JOURNAL OF
THE LEPIDOPTERISTS' SOCIETY

Volume 41 1987 Number 1

Journal of the Lepidopterists' Society
41(1), 1987, 1-12

STATUS AND HABITATS OF POTENTIALLY ENDANGERED LEPIDOPTERA IN OHIO

JOHN A. SHUEY, ERIC H. METZLER, DAVID C. IFTNER,
JOHN V. CALHOUN, JOHN W. PEACOCK, REED A. WATKINS,
JEFFREY D. HOOPER AND WILLIAM F. BABCOCK

The Ohio Lepidopterists, 1241 Kildale Square North,
Columbus, Ohio 43229

ABSTRACT. The status of eight species that are potential candidates for addition to the U.S. list of endangered species was assessed in 1985. Two of these, *Phyciodes batesii* (Nymphalidae) and *Acronicta albarufa* (Noctuidae), are known only from literature records, and their occurrence in Ohio is unverified. Three species, *Neonympha mitchellii* (Satyridae), *Catocala marmorata* (Noctuidae), and *Catocala pretiosa* (Noctuidae), have not been collected in Ohio for more than 30 years. Three species are extant in Ohio: *Lycaeides melissa samuelis* (Lycaenidae), *Speyeria idalia* (Nymphalidae), and *Erythoecia hebardi* (Noctuidae). Further investigations into the ecological requirements of all the species are suggested, as well as habitat manipulations and acquisitions to insure their continued survival in Ohio. Special emphasis should be placed upon *melissa* and *hebardi* because both are limited to small geographic areas in the State. *Speyeria idalia* seems secure in unglaciated Ohio but has undergone a decline in glaciated areas. Conservation efforts for this species should be concentrated on the isolated populations in glaciated Ohio.

Additional key words: surveys, conservation.

Eight species of Ohio Lepidoptera, four butterflies and four moths, have been identified as being potentially threatened or endangered (Anonymous 1984). The species are: 1) *Lycaeides melissa samuelis* Nabokov (Lycaenidae), 2) *Speyeria idalia* (Drury) (Nymphalidae), 3) *Phyciodes batesii* (Reakirt) (Nymphalidae), 4) *Neonympha mitchellii* French (Satyridae), 5) *Acronicta albarufa* (Grote) (Noctuidae), 6) *Catocala marmorata* W. H. Edwards (Noctuidae), 7) *Catocala pretiosa* Lintner (Noctuidae), and 8) *Erythoecia hebardi* Skinner (Noctuidae).

Concerning the butterflies, *P. batesii* is known only from literature records, and its occurrence in Ohio is unverified. *Neonympha mitchellii* has not been collected in Ohio for more than 30 years. These species

may occur in Ohio, but unless they are rediscovered, no action can be directed toward their preservation. *Lycaeides melissa samuelis* and *S. idalia* are extant in Ohio, and further investigation into their ecological requirements is necessary to insure their continued survival in the State.

Of the four species of moths, only one, *E. hebardi*, has recently been collected in Ohio. One, *A. albarufa*, is known only from literature records, and the other two, *C. marmorata* and *C. pretiosa*, have not been seen in Ohio since the end of the nineteenth century. Based on the written reports and the numbers of extant specimens, it can be deduced that *C. pretiosa* was not rare, whereas *C. marmorata* was.

The brevity of some of the species reports to follow here is evidence of how little is known about them. This is perhaps due to their rarity, but dearth of written information is typical of economically unimportant Lepidoptera. Although many collectors have "local" knowledge, it is rarely written down. Specimens in collections provide some clues, but researchers frequently work without much information.

Information on species potentially threatened and endangered in Ohio has not been adequately compiled. Many areas in Ohio provide habitats for potentially threatened or endangered species of Lepidoptera. Data on these species and their habitats are needed to enhance our ability to make biologically sound policy and management decisions concerning the species and their habitats.

The Ohio Lepidopterists, an organization dedicated to advancing the scientific knowledge of Lepidoptera, conducted a one-year study of the habitats and plant associations of the target Lepidoptera species, their presence or absence in selected habitats, and their historical occurrence in Ohio. The following is a summary of findings.

SPECIES ACCOUNTS

Lycaeides melissa samuelis

Historical distribution. The eastern subspecies *samuelis* occurs in scattered colonies in the Great Lakes area and the Northeast (Opler & Krizek 1984). This insect, the Karner blue, has long been known from Ohio (Rawson & Thomas 1939, Nabokov 1949, Forbes 1960, Price 1970, Opler & Krizek 1984). In recent years, it has been recorded only from an area adjacent to the Schwamberger Preserve in Lucas Co. (Fig. 1). A single record from Summit Co. (Albrecht 1982) was based on a misidentification.

