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***CELASTRINA SEROTINA* (LYCAENIDAE: POLYOMMATINAE):
A NEW BUTTERFLY SPECIES FROM
THE NORTHEASTERN UNITED STATES AND EASTERN CANADA**

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ABSTRACT. A new light-venter Azure species, *Celastrina serotina*, is described from the northeastern United States and eastern Canada. The flight period of this univoltine spring species is interpolated (allochry) between its sympatric congeners, *C. lucia* Auctorum (not Kirby) and *C. neglecta* (Edwards). In this regard it is similar to *C. neglectamajor* Opler & Krizek in the southern Appalachians and *C. idella* Wright & Pavulaan on the New Jersey coastal plain. In a significant portion of its range, *C. serotina* larvae feed on eriophyid mite-formed galls on the upper surface of Black Cherry *Prunus serotina* Ehrh. leaves. The larvae also utilize floral primordia of several additional hosts from different plant families. Adults are morphologically distinct from the earlier flying Spring Azures, *C. ladon* and *C. lucia* Auctorum, but have a clear resemblance to *C. neglectamajor*, *C. idella*, and *C. neglecta*. Separation from these lighter phenotype species is by size, distribution, habitat, and flight period. We propose the new species may be one of several late spring allochronic species forming a chain or great arc from the southern Appalachians to northeastern United States & eastern Canada, possibly across the northern Great Lakes region to southern Manitoba & Saskatchewan, to the Foothills of the Rocky Mountains in Colorado.

DISCOVERY OF AN UNUSUAL BUTTERFLY

During Rhode Island field surveys in 1983-84, a conspicuous sequence of *Celastrina* emergences was observed (Pavulaan, 1985). The earliest Azure to appear in early to mid-April (*C. lucia* Auctorum) consisted of small individuals with dark dusky gray venters, commonly with black discal patches (f. "*lucia*") and/or broadened margins on the hind wings (f. "*marginata* Edwards"). *C. lucia* was found widely distributed throughout the state, and was especially easy to observe in early spring along the sandy woodland roads of the Great Swamp Management Area, near West Kingston, Washington County. The Great Swamp population utilized Highbush Blueberry *Vaccinium corymbosum* L. as its host, and it was subsequently learned that *lucia* utilized several species of *Vaccinium* in Rhode Island. Shrubby plants in this genus are plentiful in the state, often forming dense thickets in old fields or a solid understory in forested habitats. Because of its association with these habitats, *C. lucia* was encountered routinely in virtually every region of the state in April. The flight reached peak numbers in late April. (See the account of *C. lucia* Auctorum ("of authors") in discussion of *Celastrina lucia* on p. 14.)

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***C. lucia* Auct.**



C. serotina



C. neglecta

Figs. 1-3. Sympatric *Celastrina* in northeastern United States (live specimens). ♂♂ **Fig. 1.** 3 May 1992, Caumsett S.P., Suffolk Co., NY. **Fig. 2.** 14 May 2000, Sayville, Suffolk Co., NY. **Fig. 3.** 15 July 2005, Jamaica Bay, Queens Co., NY. Photos by Chris Adams (Fig. 1) and Steve Walters (Figs. 2 & 3).

By early May, *lucina* individuals showed signs of wear and their numbers began to fall. It was at this time that a second irruption of Azures appeared. This emergence consisted primarily of very light-ventered individuals, some appearing almost white on the first day of emergence and contrasting sharply with the darker coarsely-patterned *lucina* phenotype. These light-ventered Azures were neither as common nor as widespread as the earlier *lucina* flight, and appeared in only a few locations such as Great Swamp. Individuals with darkened margins were entirely absent from this flight, however a few rare individuals (1%) displayed a partly-developed ventral hind wing patch, reminiscent of the earlier “*lucina*” forms. The initial thought was these were f. “*neglectamajor* Tutt”, although the biology of *neglectamajor* was poorly understood at the time. Klots (1951) wrote, “In some regions occurs a partial second brood (*neglectamajor*), large, very bright colored above, white beneath, with clear-cut markings. This is “spotty” in its occurrence...” Swayed by Klots’ description, the Rhode Island light phenotype was misidentified as *C. neglectamajor* by Pavulaan (1985). Reginald Webster (pers. com., 1984) suggested the unique Rhode Is. butterfly may represent a new species, citing erroneous reports that *neglectamajor* utilized *Viburnum acerifolium* L. (Shapiro, 1966; Opler & Krizek, 1984), a plant that was relatively scarce at Great Swamp. It was reasonably concluded that *V. acerifolium* could not support the large population of what was believed to be *neglectamajor* at this location. The first evidence of possible host association came when several females were flushed from a young *P. serotina* tree in Warwick, R.I. on May 22, 1984, though it was not immediately obvious that the species was utilizing leaf galls as the primary host.

In July, a third distant Azure flight (*C. neglecta*) was witnessed in Rhode Island. These butterflies had pale white venters with faintly seen maculations. Their occurrence was very spotty and collectively their flight was the least common of the three flights observed. Popularly thought to be the summer form of a spring species, this notion seemed unfounded because *C. neglecta* individuals were seen in far fewer numbers and in locations that often did not correspond with the earlier flights. A female was found ovipositing on White Meadowsweet *Spiraea alba* var. *latifolia* (Ait.) along a utility powerline near Cranston, Providence Co., on July 17, 1984. Because this host and cherry (*Prunus* sp.) were members of the same plant family (Rosaceae), a link seemed possible, but oddly no Azures were found at this location in May. At this point a strong suspicion emerged that the light-ventered May and July flights were separated and represented different species. Shortly thereafter, rearing studies established that the light-ventered May population was univoltine and reproductively separated from summer flights of *C. neglecta*. Similar studies also established *C. lucina* was univoltine, although this was not entirely unexpected since this Azure had a vast distribution in northern Canada and Alaska where only a single flight was known. We began an effort to learn more about the biology and distribution of the light-ventered May Azure.



***C. lucia* Auct.**

C. serotina

C. neglecta

Figs. 4-6. Sympatric *Celastrina* in northeastern United States (spread specimens). ♂♂ **Fig. 4.** 16 April 2005, Connecticut College Arboretum, New London, CT. **Fig. 5.** 21 May 2005, same site. **Fig. 6.** 24 July 2005, same site. (D/V). Photos by David Wright.

HISTORICAL TREATMENT IN LITERATURE

The North American *Celastrina* are extremely diverse in their ecology and phenotypes. Whether viewed as many closely-related species or as one polymorphous continent-wide species, the extraordinary displays of regional variation provide opportunity for research and a deeper understanding of insect evolution. This prospect must have allured those who first encountered the notable differences between our native Azures. In 1841, Edward Doubleday commented, “I may just express my opinion that two species are confounded under the name *pseudargiolus* ..”, an insightful view that foreshadowed a cascade of papers describing new species from North America. In fact, while Doubleday traveled and collected in the U.S., Kirby named one from Canada in 1837 (*lucia*), and William H. Edwards soon followed with three more (*neglecta*, *echo*, *violacea*) from the United States in the 1860s. As new discoveries unfolded during the last century, more species were continually added to our fauna. Remarkably, the light-vented spring Azure of northeastern U.S. and eastern Canada did not go unnoticed. A detailed account of its appearance in the lepidopterological literature records no less than 50 entries. (See “Synonymy”, p.6.)

In the late 19th century, recognizable references to this unique Azure came mostly from authors who resided in the species’ range. The great Azure debate of this period was the status of *neglecta*. Writing from West Virginia, Edwards (1875) concluded that *neglecta* might prove to be the summer brood of spring forms *violacea* [= *ladon*] and *pseudargiolus* (sensu Edwards) [= *neglectamajor*], and inferred that in the north *neglecta* may be the summer brood of *lucia* inasmuch it was also a spring form. Scudder (1876) in Massachusetts, Lintner (1875) in New York, & Saunders (1875) in Ontario challenged Edwards’ concept and reported *lucia* and *neglecta* were not united. Scudder (1876) pointed out that *neglecta* appeared twice a year in spring and summer, with the earlier *neglecta* appearance in May (in fact *serotina*) being too close on the heels of the *lucia* to be derived from it. He subsequently concluded that spring taxa, *lucia* in April and *neglecta* in May, were derived from diapausing chrysalids and their flights were separated by successive eclosions (Scudder 1883, 1889).

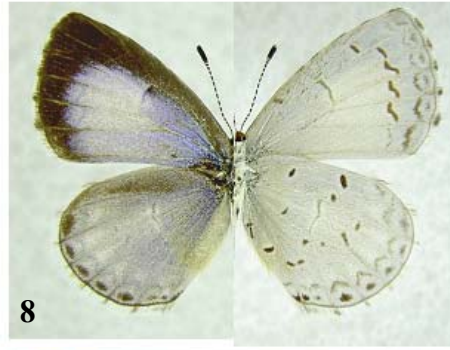
The similarity of northern spring *neglecta* to spring form *pseudargiolus* [= *neglectamajor*] in West Virginia was obvious to Scudder (1883) ...“This blue corresponds in all respects excepting size with *Pseudargiolus* proper of the south, and small southern individuals agree altogether with larger northern examples.” Edwards (1883) agreed, “It is plain these *Neglecta*, flying with *Lucia*, must have come from hibernating chrysalids, as truly did *Lucia*. The history of these *Neglecta* would appear to be identical with the history of *Pseudargiolus* in W.Va. ...they are interpolated in the series just as *Pseudargiolus* is. In fact, these early *Neglecta* would be very small *Pseudargiolus*.” Edwards (1884) believed that *pseudargiolus* in West Virginia had a small second generation in late summer, and confessed, “If these late butterflies were suppressed, *Pseudargiolus* would stand alone as a distinct species. So if anywhere to the northward the winter form is suppressed, [spring] *Neglecta* would represent the species.” A century later this proposition has been confirmed & a new Azure of the north has been gradually accepted (Ferguson, 1975; Pavulaan, 1985, 1989, 1993; Iftner *et al.*, 1992; Wright, 1995; Layberry *et al.*, 1996; Thomas, 1996; Allen, 1997).

Celastrina serotina Pavulaan and Wright, new species

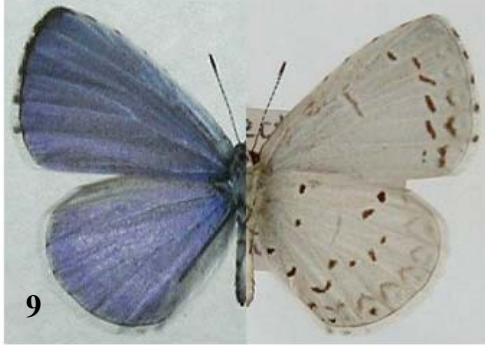
Description. *Male* (Figs. 2,5&7). Dorsal color uniform light blue; some individuals with purplish-blue tint. White insuffusion between veins on DHW common. Androconia present. Wing fringes white; black checkering minimal to absent. Ventral color uniform white to light gray-white. Black maculations reduced. Most individuals are lightly marked, similar to form “*violacea*”, except in RI, MA, and PA where a few (1%, 3%, 9% respectively) have partially fused maculations on the VHW disc (form “*lucia*”). FW length 10.2-15.0 mm (mean 13.5, n = 52). Rhode Island and southern New England males average slightly larger than those from northern New England, Canada, and higher elevations in southern range (WV, MD, PA). *Female* (Fig. 8). Dorsal color lustrous metallic light blue; some individuals with purplish tint. Black on DFW costa and outer margin. DHW with series of submarginal black dots. White insuffusion on DHW common; occasionally also on DFW. Wing fringes white; black checkering minimal to absent. Ventral color and pattern as in male. Forewing length 10.5-15.0 mm (mean 13.4, n=28). Rhode Island and southern New England females average slightly larger than those throughout rest of range. *Note:* The male genitalia of eastern North American *Celastrina* species differ from Eurasian *C. argiolus* L., but they cannot be reliably distinguished from one another. The sclerotized apical process of the valve bears small teeth, which tend to be largest in *neglectamajor* and smallest in *neglecta*. All remaining taxa, including *serotina*, are intermediate in this character. No distinguishing features of female genitalia of eastern North America are known.

