

**ARIZONA GAME AND FISH DEPARTMENT**  
**HERITAGE DATA MANAGEMENT SYSTEM**

**Invertebrate Abstract**

**Element Code:** IILEPJ6051

**Data Sensitivity:** No

**CLASSIFICATION, NOMENCLATURE, DESCRIPTION, RANGE**

**NAME:** *Speyeria nokomis nokomis*  
**COMMON NAME:** Great Basin Silverspot Butterfly, Nokomis Fritillary, Seep Fritillary, Western Seep Fritillary Nokomis, Blue-black Silverspot Butterfly  
**SYNONYMS:** *Speyeria nokomis nigrocaerulea*; *Argynnis nokomis*  
**FAMILY:** Nymphalidae

**AUTHOR, PLACE OF PUBLICATION:** For *Argynnis nokomis* it is Edwards, 1862 and for *Speyeria nokomis nokomis* it is Dos Passos and Grey, 1947.

**TYPE LOCALITY:** Some taxonomists say it is Mount Sneffels, Ouray County, Colorado and others say it is in the vicinity of Hatch Wash, San Juan County, Utah.

**TYPE SPECIMEN:** For *Speyeria nokomis nokomis* it is AMNH (#36915).

**TAXONOMIC UNIQUENESS:** NatureServe (2006, cited in Selby 2007) states that subspecies of the Nokomis fritillary are “unusually clearcut for a *Speyeria*,” but differences in opinion over the definitions of those subspecies still exist and make it difficult to assign populations to a particular taxon. Depending on the taxonomic view adopted, a subspecies can be considered narrowly endemic or widely distributed, and this has important implications for its conservation (including justifications for listing under the ESA). The following review of the taxonomic history for the species provides a context for evaluating the distribution and conservation status of the subspecies (adapted from NatureServe 2006 in Selby 2007).

dos Passos and Grey (1947) recognized six subspecies (*S. nokomis apacheana*, *S. n. coerulescens*, *S. n. nigrocaerulea*, *S. n. nitocris*, *S. n. nokomis*, and *S. n. wenona*). dos Passos (1964) reduced the number of subspecies by placing *S. n. nigrocaerulea* and *S. n. nitocris* under synonymy with *S. n. nokomis*, but he did not give reasons for the changes. Ferris and Fisher (1971) later challenged that arrangement and proposed that *S. n. nokomis* and *S. n. nitocris* be retained as a formal subspecies, and that *S. n. nigrocaerulea* should be considered a far eastern form and synonym of *S. n. nitocris*. They based those recommended revisions on differences in “facies, habitat, and geographic location.” Miller and Brown (1981) proposed a similar revision, but they placed *S. n. nigrocaerulea* under synonymy with *S. n. nokomis* rather than *S. n. nitocris*. More recently, Austin (1998) proposed recognizing a distinct phenotype of *S. n. apacheana* in western Nevada as a separate subspecies (*S. n. carsonensis*).

Based on the most restrictive definition of *S. n. nokomis*, in which *S. n. nigrocaerulea* is considered a synonym of *S. n. nitocris* (Ferris and Fisher 1971), the subspecies is narrowly endemic and restricted to a few locations in western Colorado and eastern Utah. If *S. n. nigrocaerulea* is considered a synonym of *S. n. nokomis* (Miller and Brown 1981), then the range also includes portions of northern Arizona and New Mexico.

For the subspecies, this abstract, (as well as Selby 2007 and WildEarth Guardians 2013) follows more recent and generally accepted taxonomic treatments of Miller and Brown (1981), as modified by Austin (1998, cited in Selby 2007).

**DESCRIPTION:** Adult Nokomis fritillaries are among the largest species in the genus *Speyeria*, with a wingspan from 6.3 to 7.9 cm (2.5 to 3.1 inches). Males have a dorsal wing surface that is predominantly orange-brown with black markings, and lightly to greatly darkened wing bases. Near the wing margins, black markings include a distinct marginal line and a row of submarginal chevrons. Females have a dorsal wing surface with more extensive darkening of the wing bases, and the outer portion is predominantly white-cream or bluish-white, rather than orange-brown. The ventral wing surfaces are similar in both sexes. Forewings are mostly orange-brown. The hindwing disc (area between the veins at the wing base) has a ground color ranging from light-to-dark cinnamon brown, deep olive, or blackish, depending on the subspecies. It is adorned by large black-bordered silver spots that are the basis for the “silverspot” common name. The ventral hindwing is also characterized by a fairly wide submarginal band that is tan in males and yellow-green in females (Selby 2007). Descriptions and photographs of the egg, larvae and pupae are available in Selby 2007).

