PRELIMINARY OBSERVATIONS ON PARITY AND NECTAR FEEDING IN THE BLACK FLY, SIMULIUM JENNINGSI

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ABSTRACT. Host-seeking females of Simulium jenningsi were collected in 7 sequential morning and afternoon samples in the Champlain Valley of New York state. All flies in each collection were dissected to determine 1) parity, 2) the presence of spermatozoa in the spermatheca, and 3) the presence of nectar in the crop. Parous flies were further separated according to the state of the follicular relics.

Chi-square analysis confirmed the presence of a distinct biting cycle in that nulliparous predominated in the morning (60%) and parous flies predominated in the afternoon (67%). Parous flies captured in the afternoon most frequently exhibited follicular relics in the sac stage, suggesting that oviposition probably occurs early in the morning or late in the previous evening. All flies were mated and nearly all (94%) had nectar fed. No evidence of autogamy was noted.

The black fly Simulium (Phaetodorus) jenningsi Malloch (sensu lato) is one of the most widely distributed species in this recently described subgenus (Stone & Snoddy 1969, Stone 1964). It has been observed that S. jenningsi naturally feeds on turkeys (Underhill 1944), horses, cattle, mules, and occasionally man (Fallis 1964), making it a possible vector of zoonotic pathogens. Johnson et al. (1958) incriminated S. jenningsi (= S. nigroparsum) as a vector of Leucocytozoon smithi, a blood protozan of turkeys.

Because of its vector potential and annoyance to man, we conducted a preliminary study to determine the parity of host-seeking flies, insemination rates, and prevalence of nectar-positive specimens.

MATERIALS AND METHODS

Females were collected with an aerial net as they swarmed about the head of the collector, who stood in or next to a pasture in Clinton Co., New York, in the Champlain Valley. Cattle were present in the pasture at various times each day. Seven sequential afternoon (13.00–17.25 hr) and morning (08.00–11.00 hr) collec-

1 This research was supported by USDA Specific Cooperative Agreement 612-14-1001-606.
RESULTS AND DISCUSSION

Of 125 females dissected, 58 were captured during the morning hours and 67 during afternoons (Table 1). Although the total percentage of nulliparous and parous flies engaged in host-seeking did not deviate greatly from 50%, a disparity is evident when flies are grouped by time of collection. Chi-square analysis indicated a significant difference in their distribution, in that nullipars predominated in the morning and paras in the afternoon (p < 0.005).

The cyclic host-seeking behavior of some African black flies has been elucidated over the past decade. Several researchers investigating host-seeking by S. damnosum Theobald (sensu lato) found that patterns of diurnal biting cycles were related to the predominant geographic feature of the region. Duke (1972), using the presence of abdominal fat body to indicate nulliparity, observed a bimodal peak of biting activity in the savanna regions of Cameroon, with nulliparous flies most active in the early morning and late afternoon. Disney (1970) and Duke (1968), using similar techniques, found that black flies in the forested areas of Cameroon exhibited a different biting cycle, with the nulliparous population peaking at 15.00-16.00 hr. Other researchers observed similar trends in Nigeria (Crosskey 1958) and Sierra Leone (Lewis 1956).

Similar patterns have been reported for temperate black flies in North America and Great Britain. In England, Davies (1955) noted that nulliparous S. ornatum Mg. (identified by the presence of abdominal fat bodies) accounted for 75% of the host-seeking flies until 18.00 hr at which time the proportion of parous females rose to 50%. Davies (1953) observed nearly identical biting cycles in populations of S. venustum Say in Canada.