Types. *Holotype* ♂ (Fig. 7): Great Swamp Management Area, near West Kingston, South Kingstown Township, Washington County, Rhode Island, U.S.A., May 14, 1990, along main access roadway on east side of Great Neck, collected by H. Pavulaan. *Allotype* ♀ (Fig. 8): Great Swamp Management Area, near West Kingston, South Kingstown Township, Washington County, Rhode Island, U.S.A., May 21, 1984, along main access roadway on east side of Great Neck, collected by H. Pavulaan. Holotype and allotype deposited in The Academy of Natural Sciences of Philadelphia (ANSP), Philadelphia, PA. *Paratypes:* n=212. Paratypes deposited in ANSP, Carnegie Museum (Pittsburgh, PA), National Museum of Natural History (Washington, D.C.), American Museum of Natural History (New York, NY), and collections of authors. Paratypes include: 53 ♂♂, 15 ♀♀, Kent & Washington Cos., RI, May 2-May 23, 1983-1990; 76 ♂♂, 14 ♀♀, Suffolk Co., NY, April 18-June 6, 1981-1992; 35 ♂♂, 19 ♀♀, Monroe Co., PA, May 19-June 14, 1992-2005.

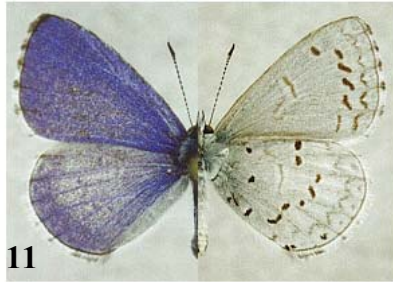
Differentiation from similar *Celastrina*.(Figs. 9-16) Phenotypically, *C. serotina* is most similar to three white-vented congeneric species in eastern North America (*neglectamajor*, *idella*, *neglecta*). Two of these species (*neglectamajor*, *idella*) also fly in interpolated flights between those of their respective congeners. *C. neglectamajor* and *C. serotina* in many respects have nearly identical color and maculation patterns. *Neglectamajor* (Figs. 9-10) is distinguished from *serotina* by size, range, habitat, and larval host. The forewing length of *neglectamajor* averages 1.5-3.0 mm larger than the forewing of *serotina*. *Neglectamajor* is found mainly in rich deciduous Transition Zone forests in the central & southern Appalachian Mts. and Ozark Mts. It flies during the month of May following the flight of *C. ladon* and before the flight of *C. neglecta*. Its sole host (*Cimicifuga racemosa*) is restricted to the same habitats, which prescribes the range of this unique sibling (Pavulaan & Wright, 2000). *Serotina* and *neglectamajor* are largely parapatric in distribution, but their ranges overlap in the central Appalachians in WV, MD, PA, northern NJ, southeastern NY, & southwestern CT. Neither species utilizes larval hosts of the other nor have adults been seen together in the same localities. *C. idella* (Fig. 11-12) is likewise distinguished from *serotina* by size, range, habitat, and hosts. The forewing length of *idella* averages 0.5-1.5 mm smaller than the forewing of *serotina*. *Idella* individuals from the type locality in the pine barrens of southern New Jersey show the greatest size discrepancy when compared to *serotina*. The primary color difference in this pair exists in the females. *Idella* females tend to be slightly more purplish; the discal streak on the hindwing of *serotina* is surrounded by a faint elongated whitish halo. *Idella* resides in the sandy oak-holly forest habitats of the outer Atlantic Coastal Plain from New Jersey to Georgia. At its type locality, *idella* flies in May after the flight of *C. lucia* and before a meager flight of *C. neglecta*. In the southern portion of its range, the flight is sandwiched between flights of *C. ladon* and *C. neglecta*, with a significant overlap with the *ladon* flight. Its primary host in southern New Jersey is *Ilex glabra*, but *I. opaca* and other holly species are also used throughout its range (Wright & Pavulaan, 1999). *Serotina* and *idella* are allopatric in distribution. Despite the presence of *C. lucia* and potential hosts (i.e. *Prunus* species with galls) in southern New Jersey, *serotina* has never been taken in this region nor have ovipositions on cherry galls been witnessed. *Idella* hosts (*I. glabra* and *I. opaca*) are locally common in the Pitch Pine/Scrub Oak barrens of Long Island, where *serotina* flies but *idella* has not been found. Accidental ovipositions by *serotina* females on *I. glabra* have been observed; however, this host ultimately proved to be toxic to neonate *serotina* larvae. *C. neglecta* (Figs. 13-16) is fully sympatric with *C. serotina* and all other eastern North American species. It ranges extensively over the eastern portion of the continent from central peninsular Florida to approximately 48° N latitude. It is absent from Newfoundland. It is most easily distinguished from *serotina* by voltinism, flight period, and physical appearance. *Neglecta* is multibrooded, except in the north where only one brood flies. Summer individuals (Figs. 13-14) have less intense blue on the dorsum of both wings, often with considerable white insuffusion between veins of the DHW. The hind wing of the female is occasionally nearly white. The ventral surface is immaculate white with weak maculation pattern. A spring phenotype (Figs. 15-16) also occurs in most of the central and southern states. (*Neglecta* tends to occur only in summer in northern states and southern Canada.) The spring flight begins early, coinciding with the flight of *C. ladon*, well before the flights of *neglectamajor* and *serotina*. Spring *neglecta* individuals have a solid blue dorsum without white insuffusion. The venter is light grayish-white, not as gray as *ladon*. The dot pattern is prominent.



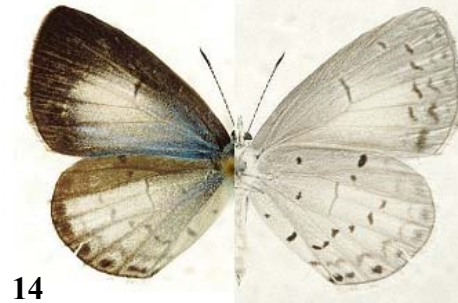
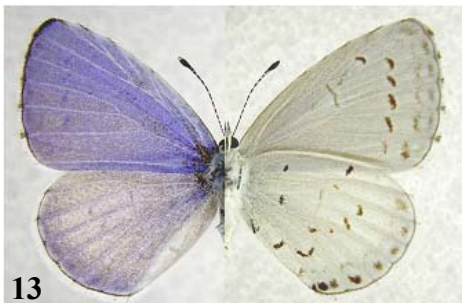
C. serotina



C. neglectamajor



C. idella



C. neglecta
summer phenotype



C. neglecta
spring phenotype

Figs. 7-16. Light-vented *Celastrina* in eastern United States. ♂♂, ♀♀ (D/V). **Fig. 7.** Holotype, 14 May 1990, Great Swamp, Washington Co., RI. **Fig. 8.** Allotype, 21 May 1984, same as 7. **Fig. 9 & 10.** 10 May 1999, Berrys, Clarke Co., VA. **Fig. 11.** Holotype, 11 May 1987, Chatsworth, Burlington Co., NJ. **Fig. 12.** Allotype, 19 May 1990, same as 11. **Fig. 13.** 23 July 1988, Red Lion, Burlington Co., NJ. **Fig. 14.** 20 June 1992, same as 11 & 12. **Fig. 15 & 16.** 5 April 1988, SGL 157, Bucks Co. PA. Photos by David Wright.

Etymology. The new species Latin name *serotina* is the feminine form of the adjective *serotinus* [L., from *sero* (adv.) = late] meaning “coming late”. In a biological sense, the name implies delayed or late development with an appearance later in the season. For the common name, although Cherry Gall Azure has appeared in print, we suggest the name Late Spring Azure is more appropriate, reflecting its distinction from Spring Azure and Summer Azure.

