

Appendix D.

Karner Blue Butterfly Recovery Plan for the Albany Pine Bush Metapopulation Recovery Unit

**Karner blue butterfly Recovery Plan
for the Albany Pine Bush Meta-population
Recovery Unit**

Submitted to:

New York State Department of Environmental
Conservation Endangered Species Unit

&

United States Fish and Wildlife Service New York
State Field Office

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INTRODUCTION

Recovery of the state and federally endangered Karner blue butterfly requires the restoration and maintenance of suitable habitat capable of supporting viable metapopulations within 13 Federal Recovery Units across the species' range. The Albany Pine Bush Karner blue butterfly recovery unit is one of four recovery areas in New York State that collectively constitute the Federal Glacial Lake Albany Recovery Unit. Of the two federal recovery units east of the great lakes, only the Glacial Lake Albany recovery unit in eastern New York State contains naturally occurring wild populations.

The Albany Pine Bush is the type-locality for the Karner blue and contains one of the best remaining global examples of an inland pitch pine – scrub oak barrens. The decline of the Karner blue in the Pine Bush is one of several indicators of the ecological deterioration of the barrens that once encompassed more than 25,000 acres of Glacial Lake Albany. Recovery of the Karner blue here depends largely upon the successful restoration of the barrens ecosystem and the maintenance of the ecological processes that drive it. An adaptive ecosystem management strategy that includes the reintroduction of fire, the removal of invasive species, and the replanting of locally derived native plants is currently being implemented to restore the barrens, facilitate the recovery of the Karner blue and advance the conservation of 44 other wildlife Species of Greatest Conservation Need.

Located in Albany and Schenectady counties, the Albany Pine Bush Recovery Unit is the southern most of the four state recovery units described in the draft New York State Karner blue butterfly Recovery Plan (NYSDEC 1998). Recovery and down or de-listing the species in New York State is contingent upon each of the four metapopulation recovery areas in Glacial Lake Albany (Albany Pine Bush, Saratoga Sandplains, Saratoga West, and Queensbury Sandplains) meeting the recovery goals established by the NYS Department of Environmental Conservation and the NYS Karner blue butterfly Recovery Team. All of these goals must be met including the establishment of a protected land base and a management entity, appropriate funding, a sufficient amount of suitable habitat, a sufficient number of butterflies and subpopulations, appropriate connectivity between subpopulations, a monitoring program, and a comprehensive management plan. According to the draft NYS Kbb Recovery Plan (NYSDEC 1998), each metapopulation recovery area management plan, hereafter referred to as the metapopulation recovery plan, must ...

“..focus [on the] establishment and long-term maintenance of that [meta-] population. The plan must include some disturbance regime designed specifically to maintain lupine, nectar species, habitat diversity, and Karner blue butterflies. The plan must indicate what necessary areas within each recovery unit will be protected, and how management and monitoring will continue to maintain viability after the Karner blue is removed from the state endangered or threatened list so that it does not simply decline again.”

Since its inception in 1988, the Albany Pine Bush Preserve Commission staff have worked with state and federal Kbb recovery teams to understand not only the biology and ecology of the Karner blue but also the management actions necessary to restore viable metapopulations throughout its historical range. While research into both the biology and management of the species continues as of this writing, we have learned much and have implemented many actions to effectively stabilized the decline of the species here. While significant recovery progress has been made in the Albany Pine Bush, the Karner blue butterfly is not yet recovered here; the continued aggressive implementation of strategies to alleviate threats (Appendix 1) to its long-term conservation are needed to meet the 2023 recovery timeline established in the Federal Kbb Recovery Plan (USFWS 2003).

The Karner blue butterfly Meta-population Recovery Plan for the Albany Pine Bush is prepared to satisfy the comprehensive management plan requirements of the draft state recovery plan and serve as an addendum to the 2010 update of the Management Plan and Final Environmental Impact Statement for the Albany Pine Bush Preserve (APBPC 2010). Since much of the biology and ecology of the butterfly is described in great detail in both federal and state Karner blue butterfly recovery plans, this plan focuses only on those proactive actions necessary to meet recovery criteria within the NYS Albany Pine Bush Recovery Unit (APBRU). It is organized to summarize state and federal recovery goals for the APBRU, recovery status in the Pine Bush, and the management prescriptions believed necessary to fully alleviate threats and recover the species here. Continuing research and monitoring will almost certainly refine these goals and strategies over time.

RECOVERY GOALS FOR ALBANY PINE BUSH RECOVERY UNIT

Recovery goals for Glacial Lake Albany and the Albany Pine Bush metapopulation, specifically, are derived from The Nature Conservancy’s Conservation Action Plan (CAP) for Glacial Lake Albany and the state and federal recovery goals described in their respective recovery plans. The APBRU goals are described in Tables 1 and 2 below. For information on the planning process itself the interested reader is encouraged to consult Parish et. al. (2003). Tear et. al (unpublished data) and Bried (2009) describe the monitoring program and assessment framework used to measure the suitability of Karner blue butterfly habitat in the Albany Pine Bush and throughout Glacial Lake Albany.

Table 1. Recovery goals and viability criteria for the Albany Pine Bush Karner blue butterfly metapopulation recovery unit. Descriptions and justification for the selection of categories, key ecological attributes, indicators, and rating schemes are described in the Tear et. al (unpublished data). Definitions and quantitative indicator ratings are derived from the Federal Recovery plan (USFWS 2003). The shaded portion of this table highlights the contribution of habitat-based metrics (see Table 2) to population-based metrics emphasized in the federal recovery plan.

Metapopulation Recovery Area Evaluation Criteria			Rating Scheme			
Category	Key Ecological Attribute	Indicator	Poor	Fair	Good	Very Good
Size	Population size	Number of viable subpopulations in the metapopulation ^a	≤1	2-4	5-9	≥9
		Total number of individuals in a metapopulation ^b	≤3,820	3,821-7,640	7,641-12,960	≥12,960
Condition	Habitat suitability	Total acres of suitable habitat in the recovery area ^c	<160	160-319	320-638	≥640
Landscape Context	Connectivity	Number of subpopulations with at least 2 connections to other viable subpopulations ^d	0	1	2-3	≥4

^aThe federal recovery plan (USFWS, 2003) defines a viable subpopulation as supporting at least 500 butterflies, and containing at least 12.4 acres of high quality habitat (USFWS, 2003; pg E-62). Subpopulations are defined as clusters of one or more habitat patches within 200 m edge to edge (based on the mean flight distance of Kbb's - see USFWS, 2003; pgs G-74 to G-80). The criteria for defining high quality habitat were modified (see Table 2). ^bTo maintain population sizes above the minimum thresholds established in the federal recovery plan Fuller (2008) determined that a minimum viable metapopulation should contain between 7,641 and 12,960 butterflies. These values were therefore used to establish the good-fair boundary. Ongoing revisions to the draft state recovery plan may change these numbers. ^cTotal acreage of suitable habitat was calculated based on a series of four separate but nested criteria. It included the sum of habitat patches more than (1) 0.62 acres in size (USFWS, 2003; pg G-84), with (2) good or better condition (as defined in Table 2), which occur within (3) a subpopulation that is at least 12.4 acres in total size, and (4) that subpopulation occurred within 1 km of other subpopulations. These habitat patches included nectar areas within 200m of lupine patches. The good-fair boundary was set at half that for a large viable population (USFWS, 2003; 640 acres, pg. F-67). ^dBased on the need for recolonization and genetic exchange, each subpopulation should be within 1 km of at least two other subpopulations (USFWS, 2003; pg G-73). There are several potential arrangements that could meet this criterion.

