (Fig. 4): ~30-40% cover little bluestem (*Schizachyrium scoparium*) (preferred species)

- Tussocks provide protection for every life stage
- Broomsedge (*Andropogon virginicus*) – alternative WSG species

d. Bare ground: ~10% cover

e. Low shrubs or small trees: ~10-20% cover

- Provides protection for female butterflies
- Increases violet and nectar plant germination

f. Other native vegetation: ~20-30% cover

- Native forbs and other grasses that fill out the remainder of the plant community

2. Habitat Management Recommendations:

a. Disturbance These grassland ecosystems are disturbance dependent. At FIG, the primary tool is fire, but a variety of mechanical, chemical, and supplemental methods are utilized to slow succession and non-native plant invasion. The resulting regal habitat can be compared to quail habitat in terms of similar plant species and disturbance regime. Initial habitat assessment and continued vegetation monitoring is recommended to guide management decisions, which should be made and adapted on various time and size scales based on goals and results. Disturbance alone may or may not be enough to reach the regal vegetation requirements described; supplemental seeding or transplants will likely be necessary. Recommendations may shift slightly once caterpillar and butterfly releases begin.

- **Prescribed Fire**
  - Effective and efficient grassland management tool
  - ~1/3 of habitat burned every 3 years; possibly more or less based on goals and results
  - Decreases thatch and creates bare ground, promotes violets and nectar plants
  - Promotes WSG over C3 grasses
  - Fall or spring; spring is often more feasible and provides quicker results
- **Mowing**
  - Reduces small woody vegetation or aggressive species such as goldenrod that are not effectively controlled by fire
  - Thatch can build up if repeatedly mowed and not hayed
  - Avoid mowing large areas at peak nectar flowering times to reduce the impact on adult butterflies
  - Selective mowing in June promotes new growth of milkweed, providing nectar for regals and ovipositional habitat for monarchs
  - Promotes pasture thistle when present on site
- **Removal of larger woody vegetation**
  - Some shrubs and small trees are necessary, as they provide protection for butterflies, but should be removed when they become invasive (i.e. exceed 10-20% cover)
  - Brush hog, chainsaw, etc.
- **Herbicide**
  - Often needed to prepare a site for planting, to control undesirable species, or on disturbed soils
  - Use species or plant group specific options when available
  - Recommended herbicides: Round-up, Garlon, Plateau
- **Topsoil removal**
  - In areas with rich soil, scrape off most the topsoil (~6”) with a bulldozer or similar equipment
  - Effective at promoting the desired vegetation structure and reducing an undesirable seed bank
  - Discarded soil should be disposed of or treated (herbicide and seeded, or other)
  - Seed drill little bluestem (LBS) in the fall to begin establishment of WSG

2. Habitat Management Recommendations:

b. Meeting regal vegetation requirements

- **Increasing WSG:** Should not be combined with other plant establishment effort (i.e. nectar or violet seeding). WSG takes longer to establish and may get outcompeted by faster growing forbs or other vegetation. NOTE: These techniques work best on poor soils.
  - WSG establishment
    - Reduce competition by clearing the site of unwanted vegetation
    - Seed drill with LBS at ~7lbs/acre in the fall
    - Reduce competition the next year with broadleaf herbicide as needed and/or mowing in June
    - Once grass establishes, desirable species can be introduced to the system either through management efforts or natural means
  - WSG maintenance
    - Seed drilling after a fire or other disturbance events if needed
    - Mowing in May/June to reduce forb and cool season grass seed heads
- **Increasing violets**
  - Identify existing and potential violet habitat
    - Indicators may include: violets present, WSG present, thin soil, soil crust, bare ground
  - Provide repeated disturbance, avoiding violet bloom time if possible (April/May)
    - Disturbance should be varied in its method and intensity depending on the need
  - Violet numbers decrease significantly after 3-5 years of no disturbance
    - **Do not respond well to competition**
  - Supplement potential violet habitat with transplants or seed collected from FIG or elsewhere
    - Violet plugs will need to be grown out by a contractor or other entity - no commercial source for arrow-leaved violet
    - If seeding, fresh seed no more than 1 year old is preferred. Older seeds can have a lower germination rate
      - Should be seeded in fall or spring to mimic natural conditions

c. Increasing Nectar plants (Table 1):

- The specific needs of each nectar species must be considered when trying to establish new plant populations
  - Common and swamp milkweed and monarda thrive in swales and areas lower in topography. These spots often provide more moisture and nutrients that many nectar plant species prefer.
  - Others such as butterfly milkweed and native thistles thrive in upland settings with drier soils
- Transplants
  - Quicker establishment, significant initial cost and effort to grow and plant
    - Will likely require a contracted greenhouse service
  - Due to a lack of commercial sources, some seeds must be collected directly from FIG or other locations
  - Utilize contractors, students, or volunteers if not feasible in house
- Seed drill
  - Slower to establish than transplants but easier to execute
  - Requires specialized machinery
  - Prefer to design seed mix focused on known primary and secondary nectar species
    - Violets, WSG's and other vegetation should be planted separately
  - If using a premade mix, analyze list to avoid known aggressive species such as rough leaved goldenrod and big bluestem, AND supplement with additional target species