Synonymy. Earlier workers most frequently referred to the northeastern May flight as *neglecta* or *violacea*. Names used in literature in bold; not italicized. ***Polyommatus pseudargiolus* “northern species”** in Doubleday (1841) [“I may just express my opinion that two species are confounded under the name of *pseudargiolus*, one a northern species, with markings of the under surface very distinct and coarse, the other a southern one, in which all the markings below are beautifully delicate..”] [EASTERN NORTH AMERICA] [Note: From Doubleday’s description above, one might suppose that his “northern species” may be referable to *lucia* (Kirby, 1837). However, see next.]. ***Polyommatus pseudargiolus* “northern species”** in Scudder (1869) [(Letter, Doubleday to Harris, April 30, 1842). “I am now quite convinced that *pseudargiolus* of the North is not *pseudargiolus* of the South. There are two species. To which does the name belong? Boisduval’s plate will not distinguish them.”] [EASTERN NORTH AMERICA] [Note: The “northern species” to which Doubleday refers certainly could not have been *lucia*, since Boisduval & Le Conte’s [1833] plate would have easily distinguished *pseudargiolus* from *lucia*. In a return letter, Harris to Doubleday (Nov. 17, 1842), Harris states, “the name *Polyommatus pseudargiolus* must be applied exclusively to the Southern species, if the Northern blue species is distinct from it. *Deutargiolus* would be a good name for the Northern species.” Neither Doubleday nor Harris ever published this name and we consider it to be a *nomen nudum*. In a footnote to Harris’ last letter, Scudder (1869) states, “It has since been named *L. neglecta* by Mr. W.H. Edwards [1862].” Scudder clearly understood that Doubleday was not referring to *lucia* in the north. Scudder’s concept of *neglecta*, which differed from Edwards’, included a spring appearance of *neglecta* [May], which may have been what Doubleday reported. Later, Harris (1862) concluded that “northern” *pseudargiolus* and *lucia* co-occurred in Massachusetts.]. ***Lycaena neglecta*** in Packard (1869) [“*Lycaena Neglecta* Edwards is very common about *Kalmia* and *Rhodora* in May, and a new brood appears in June and July.”] [MASSACHUSETTS] ***Cyaniris* sp. ?** in Parker (1874) [“like *neglecta*, but ... dusky gray beneath”; Mt. Holyoke, June 25th; “*violacea*”, Amherst, June 1] [MASSACHUSETTS]. ***Lycaena neglecta*** in Edwards (1875) [“Mr. Scudder wrote me that in Mass. ‘*neglecta*, *lucia* and *violacea* all appear in May’, the inference being that one could not be the parent of another.”] [MASSACHUSETTS]. ***Lycaena neglecta*** in Saunders (1875) [“*Neglecta* is taken every season here [London, Ontario], the first brood usually during latter part of May and early days of June, and the second brood in July and later.” “In 1862, two specimens on the 14th and one on the 15th of May.”] [ONTARIO]. ***Lycaena neglecta*** in Lintner (1875) [“I can not believe that *neglecta* and *lucia* will ever be united as seasonal varieties of the same species.”; “Our observations do not agree with those of Mr. Edwards, giving June as the earliest appearance of *neglecta*.”; “In [May] ... *neglecta* occurred in great abundance.”] [NEW YORK]. ***Cyaniris violacea*** (in part) in Scudder (1876) [“..specimens of *Cyaniris* in any one locality seem to become larger, more lightly marked beneath ... as the season advances.”; “[*violacea*] makes its advent during the first week of May ... and it still remains upon the wing throughout June.”] [NEW ENGLAND]. ***Cyaniris neglecta*** (in part) in Scudder (1876) [“*Lucia* appear[s] in New England but once, *neglecta* twice a year.”; “.. this insect [*neglecta*] is double-brooded ... earliest males appear at or shortly before middle of May, but do not become abundant before the last week of the month; the first females appear about ten days later than the males, but are still rare at the beginning of June ... earliest butterflies of the second brood appear about the first of July.”; “.. it is extremely uncommon for two such closely allied species as *neglecta* and *Lucia* to differ ... in the number of their broods.”] [NEW ENGLAND]. ***Cyaniris pseudargiolus* f. *violacea*** (in part) in Scudder (1881) [“.. in the vicinity of Boston .. first appears *Lucia* .. the next blue butterfly to appear is ... *violacea*. It makes its advent during the first week of May and remains on the wing until late June. There is no alternative but to suppose .. this blue butterfly is dimorphic in the northern part of its range, appearing as an earlier and later form, *Lucia* and *violacea*.”] [NEW ENGLAND]. ***Cyaniris pseudargiolus* f. *pseudargiolus*** in Scudder (1881) [“Shortly after the appearance of *violacea* , or about the middle of May, we encounter another blue butterfly, too early to have been produced from *violacea*, just as *violacea* appeared too soon to have been produced from *Lucia*. This blue corresponds in all respects excepting size with *Pseudargiolus* proper [= *neglectamajor*] of the south, and small southern individuals agree altogether with large northern examples.”] [NEW ENGLAND]. ***Lycaena pseudargiolus* f. *neglecta*** in Edwards (1883) [“It is plain that these [northern spring] *Neglecta*, flying with *Lucia*, must have come from hibernating chrysalids, as truly did the *Lucia*. The history of these *Neglecta* would appear to be identical with the history of *Pseudargiolus* [= *neglectamajor*] in W.Va., ... they are interpolated in the series just as *Pseudargiolus*. In fact, these early *Neglecta* would be very small *Pseudargiolus*, though perhaps indistinguishable from the examples of *Neglecta* which come ... later.”] [ONTARIO, NEW YORK]. ***Lycaena pseudargiolus* f. *neglecta*** in Edwards (1884) [“*Pseudargiolus* [= *neglectamajor*] is an interpolated spring generation. Its second generation comprises a part of the few butterflies which fly [later in summer]. If these late butterflies were suppressed, *Pseudargiolus* would stand as a distinct species. So, if anywhere to the northward the winter form is suppressed, *Neglecta* would represent the species. Prof. Lintner describes *Neglecta* as appearing in swarms at Centre, N.Y. ... and also in the vicinity of Albany, from middle of May to middle of June. These myriads of course are from hibernating chrysalids. *Neglecta* is the winter form at Albany.”] [NEW YORK]. ***Cyaniris pseudargiolus* f. *neglecta*, “the earlier *neglecta*”** in Scudder (1889) [“... how does *neglecta* appear so early?” “The only alternative .. is to regard .. the earlier *neglecta* as part of the first brood which then becomes trimorphic.” “The successive apparition of *lucia*, *violacea*, and *neglecta* before July in New England should be looked upon as the successive eclosion from wintering chrysalids of first one, then a second and finally a third form.”] [NEW

ENGLAND]. **Cyaniris pseudargiolus f. neglecta** in Scudder (1893) [“..the earliest (form lucia) generally appear about the middle of April, and in the first week of May the numbers are materially increased by the advent of the form violacea, .. further accompanied, after the middle of May, by the third form, neglecta .. In June, lucia is rarely seen and the others disappear one after the other; but in July the second brood proper appears, consisting wholly of neglecta, and continues to emerge .. even into September.”] **Celastrina ladon ladon “late spring form”** in Comstock & Comstock (1904) [“The late spring form ... appears from over-wintering chrysalids, but considerably later than the forms described above, a fourth spring form. This is the largest form of the species ... Mr. Scudder does not regard neglecta as distinct from C. ladon ladon ... according to this view neglecta is one of the spring forms as well as the summer form. And we have had difficulty in separating the two by characteristic of size ...”] [EASTERN U.S.]. **Cyaniris ladon** (in part) in Engel (1908) [“Var. violacea .. [to] May 17. Common.”; “Var. neglecta ... April 3- June 9. Common.”] [PENNSYLVANIA]. **Lycaena ladon** (in part) in Smith (1910) [“form violacea occurs in April and May”] [NEW JERSEY]. **Lycaena ladon** (in part) in Davis (1910) [“a female violacea {May 14}”] [NEW YORK]. **Lycaenopsis argiolus pseudargiolus f. vernalis neglecta-major** (in part) in Comstock (1940) [“This form follows the early spring forms and is intermediate in occurrence between them and the first summer brood.”] [NEW JERSEY]. **Lycaenopsis argiolus** (in part) in Klots (1951) [“On the average the darker specimens [lucia, marginata] ... represent earlier specimens, the lighter ones [violacea], later ones.”] [EASTERN U.S.]. **Lycaenopsis argiolus lucia** in Ferguson (1954) [“few ..violacea emerging late...localized, occurring in certain areas only.”] [See Ferguson (1975) below.] [NOVA SCOTIA]. **Lycaenopsis pseudargiolus pseudargiolus f. neglecta-major** in Clench (1958) [“The brood sequence of this species in unusually complex. In very early spring, during the latter half of April, the small dark spring form violacea flies, chiefly in the woods. In early May, this is suddenly replaced by the ..lighter, faster-flying neglecta-major, which seems to show a preference for more open areas.”] [PENNSYLVANIA].¹ **Lycaenopsis pseudargiolus “late spring brood”** in Remington (1958) [“..somewhat less numerous late spring brood”; Fig. 2, 4th column (right), top, plus probably all of 3rd column (photo).] [CONNECTICUT]. **Plebejus argiolus pseudargiolus f. violacea** in Forbes (1960) [“Three broods in the middle region, the first successively lucia auct., marginata and violacea in New England to New Jersey.”] [NEW ENGLAND, NEW JERSEY]. **Lycaenopsis argiolus** (in part) in Shapiro (1966) [“a few are [spring] form violacea resembling the summer brood beneath”; “violacea increases in frequency as the spring emergence progresses.”] [More applicable to C. idella Wright & Pavulaan, 1999] [PENNSYLVANIA, NEW JERSEY]. **Lycaenopsis argiolus** (in part) in Shapiro (1974) [“A very complex species, or perhaps group of sibling species.”; “spring form violacea”] [NEW YORK]. **Celastrina pseudargiolus** in Ferguson (1975) [“adults ... larger, paler, and fly in June, about a month later than the smaller form [lucia] but not quite late enough to be a second generation long suspected that these are two species.”] [NOVA SCOTIA]. **Celastrina lucia** in Chew & Robbins (1984) [“occasionally oviposit on galls on their normal foodplants.”] [NORTH AMERICA]. **Celastrina ladon “late spring form”** in Opler & Krizek (1984) [“The Appalachian Blue [neglectamajor] is most similar to the late-spring form of the Spring Azure, but it is significantly larger.”] [EASTERN U.S.]. **Celastrina ladon** in Leblanc (1985) [“du sud du Quebec ... 2 pics d’abondance...un en mai-debut juin, l’autre en fin juin-juillet “] [QUEBEC]. **Celastrina neglecta-major Tutt ?** in Pavulaan (1985) [“evidence suggests a sibling species”] [RHODE ISLAND]. **Celastrina ladon form “violacea type-II”** in Pavulaan (1989) [“...two spring flights overlap their flight period during May, and there may be two different species ...females have been observed to oviposit on these galls [wild cherry, P.serotina] in other states, and the larvae readily feed upon them.”] [RHODE ISLAND]. **Celastrina sp. “spring phenotype”** in Iftner et al. (1992) [“... research suggests that several sibling species are included within the C. ladon complex”; Pl. 24, row 6 (photo)] [OHIO]. **Celastrina argiolus** in Opler & Malikul (1992) [“...we know there are at least three [species], and very probably there are at least several other sibling host-plant specialists.”; “There may be as many as three species covered by our current concepts [Spring Azure].”] [EASTERN NORTH AMERICA]. **Celastrina ladon** in Glassberg (1993) [“A bewildering complex of species and forms. Although recent authors have begun treating [neglectamajor and nigra (= ebenina)] as distinct species, there are almost certainly other species—In our area there may be at least three species ...”; Plate 11, no. 4, Spring Azure, form violacea, 5/9/90, Blue Hills Reservation (photo)] [MASSACHUSETTS, EASTERN U.S.]. **Celastrina ladon “Pine Azure (in part)”** in Walter (1993) [NEW YORK]. **Celastrina ladon form “violacea type-II”** in Pavulaan (1993) [“second spring flight ... Larvae feed on leaf-surface galls of wild cherry.”] [RHODE ISLAND]. **Celastrina ladon race “violacea” type II** in Pratt et al. (1994) [“violacea” .. type II feeds on leaf galls of Prunus serotina, induced by the eriophyid mite Phytoptus cerasicrumena Walsh ... Larvae of “violacea” II populations are also known to feed locally on Viburnum and Aralia flowers ... host specialization may have selected for [adult eclosion] asynchrony .. [a] mechanism inducing genetic isolation ..”] [EASTERN NORTH AMERICA]. **Celastrina ladon “Late Spring Azure”** (in part) in Pavulaan & Wright (1994) [“The main host on Long Island and in New England is black cherry .. the larvae feed on the red leaf galls which infest the cherries. Late Spring Azures utilize several additional hosts in other areas ..”] [NEW YORK, NEW ENGLAND]. **Celastrina sp. “Cherry Gall Azure”** (in part) in Wright (1995) [“... these azures fly between the flights of Spring Azures and Summer Azures, from mid-May to mid-June ... The main host from West Virginia through Pennsylvania to southern New England is Black Cherry (Prunus serotina) leaf galls.”] [EASTERN NO. AMERICA]. **Canadian [Celastrina] species yet undescribed** in Layberry (1996). [“It flies in between the flight seasons of Spring and Summer Azures .. the provisional common name is the Cherry Gall Azure.”] [NOVA SCOTIA, PRINCE EDWARD ISLAND, QUEBEC, ONTARIO]. **Cherry Gall Azure (no scientific name)** in Thomas (1996) [“A third species that is as yet undescribed ...occurs in New Brunswick. It is single-brooded and