Table 2. Indicators and ratings used for estimating the quality of habitat patches for the Karner blue butterfly in the Glacial Lake Albany federal recovery unit in New York. Ratings with light grey shading were set as the minimum viability criteria stated in KBB federal and/or state recovery plans (USFWS 2003; NYSDEC, 1998).

Indicator	Indicator Rating			
	Poor	Fair	Good	Very Good
Lupine stem density #/acre	<400	400-809	810-1,999	>2000
Total lupine stems in the meta-population	<576,500	567,501-769,800	769,801-1,153,000	>1,153,000
Spring nectar species richness	0	1	2-3	≥4
Summer nectar species richness	0	1	2-4	≥5
nectar density (percent quartiles)	≤25	25.1-50	50.1-75	>75
nectar evenness (index)	≤25	25.1-50	50.1-75	>75
grass cover (%)	<5, >95	5-20, 71-95	21-30, 51-70	30-50
overstory cover ^a (%)	<5, >50	50-31	30-16	15-5
shade heterogeneity	0-5 or 80.1-100	5.1-20 or 60.1-80	20.1-60	20.1-60, ≥5% each ^b

^aOverstory = woody overhead canopy (>2 m height, measured via periscope densitometer). ^bShade heterogeneity is Very Good when shade is contributed by both trees and shrubs, such that each type accounts for >30% density in at least 5% of the sample transects.

RECOVERY STRATEGY

Karner blue butterfly Habitat Restoration:

The Albany Pine Bush Preserve Commission employs an adaptive ecosystem management approach to restoring a viable inland pitch pine scrub oak barrens. Pitch pine scrub oak barrens viability is described in Bried and Gifford (2008). Preserve management is designed to restore the overall plant and animal community and a fire regime capable of maintaining viable pitch pine scrub oak communities in perpetuity. Karner blue butterfly habitat restoration is a significant component of APBPC's ecosystem management approach. For example the removal of invasive black locust clones and the subsequent seeding of locally-derived native plants (lupine, various flowering plants and warm season grasses) advances invasive plant management goals, creates Karner blue butterfly habitat and facilitates the reintroduction of wildland fire, increasing fire manageable acres and improving the ecosystem's ability to support many rare and declining plant and animal species.

Restoration of a viable Karner blue butterfly metapopulation requires attaining at least 320 acres of suitable Kbb habitat. To establish a viable meta-population, extant sub-populations in the Albany Pine Bush must be secured, existing subpopulations expanded and new sub-populations created to establish a desirable number of viable sub-populations and to achieve the minimum level of connectivity described in Table 2 above. Map 2 illustrates the locations of existing lupine patches, subpopulations, and Kbb habitat restoration potential of all lands currently protected within the Albany Pine Bush Preserve. This illustration is a conservative estimate of the Kbb habitat restoration potential for all Preserve lands. This potential is varied based on the current understanding of the Commission's ability to restore appropriate quantities of lupine in these communities.

Locust clones, sand mines and abandoned agricultural fields are considered fully (100%) restorable; the restoration of these sites may add more than 900 acres of Kbb habitat. Pitch pine scrub oak barrens, thickets and forests are capable of supporting Kbb habitat, but the potential density of lupine that these communities could support is currently considered to be less than that of old fields and former locust clones. Note that unprotected developed lands (e.g. parking lots) are not included in the Map 2, but based on past restoration success can be fully restored to Kbb habitat.

Pitch pine scrub oak barrens and thickets currently support optimal quantities of nectar and appropriate overstory canopy structure, but insufficient amounts of lupine (Bried et al 2006). As a result of the high density of scrub oak in these communities, however, they are considered 50% restorable to Kbb habitat. Current efforts to reduce scrub oak abundance and expose mineral soil through growing season mow and burn treatments and growing season mow and herbicide treatments may significantly increase the restoration potential of these areas. More than 1,100 acres of these communities are potentially restorable to Kbb habitat. Greater than 600 acres of pitch pine scrub oak forest are considered 25% restorable to Kbb habitat as a result of the higher canopy tree density in this community.

With the Karner blue at dangerously low numbers in the Pine Bush and suitable habitat and dispersal corridors limiting, emphasis should be placed on maintaining existing Karner blue butterfly subpopulations and expanding the habitat adjacent to and between these subpopulations until they can be linked together by suitable dispersal corridors. In particular three recovery phases are identified:

- 1) Maintain and expand existing Karner blue butterfly subpopulations by maintaining and expanding habitat in areas supporting extant subpopulations.

- 2) Create suitable dispersal areas between occupied subpopulations by, first expanding habitat outward from existing Karner blue subpopulations; then creating a relatively contiguous corridor of scattered lupine, nectar species and grassy openings.
- 3) Establish additional Karner blue butterfly subpopulations.
- 4) Once suitable habitat has been restored in new subpopulations, translocate Kbb to accelerate colonization as outlined in the draft New York State Recovery Plan as necessary.

Karner blue butterfly Habitat Maintenance:

The maintenance of occupied habitat is governed by the Commission's state and federal endangered species permit (NYS License #132, USFWS Permit #TE838253-6). This permit allows for the management and monitoring of occupied habitat based on the following rationale and guidelines. Details of annual occupied habitat management are summarized in annual permit plans and reports submitted to the NYS Department of Environmental Conservation – Endangered Species Unit and the U.S. Fish and Wildlife Service – NYS Field Office. A detailed discussion of the benefits of each of the following management strategies is provided in Appendix G of the federal Kbb Recovery Plan (USFWS 2003). Note that Permit conditions are subject to annual review and modification, therefore Preserve managers and interested readers should always consult the annually renewed permit. The following summarizes the 2009 permit conditions.

Mowing:

Mowing is used to help control weedy species, temporarily reduce woody plant cover, facilitate growing season fire in pitch pine scrub oak barrens, and release lupine in dense stands of weeds and/or native grass. Unless otherwise permitted as described in annual permit plans, mowing of lupine cannot take place until all Kbb activity has ceased for the year and lupine has senesced. It is recommended that mowing be done after first frost (mid-October). In cases where this is not possible, mowing can occur before October, but not before August 15. In locations where early mowing is desired, the areas to be mowed must be approved by NYSDEC-ESU at least two weeks prior to mowing. Mower blades need to be set at least 6-8 inches above the ground, and areas of occupied Kbb habitat shall not be mowed more than once a year. When mowing occupied lupine areas, it is desirable to not mow more than half of any site in a single year. Preliminary results of current research by APBPC, NH Fish and Game and Union College strongly suggests that early spring mowing, before lupine flowers, may increase female fecundity and accelerate population growth as a result of first brood larvae feeding on re-sprouts of the mowed lupine. When finalized these results may facilitate the modification of these mowing guidelines since early spring mowing is not currently allowed and mower blade heights need to be low enough to actually cut the lupine.

