

Appendix A: Insects

Karner blue butterfly

Lycaeides melissa samuelis

Federal Listing	E
State Listing	E
Global Rank	
State Rank	S1
Regional Status	N/A



Photo by Janules 2014

Justification (Reason for Concern in NH)

Karner blue butterflies, as well as other members of the family Lycaenidae, are highly susceptible to environmental changes and population declines, which are a product of their host plant specificity, symbiotic relationship with attendant ants, low vagility, and small subpopulation size (Cushman and Murphy 1993, Grundel et al. 1999). Additionally, Karner blue butterflies have behavior-specific habitat requirements, where canopy heterogeneity is essential for successful mating, breeding, oviposition, and nectaring (Grundel et al. 1998b). Such specialization gives Karner blue butterflies the designation of an umbrella species. Not only do they serve as an indicator of habitat quality, but management for their stringent habitat requirements meets the needs of other state endangered and threatened wildlife species as well, thereby maximizing overall biodiversity throughout the community.

Associated species include frosted elfins (*Callophrys irus*) and Persius duskywing skippers (*Erynnis persius persius*) whose larvae also feed solely on wild lupine, as various pine barrens moth specialists, eastern hognose snakes (*Heterodon platirhinos*), grasshopper sparrows (*Ammodramus savannarum*), and common nighthawks (*Chordeiles minor*). The limiting factors for Karner blue butterflies have been compounded by a severe loss of habitat. Nearly 90% of historic pine barren communities along the Merrimack River have been lost (Helmbolt and Amaral 1994). Without enough suitable habitats to support a viable population, Karner blue butterflies became extirpated in New Hampshire in 2000 (Amaral 2000), and were subsequently reintroduced.

Distribution

The distribution of Karner blue butterflies is largely dependent on the availability of blue lupine, the larval food source, and preferred native nectar sources (Schultz and Dlugosch 1999). In New Hampshire these plants are found in pine barrens which occur primarily on glacially deposited sand, shale, and serpentine soil types in parts of eastern North America (Sutton 1925). Pine barrens once spanned the Merrimack River valley from Canterbury to Nashua, occupying Windsor sandy loams and Hinckley cobbly sandy loams (VanLuven 1994). Today, only one site in New Hampshire, the Concord pine barrens, supports a population of Karner blue butterflies. A reintroduction program was initiated in 2001 to restore a viable metapopulations of Karner blue butterflies to the area.

This population represents the easternmost extent of this species' distribution and is separated from the nearest population in New York by over 225 km (140 mi) (Helmbolt and Amaral 1994). Regionally, Karner blue butterflies formerly occurred in a band extending across 12 states from Minnesota to Maine and in the province of Ontario, Canada, but now only occur in the 7 states of Minnesota, Wisconsin, Indiana, Michigan, New York, New Hampshire, and Ohio (USFWS 2003).

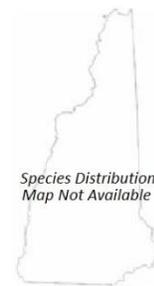
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Habitat

Karner blue butterflies inhabit pine barrens, an early-successional community composed of four distinct vegetative strata: herbaceous, heath, scrub, and canopy. Within the scrub and canopy strata, shade-providing pitch pine (*Pinus rigida*) and scrub oak (*Quercus ilicifolia*) dominate. The lower strata include grasses, vascular plants, and heath. Throughout these layers little bluestem (*Schizachyrium scoparium*) and big bluestem (*Andropogon gerardii*) are the principle grass species, affording roost sites and predator protection by attendant ants. New Jersey tea (*Ceanothus americanus*), spreading dogbane (*Apocynum androsaemifolium*), lowbush blueberry (*Vaccinium angustifolium*), and huckleberry (*Gaylussacia bacata*), as well as state threatened wild lupine (*Lupinus perennis*), blunt-leaved milkweed (*Asclepias amplexicaulis*), and golden heather (*Hudsonia ericoides*) comprise the majority of the herbaceous and heath layer and provide a critical source of nectar (United States Fish and Wildlife Service 2003). Spatially, these strata form a heterogeneous matrix of open, sub-canopied, and canopied habitat patches across the landscape, which in turn create a gradient of light intensities and thermal conditions necessary for habitat-specific behaviors. Temporally, this structural diversity is in constant flux, a process maintained by periodic disturbance, namely fire. Currently, Karner blue butterflies are restricted to fragmented pine barren remnants, highway and powerline rights-of-way, airports, military camps, and gaps in forest stands that support their obligate host plant, blue lupine (USFWS 2003).

