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NATURAL HISTORY OF SEVEN HAIRSTREAKS IN COASTAL NORTH CAROLINA

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ABSTRACT. Seven species of hairstreaks were observed in their natural habitats along coastal North Carolina. Also, larvae of each were reared in the laboratory from eggs. Various aspects of the butterflies' natural history are discussed. The species studied are: *Satyrium calanus falacer* (Godart), *S. liparops* (Leconte), *S. kingi* (Klots & Clench), *Calycopis cecrops* (Fabricius), *Mitoura hesseli* Rawson & Ziegler, *Incisalia henrici* (Grote & Robinson), and *Fixsenia ontario* (Edwards).

For the last six years (1974–1980), the senior author has observed hairstreak behavior in the field on Hatteras Island and Roanoke Island, Dare County, North Carolina. In addition, larvae were reared in captivity from eggs found in nature or obtained from caged females. The seven species considered in the present paper are *Satyrium calanus falacer* (Godart), *S. liparops* (Leconte), *S. kingi* (Klots & Clench), *Calycopis cecrops* (Fabricius), *Mitoura hesseli* Rawson & Ziegler, *Incisalia henrici* (Grote and Robinson), and *Fixsenia ontario* (Edwards). The junior author has provided comparative notes in the discussion of each species based upon prior literature reports. Each species is discussed individually and information for each species is also presented on Table 1.

METHODS

If possible, females were observed in the field in order to gain some idea of their host preferences, and in some cases, e.g., *I. henrici*, eggs were collected in the field. In most instances wild caught females

TABLE 1. Life-cycle data obtained in North Carolina on five species of hairstreaks.

Species	Hatched	1st molt	2nd molt	3rd molt	Pupated	Emerged	Food plant
S. c. falacer	6-IV-80	16-IV	21-IV	27-IV	4-V	25-V	blue jack oak (*Q. incana*)
S. kingi	6-IV-80	14-IV	26-IV	2-V	11-V	31-V	sweetleaf (*Symplocos tinctoria*)
S. l. strigosum	24-III-78	4-IV	14-IV	23-IV	15-V	4-VI	blueberry (*V. corymbosum*)
I. henrici	11-IV-80	22-IV	28-IV	3-V	11-V	19-VI-81	American holly (*Ilex opaca*)
F. ontario	4-IV-80	10-IV	16-IV	23-IV	29-IV	22-V	live oak (*Q. virginiana*)

were caged with appropriate host plant material and nectar sources if available. Larvae resulting from eggs obtained by either method were kept in individual containers and fresh host material was provided each day. The date of each molt, pupation and adult eclosion were recorded on each container. Larvae were kept on an outside porch under natural temperature conditions. Examples of eggs, larvae, and pupae of each species were preserved. Reared adults were deposited in the Carnegie Museum of Natural History and the Smithsonian Institution.

RESULTS

Satyrium calanus falacer

Eggs were obtained from females collected on Roanoke Island and caged with twigs of bluejack oak (*Quercus incana*). The egg-bearing twigs were inserted into a styrofoam block within a square cage, which was hung from a branch in the senior author's yard. They were separated to prevent mold. In general, the developmental behavior was similar to that of *Fixsenia ontario*. The *falacer* eggs hatched a few days later than those of *F. ontario*; concomitantly, the former's host (*Q. incana*) flowered and leafed out a few days later than did *Quercus virginiana*. The larvae fed on catkins at first and then switched over to young leaves when they appeared.

The larvae were dark green and marked with white. The body setae were brown. The larvae looked brownish and were accented by the white markings. The mature larvae crawled a good deal and ended up pupating on the lids or sides of the containers. Pupae were never found in the field. Typical developmental times are shown on Table 1. Adults emerged from 25 May to 4 June.

S. calanus utilizes only members of the oak (Fagaceae) and walnut (Juglandaceae) families as hosts, although Smith (1797) reports hawthorne (*Crataegus*: Rosaceae) based on a painting by John Abbot. In any one area usually only one host genus is utilized. In most situations these are various oaks (present paper; Shapiro, 1966, 1974), but hickory (*Carya*) or walnuts (*Juglans*) are utilized in Texas and some portions of Florida (Kendall, 1964; D. Baggett, pers. comm.).

It is possible that there are two or more unrecognized sibling species currently going under the name *calanus*, and that these might be host-limited (D. Baggett, pers. comm.).

Satyrium liparops

On both Hatteras and Roanoke Islands, the larvae of *S. liparops* were the first to hatch from their eggs in the spring. Their host, high

blueberry (*Vaccinium corymbosum*), was also the first shrub in the area to put out new spring growth. It may be that the same weather conditions govern both events. Eggs and larvae were collected on *Vaccinium* in the field at both localities. Eggs were laid on host twigs the previous summer. Female *S. liparops* lay eggs both on reproductive and non-reproductive hosts, but seem to preferentially select portions of the shrub which will produce the most rapid growth. Eggs must be kept under natural moisture conditions outside or they will desiccate, and the young larvae will be unable to chew a hole through the egg. The remainder of the egg was not eaten. The young larva crawled to the nearest bud and bored into it. It fed within the bud until the leaves began to unfurl, after which time it fed on the leaves. In some instances the larvae bored into flower buds, open flowers and developing fruits, all of which were fed upon. The larvae were dark green when mature with transverse white markings. The body setae were dark brown. Typical developmental times are indicated on Table 1. Adults emerged between 30 May and 6 June.

This hairstreak is the most catholic *Satyrium* in its choice of larval hosts, although only one or a few may be used in any one region. Brown (1976) reported a Florida population to utilize blueberry as its host, while Knudsen (1955) reported rhododendron as a host in Georgia. Thus, southeastern populations may oviposit only on members of the heath family (Ericaceae). In contrast, more northern populations are known to utilize a wide array of woody hosts, including hawthorne (*Crataegus*), wild plum and cherry (*Prunus*), shadbush (*Amelanchier*), blackberry (*Rubus*), oak (*Quercus*), willow (*Salix*), and hornbeam (*Carpinus*) (Klots, 1951; Shapiro, 1974).

Satyrium kingi

Found on Roanoke Island, adult females and larvae of *S. kingi* were found in close association or upon sweetleaf or horse-sugar tree (*Symplocos tinctoria*: Symplocaceae). This plant occurs in isolated patches scattered through the woods on Roanoke Island, where adults were also seen nectaring on flowers of chinquapin (*Castanea pumila*). Eggs were placed near twig tips by captive females. The larvae did not eat the egg shells after chewing their way out, but bored directly into leaf buds and fed there until after the first molt when the leaves began to unfurl. Larvae presented with host flowers or fruits refused to feed. Two larvae found in nature, when collected with host material for captive stock, completed their development at the same time, and the resultant adults eclosed on about the same dates.

The larvae were lighter green than those of *S. liparops* and were a

little larger when mature. Typical developmental times are shown on Table 1. Adults emerged between 31 May and 6 June.

King's hairstreak is probably limited to *Symplocos tinctoria* throughout its range, as it was also reported on this plant in Georgia (Floyd, 1974), and its distribution agrees well with that of the plant. The report by Harris (1972) that flame azalea (*Rhododendron calendulaceum*) is a host for this butterfly may have resulted from a misidentified *S. liparops*.

Calycopis cecrops

The habits of *Calycopis cecrops* are bizarre. Found on both Hatteras and Roanoke Islands, the butterfly has two full broods and a partial third (April, July, September). Robert Cavanaugh of North Carolina observed female *C. cecrops* ovipositing on dead leaves on the ground under plants (pers. comm.). With this cue the senior author began to watch females in the field and eventually saw the act repeated. The eggs are laid on the underside of dead leaves and are hidden from view. The one found by Gifford was laid on a dead leaf three inches from the base of the nearest plant, a wax myrtle (*Myrica cerifera*). The larvae were dull blackish brown and densely setate in all their instars.