**AIDS TO IDENTIFICATION:** The color of the ventral hindwing disc is useful for differentiating the subspecies, and the typical color per subspecies is summarized in the Table below. Great Basin silverspot butterflies (*S. n. nikomis*) are characterized by a light brown disk color in males and a deep olive color in females. Apache fritillaries (*S. n. apacheanna*) are found to the west, with a hybrid blend zone with Great Basin silverspot butterflies in Utah. Their disk color is more yellowish buff in males and light olive-green in females. Nitochris fritillaries (*S. n. nitocris*) occur immediately to the south of the Great Basin silverspot butterfly’s range in central to southern Arizona and New Mexico. Their disk color is deep reddish brown in males and black in females.

Subspecies	Male	Female
<i>S. n. apacheanna</i>	yellowish buff	light olive-green
<i>S. n. carsonensis</i>	buff; slightly greenish aspect	buff; olive-yellow aspect
<i>S. n. coerulescens</i>	red-brown	brown to green
<i>S. n. nitocris</i>	deep reddish brown	black
<i>S. n. nokomis</i>	light brown	deep olive

[Adopted from Tilden and Smith 1986, Austin 1998 in Selby 2007]

**ILLUSTRATIONS:**

Photos, male, female, larva and pupa: Selby 2007

[www.fs.fed.us/r2/projects/scp/assessments/greatbasinsilverspotbutterfly.pdf](http://www.fs.fed.us/r2/projects/scp/assessments/greatbasinsilverspotbutterfly.pdf).

Photos: Scott, J.A. and M.S. Fisher 2014.

[https://mountainscholar.org/bitstream/handle/10217/86007/Papilio\\_New\\_Series\\_21\\_Jan2015\\_rev.pdf?sequence=1&isAllowed=y](https://mountainscholar.org/bitstream/handle/10217/86007/Papilio_New_Series_21_Jan2015_rev.pdf?sequence=1&isAllowed=y).

**TOTAL RANGE:** The historic range of the Nokomis fritillary species includes basin and range country from the Sierra Nevada in eastern California through Nevada and Utah to the Rocky Mountains in western Colorado, and south through eastern Arizona and New Mexico to northern Mexico. Determining the historic range for the individual subspecies is problematic due to differences in opinion over their classification, clinal variation within portions of the range, and the tendency for publications to present distribution data at the species level rather than the subspecies level (Selby 2007).

For the subspecies *S. nokomis nokomis* (Great Basin silverspot butterfly), they have been collected in Duchesne and Uintah counties in northeastern Utah, Grand County in east-central Utah, and San Juan County in southeastern Utah, although Ferris and Fisher (1971) suggest that the distribution of the Great Basin silverspot butterfly in Utah might be restricted to San Juan and Uintah counties, and that populations farther west represent a hybrid blend zone with the Apache fritillary. According to Selby (2007), there are eight occurrences in southwestern Colorado, and historic records from San Juan, Mora, San Miguel and Taos Counties, New Mexico. In the Arizona Chuska Mountains, on Navajo Nation lands in Apache County, and in adjacent New Mexico Defiance Plateau, there were two known populations in 1994. Since then, an additional 10-11 breeding populations have been found (Selby 2007).