3. Monitoring goals:

a. Staffing and data management

- FIG and ZooAmerica staff will assist as much as possible
  - Limited approval to conduct work outside of FIG
- Survey123 apps on cell phones to collect field data and upload it directly to the FIG ARCGIS portal
- FIG will work with partners to determine staffing options
- FIG will provide initial training in vegetation and butterfly monitoring
  - The goal is to identify partners who will eventually take over primary training, management, and monitoring of the site

b. Habitat monitoring:

- Initial site assessments: identify high quality habitat within site, map out/quantify
  - Methods to identify possible areas that support WSG's or other plant communities of interest
    - Use aerial images and GIS to assess site
    - Ground truth in the fall or winter when dead WSG stems are more visible (if not mowed or burned)
  - On the ground: host plants are significantly easier to detect at specific times of the year
    - Spring/mid Apr-May: blooming violets (very difficult to find when not in bloom)
    - Jun: early season nectar (dogbane, common milkweed, butterfly milkweed)
    - July: midseason nectar (butterfly milkweed, pasture thistle, monarda, mountainmint)
    - Late summer/fall: WSG, late season nectar (field thistle), some violet leaves turn yellow in fall
- Systematic monitoring in high quality habitat
  - May-Jun: violet plots
    - Randomly placed $2m^2$ plots
  - Jul-Aug: point intercept vegetation surveys
    - Uses the same locations as violet plots
- Use info to guide management recommendations

c. Butterfly work:

- Regal reintroduction
  - Beginning of May: Caterpillar releases
    - FIG and Zoo staff either come to site in person to assist, or ship caterpillars to collaborators for release
- Occupancy survey (mid-June-end of Sept)
  - Meandering survey within release sites and core habitat; driving survey if applicable
  - Conducted between hours of 10-1500
  - Preferred weather- between 70F and 100F, no rain, excessive wind, or complete cloud cover
  - Compliment with game cam surveys
- Additional adult survey led by FIG/Zoo Staff: Limited scale mark-recap, 2-3 trips Jul-Aug
- Butterfly species list (optional but beneficial)

If you have any questions or would like to discuss a possible partnership, please email:

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NOTE: This guide is adaptive, and subject to change.

Table 1. Plant Seed Species List: Ernst has FIG and/or PA ecotype seed, all which should be planted by Truax. Thistle and violet seed are not commercially available so it must be collected; best practice at this time is propagation of transplants to minimize effort and maximize speed of establishment. Priority: 1 =required, 2= secondary beneficial, 3 =presumed beneficial

Scientific Name	Common Name	Source	Ecotype	Truax Seedbox	Seeding rate (lb/acre)	Priority
Schizachyrium scoparium	Little bluestem	Ernst	FIG-PA	Fluffy	≤6	1
Asclepias syriaca	Common milkweed	Ernst	PA	Fluffy	≤0.1	1
Asclepias tuberosa	Butterfly milkweed	Ernst	PA	Fluffy	≤0.5	1
Cirsium discolor	Field thistle		FIG			1
Cirsium pumilum	Pasture thistle		FIG			1
Viola sagittata	Arrow-leaved violet		FIG			1
Asclepias incarnata	Swamp milkweed	Ernst	PA	Fluffy	≤0.6	2
Liatris spicata	Marsh blazing star	Ernst	PA	Fluffy	≤1	2
Monarda fistulosa	Wild bergamot	Ernst	FIG-PA	Fine	≤0.1	2
Penstemon digitalis	Tall white beardtongue	Ernst	PA	Fine	≤0.8	2
Pycnanthemum tenuifolium	Narrowleaf mountainmint	Ernst		Fine	≤0.08	2
Pycnanthemum virginianum	Virginia mountainmint	Ernst	PA	Fine	≤0.08	2
		Ernst				
Vernonia noveboracensis	New York Ironweed	Ernst	PA	Fine	≤0.2	3
Penstemon laevigatus	Appalachian beardtongue	Ernst	PA	Fine	≤0.1	3
Aster novae-angliae	New England aster	Ernst	PA	Fine	≤0.4	3
Aster oblongifolius	Aromatic aster	Ernst	PA	Fine	≤0.4	3

Fig 1: The arrow leaved violet (*Viola sagitatta*), the larval host plant of the regal. Leaves are small and cryptic (**A**) after first emerging in early spring. Once violets begin to bloom (**B**), the plants become more apparent- multiple stalked purple flowers sit above a rosette of arrow-shaped leaves (**C**). Mature leaves of *V. sagitatta* and pointed at the ends and deeply lobed (**D**).