Habitat and plant associations. *Lycaeides melissa samuelis* inhabits sandy pine barrens, oak openings, lakeshore dunes and sandy pine prairies. These habitats must support the lupine, *Lupinus perennis* L., the only known larval hostplant of *samuelis*. *Lupinus perennis*, itself considered "potentially threatened" in Ohio (Cooperrider 1982), requires periodic fire or other disturbances to compete with woody plants (Dirig & Cryan 1976, Miller 1979). Lupine grows in sandy soils, and is important in stabilizing open sand. However, as the soil is stabilized, trees become established, and herein lies the problem for the continued survival of the Karner blue. Apparently, the butterfly will not utilize shaded lupine plants. Originally, natural wildfire was probably an important factor in

FIG. 1. Distribution of *Lycaeides melissa samuelis* and *Neonympha mitchellii* in Ohio, based on examined specimens.

controlling trees that encroached the prairies and other openings. The recent advent of fire prevention has resulted in many of the prairies of the area becoming overgrown with shrubs. Some of these areas have become quickly forested. One of the many results of this has been the near extinction of the Karner blue in Ohio. The last known population could easily become extinct despite efforts to protect it.

Current distribution in Ohio. Presently, a small area in and near the Schwamberger Preserve harbors the only known natural population of the Karner blue remaining in Ohio. Several other potential habitats in Lucas Co. have been surveyed by the Ohio Lepidopterists and others in recent years. Only one other population of *samuelis* was discovered, an introduced small colony in Oak Openings Metropark near Toledo. Scattered populations of lupine were discovered at a few sites in Lucas Co. (Campbell State Nature Preserve, and Oak Openings Metropark system) and in Henry Co., but no *samuelis* were seen at any of these locations.

Discussion. Presently, the outlook for the Karner blue in Ohio is not favorable. The butterfly has been virtually eliminated from the Oak

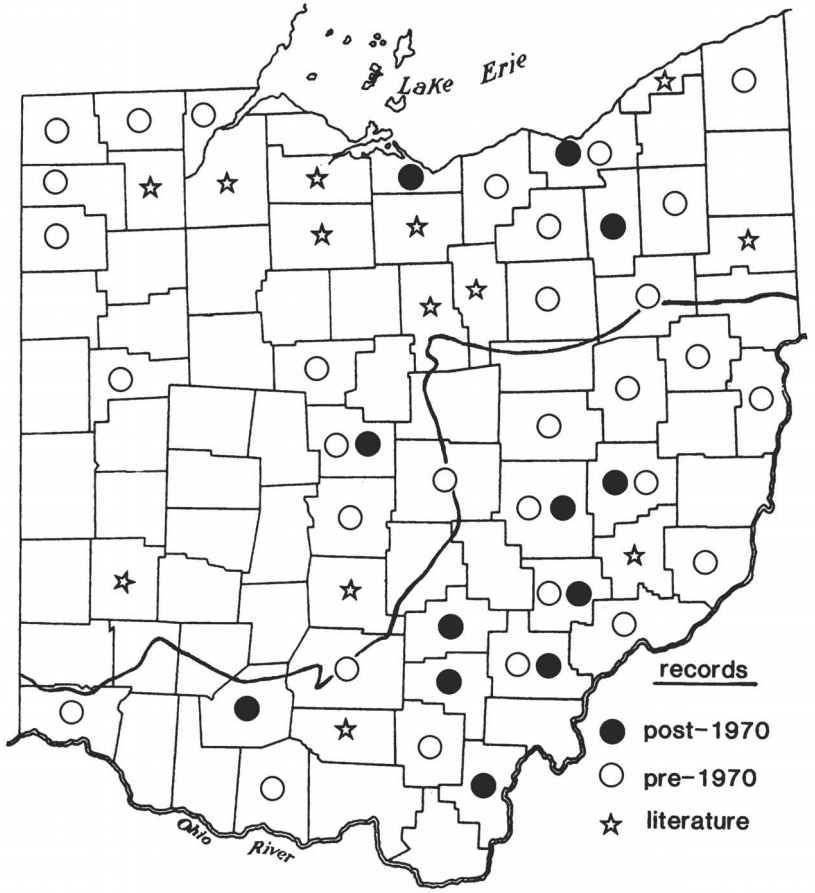

FIG. 2. Distribution of *Speyeria idalia* in Ohio, based on examined specimens and literature records. Line indicates S limit of Wisconsin glacier.

Openings area, very likely as a result of the forestation of the original sandy prairies. Lands in and near the Schwamberger Preserve contain a small population of *samuelis*, but these areas will require intense management if the population of *samuelis* (and other rare butterflies and plants) is to survive.