**RANGE WITHIN ARIZONA:** There are three documented occurrences in Arizona, and all are historical. There is one along Tsaille Creek in the Chuska Mountains in northern Apache County, and another along the Mogollon Rim east of McNary in southern Navajo County. The third record is also along the Mogollon Rim northeast of Pine in Coconino County

**SPECIES BIOLOGY AND POPULATION TRENDS**

**BIOLOGY:** Selby (2007) provides a generalized time frame of the seasonal phenology for the Great Basin silverspot butterfly (adapted from Scott and Mattoon's 1981 laboratory study). The male adult flight period initiates towards the end of July and concludes in early September. This overlaps with the female flight starting around mid-August until almost the end of September. Egg incubation is an estimated 17-18 days between mid-September and mid-October. The 1<sup>st</sup> instar larvae stage (including the winter diapause) is from October through the beginning of May and the

2<sup>nd</sup>-6<sup>th</sup> instar post-diapause phase lasts about 72-86 days from May through July. The pupal stage lasts about 17 days, followed by the emergence of the adults. The actual development times for immature stages and the flight period for the adults vary somewhat across their range, and they can vary significantly from year-to-year depending on weather patterns. Females have a longer larval development period and emerge about one to two weeks after the males. Delaying female emergence until males are more abundant may help minimize the time required for females to find a mate and maximize the number of mating opportunities for males. Great Basin silverspot butterflies are univoltine (having a single generation per year).

Larvae of members of the genus *Speyeria* are generally thought to be nocturnal, feeding at night and resting during the day in a hidden location that is usually away from the hostplant. However, observations on another fritillary species in Kansas found this species was actually diurnal. Foraging behavior data need to be collected for the Great Basin silverspot butterfly to determine whether it exhibits the typical nocturnal feeding behavior or not (Selby 2007).

Great Basin silverspot butterfly movements fall into two categories defined by two different ecological boundaries. Males search for females within the meadows or seeps that define the colonies (the colony boundary), and it is assumed, but not proven, that individuals of both sexes travel more extensively along riparian corridors (the habitat continuity boundary) in search of nectar. The localized patrolling of the males maximizes the probability of finding females, and the more extensive movement along riparian corridors in search of nectar increases the probability for exchange of individuals among colonies (Ellis 1989).

Great Basin silverspot butterflies do not migrate, but they are strong fliers and can move between isolated colonies within a continuous riparian zone (Arnold 1989, Fleishman et al. 2002, cited in Selby 2007). However, it is unlikely that they will disperse long distances between highly isolated riparian systems. For these populations to persist, the entire life cycle must be completed successfully each year at each colony or system of colonies within a given riparian system. In Unaweep Canyon in Mesa County, Colorado, there are five confirmed small (5 to 20 acres) colonies along a 5-mile stretch of West Creek (Ellis 1989). In a mark-recapture study by Arnold (1989, cited in Selby 2007), 50 percent of the recaptured butterflies had moved between two colonies separated by about 0.75 miles. Based on those data, the butterfly's strong flying ability, and the continuity of the riparian zone between colonies, Ellis (1989) speculated that there should be a routine (e.g., every 1 to 5 years) exchange of individuals among the colonies at that site. This exchange of individuals mitigates short-term extinctions of individual colonies and helps to ensure the long-term survival of the overall population. Conservation strategies, therefore, should focus on protecting as many colonies as possible within a given riparian system, and on maintaining the quality and continuity of the riparian habitat between colonies. Adults might be capable of dispersing greater distances (e.g., between riparian corridors), but there is no evidence to date that confirms this long-distance dispersal hypothesis. If an entire system of colonies within a given riparian system is extirpated, there is a low probability that they will be repopulated.

It is well known that habitat fragmentation can lead to smaller and increasingly isolated populations, and the resulting genetic isolation can reduce population fitness because of genetic drift and decreased heterozygosity. Britten et al. (1994) conducted a study examining population structure and genetic variability within 13 populations of the Apache fritillary subspecies in eastern California and Nevada, and found that mean heterozygosity estimates for those populations were consistently lower than they were for other nymphalids. This result is not unexpected given that colonies of this Nokomis fritillary subspecies tend to be small, local, restricted to a relatively narrow elevational range, and susceptible to occasional severe population declines. Williams (personal communication 2006 to Selby 2007) collected preliminary genetic data for Great Basin silverspot butterfly and Apache fritillary populations in Colorado, Utah, and Nevada, and his preliminary assessment from the data was (1) there was very little genetic variation in these populations; (2) they either shared a recent common ancestry (likely) or a lot of gene flow (unlikely); and (3) they have suffered from many population bottlenecks.

It is not unusual for many *Speyeria* species to occur together. Although there is no documentation for Great Basin silverspot butterflies hybridizing with other species, it is quite likely that hybridization between subspecies occurs where they come together. This is evidenced by the apparent hybrid blend zone for the Great Basin silverspot butterfly and the Apache fritillary in Utah (Selby 2007).

