

## SPECIES PROFILE

# Karner Blue Butterfly

*Lycaeides melissa samuelis*

Federal Listing: Endangered

State Listing: Endangered

Global Rank: G5T2

State Rank: S1

Author: NHFG

## ELEMENT 1: DISTRIBUTION AND HABITAT

### 1.1 Habitat Description

Karner blue butterflies inhabit pine barrens, an early-successional community composed of 4 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 blue 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).

### 1.2 Justification

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 (*Incisalia irus*) and Persius duskywing skippers (*Erynnis persius persius*) whose larvae also feed solely on wild lupine, as well as pine barrens zanclognatha moths (*Zanclognatha martha*), 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.

### 1.3 Protection and Regulatory Status

- National Plant Protection Act: promotes the preservation of blue lupine, blunt-leaved milkweed, and golden heather (*Hudsonia ericoides*) on state lands, but provides no protection on private property (VanLuven 1994)
- RSA 217-A, Native Plant Protection Act: blue lupine is threatened in New Hampshire and thus cannot be disturbed on public land

### 1.4 Population and Habitat Distribution

The distribution of Karner blue butterflies is largely dependant on the availability of blue lupine, the larval food source, and preferred native nectar sources (Schultz and Dlugosch 1999). These plants occur in pine barrens habitat. These pine barren communities occur primarily on glacially deposited sand, shale, and serpentine soil types in parts of eastern North America (Sutton 1925). In New Hampshire, this community type 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. Prior to their extirpation in 2000, Karner blue butterflies inhabited 2 sites within the 227 ha (563 ac) of the Concord Pine Barrens (Schweitzer 1983). A reintroduction program has since been initiated to restore viable metapopulations of Karner blue butterflies throughout their range.

Locally, the Concord 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).

### 1.5 Town Distribution Map

*A map is provided.*

### 1.6 Habitat Map

*Incomplete*

### 1.7 Sources of Information

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.

### 1.8 Extent and Quality of Data

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.

### 1.9 Distribution Research

A captive rearing and reintroduction program initiated by TNC in 1992 and then continued under the direction of NHFG in 2000 has worked towards restoring viable metapopulations of Karner blue butterflies throughout their historic range. Dispersal and colonization rates have been monitored to adequately assess habitat utilization, movement patterns, and reintroduction success (Fuller et al. 2003). Current distribution data should be acquired, and historic observations in Webster, Manchester, Milford, and south Merrimack warrant further investigation.

## ELEMENT 2: SPECIES/HABITAT CONDITION

### 2.1 Scale

Conservation Zones as delineated under the Concord Municipal Airport Development and Conservation Management Agreement (2000) will be used as the conservation-planning unit for Karner blue butterflies. Outlying historic populations and remnant habitat patches may be treated independently.

### 2.2 Relative Health of Populations

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 native population in the state. In 1980, an estimated 3,700 butterflies occu-

ped this area but the population was soon reduced to less than 50 by 1994 (Schweitzer 1983, Peteroy 1998). Extirpation followed in 2001, resulting in the initiation of a captive rearing and reintroduction program (USFWS 2003). Translocation success is difficult to measure in the short term, but survey results suggest that more than 100 Karner blue butterflies completed their life cycles in the wild during 2003. The New Hampshire population will be designated as fully recovered upon the establishment of one metapopulation of at least 1,500 first brood or second brood adults that is sustained for a minimum of 5 years (USFWS 2003).

### 2.3 Population Management Status

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

### 2.4 Relative Quality of Habitat Patches

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 per 0.4 ha or 810 blue lupine stems per 0.4 ha, 3) larger habitat areas (>5 ha) having at least 0.1 blue lupine stem per m<sup>2</sup> or 405 blue lupine stems per 0.4 ha, 4) available nectar for each adult butterfly flight period, and 5) habitat heterogeneity (USFWS 2003). Based on these criteria, the South Airport Conservation Zone (144 ha) and the North Airport Conservation Zone (24 ha), both of which support the largest population of blue lupine and nectar plants, are considered the highest quality and most critical habitat patches (VanLuven 1994).

### 2.5 Habitat Patch 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 on the 227 ha of airport land, which will be 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 1 ha left of the historic main site, located along a power-line right-of-way, is privately owned, and maintained by Public Service of New Hampshire.