Our samples encompassed only 4 days and therefore may not accurately reflect the host-seeking behavior of S. jenningsi over the entire season. However, since differences in parity, suggesting a host-seeking cycle, were statistically significant,

Table 1. Reproductive characteristics of Simulium (Phostereoros) jenningsi collected from 05 June through 08 June 1977 in the Champlain Valley, New York. ¹

| Time of Collection | No. per age class² ¹ | No. per stage of follicular relic | No. per stage of ultimate follicle | No. nectar fed | No. mated
|-------------------|----------------------|-------------------------------|----------------------------------|----------------|----------------
| AM (08.00-11.00 hr) | 55 (60)              | 23 (40)                       | 0 (+5)                           | 30/34          | 55/55          |
| PM (13.25-17.25 hr) | 22 (33)              | 45 (67)                       | 14 (86)                          | 43/45          | 44/44          |
| Total             | 77 (68)              | 68 (30)                       | 18 (25)                          | 117/124        | 124/124        |

¹ Numerals in parentheses reflect percentage of total number examined per age class unless noted otherwise.
² N = nulliparous; P = parous.
³ Numerals in parentheses reflect percentage of total number examined per time of collection.
⁴ Percentages computed on total number of females dissected.
further assessment of the reproductive biology is warranted.

The follicular relics also suggested a cyclic pattern of oviposition by *S. jennisii*. Parous flies were further separated according to the state of the relics. Females collected in the morning exhibited relics predominantly in the contracted state and those captured in the afternoon primarily had sac-stage follicular tubes (Table 1). Chi-square analysis confirmed significance of these data (p < 0.005). In Guatemala, Garms (1975) used follicular relics to show a diurnal cycle of oviposition in *S. ochraceum* Walker, hypothesizing that egg deposition occurred in the early afternoon. Capp and Collins (1979), also working in Guatemala, demonstrated that the sac stage in *S. ochraceum* coalesces to the contracted state within 4–12 hours, lending support to Garms’ hypothesis. Assuming similar rates of contraction, this finding supports our conclusion that *S. jennisii*, captured in the afternoon with sac-stage follicles, had oviposited during the late morning or early afternoon of the same day.

Examination of the developing follicles in host-seeking black flies can reveal the presence of autogenous or anautogenous (Davies 1961). Magnarelli & Capp (1977) found no follicles past stage II in blood-seeking, nulliparous *S. tuberosum* (Lundström) and *S. tectum*, and considered both species anautogenous. Similar results are reported for *S. ochraceum* in Guatemala by Capp & Collins (1979). Of the 57 nulliparous *S. jennisii* examined in the Champlain Valley, none exhibited follicular development beyond stage I–II: 85% were in this stage. Therefore, we conclude that this population of *S. jennisii* is chiefly anautogenous with ovirole stage I–II being the resting stage. The fact that all females were inseminated also suggests that mating occurs soon after emergence and may serve to stimulate host-seeking behavior.

Nectar-feeding was prevalent among both nulliparous and pars (Table 1). Of the 124 females tested, 117 (94%) reacted to the anthrone reagent, indicating the presence of fructose or sucrose in the crop. There were no significant differences in the incidence of nectar feeding between morning and afternoon collections or nulliparous and parous flies. This relatively high percentage of nectar-positive females parallels results on Australian, African, and Central American simulids. Hunter (1977) found that “almost all adults” of *Austrosimulium psilobilium* Mack. & Mack. captured in the field were fructose positive. In Ghana, Lewis & Domoney (1966) found sugars in each of 89 specimens of *Simulium* spp. Capp and Collins (1979) found 68% of 334 females of *S. ochraceum* females nectar-positive.

Magnarelli (1977) hypothesized that some salt marsh *Aedes* mosquitoes, known to fly great distances, might convert carbohydrates to stored energy reserves (glycogen and triglycerides) and use the remaining sugars for flight energy. Therefore, a single feeding of nectar may be entirely metabolized in a prolonged flight from the site of emergence, and would not be detected using anthrone. *S. jennisii* and other members of this subgenus have been reported to fly up to 48 km from known breeding sites (see Stone & Jamback, 1955). In the Champlain Valley, the nearest known larval habitat was 13 km from our collecting site. Consequently, the high order of nectar imbibition determined in this study suggests that members of this subgenus 1) metabolize sugars slowly and are highly efficient in using nectar as sources of energy for flight, or 2) imbide nectars frequently.

ACKNOWLEDGMENT

The authors wish to thank Dr. Art Burrrell for providing facilities during the course of this investigation, and to Dr. L. A. Magnarelli for his helpful comments during the preparation of this manuscript.

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