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**NATURAL HISTORY OF THE COMMON SOOTY WING
SKIPPER, *PHOLISORA CATULLUS*
(LEPIDOPTERA:HESPERIIDAE), IN CENTRAL ILLINOIS**

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ABSTRACT

The common sooty wing skipper, *Pholisora catullus*, has three broods each year in east-central Illinois. Adults are active for only a few hours at mid-day. Wing color is a rough indicator of age in the field, changing from black to brown over 5 days. These skippers have adult lifespans of about 1 week in the field. Females mate early on their first morning of adult life, and some females mate more than once in their lifetime. Females can lay up to 32 eggs daily, and appear to be able to detect host plants visually over a distance of up to one meter. Densities of these insects are lower in and around urban areas even though larval host plants and suitable nectar sources for adults are present.

The common sooty wing skipper, *Pholisora catullus* Fabricius, is a black or brownish skipper with a variable number of white dots on the forewings. This native skipper is widespread in North America (Klots 1951, Opler and Krizek 1984). In east central Illinois, larvae of this species are often the most frequently encountered leaf-feeding insect on lamb's-quarters (*Chenopodium album*, Chenopodiaceae) in open fields (Capman 1988). This paper reviews my observations on the natural history of this species.

Chenopodium album is an annual plant that generally grows on recently disturbed soil. Its seeds can remain dormant in the soil for 30–40 years (Holm et al. 1977), allowing rapid colonization of newly plowed fields. Mature plants range from several centimeters to more than 2 m in height, depending on growing conditions. There are several similar species of *Chenopodium* that are native to North America (Gleason and Cronquist 1963), and although *C. album* is generally considered to be an introduced species from Eurasia, some archaeological evidence suggests that it may also be native to North America (Johnston 1962).

METHODS AND MATERIALS

Field observations were made over four growing seasons, from 1982 through 1985, in open fields near Urbana, Illinois (Champaign Co.). I seldom saw this skipper in the city even though larval host plants and suitable nectar plants occurred there.

Most work was concentrated at the Ecological Research Area of the University

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of Illinois (Phillips Tract) located about 5 km northeast of Urbana. Habitat types included weedy alfalfa (*Medicago sativa*) fields, weedy bluegrass (*Poa pratensis*) fields, and fields in various stages of secondary succession. I made some observations in an experimental field in which *Chenopodium* plant patches of three sizes (60 cm, 120 cm, or 240 cm diameter) were distributed uniformly, spaced 7 m apart in a 40 m x 100 m area of mowed foxtail grass (*Setaria faberi*). Results of experiments conducted at this site are reported in Capman et. al. (1990). Additional field observations were made at the Meadowbrook Park community garden plots at the edge of town in south Urbana.

Captive adults were observed in a 9 m x 3.6 m x 2.4 m outdoor flight cage (constructed of a fine nylon mesh [ca. 10 threads/cm] that let most of the sunlight through) erected in a grassy, sunny area between two wings of a building. .

Voucher specimens of *P. catullus* have been deposited at the Illinois Natural History Survey in Champaign, Illinois.

PATTERNS OF ABUNDANCE

Opler and Krizek (1984) report two broods per year, but I consistently observed three broods. At Phillips Tract, the three broods of adults appeared during the spring and summer at roughly monthly intervals, with the population size increasing substantially with each brood. Adults of the first brood occurred in late May and early June, the second occurred in middle to late July, and the last brood in middle to late August. The August brood in particular was very synchronized; the adults appeared over a brief period (2 to 3 days) at the beginning of the two-week flight period and disappeared over a similarly short interval at the end. Generally, the August brood had no stragglers outside of this 2 week flight period.

At Meadowbrook Park the broods were less synchronized. I often found adults at Meadowbrook when none were seen at Phillips Tract even though the *P. catullus* densities were much higher at Phillips Tract. I rarely found *P. catullus* larvae on *Chenopodium* plants at Meadowbrook, but they could be found with only a casual search at Phillips Tract. The reasons for these differences are not clear, but a possible explanation for the differences in synchrony is that adult lifespans may have been longer at Meadowbrook due to a greater abundance of nectar producing plants in the gardens and a greater availability of water due to watering by gardeners.

