Table 2. Incidence of sex-linked recessive lethals.

	Brood	Number of chromosomes	Recessive lethals
Control	0-3 days	8783	4 (0.04%)
	3-6 days	8478	4 (0.05%)
.003g of Black Pepper per 10ml of food	0-3 days	1508	0
	3-6 days	1321	0

Black pepper when fed to Drosophila melanogaster did not increase loss of chromosomes or increase the incidence of sex-linked recessive lethals.

References: Concon, J.J., T.W. Swerczek & D.S.Newburg 1979, Nutrition and Cancer 1(3):22; Rockwell, P. & I.Raw 1979, Nutrition and Cancer 1(4):10.

Montague, J.R. Barry University, Miami Shores, Florida USNA. Spatial and temporal dispersions of mushrooms and mycophagous Drosophila in a central New York woods.

Recent investigations of mycophagous drosophilid species focused on ecology and life-history traits (Kimura et al. 1978; Charlesworth & Shorrocks 1980), genetic variation and niche breadth (Jaenike & Selander 1979; Lacy 1982), and the evolution and diversity of host-mushroom preferences (Jaenike 1978; Kimura 1980). Jaenike & Selander (1979) suggested that mushrooms are highly unpredictable oviposition substrates, and a number of mycophagous drosophilid species have evolved "generalist" oviposition preferences (Lacy 1982).

This note reports spatial and temporal dispersions of mushrooms, and fluctuations in drosophilid population density during the summer months of 1980. These data should provide some insight into the availablity and abundance of suitable breeding substrates, as well as insight into the population dynamics of mycophagous drosophilds.

The field site was mixed Beech-Maple woods adjacent to a swampy area in Fayetteville, New York (Figure 1). An approximate 100,000 m^2 area was searched during five periods (May 18-20, May 28-30, June 9-15, July 7-8, and August 13-19). Five types of mushrooms were collected and removed from the area: Polyporous squamosus (a large, fleshy polypore); an unidentified polypore-like species; Tricholomopsis platyphylla (a singly-occurring agaric); a group of unidentified, singly-occurring "agaric-like" spp.; and clusters of "Coprinus-

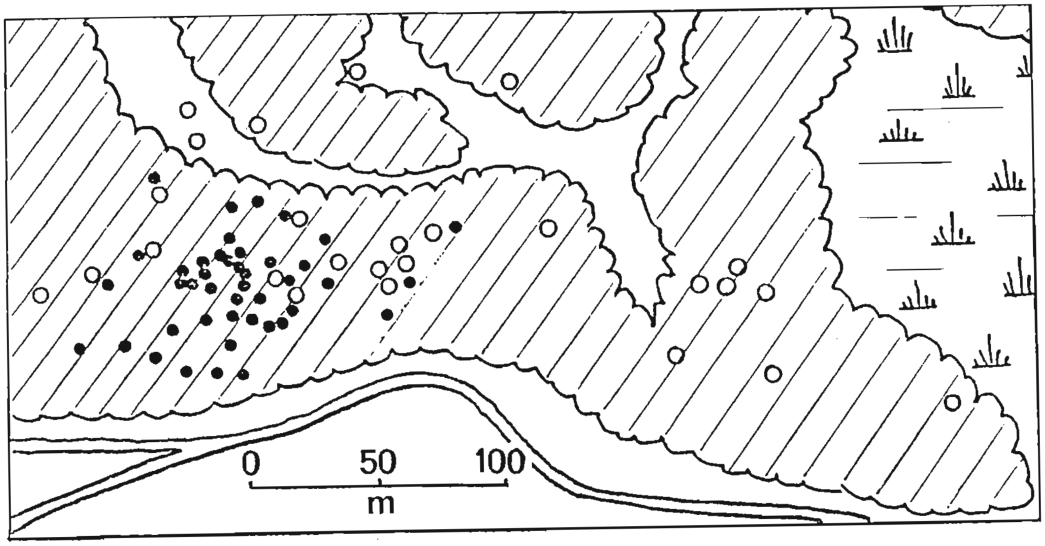

Figure 1. Field site in Fayetteville, New York. Open circles mark locations of natural mushroom substrates during Summer 1980; the solid circles mark the locations of artifical baits used in the mark-recapture census in Summer 1980.

like" (inky caps and shaggy manes) spp. Although the exact taxonomic status of most of the mushrooms could not be determined, each attracted mycophagous drosophilids, and were simply classified by general appearance.