Great Basin silverspot butterflies require streamside meadows and seepage areas with an abundance of their larval food plant (bog violet), and the availability of a constant supply of nectar sources (mostly composites) during the adult flight. These habitat types tend to be small and isolated, resulting in small populations with limited reproductive potential, making it more likely that a catastrophic event will affect the entire population. Consequently, it is important to protect multiple colonies within an area in order to buffer the entire population from likely extinctions of individual colonies.

**REPRODUCTION:** Nokomis fritillary males spend most of the day patrolling the meadows or seeps in search of females. A study of the mating behavior of Nitochris fritillary found that males became active early in the morning as the dew was drying (about 8:30 a.m.), and after feeding briefly, they spent the rest of the morning patrolling close to the ground without feeding. Females emerged either from the tree cover on adjacent slopes or from low shrubbery (mainly willows) adjacent to the streams about 1.5 to 2.0 hours later. They landed in the grass, where they were discovered by the males. All courtship and mating behavior was observed between 11:00 a.m. and 1:00 p.m. Although such detailed behavioral observations for the Great Basin silverspot butterfly are not available, it is assumed that their behavior is similar.

Reproductive diapause is a characteristic life history trait for members of the genus *Speyeria*, but the factors leading to the onset of reproductive diapause are poorly understood. This strategy may be an adaptation to the seasonal phenology of the larval food plants. Most violet species are senesced during the *Speyeria* adult flight period, and the fresh young leaves required by first instar larvae are not available until the following spring (Wagner et al. 1997, Kopper et al. 2001b, cited

in Selby 2007)). Delaying oviposition until early fall reduces the exposure of first instar larvae to the desiccating effects of the hot, dry summer, and the overall time that the overwintering larvae are exposed to the elements.

Great Basin silverspot butterflies lay eggs singly and haphazardly near their larval host plant (Scott 1986). Unlike most other violets species, bog violet leaves are still green at the time when eggs are laid in the late summer to fall, and olfactory cues given off by the plants might help females to select areas with violet concentrations (Hammond 1974, in Selby 2007). Hard substrates such as tree trunks, downed logs, and willow stems appear to be preferred for oviposition, and they may provide additional protection for the small first instar larvae during winter diapause (Selby 2007). Great Basin silverspot butterfly eggs require approximately 17 to 18 days to hatch, and the first instar larvae enter winter diapause immediately after hatching. Mortality is very high during this life stage for most *Speyeria* species (Mattoon et al. 1971, in Selby 2007). The tiny, unfed larvae must survive the harsh conditions of winter and then locate freshly emerging violet leaves before exhausting their limited reserves. Larval development resumes in the spring with the emergence of young violet leaves (Selby 2007), and progresses through the 2<sup>nd</sup> – 6<sup>th</sup> instar stages. The pupal phase last about 17 days and then the adults emerge.

**FOOD HABITS:** The availability of suitable adult food resources throughout the adult flight period can be as important as the presence of larval hostplants in determining whether an area can support populations of particular butterfly species. Most butterflies use nectar resources primarily to meet energy needs, but many long-lived butterflies also use food resources for egg production. Adding protein to the diet of female regal fritillaries increased both their fecundity (number eggs laid) and fertility (number eggs hatching), suggesting the importance of late-summer nectar sources to their long-term survival (Wagner 1995, in Selby 2007). Similar results should be expected for Great Basin silverspot butterflies, and a diverse assemblage of nectar producing plant species may be needed to ensure the continuous supply of nectar needed throughout their flight.

Great Basin silverspot butterflies utilize a variety of plant species as nectar sources, but thistles are strongly favored (Scott 1986, Opler and Wright 1999, in Selby 2007)). Ellis (1989) says they prefer blue- and yellow-flowered composites. Documented nectar sources include native and introduced thistles, horsemint, and joe pye weed (*Eupatorium maculatum*), according to Selby 2007.