Larval densities on *Chenopodium* plants growing at Phillips Tract varied with location within the field. I usually found many more larvae per plant on small isolated patches (less than 1 m diameter and at least 5 m away from other *Chenopodium* plants) than on plants growing in large patches (several meters across). Larval densities in August and September ranged from more than ten larvae per plant on small isolated patches to fewer than one larva per plant in very large patches (see Capman et. al. 1990 for additional details). Similar larval dispersion patterns have been described for a number of other butterflies (see Stanton 1983 for a general review of insect dispersion patterns on patchily dispersed host plants).

APPEARANCE AND LIFE HISTORY

Holland (1901), Klots (1951), Opler and Krizek (1984), and, particularly, Scudder (1889) give descriptions of the appearance and life history of *P. catullus* (see Tietz [1972] for additional references). In the summary given below, any unattributed information is based on my observations.

As described by the above authors, *P. catullus* adults are black or brownish skippers with a variable number of white spots on the forewings. These white spots tend to be more numerous on females than on males (Scudder 1889), and I have

found that individuals with very prominent white spots are almost invariably females. The size and number of these spots vary considerably in both sexes, however, and the most reliable way to determine the sex of individuals at a distance in the field is by their flying behavior. Male flight is extremely rapid and erratic. Females usually have a noticeably slower, more fluttery flight, particularly when in the presence of host plants.

The fact that the August brood of adult *P. catullus* appeared abruptly at Phillips Tract made it possible to make rough correlations between age and wing color. For the first few days after adults start appearing, all individuals have the glossy black wing color of newly eclosed adults. After about two days, some individuals have brownish black wings. After about five days, individuals with dull brown wings (that are usually badly frayed) become common (although, as mentioned below, newly emerged individuals are still seen). Thus the approximate age of an individual with glossy black wings is 1 or 2 days, brownish black wings indicate an age of about 3 to 5 days, and dull brown wings indicate the adult is probably 5 or more days old. The wings of individuals held in small cages in the laboratory show roughly the same rate of change in color as seen for adults in the field. Lederhouse (1983) proposed a similar method of estimating the ages of black swallowtail butterflies, *Papilio polyxenes asterius* Stoll, on the basis of wing condition.

Adult *P. catullus* appear to live about a week in the field. This estimate is based on the observation that in August, adults are present for about two weeks, but freshly emerged adults are found only during the first week of this time period.

Pholisora catullus eggs are laid singly on the upper surface of the leaf, generally near the midrib (Scudder 1889). Opler and Krizek (1984) note that the eggs are white or creamy when laid, but I have always observed a muddy brownish-pink color from the moment eggs are laid. Larvae do not eat the eggshells after hatching, and these shells remain on the leaf for at least a week.

Newly-hatched larvae are yellow with black heads; older larvae are green with black heads. They are typical skipper larvae in that their bodies narrow just behind the head and their heads are very large (Scudder 1889). These skippers overwinter as larvae in cocoons (Opler and Krizek 1984). Overwintering larvae take on a slightly pink color in late summer or early fall (Scudder 1889).

Eggs hatch in about 8 days and larvae pupate in the spring and summer after about 17 days. Overwintering larvae, which develop in late August and September when the weather is cooler, take approximately one month to reach full size. The pupation period for spring and summer broods is 7 days.

BEHAVIOR AND REPRODUCTION

On a typical hot sunny summer day, females are active from about 1000–1300 h. Males begin flying about an hour before females but stop flying at about the same time as females. On cooler or slightly overcast days, adults do not become active until 1100 h and may continue flying until as late as 1600 h. Opler and Krizek (1984) report similar daily activity periods.

Males appear to patrol for females, circling around and zigzagging across areas a hectare or more in size. They seem to prefer areas with very low vegetation and they commonly follow the borders of mowed fields or pathways that are surrounded by taller vegetation. Males will pursue any dark-colored insect that flies past, whether it is a banded-wing grasshopper (Orthoptera: Acrididae subfamily Oedipodinae), black swallowtail butterfly (*Papilio polyxenes asterius*), or male or female *P. catullus*. Flights in pursuit of insects that are not *P. catullus* females generally end quickly; the males land or fly off after overtaking the insect being chased. Thus, this behavior does not appear to be aggressive or territorial, but rather, that of males searching for mates.

