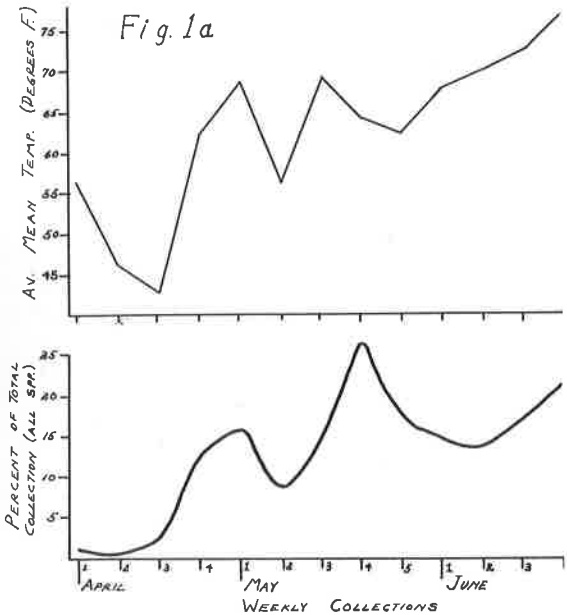
Report of the REELFOOT LAKE BIOLOGICAL STATION, Vol. 17, 1953,
and JOURNAL OF THE TENNESSEE ACADEMY OF SCIENCE, Vol. 28,
No. 1, Jan., 1953

TEMPERATURE AS A FACTOR IN SIZE AND ACTIVITY OF WILD POPULATIONS OF DROSOPHILA

RICHARD STEVENSON AND JAMES H. ST. CLAIR
East Tennessee State College, Johnson City, Tennessee

INTRODUCTION

During the summer of 1950, collections of *Drosophila* were made on Unaka Mountain, Tennessee-North Carolina (Stevenson, 1952).

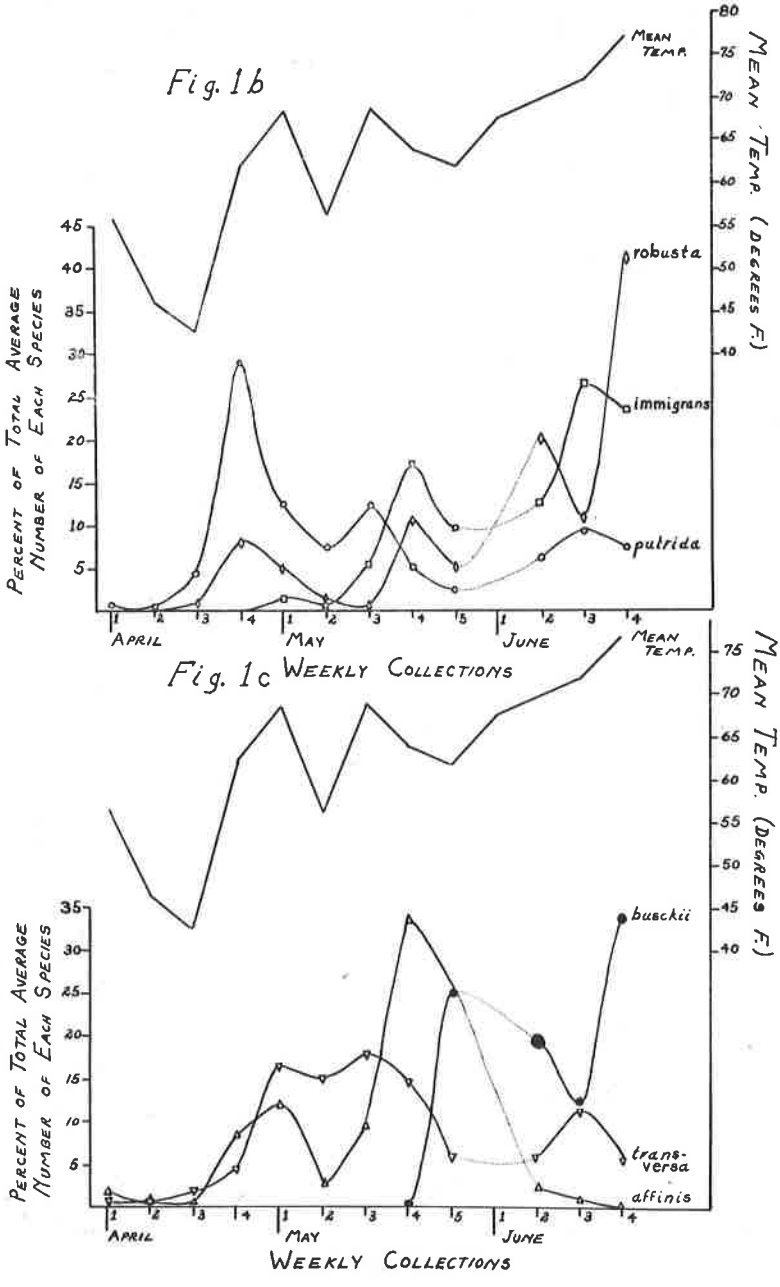


Many fluctuations in the total number of flies collected occurred at various elevations. Monthly fluctuations in the number of each of several species of *Drosophila* were also noted at different elevations. The role of altitude as an ecological factor was not determined, but it was suspected that altitude itself might be incidental to more definite factors such as temperature, moisture, and the availability of food. The present study was undertaken in an attempt to determine the correlation of temperature with the activity of wild populations of *Drosophila* from day to day, and the size of these populations during a three-month period.