The Karner blue (and two other rare Ohio butterflies, *Incisalia irus* (Godart) and *Erynnis persius* Scudder) should benefit from habitat manipulations that would increase the local distribution and density of *Lupinus* at the Preserve. Large stands of *Lupinus* currently exist in at least two sites within the Preserve. One site seems ideal for manipulations to establish the plant in the nearby sandy ex-agricultural area. It is likely that prescribed burns could be utilized to enhance the prairie

aspects of the Preserve. *Samuelis* may also benefit from the thinning of shrubby vegetation within the *Lupinus* stands. Recent bulldozing of aspen from land in the Preserve may have inadvertently benefited *samuelis* by removing shade from existing lupine. *Samuelis* was not observed in this area in July 1983, but was frequent in May and July 1984.

Speyeria idalia

Historical distribution. *Speyeria idalia*, the regal fritillary, ranges from N New England W to S North Dakota, S across the N half of the U.S. to E Colorado and Montana (Opler & Krizek 1984). This species was first recorded in Ohio in 1854 (Kirtland 1854). Historically, *idalia* has been most often recorded from the E half of Ohio, although early records indicate it was once common in NW Ohio (Dury 1878, Bubna 1897, Hine 1898a, 1898b, Bales 1909, Henninger 1910, Wyss 1930, 1932). Albrecht (1982) reported that Ohio records include much of the State. It is ironic that there are so few records for *idalia* in the W-central counties of Ohio. This region was once a vast mesic prairie, which should have supported large populations of *idalia*. Perhaps the paucity of records from W-central counties reflects the rapid degradation of *idalia* habitat following conversion of prairies to agricultural land in the mid-1800's, which occurred prior to active collecting in Ohio. In recent years, most collections have been in the SE quarter of the State (Fig. 2).

Habitat and plant associations. The regal fritillary is a butterfly of tall-grass prairie in the Midwest, but is found in other open grassy situations elsewhere. In the East, it is found in damp meadows or pastures with boggy or marshy areas, but it inhabits dry mountain pastures in some areas. The reported primary larval host of *idalia* is bird's foot violet (*Viola pedata* L.); other *Viola* species may be utilized. *Pedata* is extremely rare in SE Ohio (Cusick & Silberhorn 1977), so another violet may be the larval host there. Adults commonly nectar on thistles and milkweeds, along with red clover in pastures.

Current distribution in Ohio. The range of *idalia* in Ohio has apparently diminished in recent years. Most recent records are from SE counties, although there are some records for a few N-central counties since 1970. It has not been recorded in recent years from the NW part of the State. This decline in numbers is not limited to Ohio, as this species appears to have declined precipitously in many areas, and is common only in the few remaining untilled areas in the prairie States (Hammond & McCorkle 1983). In most states, *idalia* is now present only in fragmented populations, and has been extirpated from large regions where it was once common, such as parts of the Ohio Valley and the N Midwest (Opler & Krizek 1984). Its disappearance is likely due to destruction of native prairie habitat, and along with it, destruction of larval host violets.

Discussion. *Speyeria idalia* could probably be preserved in glaciated Ohio by promoting a return of suitable areas to original wet prairie habitats through land purchases or specific land management practices. Presently, this species appears to be unthreatened in unglaciated Ohio. However, it is conceivable that the general decline of *idalia* indicates the future for this species in SE Ohio, and thus its status should be periodically monitored. An effort should be made to determine the larval host plant in SE Ohio.

Phyciodes batesii

Historical distribution. The tawny crescent, *Phyciodes batesii*, ranges from S Quebec and Ontario S to Pennsylvania and Michigan, and W to Nebraska and Colorado. It has

been found in isolated colonies farther S in the Appalachians in Virginia, Kentucky, North Carolina, and Georgia (Opler & Krizek 1984).

All the numerous literature records for this species in Ohio (Bales 1909, Henninger 1910, Wyss 1932, Studebaker & Studebaker 1967) are considered dubious; existing specimens thought to be *batesii* have been determined to be *Phyciodes tharos* (Drury), a common Ohio species.

Habitat and plant associations. In the N part of its range, *batesii* is found in low-lying moist meadows or pastures. In its S distribution, it is found on the tops of dry, rocky bluffs above rivers, or on dry hillsides or rocky upland pastures, usually in association with *Andropogon* grass. The larval foodplant is wavy-leaved aster (*Aster undulatus* L.) and possibly other true asters (Opler & Krizek 1984).

Current distribution in Ohio. There is no evidence that this species currently exists in Ohio.

Discussion. Cusick and Silberhorn (1977) record *A. undulatus*, the known larval foodplant, in 21 of 33 SE Ohio counties. These areas and others where *A. undulatus* is native should be thoroughly explored for *batesii*.

Neonympha mitchellii

Historical distribution. Mitchell's satyr, *Neonympha mitchellii*, displays a disjunct distribution. The only known localities are in New Jersey (Rutkowski 1966), South Carolina, Indiana, Michigan, and Ohio. Midwestern sites occur in a limited area characterized by glacial till topography and calcareous springs.