When a *P. catullus* female is being pursued by a male, the two insects flutter

together for a distance of 10 to 40 meters before the female lands. The male then flutters or walks excitedly around her, curling his abdomen toward hers with his claspers spread open. If the female is receptive, copulation occurs almost immediately, otherwise, the female sits with her wings folded and turns frequently to avoid the advances of the male. In such cases, males may persist in their advances for a minute or more before flying away. Patrolling males also frequently detect and attempt to mate with females sitting in vegetation or on the ground. In the flight cage described above, I observed two males each attempting to copulate with the other (their abdomens were curled toward each other with claspers spread).

A female adult emerges from the pupa shortly after sunrise, and will probably have mated by 1000–1100 h that same morning. I observed several newly emerged females, which were still sitting near their site of emergence, fly up toward passing males, flutter in the air with them as described previously, and subsequently copulate with them. Thus, a female's first flight is likely to be a mating flight. Although it seems likely that virgin females mate soon after eclosion, matings can be seen in the field as late as 1500 h. Opler and Krizek (1984) report that matings occur between 930 and 1400 h.

Although males frequently attempt to mate with females that are actively searching for host plants and laying eggs, in all cases I observed, such females rejected the male. However, of two females that I dissected and checked for spermatophores, one had two spermatophores in her bursa copulatrix, indicating that multiple matings can occur.

Oviposition and successful larval development occur on both *Chenopodium* and *Amaranthus retroflexus* plants, and an individual female may visit both species during the same bout of oviposition. However, I seldom found eggs or larvae on *Amaranthus* plants, even in areas where *Amaranthus* plants were abundant, suggesting that *Chenopodium* may be the preferred host in central Illinois. Shapiro (1968) has also found larvae on *Celosia argentea* var. *cristata* (cockscorn, Amaranthaceae). Opler and Krizek (1984) note that several members of the mint family may be fed upon, but I have not observed this. On several occasions I have observed females ovipositing on *Chenopodium* plants within meters of *Monarda* spp. or *Mentha* spp., but these mints were always completely ignored.

An ovipositing female often lands several times on several different leaves within a patch of *Chenopodium* before laying an egg. At many of these landings, the female curls her abdomen and presses her abdomen tip against the upper surface of a leaf, sometimes dragging her abdomen tip a short distance along the leaf surface. An egg may or may not be laid at this point. The female flies off immediately following oviposition. She may then lay several more eggs in the immediate vicinity or she may fly 10 m or more before resuming oviposition activity (see Capman et. al. 1990 for additional details on oviposition behavior). Females show no obvious tendency to avoid laying eggs on plants or leaves that already harbor eggs.

The initial attraction of female *P. catullus* to host plants appears to be by visual cues. This is suggested by the fact that females initially seen flying in a straight line occasionally veered abruptly toward nearby *Chenopodium* patches. Since these patches were downwind, response to chemical cues seems unlikely. The greatest distance over which this attraction occurred was approximately one meter.

The fact that females often land and drag their abdomen tips along the surfaces of several different leaves before laying an egg suggests that some physical and/or chemical cues are involved in the choice of oviposition sites. This notion is further supported by the fact that on several occasions, individual *Chenopodium* plants had large numbers of eggs (more than 10 per plant) while neighboring plants had no eggs. In these cases, all of the plants in the vicinity looked identical to me, and the branches of the plants were so interwoven that I could not tell which branch belonged to which plant without carefully tracing it to its source.

Three females caught early in the morning before oviposition and three caught in late afternoon after the day's oviposition were dissected and compared to get an

estimate of daily oviposition. These females were all roughly 3–5 days old, based on the wing color criteria discussed above. Four ovarioles occurred in each of two ovaries. These ovarioles converged on a median oviduct (there were no lateral oviducts) that was approximately three egg diameters long. In females caught early, there were three to four fully chorionated eggs in each ovariole, plus three chorionated eggs in the median oviduct. In contrast, a total of only three or four chorionated eggs were present in females caught late in the day. Thus, females probably laid between 24 and 32 (8 ovarioles times 3 or 4 eggs per ovariole) eggs daily.