### 2.6 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 are used to create sandy and herbaceous openings within a matrix of heath, scrub-shrublands, and woodlands. Habitat monitoring is completed before and after management implementation. The goal is to create a shifting mix of native grassland, shrubland, and woodland features (Fuller et al. 2003).

### 2.7 Sources of Information

Information on habitat protection and management was obtained from Concord pine barrens recovery and management plans.

### 2.8 Extent and Quality of Data

The Karner blue butterfly is one of the most intensely monitored and studied species in New Hampshire. The Concord pine barrens have been monitored for Karner blue butterflies for at least the past 20 years. Blue lupine has been mapped and/or monitored for almost 10 years.

### 2.9 Condition Assessment Research

Habitat quality and restoration feasibility of the Goldstar Farms easement in Canterbury, New Hampshire needs to be evaluated. Further investigation of historic occurrence records associated with this location is needed.

### ELEMENT 3: SPECIES AND HABITAT THREAT ASSESSMENT

#### 3.1.1 Development (Habitat Loss and Conversion)

##### (A) Exposure Pathway

The properties associated with pine barrens communities (i.e., sandy soils, high stability, high permeability, low compaction, and ease of excavation) 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 and 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.

##### (B) Evidence

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).

#### 3.1.2 Scarcity (Natural Variation on Reproductive Success)

##### (A) Exposure Pathway

Cool/wet and hot/dry conditions can delay or accelerate Karner blue butterfly larval hatching and development, reduce adult flight times, mating opportunities, and oviposition rates, and upset host plant-larvae synchronicity (Schweitzer 1989). Natural variation in weather may result in wide population fluctuations. Added to depressed population size, wide population fluctuations may result in local extinction.

##### (B) Evidence

Monitoring trends for northeastern populations show that annually, Karner blue butterfly populations fluctuate widely (S. Fuller, NHFG, unpublished data, K.

O'Brien, New York Endangered Species Program, unpublished data). Captive rearing programs at the Toledo Zoo in Ohio and Concord, New Hampshire report that mating and oviposition are related to environmental factors (New Hampshire Fish and Game unpublished data, Toledo Zoo unpublished data). The especially cool wet spring during the 2003 Karner blue butterfly season in New York resulted in a population crash of first brood adults (K. O'Brien, New York Endangered Species Program, personal communication).

#### 3.1.3 Development (Dispersal Barriers)

##### (A) Exposure Pathway

Development is occurring rapidly in the area surrounding the Concord Municipal Airport. Karner blue butterflies utilize grassy openings, but paved areas, buildings, and closed-canopy forest stands are increasingly dominant on the landscape. As a result, dispersal is limited, even when high quality habitat is restored.

Land managers face the challenge of not only maintaining quality habitat, but also ensuring that habitat patches are situated over the landscape in a manner that allows movement and genetic exchange among patches (Grundel et al. 1999). The presence of nectar sources between sites can enhance inter-site dispersal (King 1998b).

##### (B) Evidence

The implications of disrupted metapopulation processes are well documented in the literature for Lepidoptera. Dispersal between subpopulations may be depressed in metapopulations fragmented by paved areas, limiting the establishment of new colonies and viability of existing ones. Karner blue butterflies are less likely to fly over paved areas, around buildings, or through closed-canopy forest stands (King 1998a, Grundel et al. 1999, Fuller, unpublished data). Karner blue butterflies may become 'stuck' at the edges of paved areas. Shopping centers, an industrial park, and the Concord Municipal Airport fragment remnant habitat patches.

#### 3.1.4 Introduced Species (Introduced Insects)

##### (A) Exposure Pathway

Biological controls for horticultural pests may be

detrimental to Karner blue butterfly populations via multiple pathways. Ladybird beetles (*Coccinella septempunctata*) and parasitic wasps that are used to control aphids may prey on Karner blue butterfly larvae. Aphids feed on the fluids of blue lupine, causing the plants to wilt and become unsuitable food for Karner blue larvae.

(B) Evidence

Koch et al. (2003) observed that Asian lady beetles (*Harmonia axyridis*) that are used for biological control of aphid species were a significant predator of immature monarch butterflies (*Danaus plexippus*). Escaped parasitic wasps and flies have been known to utilize native lepidopteran hosts.