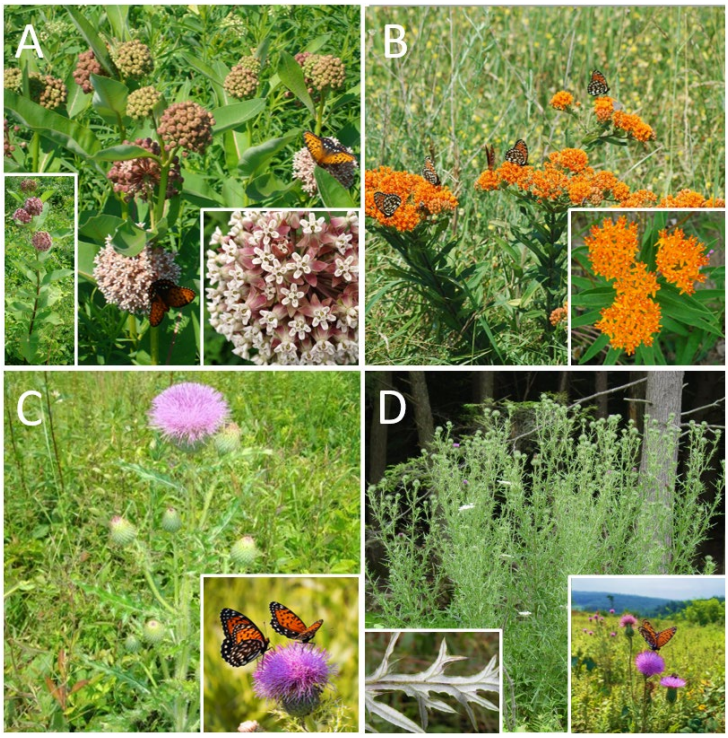

Fig 2: Primary nectar sources of the regal fritillary- Common Milkweed (*Asclepias syrica*)(**A**), Butterfly Milkweed (*Asclepias tuberosa*)(**B**), Pasture Thistle (*Cirsium pumilum*)(**C**), and Field Thistle (*Cirsium discolor*) (**D**).

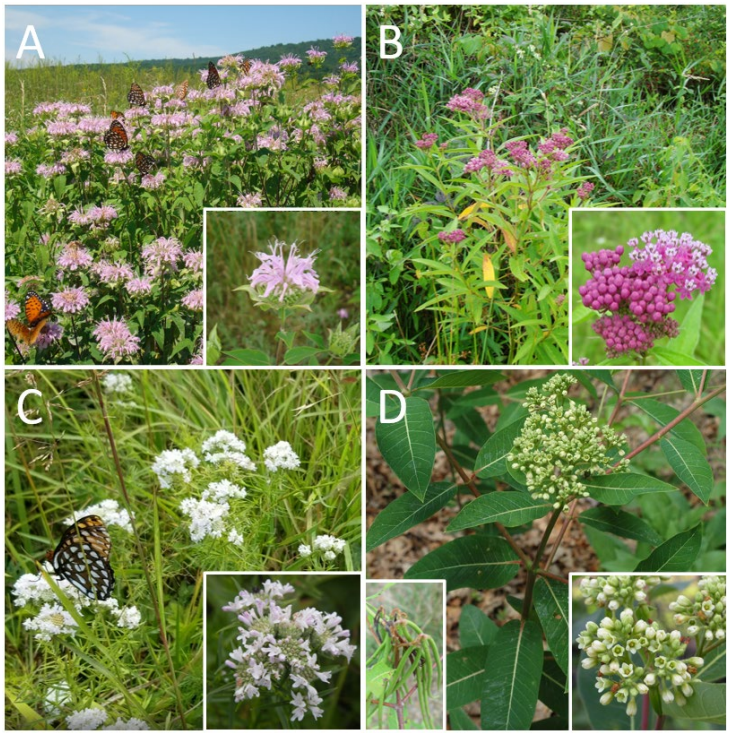

Fig 3: Secondary nectar sources of the regal fritillary- Wild Bergamot (*Monardo fistsulosa*)(**A**), Swamp Milkweed (*Asclepias incarnata*)(**B**), Mountainmint (*Pycanthemum sp.*)(**C**), and Dogbane (*Apocynum cannabinum*) (**D**).

Fig 4: Warm season grasses provide protection for all life stages of the regal fritillary. The preferred species is Little Bluestem (*Schizachyrium scoparium)*(**A**), however, Broomsedge (*Andropogon virginicus*)(**B**) is an acceptable alternative.