

Saint Francis' Satyr
(Neonympha mitchellii francisci)
5-Year Review:
Summary and Evaluation



Photo by Dave Pavlik

U.S. Fish and Wildlife Service
Southeast Region
Raleigh Ecological Services Field Office
Raleigh, North Carolina

September 2025

5-YEAR REVIEW
Saint Francis' satyr (*Neonympha mitchellii francisci*)

GENERAL INFORMATION

Current Classification: Endangered

Lead Field Office: Raleigh Ecological Services Field Office

Review Author: Becky Bartel Harrison, Southeast Regional Office

Lead Regional Office: Southeast Region, Carrie Straight

Date of original listing: April 18, 1994 (Emergency listing rule; 59 FR 18324) and final listing rule January 26, 1995 (60 FR 5264)

Methodology used to complete the review:

In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a status review is to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants ([50 CFR 424.11](#)). The U.S. Fish and Wildlife Service (Service) evaluated the best available information about the biology, habitat, and threats of the Saint Francis' satyr butterfly to inform this status review. We announced initiation of this review in the Federal Register notice on June 6, 2024 ([89 FR 48437](#)) with a 60-day comment period and received no public comments. The primary sources included the final rule listing this species under the Endangered Species Act (Act) (60 FR 5263); the Recovery Plan (Service 1996); peer-reviewed reports, agency reports, unpublished survey data and reports, and personal communication with recognized experts. This review was finalized by the U.S. Fish and Wildlife Service, North Carolina Ecological Services Field Office, Raleigh, North Carolina. All literature and documents used for this review are on file at the Field Office. All recommendations resulting from this review are the result of thoroughly reviewing the best available information on the Saint Francis' satyr.

FR Notice citation announcing species is under active review: June 6, 2024 ([89 FR 48437](#)).

Species' Recovery Priority Number at start of review (48 FR 43098): 3. The St. Francis' satyr is a subspecies with a high degree of threat and high degree of recovery potential.

Review History:

Two previous 5-year reviews recommending no status change were signed in 2013 and 2020 (Service 2013 and 2020).

REVIEW ANALYSIS

Listed Entity

Taxonomy and nomenclature

The Saint Francis' satyr was first described in 1989 from collections in North Carolina (Parshall and Kral 1989). It is a recognized subspecies of the federally endangered Mitchell's satyr (*Neonympha mitchellii*) by the Integrated Taxonomic Information System (ITIS 2025). Genetic analysis has confirmed that the Saint Francis' satyr is in a separate lineage from all other populations of *Neonympha mitchellii* (Goldstein et al. 2004, Hamm et al. 2014b). We are not aware of any changes to the taxonomy of this entity, and it is still considered valid by the Service.

Distinct Population Segment (DPS) ([61 FR 4722](#))

The ESA defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing DPSs to only vertebrate species of fish and wildlife. Because the species under review is an invertebrate, the DPS policy is not applicable and is not addressed further in this review.

Recovery Criteria

Recovery Plan or Outline

Final Recovery Plan for the Saint Francis' satyr (*Neonympha mitchellii francisci*), April 23, 1996.

Recovery plans are not regulatory documents and intended to provide guidance to the Service, States, and other partners on methods of minimizing threats to listed species and on criteria that may be used to determine when recovery is achieved. If the recovery criteria defined in the plan are still valid, meeting recovery criteria can indicate that the species no longer requires protections under the Act. However, when recommending whether a listed species should be delisted, the Service must apply the factors in section 4(a) of the Act ([84 FR 45020](#)).

Saint Francis' satyr will be considered for reclassification from endangered to threatened status when the existing metapopulation has been stable or increasing in numbers for at least 10 to 15 years and when a long-term protection and management plan is in place to ensure its continued survival. Delisting will be considered when the existing metapopulation has been protected and stabilized and when at least three other populations have been found or established in the sandhills region and have been stable or increasing for 10 to 15 years. Protection and management plans must be implemented for all populations before reclassification can be considered.