### 3.1.5 Altered Natural Disturbance Regime (Natural Succession)

(A) Exposure Pathway

Suppression of wildfires can lead to succession of pine barrens communities to closed-canopy forest communities, eliminating suitable habitat for blue lupine and Karner blue butterflies. A lack of a regular mild fire regime may result in fuel loading. In a fuel-loaded system, fires may reach a higher intensity than fires in a well-maintained system, which would impact the remnant habitat patches more broadly and severely and potentially lead to direct mortality of Karner blue butterfly populations.

(B) Evidence

Before intense management practices were initiated at the Concord pine barrens in 1994, the area had reverted to closed-canopy pine forests and woodlands, mixed scrub thickets, and disturbed grassy openings (VanLuven 1994). Karner blue butterflies prefer early to mid-successional habitats whose suitability can deteriorate in a few years in the absence of disturbance (Grundel et al. 1999). Woodland management policies that do not promote opening of canopies often negatively affect Karner blue butterfly habitat (Grundel et al. 1998a). Increased canopy cover is a major factor implicated in the decline of Karner blue butterflies at many locales (Grundel et al. 1998b).

### 3.1.6 Predation and Herbivory

(A) Exposure Pathway

Access to protected Karner blue butterfly habitat is limited for hunters and predators. Heavy browsing of blue lupine plants by white-tailed deer (*Odocoileus virginianus*) and woodchuck (*Marmota monax*) could severely reduce blue lupine populations and result in Karner blue butterfly mortality by accidental ingestion of eggs and larvae.

(B) Evidence

Approximately 80% of the blue lupine plants that were planted in 2 restoration plots (including a captive breeding release site) had their flower stalks removed by grazing during 2004 (NHFG, unpublished data). Significant browse is common in blue lupine populations (USFWS 2003).

### 3.1.6 Altered Natural Disturbance Regime (Mowing)

(A) Exposure Pathway

The majority of extant Karner blue butterfly habitat has been maintained inadvertently via non-conservation land uses, such as maintenance of powerline rights-of way and airport runway safety zones. The optimal window (April-August) for mechanical vegetation management practices such as mowing coincides with the blue lupine growing season and sensitive phases of the Karner blue butterfly life cycle. Mowing during this period may cause blue lupine mortality, reduce seed production, reduce forage for emerging larvae, dislodge eggs and larvae from hosts, or cause direct mortality of any life stage. There is currently no established forum for communication between wildlife managers and other land managers to reduce these impacts.

(B) Evidence

Extensive mowing occurs on the Concord Municipal Airport to manage the runway safety and approach areas. Mowing also occurs along fence-lines for security purposes. In spite of regulatory efforts, mowing and other non-compatible land-uses have inadvertently occurred. It is difficult to document direct mortality because plant cuttings (blue lupine) can easily be spread far from established plants by rotating blades.

### 3.2 Sources of Information

Information on threats was taken from the Karner blue butterfly recovery plan, habitat conservation plan, scientific journal articles, and personal communications and observations.

### 3.3 Extent and Quality of Data

Threats to Karner blue butterflies and their habitat are well documented in management and conservation plans. While there may be little evidence documenting the actual occurrence of certain threats, the potential for the threat to occur is well documented.

### 3.4 Threat Assessment Research

- Identify threatening introduced insect species
- Assess impact of herbivory on butterflies
- Evaluate impacts of maintenance mowing on Karner blue butterflies

## ELEMENT 4: CONSERVATION ACTIONS

### 4.1.1 Habitat Management

(A) List of Direct Threats Affected: Habitat loss, succession, and barriers to dispersal

(B) Justification

Habitat management will increase the availability of suitable habitat in areas currently or potentially occupied by 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.

Blue lupine and early-successional nectar plant species abundances increase in response to a broad range of vegetation management techniques (Smalldge et al. 1996). Management creates areas of open

or semi-open habitat that provide a range of light intensity and diverse vegetation, all necessary for successful dispersal, foraging, and oviposition (Grundel 1998a). Habitat heterogeneity satisfies microhabitat needs and moderates the impact of large-scale environmental events (USFWS 2003). Habitat management also provides connectivity among resource-rich habitat patches, increasing dispersal rates, colonization, and overall suitable habitat area.