NH Wildlife Action Plan Habitats

- Pine Barrens



Distribution Map

Current Species and Habitat Condition in New Hampshire

Historically, Karner blue butterflies occurred in 5 sites in New Hampshire: Milford (1880), Merrimack (1880), Webster (1896), Manchester (no date), and Concord (New Hampshire Natural Heritage Bureau 2005). Of these sites, the Concord pine barrens supported the last remaining population in the state. In 1980, an estimated 3,700 butterflies occupied this area but the population was soon reduced to less than 50 by 1994 (Schweitzer 1983, Peteroy 1998). Extirpation followed in 2000, resulting in the initiation of a captive rearing and reintroduction program (USFWS 2003). Translocation success has been observed with a population existing in the Concord pine barrens consistently since reintroduction in 2001. Mark recapture surveys indicate that the wild population has reached the minimum 1,500 adults periodically over the past 10 years and may have reached over 2400. The New Hampshire population will be designated as fully recovered upon the establishment of one metapopulation of at least 3,000 first brood or second brood adults that is sustained for a minimum of 5 years (USFWS 2003).

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Population Management Status

Release of translocated captive-reared butterflies has been underway at Concord Municipal Airport since 2001 (USFWS 2003). A reserve design has been developed in a metapopulation context, with intensive restoration sites connected by managed corridors (Fuller et al. 2003).

Regulatory Protection (for explanations, see Appendix I)

- Native Plant Protection Act RSA 217-A
- National Plant Protection Act

Quality of Habitat

The minimum habitat requirements of Karner blue butterflies include: 1) suitable habitat and occupied sites greater than 0.25 ha, 2) small areas (0.25-5 ha) having at least 500 blue lupine stems or 810 blue lupine stems per 0.4 ha, 3) larger habitat areas (>5 ha) having at least 0.1 blue lupine stem per m² or 405 blue lupine stems per 0.4 ha, 4) available nectar for each adult butterfly flight period, and 5) habitat heterogeneity for thermal regulation (USFWS 2003). Currently there is suitable habitat for the species in all the conservation zones. Quality of habitat varies over time based on management rotation. Some locations within the operational area of the airport are of lower quality. Annual mowing to maintain safety areas prevents the establishment of shrub and small trees for shade.

Habitat Protection Status

Approximately 227 ha of the remnant Concord pine barrens are protected through the Concord Municipal Airport Development and Conservation Management Agreement (2000). Conservation Zones have been established which are managed to enhance and restore critical habitat for Karner blue butterflies as well as a suite of other rare species. The land is owned by the city of Concord, with an 11 ha conservation easement granted to the USFWS. The conservation easement is open to the public but wheeled vehicles are forbidden. The historic main site, located along a powerline right-of-way, is privately owned. This site is generally maintained in coordination with Eversource during routine management cycles every 3 years. Since 2013 the private landowner has funded additional habitat management expanding the site from 1 ha to 5 ha. Staff have assisted NHFG with propagating and planting lupine and nectar in the area following a timber removal.

Habitat Management Status

Current habitat management and restoration techniques used in the Conservation Zones include native plant propagation, vegetation management using specialized mowers and feller bunchers, and prescribed fire. These techniques create sandy and herbaceous openings within a matrix of heath, scrub-shrublands, and woodlands. Habitat monitoring is completed before and after management implementation.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

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Habitat conversion and mortality due to development (conversion to pavement or infrastructure) (Threat Rank: High)

The sandy soils associated with pine barrens communities make them optimal for development. Both commercial and residential developments contribute to habitat reduction and fragmentation. As habitat is lost and becomes more fragmented, colonization of the remaining habitat patches becomes increasingly difficult. Population reduction, extirpation or extinction is the ultimate result if habitat conditions are not improved. Karner blue butterfly populations fluctuate widely. As local populations become extinct, it is improbable that recolonization will occur.