In Ohio, *mitchellii* was first recorded in Streetsboro Fen in Portage Co. (Pallister 1927) (Fig. 1). Holland (1931) and Macy and Shepard (1941) also cited *mitchellii* in Ohio. Pallister found *mitchellii* abundant in Streetsboro Fen on 4 July 1925 and 10 July 1926. He described the area as a several-hundred-acre peat swamp, but found that *mitchellii* was restricted to approximately one acre of "sedge meadow" surrounded by tamarack and maple. According to McAlpine et al. (1960), *mitchellii* was last reported from the area on 19 June 1950. By 1954, most of Streetsboro Fen had been converted to a truck farm.

Habitat and plant associations. Although the literature reports that *mitchellii* occurs in bogs, all of the habitats described are clearly fens (Shuey 1985) (bog fens in the terminology of Stuckey & Denny 1981). Fens occur over alkaline springs on deposits of peat, and are dominated by sedges (bogs are acidic and are dominated by mosses in the genus *Sphagnum*) (Pringle 1980). Reliable indicators of potential *mitchellii* habitats include tamarack, poison sumac, shrubby cinquefoil and abundant sedges. *Mitchellii* has a strong preference for flying in open stands of tamarack, especially along stream banks.

Mitchellii has been reared on several *Carex* species (McAlpine et al. 1960), but it is not known what species are utilized in the natural habitat. *Mitchellii* is usually closely associated with narrow-leaved *Carex*, probably *C. stricta* Lam. or *C. aquatilus* Wahlenb.

Current distribution in Ohio. Today, there remains little habitat in Ohio resembling the habitats that support viable colonies of *mitchellii* in Indiana and Michigan. Gott Fen State Nature Preserve, located within Streetsboro Fen, is primarily a shrubby cinquefoil meadow, but some limited areas support lush *Carex* openings with which *mitchellii* is associated. *Mitchellii* generally flies in lush sedge meadows adjacent to such areas, but at Streetsboro these are the areas that seem most heavily disturbed. Most sedge meadows in Streetsboro Fen support the broad-leaved sedge, *Carex lacustris* Willd., or rushes, *Scirpus* spp., not the narrow-leaved species with which *mitchellii* is typically associated.

On 29, 30 June, and 6, 7 July 1985, several members of The Ohio Lepidopterists surveyed for *mitchellii* at four fens in Portage Co. (Wingfoot Lake, Mantua Swamp, Frame Lake Bog/Herrick Preserve and Gott Fen State Nature Preserve), one fen in Stark Co. (Timken Bog), and two fens in Summit Co. (Standard Slag Bog and Nimisila Bog

Meadow). *Mitchellii* was not located in these surveys and, because *mitchellii* is usually common when found, and the flight period was well covered in these surveys, it was concluded that *mitchellii* probably is not present at these sites.

Discussion. If *mitchellii* is to be rediscovered in Ohio, efforts should be concentrated in habitats similar to the original Streetsboro Fen. The fen at Herrick Nature Preserve, just S of Streetsboro Fen, lacks suitable sedge meadows, but as far as known, no one has searched Tinkers Creek between these two areas. Many other fens (Mantua Swamp, Kick Fen, others) in NE Ohio fit the general habitat description. Unfortunately, fire suppression has allowed many of these areas to become overgrown with species of dogwood, reducing the amount of suitable sedge meadow. Mantua Swamp and Standard Slag Bog were not completely surveyed in 1985 because of their large size. If sedge meadows occur in the center of these sites, they deserve a closer look. If "new" fens are discovered in the Portage Co. area that contain extensive stands of tamarack, they, too, should be sampled for *mitchellii*.

In NW Ohio, the only likely habitat that remains in undisturbed condition is Mud Lake in Williams Co. *Mitchellii* does not occur at Mud Lake, and probably has not occurred there in recent times (Price 1970). However, Mud Lake is very similar botanically to nearby Cedar Lake fen in NE Indiana, which does support a colony of *mitchellii*.

Catocala marmorata

Historical distribution. The marbled underwing, *Catocala marmorata*, is one of the rarer taxa in the genus. It has not been seen in Ohio since late in the nineteenth century (Dury 1876, 1878, Pilate 1882), and has always been rare over its entire range (Holland 1903, Barnes & McDunnough 1918, Forbes 1954, Sargent 1976). Sargent (pers. comm.) indicated that *marmorata* was collected more regularly in recent years. Collectors in Kentucky have taken about a dozen specimens in the past 10 years; compared to previous years, this would seem a population explosion.

All records for Ohio are from the S half in Hamilton, Montgomery, and Franklin counties (Fig. 3). These records were made by very active collectors (Charles Dury, Cincinnati; George Pilate, Dayton; and W. N. Tallant, Columbus) in the late 1800's. A specimen in the Strecker collection in the Field Museum of Natural History, Chicago, is simply labeled "S. Ohio, 8-26-[18]76". Specimens in the Cincinnati Museum of Natural History and the Field Museum substantiate the historical occurrence of *marmorata* in Ohio. Because this species is not easily confused with others, literature records can be accepted with little hesitation.