Karner blue butterfly populations have persisted in landscapes of similar structure and lesser size than the area managed in Concord. Habitat management is necessary to prevent the loss of protected habitat to succession, but is not adequate to secure unprotected remnants and buffer existing conservation land from development.

Restorative management intensity is high in the short-term, but can be reduced to a sustainable maintenance level in the long-term. Depending upon the intensity of management, beneficial responses can be observed in 0-3 years, and maintained with management on a 5-10 year rotation.

The densities of blue lupine and other early successional plants can be controlled and maximized by adjusting the frequency and intensity of habitat management to modify current densities of canopy species and scrub oak. The prescription may be adapted to guide management in new habitat areas.

(C) Conservation Performance Objective

The habitat management performance objective is to create a matrix of interconnected grasslands, shrublands, and woodlands by manipulating the densities of woody species in key vegetative strata. Management schedules and target levels for management units by strata and species are described in Fuller et al. (2003). Progress toward target levels (i.e., reduction in canopy and shrub strata) will indicate the performance of habitat management.

(D) Performance Monitoring

Densities of woody species will be monitored as prescribed in Fuller et al. (2003) prior to implementation of management and in subsequent years.

(E) Ecological Response Objective

The habitat management response objective is to increase the densities of blue lupine, key nectar plant species, and the proportion of early successional veg-

etative strata. Target levels for management units by strata and species are described in Fuller et al. (2003). Progress toward target levels (i.e., increase in blue lupine and nectar plant species densities and in proportion to sand, herbaceous, and heath strata) will indicate a beneficial response to habitat management.

#### (F) Response Monitoring

The density of blue lupine and richness of other key habitat plants will be monitored as prescribed in Fuller et al. (2003) prior to implementation of management and in subsequent years.

#### (G) Implementation

NHFG, NHDRED, the New Hampshire Army National Guard, USFWS, the Federal Aviation Administration, and the City of Concord will cooperate to implement habitat management as per the Concord Municipal Airport Development and Conservation Management Agreement (2000), the management plan (Fuller et al., 2003), and under the guidance of the management team.

#### (H) Feasibility

The partnership described has successfully implemented habitat management. Future feasibility is limited only by funding, which is secure through 2012.

### 4.1.2 Education and Outreach

#### (A) List of Direct Threats Affected

Habitat loss, barriers to dispersal, succession, mowing during critical periods

#### (B) Justification

Engaging the public to propagate habitat plants on public and private land will increase the habitat available to Karner blue butterflies. School children have successfully planted over 1,000 blue lupine plants. Informing the public about native plants will increase the availability of habitat in developed landscapes, and reduce the frequency of mowing habitat plants during critical periods.

Karner blue butterflies have been documented ovipositing and feeding on blue lupine planted by schoolchildren. In areas outside Concord where mowing has been controlled, Karner blue butterfly populations have flourished. Studies have shown that

Karner blue butterflies use commercial and residential landscape plants to augment 'natural' habitat.

Karner blue butterfly populations and restoration efforts are currently restricted to Concord, New Hampshire. Efforts will be targeted towards decision-makers, professionals, landowners, and school children within the Concord community.

Restoration and recovery of Karner blue butterflies and their habitat is ongoing and the importance of this work needs to be addressed now and in the long term. Children that plant blue lupine today will provide an immediate benefit, and may support recovery efforts as adults.

Education and outreach can be molded to meet different target audiences (landowners vs. school children) or habitat areas (private land vs. public land), and evolve as new techniques are developed. Content of educational materials can be geared towards specific threats to Karner blue butterflies and their habitat.

#### (C) Conservation Performance Objectives

- Increase the number of blue lupine plants planted by schoolchildren and other volunteers to more than 500 plants per year for the next 5 years
- Within 5 years, increase the proportion of residential or commercial landowners adopting Karner blue butterfly-friendly management and landscaping practices to more than one-half for buildings currently existing within the potential habitat area
- Within 5 years, increase the proportion of new developments maintained in Karner blue butterfly-friendly management and landscaping practices to more than one-half of the new development plans approved by local planning boards within the potential habitat area
- Increase volunteer participation in restoration activities to more than 20 per year for the next 5 years.