Violets are the larval food plants for all members of the genus *Speyeria*. According to Ellis (personal communication 2000 to Selby 2007, and NatureServe 2019), Great Basin silverspot butterflies are found only at sites with bog violets (*Viola nephrophylla*), the only confirmed larval food source for this butterfly in the wild. Microhabitat conditions for the bog violet include soggy soil and shade, often under shrubs such as willows. Bog violets appear to be more abundant and to regenerate more readily in grazed habitats, perhaps due to reduced competition. They may also benefit from periodic burning, which concentrates cattle grazing on the young willow shoots and helps to keep the willow stands from becoming dense and closed (Ellis 1989).

**HABITAT:** Nokomis fritillary habitat is usually described as permanent spring-fed meadows, seeps, marshes, and boggy streamside meadows associated with flowing water in arid country. Great Basin silverspot butterfly is found in wet meadow and seep communities associated with arid desert landscapes of the Upper Sonoran (pinyon-juniper, various shrubs), and Canadian (fir-spruce-tamarack, some pine, aspen-maple-birch-alder-hemlock) Life Zones of the southwestern United States and northern Mexico (Hammond 1974, Scott 1986). [Note: none of the known collections in Arizona, all at 7,400 feet or higher, are associated with the Upper Sonoran Life Zone.] The presence of an adequate supply of the larval food plant, the bog violet (*Viola nephrophylla*) is a critical habitat component. Microhabitat conditions for the bog violet include soggy soil and shade, often under shrubs such as willows. An adequate supply of nectar sources is another important habitat requirement. Nokomis fritillaries utilize a variety of species, including native and introduced thistles (e.g., *Cirsium*, *Carduus*, and *Onopordon* species), horsemint (*Agastache*), and joe pye weed (*Eupatorium maculatum*), per Selby 2007.

Ellis (personal communication 2000, in Selby 2007) identified the following habitat components for western Colorado Great Basin silverspot butterfly populations: (1) spring fed and/or sub-irrigated wetlands, (2) larval food plant (*Viola nephrophylla*), (3) wet meadows interspersed with willows and other woody wetland species, and (4) adult nectar sources (mostly composites).

Violets tend to be most abundant near the margins of the wet meadows and under shrubs, especially willows, and they can be locally more abundant in grazed habitats (Ellis 1989). Violets are able to regenerate readily under grazed conditions, and grazing probably favors them by reducing competition from other species. Periodic burning can help to keep woody species from taking over the wet meadows and to improve the vigor and flowering of the herbaceous wetland plants. Cattle browse young willow shoots following a burn, so the combination of fire (periodic) and grazing (light) can prevent the willows from forming dense, closed stands.

**ELEVATION:** For the three known historical collections in Arizona, the elevations range from 7,440 – 7,880 feet (2,268 – 2,402 m).

**PLANT COMMUNITY:** Wet meadow and seep communities associated with arid desert landscapes of the Upper Sonoran and Canadian Life Zone [Note: all of the sites in Arizona are above 7,400 feet in elevation and would not be considered associated with the Upper Sonoran Life Zone]. The bog violet (*Viola nephrophylla*), the only food source for larvae, is a critical habitat component. *Cirsium*, *Carduus*, and *Onopordon* species, horsemint (*Agastache*), and joe pye weed (*Eupatorium maculatum*), as well as other composite flowers, are key adult food source plants.

**POPULATION TRENDS:** NatureServe's national ranking, as well as Colorado's and New Mexico's, lists *S. n. Nokomis* as critically imperiled. Utah and Arizona do not rank the subspecies (although it would qualify as critically imperiled in Arizona). Only one of the 16 recorded occurrences has been documented within the past 20 years. The long-term trend is down >90% (NatureServe 2019).

In Arizona, there are three mapped, historic occurrences. According to Selby (2007), the Chuska Mountain occurrence was re-visited in 1994 and was thought to contain 10-12 colonies. Each colony was typically one to two acres in size, and most of the populations appeared to be stable. Threats identified at the time were grazing as it was typically practiced in the area (e.g., intense grazing by cattle, horses and sheep), and hydrologic changes that resulted from water usage and drought.

The seemingly perilous status of the Great Basin silverspot butterfly prompted WildEarth Guardians to petition the USFWS in 2013 to list the subspecies under the Endangered Species Act (ESA). They argued that *Speyeria nokomis nokomis* is threatened by at least three factors identified in the ESA as listing criteria (1) habitat loss and fragmentation due to development, altered hydrology, heavy grazing, mineral extraction, and other human activities are the most severe ongoing threats to the silverspot; (2) it has no legal protection at either the state or federal level, except on Navajo Nation lands; and (3) severe weather exacerbated by climate change, biocides, and the synergistic impacts of all the above threats is also a concern.