The mean distance between mushrooms was estimated for each collecting period by a method described by Endler (1979): A= area of smallest circle enclosing all mushrooms; N = number of mushrooms, $\sqrt{A/N}$ = mean distance between mushrooms. The July 7-8 collection contained only two mushrooms, so the mean distance was simply the linear distance between them.

The field site was examined on April 20, April 28, and May 8 for drosophilids. The mycophagous drosophilids first appeared on May 15.

The population density of drosophilids was estimated from mark-recapture data from six collection periods (May 20-23, June 19, June 26-28, July 8-11, August 7-8, and August 26). Prior to each period, adults were collected from rotted commercial mushrooms and dusted with micro-fluorescent dusts (Helecon Pigments, U.S.Radium Corp.). The rotted mushrooms were then removed. The marked drosophilids were released at dusk from the center of an area containing 41 baits (Figure 1). Each bait consisted of a small square cloth wrapped around several rotted commercial mushrooms and soaked in rotted mushroom juices. The mean distance between baits was 21 meters (after Endler 1979). Flies were continuously aspirated from the baits every morning (7AM-10AM) until no marked adults were found, or until rain interrupted the collection schedule (June 20, August 27). Temperatures were recorded at 9AM on re-capture days. The September and October populations were not assessed.

Two density estimates described by Begon (1979) were calculated. Jackson's Positive Method (JPM) was used when collections over successive days were available. A simple Peterson Estimate (PE) was

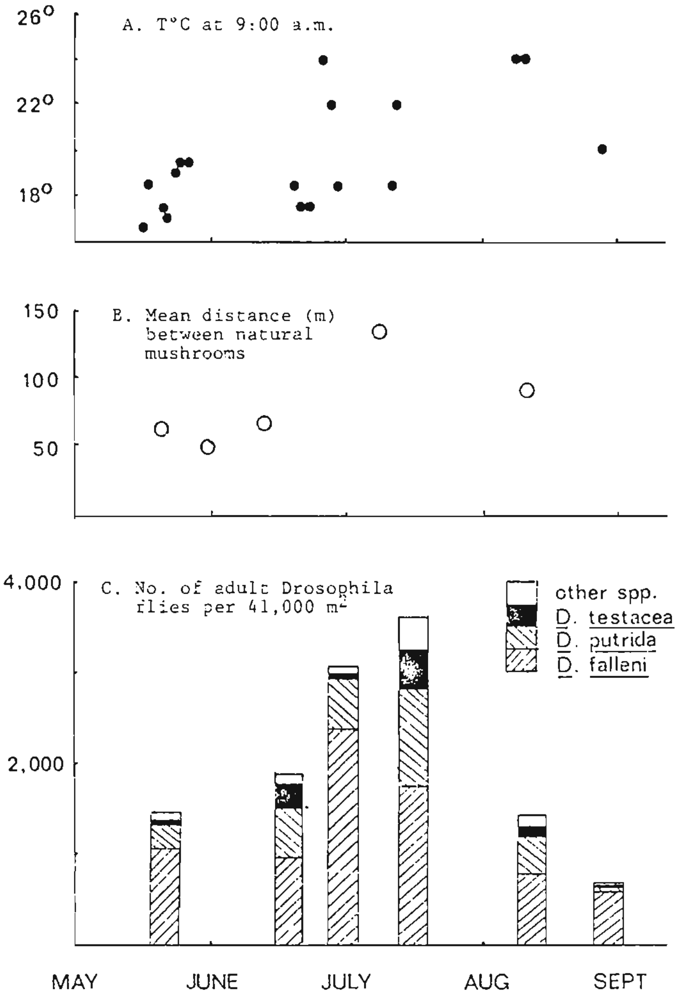

Figure 2. A: seasonal variation in temperature at 9 AM on re-capture days. B: mean distance in meters between natural mushroom substrates. C: estimates of the number of mycophagous drosophilid adults within the area of artificial baits (Figure 1).