#### (D) Performance Monitoring

Performance may be monitored via: documentation of the number of blue lupine plants planted each year by school children and other volunteers; random surveys of Concord Heights landowners to determine current land management practices; documenting number of approved plans that adopt Karner blue butterfly-friendly landscaping and management practices; and documenting the number of competent and reliable volunteers.

(E) Ecological Response Objective

The desired ecological response is to increase the availability of blue lupine and nectar plants within and between habitat restoration areas. Successful education and outreach will be indicated by Karner blue butterfly utilization of plants propagated by school children and by Karner blue butterfly utilization of new and existing developed landscapes managed under Karner blue butterfly-friendly programs.

(F) Response Monitoring

Karner blue butterfly use of plants propagated by school children will be documented when it is observed during structured population monitoring as described in the management plan (Fuller et al. 2003). As suitable landscaping is cultivated in the landscape surrounding restoration areas, monitoring will be adapted (with landowner permission) to document Karner blue butterfly movements through habitat between restoration areas.

(G) Implementation

Continue and expand the elementary classroom blue lupine planting program. This is a yearly program partnering NHFG, the National Wildlife Federation, the Roger Williams Park Zoo in Providence, Rhode Island, and the Concord school district funded by grants from Disney and Conservation License plates. Teachers participate in a training session on blue lupine propagation and pine barrens ecology, incorporate the material into curricula, and coordinate a hands-on field trip. Since 2000, over 2300 2<sup>nd</sup> and 4<sup>th</sup> graders from 8 local Concord grade schools have completed the program, and over 1,000 blue lupine plants have been planted in the wild. Schoolchildren from local Concord schools grow blue lupine in their classrooms in February and then transplant them in restored Karner blue butterfly habitat at the USFWS Karner Blue Butterfly Easement in May.

Provide native seed mixes to local residents, landscapers and business owners to incorporate into their landscaping. A training program for local landscapers and developers on how to incorporate native seed mixes and plantings into their landscape designs will be developed, along with providing native landscaping guidelines and sources for native seeds and plants. NHFG is collaborating with DRED, Roger Williams Park Zoo and local plant nurseries to collect native seed and prepare seed mixes for distribution. Initially

these mixes will be used for NHFG conservation projects, and will be available to the public once a substantial seed bank is accrued.

Present to the Concord planning board and Conservation Commission lectures or materials that focus on ways to minimize impact to Karner blue butterflies and their habitat. NHFG will be contacted to review plans for projects that could potentially impact Karner blue butterflies and pine barrens, and offer guidance to minimize those impacts. Developers will be encouraged to landscape with native vegetation in areas adjacent to pine barrens.

Plan college level educational field trips to the captive rearing lab and pine barrens, targeting university wildlife management and biology students for volunteer and internship opportunities. Encourage butterfly and garden clubs to visit the pine barrens, and volunteer with plant propagation or captive rearing. Develop a volunteer recruitment, training, and maintenance program to involve volunteers in captive rearing and habitat management.

(H) Feasibility

The limiting factor in educational implementation is funding and personnel resources. NHFG is limited in staff and funding to carry out restoration and recovery work. More integration with the Public Affairs Division is needed to focus on education and outreach. Resources must be made available for targeted education material development and training. The National Wildlife Federation has assisted with blue lupine planting by school children and will continue to do so.

## 4.2 Conservation Action Research

Continue to monitor Karner blue butterfly populations, and search for additional areas where this species could flourish, particularly as pine barrens habitats are restored.

## ELEMENT 5: REFERENCES

### 5.1 Literature:

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## 5.2 Data Sources

- New Hampshire Natural Heritage Bureau. 2005. Database of Rare Species and Exemplary Natural Community Occurrences in New Hampshire. Department of Resources and Economic Development, Division of Forests and Lands. Concord, New Hampshire, USA.

## Distribution of Karner Blue Butterfly in New Hampshire

### Distribution

- Known
- Historic



Known = confirmed observations as reported in the NH  
Natural Heritage Bureau's Element Occurrence Database.  
Historic = observations more than 20 years old.