Habitat and plant associations. Habitats and plant associations of *marmorata* are unknown. This species is placed with those of the genus whose caterpillars feed on willow and aspen. This placement is supported by overall moth appearance and genitalia (Gall 1984).

Current distribution in Ohio. It is difficult to assess the present status of this species in Ohio. Although it has not been seen in Ohio for approximately 90 years, there have been few active moth collectors in Ohio in that time, and none of them have collected in the SW part of the State where *marmorata* might be found. The species has been collected in an upland oak woods in S Kentucky (Loran Gibson, pers. comm.), but collecting in SW Ohio in similar habitats has not yielded it. *Marmorata* certainly is vagile, and may well have been a temporary resident or even a vagrant in Ohio, as is probably

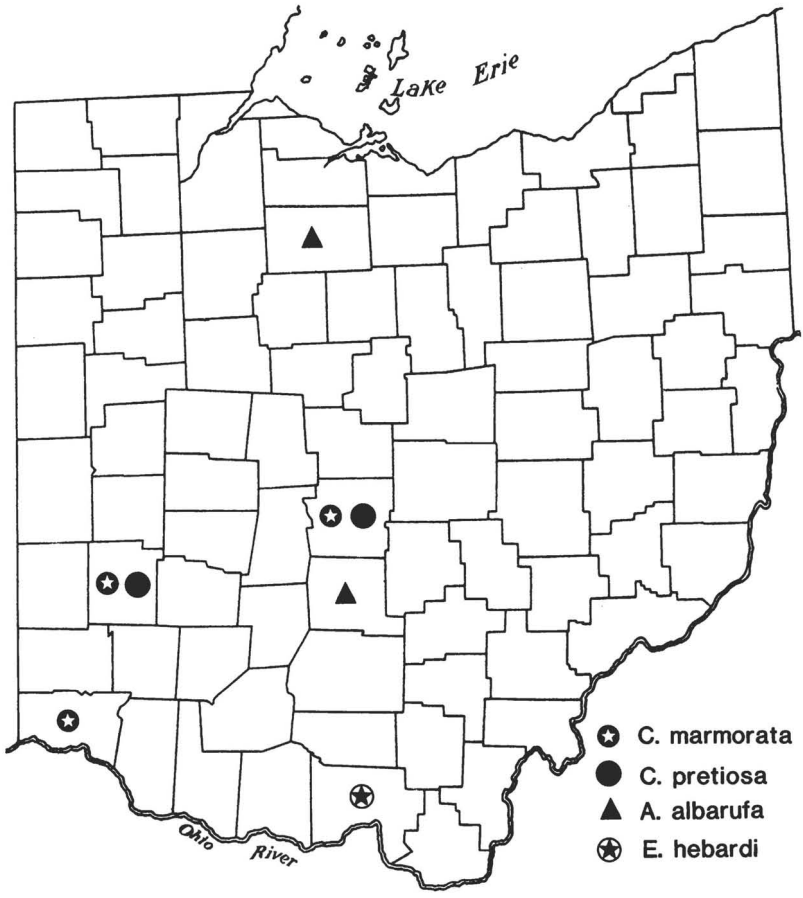

FIG. 3. Distribution of *Catocala marmorata, C. pretiosa, Acronicta albarufa,* and *Erythoecia hebardi* in Ohio, based on examined specimens and literature records.

the case for Connecticut, New York, and New Jersey. Given its rarity, *marmorata* might still be found in Ohio.

Discussion. A stronger effort to collect in SW Ohio in willow, cottonwood, and oak habitats is needed. If the supposition is correct that the foodplant is salicacious, wet areas of S Ohio, particularly the SW portion, will be critical to the survival of this species. If, as indicated by some recent captures, the species is associated with oak forests, the concern with wet areas will be lessened. With current environmental emphases on wetlands as habitats, *marmorata* may be protected unwittingly. Land changes affecting other forested areas are more difficult to control.

Catocala pretiosa

Historical distribution. *Catocala pretiosa* has been collected in Ohio several times in Montgomery and Franklin counties (Fig. 3). All collections were made by W. N. Tallant and George Pilate. Pilate and Tallant stopped collecting in Ohio before 1900, when Pilate moved to Georgia, and Tallant moved to Richmond, Indiana; *pretiosa* has not been taken in Ohio since. Extant specimens from Ohio are in the Dayton Museum of Natural History, Dayton, Ohio, the U.S. National Museum of Natural History, Washington, D.C., and the Allyn Museum of Entomology, Sarasota, Florida. Although John and Edward Thomas collected extensively in central Ohio (as well as other areas of the State) in the 1930's, they did not collect *pretiosa*. This is consistent with the distribution reported by Sargent (1976), who states, "This moth was not taken by collectors for many years" (from about 1920 to 1968), and "was often presumed to be extinct". Schweitzer (1982) discussed recent captures of *pretiosa*, and indicated this species may be restricted to southern New Jersey. The New Jersey populations apparently did not exist when *pretiosa* was being collected in other areas, and now that *pretiosa* is being collected in New Jersey, it is unknown in the former locations.