## **SPECIES PROTECTION AND CONSERVATION**

### **ENDANGERED SPECIES ACT STATUS:**

None (USDI, FWS 1996)  
[C2 USDI, FWS 1994]  
[C2 USDI, FWS 1991]  
[C2 USDI, FWS 1989]

### **STATE STATUS:**

None

### **OTHER STATUS:**

Group 3 (Navajo Nation, 2008)  
Sensitive (USDA Forest Service 2013) –  
only in New Mexico, Carson NF

### **MANAGEMENT FACTORS:**

Habitat loss and fragmentation is the greatest historic, current, and future threat to the long-term survival of the Great Basin silverspot butterfly. This subspecies is highly restricted to streamside meadows and seepage areas with an abundance of their larval food plant (bog violet), and the availability of adult nectar sources (mostly composites). Over the past century, these wetland communities became restricted to small, widely separated and isolated fragments of their former ranges, surrounded by an arid landscape. Although the Great Basin silverspot butterfly is a strong flyer and is known to travel modest distances along a stretch of riparian habitat, it is not known to be able to travel (migrate) between distant drainages. Human activities such as housing developments, and modifications to the natural hydrology that maintains these wetlands (e.g., water diversions, wetland draining for cultivation, and/or capping springs), and mineral extraction (e.g., gravel mining) continue to contribute to habitat loss and fragmentation. Activities such as logging and road construction can also affect the local hydrology.

Other threats and their potential impact of the Great Basin silverspot butterfly are as follows (from Selby 2007):

Excessive livestock grazing can be a serious threat to Great Basin silverspot butterflies and their habitat, but light or moderate grazing may actually benefit the butterflies by giving their larval food plants a competitive advantage. However, Mikesic (personal communication 2006 to Selby 2007) has observed that grazing (e.g., cattle, horses, sheep) as it is typically practiced, is generally a threat. He also notes that while the violets might persist, nectar sources are often negatively impacted. The timing, intensity and impacts of grazing are critical factors that necessitate further study.

The invasion of exotic, noxious herbaceous weed species probably represents a serious ecological threat to the maintenance of native plant species diversity within these wetlands. However, some species (e.g., bull thistle, *C. vulgare*, and burdock, *Arctium minus*) may actually benefit the Great Basin silverspot butterflies by providing nectar sources.

Prescribed burning can be used to maintain the complex of wet meadows, willows, and other woody wetland species that provides optimal microclimates for the larval foodplant (bog violet) and adult nectar plants the Great Basin silverspot butterfly needs. Direct short-term mortality from burning might be heavy for the Great Basin silverspot butterfly, but both the butterfly and its larval food plant appear able to survive, and perhaps even benefit. While some studies have shown that aggressive fire management programs tend to depress prairie-specialist butterfly populations, moderate burn regimes, and permanent non-fire refugia may be benefiting the populations. Extensive burns (e.g., burning all or most of the habitat in an area at one time), or frequent burns (e.g., every one to two years) should be avoided.

Indiscriminant use of insecticides for pest control on rangeland or adjacent cropland can be a major direct threat to Great Basin silverspot butterflies. Broadcast spraying of herbicides, can also affect their populations indirectly by eliminating larval food plants and important nectar sources.

No documentation was found for diseases, parasitic organisms, or predators that are specific to the Great Basin silverspot butterfly. Stage specific data on the impacts of disease, parasitism, and predation were also lacking.

The larvae of all *Speyeria* species feed on violets, and many of these species are widely sympatric. No documentation was found that described significant effects of competition with other *Speyeria* species or subspecies. However, the effects of competitive interactions are poorly understood and merit further study.

One of the factors used to determine whether a species merits ESA listing is over-utilization for commercial, recreational, scientific, or educational purposes. Collecting rarely has an impact on insect populations due to their high reproductive capabilities and should not generally be a problem

for most butterflies. However, populations that are already depressed or concentrated in small habitat fragments, like Great Basin silverspot butterflies, can be more sensitive to over-collecting.