Karner blue butterflies have a positive association with habitat areas that are large, have high light intensity, and are recently managed (Smallidge et al. 1996). Extensive commercial and residential development of the Concord pine barrens has severely reduced habitat for Karner blue butterflies. About 5-10% of the original Concord pine barrens remains today, and virtually all pine barrens south of Concord have been lost (Helmbolt and Amaral 1994).

Habitat degradation from lack of high intensity disturbance (Threat Rank: High)

Lack of fire in the pine barrens allows leaf litter to accumulate over time and canopy cover to increase.

Seedling survival of lupine was four times greater in openings and partial shade than dense shade (Pavlovic and Grundel 2009). Seedling survival was also greatest when litter cover was low, but moderate amount of vegetation available to provide shade. Similar results were observed by Plenzler (2008), litter removal from prescribed burning was important to the establishment and recruitment of lupine, but the microhabitat influenced by soil moisture, ferns, moss cover etc. provided conditions for better seedling survival.

Mortality from litter and fuel accumulation that cause fires (Threat Rank: High)

The population of Karner blue butterflies in Concord is limited to 227 ha. A large-scale fire that burned a significant portion of this habitat could result in extirpation of the species.

Insects that are small in number and have a high degree of ecological specialization are extremely susceptible to extirpation from local fire (New 2014).

Disturbance from severe weather that limits reproductive success (Threat Rank: Medium)

Preliminary research indicates that increasing temperatures are likely to result in production of third and possibly fourth broods of adults. Due to reduced quantity and quality of lupine resources for larval development, these third and fourth broods will likely be less fit, leading to reduced reproduction and overall population numbers (USFWS 2012).

Early spring emergence may result in variation of light exposure during grandparent or parent generations. This exposure may prevent eggs that normally overwinter from entering diapause producing additional broods later in the year when food sources are no longer available.

Habitat impacts from roads that limit dispersal and prevent colonization (Threat Rank: Medium)

Paved surfaces generate substantial heat during hot summer months; this heat combined with lack of herbaceous habitat limits the dispersal of butterflies across these surfaces between habitat patches.

Analysis of Karner blue butterfly population data in NY found no evidence of mortality associated with roads, but the distribution of the species was influenced by roads and other paved areas (Fuller

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2008). Evidence from the work supported the barrier hypothesis that paved areas are barriers inhibiting flight, and adjacent areas become congested with individuals. Overtime selection for non-dispersive individuals may occur (Leimar and Norberg 1997).

Mortality caused by mowing activity (Threat Rank: Medium)

Maintenance of active runways and taxiways is required for safety compliance with FAA regulations. Mowing during the growing season may scatter eggs and developing larvae from lupine plants. Larvae dispersal is limited, and without access to a sufficient amount of lupine to complete development there could be a negative impact to the population.

Delayed annual mowing and partial mowing resulted in higher species richness and abundance of butterflies on road verges in Europe (Valtonen et al. 2006). Mowing no more than once a year after the adult flight resulted in the persistence of two endangered butterfly species across multiple meadows, but only if mowing was done every second or third year did both species persist at the local level (Johst et al. 2006). Leaving an unmown grass refuge within hay meadows resulted in a higher abundance of butterflies (Kuhne et al. 2015).

Habitat impacts from roads (limited dispersal) (Threat Rank: Medium)

Mortality of lupine, other plants, eggs and larvae from vehicles or equipment (Threat Rank: Medium)

Open space areas in the City of Concord are limited. Powerline ROW often serve as corridors for ATV use across the landscape.

OHRV traffic in lupine patches could result in direct loss of larvae or depletion of lupine available.

Species impacts from competition (aphids, beetles) (Threat Rank: Medium)

Large outbreaks of aphids in lupine patches of the conservation area result in early decline of the plants limiting the quality and quantity of food available for developing larvae. Outbreaks of beetles on lupine habitat may alter adult butterfly behavior such as oviposition in Karner blue butterflies (Swanson and Neff 2007), there may be a similar behavior disruption in Frosted elfins.