Habitat and plant associations. Schweitzer (1982) reported rearing *pretiosa* on *Prunus maritima* Marsh in New Jersey; also (pers. comm.) that he found one larva on *Pyrus arbutifolia* (L.), red chokeberry, in New Jersey in 1986. Other species in this group of *Catocala* also use *Pyrus* spp. (crabapples), *Prunus* spp. (plums, cherries) and *Crataegus* spp. (hawthorns) as larval host plants. *Prunus maritima* and *Pyrus arbutifolia* do not occur in Ohio; therefore, the larval host in Ohio must be some related plant. If the Ohio foodplant is a species of *Pyrus*, *Prunus*, or *Crataegus*, the list of possible host species is extensive.

Current distribution in Ohio. Three collecting trips were made in central Ohio (SW Franklin, Madison counties) in late June–early July 1985 to areas with a concentration of possible foodplants. These areas were selected on the basis of the historical distribution of *pretiosa*. General collecting was very good; however, *pretiosa* was not seen.

Discussion. Based on current records and Schweitzer's assumptions, we should not expect to find *pretiosa* in Ohio.

Acronicta albarufa

Historical distribution. *Acronicta albarufa* is recorded from Ohio in only two literature records (Bales 1909, Henninger 1910) (Fig. 3). This species is very similar to *Acronicta ovata* Grote, a common species in Ohio. Without verified specimens from Ohio, it is easy to imagine that the specimens identified as *albarufa* may have been *ovata*. It is not possible to exclude *albarufa* from Ohio's fauna, however, because the reported species range crosses the U.S. from the E coast to New Mexico and Colorado, N to Canada, and S to Georgia (Forbes 1954).

Habitat and plant associations. The apparent habitat requirements of *albarufa* limit the areas where it may be found in Ohio. According to J. G. Franclemont (pers. comm.), the E distribution of *albarufa* is restricted to sandy soils and habitats consistent with "pine barrens" or "sand barrens". Once widespread in the E, according to Franclemont, *albarufa* now seems more confined to coastal areas from New Jersey to Cape Cod, and to pine barrens near Albany, New York. Schweitzer (pers. comm.) has taken *albarufa* at two locations (Ontario and Massachusetts), and states that the moth occurs in the "oak-pine forest on the coastal plain". The oaks are "primarily *Quercus velutina, coccinea, stellata* and *alba* with some *Q. ilicifolia* in the understory". In Massachusetts, where he has collected *albarufa*, Schweitzer reported "The only tree is *Pinus rigida*" with an understory of scrubby oaks that "are well in excess of 99% *Q. ilicifolia*". In Grand Bend, Ontario, Schweitzer collected *albarufa* in a "sandy oak (mostly *Q. velutina*)-pine forest".

Current distribution in Ohio. The oak forests of Ohio have been heavily collected in the past and *albarufa* has not been taken. Three collecting trips were carried out in 1985

in the Oak Openings area of Lucas Co., and the Erie sand barrens in Erie Co. during the known flight period which is May through August. General collecting was good, but no specimens of *albarufa* were seen.

Discussion. Further collecting is needed in suitable habitats, such as the Oak Openings area in Lucas Co., and dry ridge tops of S Ohio. For now, inclusion of *albarufa* as part of Ohio's fauna is tentative.

Erythroecia hebardi

Historical distribution. A population of *Erythroecia hebardi*, one of the rarest moths in North America, occurs in Scioto Co., Ohio (Fig. 3). The size of the Ohio population is unknown. Originally described in 1917 from two specimens from Hot Springs, Virginia, *hebardi* has not been seen from Virginia since. Until 1984, all known specimens, except the types, have come from N-central New Jersey, near Lake Hopatcong and Johnsonburg. Before 1984, fewer than 10 specimens were known in collections. Of these, only two, those from Johnsonburg, are recent records; all others predate 1930. Nothing is known of the life history, and only guesses can be made about its habitat requirements.

This species was first collected in Ohio at UV light on 26 August 1984 in Shawnee State Forest, Scioto Co. The site was a clearing that resulted from a recent clearcutting. More collecting in 1985 and 1986 yielded additional specimens, several of which came from two additional locations, 1.2 km and 4.2 km S of the first site. The second and third sites are also recent clearcuts.