Extreme weather conditions can pose a threat to Great Basin silverspot butterflies, and the impact can be expressed over a large geographic area. Climatic warming and droughts could affect the butterflies by altering the hydrology of wetlands. During the adult flight, severe storms can cause direct adult mortality, and prolonged periods of cool temperatures, overcast skies, and rain can limit reproduction by inhibiting adult activity. Disease, parasitism, and predation can also influence the survival of each stage in the life cycle. The first instar larvae are susceptible to extreme winter weather, late spring hard frost, severe storms, or cool damp conditions. Observations and/or data pertaining to these potential threats need to be made to document possible impacts.

Historic loss, degradation, and fragmentation of wetland communities and the riparian corridors where they occur have contributed to the decline and current vulnerability of Great Basin silverspot butterfly populations.

As of 2018, NatureServe (2019) states that only one of 16 recorded occurrences has been documented in the last 20 years. The top management priority is to revisit known occurrences (colonies) to verify their present-day status. The second priority is to search for new populations in wet meadows and seeps within the known range of the subspecies. This search can be assisted by researching herbarium records for locations of the critical larval food plant, the bog violet (*Viola nephrophylla*). Once this updated status information is obtained, the third management priority will be to develop a conservation strategy designed to protect extant populations and to maintain or improve the size, quality, and connectivity of their habitats.

Overall, management should be directed toward controlling, but not eliminating, native woody species (e.g., preventing willows from forming dense, closed stands), eliminating exotic species, increasing the vigor of larval food plants, and maintaining adequate nectar sources. Other objectives would be to mitigate both direct (e.g., mortality of larvae during fires; mortality of eggs, larvae, and pupae due to trampling by cattle) and indirect (e.g., unfavorable shifts in community composition or structure; untimely elimination of nectar sources; removing protective cover for overwintering larvae) detrimental impacts.

Some best management practices presented in Selby (2007) are summarized below:

The negative effects of fire can include direct mortality of larvae in the litter layer during dormant season burns, and indirect mortality of larvae due to increased exposure to extreme winter conditions after fall burns remove the insulating litter layer. Burns can also temporarily limit the availability of critical resources immediately following the burn (e.g., larval food plants after spring burns, nectar sources after summer burns) or by altering their phenology (e.g., delayed blooming due to a late spring burn). it is important that adequate areas are left unburned to serve as recolonization sources, and that return intervals of fires should be long enough (e.g., 3 to 6 years for prairies) to allow for full recovery of populations between burns.

Light to moderate grazing has been shown to benefit Great Basin silverspot butterflies by giving a competitive advantage to their larval food plants, but sustained and intense grazing can degrade habitat and eliminate nectar sources during the adult flight. Any grazing regime should be implemented with caution. Populations of Great Basin silverspot butterflies and their essential habitat components should be monitored, so that the intensity, timing, and duration of grazing can be adjusted in response to observed impacts on them.

It is not recommend using herbicides for willow control because concentrations needed to kill the willows are very high. Non-persistent herbicides (e.g., glyphosphates) are preferable to more persistent herbicides (e.g., picloram). Broadcast spraying is not recommended since native forbs are killed along with the targeted exotics.

Biological control methods are recommended for two invasive plants if present. Chinese leaf beetles (*Diorhabda elongata*) are a potential control agent for tamarisk. They have been tested extensively and tamarisk is the only plant on which the beetles feed and reproduce. The most effective control agents for leafy spurge include several species of flea beetle (*Aphthona* spp.), and they have proven to be much more cost-effective than chemical control methods.

For inventory and monitoring, Pollard transect surveys (Pollard et al. 1975, Pollard 1977, Pollard 1982, Pollard and Yates 1993) are the standard butterfly monitoring methodology adopted by many lepidopterists. The “checklist” survey is an alternate methodology in which the survey route is not fixed (Royer et al. 1998). The checklist method is better for obtaining an initial site-specific butterfly species list, but the transect method is better for long-term monitoring. Mark-recapture studies, such as those by Arnold (1989) at Unaweep Canyon, provide valuable information on the meta-population dynamics among colonies along a riparian corridor.

