

**West Virginia Diana Fritillary Surveys**  
**Summary Report – October 2024**



**United States Fish & Wildlife Service**  
**Science Applications – At-Risk Species Program**  
**Award # F23AC01276-00**

## Introduction

In 2023, US Fish and Wildlife Service (Service), National Alliance of Forest Owners (NAFO), and the National Council for Air and Stream Improvement, Inc. (NCASI) finalized a Memorandum of Understanding (MOU) that formalized and strengthened the Wildlife Conservation Initiative (WCI) that advance efforts to improve the status of at-risk and Endangered Species Act-listed species inhabiting private working forests. The WCI promotes collaborative research and conservation of rare and declining species for the purpose of informing sustainable forest practices on lands owned and managed by NAFO member companies. The WCI and the West Virginia Division of Natural Resources (WVDNR) have identified the Diana fritillary (*Argynnis diana*) butterfly as a priority species for research. This species is a large, forest-dependent butterfly that relies on robust concentrations of violets (*Viola spp.*), their larval host plants (Vaughan and Shepherd 2005). The species' range in the Appalachians extends from West Virginia south to northern Georgia and Alabama (Vaughan and Shepherd 2005).

The Diana fritillary is undergoing range contraction and shifting to higher elevations, possibly in response to climate change (Wells and Tonkyn 2014). In West Virginia, the species is identified as a Species of Greatest Conservation Need threatened by mountaintop coal mining and associated valley fills (WVDNR 2015). In other parts of the Diana fritillary's range, forest management and pest control have been identified as important factors influencing the species' status (Vaughan and Shepherd 2005). Over-browsing of host and nectar plants by white-tailed deer (*Odocoileus virginianus*) may also be affecting this species (Wells and Tonkyn 2014, Schweitzer et al. 2018).

In West Virginia, observations of the Diana fritillary are largely from the southern half of the state. Many historical and recent observations occur on state-owned properties, such as Wildlife Management Areas (WMAs) and State Parks, or on private, working forests owned or managed by companies that are members of NAFO. In partnership with NAFO, WVDNR, NCASI, and the Service, with support from The Lyme Timber Company, LLC and Weyerhaeuser Company, we initiated field investigations of Diana fritillary in West Virginia to better understand distribution of Diana fritillary on private, working forests. We were also interested in better understanding the relationship between forest management and Diana fritillary to identify measures that may benefit the species. During summer 2023, the Service's Science Applications (SA) program conducted a pilot study to test methods for field investigations and recommend a more comprehensive approach to compare Diana fritillary occupancy under various sustainable forest management practices. We used our results from 2023 to revise our approach for the 2024 field season, refining the survey methods used and habitat variables collected. Surveys during 2024 focused more on exploring the relationship between habitat condition and Diana fritillary presence.

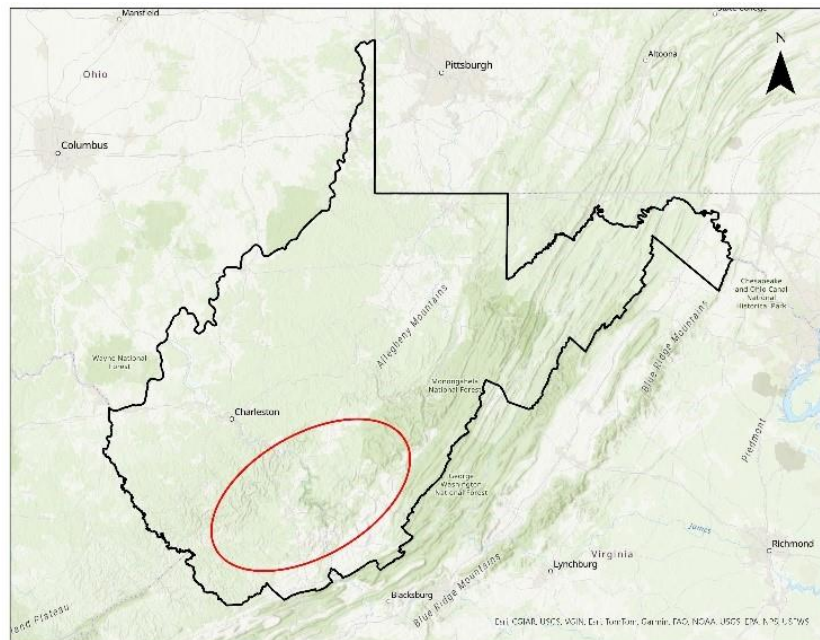
Our objectives were to:

- Evaluate Diana fritillary survey methods on state lands and private, working forests;
- describe habitat conditions at locations where Diana fritillary are detected and compare to randomly selected locations;
- examine effects of sustainable forestry management practices on Diana fritillary presence; and
- develop recommendations for habitat management to promote Diana fritillary.

## Summary of Survey Results

We identified survey areas based on historic occurrence records obtained from WVDNR and Butterflies and Moths of North America (Lotts and Naberhaus 2024). We considered all NAFO and state lands within 2km of historic occurrences for surveys provided that habitat was still present at the site. We selected five properties: Twin Falls State Park, Babcock State Park, Beury Mountain Wildlife Management Area, Weyerhaeuser Company lands, and The Lyme Timber Company, LLC lands. We stratified each property into 25-hectare (61.8 acre) grid cells. We selected a subset of these grids for butterfly surveys and habitat assessments, with the objectives of detecting the Diana fritillary, gathering information on habitat variables, and confirming host plant (*Viola* spp.) presence.

Over two field seasons, we conducted surveys covering 121 grid cells across southeastern West Virginia (Figure 1, Table 1), representing approximately 3,025 hectares surveyed.



**Figure 1.** Map of West Virginia, with the general study area for the Diana fritillary surveys indicated in red. Surveys occurred across five properties in southeastern West Virginia: Twin Falls State Park, Babcock State Park, Beury Mountain Wildlife Management Area, Weyerhaeuser Company properties, and The Lyme Timber Company, LLC properties.

Effort between the two seasons differed significantly (Table 1). During 2023, surveys were conducted for 8 weeks (Jul 5-Aug 22) by 4 field technicians. During 2024, surveys were conducted for just over 4 weeks (Jul 31-Aug 28) by 2 field technicians. The shorter field season in 2024 was the result of staffing capacity and a desire to focus more on later during summer when females are more likely to be ovipositing.

**Table 1.** Comparison of effort in the 2023 and 2024 field seasons. Effort, in terms of number of surveyors, days surveys were conducted, staff time, and survey period, was significantly higher in 2023. Staff capacity in 2024 resulted in the shorter overall season and reduced effort.

	2023	2024
<b>Surveyors</b>	4	2
<b>Survey days</b>	32	23
<b>Staff days</b>	100	36
<b>Survey period</b>	48 days	28 days
<b>First survey day</b>	July 5	July 31
<b>Last survey day</b>	August 22	August 28

We assessed grids using a combination of structured surveys within selected grid cells and opportunistic sightings while traveling between survey sites. We observed *Diana fritillaries* in 51 cells (42% of the surveyed area; Table 2). We observed 116 *Diana fritillaries* across the two seasons, 85 males and 31 females (Table 2).

**Table 2.** Comparison of survey results in the 2023 and 2024 field seasons. Effort was greater in 2023, with greater numbers of cells surveyed and corresponding increases in the number of grids where *Diana fritillary* were detected and the total number of individuals observed.

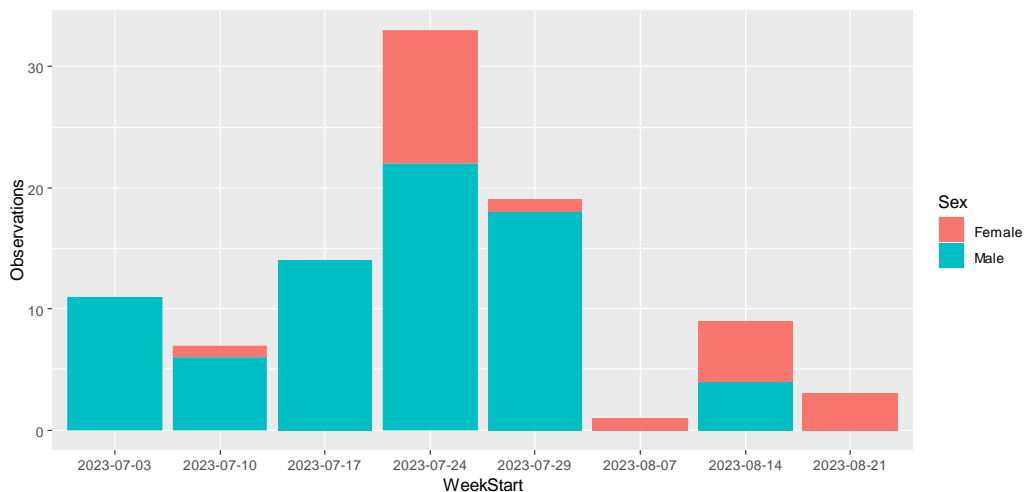
	2023	2024	Combined
<b>Cells surveyed</b>	81	65	121
<i>Structured cells</i>	61	61	95
<i>Opportunistic cells</i>	20	4	28
<b>Structured surveys</b>	190	98	292
<b>Cells with detections</b>	41	15	51
<b>Butterflies observed</b>	97	19	116
<i>Males</i>	75	10	85
<i>Females</i>	22	9	31

## Summer 2023

For the pilot study in 2023, we evaluated two butterfly survey methodologies, wandering transects and timed point counts, to determine which would better enable us to address the goals for the larger study. Full descriptions of both methodologies are available on request.

Surveyors conducted reconnaissance throughout the month of June, prior to the start of the official surveys. This reconnaissance included ensuring sites were accessible and navigable, determining which properties were most likely to support Diana fritillary, and testing survey methodologies. Diana fritillary were observed opportunistically during this period, but these sightings were not recorded using the same metrics as during the official surveys (conducted July 5 through August 22) and have thus been excluded from this report.

Most detections occurred while Diana fritillaries were flying or nectaring, primarily on milkweed (*Asclepias* spp.) and ironweed (*Vernonia* spp.). The first detection occurred July 5, 2023, the first day surveys occurred. Individuals continued to be detected through August 21, 2023, one day before the surveys ended. While number of detections varied, Diana fritillary were observed at all five properties surveyed consistently throughout July and August, with numbers peaking in late July (Figure 2). Males were active from early July to early August, peaking the week of July 31, while females appeared and persisted later in the season (Figure 2). Importantly, larval host plants for Diana fritillary were also observed in high densities at each of the five properties and often near detections of Diana fritillary, along roads, and within forested areas.



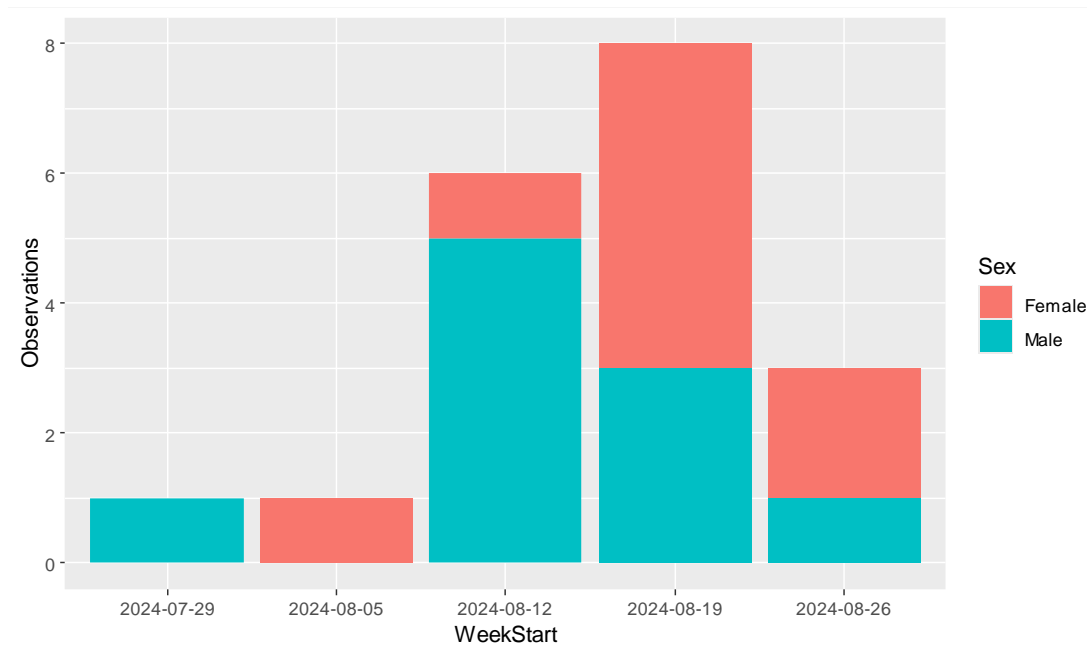
**Figure 2.** Male and female Diana fritillary detections throughout the sampling period in 2023. Observations were summed by sex and week to detect trends over the sampling period. The species was detected throughout July and August, with numbers peaking in late July and a secondary peak in mid-August.

## Summer 2024

We used results from 2023 to refine survey methods used in 2024. We focused on the wandering transect methodology and ensured habitat data were collected both at random points and at each location where Diana fritillary was observed. We also reduced number of habitat variables being collected, eliminating those that did not perform well in 2023 and adding variables more relevant to forestry (e.g., basal area, canopy closure). Based on the lack of observations in June of 2023 and a desire to focus on female butterflies, which appeared later in the 2023 season, we did not start surveys until July 31.

Most observations were of Diana fritillary flying or nectaring on thistle (*Cirsium* spp.), ironweed (*Veronia* spp.), and joe-pye weed (*Eutrochium* spp.). This is a shift from 2023, where the primary nectar plants were milkweeds. This shift is largely the result of our later sampling dates; milkweeds bloom earlier in the summer, providing most of the forage during June and early July. During late summer, milkweed becomes much less prevalent and Diana fritillaries shift to other nectar plants based on their availability.

Diana fritillary were again detected on all five properties throughout July and August. In contrast to 2023, we observed only a single spike in detections in mid-August, which corresponded to the secondary spike from 2023 (Figure 3). It is likely our surveys missed the earlier peak male emergence. Males and females were both active throughout the season, though male detections appeared to be declining across the 2024 survey period (Figure 3).



**Figure 3.** Male and female Diana fritillary detections throughout the sampling period in 2024. Observations were summed by sex and week to detect trends over the sampling period. The species was detected throughout the sampling period, with a single peak occurring in mid-August.

## Next Steps

The SA program will analyze data from both years to identify any trends or patterns in Diana fritillary detections and habitat associations. We will also develop recommendations and habitat management guidelines to inform future conservation work for Diana fritillary. These results will be summarized in a report later this winter. We anticipate providing a report early in 2025.

## Literature Cited

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