METHODS

The flies were taken from ten-gallon cans that had been baited with

yeasted banana mash (Patterson, 1943). The cans were placed in a wooded area near the banks of a small stream on the campus of



East Tennessee State College, at an elevation of approximately 1700 feet above sea level. The predominant vegetation included hickory, laurel, sumac, and honeysuckle. Collections were made daily, weather permitting, five days a week, except during the first week in June, when no collections were made. The flies were taken by net, transferred to food vials, brought to the laboratory for identification, and the numbers recorded.

The daily maximum and minimum temperature readings were obtained from standard United States Weather Bureau instruments maintained on the campus by the Department of Geography, East Tennessee State College. The daily mean temperatures were determined from these records.

The collection and temperature records were treated in two ways. First, the average number of flies for each week was plotted against the average mean temperature for that week. Then the daily mean temperatures were grouped into thirteen classes of three degrees each, beginning at 40° F. and ranging upward to 76° F. The average number of flies of each species collected within each temperature class was plotted against the temperature.

Results

Eight species of *Drosophila* were collected during the months of April, May, and June. Of these eight species, the *D. affinis* subgroup, and *D. robusta, D. immigrans,* and *D. transversa* were collected in the largest numbers. The other species, *D. busckii, D. melanogaster,* and *D. tripunctata,* were never collected in large numbers.

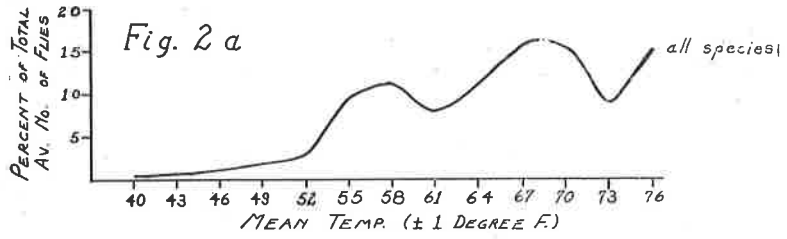
In terms of calendar time, the largest numbers of all species were taken during the first and fourth weeks in May and the fourth week in June. These three periods also showed corresponding increases in mean temperatures (Fig. 1a). The individual species showed rather close agreement with this general trend, although only *D. robusta* and *D. busckii* showed an increase during the fourth week in June, the other species showing a marked decrease in numbers during the same period (Figs. 1b and 1c). In terms of calendar time, all species showed two or more peaks, and these increases in numbers tended to parallel the fluctuations in average mean temperature for those periods.

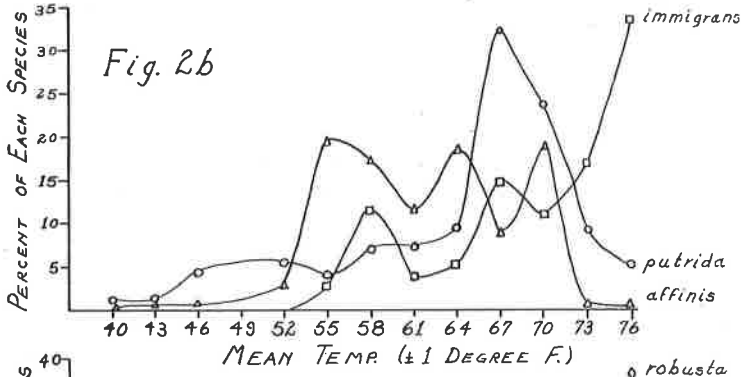
When considered from the standpoint of temperature alone, there generally were seen two or more marked increases in the numbers for individual species (Fig. 2a). The *D. affinis* subgroup of species was taken in the largest numbers when the average mean temperatures ranged between 54° and 56° F., and a secondary increase in numbers occurred in the 69° to 71° F. class. *D. transversa* (Fig. 2c) also showed two marked increases, the maximum numbers being collected in the 65° to 68° F. class. *D. immigrans* (Fig. 2b) showed three peaks, the highest occurring in the 75° to 77° F. range. *D. putrida* (Fig. 2b) was collected in the largest numbers in the 66° to 68° F. range, with a secondary peak at 58° F. *D. robusta* (Fig. 2c) showed its major peak at 66° to 68° F., with other increases occurring at 67° and 58° F. *D. busckii* showed three well-defined fluctuations