List of Lower Ranking Threats:

Mortality from pesticide use

Mortality from herbivory (deer and woodchuck feed on lupine and ingest larvae)

Habitat degradation due to invasive or introduced plants

Mortality from the collection of individuals from the wild

Actions to benefit this Species or Habitat in NH

Coordinate annual mowing activities with Concord Airport.

Primary Threat Addressed: Mortality caused by mowing activity

Specific Threat (IUCN Threat Levels): Transportation & service corridors

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Objective:

General Strategy:

Coordinate maintenance in operational area to comply with safety requirements, while minimizing negative impacts to Karner blue butterfly.

Political Location:

Merrimack County

Watershed Location:

Merrimack Watershed

Monitor illegal OHRV use in the conservation area.

Primary Threat Addressed: Mortality of lupine, other plants, eggs and larvae from vehicles or equipment

Specific Threat (IUCN Threat Levels): Human intrusions & disturbance

Objective:

General Strategy:

Maintain signs posting sensitive habitat for Frosted elfins. Monitor OHRV activity, especially in spring and summer where the most impact can occur. Provide information to law enforcement upon detection to facilitate issuance of a citation.

Political Location:

Watershed Location:

Habitat Management and Restoration

Primary Threat Addressed: Habitat degradation from lack of high intensity disturbance

Specific Threat (IUCN Threat Levels): Natural system modifications

Objective:

General Strategy:

Habitat management will increase the availability of suitable habitat for Karner blue butterflies by converting closed-canopy stands to an early-successional structure. Standard habitat management techniques including forestry, fire, and herbicide have well-documented efficacy in reducing the cover of canopy-forming, shade-tolerant, and fire-sensitive species. The technique, frequency, and intensity of management will be prescribed to increase light reaching the herbaceous strata, to create soil disturbances, and to connect existing blue lupine populations. Open-canopy corridors will offset failed dispersal and foraging in impermeable and/or unsuitable landscapes, such as the edges of runways and roads.

Political Location:

Watershed Location:

Monitor population annually for health and trend.

Objective:

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General Strategy:

Mark recapture surveys have been performed annually on first and/or second brood since the start of reintroduction. Continued monitoring of the population will inform decisions regarding augmentation and habitat management. As the population grows, the monitoring protocol may be switched to a less intensive method that provides sufficient sensitivity for detecting change in the population.

Political Location:

Merrimack County

Watershed Location:

Merrimack Watershed

Captive Rearing and Augmentation

Primary Threat Addressed: Habitat conversion and mortality due to development (conversion to pavement or infrastructure)

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:

General Strategy:

A captive rearing program provided the opportunity for re-establishing a population of Karner blue butterflies at the Concord Pine Barrens following the species extirpation from the state. The program has also contributed to the recovery effort in Albany, NY providing butterflies for accelerated colonization in recently managed habitat. NHFG should continue to coordinate and run the captive rearing program until it has been sufficiently demonstrated that there is no longer a need to augment the population in NH.

Political Location:

Watershed Location:

Conserve remaining parcels of pine barrens in the Concord area.

Primary Threat Addressed: Habitat conversion and mortality due to development (conversion to pavement or infrastructure)

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:

General Strategy:

Maintain the current conservation agreement with the City of Concord and conservation partners to protect habitat for Frosted elfin and Karner blue butterfly. Look for additional opportunities to conserve the limited remaining patches of pine barrens nearby to increase habitat availability.

Political Location:

Merrimack County

Watershed Location:

Merrimack Watershed

References, Data Sources and Authors

Data Sources

Information on Karner blue butterfly habitat, population distribution, and status was collected from habitat and recovery conservation plans, technical field reports, agency data, and scientific journals. Information on habitat protection and management was obtained from Concord pine barrens recovery and management plans.

Data Quality

The Karner blue butterfly is one of the most intensely managed and monitored species in New Hampshire. The Concord pine barrens have been monitored for Karner blue butterflies for at least the past 20 years and results are well documented.

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2015 Authors:

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2005 Authors:

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