flies in June. Any freshly-emerged azure butterfly flying in early-to-mid June is likely to be this species.”] [NEW BRUNSWICK]. **Celastrina ladon ladon race “violacea” Type II** in Allen (1997) [“A separate sibling flight of blues appears between the flights of .. lucia .. and neglecta at higher elevations .. flight parallels that of the Appalachian Blue (*Celastrina neglectamajor*) .. univoltine in West Virginia.” (photo)] [WEST VIRGINIA]. **Celastrina sp. “Cherry Gall Azure”** in Gochfeld & Burger (1997) [“This entity is slightly smaller than the very similar Appalachian Azures which would be flying at the same time.”] [NOVA SCOTIA, QUEBEC, ONTARIO, MAINE, MASSACHUSETTS, NEW YORK, PENNSYLVANIA, WEST VIRGINIA, NEW JERSEY, OHIO, S.E. MICHIGAN]. **Celastrina n.sp. (unnamed new species) CHERRY GALL AZURE** in Wright (1998) [“Originally discovered on black cherry *Prunus serotina* leaf galls created by leaf mites. Now known to be multiphagous utilizing other hosts in allochronic flight window (between ladon and neglecta flights). Univoltine.”] [OHIO]. **Celastrina ladon “violacea” type II** in Scott & Wright (1998) [“This taxon [*C. humulus*] is named as a species here because its closest relative in eastern U.S., namely ‘violacea’ II (of Pratt et al. 1994) whose larvae eat *Prunus serotina* galls, is being named as a species.”] **Celastrina sp. “Cherry Gall Azure”** in Layberry et al. (1998) [“This species looks more like a Spring Azure than a Summer Azure but tends to be slightly paler, with more white dusting over the blue than in the Spring Azure.” “Adults ... in areas where cherry leaves are infested with mite galls after the flight of the Spring Azure has waned.” (photo)] [NOVA SCOTIA, PRINCE EDWARD ISLAND, QUEBEC, ONTARIO]. **Celastrina complex “Cherry-gall Azure”** in Pelikan (1998) [“It was not until May 12, when azures [*C. lucia*] had been flying for a full month, that I first encountered a ‘violacea’ ... But on May 16 the relative abundance of the form ‘violacea’ underwent a meteoric rise. This second flight (apparently consisting exclusively of the form ‘violacea’) continued widespread into June. Azures flying from mid-May into early June were probably Cherry-gall Azures, a newly-defined species....” (Martha’s Vineyard)] [MASSACHUSETTS]. **Celastrina ladon unnamed ssp. “Cherry Gall” Spring Azure** in Glassberg (1999) [“Flies between broods of Spring and Summer azures”; Plate 23, no. 6, 6/14/93, Mt. Greylock, MA (photo)] [EASTERN NORTH AMERICA]. **Celastrina “ensemble innommé” (sp.)** in Handfield (1999) [“Selon Wright (1995) (ensemble nommé ‘Cherry Gall Azure’)”] [QUEBEC, ONTARIO]. **Celastrina undescribed species** in Wright & Pavulaan (1999) [“The species associated with mite-induced leaf galls of cherry trees *Prunus serotina* Ehrh. and *P. virginiana* L. occurs further north {than *C. idella*} (photo)] [NEW JERSEY, PENNSYLVANIA, CANADA]. **[U]ndescribed cherry-gall feeding taxon** in Pavulaan & Wright (2000) [“Subsequent research by the present authors shows that this Rhode Island insect is not Appalachian *neglectamajor*, but a distinctly different undescribed species that feeds on cherry galls (Pavulaan and Wright, in prep.)”] [RHODE ISLAND]. **Cherry Gall Azure (species unnamed)** in Pavulaan (2002) [“... emerges in early May (fresh) and flies into early June (worn) ... caterpillars feed on the red leaf galls of Black Cherry trees in most of the northeast but some colonies have switched to other hosts in some areas.”] [CONNECTICUT]. **Spring Azure (*C. ladon ladon*)** in Dirig (2002) [“.. a male Spring Azure offers rare view of its shining blue topside.” (photo)] [NEW YORK]. **Celastrina ladon “Spring Azure Cherry Gall population”** in Allen et al. (2005) [“The named populations of Spring Azure, adapted to particular hosts or groups of hosts, may eventually be considered to be anything from full species to less than subspecies.” (larval photo)] [PENNSYLVANIA]. **Celastrina ladon species complex** in Wagner (2005) [“The Spring Azure is a complex of several sibling species. The most remarkable entity in this confusing array may be the undescribed Cherry Gall Azure, whose larvae consume the eriophyid mite nipple galls that occur on cherry leaves.”] [EASTERN NORTH AMERICA]. **Celastrina sp. Cherry Gall Azure** in Cech & Tudor (2005) [“A confusing segregate, not yet systematically described ... Best noted for the fact that in many populations caterpillars feed on leaf galls, especially those of cherries. Single-brooded, the Cherry Gall flies slightly later than Northern or Spring Azure at any given location (overall mid-May to early June).” (photo)] [NEW ENGLAND, NEW YORK, PENNSYLVANIA].

¹ In Carnegie Museum files, there is an unpublished manuscript by H. K. Clench (approx. 1974 - 78) titled, "*Celastrina pseudargiolus* form *neglectamajor* Tutt and its types (Lycaenidae)." This manuscript has the following enlightened description: "An interesting and little known fact is that *neglectamajor* exists in two forms. They have different facies, and different ranges, but preserve the same phenological attributes (appearing towards the end of the first brood of *pseudargiolus*). Form (1) true *neglectamajor*. Large... Form (2) Small. un [underside] with markings much stronger, barely less intense than in *pseudargiolus* form "violacea", but the ground usually quite white. This is the only form of *neglectamajor* that I have found at Powdermill Nature Reserve (Westmoreland Co., Penna.). There it consistently appears near the end of the spring brood of *pseudargiolus* (from May into June). "

Flight period: One brood per year. Follows flight of *C. lucia* Auct.; precedes flight of *C. neglecta*. **CANADA:** Mid-May to mid-June in eastern Ontario. June to early July in Quebec and Maritime provinces. **UNITED STATES:** Late May through June in northern New England and northern New York. Mid-May to mid-June in so. New England south to Virginia and West Virginia. **CONNECTICUT:** May 2 - June 16 (May 23rd mean, n = 40). **MASSACHUSETTS:** May 3 - June 26 (May 27th mean, n = 118). **RHODE ISLAND:** May 2 - June 22 (May 20th mean, n = 698). **PENNSYLVANIA:** May 16 - June 28 (May 29th mean, n = 600). The annual flight period typically lasts 3 1/2 to 4 weeks.

Phenology: Flight phenogram (Fig. 17) of southern New England *C. serotina* population demonstrates the interpolated flight of *C. serotina* relative to its sympatric congeners *C. lucia* Auct. and *C. neglecta*. Flights of the three species appear as successive irruptions in the spring. In general, *C. serotina* emerges about three to four weeks later than *C. lucia* Auct., and three and a half to four weeks before *C. neglecta*. The phenological pattern is analogous to *C. neglectamajor* in Appalachians, which flies between flights of *C. ladon* and *C. neglecta*.

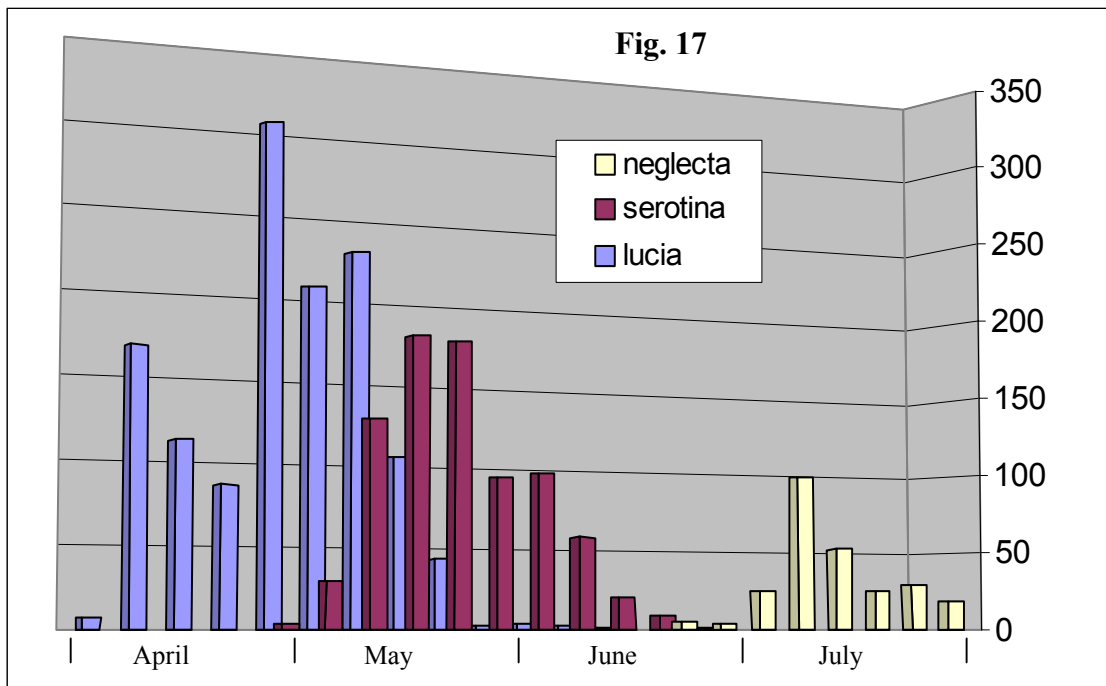


Fig. 17. Flight phenogram of sympatric *Celastrina* species in southern New England. Adults in six-day intervals. Data from Massachusetts Butterfly Atlas Project (1986-1990), Connecticut Butterfly Atlas Project (1995-1999), Rhode Island surveys (1984-2004), museum & private collections (n = 2417).

Adult Nectar Sources: *C. serotina* males are known to frequent damp earth along dirt roadways, especially early in their emergence period. Females are not known to frequent damp earth. Adults have been observed on blossoms or flowers of Black Cherry *P. serotina*, Pussy Willow *Salix discolor* Muhl., Chokeberry (*Aronia* sp.), Daisy Fleabane *Erigeron annuus* (L.) Pers., Red Clover *Trifolium pratense* L., and Yellow Mustard *Barbarea vulgaris* R. Br.