Prescribed Fire:

Prescribed fire is considered a requisite management treatment to maintain suitable Kbb habitat (USFWS 2003, NYSDEC 1998) and is preferred over other management strategies where safe and effective fire management is possible. Like mowing, wildland fire is used to temporarily reduce woody plant cover and other competing vegetation, but it also exposes mineral soil, recycles nutrients, and stimulates seed production of Pine Barrens plants. However, since all Kbb life stages are considered vulnerable to wildland fire, precautions need to be employed to ensure that adequate refugia remain to facilitate recolonization of burned lupine patches. Therefore NYSDEC permit

#132 allows for the use of prescribed fire in occupied habitat in the Albany Pine Bush Preserve under the following guidelines.

Prescribed fire may take place at any point during the year on no more than one third of a given subpopulation (in a single year) and adjacent thirds may not be burned in consecutive years. Burning can only occur as necessary and must be coordinated with NYSDEC and USFWS by March 1, annually.

Herbicides:

Herbicides are used to control problematic native and non-native plants that have the potential to reduce Kbb habitat suitability. Herbicides should be applied only after lupine has senesced for the year. Garlon 4 and roundup cannot be used in close proximity to wetlands or water bodies. Herbicides must be applied by pesticide-certified and experienced personnel trained to identify lupine and Kbb. Applicators must take care to avoid stepping on lupine and/or accidentally spraying lupine. If broadcast ground application of herbicides adjacent to occupied habitat is employed, steps must be taken to avoid drift into occupied habitat if such applications occur while lupine is photosynthetic.

Population and Habitat Monitoring

Monitoring of both the butterflies and their habitat is a requirement of state and federal recovery plans. APBPC currently monitors butterflies annually and habitat on a bi-annual rotation. A comprehensive population monitoring program was initiated in 1991 by the NYSDEC and APBPC in occupied habitat patches within and surrounding the Albany Pine Bush Preserve (Gifford and NYSDEC, 2008). Habitat monitoring was initiated in 2005 and is described in Bried et. al. (2006). Population monitoring employs modified Pollard Yates transects through occupied habitat and produces an annual index of population size that can be used to track population growth trends, rather than absolute population sizes. In 2007 the APBPC and NYSDEC began using Distance sampling at several larger subpopulations to acquire population sizes. Population monitoring throughout the APBRU now employs both of these techniques in addition to the intensive surveys described below.

Butterfly Survey Protocols

The Karner blue butterfly has two broods and flight periods per year; the first flight normally begins in mid- to late May and ends in mid- to late June and the second flight normally begins in mid-July and ends in mid-August. However, the timing of the flight periods can vary by as much as 2-3 weeks from year to year and/or site to site due to weather and microclimatic influences. The length of the flight periods may also vary from year to year (generally 2-5 weeks). Since it cannot be known when the flight periods commence until field observers begin to report sightings of the butterflies, discussions with the Service/State are necessary prior to conducting surveys for either species to refine the survey window for any particular year. Surveys shall be conducted by an individual knowledgeable in identification of the butterflies (see descriptions and photographs in the Recovery Plan for the Karner blue butterfly attached below). Identification photographs of butterflies can also be obtained from the State/Service. Please note that scientific collector permits are required by the State for butterfly surveys. Please allow for adequate processing time to ensure that permits are in place prior to the first flight period.

Determining Butterfly Presence and Abundance: Intensive Search Method

Survey all potential habitat areas for the butterflies. This includes all lupine patches as well as nectar and grassy areas that may provide adult food and/or shelter for butterflies.

- All of the lupine, nectar, and nearby grass habitat should be carefully searched by slowly walking over it, gently prodding vegetation with butterfly net or meter stick, and/or stopping frequently and scanning the area for movement. The search should criss-cross all of the potential habitat area until the surveyor can be confident that all potential habitats have been searched. If more than five individuals are found, a zigzag transect may be done in later surveys to establish butterfly abundance (see Zigzag Transect Methods below). However, if the zigzag method is subsequently employed and such surveys do not pick up butterflies regularly, the intensive search should be conducted to continue to confirm presence.
- To determine butterfly presence, conduct a minimum of 5 surveys per Karner blue butterfly flight period with a total of 10 surveys needed to establish baseline conditions for the Karner blue butterfly (weather permitting) (call the State to confirm the start and finish of flight periods at nearby locations). At least 2 of the surveys should be conducted during mid- to late May to overlap with the frosted elfin flight period.
- Visits should be spaced so that no more than 2 days pass between visits unless weather is unsuitable. This reduces the potential for missing peak butterfly abundance in each brood. If poor weather is predicted, consider making visits the day before if waiting until after the bad weather will cause more than 3 days to pass between visits. If bad weather is expected part of a monitoring day, try to survey that day by adjusting the monitoring schedule accordingly.
- We recommend conducting all 10 surveys, even if butterfly presence is documented during an earlier survey, to document the use of nectar areas and get the best possible peak count of butterflies within each flight period. This will assist the Service/State with determining an initial index count of butterflies within the site, which can be monitored over time to determine the effects of the proposed management actions.
- Conduct surveys during optimal time and weather conditions as listed below:
 - between 8:00 a.m. and 6:00 p.m.
 - when temperatures are above 65°F
 - when temperatures are between 65-70°F, surveys should only be conducted under mostly sunny skies with calm to light wind
 - when temperatures are above 70°F, no restrictions on cloud cover
 - when eye-level winds are less than 20 mph
- Additional weather notes:
 - do not survey under drizzly or rainy conditions, however surveys can continue through very light rain if the sun is shining and the temperature is 75°F or higher.
 - delay surveying after heavy rain until the vegetation and the butterflies have had a chance to dry
- Time Keeping:
 - Record the duration of each survey. For sites with more than one transect, record duration of each transect and provide a total time (and total butterflies) as a separate data sheet entry. Duration must be recorded to the second. Do not round off minutes! Record time of day in military time. Record the time of day you visit the site even if you use a stop watch to time the duration. If you are not using a stopwatch, record your start time and end times in military time and include the second (*e.g.*, 1417:00 - 1418:23). It

helps to start at 00 seconds or 30 seconds to make it easier to subtract out later. Include duration of search even for zigzag and exhaustive searches.

Determining Butterfly Abundance: Zigzag Transects Method

- Establishing Transects
 - As reported in McCabe (1993), zigzag transects should be designed to cover each site. Transects should remain constant from day to day and for both broods. If monitoring longer term, transects should also remain constant from year to year so that data can be accurately compared through time. If the transect needs to be expanded (i.e., due to expansion of lupine population), it should be segmented so that data collected from the original transect can continue to be compared to that of previous years.
 - The distance between zigzags shall be sufficient to avoid counting an individual butterfly more than once. The distance between zigzags can be increased in areas where high butterfly densities would have resulted in many butterflies being counted more than once.

