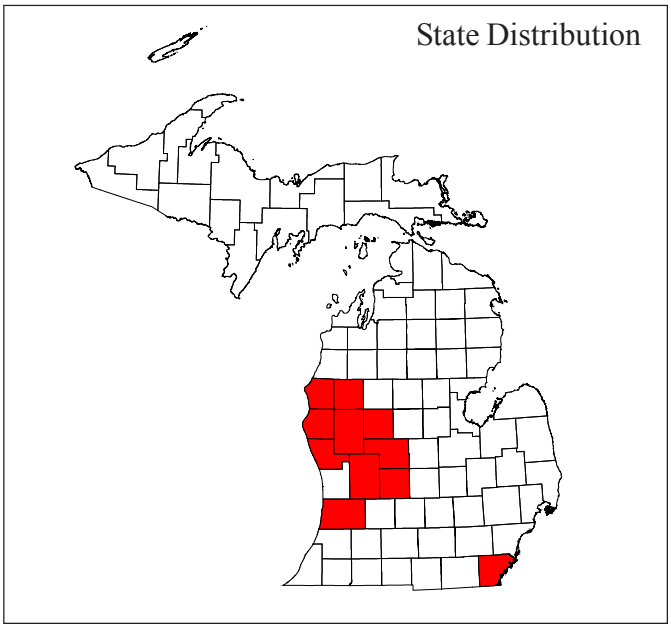
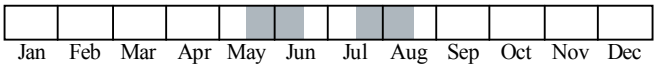
# *Lycaeides melissa samuelis* Nabokov — Karner blue


Best Survey Period




**Status:** State threatened, Federal endangered

**Global and state rank:** G5T2/S2

**Family:** Lycaenidae (the gossamer winged butterflies)

**Taxonomy:** Currently, seven species and 75 subspecies are recognized for *Lycaeides* (Bridges 1988). Two species, *idas* and *melissa*, occur in North America with 12 and 6 recognized subspecies, respectively. Main characters for distinguishing the two species involve wing markings and male genitalia.

To date, the Karner blue is still considered to be a subspecies of the species *melissa* (Nabokov 1943, 1949; Opler 1992). The Karner blue lacked a scientific name until Nabokov described it as a subspecies in 1944. Sometime after Nabokov's published work in the 1940s, he concluded that the butterfly should be classified as a distinct species. In a letter to Robert Dirig (Nabokov 1989), Nabokov gave three reasons for elevating the Karner blue to species status. He believed that there were sufficient "structural and larval differences" (probably structural differences in male genitalia) to warrant specific designation. Nabokov noted that the male genitalia of *L. m. melissa* were very variable geographically, but the male genitalia of *L. m. samuelis* were remarkably constant over the entire range of the subspecies. Moreover, *L. m. samuelis* larvae use only one host plant throughout their geographic range, while *L. m. melissa* larvae feed on many plants. Also, he noted the absence of interbreeding of *L. m. samuelis* and *L. m. melissa* where the specific ranges of each came into contact. Taxonomic work to elevate *L. m. samuelis* to species level was never published.

**Total range:** The Karner blue has a disjunct range. Historically, it occurred in eastern Minnesota, northeastern Iowa, northwestern and central Wisconsin, southwestern Michigan and northern Indiana, extreme southeastern Michigan and northeastern Ohio, central Ontario near the southern Lake Huron shoreline, in the pine barrens near Albany, New York and at a few localized sites elsewhere in New York, and in New Hampshire, Massachusetts, Pennsylvania, and Illinois (U.S. Fish and Wildlife Service 2000). The species is now extirpated in Iowa, Illinois, Pennsylvania, Massachusetts, Maine and Ontario. Today, wild populations of Karner blue exist only in Indiana, Michigan, Minnesota, New Hampshire, New York and Wisconsin. It is actively being reintroduced in northern Ohio after nearly a decade of absence.

**State Distribution:** Historically the Karner blue has been found in the southern Lower Peninsula in 11 counties. It has not been seen in Monroe County since

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1986, but still persists in Mason, Lake, Oceana, Newaygo, Mecosta, Muskegon, Montcalm, Ionia, Kent and Allegan counties.