Larval Hosts: ROSACEAE: In a significant portion of its range, from southern New England to southwestern Ontario & south to Appalachian plateaus of West Virginia-Maryland-Pennsylvania, *C. serotina* larvae eat elongate red galls formed on the upper surface of *Prunus serotina* leaves (Fig. 19). The galls are induced by the wormlike eriophyid mite *Phytoptus cerasicrumena* Walsh (Eriophyidae). Individual galls often start as small greenish bumps on the surface of young leaves, then acquire red pigment (anthocyanin) as they mature. They may extend up to about 8 mm in length when fully formed, attached to the leaf by a slender stalk. The galls tend to crowd the leaf surface and may often cover entire leaves, generally causing them to curl into distorted shapes. The interior of the galls is hollow, sheltering the mites. Young larvae feed by boring a hole in the side and extending their heads into the gall. Older larvae will devour the entire gall. Larvae inadvertently consume mites residing within the galls. Although not primary carnivory, this is the second documented carnivorous butterfly caterpillar in North America after *Feniseca tarquinius* (Fab.). The larvae are also occasionally found on leaf galls of Chokecherry *P. virginiana* L., formed by the same mite. Very small galls are present on leaves of Pin Cherry *P. pensylvanica* L., but no larvae have been discovered on this host to date. Rarely, *C. serotina* females have been observed ovipositing on the floral buds of *P. serotina* in mid-May (Middlesex Co., MA, fide Schweitzer). A single mature 4th instar larva was found on floral buds of *Spiraea alba* var. *latifolia*. [Note: Other host families may serve as secondary hosts in habitats with high gall density, or as primary hosts in habitats with low or absent gall numbers. Larvae and eggs have been collected on the following families.] CAPRIFOLIACEAE: Nannyberry *Viburnum lentago* L., Possumhaw *V. nudum* L., Northern Bush Honeysuckle *Diervilla lonicera* Mill. ARALIACEAE: Bristly Sarsaparilla *Aralia hispida* Vent. (Ferguson, 1975; Layberry *et al.* 1998). RHAMNACEAE: NJ Tea *Ceanothus americanus* L. CORNACEAE: Alternate-leaved Dogwood *Cornus alternifolia* L., Red Osier *Cornus stolonifera* Michx. [Note: Some hosts may also serve as host for *C. neglecta*, following the flight of *C. serotina*.] Several *C. serotina* females were reported in close association with Wild Sarsaparilla *Aralia nudicaulis* L. in May, but no ovipositions were observed (Worcester Co., MA, fide Ziegler). Wagner & Mellichamp (1978) collected *Celastrina* eggs and first instar larvae in Washtenaw Co., MI, on two of the aforementioned hosts (*V. lentago*, *C. stolonifera*) in May. They reared these to maturity, but did not state if pupae diapaused. **Accidental Hosts:** Rare ovipositions were witnessed in May on Crown Vetch *Coronilla varia* L (Monroe Co. PA) and Inkberry *Ilex glabra* L. (Suffolk Co., NY). In both instances, the host proved to be toxic and 1st instars did not survive. **Other *Celastrina* larvae on galls:** Cherry gall feeding is not exclusive to *C. serotina*. Larvae of several other *Celastrina* species have occasionally been discovered in nature consuming galls, consistent with their polyphagous habits. Documented cases are spotty, but may be more widespread wherever leaf galls occur. Records: *C. lucia*. PA: Franklin & Monroe Cos.; eastern MA (R. Robbins, pers. com.). *C. ladon*. PA: Bucks Co. *C. neglecta*. PA: Monroe, Montgomery & Schuylkill Cos.; VA: Madison Co.; WV: Marshall

& Ohio Cos.; and IN: Howard & Monroe Cos. **Rearing:** Of 125 wild larvae collected on cherry galls in nature (MD, NY, PA, RI), 117 developed successfully and pupated in the lab. *C. neglectamajor* will not oviposit on leaf galls in nature. When young *neglectamajor* larvae are switched from their natural host Black Cohosh *Cimicifuga racemosa* (L.) to cherry galls in captivity, they will readily accept them but produce dwarfed adults (Pavulaan & Wright, 2002).

Immature Stages. Egg (Fig. 20) white, similar to other *Celastrina*; placed on cherry galls or floral buds of hosts. Four larval instars. First instar light green; bores into floral buds. Mature larva (4th instar) variable, usually light green to creamy white, lightly contrasted with rosy mid-dorsal stripe, dorsal white chevrons, dark green & brown subdorsal blotches, maroon prothoracic shield, and thin lateral white line. Generally lighter and less boldly marked than larvae of *C. lucia* Auct. Some larvae dark red or brown with white chevrons, or occasionally wine red (Fig. 21), matching color of galls. Myrmecophilous mature larvae with dorsal nectary organ on abdominal segment A7 and eversible tubercles on A8. Larvae attended by worker ants of *Formica subsericea* Say, *Lasius alienus* (Foerster), *Camponotus noveboracensis* (Fitch), and *C. pennsylvanicus* (DeGeer). Hymenopterous parasitoids recovered during rearing include a red-eyed and a black-eyed trichogrammatid species (*Trichogramma minutum* & *T. parkeri*) from eggs, a small wasp *Cotesia cyaniridis* (Riley) from mature larvae, and a larger wasp *Anisobas luzernensis* (Bradley) from pupae in the spring following overwintering diapause. The tachinid fly *Aplomyia theclarum* (Scudder) was also recovered from mature larvae. Pupa light brown (7.7-9.0 mm, n=17), obtect. Pupation dates, June 20-July 17 in Monroe Co., PA. Pupae diapause. Of 117 pupae formed *ex* larvae found on cherry galls, 116 diapaused. The single non-diapausing pupa in retrospect may have been *C. neglecta*.

Habitat. At Great Swamp, Washington Co., Rhode Island (type locality), 90-150 ft. elevation, *C. serotina* is most commonly found along woodland roads of a “neck” of upland mixed deciduous hardwood forest surrounded by wetlands. The forest on Great Neck consists primarily of Red Maple *Acer rubrum* L., several species of oaks (*Quercus* sp.), a mid-level understory of American Holly *Ilex opaca* Ait., and a lower understory of blueberries and huckleberries (*Vaccinium* sp.). Black Cherry *Prunus serotina* trees, uniformly and heavily-infested with eriophyid leaf galls, are frequent along the woodland roads, forest edges, and sandy open, scrubby areas. The butterflies are seldom found within the wetlands except as transitory strays. Throughout eastern Long Island (Suffolk Co.), in southeastern New York, *C. serotina* is common and widespread in a variety of habitats. The host *Prunus serotina* is widespread in natural habitats on Long Island's acid sandy soil (deciduous forests, Pitch Pine/Scrub Oak barrens), as well as a rather profuse pioneering species (“weed tree”) in old-field habitats and in virtually any area affected by human activity including heavily urbanized and industrialized settings. The majority of these Long Island trees are heavily infested with *Phytoptus* mites. During the first week of the *C. serotina* emergence, adults are primarily restricted to forest-associated habitats and always near the host trees. As the flight season progresses, adults (mainly females) stray out into the surrounding region, and can be found in virtually any habitat. The adults have been seen as strays in suburban yards, neighborhood parks, schoolyards, commercial districts and industrial parks. It is not surprising to encounter females in any wild or neglected open space. Some host trees in old-field habitats eventually succumb to an overgrowth of invasive Common Greenbrier *Smilax rotundifolia* L. *C. serotina* occurs throughout the Pocono Mountains of northeastern Pennsylvania. This area is a glaciated rugged highland plateau, 1800-2100 ft. elevation, with rocky soil, nutrient-poor bogs, and an extensive forest cover dominated by a Beech-Maple forest. Black Birch *Betula lenta* L., Yellow Birch *B. alleghaniensis* Britton, Quaking Aspen *Populus tremuloides* Michx., Bigtooth Aspen *P. grandidentata* Michx., Chokecherry *Prunus virginiana*, and Black Cherry *P. serotina* are frequent associates of the Beech-Maple forest. Eastern Hemlocks *Tsuga canadensis* (L.) are scattered throughout forest, especially in shaded river ravines. Serviceberries *Amelanchier* sp. and Mountain Laurel *Kalmia latifolia* L. provide the understory. The wetlands are dominated by Highbush Blueberry *Vaccinium corymbosum* and Great Laurel *Rhododendron maximum* L. The Pocono region has a large population of *C. lucia* Auct., whose emergence begins initially in the wetlands in mid-late April and then “explodes” in the surrounding forest in early May. The earlier *lucia* females oviposit on blueberry floral buds, while the later woodland females lay eggs on cherry flower buds. (There is speculation that more than one species under the name *lucia* occurs in this region.) *C. serotina* does not begin to fly until late May when the woodland *lucia* is markedly worn and its numbers have radically declined. Shortly after the flight begins, large aggregations of fresh *serotina* males are seen at mud puddles in streamside trails and on gameland & state forest roads. Females are observed exploring host trees. They selectively oviposit on leaf galls, even though a few cherry flowers may still be unopened. They also utilize floral primordia of Nannyberry *Viburnum lentago* and shrubby dogwood species (*C. alternifolia*, *C. stolonifera*). An interesting parallel has been observed between the spring *Celastrina* emergences of the region and a sympatric pair of small day-flying moths. The delicate bluish spring geometrid *Lomographa semiclarata* (Wlk.) begins flight in early-mid May. At the end of May and early June, as its numbers decline, a second whiter species *L. vestaliata* (Gn.) begins to fly. Both *Lomographa* species utilize cherry and their staggered flights are reminiscent of the irruptive emergences of different *Celastrina* species in the same woodland habitat. In higher elevations of northern Virginia & West Virginia, *C. serotina* has been observed in relatively open mixed hardwood forest and associated open places where the understory host *P. serotina* trees reach 25 ft. One studied location is the ridgetop forest to the south & east of Big Meadows Recreation Area, on top of the Blue Ridge, 3200-3600 ft. elevation, in Shenandoah National Park (Madison and Page Cos., VA). *C. serotina* emerges in mid-May about three weeks later than *C. ladon*. It flies with similar-looking, light-ventered siblings *C. neglectamajor* and *C. neglecta*, which both begin to emerge in late-May, making accurate identification either by sight or binoculars very difficult, if not impossible. To compound matters, where *C. serotina* larvae feed on gall-infested leaves, later-emerging *C. neglecta* females will occasionally oviposit on the same leaf galls. However, in all instances, reared immatures of gall-feeding *C. neglecta* do not diapause.



Figs. 18-21. Cherry galls and *Celtastrina serotina* immatures. **Fig. 18.** Old growth field with Black Cherry (*Prunus serotina*) saplings (arrow) (Dauphin Co., PA). **Fig. 19.** Eriophyid mite galls on upper surface of Black Cherry leaves (Monroe Co., PA). **Fig. 20.** Egg of *C. serotina* on Black Cherry gall. (Monroe Co., PA) **Fig. 21.** Mature 4th instar larva of *C. serotina* consuming Black Cherry leaf gall (Monroe Co., PA). Photos by David Wright.

C. serotina can stray widely and otherwise occur in a diverse array of habitats, attesting to its abundance in some regions. We examined the voucher specimens and records of the Massachusetts Butterfly Atlas Project (1986-1990) and Connecticut Butterfly Atlas Project (1995-1999) to index the habitat types from which this species has been recorded. They are as follows: black spruce bog; heath lands; mature scrub habitats including thickets, brambles and scrub marsh; oak woods; pitch pine-scrub oak barrens; a very broad range of deciduous & coniferous woods with species of oak, beech, birch, maple, hemlock, pines, and black spruce intermixed to varying degrees; wood edges; power line utility right-of-ways; rocky hilltops or mountain summits; various disturbed areas such as abandoned farms, fields, hillsides, gravel pits; a variety of open areas ranging from open fields, wet & dry meadows, “old field” (second-growth) successional habitats of varying stages; suburban lawn and garden areas; pasture. These descriptions detail a sizeable range of wooded and open habitat types, providing a sense of the resourcefulness of this species.