Currently, no criteria have been fully met.

Biology and Habitat Summary

The Saint Francis' satyr butterfly is small, dark brown butterfly found only on Fort Bragg Military Installation in central North Carolina (Figure 1). It occupies open ephemeral wetlands

that are dependent on disturbance from flooding from beaver activities or frequent, low-intensity fires that control woody succession (Hall 2003, Kuefler et al. 2008, Bartel et al. 2010).

The satyr is bivoltine, with adults emerging in May through early June and again in July through early August. The onset of each of two flight periods can vary. The first flight period can be predicted by assessing patterns of growing degree days, which account for heat input into ecosystems. The peak activity of the second flight period is approximately 62 days after the peak of the first flight period. The last brood overwinters in a larval stage and then resumes feeding and development before pupating in the spring. Adult lifespan is 1-4 days (Cayton et al. 2019). Caterpillars are very difficult to detect in the field and have only been observed twice since regular monitoring efforts began in 2002. A third flight period was detected four years in a row from 2015-2018 within a restoration area and occurred 53-63 days after the second flight period, usually in early to late September (Cayton et al. 2019).

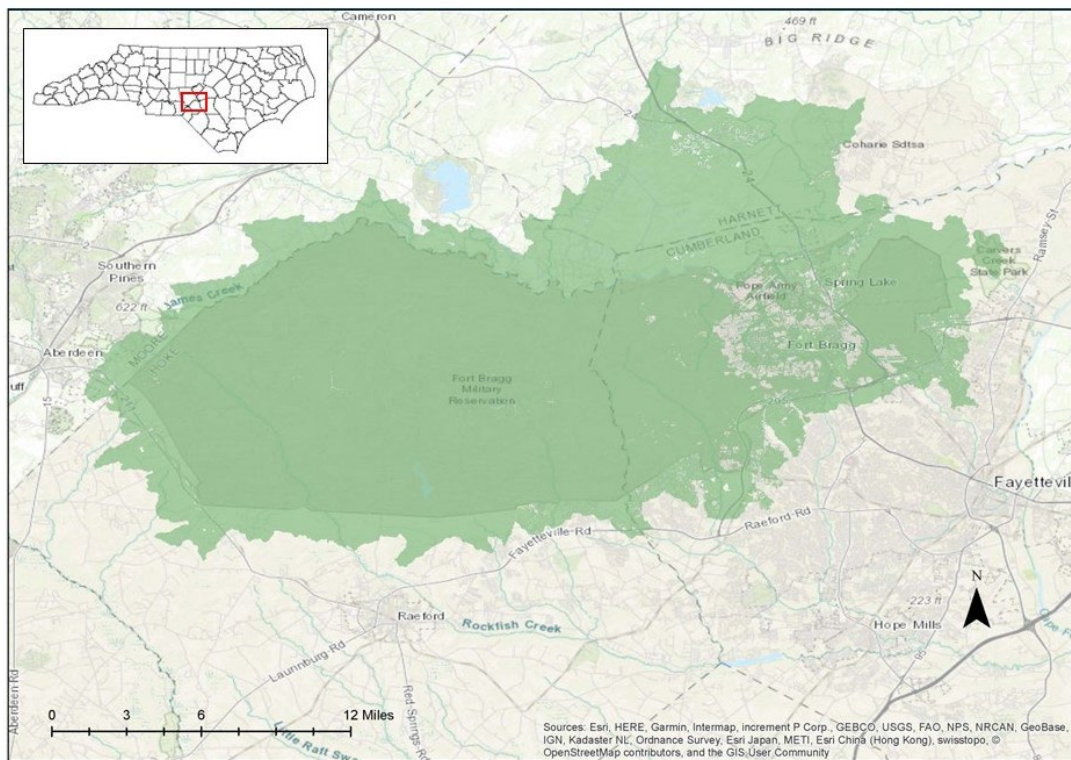


Figure 1. Current range of St. Francis' satyr butterfly in North Carolina.

Saint Francis' satyr habitats include herbaceous wetlands along stream corridors comprised of bottomland hardwood forests with adjacent longleaf pine forest uplands (Hall 2003, Kuefler et al. 2008). Host plants for the Saint Francis' satyr include sedges in the *Carex* genus including *C. mitchelliana*, *C. atlantica*, *C. turgescens*, and *C. lurida*; Cayton et al. 2022). Adults generally do not feed on nectar. There have only been two confirmed observations feeding on flowers of sweet pepperbush (*Clethra alnifolia*; Hall et al. 2001, Haddad et al. 2004).

Despite extensive searches of habitats in central North Carolina, no populations have been detected outside of Fort Bragg (Hall 2003, Haddad 2018). The species exists as a metapopulation

of several small subpopulations patchily distributed across wetland sites (Bartel et al. 2010, Cayton et al. 2015). Historically, the metapopulation at Fort Bragg has consisted of numerous subpopulations inside the duded impact areas (e.g., training areas with munitions that failed to detonate as intended) and formerly occupied [inactive] sites and active and/or restored sites outside of munitions areas. Most active sites are found in the duded impact areas that are restricted in access due to ongoing training activities or hazards related to live fire or unexploded ordnance. For those impact areas that limited access is still permitted, the timing and frequency of access depends on military training schedules, the nature of weapon(s) used, and associated risk assessments. Due to these safety concerns and access issues, monitoring of Saint Francis' satyr subpopulations in the impact areas is very limited and systematic sampling has not been feasible.

Regular monitoring of a subset of sites within the impact areas has been conducted annually since 2014 and provided some insights into population trends, with peak levels observed in 2018 (Cayton et al. 2019; Figure 2). Since 2020, there has been evidence of population declines in the impact areas with no individuals being observed in 2023 and only 2 individuals observed in 2024 surveys. In 2025, no individuals were observed during surveys of selected sites in impact areas (Ball pers. comm. 2025).

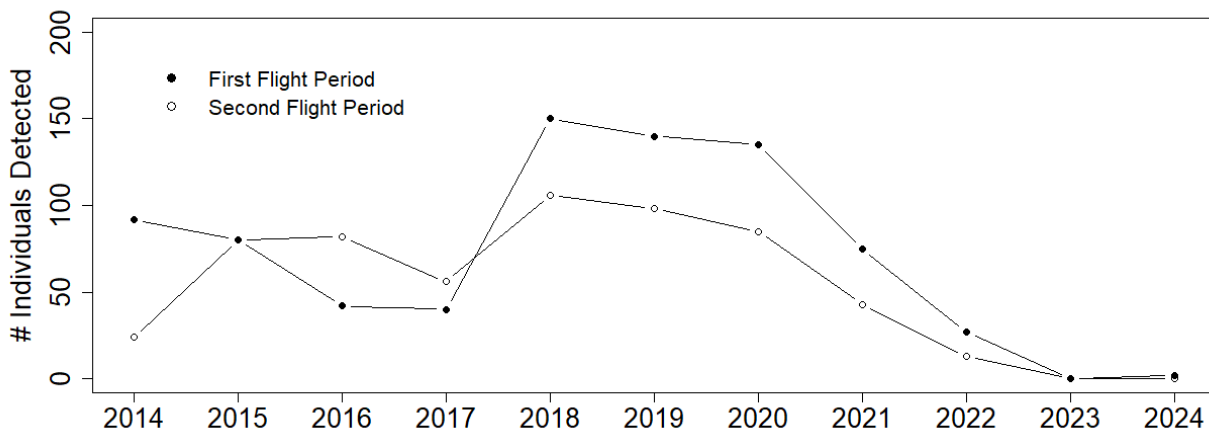


Figure 2. Saint Francis' satyr detections inside of artillery impact areas 2014-2024 (adapted from Cayton et al. 2024).

The number and size of Saint Francis' satyr subpopulations within live-fire impact areas are still largely unknown and efforts have focused on evaluating population trends outside the impact areas. Since 2002, several large colonies were monitored using both transect counts (a modified Pollard-Yates method; Pollard 1977) and mark-release-recapture techniques (Kuefler et al. 2008) outside the impact areas annually during each flight period to estimate population size (Haddad et al. 2008). Evaluation of 20+ years of data showed that populations peaked in 2004 (Cayton et al. 2019; Table 1, Figure 3). From 2006 to 2009, the overall population stabilized near 500 individuals for several years, although subpopulation levels fluctuated annually (Figure 3). Rapid declines occurred in 2009 and 2010 and by 2011, several subpopulations declined or went extinct and the overall population size was fewer than 100 individuals (Cayton et al. 2013, Haddad

2015; Table 1). This decline is most likely due to several factors that have continued to impact populations in the past several years, most notably dry environmental conditions and vegetative succession (Cayton et al. 2015, 2019).

Table 1. Total observations of Saint Francis’ satyr individuals outside of artillery impact areas in both flight periods for historic and restored habitats from 2002-2024.

Year	Historic sites 1st flight period	Historic sites 2nd flight period	Restoration sites 1st flight period	Restoration sites 2nd flight period
2002	NA	472	NA	NA
2003	573	621	NA	NA
2004	473	939	NA	NA
2005	463	638	NA	NA
2006	251	341	NA	NA
2007	260	714	NA	NA
2008	248	256	NA	NA
2009	155	246	NA	NA
2010	112	82	NA	NA
2011	18	29	NA	NA
2012	34	20	14	21
2013	8	31	32	47
2014	0	0	21	62
2015	0	0	139	362
2016	0	0	197	18
2017	0	0	215	235
2018	0	0	176	330
2019	0	0	255	291
2020	0	0	142	202
2021	0	0	27	56
2022	0	0	35	49
2023	0	0	0	0
2024	0	0	0	0

In 2011, partners began a large-scale restoration project to create high quality habitat near remaining or historic Saint Francis’ satyr populations (Cayton et al. 2015, 2023). Activities included hardwood removal and the installation of artificial dams to mimic beavers and the natural creation of wetlands where Saint Francis’ satyrs are found. Annual vegetation surveys tracked host plant response over time (Cayton et al. 2023) and captive-reared adults were

released into restored areas (Pavlik et al. 2022; Figure 3). These efforts occurred within two main restoration sites located along two historically occupied stream drainages with 1-5 active sites over the years. Continued maintenance of sites and increased successful captive rearing efforts led to population growth in the restored sites 2013-2016 (Figure 3). In 2020, populations began to decline, with no butterflies being detected outside of restored areas (Cayton et al. 2021). Another significant population decline occurred in 2021 likely due to deteriorating habitat quality in some restored plots, along with fewer captive-reared individuals being released at each site (Cayton et al. 2022). This trend continued with no St. Francis' satyrs detected in restored sites or outside artillery impact areas since 2022 (Cayton et al. 2024).

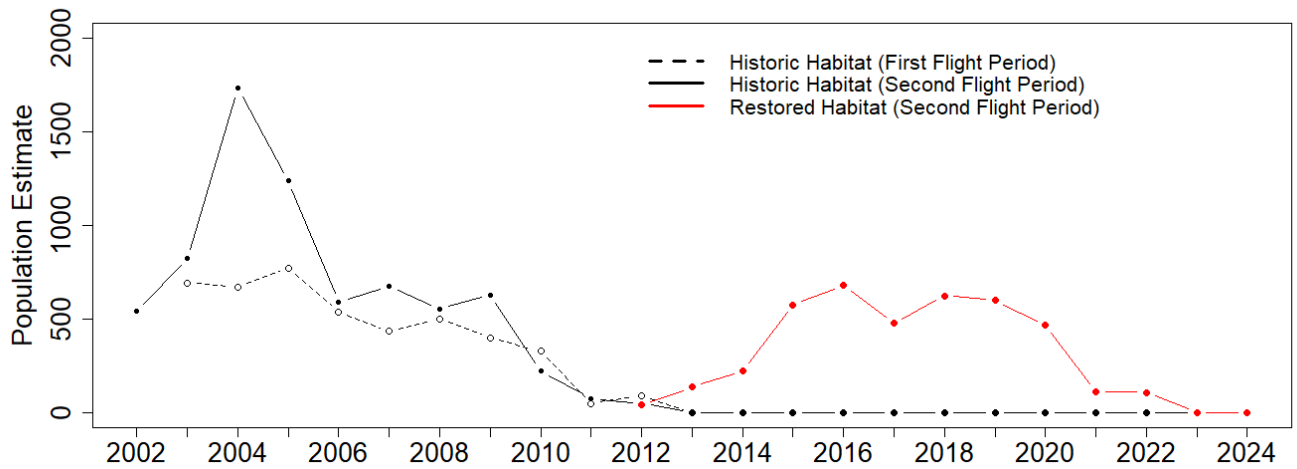


Figure 3. Total estimated population size of St. Francis' satyr occurring outside of restricted access impact areas for the first and second flight periods 2002-2024 in historic and restored habitats (from Cayton et al. 2024).

The combination of observed habitat degradation and population declines within the impacts areas and fewer restored sites being occupied has resulted in the inability to propagate individuals in the captive breeding program in recent years. While some habitat restoration efforts have occurred in the restored habitats outside the training areas, no populations have been observed since 2022, and no restoration sites are currently maintained. Regular surveys in some of the accessible sites within the impact areas continue, but it is unclear whether populations can recover over time.

Threats (Five-Factor Analysis) Summary

The status of a species is determined from an assessment of factors specified in section 4 (a)(1) of the Act. A summary of this assessment is detailed below.

Factor A. Present or threatened destruction, modification or curtailment of its habitat or range: The primary threat to the Saint Francis' satyr is habitat loss due to both natural and human-caused changes. Habitat modification has occurred due to beaver eradication and suppression of periodic fires, both of which can be restored to the landscape around known satyr populations. Suitable habitat is also highly susceptible to variation in rainfall and subpopulations

can be reduced with too much or too little stream flow. Although it is impossible to completely manage natural fluctuations in environmental conditions, the highly fragmented nature of the population means that uncontrollable factors can cause extinctions of small populations (Cayton et al. 2023).

Fire suppression, the regional extirpation of many beavers, and increased land development have reduced the availability of early-successional habitats with connected stream corridors that would support satyr populations (Cayton and Haddad 2018). Understanding the relative importance of beaver activity and periodic fires on the Saint Francis' satyr populations has been challenging, especially given the different observed site conditions of habitats within and outside of the impact areas. Military activities on the artillery ranges help maintain the open wetland habitats in the absence of beaver with frequent, low-intensity fires. The largest known subpopulations of satyr have occurred in the live-fire ranges where the lack of roads, frequent small fires, and beavers have allowed the creation and persistence of high-quality habitat (Cayton et al. 2015). The ideal level of disturbance needed for satyr habitat maintenance and restoration is unknown as disturbance can both create habitat (e.g., allow early-successional host plants to establish) and destroy habitat (e.g., flood out or burn existing habitat). Restoration involves several stages, including the ability to predict accurately high-quality habitat, to rear butterflies to adulthood in large quantities, to create new habitat via hardwood removal to facilitate host plant establishment, or temporary inundation to create wetlands, and to introduce Saint Francis' satyr into augmentation or experimental populations (Cayton et al. 2015, 2023).

