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FLOWER ASSOCIATIONS AND MATING BEHAVIOR OR ITS ABSENCE AT BLOSSOMS BY *SPILOMYIA* SPP. (DIPTERA, SYRPHIDAE)

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Syrphid flies of many species visit blossoms to obtain nectar and pollen (see Waldbauer 1983 for references). Many of these syrphids, in common with other insects (Parker 1978), also find mates at the blossoms. Males of these syrphid species make aerial patrols of inflorescences frequented by females, alternating these patrols with sitting on foliage. They pounce on or chase insects of various species and swiftly initiate copulation with conspecific females (Collet and Land 1975; Maier 1978; Maier and Waldbauer 1979a,b).

We here present evidence that *Spilomyia quadrifasciata* (Say) also mate at the plants that they visit for nectar and pollen, while *S. fusca* Loew do not. We also indicate the seasonal occurrence of these species and list the host plants that they visit.

METHODS

Samples were taken from flowers at the edge of the woods along the Reed Road transect (Waldbauer 1983) between the towns of Pellston and Carp Lake in Emmet County, northern Lower Michigan. Almost all of the *Spilomyia* were caught along a railroad track where it crosses a mesic woodland of second growth conifers and hardwoods just south of Carp Lake. Samples were taken with a hand net on every clear or partly clear day from 2 June to 18 August, and on 25 August and 4 September in 1982. They were also taken in 1983 from 20 July to 9 August. Sampling usually began in the morning just before syrphids appeared at flowers and continued until their numbers diminished from early to mid-afternoon. Each plant species in blossom was checked several times to see if it attracted the syrphids in question; plants that did were sampled regularly as long as they were in blossom. Every *Spilomyia* seen was pursued; about 80% were caught. Specimens were segregated according to whether they were feeding when caught (on an inflorescence) or not feeding when caught (on the foliage of the host plant or flying nearby). Mating pairs were kept together and mounted on the same pin. The first author identified the syrphids; voucher specimens are in his collection. Voucher specimens of the plants are in the Herbarium, Department of Plant Biology, University of Illinois.

RESULTS AND DISCUSSION

The 1982 seasonal distributions of adults of the two species of *Spilomyia* are shown in Figure 1. The last date on which *S. quadrifasciata* appeared is not known because this species was still present when the last sample was taken on 4 September. It could not, however, have been present for much longer because 1 September is the average date for the first freezing temperature in the Pellston area (Strommen 1974). In 1983 *S. quadrifasciata* and *S. fusca* first appeared on almost the same dates, 1 August and 20 July, respectively.

In 1982 and 1983 *S. fusca* was caught on or flying about blossoming plants of *Pastinaca sativa* L. (86 specimens), *Solidago* spp. (9), *Clematis virginiana* L. (4), *Eupatorium maculatum* (L.) (1), *Sambucus canadensis* L. (1), *Spiraea alba* DuRoi (1), and *Verbascum thapsus* L. (1). In the same years *S. quadrifasciata* was taken on or about *Solidago* spp.

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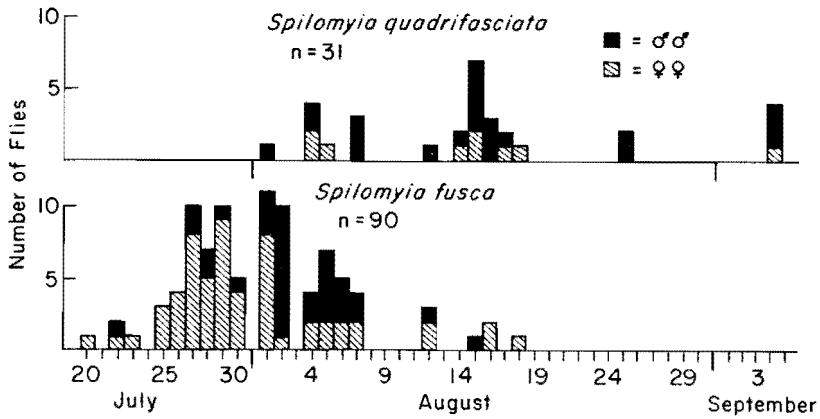

Fig. 1. The seasonal occurrence at blossoms of the adults of two species of *Spilomyia* in Emmet County, Michigan, in 1982.

(= *S. rugosa* Mill., *S. canadensis* L., and *S. gigantea* Ait.) (132) or *P. sativa* (10). It is noteworthy that the native *S. fusca* was so frequently associated with the non-native *P. sativa*. *S. quadrifasciata* (also native) was much less often associated with *P. sativa*, probably because *S. quadrifasciata* occurs later in the season than does *S. fusca* (Fig. 1), and thus does not coincide with *P. sativa's* peak blossoming period.