On 8 August 1980, several female *Calycopis* were placed in a cage with sprigs of wax myrtle and staghorn sumac (*Rhus typhina*), as well as some fall flowers. Small dead dry leaves were scattered on the bottom of the cage. The females laid a number of eggs, all under the dead leaves hidden from view. When the eggs hatched, the young larvae had their choice between wax myrtle and sumac. Wax myrtle was selected by 36 larvae (59%) and sumac by 25 (41%).

Fresh leaves of the plant selected were provided daily, and all larvae survived until hibernation in late fall. Larvae on sumac grew at a normal rate, although their growth slowed after the third molt. The molting process normally required about three days, but was lengthened to five or six days for the third molt. After this molt the larvae each rested under a sumac leaf until the following March when they pupated. Sixteen larvae (64%) survived until spring.

The larvae on wax myrtle grew more slowly but molted at the same time as the sumac group. They were relatively smaller and spent more time resting. The three larvae (8%) which successfully overwintered began moving about with the first warm weather in February. The larvae were then provided wax myrtle sprigs with overwintered leaves and male flower buds. The larvae fed on the flower buds and ignored

the leaves. They completed development and pupated about the time the flowers opened in nature.

Wax myrtle is the primary natural host in coastal North Carolina, although sumac and oak may be selected on occasion. The fact that different hosts may be used results in different developmental times and, therefore, extended flight periods. For example, spring generation adults may be found from 10 April to 15 May.

The life stages of this species were previously described by Rawson & Hessel (1951). They associated the butterfly with dwarf sumac (*Rhus copallina*) in New Jersey, and obtained eggs by enclosing females in paper bags with suspected host material. They reported the larvae to prefer leaves and to show strong negative phototropism.

Mitoura hesseli

On 20 July 1980, three female *M. hesseli* were collected near East Lake, Dare County, North Carolina, visiting flowers of sweet pepperbush (*Clethra alnifolia*). In the vicinity grew white cedar (*Chamaecyparis thyoides*), the only host of *C. hesseli*. The females were taken back to Roanoke Island where they were confined with branches of white cedar and flowering branches of sweet pepperbush. One female died the first day, but the other two lived until about 25 July by which time 20 eggs had been laid.

The larvae were transferred to red cedar (*Juniperus virginiana*), since white cedar was not readily available. Two larvae would not accept the alternate host and died without feeding. The remaining larvae accepted red cedar and developed normally. The young larvae were bright green. At the third molt the white transverse markings began to appear, but were not fully developed until the last instar. Larvae in the third instar would hang by a silk thread when accidentally dislodged. Some larvae molted five times prior to pupuation and others molted only four times. *M. hesseli* larvae required two days to molt before feeding was reinitiated. Larvae always ate the shed exuviae.

The life history of *Mitoura hesseli* was described previously by Rawson et al. (1951), and the observations reported herein are generally confirmatory. This hairstreak is well known to be closely associated with its host white cedar throughout its range from New Hampshire to Florida.

Previously, Remington and Pease (1955) found that *Mitoura gryneus* larvae, whose normal host is red cedar (*Juniperus virginiana*), will readily feed and develop normally on white cedar. Thus, results of the reverse experiment reported here are of more than passing interest.

Incisalia henrici

On Hatteras Island, *I. henrici* fed only upon yaupon (*Ilex vomitoria*), but on Roanoke Island, only American holly (*Ilex opaca*) was utilized. Individuals of the Hatteras Island population had a greenish cast ventrally, and might eventually be described as a separate subspecies (L. D. Miller, pers. comm.).