**Recognition:** The Karner Blue is a small silvery butterfly with a 22 -32 mm (0.90 - 1.25 inch) wingspan (Pyle 1981). **The dorsal (top) surface is silvery blue in males with a narrow, dark border and white fringe. Females range from dull violet to bright purplish blue near the body and central portions of the wings; the remainder of the wing can range from light to dark gray-brown. The hindwing of the female also has a row of dark spots with orange crescents along the outer edge. The ventral (bottom) surface of both sexes is grayish fawn to pearly gray with several rows of small black spots on the inner portions of both wings and a row of metallic blue-green, orange, and black spots just inside the outer margin of both wings, becoming less pronounced in the forewing.** The black marginal line is not distinctly inflated into triangles at the ends of the veins. Several other blues resemble the Karner blue, but none have the combination of being tail-less with orange spots on the dorsal border of the hindwing. Neither the silvery blue (*Glaucopsyche lygdamus*) nor the spring azure (*Celastrina ladon*) has orange on any wing surface. The eastern tailed blue (*Everes comyntas*) has similar pattern and coloration, but both sexes have tails that look like small threads extending from the rear edge of the hind wing. The northern blue (*Lycaeides idas nabokov*) occurs only in the Upper Peninsula, and therefore does not overlap the range of the Karner at any point in Michigan. Larvae are green or whitish green, covered with white hairs, with a cream lateral stripe; the head is small and dark (Scott 1986). Larvae of the frosted elfin (*Incisalia irus*), another lupine-dependent species, often co-occur with Karner blue larvae, are similar in appearance, but have heads that are greenish white like the body.

**Best Survey Time:** Peak Karner blue flight dates in Michigan are mid-May through early June and mid-July through early August, with stragglers found between peak dates. Since the larvae are only 1 mm long at hatching, the best time to search for them feeding on lupine plants is 7-10 days before the adults begin to fly.

**Habitat:** The Karner blue usually is associated with landscapes composed of sandy soils, which supported oak or oak-pine savanna or barrens prior to European settlement. Since their historical habitat suffers from fire suppression efforts, the butterfly often occurs in openings, old fields, and right-of-ways surrounded by close-canopied oak forest. Karner blue larvae feed exclusively on wild lupine (*Lupinus perennis* Linneaus). Adults visit a wide variety of flowering plants for nectar.


MDNR Photo by Dave Kenyon

**Biology:** The Karner blue has two generations each year, with the later, or summer, generation typically having three to four times the number of adults as the earlier, or spring, brood. Males emerge earlier than females and some may disperse for a short time after emergence. Adults are active most of the day, decreasing activity during midday and during cool, rainy weather. Females can live up to two weeks in the field, but adults typically live an average of five days.

Spring females lay eggs on or near lupine and the summer brood larvae hatch in about a week. The larvae grow rapidly, feeding on the upper surfaces of the lupine leaves, as they pass through four instars where the relatively soft exoskeleton is shed each time. Pupation occurs in the litter near or on lupine. The summer adults emerge, mate and lay eggs that overwinter; the spring brood larvae hatch in April. Karner blue larvae are frequently tended by a variety of ant species (Packer 1987, Savignano 1987) that feed on the sweet secretions they produce. Although the results of recent experiments are inconclusive, the ants may help to protect larvae from predators or parasitoids. Tending levels for late instar larvae are close to 100 %, however, very few early instars are tended (Lane 1994, Savignano1990). Adults require adequate nectar resources and will utilize a wide variety of native and introduced flowering plants. In

Michigan they frequently nectar on lupine and dewberry (*Rubus* spp.) during the spring brood and horse mint (*Monarda punctata*), butterfly weed (*Asclepias tuberosa*), spotted knapweed (*Centaurea maculosa*), and blazing star (*Liatris aspera*) during the summer brood (Ewert and Ballard 1990). All life stages are fire sensitive.