Frequent Associates. *C. serotina* is occasionally found in woods, but more commonly along edges of woodlands and open sunny second-growth habitats with *Papilio glaucus* L. (so. New England & Long Is., NY), *P. canadensis* Rothschild & Jordan (no. New England, southeastern Canada), *P. canadensis* x *glaucus* (hybrid zone, no. PA.), *P. appalachiensis* Pavulaan & Wright (so. PA, WV), *P. rapae* (L.), *Colias philodice* Godart, *C. eurytheme* Boisduval, *Lycaena phlaeas* (L.), *Callophrys (Mitoura) gryneus* (Hübner), *C. (Deciduphagus) augustinus* (Westwood), *C. (Deciduphagus) henrici* (Grote & Robinson), *C. (Incisalia) nippon* (Hübner), *Chlosyne harrisii* (Scudder), *Phyciodes tharos* (Drury), *P. cocyta* (Cramer), *Nymphalis antiopa* (L.), *L. arthemis arthemis* (Drury), *L. a. astyanax* (Fab.), *Megisto cymela* (Cramer) (type 1), *Coenonympha tullia* (Müller), *Erynnis icelus* (Scudder & Burgess), *E. brizo* (Boisduval & Le Conte), *E. juvenalis* (Fab.), *E. horatius* (Scudder & Burgess), *Poanes hobomok* (Harris), and *Amblyscirtes hegon* (Scudder).

Range. The range of *C. serotina* (Fig. 22) coincides with the range of *C. lucia* Auct., which it follows in flight. Prime densities occur in northeast Pennsylvania, New England, and eastern Canada. Should be looked for in Michigan and other Great Lake states. More local records should turn up following careful search of proper habitat. Look for a new allochronic flight after the flight of *lucia*. We have examined and verified specimens and reports from the following locations:

CANADA. NEW BRUNSWICK: CHARLOTTE CO.: “southern county”; GLOUCESTER CO.: Allardville, Daly Point, Nigadoo, Petit-Rocher; KINGS CO.: Belleisle; MADAWASKA CO.: St. Jacques; NORTHUMBERLAND CO.: Holtville; SAINT JOHN CO.: Saint Martins; WESTMORLAND CO.: Cap-Pelé, Moncton, Sackville, Shediack; YORK CO.: Charters Settlement, Tower Lake, University of New Brunswick woodlot. **NOVA SCOTIA:** ANNAPOLIS CO.: Lequille; CAPE BRETON CO.: Locality not given; COLCHESTER CO.: Truro; DIGBY CO.: Digby, Beamans Mountain; HALIFAX CO.: Prospect Bay; HANTS CO.: Mount Uniacke; INVERNESS CO.: Cape Breton Highlands National Park; KINGS CO.: Black Rock; LUNENBURG CO.: Petite Rivière; SHELBURNE CO.: Locality not given; VICTORIA CO.: Baddeck, Beinn Bhreagh, Cape Breton Highlands National Park; YARMOUTH CO.: Argyle. **ONTARIO:** BRUCE CO.: MacGregor Point Provincial Park, Port Elgin; DUFFERIN CO.: Luther Lake; DURHAM (Regional Municipality): Ajax; FRONTENAC CO.: Fermoy, Thousand Islands; GREY CO.: Owen Sound; HALIBURTON CO.: Kinmount, Miner’s Bay, near Norland; HALTON CO.: Campbellville; KAWARTHA LAKES (City, formerly Victoria Co.): Norland; LENNOX & ADDINGTON CO.: Cloyne; MIDDLESEX CO.: London; MUSKOKA CO.: Bracebridge; NORTHUMBERLAND CO.: Northumberland Forest, Baltimore OTTAWA (City, formerly Ottawa-Carleton Regional Municipality): Bells Corners, Constance Bay, Fitzroy Harbour, Kanata, Ramsayville; PETERBOROUGH CO.: Warsaw Caves; SIMCOE CO.: Lefroy, Midhurst; TORONTO (City, formerly Metropolitan Toronto): Saint Michael’s, Toronto; WELLINGTON CO.: Arkell, Guelph, Rockwood Conservation Area; YORK (Regional Municipality): Brown Hill, Koffler Scientific Reserve at Joker’s Hill (U. of Toronto) west of Newmarket, Vivian Forest. **PRINCE EDWARD ISLAND:** KINGS CO.: Pooles Corner; QUEENS CO.: Brackley Beach, Dalvay by the Sea. **QUEBEC:** BELLECHASSE (Regional County Municipality): Saint Charles, Saint Raphael; LES COLLINES-DE-L’OUTAOUAIS (Regional County Municipality): Chelsea; LES LAURENTIDES (Regional County Municipality): Parc du Mont-Tremblant; LEVIS (City, separate municipality): Saint Jean Chrysostome, Saint Redempteur; LA JACQUES-CARTIER (Regional County Municipality): Stoneham; LA CÔTE-DE-GASPÉ (Regional County Municipality, formerly Gaspé-Est Co. in part): Forillon National Park; MONTMAGNY (Regional County Municipality): Montmagny; MONTREAL (City, separate municipality): Montreal; QUEBEC (City, separate municipality): Quebec; RIMOUSKI-NEIGETTE (Regional County Municipality): Macpes, Parc du Bic, Pointe-au-Pere, Saint Fabien.

UNITED STATES. CONNECTICUT: FAIRFIELD CO.: Sherman; HARTFORD CO.: Berlin, East Granby, Enfield, Rocky Hill, Windsor; LITCHFIELD CO.: Canaan, Litchfield, Mohawk Mountain State Park, Nepaug, Norfolk, Salisbury; MIDDLESEX CO.: East Haddam, Essex, Killingworth, Middletown, Middlesex, Old Saybrook; NEW HAVEN CO.: Branford, 2 miles W of Clinton, East Haven, North Haven; NEW LONDON CO.: Colchester, Connecticut College Arboretum (New London), East Lyme, Franklin, Groton, Montville Center, New London, Old Lyme, Salem; TOLLAND CO.: Coventry, Union; WINDHAM CO.: Plainfield, Scotland, Sterling, Thompson. **MAINE:** CUMBERLAND CO.: Brunswick; FRANKLIN CO.: Locality not given; HANCOCK CO.: Bar Harbor, Southwest Harbor; KENNEBEC CO.: Augusta, Oakland; LINCOLN CO.: Newagen, Boothbay; OXFORD CO.: Magalloway; PENOBSCOT CO.: Chester, Enfield, Lincoln, Lowell, Orono, Passadumkeag; WALDO CO.: Isleboro; YORK CO.: Shapleigh. **MARYLAND:** GARRETT CO.: Swallow Falls State Park; ALLEGANY CO.: near Frostburg. **MASSACHUSETTS:** BARNSTABLE CO.: Barnstable, Eastham, Harwich, Mashpee, Truro, West Falmouth, Yarmouth; BERKSHIRE CO.: Ashley Falls, Becket, Egremont, Florida, Hinsdale, Lenox, Monterey, Mount Greylock, New Ashfield, North Egremont, Sandisfield, Savoy, Sheffield, South Egremont, Washington, West Stockbridge, Williamstown; BRISTOL CO.: Dartmouth, New Bedford, North Easton, Raynham, Westport; DUKES CO.: Chilmark, Edgartown, Naushon Island, West Tisbury; ESSEX CO.: Ipswich, Manchester, Marblehead, Peabody, Rockport, Salisbury; FRANKLIN CO.: Ashfield, Heath, Montague Barrens, Monroe, Northfield, Quabbin (Reservoir Gate #15), Rowe, Shelburne; HAMPDEN CO.: Granville, Hampden, Holyoke, Wales; HAMPSHIRE CO.: Amherst, Belcherton, Mount Holyoke, Northampton, Plainfield; MIDDLESEX CO.: Ashby, Billerica, Chelmsford, Concord, Dracut, Lexington, Medford, Middlesex Fells Reservation, Stoneham, Waltham; NANTUCKET CO.: Siasconset; NORFOLK CO.: Blue Hills Reservation, Medfield, Walpole, Wellesley, Westwood, Wollaston; PLYMOUTH CO.: Hingham, Lakeville, Marion, Marshfield, Middleboro, Miles Standish State Forest, Plymouth, Scituate; SUFFOLK CO.: Boston, Hyde Park, Stony Brook Reservation; WORCESTER CO.: Ashburnham, Douglas, Dudley, Gilbertville, North Brookfield, Petersham, Princeton, Sturbridge, Uxbridge, West Brookfield, West Springfield, Westminster. **NEW HAMPSHIRE:** CARROLL CO.: Albany, Effingham; CHESHIRE CO.: Marlow, Roxbury. COOS CO.: Crawfords Purchase, Pinkhams Grant, Second College Grant, Scott Bog, Thompson & Meserves Purchase; GRAFTON CO.: Benton, Dorchester, Glencliff, Hanover, Lebanon; HILLSBOROUGH CO.: Deering, Francestown, Goffstown, Greenville, Hancock, Mason, Pelham, Peterboro, Sharon, Windsor; MERRIMACK CO.: Boscawen, Bow, Concord, Epsom, Hopkinton, Pembroke, Webster; ROCKINGHAM CO.: Newmarket, North Ampton, Northwood, Portsmouth, Rye; STAFFORD CO.: Durham, Middleton, Rollinsford; SULLIVAN CO.: Croyden. **NEW JERSEY:** SUSSEX CO.: Delaware Water Gap National Recreation Area, High Point State Park, Mashipacong Pond. **NEW YORK:** ALBANY CO.: Albany, Colonie; Centre, Karner; CATTARAUGUS CO.: Allegany State Park; CHAUTAUQUA CO.: Boutwell State Forest, Stockton State Forest; ESSEX CO.: Keene Valley; ALLEGANY CO.: near Wellsville; GREENE CO.: Tannersville; MONROE CO.:

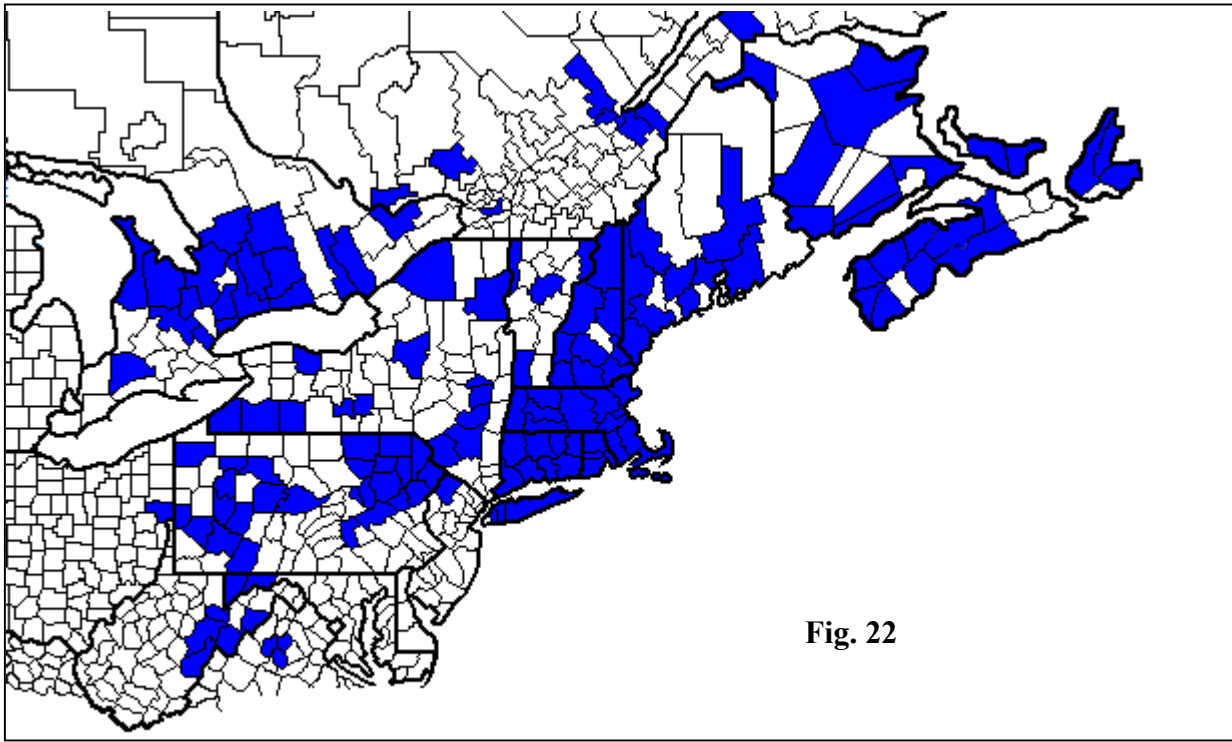
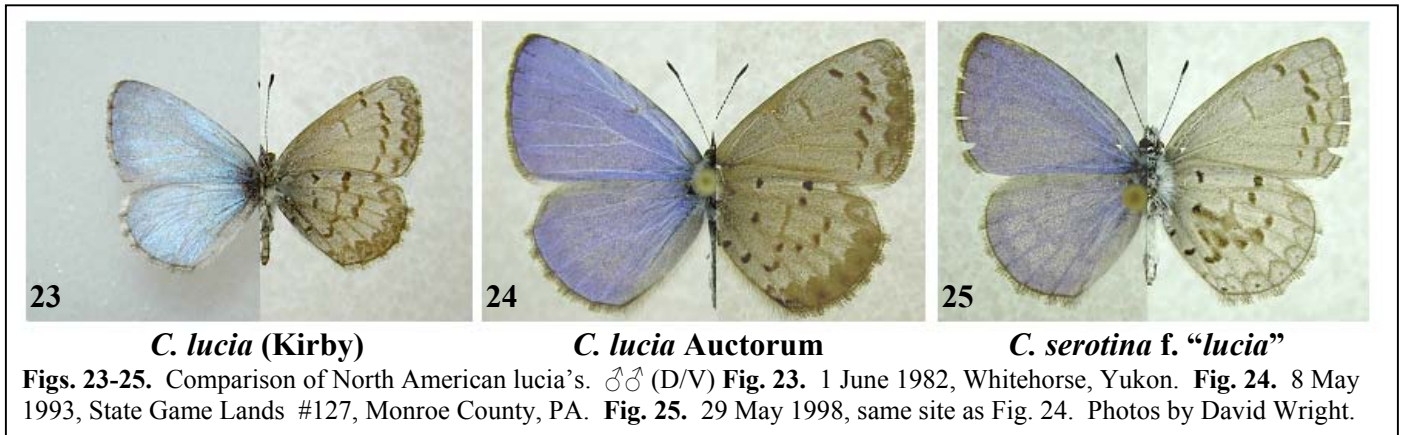


Fig. 22

Rochester; NASSAU CO.: Bethpage State Park; ONEIDA CO.: Trenton Falls; QUEENS CO.: Corona; ST. LAWRENCE CO.: Madrid, Morristown; SCHENECTADY CO.: Schenectady, Niskayuna; SCHUYLER CO.: Cayuta Lake; SUFFOLK CO.: Babylon, Bay Shore, Brentwood, Brookhaven, Commack, Deer Park, East Islip (Heckscher State Park), East Moriches, Eastport, Edgewood, Great River, Manorville, Middle Island, North Babylon (Belmont Lake State Park), Oakdale (Connetquot State Park), Riverhead, Sarnoff Preserve, Sayville, Smithtown, Tiana (Munn's Pond), West Islip, Yaphank, Wyandanch; SULLIVAN CO.: Catskill Township (Catskill Mts.); TOMPKINS CO.: Ithaca, McLean Bogs Preserve, Monkey Run Road; ULSTER CO.: New Paltz, Oliverea, Wittenberg Mountain. **OHIO:** COLUMBIANA CO.: Beaver Creek State Park. **PENNSYLVANIA:** ALLEGHENY CO.: Pittsburgh; ARMSTRONG CO.: Elderton; BEAVER CO.: Locality not given; BRADFORD CO.: Barclay; CARBON CO.: Split Rock; CENTRE CO.: State College; CLARION CO.: Clarion; CLEARFIELD CO.: Shawville; COLUMBIA CO.: Bloomsburg; CRAWFORD CO.: Little Cooley; DAUPHIN CO.: Rt. 325 (3 miles SW of Orwin); ELK CO.: Allegheny National Forest (Buzzard Swamp); FOREST CO.: Allegheny National Forest (Buzzard Swamp); INDIANA CO.: Clarksburg; LACKAWANNA CO.: Choke Creek (near Thornhurst); LUZERNE CO.: Mountain Springs Road, Ricketts Glen State Park, Stoddartsville; MONROE CO.: Pocono Lake, Pocono Pines, State Game Lands #127; MONTOUR CO.: Danville; PIKE CO.: Sugar Creek near Carlton Hill; SCHUYLKILL CO.: near Tamaqua (Owl Creek); SOMERSET CO.: Seven Springs; SULLIVAN CO.: Lopez, near Ricketts Glen State Park (Rt. 487); SUSQUEHANNA CO.: Montrose; WAYNE CO.: Gouldsboro; WESTMORELAND CO.: Jones Mills, Powdermill Nature Reserve, Bushy Run Battlefield (5 mi. NE of Irwin), Greensburg; WYOMING CO.: Mountain Springs Road. **RHODE ISLAND:** BRISTOL CO.: Barrington, Bristol, Warren; KENT CO.: Coventry, Greene, Warwick, West Greenwich, West Warwick; NEWPORT CO.: Jamestown, Little Compton, Middletown, Portsmouth; PROVIDENCE CO.: Burrillville, Cumberland, East Providence, Foster, Johnston, North Smithfield, Scituate; WASHINGTON CO.: Charlestown, Exeter, Hopkinton, Middlebridge, Narragansett, New Shoreham, Richmond, Shannock, South Kingstown, West Kingstown (Great Swamp Management Area), Westerly. **VERMONT:** BENNINGTON CO.: Beartown, Equinox Mountain, Manchester; ESSEX CO.: Victory Township; GRAND ISLE CO.: Grand Isle (West Shore Road); WASHINGTON CO.: Montpelier. **VIRGINIA:** MADISON CO.: Big Meadows (Shenandoah National Park); PAGE CO.: Tanners Ridge (Shenandoah National Park); RAPPAHANNOCK CO.: Sperryville (Shenandoah National Park). **WEST VIRGINIA:** HAMPSHIRE CO.: Ice Mountain; HARDY CO.: River Road east of Moorefield; PENDLETON CO.: 1.5 mile NW of Upper Tract (Briggs Run Forest Road); POCAHONTAS CO.: Cass; RANDOLPH CO.: Spruce Knob; TUCKER CO.: Blackwater Falls State Park.

A SHORT DISCUSSION OF *CELASTRINA LUCIA*



Presently, the name *lucia* comprises multiple meanings:

(1) William Kirby (1837) named *Polyommatus lucia* from material collected at Cumberland House, Saskatchewan, 54° N latitude, during Franklin's expedition to western Canada in 1825-27. This population is widespread throughout the northern boreal forest where Labrador Tea *Ledum groenlandicum* Oeder (Ericaceae) is a frequent larval host. Adults are small and very pale blue above (Fig. 23), sometimes tending to greenish. The venter is dark gray with coarse brown markings. Following its discovery, *lucia* Kirby had been treated for an extended period as a subarctic subspecies of a single continent-wide species (*ladon*). Recent reappraisals by Wright (1998), Nielsen (1999), Ochlenchlagel & Huber (2002), and Opler & Warren (2002) have returned *C. lucia* (Kirby) to a full species. The precise relationships between *lucia* populations at Cumberland House (Saskatchewan) and those in western North America, Yukon-Alaska, and eastern North America have not been worked out.

(2) In eastern North America, *lucia* was loosely considered to be the northern population of the first spring brood of the nominate eastern subspecies (*ladon*). It was pointed out by Klots (1952) and Forbes (1960) this was not *lucia* Kirby, rather a highly polymorphic larger entity, solid blue above and quite variable below (Fig. 24). Pratt *et al.* (1994) designated it ssp. *lucia* Auctorum ("of authors") and extended its range into the central Appalachians. *Lucia* Auct. differs significantly from *ladon* in scale morphology and ecology (Wright & Pavulaan, 1999). It is a separate species, but its relationship with *lucia* Kirby and other *lucia* populations needs further study. The newly-described species (*serotina*) is closely linked with eastern *lucia* Auctorum. We propose there may be a chain or great arc of allochronic late spring siblings from southern Appalachians, north through northeastern U.S. & eastern Canada, west through the Great Lakes to the Manitoba & Saskatchewan, and south to the Foot Hills of the Rockies in Colorado. In the central continent, *argentata* Fletcher and *humulus* Scott & Wright should be examined in this light.

(3) Males from southern New England possess the unique scale of *ladon* males, but in all other respects they are *lucia* Auct. This is believed to be an example of single character introgression during a warmer postglacial period (Hypisthermal) when southern deciduous forests invaded southern New England (Wright, 1971). Because of the introgressed trait, wings of males from this region (Fig. 4) contrast with males elsewhere (Fig. 24). By good fortune, this circumstance allowed us to separate *lucia* Auct. and *serotina* in southern New England not only by flight period but also by a precise morphological analysis. We found no introgression of the unique scale trait into *serotina*, boosting our confidence in its status.

(4) The name *lucia* has also been adopted as a form name (f. "*lucia*") that appears in many *Celastrina* taxa. This form is characterized by coalesced macules in the middle of the VHW resulting in a black discal patch. The form commonly occurs in early spring taxa like *lucia* and *ladon*, but also occurs in light-ventered allochronic taxa like *idella* and *serotina* (Fig. 25). By itself, the presence of a dark VHW patch is not a diagnostic trait of any specific taxon.