- Standard Methods
 - Observers walk at a comfortable pace gently swinging a butterfly net above the vegetation to stir the butterflies into motion. All butterflies seen, both at rest and in flight, are counted and their numbers recorded on a data sheet. Butterflies that fly into areas not yet walked are to be counted only if they fly no further than one zigzag ahead. Butterflies which fly farther than one zigzag ahead are left to be counted later in the walk-through (McCabe 1993). Butterflies that fly out of the census area are counted.
 - The sex of a butterfly should be recorded during the walk if it is obvious to the observer (i.e., a butterfly sitting in the path of the observer with its wings open). However, sexing butterflies during the transect walk should be done judiciously so as not to change the length of time necessary to walk the site or introduce inaccuracies caused by losing track of counted butterflies. A separate walk-through should be conducted in order to determine the sex ratio of the butterflies.
 - After completing the transect walk and sex ratio determination, Karner blue butterfly nectar species should be noted and the number of butterflies observed to be nectaring recorded. Other plants in bloom and weather notes should also be recorded on the data sheet.
 - Follow weather and time protocols listed above.
 - Marked transects may be along a continuous line or in zigzags, as long as they cover the entire potential habitat on a site.
 - Keep eyes forward a short distance ahead but regularly glance toward your feet and about 10 feet ahead. This will help you to stay on the transect and avoid trampling too much lupine. Also sometimes the butterflies won't fly up as you step over them.
 - Keep walking at a steady pace, about one heart beat per step. Avoid the tendency to slow down as you get into a lot of butterflies and speed up when there isn't much lupine. If you wander off the transect route by more than a few feet, start over again. Do not try to slow down or speed up to keep your time exactly the same, but practice your pace to try to keep it steady enough that you are doing the transect within 10-15 seconds of the same duration each time.

NOTE: CENSUS NUMBERS SHOULD NOT BE INTERPRETED AS THE ABSOLUTE NUMBER OF KARNER BLUE BUTTERFLIES IN A GIVEN SUB-POPULATION. RATHER THEY REPRESENT AN INDEX FOR THE SIZE OF AN INDIVIDUAL SUB-POPULATION THAT CAN BE COMPARED FROM YEAR TO YEAR. ONLY IN INSTANCES WHERE THE SUB-POPULATION IS QUITE SMALL AND CONFINED TO A WELL-DEFINED AREA THAT CAN BE CENSUSED THOROUGHLY DO CENSUS NUMBERS APPROACH THE ABSOLUTE NUMBER OF KARNER BLUES IN A GIVEN SUB-POPULATION AT A GIVEN DAY.

- Zigzag surveys (for sites too small to effectively monitor with marked transects) Monitors should strive to walk the same areas each time, but essentially should cover the entire habitat without counting butterflies twice. The zigzag surveys for unmarked transects should be done as described above for marked transects.

Translocation

The translocation of Kbb to accelerate colonization of suitable habitat is also governed by NYSDEC permit #132. See appendix B for 2008 translocation guidelines.

ALBANY PINE BUSH RECOVERY UNIT STATUS

Table 3. Summary of the 2008 viability status of the Albany Pine Bush Karner blue butterfly meta-population recovery area.

<u>Metapopulation Recovery Area Evaluation Criteria</u>			<u>Rating Scheme</u>			
Category	Key Ecological Attribute	Indicator	Poor	Fair	Good	Very Good
Size	Population size	Number of viable subpopulations in the metapopulation ^a	≤1	2-3	4	≥5
		Total number of individuals in a metapopulation ^b	≤3,000	3,001-5,999	6,000-9,000	≥9,000
Condition	Habitat suitability	Total acres of suitable habitat in the recovery area ^c	<160	160-319	320-638	≥640
Landscape Context	Connectivity	Number of subpopulations with at least 2 connections to other viable subpopulations ^d	0	1	2-3	≥4

Table 3 indicates that the APBRU metapopulation cannot currently be considered recovered or viable. Significant progress toward these goals has been made however. Since its inception the APBPC has protected 3,100 acres and increased the potentially occupied Kbb habitat in the preserve

from 14 acres to more than 1,000 acres (Map 1) through habitat management. This management has included the application of prescribed fire, the management of invasive plants, and the planting of lupine and other native plants. Despite more than 1,000 acres of potentially occupied habitat, not all of this acreage can be considered suitable using the criteria described in Table 2.

Bried et. al. (2006) and unpublished Commission data show that the establishment of the larval food plant, wild blue lupine, adult nectar plants and grasses has been successful in exceeding nearly all of Good and in several cases the Very Good criteria described in Table 2. To date more than 260 acres of Karner habitat have been planted. Nearly all of these sites are best categorized as pine barren grassy openings but are at or below the Poor shade heterogeneity rating due to a lack of tree and shrub canopy. These sites are in former locust clones, which were clear-cut to eliminate that species, and in the process eliminated nearly all tree and shrub cover. Natural recruitment and additional plantings of tree and shrub seeds and seedlings is increasing woody plant cover in these sites, but it will take several years to sufficiently meet the shade heterogeneity thresholds described in Table 2 above.

Subpopulations (*NOTE: this section is FOIL exempt per NYSECL*)

In accordance with the NYS Karner blue Recovery Team, the Albany Pine Bush recovery unit includes the 12,260 acre study area boundary defined in the 2002 Management Plan and Final Environmental Impact Statement for the Albany Pine Bush Preserve (APBPC, 2002) and an area extending west of that boundary into Schenectady County. The U.S. Fish and Wildlife Service and the NYS Department of Environmental Conservation define occupied habitat as all lupine patches occupied with Karner blue butterflies within the last five years and all areas within 200 meters of those sites that contain lupine and/or nectar plants, excluding mowed lawns, manicured landscapes and areas of pavement. (*Note that defining the exact limits of potentially occupied habitat requires on-site consultation with both USFWS and NYSDEC.*)

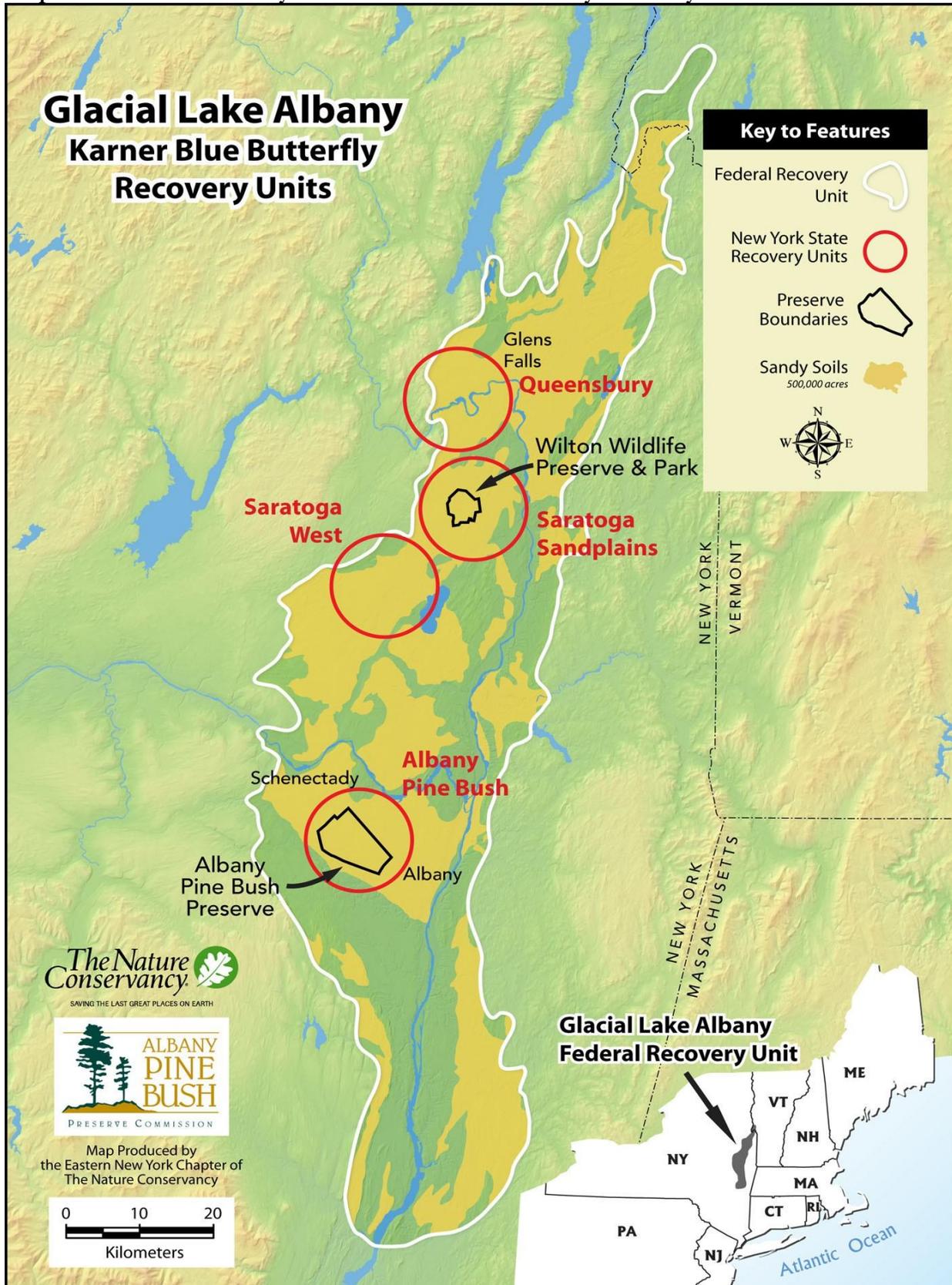
Ten sub-populations are currently identified in the Albany Pine Bush Recovery Unit (Map 1):

1. Pine Bush Southeast: extending from Crossgates Hill northwest to Blueberry Hill.
2. Karner Barrens East: extending from the Albany Landfill northwest to New Karner Road.
3. Madison Avenue Pinelands: extending from New Karner Road south of the NYS Thruway west to the National Grid power line.
4. Pine Bush Southwest: extending from the National Grid power lines west and south and west to the Preserve boundary on Western Avenue.
5. Karner Barrens West: including all Preserve lands from Old State Road south to the New York State Thruway and East to New Karner Road.
6. Apollo Drive: sites within and adjacent to Apollo Drive.
7. Kings Road Barrens: including all preserve lands north of Old State Road, and west of Kings Road, northwest to the National Grid power line.
8. Pine Bush Northwest: including Preserve lands north of Kings Road to the Conrail tracks and southeast to the National Grid power line.
9. Barron's House Sandplain: including all Preserve lands east of Morris Road, south of Kings Road and north of Curry Road Extension.
10. Curry Road Sandplain: including occupied public and private lands west of Morris Road, north of Curry Road and south of Kings Road, extending west to the Schenectady County boundary.

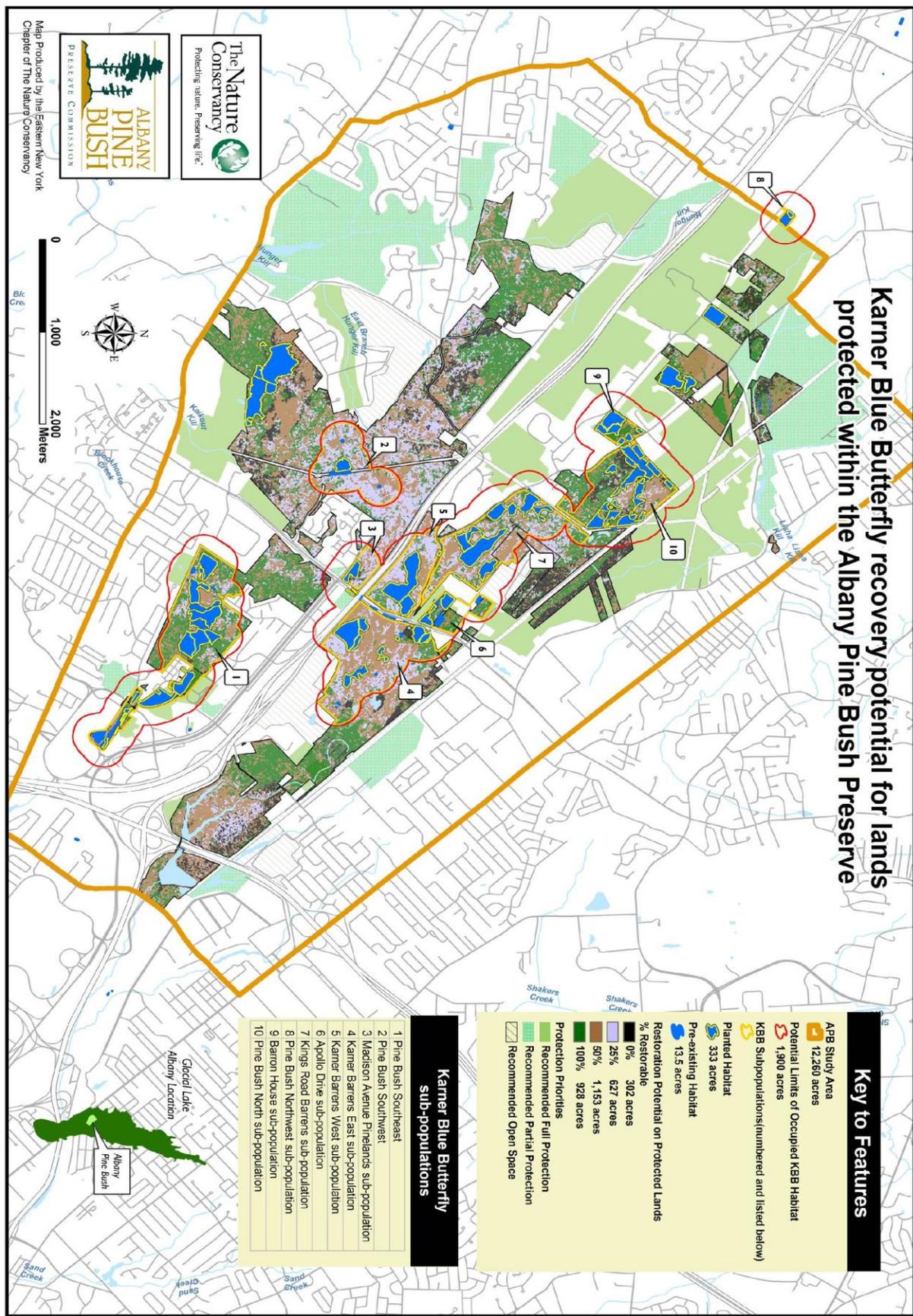
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Map 1. Glacial Lake Albany Federal Karner blue butterfly Recovery Units



Karner Blue Butterfly recovery potential for lands protected within the Albany Pine Bush Preserve



Key to Features

- APB Study Area: 12,260 acres
- Potential Limits of Occupied KBB Habitat: 1,900 acres
- KBB Subpopulations (numbered and listed below)

Planted Habitat: 333 acres

Pre-existing Habitat: 13.5 acres

Restoration Potential on Protected Lands

- % Restorable: 0% (302 acres)
- 25% (627 acres)
- 50% (1,153 acres)
- 100% (928 acres)

- Protection Priorities: Recommended Full Protection
- Recommended Partial Protection
- Recommended Open Space

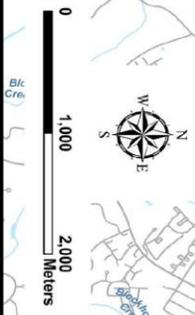
Karner Blue Butterfly sub-populations

- 1 Pine Bush Southeast
- 2 Pine Bush Southwest
- 3 Madison Avenue Pinelands sub-population
- 4 Karner Barrens East sub-population
- 5 Karner Barrens West sub-population
- 6 Apollo Drive sub-population
- 7 Kings Road Barrens sub-population
- 8 Pine Bush Northwest sub-population
- 9 Baron House sub-population
- 10 Pine Bush North sub-population

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ALBANY PINE BUSH PRESERVE COMMISSION

Map Produced by the Eastern New York Chapter of The Nature Conservancy



APPENDIX A. THREATS ASSESSMENT

2015 Strategies and Objectives for Abating Sources of Very-High Ranked Stress a.k.a. Threats

Threat: Low Population Size (*Stress Rank = Very High*)

Rationale'

In the Albany Pine Bush Recovery Unit low Karner blue butterfly populations are the highest ranked (and only High or Very High) stress or threat to meeting recovery and viability goals. The 2009 Management Plan and Final Environmental Impact Statement for Albany Pine Bush Preserve prescribes a viable meta-population containing at least 6-9000 1st or 2nd flight adults. The 2007 Glacial Lake Albany Kbb viability assessment prescribes a "Good" metapopulation size of 6,000 1st or 2nd flight adult butterflies. The New York State Department of Environmental Conservation has indicated that as a result of participating in The Nature Conservancy's viability Assessment process, the NY Kbb Recovery Plan will likely prescribe a viable metapopulation as one containing at least 9,000 butterflies, but potentially more. Lastly indications from the USFWS Federal Recovery Team indicate that as a result of observed temporal fluctuations in Kbb population sizes throughout the species range, a viable metapopulation needs approximately six times (18,000) the current minimum population size in 4 out of 5 years to ensure viability. Independent research corroborates this. Fuller (in prep) has completed a spatially implicit population viability assessment and determined that a minimum metapopulation may need as many as 27,000 butterflies to be viable (*<.01 probability of falling below 1500 adult butterflies*). Based on this information, significantly larger population sizes are needed to meet any of these minimum viability metrics. Extant population sizes are small, and estimated to be between 1,000 and 3,000 adult butterflies. Since existing management strategies have protected a significant land-base (*although additional land protection is needed to complete Preserve contiguity*) and habitat management on much of this land is occurring at a desired rate, low population sizes represent the highest threat to achieving viability.

Sources identified as contributing to low populations include: incompatible/no management (M), development (L), herbivory (L), and traffic volume (L). The relatively low rankings for these sources is a function of the protected land-base under management and a 10-year timeframe for continued protection and management. Should we have insufficient resources to continue current activities these ranks would certainly be higher.

Source: Incompatible Management (*other ecosystem modifications*)

Rationale: Prescribed fire, invasive plant management, mowing, and herbicide are all tools used to restore and maintain Kbb habitat. The frequency, seasonality and amount of occupied habitat receiving these treatments can have a positive or negative effect. Most significantly a lack of management will most certainly have negative impacts on the amount and composition of suitable habitat through the alteration of disturbance regimes and other ecological processes (e.g. nutrient cycling). Note that management of occupied habitat requires enhancement of survival and/or other permits from state and federal regulators.

OBJECTIVE:

Ensure that compatible annual habitat management occurs where necessary in areas owned and/or managed by APBPC/TNC/DEC (including SH sites) within each sub-population in the APB RU by March 31 of each calendar year.

ACTION STEPS

- a)** Draft a Recovery Plan for the Albany Pine Bush RU by July 2008 that describes sub-population specific management objectives consistent with Kbb and suitable habitat viability ratings, including plans for accelerating Kbb colonization to restored habitat through the translocation and/or captive breeding of Karner blue butterflies.
- b)** Complete a site specific habitat management plan by March 1 of each calendar year that details annual habitat management plans and captive rearing/translocation goals. This plan should include prescriptions (pyric, mechanical, chemical) for occupied sub-populations and areas between sub-populations to improve and/or maintain connectivity and metapopulation function, thus improving sub-population size.
- c)** Secure/annually renew and comply with all necessary state and federal permits to manage occupied Kbb habitat in compliance with state and federal endangered species laws by January 2008.
- d)** Draft management guidelines with state and federal regulators regarding the amount, frequency and timing of all applicable land management practices that could be used in occupied Kbb habitat by January 2008.
- e)** Ensure that annual APBRU (APB Preserve and non-Preserve areas) work plans and budgets provide the logistical (staff and equipment) and financial support required to implement site specific habitat management plans.
- f)** Restore at least 640 acres (259ha) of suitable Karner blue butterfly habitat on protected lands by 2025.
- g)** Monitor restoration effectiveness by means of annual Kbb surveys and habitat assessments
 - a.** ensure financial resources are in place to monitor Kbb populations at all occupied Kbb sites
 - b.** ensure financial resources are in place to assess habitat suitability at 10% of restored acres annually.

OBJECTIVE:

Accelerate Kbb colonization to expedite metapopulation viability in the Albany Pine Bush Kbb Recovery Unit by rearing and releasing Kbb at sites where suitable habitat has been restored.

ACTION STEPS

- a)** Annually secure necessary state and federal permits and logistical arrangements with captive rearing facilities.
- b)** Report annual translocation results to USFWS and NYSDEC-ESU.

OBJECTIVE:

Ensure that annual habitat management in areas owned and/or managed by municipalities/utilities/private landowners in/adjacent to the Preserve are consistent with occupied habitat management guidelines and in compliance with state and federal laws.

ACTION STEPS

- a) Draft and send habitat management guidelines, including maps when available, to applicable municipalities/utilities/private landowners by March 31 of each calendar year.
- b) Notify state and federal regulatory agencies of any potentially non-compatible habitat management activities in occupied habitat within 24 hours of discovery.

APPENDIX B: 2008 TRANSLOCATION PROTOCOLS

ALBANY PINE BUSH PRESERVE COMMISSION 2008 KARNER BLUE CAPTIVE REARING PROTOCOL

May 19, 2008

Captive-rearing efforts conducted by the Albany Pine Bush Preserve Commission and their approved agents will follow all permit conditions as provided by the U.S. Fish and Wildlife Service and the New York State Department of Environmental Conservation.

Goal: Accelerate Karner blue butterfly colonization into restored habitat throughout the Albany Pine Bush Recovery Unit.

Objectives:

1. Capture fresh likely gravid female Kbb for transportation to rearing facilities as early in each Kbb flight as possible.
2. Facilitate egg laying in captivity.
3. Raise and release as many Kbb pupae as possible at designated restoration sites that have been demonstrated to have appropriate quantities of lupine and nectar.

Note that while it would be ideal to know how many butterflies need to be captured and released to successfully establish a new viable and self-sufficient Kbb deme, that information is simply not available. As recently as February 2008, the federal Kbb recovery team captive breeding sub-committee recommended that Kbb captive rearing programs aim to capture as many female Kbb as is deemed feasible and release as many Kbb into restoration sites as possible until monitoring demonstrates that a sufficient number of Kbb are present at the site. As of March 2008, eight (8) restoration sites are available as potential release sites.

Captive Rearing Facilities

Farnsworth Middle School, Guilderland New York: Dr. Alan Fiero
New Hampshire Fish and Game, Concord, New Hampshire: Steven G. Fuller

Collection (2008)

First Flight:

As early in the brood as possible, up to 20 recently-mated female Karner blue butterflies may be collected using soft cloth nets from two sub-populations in the Albany Pine Bush Recovery Unit, including the Apollo Drive sub-population and the Pine Bush Southeast sub-population by NYSDEC staff or their designated agents. Females will be collected over a 2-3 day period to maximize the potential that females will be successfully mated and to optimize diversity in the collected individuals. Females will be collected in the afternoon on bright sunny and warm (60-80 degrees F) days. Females exhibiting signs of excessive wing-wear or too freshly emerged will not be collected.

Collected females shall be immediately transferred to temporary transport containers. These are simple 6 oz. plastic food containers with a vented lid supplied with a lupine cutting, a native nectar source cutting and/or an artificial nectar source consisting of cotton held in a .5 inch section of clear plastic tubing, secured in the container and soaked with a 10-20% honey-water solution. Females will then be placed in a solid lunchbox type cooler and transported from the field to the rearing

facility (Farnsworth Middle School). Collected individuals will not be held in these containers longer than 3 hours including total time from initial collection to final transfer at the rearing facility.

Five (5) Kbb will be transported to the Farnsworth Facility
Fifteen (15) will be transported to the NH facility.

Second Flight:

As early in the brood as possible, up to 20 recently-mated female Karner blue butterflies may be collected using soft cloth nets from two sub-populations in the Albany Pine Bush Recovery Unit, including the Apollo Drive sub-population and the Pine Bush Southeast sub-population by NYSDEC staff or their designated agents. Females will be collected on a single day and immediately transported to the NH rearing facility. Females will be collected in the afternoon on bright sunny and warm (60-80 degrees F) days. Females exhibiting signs of excessive wing-wear or too freshly emerged will not be collected.

Collected females shall be immediately transferred to temporary transport containers. These are simple 6 oz. plastic food containers with a vented lid supplied with a lupine cutting, a native nectar source cutting and an artificial nectar source consisting of cotton held in a .5 inch section of clear plastic tubing soaked with a 10-20% honey-water solution. Females will then be placed in a solid lunchbox type cooler and transported from the field to the rearing facility in Concord New Hampshire. Collected individuals will not be held in these containers longer than 3 hours including total time from initial collection to final transfer at the rearing facility. These individuals will be held in captivity in NH for the remainder of their adult life stage and/or released in Concord once egg laying is complete in compliance with NHF&G's USFWS permit. Eggs resulting from these female Kbb will be over-wintered in NH as part of their ongoing captive breeding program.

Captive Rearing Females

At Farnsworth Middle School students assisting with captive-rearing efforts will be under adult supervision at all times. Once at the rearing facility collected females will be transferred to individual marked host plants. Host plants will be potted lupine plants (grown from local seed) about 6 inches in diameter and height and covered with a green mesh fabric secured with string around the lip of the pot. Host plants will be marked and recorded with numbers 1-20. Each potted plant shall also be accompanied by native nectar source cuttings in florist sipper tubes and an artificial nectar source consisting of a .5 inch cube sponge soaked in honey-water solution. Mesh tents will be held fairly close over the host plant to limit movement of females away from the host plant and stimulate ovipositing. All host plants will be held in a simple mini greenhouse with UV spectrum fluorescent lights directly above them and the temperature held between 80 and 95 degrees Fahrenheit. When possible as much ambient natural light will also be utilized. Lights will be placed on a sixteen hour light-eight hour dark cycle. Females will be observed closely each day to monitor for signs of ovipositing. If eggs are not visible after three days in captivity females will be returned to the field. If eggs are visible females will be held for five days and then also returned to the field.

In Concord New Hampshire first flight adults resulting from 2007 over-wintered eggs will be held for captive breeding (with each other and 2008 newly captured wild GLA females) to benefit both the Merrimack River metapopulation recovery goals and the Glacial Lake Albany APB recovery goals. GLA females will be bred with GLA males. Housing conditions and durations will follow the NH Fish and Game protocols and permits.

The resulting second flight Karners will be distributed in the following quantities:

- a) (75%) released as pupae in the Albany Pine Bush at designated restoration site(s)
- b) (25%) held for captive breeding in NH. and/or released as adults in the Concord Pine Barrens.

Egg Collection

Note: NH protocol will follow their existing USFWS and NHF&G permits.