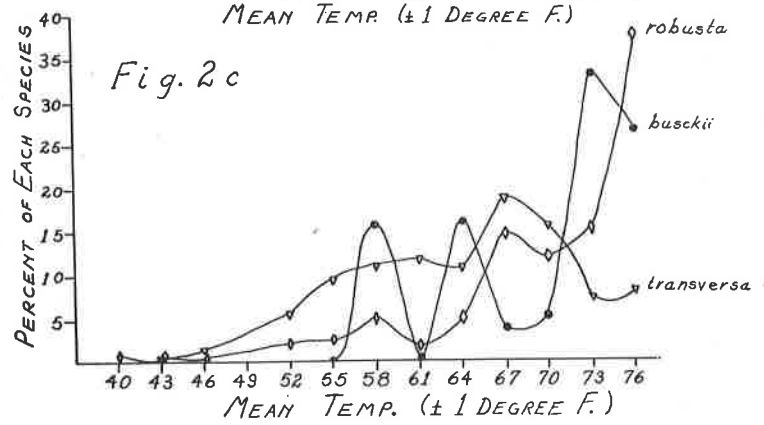
(Fig. 2c), but since this species was collected in very small numbers it is probable that these fluctuations are not significant.

Discussion

That wild populations of *Drosophila* show marked fluctuations in size has been shown by Patterson (1943) and others. Factors influencing these fluctuations, however, are known for only a few







species. Carson (1951) has reported that *D. pseudoobscura* and *D. persimilis* may feed and breed on infected sap exudations of the California black oak (*Quercus kelloggii*). These species oviposit on those exudations that are in a "critical microbiological condition,"

according to Carson. Since *D. mulleri, D. aldrichi,* and *D. meridiana* are known to breed on the fruits of several species of the cactus genus *Opuntia* (Patterson, 1943), they too would be expected to be highly seasonal in their abundance. Other species of *Drosophila* appear to be less selective in regard to their breeding and feeding habits, and it is probably in these species that temperature fluctuations are reflected as actual variations in the numbers of flies, when considered over a period of several months.

From this study it appears that most of the species here considered have primary and secondary temperature ranges, as indicated by the peaks in the population when plotted against mean temperature. Whether these are actually optimum temperature ranges for the developmental processes in the flies themselves, the optimum for the growth of their food supply, or simply those temperatures at which the adults are most active is not indicated from this preliminary study. For those species having highly diversified feeding habits it may well be that these are near the optimum temperature ranges for the flies themselves. This would mean in turn that those species populations are composed of several physiological races, or chromosomal races. The studies of Dobzhansky (1947, 1948) and Dobzhansky and Epling (1944) on *D. pseudoobscura,* and Carson and Stalker (1949) and Levitan (1951) on *D. robusta* have shown that most populations are composed of a number of gene arrangements having differential selective values. The *D. affinis* subgroup is also known to show variations in gene arrangement (Miller, 1939; Novitski, 1946).

Summary

Eight species of *Drosophila* were collected during the months of April, May, and June, 1951, on the campus of East Tennessee State College, Johnson City. Each species showed fluctuations in numbers of individuals, having in general a rather close correlation with mean temperature and calendar time. The collection data generally showed two or three peaks for each species. The largest collections were made in late May and early June, when the average mean temperature ranged between 60° and 70° F. It is suggested that the several peaks in numbers represent different physiological races within those species showing this peculiarity.

Acknowledgements

The authors are indebted to those students and staff members of the Department of Geography, East Tennessee State College, who kindly furnished the weather data used in this study.

References Cited

Carson, Hampton L. 1951. Breeding sites of *Drosophila pseudoobscura* and *Drosophila persimilis* in the transitional zone of the Sierra Nevada. *Evol.,* 5:91-96.

Carson, Hampton L., and Harrison D. Stalker. 1949. Seasonal variation in gene arrangement frequencies over a three-year period in *Drosophila robusta* Sturtevant. *Evol.,* 3:322-329.

Dobzhansky, Th. 1947. Adaptive changes induced by natural selection in wild populations of *Drosophila*. *Evol.*, 1:1-16.

Dobzhansky, Th. 1948. Genetics of natural populations. XVI. Altitudinal and seasonal changes induced by natural selection in certain populations of *Drosophila pseudoobscura* and *Drosophila persimilis*. *Genetics*, 33:158-176.

Dobzhansky, Th., and Carl Epling. 1944. Contributions to the genetics, taxonomy, and ecology of *Drosophila pseudoobscura* and its relatives. *Carnegie Inst. Wash., Pub.* 554.

Levitan, Max. 1951. Response of the chromosomal variability in *Drosophila robusta* to seasonal factors in a southwest Virginia woods. *Genetics*, 36:561-562.

Miller, Dwight D. 1939. Structure and variation of the chromosomes in *Drosophila algonquin*. *Genetics*, 24:699-708.

Novitski, E. 1946. Chromosome variations in *Drosophila athabasca*. *Genetics*, 31:508-524.

Patterson, J. T. 1943. Studies in the genetics of *Drosophila*. *The Univ. Tex. Pub.*, No. 4313.

Stevenson, Richard. 1952. Altitudinal distribution of species of the genus *Drosophila* (Diptera) on Unaka Mountain, Tennessee-North Carolina. *Jour. Tenn. Acad. Sci.*, 27:97-108.

NEWS OF TENNESSEE SCIENCE

(Continued from page 37)

Lageman, R. T., B. F. