Uncompahgre Fritillary Butterfly
(*Boloria acrocnema*)
5-Year Status Review
August 2023

General Information:

Species Reviewed: Uncompahgre fritillary butterfly (*Boloria acrocnema*)

Federal Register Notice of Listing Determination: June 24, 1991. Endangered and Threatened Wildlife and Plants; Uncompahgre Fritillary Butterfly Determined to be Endangered (56 FR 28712).

Most Recent Status Review: September 28, 2018. Uncompahgre fritillary butterfly (*Boloria acrocnema*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Western Slope Office, Colorado Ecological Services, Grand Junction, Colorado.

Federal Register Notice Announcing this Status Review: August 5, 2022. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews of Five Listed Species in the Mountain-Prairie Region (87 FR 48037).

Lead Region: Region 6, Mountain-Prairie Region, Colorado Ecological Services Field Office-Western Team, Nathan Darnall, Western Colorado Supervisor, nathan_darnall@fws.gov, 970-628-7180.

Classification: Endangered

Current Recovery Priority Number: 12

Methodology used to complete this review:

In accordance with section 4(c)(2) of the Endangered Species Act of 1973 (16 U.S.C Section 1531 et seq.), as amended (Act), the purpose of a 5-year status review is to assess each threatened and endangered subspecies to determine whether its status has changed, and it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants. Status reviews are to be completed in accordance with Sections 4(a) and 4(b) of the Act (16 U.S.C. Section 1533(c)). We solicited data for this 5-year status review from interested parties through an August 5, 2022, *Federal Register* notice announcing this review (87 FR 48037). No new information was submitted by members of the public. For this 5-year status review, we relied on information provided in field reports based on monitoring conducted by the Uncompahgre fritillary butterfly (UFB) field crew over the last several years (Alexander and

Cohen 2019, 2020; Williams et al. 2021, 2022; Donahue and Alexander 2023) and other related documents. Additionally, some information from the 2023 field season was obtained at a couple colonies from the crew leader through verbal communication.

ASSESSMENT:

Information acquired since the last status review:

We reviewed field reports for the 2018 to 2022 field seasons for quantitative and qualitative population monitoring to assess the current population status of the butterfly (Alexander and Cohen 2019; Alexander and Cohen 2020; Williams et al. 2021; Williams et al. 2022; Donohue and Alexander 2023). Information from other documents and verbal communication is also included to support this review.

Three of the 11 known colonies of the UFB are quantitatively monitored throughout the adult flight season. In 1979 and 1982, the Uncompahgre Peak (UP) and Red Cloud Peak (RC) colonies were discovered, respectively. Those two colonies have been monitored consistently since 1990 (primarily presence/absence prior to 1990), though quantitative techniques changed in 2003. Colony C was discovered in 1988 and has been monitored consistently since 1994. All three colonies have been present since monitoring began, although one of the two sub-colonies at Colony C has not been present every year and a sub-colony or two at UP may not have been present in the early 1980s. The other eight colonies are qualitatively monitored for presence/absence information, typically only once per year. These eight colonies were discovered between 1995 and 2002. UFB has been present in most years; however, only 25 to 75 percent of the colonies may be present in some years. For example, in 2021, only two of the eight qualitatively monitored colonies were present but that increased to four out of eight colonies in 2022. Nonetheless, only a 25 to 50 percent presence of the qualitatively monitored sites in 2021 and 2022 is of concern.

Quantitative monitoring at UP's three sub-colonies reveals variation in abundance (recruitment) among the sub-colonies and among years during 2018–2022. For 2018 and 2019, abundance at UP was low compared to other years, but has been near average since 2020. Quantitative monitoring at RC's two sub-colonies revealed variation in abundance among the sub-colonies and among years as well. In contrast to UP, both sub-colonies at RC had higher abundance in 2019, creating its third highest peak abundance since 2003. Abundance dropped in 2020 for both UP and RC but increased again in 2021 and 2022 and were variable compared to each other. Colony C has contributed little to the overall abundance of UFB since 2014. In 2022, 11 butterflies were seen off the population monitoring transect at one of the two sub-colonies that make up Colony C. Comparatively good years for Colony C were 2006-2007 and 2011-2013 with the combined abundance at Colony C appearing to surpass abundance at UP and RC in 2012. Abundance in 2007 was the highest for all three colonies from 2003 to 2022. The combined abundance for all three colonies was variable during 2018–2022 with UFBs from the UP and RC colonies contributing the most to total recruitment since 2014 (Figure 1).

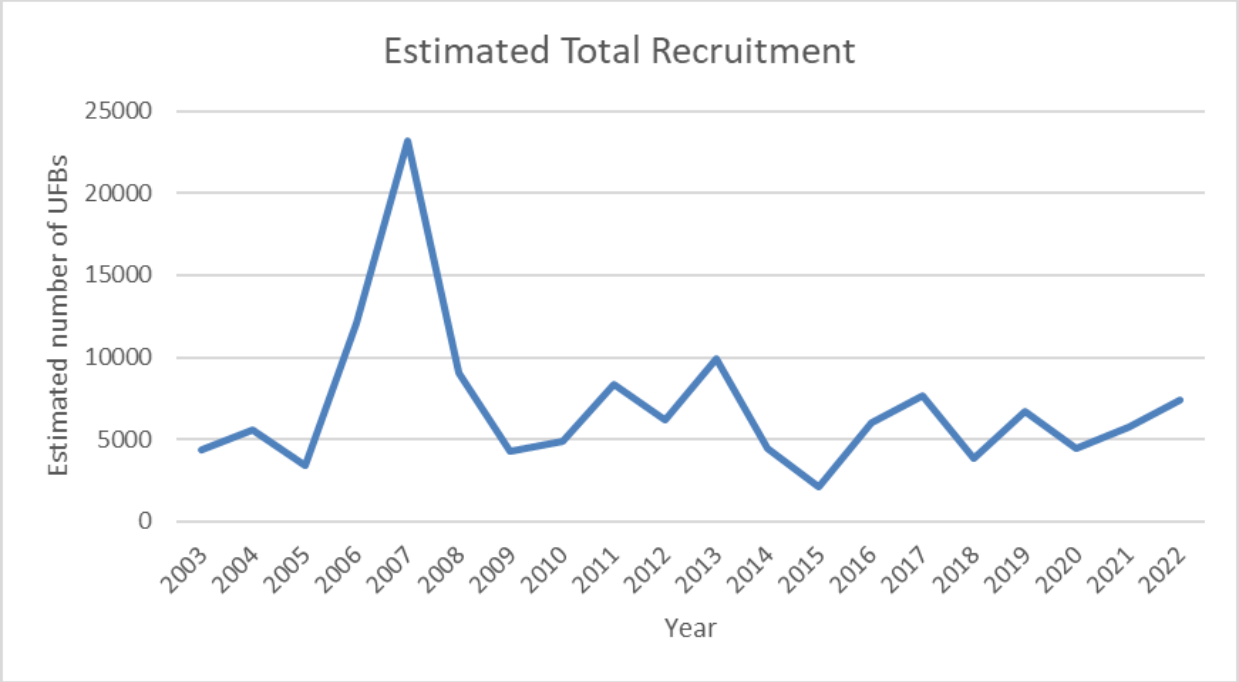

Figure 1. Estimated total UFB recruitment for UP, RC and Colony C (2003-2022).

Qualitative monitoring during the 2018 to 2021 field seasons revealed up to 10 out of the 11 colonies were present in any given year, but in 2022 only 7 colonies were present. Presence requires observation of one adult butterfly. One of the missing colonies was not seen in 2021 and 2022 and has only been seen four times irregularly since 2008. Furthermore, a landslide occurred through a substantial part of this colony in 2022, and the colony's persistence is tentative. At another colony, UFB have only been observed in odd years since 2017, suggesting extirpation of the even-year brood. A sub-colony at another one of the qualitatively monitored colonies has been absent for 10 years and is assuredly extirpated.

Recent research has revealed potential climate related UFB and habitat relationships. Climate related research in 2020 and 2021 found that increases in slope from 11 degrees to 31 degrees, coverage of five alpine plant species (*Salix nivalis*, *Geum rossii*, *Phacelia sericea*, *Noccaea fendleri*, and *Lewisia pygmaea*), and soil moisture content between 0.09–0.38 cubic meters (m^3) of water/m^3 of soil positively influence UFB abundance (Williams et al. 2021). However, increases in elevation, bare ground, and presence of *S. planifolia*, *Aster alpinus*, *Antennaria media*, and *Androsace chamaejasme* were correlated with lower abundance estimates. A declining snow-water equivalent at UP correlated with a declining trend of the UFB, though the same correlation did not appear at RC (Williams et al. 2021). UFB abundance increased as maximum temperature increased to 16.6˚C (62°F), which is close to the average maximum temperature at UP (Williams et al. 2021). This nearly matches the maximum temperature and temperature range for ideal flight conditions identified by Jocelyn Leroux in 2016, which were 8.8 to 16.9°C (47.8–66.4°F) (Leroux et al. undated poster). Empirical data recorded warmer temperatures at UP during the 2021 summer field season. A hypothesis related to temperature is that a warming climate could cause subalpine species to move upward displacing alpine species or could limit suitable habitat for the UFB at lower elevations that may serve as paths between colonies (Monroe et al. 2016). The topographical and climate data appear to indicate that the

UFB prefers certain slope aspects, and plant communities, and that those plant communities need adequate snowpack and water derived from snow in order to be maintained and support the colonies. Furthermore, temperatures that are too low or too high are unsuitable for adult flight conditions and higher temperatures may lead to unsuitable habitat.

Additional research in 2022 found that the UFB nectars on at least 15 species of alpine plants, selecting for shorter flowers, and solidifying past data and observations that the UFB appears to be a nectar generalist (Donohue and Alexander 2023). The research also revealed that the adult UFB will shift to different flowers throughout the season and select for flowers that have higher sugar content, suggesting some adaptability.

Threats:

The number of hikers to UP and RC, including hikers with dogs, has increased in the last several years (Williams et al. 2021). Most hikers stay on the trail, but some hikers and their dogs cross UFB habitat increasing potential for mortality or habitat impacts. No population impacts or user-created trails have been detected through the colonies, however. Domestic sheep trailing and especially bedding on UFB habitat could affect the butterfly by degrading its habitat. Sheep were observed on UP in past years since 1990 but appeared to have just trailed through there within a day or two. Nectar sources were eaten by past sheep grazing on UP, which could impact energy levels for UFB flying and mate seeking (Donohue and Alexander 2023). Immediate or lingering population impacts were not detected in subsequent and recent years, but it is hypothesized that annual sheep grazing at UP prior to 1980 could have influenced the small numbers or absence of the UFB there in the 1980s and could have influenced genetics at UP (Monroe et al. 2016). After a few years of no sheep grazing, a large, but currently unknown, number of sheep were also grazed on UP in 2023 (O. Wilmot, personal communication, July 25, 2023). They knocked over population monitoring transect stakes and flags, but the habitat and population abundance impact to the UP sub-colonies is currently unknown. A number of sheep were observed laying down on the colony, so it appears they were not being trailed through rapidly. The U.S. Forest Service and the U.S. Fish and Wildlife Service are in consultation regarding this year's sheep grazing on UP and will continue discussions on avoidance or minimization of impacts at UP (as well as other colonies). Subsequent years' habitat and population monitoring at UP following the 2023 grazing event will reveal if substantial impacts to the habitat and UFB occurred. The threat of illegal collection remains, but UFB field crew members have only detected people attempting to collect one year since its listing (those people appeared unaware of the collecting closure despite signage).

The UFB has some plasticity to climate variables as shown through timing shifts of adult emergence based on yearly snowpack level. The species also appears to have the ability to recolonize even or odd-year broods over several years, through developmental delays, if one of the broods becomes extirpated (Britten and Brussard 1992; Britten et al. 1994; Monroe et al. 2016). Climate change is the most widespread and looming threat to the UFB. Current observations show that human influence has very likely contributed to decreased Northern Hemisphere spring snow cover (Intergovernmental Panel on Climate Change (IPCC) 2023). With every additional increment of global warming, changes in extremes continue to become larger. There is high confidence that additional warming will lead to more frequent and intense

marine heatwaves and is projected to further amplify permafrost thawing and loss of seasonal snow cover, glaciers, land ice, and Arctic sea ice (IPCC 2023).

Snowpack has generally been below average in Colorado since 2000, but no long-term precipitation trends have been detected (Lukas et al. 2014). Winter precipitation is expected to generally increase in Colorado but more of it may come in the form of rain and the southern half of the state is predicted to get less precipitation, so both future snowpack and precipitation amount in the San Juan Mountains (the known range of the UFB) is uncertain. Within Colorado, short-term temperature predictions by Ray et al. (2008) were accurate, and the average temperature increase has met or even exceeded the global average in the last 30 years (Lukas 2014). Earlier snowmelt of 1 to 4 weeks has been observed due to this warming (Lukas et al. 2014). Regional or correlative studies have also shown that snow is melting earlier and will melt earlier with warmer temperatures and may affect the timing of flowering, availability of water and related abundance of nectar sources (see the 2018 5-Year Review for more information). The decrease in nectar sources could affect UFB productivity, as shown with a study on *S. mormonia* (Boggs and Inouye 2012) but results may not be directly related to the UFB due to different life patterns. There is the possibility of decline in the snow willow and nectar sources due to reduced snowpack and, therefore, the soil moisture that supports UFB habitat. As presented in the 2018 5-Year Review, research on water isotopes revealed that snowmelt supports the UFB habitat much more so than summer rains (Gianniny 2018). Research results suggest that effects of climate change that decrease coverage of alpine plant species, allows encroachment of lower elevation species, or reduces soil moisture could decrease UFB abundance and also suggests that the UFB has some extinction risk due to range limitations or prolonged drought (Williams et al. 2021). Consequently, if climate change reduces the snowpack and snow-water equivalent, or increased temperature results in higher evapotranspiration causing drying of alpine areas, habitat for the UFB is expected to decline.

A shift in habitat usage on Colony C to off-transect areas could be indicative of current climatological impacts. Erratic climatological conditions, such as abnormally timed thaws or freezes could affect the UFB phenology in relation to its habitat's phenology (Donohue and Alexander 2023). Furthermore, if the UFB is using lower alpine habitat between colonies as migration paths, these areas may be affected by a changing climate and may not serve as corridors or stepping-stones as suspected by Monroe et al. (2016). However, reasons for shifts in habitat at Colony C and effects of climate are not fully known. Additional research and use of climate models will have to be conducted to better evaluate and predict the influence of climate to the UFB. Data for genetic flow between colonies was only sufficient to be analyzed at UP, RC, and Colony C (Monroe et al. 2016). Consequently, genetic connectivity between all the colonies also needs further study.

Taxonomy:

Taxonomic uncertainty remains for UFB. The UFB was discovered and described as a full species by Gall and Sperling (1980) based on phenotypic appearance. Not all experts agreed with its species status or even the genus within which it should be placed. Consequently, since its original description, a number of proposed taxonomic changes have occurred. The latest taxonomic update in one source lists UFB as *Boloria improba acrocnema* (Pelham 2023).

However, we recommend that a genomic study be conducted evaluating the full genome of the UFB and other related species or subspecies in the *B. improba* complex.

Conclusion:

The overall abundance of UFB at UP and RC over the last two years was within the range of abundance values observed since 2003 (see Figure 1), suggesting a stable trend at those two colonies, although a quantitative trend analysis needs to be completed. However, Colony C has extremely low numbers and its persistence is tentative despite some butterflies seen in 2022 and 2023 at one sub-colony. Having four of the eight qualitatively monitored colonies absent in 2022 is concerning, especially the colony where the 2022 landslide occurred. The same colony's persistence is also tentative due to irregular occurrence since 2008. The UFB illustrates some plasticity through timing of emergence based on yearly snowpack level, ability to nectar on a variety of alpine plants, and ability to shift to nectar sources with higher sugar content as the flight season progresses. It also appears to have the ability to recolonize even or odd-year broods over several years through developmental delays if one of the broods becomes extirpated. However, the near extirpation of Colony C and tentative nature of other qualitatively monitored colonies is cause for concern. Climate change is the biggest threat since it can affect all 11 known colonies, especially as global temperatures continue to rise, and traditional weather patterns are altered. Reduction in snowpack level, shorter duration of snowpack, and reduced water availability from snowmelt have already been observed and these conditions are expected to continue. Expected warmer temperatures will increase evapotranspiration, further reducing water availability. These changes will likely result in reduction of nectar sources and thus reduction in abundance of the UFB despite observed plasticity of the UFB. Climate-induced habitat changes at Colony C are already possibly happening and could be affecting persistence of some of the other qualitatively monitored populations based on lack of presence the last couple years or irregular presence over several years. Without substantial measures to ameliorate impacts, climate is expected to continue changing into the future and may pose increasing threats to the UFB. Consequently, we recommend that the UFB retain its status as endangered.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR STATUS REVIEW FOR
UNCOMPAHGRE FRITILLARY BUTTERFLY
(*Boloria acrocnema*)

CURRENT CLASSIFICATION: Endangered

RECOMMENDATION RESULTING FROM THIS 5-YEAR STATUS REVIEW:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist:
___Extinction
___Recovery
___Original data for classification in error
_x_ No change is needed

APPROPRIATE LISTING/RECLASSIFICATION PRIORITY NUMBER, IF APPLICABLE: In our last 5-year status review, we recommended a change to the Recovery Priority Number from 14 to 12. We based this change on the observed and projected effects of climate change, which increased the level of threat to the species from low to moderate and reduced its recovery potential from high to low. We also recommended a taxonomic change from full species to subspecies based on a review of the taxonomy (Tuzov and Bozano 2006). However, until additional genomic analysis is completed to resolve the taxonomic uncertainty, we consider the butterfly a full species. Thus, we recommend a change to the Recovery Priority Number from 12 to 11, indicating a species with a moderate degree of threat and a low potential for recovery.

FIELD OFFICE APPROVAL:

Signature: NATHAN DARNALL Digitally signed by NATHAN DARNALL Date: 2023.08.14 13:48:25 -06'00'

Nathan Darnall, Western Colorado Supervisor
U.S. Fish and Wildlife Service
Mountain-Prairie Region 6, Ecological Services
Colorado Ecological Services Field Office-Western Team

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