Table 1. Temporal dispersions and diversity of natural mushroom substrates (these do not include mushrooms that were too dry to attract mycophagous drosophilids).

Date	"polypore-like" mushrooms	Singly-occurring "agaric-like" mushrooms	Clusters of "Coprinus-like" mushrooms
May 18-20	11	0	0
May 28-30	16	0	2
June 9-15	18	5	3
July 7-8	0	1	1
Aug 13-18	1	3	3

when only a single day's catch was available. Both methods are based upon the proportions of recaptured marks in the total catch (Begon 1979).

The spatial and temporal dispersions of natural mushrooms during 1980 are shown in Table 1 and Figure 1. The mean distances between mushrooms are shown in Figure 2b. During May and June, the "polypore-like" mushrooms increased in density. These large mushrooms became dry and unattractive to drosophilids during the warmer days of July and August (Figure 2a). The predictability of breeding opportunities is difficult to assess since these data were collected within a single season. Statistical comparison between years would be necessary to determine if the observed variation in mushroom densities is significant or merely due to sampling error. Pilot surveys completed during the summer months of 1979 suggested a similar pattern: high polypore density in May and June followed by a decline in total density in July.

The total catch of drosophilids is shown in Table 2, and estimates of the total drosophilid density are shown in Figure 2c. D.fallini (from the quinaria sub-group of the New World hirtodrosophila radiation), and D.putrida and D.testacea (from the testacea sub-group of the New World hirtodrosophila radiation) are among the most common mycophagous drosophilid species in the Eastern U.S. deciduous forests (Collier 1978; Jaenike 1978). Little is known about the full range of oviposition preferences of these species. Kimura (1980) and Lacy (1982) suggested that D.putrida and D.testacea may oviposit in deciduous sap exudates, decaying fruits and vegetation as well as in the fruiting bodies of mushrooms.

The highest drosophilid density was observed during mid July, which coincided with the lowest density of mushrooms (Figure 2b,c). The decline in drosophilid density during August is possibly the result of increased mortality in late July and August. An alternative explanation is that the decline in mushroom density in July resulted in a significant decrease in breeding opportunities. Further investigations of Autumn populations need to be completed.

In summary, observed dispersions of mushrooms and the Drosophila that breed in them suggest seasonal variation in species diversity of the mushrooms, as well as seasonal fluctuations in Drosophila density.

Acknowledgements: I thank my PhD advisor, William T. Starmer (Syracuse University) for his suggestions and patience. John Jaenike and Robert Lacy contributed taxonomic information and useful suggestions.

References: Begon, M. 1979, Investigating animal abundance, University Park Press, Baltimore; Charlesworth,P. & B.Shorrocks 1980, Ecol.Entomol. 5:315-326; Collier, G.E. 1978, DIS 53:168-169; Endler, J.A. 1979, Genetics 93:263-284; Jaenike, J. 1978, Ecology 59:1286-1288;

Table 2. Total catch of Mycophagous Drosophila, Fayetteville, New York, Summer 1980.

Date		D.falleni	D.putrida	D.testacea	Others	Total	#marks recaptured / #released	Population Estimate(a)
5/20-23	Total	1386	408	75	100	1969	57/200 = 0.29	JPM
	♀♀/total	0.34	0.37	0.04	0.04	0.32		
6/19	Total	129	93	41	8	271	236/850 = 0.28	PE
	♀♀/total	0.30	0.52	0.24	0.13	0.36		
6/26-28	Total	407	117	8	3	535	65/420 = 0.15	JPM
	♀♀/total	0.42	0.38	0.25	0.00	0.40		
7/8-11	Total	208	148	41	38	435	13/270 = 0.05	JPM
	♀♀/total	0.28	0.39	0.17	0.24	0.30		
8/7-8	Total	81	50	6	10	147	13/175 = 0.07	JPM
	♀♀/total	0.37	0.38	0.50	0.30	0.37		
8/25	Total	57	6	2	6	71	7/70 = 0.10	PE
	♀♀/total	0.35	0.50	0.50	0.50	0.40		