Female *I. henrici* oviposited when the hollies were beginning to leaf out. Females circled about investigating expanding buds. If a bud seemed suitable a female would fly to a nearby leaf (the previous year's—holly being an evergreen) and laid an egg on the upper surface adjacent to the midrib. Eggs were laid indiscriminately with regard to sex of the host (*Ilex opaca* being dioecious). Eggs hatched seven to 11 days after oviposition. Upon hatching the young larvae crawled to the expanding leaf buds and bored in. As the leaves expanded, the larvae skeletonized them; then as they became larger, they fed on entire leaves. Fruits or flowers were not fed upon. Older larvae fed at night and rested under year-old leaves by day.

I. henrici larvae were green, molted three times, and required about a month for development to pupation.

On Hatteras Island, adult *I. henrici* fed at willow flowers. Typical developmental times are shown on Table 1. Adults emerged from 10 to 16 April.

The geographic distribution of *I. henrici*'s host associations are unusual. The butterfly, which uses a single host in any one area, feeds on quite different hosts in different portions of its range. In much of its inland range, the insect selects redbud (*Cercis canadensis*) with its larvae feeding on flowers and young fruits (many reports). Apparently, Atlantic coastal plain populations are associated with various hollies, as there are also reports from Florida (Baggett, 1980) and New Jersey (W. Wright, pers. comm.). In Texas, *henrici* feeds on persimmon (*Diospyros texana*) (Kendall, 1964), while the larva feeds on huckleberry (*Gaylussacia*) or blueberry (*Vaccinium*) on the southeastern Piedmont and in the upper Great Lakes States (Harris, 1972; Baggett, 1980; Nielsen, 1970). Shapiro (1966) reports it on wild plum (*Prunus*) and possibly blueberry in western Pennsylvania.

Fixsenia ontario

In nature, females must usually oviposit on high branches of their host plants, since larvae were never found on low branches. In addition, females accepted as oviposition substrata only twigs which would produce male catkins the following spring. On Hatteras Island, a female was observed depositing an egg on laurel oak (*Quercus laurifolia*). She was taken alive and caged with branches of both laurel

oak and live oak, the only oaks found at that locality. The *ontario* female laid six eggs on the former and eight on the latter. On Hatteras, the host leaves began to expand before the eggs hatched, and larvae always ate host leaves. There was no difference in rate of growth, size or timing of adult emergence for larvae raised on the two hosts.

On Roanoke Island, matters were quite different; two females caged with branches from non-reproductive individuals of *Q. laurifolia* laid only two or three eggs before dying. The following spring the larvae hatched before the hosts had begun to leaf out. At that time both oaks were in flower, so the larvae were provided with male catkins, which they fed upon until young leaves were available. The following year females were caged with branches of reproductive-aged trees of the hosts mentioned above, as well as black jack oak (*Quercus marilandica*), blue jack oak, and Spanish oak (*Q. falcata*). All five occurred naturally on that island. All females were caged together, and quite a lot of eggs were laid but only on *Q. virginiana*. Subsequent attempts to obtain oviposition on black jack, blue jack and Spanish oaks were also unsuccessful. A few larvae obtained from eggs laid on live oak were fed catkins and leaves of black jack oak. They developed normally and adults eclosed at the same time as those raised on live oak.

Young larvae bored into individual flowers and fed on pollen leaving the outer portion uneaten. The catkins were available until the third larval molt by which time the young leaves appeared. The larvae finished their feeding on young leaves. The larvae were always pale green, about the shade of the lower surface of a live oak leaf. In nature, they must pupate on the leaves or branches. In captivity, they usually pupated on leaves on the bottom of the container. Developmental times for a typical individual are given on Table 1. Adults emerged from 22 May to 6 June.

Little has been published previously on the life history of this insect, save for a few reports of host associations. Kendall (1964) reared the butterfly from larvae found on live and laurel oaks in Texas, while Shapiro (1974) reported white oak (*Quercus alba*) as the host in New Jersey. Clench (1971) found this hairstreak on shale barrens in Virginia and Pennsylvania where bear oak (*Quercus ilicifolia*) is prevalent.

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