At Farnsworth Middle School: After a female is returned to the field the host plant will be removed from the rack and thoroughly inspected for eggs. The first step is the careful removal of the host plant tent as many eggs are oviposited on the mesh. Eggs on the mesh will be cut around using cuticle scissors and then placed in larval rearing containers. Several eggs may be oviposited next to each other so sometimes pieces of removed mesh could include up to five eggs. The mesh is then placed temporarily next to the host plant. After inspecting the mesh the host plant is then basically dissected to remove all eggs oviposited on the leaves and stems. Female ovipositing often displays distinct patterns especially concentrated on the underside of the radial leaflets and the stem where the individual leaves attached. Many eggs could be near each other so pieces of leaves could contain as many as five eggs when transferred to larval rearing containers. If eggs could be brushed off safely they will be done so with 0 gauge model paint brushes. If this method is employed no more than five eggs will be brushed together into larval rearing containers. When dissecting the host plant for eggs it is important to leave some leaves intact as not every egg is discovered and those larvae that hatch out onto the host plant will need a food source. When inspection is completed the mesh is returned to the host plant and then the pots will be returned to the frame rack. These host plants would then be inspected daily for 'wild men' or larvae that hatched from undiscovered eggs. Once found these larvae will be then also transferred to larval rearing containers. Total number of eggs harvested per female is recorded as well as the total number of hatched larvae from these collected eggs.

Captive Rearing Larvae

Note: NH protocol will follow their existing USFWS and NHF&G permits.

Larval rearing containers will be small 2 oz. clear food portion cups with lids. Containers will be stacked and placed inside clear plastic Rubbermaid storage boxes covered with clear plastic film. Each container is supplied with lupine cuttings to serve as a food source for developing larvae. Upon initial transfer to these containers eggs laid on host plant leaves will be often simply placed in the containers without adding more leaves. If eggs will be laid on mesh they will be placed in containers including lupine leaf cuttings. Each container is monitored daily for hatching and fresh leaves will be added when needed. Often, if the lupine leaves are too small, they would dry out, to avoid this larger leaflets will be selected or several leaflets will be placed in the containers to retain more moisture. Each lid is marked with an E and a number representing the number of eggs. If eggs did not hatch after 5-7 days these will be considered infertile and discarded. Sometimes eggs also perished from infection and mold and will be also discarded. As larvae began to hatch they will be transferred to new containers with host leaves and marked with an L and the number of larvae. When the larvae are small 2-3 may be held in each container but as second instar larvae most will be transferred to individual containers. In this manner of daily inspection, each larva is monitored through the duration of the rearing process. Each container is opened, larva accounted for, growth and health noted, host leaves discarded and replaced with fresh host leaves. Total number of larvae is recorded each day and all mortality events will be accounted for. Cleanliness becomes a real issue very fast as the developing larvae excrete significant amounts of frass. To reduce the chance of infection after first instar the larval rearing containers should be changed each day. This means

transferring the individual larvae from that day's container to a new container with fresh host leaves. All equipment used in transfer should be cleaned with alcohol after use. New fresh host plant leaves will be collected on a 1-2 day basis from local lupine plant sources but may also be collected from greenhouse or nursery stock if available. Old soiled containers would then be discarded. In the first instar stages this presents a tedious and repetitious task and extreme care will be taken to identify, locate and transfer each larvae. Magnifying hand lenses, forceps and paint brushes will be the tools used to transfer larvae. Most often larvae remain on host plant leaves so care must be taken to locate the larva before using forceps to pick up the host plant leaf to avoid crushing. Having the containers over a large flat white table will help considerably. As larvae develop, this process becomes easier and quicker but more host plant is required and significantly more frass is produced. After about 10-14 days most larvae have reached fourth instar and begun the process of pupation. Larvae will slow down and often become fixed at a point on a host leaf or the base of the container. Larvae will stop feeding at this time. Larvae contract and the exoskeleton begins to harden and take the shape of the pupa. Once this occurs each pupa should be removed from the host leaf to avoid mold growth and transferred to a pupal container. Final number of larvae reaching pupation is recorded.

Captive Rearing Pupae

Farnsworth Middle School and Concord NH:

Pupae will be transferred to larger 4 oz. food portion cups with lids. As pupae developed they will be held together in the same age groups with up to five pupae per container. Pupae will be kept separate depending on which female they originated from. Pupae will also be monitored daily for the onset of eclosion. As the green pigment begins to turn to light brown and then the darkened eye spots begin to form the pupae are ready to be placed in release nets. These pupae are then placed in simple 10-12 oz. plastic food containers including some grass stems criss-crossing through the food container to serve as supports and climbing structures in case of premature eclosion. Once all pupae have been inspected and those ready to go have been determined, the transfer containers are then taken to the field to be placed in the release nets.

Release

The 18-acre "Antelope" restoration site and the 4.8 acre "New Hope" restoration site, both located on King's Road in the Town of Colonie, NY are the targeted 2007 release sites in the Albany Pine Bush Preserve. Release nets are inverted mosquito hats, lined with a drainable hard hat, with the neck opening facing upwards and suspended by fishing line from tree limbs about 3-4 feet above the ground. Metal plant hangers, aka Sheppard's Crooks may be used instead of tree branches to reduce the potential for wind damage. Over the top opening is a plastic lid or squirrel guard used to keep rain from soaking the interior of the release net. Enough space is allowed for adults to climb up to the opening and fly away freely. Inside the nets there are dried grass stems for supports and climbing as the adults emerge from the pupae. Grass stems are collected in the field and sterilized in a conventional or micro-wave oven. Release nets are also secured with fishing line from the base to the ground, usually attached to a large and weighty branch to keep the nets from blowing around in wind or severe weather. The fishing line is also coated with Vaseline to keep ants at bay. Pupae are simply placed in the bottom of the release nets and then left to eclose unassisted. No more than 40 pupae should be in a net at any one time. Adults usually emerge in the morning, climb up the sides of the nets or the grass, unfold and allow their wings to dry and harden and then fly out the top opening. Any pupae that do not complete metamorphosis will be discovered when the nets are taken down about 10-20 days following the last placement of pupae. The final number of adults released is then recorded.

Monitoring Kbb at Release Site(s):

Kbb population monitoring will be initiated once adults begin to eclose and emerge from the release nets. Monitoring will employ zigzag index transect counts throughout the release site(s) following methods used for other occupied Kbb sites. Monitoring will continue for all subsequent years, until the population is sufficiently large to facilitate Distance sampling or is no longer considered occupied.

Low Tech Low Budget

Most of the captive rearing and release project can be done with low tech low budget materials and methods. The greatest investment of time occurs during the initial egg harvesting and larval rearing stages. In order to rear 500 individuals it would require a full-time investment by a two person staff through the duration, although the work load becomes easier as the larvae mature and increase in size and a one person staff may be capable of handling the processing. Full-time includes at least an 8-10 hour day spent processing 7 days a week for about 3 weeks. Over the last 2 weeks the larvae begin to pupate, fewer daily changes are required and the processing becomes faster. Eventually toward the end of the rearing process just a daily check of the status of the pupae is required.

Materials

Potted lupine host plants
Host plant light mesh fabric
String
Florist sipper tubes
Cuticle scissors
Eye dropper (for honey solution)
Cotton
Forceps
Clear plastic tubing
6 oz. food containers
10-12 oz. food containers
2 oz. food portion cups
4 oz. food portion cups
2 oz. food portion cup lids
4 oz. food portion cup lids
Marker and Labels for marking host plants
4-8 plastic storage containers
Clear plastic film
Magnifying hand lenses
Honey
Distilled water
Alcohol
Dried grass
Mosquito hats
Fishing line and Vaseline