Karner blue adults and larvae use a variety of subhabitats created by variations in tree canopy and shrub cover, topography and soil moisture. Adult butterflies use open-canopied areas for nectaring, roosting and mate location. Females have been observed ovipositing in open to closed-canopied areas and in a variety of slopes and aspects. Optimal subhabitat for larval stages contrasts with that used by adults. For second brood larvae, survival is highest in closed-canopied areas, intermediate in partial-canopied areas, and lowest in open-canopied and very xeric areas (Lane 1999). Maxwell (1998) found lupine shaded by shrubs and dense herbaceous cover contributed to larval survival and noted that removal of tree and shrub cover over a large area can be detrimental to the butterfly even when nectar and lupine resources are enhanced. It is important, then, that butterflies be able to move easily between these subhabitat types.

Nearly all researchers that have examined Karner blue dispersal have concluded that dispersal rates and distances for the butterfly are relatively low and short with nearly all movement less than 200 m (1/8 mile). Long distance movements up to 1600 m (one mile) and 1195 m (2/3 mile) for males and females, respectively, have been recorded (Bidwell 1994). The percent of marked individuals dispersing between suitable habitat sites have varied from 0 to 11 % (Bidwell 1994, Fried 1987, King 1998, Lawrence 1994, Schweitzer 1994a). Today's habitat patches are often small isolated remnants, which likely affects our ability to measure true dispersal capability. Definitive studies on insect dispersal frequently uncover unanticipated high frequencies of movement and distances far greater than expected. In studies of the Heath fritillary butterfly in England, Warren (1987) found an average of 1.5 % dispersal between habitat areas. He argued that if similar rates of dispersal were observed to other areas not sampled, that a fairly substantial proportion of adults might be emigrating from the populations studied and arriving at new habitat areas. It is unclear if observed rates of between-habitat dispersal will limit recolonization of suitable habitat by Karner blue, but the 11 % dispersal rate observed by King (1998) in Wisconsin indicates that recolonization can be extensive.

Barriers to dispersal might include many topographical features, vegetation types, and human structures like roads and parking lots. Currently, scientific evidence to identify actual barriers is absent. Welch (1993) found that dispersing butterflies almost always followed canopy openings along fence rows, woodland trails, or small gaps in the canopy, stopping frequently to bask in the sun. Thus dispersal corridors may be quite diaphanous in native habitat, formed by a network of partially connected canopy gaps and trails.

Karner blue populations have a metapopulation structure. The federal recovery team defines a metapopulation as a "population of populations" (U.S. Fish and Wildlife Service 2000). Such a metapopulation is distributed across a landscape at relatively discrete sites. Each of the relatively discrete sites that harbor Karner blue can be referred to as a subpopulation or local population. The number of subpopulations present at any given time is governed by the spatial structure of suitable and unsuitable habitat and the balance between local extirpation and local colonization. Factors that create a healthy metapopulation include sufficient suitable habitat to support the metapopulation, sufficient connectivity to promote recolonization, and management guidelines to aid decision-making. Because complete information is not available, adaptive management for improving or maintaining Karner blue metapopulations is essential. Monitoring can be adapted as the duration of successful management increases. As confidence is gained in the management practices, the need for monitoring declines.

**Conservation/Management:** In December of 1992, the Karner blue was listed as federally endangered rangewide (U.S. Fish and Wildlife Service 1992). The goal of the federal recovery plan is to perpetuate viable metapopulations of the Karner blue in the major ecological regions throughout its geographic range. This will be accomplished by maintaining extant populations throughout the range, and improving and stabilizing populations where the butterfly is imperiled. Wisconsin and Michigan now harbor the largest remaining metapopulations of Karner blue. Four recovery units

have been identified for Michigan: Ionia, Allegan, Newaygo, and Muskegon. Recovery goals for the state include having two viable populations in each recovery unit except Ionia, which has the option to contribute only one because of its small size and fragmented ownership.

Savignano (1994) showed that Karner blue subpopulations on sites with extensive lupine are more likely to persist than those on sites with less lupine. Lupine is an early successional species adapted to dry, relatively infertile soils. Lupine does not reproduce in dense shade. Shading from tree canopy and competition from sod-forming grasses and sedges have excluded lupine from many former barrens and prairies where it once was common (Bess et al. 1989). Consequently, disturbances that reduce tree and shrub canopy cover are necessary for lupine to persist, and under some conditions, occasional disturbances that remove the litter layer are needed for lupine regeneration. Disturbances that may be beneficial for renewing lupine habitat, include prescribed fire, tree removal, and a variety of methods to kill trees and shrubs.