The accessory glands of female *P. catullus* are very large and dark reddish brown in color. Eggs in the median oviduct, soon to be laid (in females caught in the middle of egg-laying), are creamy white in color, but eggs are a muddy brownish pink immediately after being laid. These observations suggest a secretion from the accessory gland coats the eggs as they are being laid.

Very soon after hatching, a first instar larva crawls down the petiole of the leaf to the stem of the shoot, and then upward to the crown of new leaves at the tip of the shoot. The larva webs these young leaves together with silk and stays and feeds in this leaf nest through the first or second instar. As the larva grows larger it makes progressively larger leaf nests. At first, two cuts are made in a leaf edge. The resulting flap is folded over and secured with silk. Later the larva rolls leaves lengthwise or ties together several adjacent leaves. Late in the summer, leaf nests may be constructed by tying together adjacent branchlets of *Chenopodium* inflorescences. The larva spends the day inside the leaf nest and comes out only at night to feed.

During the summer, pupation occurs within loosely woven cocoons (Scudder 1889). Captive larvae spin these cocoons within their leaf nests, in corners of the rearing cage, or among dead leaves on the soil. In the field, it is extremely rare to find pupae within leaf nests, suggesting either that most pupation occurs in leaf litter on the soil, or that mortality rates of last instar larvae are extremely high. Overwintering larvae produce much tougher cocoons made of coarser, darker colored silk (Scudder 1889).

I observed adults of both sexes feeding at several kinds of flowers, including *Sida spinosa* (Malvaceae), white and red clovers (*Trifolium* spp.), and alfalfa (*Medicago sativa*); however, they do not spend a great deal of time feeding. I also observed males gathering at, and apparently drinking water from, puddles and patches of wet mud.

SOURCES OF MORTALITY

When predaceous pentatomid bugs feed on *P. catullus* larvae, the larvae become black and shrivelled. It was not uncommon to find larvae that died in this way in leaf nests on plants in the field, and occasionally I found the bugs in the act of feeding. In addition, on one occasion I saw a vespid wasp cutting open leaf nests and carrying off the larvae.

I found one larva dead in its leaf nest together with a mass of small, white, oval wasp cocoons that appeared to have come from parasitoids that developed inside the caterpillar. These wasps were not reared out and could not be identified.

Survivorship curves for *P. catullus* from eggs through the fourth instar are presented in Capman, et. al. (1990), but the percent mortality caused by each of the above factors is not known.

CAPTIVE REARING

Although it is simple to rear larvae to the adult stage, adult *P. catullus* are extremely difficult to manage in captivity. A few adults survived about five days

when kept in a small plexiglas cage (a plexiglas tube, 11 cm wide x 22 cm long, covered at one end with nylon mesh, and set over a potted *Chenopodium* plant), but no mating or egg laying occurred. Several wild-caught females laid a few eggs when kept in small (100 ml) jars with some *Chenopodium* leaves, but the females lived only about two days.

Although a few individuals mated and laid eggs within the confines of the outdoor flight cage, their behavior was erratic and most individuals died quickly. In nature, *P. catullus* adults spend most of their time flying within a meter of the ground, but adults placed in the flight cage spent most of their time in the upper corners of the cage trying to escape. This resulted in frayed wings, weakening, and death within a day or two of being placed in the cage.

DISCUSSION

The near absence of *P. catullus* in urban areas is puzzling, particularly considering that *Chenopodium* and suitable nectar sources are abundant in town, and the skippers are abundant in the surrounding areas. A possible explanation is that the many physical obstructions in the city might interfere with the natural flight patterns of the adult skippers. Adult *P. catullus* are strong, rapid fliers that traverse large areas very quickly, staying close to the ground at all times. In the field, these skippers will usually try to fly around obstructions such as large shrubs, cars, or buildings rather than flying over them. Just as the confines of the flight cage discussed above interfered with the normal activities of the captive skippers, so might the large number of physical obstructions in urban areas make cities unsuitable habitats for this skipper.

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