We employed a three-dimensioned contingency analysis (Table 1) to assess the significance of the three two-way interactions, and a possible three-way interaction, among species, gender, and activity (feeding vs. not feeding at time of capture). All three two-way interactions (gender vs. species, activity vs. species, and activity vs. gender, bottom of Table 1) proved highly significant in the 13-week 1982 data set, but only the gender vs. species interaction could be detected in the three-week 1983 data set (analysis not shown). A satisfactory description ($P = 0.263$) of the 1982 data set is obtained if all three two-way interactions are included (eighth model, Table 1), indicating that there is no need to postulate the existence of a three-way interaction. The first of the conditional models (fifth model, Table 1) incorporating only the two strongest two-way interactions is conventionally acceptable at the 0.05 significance level, but it comes very close ($P = 0.06$) to being rejected; it also excludes a two-way interaction known to be highly significant, and clearly provides a less adequate description of these data.

The qualities of these three significant two-way interactions can be appreciated from their associated percentages (Table 2). It is apparent that *S. quadrifasciata* and *S. fusca* differed from each other in sex ratio, females predominating in *S. fusca* and males predominating in *S. quadrifasciata*. It is also apparent that *S. fusca* of either sex were the more likely to be caught while feeding, and that males of *S. fusca* were more likely to be caught in the act of feeding than were males of *S. quadrifasciata*.

These differences must reflect species differences in the activity patterns of the sexes (Maier and Waldbauer 1979a, b). More specifically, these differences suggest that *S. quadrifasciata* mates at the host plants and that *S. fusca* mates elsewhere. Female *S. quadrifasciata* apparently feed and then immediately move off, either in copulo or directly to the oviposition sites. The males apparently spend most of the day at the host plants looking for females to inseminate. On the other hand, it is the *S. fusca* males that eat and run, presumably rushing off to some other site where mating occurs. The strongly female-skewed sex ratio of *S. fusca* at the host plants strongly suggests that males do not tarry there to find females. It also suggests that females spend more time feeding than do males, presumably because the females make the greater parental investment of energy and biomass.

Table 1. Three-dimensioned contingency analysis of 1982 species-sex-activity data. Designators: S = species, G = gender, F (vs. F′) = feeding (vs. not feeding) at time of capture. Probabilities for log-likelihood G^2 values approximated by chi square; df = degrees of freedom.

	S. quadrifasciata Activity				*S. fusca* Activity	
	F	F′			F	F′
SEX ♂	13	12	SEX ♂		28	4
SEX ♀	1		SEX ♀		58	0

Descriptive Model				G^2	df	Probability
Complete independence	[F]	[G]	[S]	47.47	4	<.0005
Conjoint independence	[F]	[GS]		34.18	3	<.0005
Conjoint independence	[G]	[FS]		26.97	3	<.0005
Conjoint independence	[S]	[FG]		26.16	3	<.0005
Conditional independence	[GF]	[SF]		5.65	2	.06
Conditional independence	[FG]	[SG]		12.86	2	.002
Conditional independence	[FS]	[GS]		13.68	2	.001
Three 2-way interactions	[GS]	[FS]	[FG]	1.26	1	.263

G^2 tests of 2-way interactions

GS: 47.47 − 34.18 = 13.29 with 4 − 3 = 1 df, p = <.0005
FS: 47.47 − 26.97 = 20.50 with 4 − 3 = 1 df, p = <.0005
FG: 47.47 − 26.16 = 21.31 with 4 − 3 = 1 df, p = <.0005

Table 2. Distribution by feeding activity and sex of the adults of two species of *Spilomyia* caught on or near their food plants in Emmet County, Michigan, in 1982. Individuals sitting on flowers were assumed to be feeding. The "not feeding" category includes individuals that were flying about the plants or sitting on their foliage. Percentages for activities within sexes add to 100 horizontally; percentages for sexes within species add to 100 vertically.

Species		Feeding		Not feeding		Total	
		No.	%	No.	%	No.	%
S. quadrifasciata							
	♂	13	52.0	12	48.0	25	71.4
	♀	9	90.0	1	10.0	10	28.6
S. fusca							
	♂	28	87.5	4	12.5	32	35.6
	♀	58	100.0	0	0.0	58	64.4

Our view of the mating behavior of the two species is supported by other observations. First, on a few occasions males of *S. quadrifasciata* were seen to patrol blossoming plants as if they were in search of females. This behavior was not seen in *S. fusca*. Futhermore, three mating pairs of *S. quadrifasciata* were found on *Solidago* inflorescences, while mating pairs of *S. fusca* were not seen. It is possible that either or both species mate at the oviposition sites or at stations and (or) leks that are not associated with resources. It should be noted that mating pairs of *S. quadrifasciata* are relatively secretive as compared to mating pairs of *Temnostoma* spp. that continue to feed while the females fly from inflorescence to inflorescence dragging the males behind them (Waldbauer, in press).

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