Well-planned fire management is an important tool for rehabilitating and eventually maintaining Karner blue habitat. The frequency of fire management should be tailored to each management unit, taking into consideration the desired final community matrix, current community conditions, site characteristics, and the life histories of all fire sensitive species present. On a large scale, the final product should be a landscape complex of barrens, prairies and woodlands at different stages in succession. In this setting, semi-isolated Karner blue populations within the landscape complex would wax and wane as lupine populations changed, and would provide colonizers to sites recently opened by fire or to sites where butterflies have been lost to localized extinction events.

Inappropriate or incompatible management practices threaten some populations of Karner blues. These practices occur because land mangers have several management goals and they either are unaware of the detrimental effects on Karner blue or they judge them to be acceptable. Poorly timed or poorly located use of herbicides can have a negative effect on Karner blue butterflies by killing or suppressing lupine or important nectar plants. Their direct effect on Karner blue larvae is under investigation. In laboratory tests, even the relatively specific insecticide, *Bacillus thuringiensis kurstaku*, kills all larval instars of the Karner blue (Herms 1996). Mowing between late spring and mid-summer is anticipated to have detrimental effects on Karner blue populations. Mowing can damage lupine, eliminating food for larvae. Mowing during adult nectaring periods can greatly reduce flower and nectar availability. In addition, mowing can kill larvae that are present and may crush eggs laid on lupine plants. One of the most useful restoration and management tools, prescribed fire, may threaten Karner blue populations if the burning is conducted on the majority of the habitat, or if high intensity fires are used at frequent intervals. High deer densities can devastate Karner blue habitat and cause direct mortality by ingestion of larvae (Packer 1994, Schweitzer 1994b). Schweitzer recommends that deer be managed to density levels where no more than 15% of lupine flowers are consumed, but this recommendation has not been rigorously tested.

Many environmental effects that are potentially detrimental to Karner blue can extend over extensive areas, such as large-scale wildfire, extended periods of extraordinary weather (summer-long, hot droughts or extremely delayed and cool summers) or disease epidemics. In these cases, local extirpation is likely to increase throughout the metapopulation, perhaps to the point that the entire metapopulation has no chance of recovery. It is critical, therefore, for management decisions to be made in ways that bring greater stability to the Karner metapopulation.

**Research Needs:** Considerable research has been conducted on this species, and a thorough review is provided in the federal recovery plan. In Michigan, additional surveys are still needed to describe the extent of populations and habitat persisting in the northwest lower peninsula (Mason, Lake, Oceana, Newaygo, Mecosta, and Muskegon counties). Karners were discovered in Kent counties for the first time in 2000. While suitable habitat may have existed there at one time, no historical records for Karners were ever reported, and much of the former oak-pine barren habitat has been converted to agricultural uses. Further surveys in Kent county would be useful. Systematic surveys for two other state threatened lupine-feeders, the Persius duskywing (*Erynnis persius persius*) and frosted elfin (*Incisalia irus*), as well as the state threatened

Ottoe skipper (*Hesperia ottoe*) which inhabits the dry sand prairie habitats associated with barrens and savannas, are lacking.

Of particular importance is research to determine the relationship of fluctuation in the butterfly population to the size, phenology, and distribution of the lupine population. The dispersal capabilities of the butterfly must also be determined to ensure proper design and spacing of habitat patches within each landscape complex. Finally, the impact of ant species on the reproductive success of the butterflies and the effects of management activities on the ants must be determined. Experiments with a variety of burn regimes would be useful to managers. Some areas may need additional information on the establishment of lupine and site-appropriate nectar plants to improve long-term viability.

**Related Abstracts:** Oak-pine barrens, dry sand prairie, coastal plain marsh, frosted elfin, Persius duskywing, Ottoe skipper, dusted skipper, Culver's root borer, Great Plains spittlebug, phlox moth, leadplant flower moth, box turtle, eastern massasauga, prairie smoke, Hill's thistle, meadow beauty.

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