(a) PE = Petersen Estimate, JPM = Jackson's Positive Method

Jaenike,J. & R.K.Selander 1979, Evolution 33:741-748; Kimura, M.T. 1980, Evolution 34:1009-1018; Kimura,M.T., K.Beppu, N.Ichijo & M.J.Toda 1978, Bionomics of Drosophilidae (Diptera) in Hokkaido. II drosophila testacea, Kontya, Tokyo 46(4):585-595; Lacy, R.C. 1982, Evolution 36:1265-1275.

Moya, A., A.Barbera and J.Dopazo. Universidad de Valencia, Espana. Simulation of the larval competition process.

The present work is an attempt to bring light on the relevance of Wallace's (1981) "biological space unit". The validation procedure was the simulation of the larval competition process, where the medium is divided into K preexisting biological space units. The following assumptions were made:
(i) This simulation has no replacement. (ii) Once one larva occupies a biological space unit it will remain in it. This occupation will be at random, taking into account the relative frequency of genotypes before the random number is generation. (iii) Once the larva is inside a unit an intrinsic probability of survival exists, which is obtained from a normal distribution for each genotype. The mean value and standard deviation used for each genotype are obtained from experimental data on Drosophila. (iv) The process ends when the units are exhausted. Then the survivors of each genotype are counted, and the relative viability for each is calculated.

This simulation is a first attempt to find density- and frequency-dependent selection using Wallace's concept. For this reason several values of biological space units (density-dependent selection) and different genetic compositions (frequency-dependent selection) were essayed.

The programming used was PASCAL. The abbreviations used for the parameters were the following:

- N : number of total larvae
- K : number of biological space units
- N_1 : number of larvae of genotype 1
- N_2 : number of larvae of genotype 2
- m_1 : intrinsic viability of larvae of genotype 1
- m_2 : intrinsic viability of larvae of genotype 2
- s_1 : standard deviation of m_1
- s_2 : standard deviation of m_2
- V_1 : viability larva-to-adult of genotype 1
- V_2 : viability larva-to-adult of genotype 2

The results showed that no frequency-dependent selection existed in this kind of simulation (at least when these assumptions). On the contrary, positive density-dependent selection was generated, according to the available biological space unities. Table 1 shows the mean value of viability according to genetic composition for each density. As can be seen, no differences appear between the viabilities of genotypes 1 and 2 due to the similarity of m_1 and m_2. Results not shown here indicate that neither do reductions in the values of s_1 and s_2 statistically permit differences to be on between the viabilities for the different frequencies of the same genotype and density. The same occurs when the mean values of the frequencies are taken and the viabilities of genotypes 1 and 2 are compared. Great differences between m_1 and m_2 will permit differences between V_1 and V_2 to be found and only when other additional parameters are taken into account will it be possible to detect some kind of frequency-dependent selection. More simulations are needed.

Table 1. Results of the simulations: mean viabilities with standard errors.
$m_1 = 0.755$, $s_1 = 0.378$, $m_2 = 0.760$, $s_2 = 0.380$

N	n^*	K	V_1	V_2
20	19	4	0.19630 ± 0.04638	0.15945 ± 0.02600
		8	0.32514 ± 0.05515	0.25372 ± 0.05427
		12	0.35762 ± 0.02643	0.38887 ± 0.03730
		16	0.50645 ± 0.04924	0.56807 ± 0.04152
		19	0.62756 ± 0.02937	0.63428 ± 0.03918
30	14	6	0.11469 ± 0.01595	0.11158 ± 0.03164
		12	0.26000 ± 0.02799	0.24654 ± 0.02940