**PROTECTIVE MEASURES TAKEN:** *Speyeria nokomis nokomis* is considered critically imperiled, but has no legal protection at either the Federal or State level. The Navajo Nation, which has designated the subspecies as endangered, is the only exception. *S. n. nokomis* was listed under the ESA as a candidate species, but was removed in 1996. The Forest Service considers the Great Basin silverspot butterfly to be a Sensitive Species in Colorado (Region 2), and in New Mexico (Region 3) but not in Arizona (where one of the historic records is on the Coconino National Forest. Although Forest Service listing as a sensitive species does not confer legal protection, it does help to ensure that appropriate conservation/management objectives and practices are implemented on National Forest lands.

To remedy this situation, WildEarth Guardians (2013), petitioned the USDI Fish and Wildlife Service to list the Great Basin silverspot butterfly as endangered or threatened under the ESA, and to concurrently designate critical habitat. According to the petition, the subspecies is threatened by at least three factors identified in the ESA as listing criteria (and only a single factor is required).

For Factor A) the Present or Threatened Destruction, Modification, or Curtailment of Habitat or

Range, the petition states that more than half of wetlands in the Great Basin, which is otherwise considered an arid landscape, have been completely eliminated in the last 150 years. Remaining wetland communities, which include springs, seeps, and riparian areas, are now more isolated than they were historically and are subject to diverse impacts from human activities, receiving disproportionate use in the form of recreational vehicles, livestock grazing, water diversions, and well development (Sanford 2011). Habitat loss constitutes the greatest historic, current, and future threat to the long-term survival of the Great Basin silverspot butterfly (Selby 2007). The petition also provides additional information on the anticipated future impacts of human population growth and development, altered hydrologic regimes, exotic species, grazing impacts, and habitat fragmentation.

For Factor B) Over-utilization for commercial, recreational, scientific, or educational Purposes, the petition notes that while collecting of invertebrate species is usually not a major detriment due to their high reproductive capacity, populations that are already depressed or concentrated in small habitat fragments, like Great Basin silverspot butterflies, can be more sensitive to over-collecting (Selby 2007).

For Factor D) the Inadequacy of Existing Regulatory Mechanisms, see the previous discussion.

For Factor E) Other Natural or Man-made Factors Affecting its Continued Existence, the petition summarizes the impact of biocides and climate change. Climatic warming and droughts can affect butterflies by altering the hydrology of wetlands. Additionally, the first instar larvae are susceptible to extreme winter weather, late spring hard frost, severe storms, or cool damp conditions. Severe storms can cause direct adult mortality, while prolonged periods of cool temperatures, overcast skies, or rain can limit reproduction by limiting adult activity.

In January 2016, the USDI, Fish and Wildlife Service (2016) published in the Federal Register that a listing may be warranted based on Factors A and E. The Service did request additional information for a review of all factors. There was no explanation as to why they did not accept the merits submitted for Factor D (Inadequate Existing Regulatory Mechanisms), but this can be expected to be addressed in the final rule.

**SUGGESTED PROJECTS:** There are numerous studies needed to fill in information gaps about the Great Basin silverspot butterfly and various management practices. The first and foremost are to revisit known occurrences (colonies) to verify their present-day status, and to search for new populations in wet meadows and seeps within the known range of the subspecies. To find new populations, soils vegetation maps can be used to identify potential areas with suitable habitat, and herbarium records can be used to narrow the search to sites where the habitat and larval food plant co-occur.

Regular monitoring programs should be implemented for all known populations, and data should be used to develop, implement, and evaluate policy and management decisions for those sites.

Regarding the butterfly itself, the effects of intra-specific competition are poorly understood and merit further study. Actual observations and data on stage specific mortality factors and the probabilities of completing each stage in wild populations would also be helpful.

There is a need for more rigorous research to identify the actual impacts of different intensities of grazing. There is also a need to conduct research examining the short- and long-term effects of prescribed burns on butterfly populations, and to define the appropriate size (relative to the total area) of areas not burned, as well as the frequency, and timing of burns, and the value of “permanent non-fire refugium”

**LAND MANAGEMENT/OWNERSHIP:** USDI, Bureau of Indian Affairs (BIA): Navajo Nation and White Mountain Apache Tribe lands, and USDA Forest Service: Coconino National Forest.

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**ADDITIONAL INFORMATION:**

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