Habitat and plant associations. In all occurrences of this moth in Ohio, the habitat is a recent clearcut area in mature second growth forests in the rugged unglaciated Allegheny Plateau of the S part of the State. This is an area of steep hills capped with sandstone ridges, and acidic, dry soils. Common forest trees are upland mixed oaks, hickories, maples, native pines (Virginia, yellow, and pitch), and yellow poplar. Usual forest groundcover plants are several kinds of blueberries, huckleberries, and other members of the heath family. Because of the acidic soils, diversity of wildflowers is low (King 1979).

Adventive species of plants such as clovers, sunflowers, goldenrods, ragweeds, etc., quickly invade the clearcut areas to provide considerable diversity of plants not found in the forest. All specimens of *E. hebardi* collected so far have come from clearcut areas immediately adjacent to the forest. Larval foodplant and habitat requirements are unknown.

Current distribution in Ohio. To date, this species has been collected only in Scioto Co., in S Ohio.

Discussion. Based on information gathered to date, the continued survival of *hebardi* in Ohio is encouraging. More complete information pertinent to its habitat and food requirements is essential. The occurrence of *hebardi* in Ohio provides a unique opportunity for research to discover reasons for its previous rarity.

CONCLUSIONS

Most of the species discussed indicate unique ecological situations in Ohio. Further investigation into the ecological requirements of all the species and their habitats is warranted. The presence of populations can and should be used in decisions concerning the preservation of unique and endangered habitats. Special emphasis should be placed on *Lycaeides melissa samuelis* and *Erythoecia hebardi* because both are limited to very small geographic areas in Ohio; survey work should be

directed toward locating additional populations of these species. *Speyeria idalia* seems secure in unglaciated Ohio, but further research is needed to determine larval host plants and the reasons for population fluctuations. On the other hand, this species has declined in glaciated areas. Conservation efforts for this species should therefore be concentrated on the isolated populations in glaciated Ohio. There should be a continuing effort to locate *Phyciodes batesii, Neonympha mitchellii, Catocala marmorata, Catocala pretiosa* and *Acronicta albarufa* in Ohio.

ACKNOWLEDGMENTS

Thanks are due the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, for a grant to The Ohio Lepidopterists for this research, and for providing access to properties under their jurisdiction. Thanks are also extended to the divisions of Parks and Recreation, Forestry, and Wildlife, the Toledo Metroparks, Columbus Metroparks, The Nature Conservancy, and the Ohio Historical Society for information and access to properties under their control. We are grateful to J. G. Franclemont, J. D. Lafontaine, and D. F. Hardwick for their continuing contributions to research on *E. hebardi*. We thank The Ohio Lepidopterists, curators, collectors, and others too numerous to mention who allowed us to visit their collections and take data. Without their generous support, this study would not have been possible.

LITERATURE CITED

ALBRECHT, C. W., JR. 1982. The taxonomy, geography, and seasonal distribution of Rhopalocera in Ohio. Ph.D. Thesis, The Ohio State Univ. 512 pp.

ANONYMOUS. 1984. Endangered and threatened wildlife and plants; review of invertebrate wildlife for listing as endangered and threatened species. U.S. Fish and Wildlife Service, Notice of Review. Federal Register 49:21664–21675.

BALES, B. R. 1909. A partial list of the Lepidoptera of Pickaway County, Ohio. Entomol. News 20:169–177.

BARNES, W. & J. MCDUNNOUGH. 1918. Illustrations of the North American species of the genus *Catocala*. Mem. Am. Mus. Nat. Hist. New Series Vol. 3, Part 1. 47 pp.

BUBNA, M. 1897. Entomology at Cleveland, Ohio. Entomol. News 8:97–99.

COOPERRIDER, T. S. 1982. Endangered and threatened plants of Ohio. Ohio Biol. Surv., Biol. Notes No. 16. 92 pp.

CUSICK, A. W. & G. M. SILBERHORN. 1977. The vascular plants of unglaciated Ohio. Bull. Ohio Biol. Surv., New Series Vol. 5, No. 4. 157 pp.

DIRIG, R. & J. F. CRYAN. 1976. The Karner blue project: January 1973 to December 1976. Atala 4:22–26.

DURY, C. 1876. List of *Catocalae* observed in the vicinity of Cincinnati, Ohio, 1876. Can. Entomol. 8:187–188.

——— 1878. Catalogue of the Lepidoptera observed in the vicinity of Cincinnati, Ohio, including diurnals, Sphingidae, Aegeridae, Zygaenidae, Bombycidae, Noctuidae, Phalaenidae, and Pyralidae. J. Cincinnati Soc. Nat. Hist. 1:12–23.

FORBES, W. T. M. 1954. Lepidoptera of New York and neighboring states. Part III. Noctuidae. Cornell Univ. Agr. Exp. Stat. Mem. 329. 433 pp.