The presence of roads may interact with beavers to affect habitat quality. Outside duded impact areas on Fort Bragg, a series of firebreaks intersect streams at regular intervals (approximately every 400m). These sandy roads can fragment existing satyr habitats, disturb host plant populations through increased siltation into streams, and cause sedimentation in additional habitats downstream (Hall 2005). Beavers often dam streams where culverts cross under roads, flooding out adjacent habitat and further disrupting existing occupied satyr sites. Inside impact areas, there are few roads, and beaver dams occur in complexes, with a mixture of inundated, abandoned, and successional sites near long stream networks.

Factor B. Overutilization for commercial, recreational, scientific, or educational purposes: Since the emergency listing of the species in 1994 and simultaneous federal prosecution of illegal butterfly collectors (Williams 1996), there has been no evidence of collection of Saint Francis' satyr other than minimal permitted collection for scientific purposes. However, poaching remains a significant threat to the satyr based on its extreme rarity and has required that all locations and/or maps of all colony sites be kept strictly confidential among researchers. If these sites were made publicly known, individuals could be threatened by collection again.

Factor C. Disease or predation: There has been no research into disease or predation in Saint Francis' satyr. The bacterial parasite *Wolbachia* has been detected in Mitchell's satyr (*Neonympha mitchelli mitchelli*), and limited data are available about infection rates in Saint Francis' satyr (Hamm et al. 2014a, Fenner et al. 2017). Field observations suggest the primary source of predation for adult satyrs is the eastern pondhawk dragonfly (*Erythemis simplicicollis*), with additional predators including the black-and-yellow Argiope spider (*Argiope arantia*) and fishing spider (*Dolomedes* sp.; Cayton et al. 2014). Indirect evidence of bird predation has also

been observed through beak mark on Saint Francis' satyr wings (Hall et al. 2001, Haddad et al. 2005). There is no clear evidence that predation is a threat to adult population sizes (Cayton et al. 2014).

Factor D. Inadequacy of existing regulatory mechanisms: The Saint Francis' satyr is federally protected by the Act but has no additional state protections in North Carolina. Permits are required for all research conducted on the species and are currently held by researchers at Michigan State University.

Since the entire species range is restricted to military lands, current regulatory mechanisms provide adequate protection to prevent some level of human-induced habitat destruction. However, the inability to access and evaluate subpopulations within impact areas limits the ability to accurately assess subpopulation sizes.

The Fort Bragg Endangered Species Branch has provided significant support in maintaining communication between military personnel and researchers and in obtaining access to restricted areas on base that are critical for researchers, conducting and assisting with surveys, implementing restoration activities, and facilitating captive-rearing efforts. In coordination with the Service, Fort Bragg has developed a Saint Francis' satyr research and monitoring program with specific goals and objectives in their Integrated Natural Resource Management Program (INRMP; U.S. Army 2018) to facilitate recovery efforts of the species.

Although the species is only found on federal lands, monitoring data indicate a decline in those populations for which access is permitted. This would indicate threats are not being mitigated by regulatory mechanisms.

Factor E. Other natural or manmade factors affecting its continued existence: Research has also determined that Saint Francis' satyr populations can be significantly impacted by long-term declines in water availability and low stream levels resulting in declining host plant growth rates and availability (Cayton and Haddad 2018). Those trends were compounded by small-scale factors such as woody encroachment and beaver eradication that alter hydrology within occupied sites, but can also be influenced by large-scale, long-term changes such as climate and human activities (Cayton and Haddad 2018). Although North Carolina appears to have no historical trend in precipitation, future projections indicate that the state will experience more intense droughts when they occur and may experience increases in precipitation overall (Frankson et al. 2022). These changes could result in changes in water availability and stream levels. In addition, extreme precipitation associated with tropical storms and hurricanes may cause periodic flooding and scouring and associated tornados (Frankson et al. 2022). Although the impacts of these changes directly on the satyr is unknown, these changes may result in damage to host plants and may cause periodic impacts to the species.

Synthesis

The Saint Francis' satyr butterfly is small, dark brown butterfly that has only been detected on Fort Bragg Military Installation in central North Carolina despite extensive searches in appropriate habitat off base. The butterfly occupies open ephemeral wetlands dependent on disturbance from flooding from beaver activities and/or periodic fires that control woody succession. Populations have historically occupied suitable habitat both within restricted access

impact areas and training areas and along stream networks outside impact areas. Currently, there are no known populations outside impact areas. Since 2020, there has been evidence of population declines in the impact areas, only a few individuals have been observed in the portions of the impact areas that were available for limited surveys. Other subpopulations may exist in suitable habitats on impact areas, but cannot be assessed due to combined limited access, ongoing training activities, and safety risks. The primary threats to the Saint Francis' satyr are habitat loss and degradation, along with potential for illegal collections. Small population size, limited dispersal ability, limited disturbance regimes, and highly restricted distribution range continue to make the Saint Francis' satyr highly vulnerable and require continued management intervention to persist in the wild. Due to continuing threats and population declines, the Saint Francis' satyr continues to meet the definition of an endangered species under the Act.

RECOMMENDATIONS FOR FUTURE ACTIONS

- Continue collaboration with Fort Bragg to inform the Integrated Natural Resource Management Program with updated monitoring and management goals for Saint Francis' satyr populations. These updates should include specific policies that coordinate Saint Francis' satyr, beaver, and fire management. Management actions should include extending prescribed burning efforts through riparian areas outside impact areas, closing firebreaks at stream crossings near detected or restored Saint Francis' satyr populations to reduce habitat fragmentation and sedimentation downstream, continued housing and support of captive breeding efforts, coordination of permitted access for monitoring existing Saint Francis' satyr populations and searching for additional habitats and subpopulations within the impact areas, and cross-program coordination of beaver removal or management activities. Beaver removal actions should be well documented and coordinated with key partners including the Endangered Species Branch, the Wildlife Branch and Range Control through Fort Bragg's Training Lands Working Group, as the timing of removal efforts are critically important to the intensity of disturbance that may be caused in satyr habitats.
- Systematic annual monitoring of suitable habitats and potential populations within impact areas. Because no populations have been detected outside the impact areas since 2022, surveys of habitats within impact areas are critical for understanding population trends and locating individuals for captive propagation and supplemental releases in restored habitats outside of training areas. Consistent access would occur weekly during both flight periods (May/June and July/August) to evaluate habitat conditions and create accurate population indices.
- Implementation of Saint Francis' satyr Captive Propagation and Reintroduction Plan and maintenance of greenhouse facilities on the installation. Using captive-reared individuals as available to create new colony sites in suitable habitats outside of impact areas. Active, repeated restoration activities will be necessary to re-establish and maintain any Saint Francis' satyr habitats and subpopulations outside the impact areas (see Cayton et al. 2023, 2024). Restoration actions would include vegetation management, application of frequent low intensity fires to replicate natural disturbance regimes. Reducing road frequency in any restored areas would also reduce habitat fragmentation and sedimentation and assist in complying with base management

policies. Long-term monitoring and management will be needed at any re-established restoration sites to maintain high-quality habitat and document population trends.

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RESULTS / SIGNATURES

U.S. Fish and Wildlife Service Status Review of Saint Francis satyr butterfly

Status Recommendation:

On the basis of this review, we recommend the following status for this species ([50 CFR § 424.11](#)). A 5-year review presents a recommendation of the species status. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the Act.

- Downlist to Threatened.
- Uplist to Endangered.
- Delist:
 - The species is extinct.*
 - The species is recovered.*
 - New information indicates the species does not meet the definition of an endangered or threatened species.*
 - The listed entity does not meet the statutory definition of a species.*
- No change needed.

FIELD OFFICE APPROVAL:

Acting Field Supervisor, Eastern North Carolina Ecological Services Field Office, U.S. Fish and Wildlife Service

Approve _____

* Since 2014, Southeast Region Field Supervisors have been delegated authority to approve 5-year reviews that do not recommend a status change.