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LITERATURE CITED

- Allen, T.J. 1997. The butterflies of West Virginia and their caterpillars. Univ. of Pittsburgh Press, Pittsburgh, Pennsylvania, 388 pp.
- Allen, T.J., J.P. Brock & J. Glassberg. 2005. Caterpillars in the field and garden. A field guide to the caterpillars of North America. Oxford Univ. Press, New York, NY, 232 pp.
- Boisduval, J.B.A. & J.E. Le Conte. [1833]. Historie générale et iconographie des lépidoptères et des chenilles de l'Amérique septentrionale. Roret, Paris, 228 pp., 78 pl.
- Cech, R. & G. Tudor. 2005. Butterflies of the East Coast: An observer's guide. Princeton Univ. Press, Princeton, NJ, 345 pp.
- Chew, F.S. & R.K. Robbins. 1984. Egg-laying in butterflies (Chapter 6). In The Biology of Butterflies. Vane-Wright & Ackery (eds.), Academic Press, London, 429 pp.
- Clench, H.K. 1958. The butterflies of Powdermill Nature Reserve. Research Report no.1, Powdermill Nature Reserve. A Research Station of Carnegie Museum, December 30, 11 pp.
- Comstock, J.H. and A.B. Comstock. 1904. How to know the butterflies. A manual of the butterflies of the eastern United States. D. Appleton & Co., New York, NY, 311 pp.
- Comstock, W.P. 1940. Butterflies of New Jersey. J. New York Ent. Soc. 48:47-84.
- Davis, W.T. 1910. List of the Macrolepidoptera of Staten Island, New York. Staten Island Assoc. Arts Sci. Proc. 3:1-30.
- Dirig, R. 2002. Definitive Destination McLean Bogs Preserve: Finger Lakes Region, New York. American Butterflies 10(4) : 4-16.
- Doubleday, E. 1841. Description of a new North American Polyommatus. The Entomologist 1:209-211.
- Edwards, W.H. 1862. Descriptions of certain species of diurnal Lepidoptera found within the limits of the United States and British America. – No.2. Proc. Acad. Nat. Sci., Phila. 14:54-58.
- Edwards, W.H. 1875. Some notes on *Lycaena Pseudargiolus*. Canad. Ent. 7(5): 81-83.
- Edwards, W.H. 1883. On the polymorphism of *Lycaena Pseudargiolus*. Bois. Papilio 3: 85-97.
- Edwards, W.H. 1884. Butterflies of North America. Vol. 2. Houghton, Mifflin & Co., Boston, MA, 357 pp., 51 pl.
- Engel, H. 1908. A preliminary list of the Lepidoptera of western Pennsylvania collected in the vicinity of Pittsburgh. Ann. Carnegie Mus. 5(1): 27-136.
- Ferguson, D.C. 1954. The Lepidoptera of Nova Scotia. Proc. Nova Scot. Inst. Sci. 23(3):161-375.
- Ferguson, D.C. 1975. Host records for Lepidoptera reared in eastern North America. USDA Tech. Bull. 1521:1-49.
- Forbes, W.T.M. 1960. Lepidoptera of New York and neighboring states. Part IV. Agaristidae through Nymphalidae including butterflies. Memoir 371. Cornell Univ. Agric. Exp. Sta. NY State College of Agric., Ithaca, NY, 188 pp.
- Glassberg, J. 1993. Butterflies through binoculars: A field guide to butterflies in the Boston-New York-Washington region. Oxford University Press, New York, NY, 160 pp.
- Glassberg, J. 1999. Butterflies through binoculars: The East. Oxford University Press, New York, NY, 242 pp.
- Gochfeld, M. & J. Burger. 1997. Butterflies of New Jersey: A guide to their status, distribution, conservation, and appreciation. Rutgers University Press, New Brunswick, NJ, 327 pp.
- Handfield, L. 1999. Le guide des Papillon du Québec. Broquet, Boucherville, Quebec, 960 pp.
- Harris, T.W. 1862. A treatise on some of the insects injurious to vegetation. Revised edition. (C.L. Flint, ed.) William White, Printer to the State, Boston, MA, 640 pp.
- Iftner, D.C., J.A. Shuey, and J.V. Calhoun. 1992. Butterflies and skippers of Ohio. Ohio Biol. Surv. Bull. New Series, vol. 9, no. 1, xii + 212 pp. (incl. 40 pls.).
- Kirby, W. 1837. Part 4. The insects. pp. xxxix + 325, pl. I-VIII. In J. Richardson: Fauna-boreali-Americana; or the zoology of the northern parts of British America: containing descriptions of the

- objects of natural history collected on the late Northern Land expeditions, under command of Captain Sir John Franklin, R.N. Longman, London.
- Klots, A.B. 1951. A field guide to the butterflies of North America east of the Great Plains. Houghton Mifflin Co., Boston, MA, 349 pp.
- Layberry, R.A. 1996. The Spring Azure species complex. In *Butterflies of Ontario & Summaries of Lepidoptera Encountered in Ontario in 1995*. Toronto Ent. Assoc. Occ. Pub. #28-96, Section 4.5, p. 12-15.
- Layberry, R.A., P.W. Hall & J.D. Lafontaine. 1998. *The butterflies of Canada*. Univ. of Toronto Press, Toronto, Ontario, 280 pp.
- Leblanc, A. 1985. Les Lycaenides (Lepidoptera: Lycaenidae) du Quebec. *Fabriques*. Supplement 4, 66 pp.
- Lintner, J.A. 1875. On *Lycaena Neglecta*, Edw. *Canad. Ent.* 7:122-123.
- Nielsen, M.C. 1999. Michigan butterflies and skippers. Michigan State University Extension, East Lansing, 248 pp.
- Ochenschlager, R. & R. Huber. 2002. The butterflies of Wadena County, Minnesota. *Scientific Publications of the Science Museum of Minnesota, New Series* 8(1): iv, 1-26.
- Opler, P.A. & G.O. Krizek. 1984. *Butterflies east of the Great Plains*. The Johns Hopkins University Press, Baltimore, MD, 294 pp.
- Opler, P.A. & V. Malikul. 1992. A field guide to eastern butterflies. Peterson field guide series, no.4. Houghton Mifflin Co., Boston, MA, 396 pp.
- Opler, P.A. & A.D. Warren. 2002. *Butterflies of North America. 2. Scientific Names List for Butterfly Species of North America, north of Mexico*. Contributions of the G.P. Gillette Museum of Arthropod Diversity, Colorado State University, 79 pp.
- Packard, A.S. 1869. *Guide to the study of insects and a treatise on those injurious and beneficial to crops for the use of colleges, farm schools, and agriculturists*. Salem, Naturalist's Book Agency, 702 pp.
- Parker, H.W. 1874. *Novelties in Amherst, Mass.* *Psyche* 1(7); 26.
- Pavulaan, H. 1985. Field survey of the true butterflies (Papilionoidea) of Rhode Island. *J. Lepid. Soc.* 39(1):19-25.
- Pavulaan, H. 1989. The butterflies of West Warwick, Rhode Island, and vicinity: A study of urban butterflies. *Y.E.S. Quarterly* 6(2):4-31 [April/June].
- Pavulaan, H. 1993. Butterflies at Rhode Island's Great Swamp. *Y.E.S. Quarterly* 10(2): 1-32 [April/June] & 10(3):1-32 [July/Sept].
- Pavulaan, H. 2002. Azure butterflies redefined. *The Connecticut Butterfly Association Newsletter*. No. 9, March, p. 7.
- Pavulaan, H. & D.M. Wright. 1994. Out of the azure and into the lab: The current state of *Celastrina* research. *The Mulberry Wing* 10(1):406.
- Pavulaan, H. & D.M. Wright. 2000. The biology, life history, and taxonomy of *Celastrina neglectamajor* (Lycaenidae: Polyommatainae). *The Taxonomic Report of The Intl. Lep. Survey* 2(5):1-19.
- Pelikan, M.L. 1998. Island blues: 1998 azure flights on Martha's Vineyard. *Massachusetts Butterflies*, no. 11, August, p. 4-8.
- Pratt, G.F., D.M. Wright, and H. Pavulaan. 1994. The various taxa and hosts of the North American *Celastrina* (Lepidoptera: Lycaenidae). *Proc. Entomol. Soc. Wash.* 96(3):566-578.
- Remington, C.L. 1956[58]. Genetics of populations of Lepidoptera. *Proc. Tenth Int'l Congr. Ent.* 2:787-805.
- Saunders, W. 1875. [Note. Ed. C.E. {Canadian Entomologist}]. *Canad. Ent.* 7(5): 82-83.
- Scott, J.A. & D.M. Wright. 1998. A new *Celastrina* from the eastern slope of Colorado. *Papilio n.s.*, no. 9, 15 pp.
- Scudder, S.H. 1869. Entomological correspondence of Thaddeus William Harris, M.D. *Occ. Papers Boston Soc. Nat. History*, no.1, 375 pp.
- Scudder, S.H. 1876. The relationship of the early spring blues. *Canad. Ent.* 8(4): 61-66.

- Scudder, S.H. 1881. Butterflies: their structure, changes, and life-histories. Henry Holt and Co., New York, NY, 322 pp.
- Scudder, S.H. 1889. Butterflies of eastern United States and Canada. 3 vols., Published by author, Cambridge, Massachusetts.
- Scudder, S.H. 1893. Brief guide to the commoner butterflies of the northern United States and Canada; being an introduction to a knowledge of their life-histories. Henry Holt and Co., New York, NY, 206 pp.
- Shapiro, A.M. 1966. Butterflies of the Delaware Valley. Special Publication of the American Entomological Society, Philadelphia, PA, 79 pp.
- Shapiro, A.M. 1974. Butterflies and skippers of New York State. Search 4(3):1-59.
- Smith, J.B. 1910. The insects of New Jersey. Annual Report of the New Jersey State Museum 1909. Trenton, NJ, 888 pp.
- Thomas, A.W. 1996. A preliminary atlas of the butterflies of New Brunswick. New Brunswick Museum Publications in Natural Science No. 11, 41 pp.
- Wagner, W.H., Jr. & T.L. Mellichamp. 1978. Foodplant, habitat, and range of *Celastrina ebenina* (Lycaenidae). J. Lepid. Soc. 32(1):20-36.
- Wagner, D.L. 2005. Caterpillars of eastern North America: A guide to identification and natural history. Princeton Univ. Press, Princeton, NJ, 512 pp.
- Walter, S. 1993. Out of the Blue (?) and into the Azure. The Mulberry Wing 9(1):5-6, April-May.
- Wright, D.M. 1995. The American Azures: Our blue heaven. American Butterflies 3(1):20-28 & 30.
- Wright, D.M. 1998. Update on *Celastrina* including notes on Ohio species. The Ohio Lepidopterist 20(2): 18-21.
- Wright, D.M. & H. Pavulaan. 1999. *Celastrina idella* (Lycaenidae: Polyommatainae): a new butterfly species from the Atlantic coastal plain. The Taxonomic Report of The Intl. Lep. Survey 1(9): 1-11.
- Wright, H.E. 1971. Late quaternary vegetational history of North America. (pp. 425-464) In K.K. Turekian (Ed.) The Late Cenozoic Glacial Ages. Yale University Press, New Haven.

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