——— 1960. Lepidoptera of New York and neighboring states. Part IV. Agaristidae through Nymphalidae, including butterflies. Cornell Univ. Agr. Exp. Stat. Mem. 371. 188 pp.

GALL, L. F. 1984. The evolutionary ecology of a species-rich sympatric array of *Catocala* moths. Ph.D. Thesis, Yale Univ. 264 pp.

HAMMOND, P. C. & D. V. MCCORKLE. 1983. The decline and extinction of *Speyeria*

populations resulting from human environmental disturbances (Nymphalidae: Argynninae). J. Res. Lepid. 22:217–224.

HENNINGER, W. F. 1910. The macro-Lepidoptera of Seneca County, Ohio. Ohio Nat. 11:233–242.

HINE, J. S. 1898a. List of butterflies known to have been taken in Ohio. Ohio Acad. Sci., 6th Ann. Rpt. Pp. 22–27.

——— 1898b. Ohio butterflies. J. Proc. Columbus Hort. Soc. 12:77–79.

HOLLAND, W. J. 1903. The moth book. Doubleday, Page & Co., New York. 479 pp.

——— 1931. The butterfly book. Doubleday, Garden City, New Jersey. 424 pp.

KING, C. C. 1979. Hill country, pp. 161–181. *In* Lafferty, M. B. (ed.), Ohio's natural heritage. Ohio Acadamy of Science, Columbus, Ohio.

KIRTLAND, J. P. 1854. Diurnal Lepidoptera of northern and middle Ohio. Proc. Cleveland Acad. Nat. Sci. 2:5, 73–75.

MACY, R. W., & H. H. SHEPARD. 1941. Butterflies, a handbook of the butterflies of the United States, complete for the region north of the Potomac and Ohio rivers and east of the Dakotas. Univ. Minnesota Press, Minneapolis. 247 pp.

MCALPINE, W. S., S. P. HUBBELL & T. E. PLISKE. 1960. The distribution, habits, and life history of *Euptychia mitchellii* (Satyridae). J. Lepid. Soc. 14:209–226.

MILLER, W. E. 1979. Fire as an insect management tool. Bull. Entomol. Soc. Amer. 25: 137–140.

NABOKOV, V. 1949. The nearctic forms of *Lycaeides* Hübner. (Lycaenidae, Lepidoptera). Psyche 50:87–99.

OPLER, P. A. & G. O. KRIZEK. 1984. Butterflies east of the Great Plains. Johns Hopkins, Baltimore, Maryland. 294 pp.

PALLISTER, J. C. 1927. *Cissia mitchelli* (French) found in Ohio, with notes on its habits. Lepidoptera-Satyridae. Ohio J. Sci. 27:203–204.

PILATE, G. R. 1882. List of Lepidoptera taken in and around Dayton, Ohio. Papilio 2: 65–71.

PRICE, H. F. 1970. Butterflies of northwestern Ohio. Mid-Continent Lepid. Ser., No. 14. 16 pp.

PRINGLE, J. S. 1980. An introduction to wetland classification in the Great Lakes region. Royal Bot. Gardens. Tech. Bull. No. 10. 11 pp.

RAWSON, G. W. & J. S. THOMAS. 1939. The occurrence of *Hemiargus isola* (Reakirt) in northern Ohio. Bull. Brooklyn Entomol. Soc. 34:9–10.

RUTKOWSKI, F. 1966. Rediscovery of *Euptychia mitchellii* (Satyridae) in New Jersey. J. Lepid. Soc. 20:43–44.

SARGENT, T. D. 1976. Legion of night: The underwing moths. Univ. Massachusetts Press, Amherst. 222 pp.

SCHWEITZER, D. F. 1982. The larva and status of *Catocala pretiosa* (Noctuidae), with designation of a lectotype. J. Lepid. Soc. 36:18–30.

SHUEY, J. A. 1985. Habitat associations of wetland butterflies near the glacial maxima in Ohio, Indiana and Michigan. J. Res. Lepid. 24:176–186.

STUCKEY, R. & G. DENNY. 1981. Prairie fens and bog fens in Ohio: Floristic similarities, differences, and geographical affinities. *In* Romans, R. C. (ed.), Geobotany II. Plenum, New York. 271 pp.

STUDEBAKER, O. & D. STUDEBAKER. 1967. Butterflies of Miami County, Ohio. Newsletter Assoc. Minnesota Entomol. 1:61–65.

WYSS, A. 1930. A list of Rhopalocera taken in Cincinnati and vicinity. Proc. Junior Soc. Nat. Sci. 1(8&9):4–6.

——— 1932. Guide to the butterflies of Cincinnati and vicinity. Junior Soc. Nat. Sci. Misc. Publ., No. 7. 37 unpaged.

Received for publication 23 May 1986; accepted 14 November 1986.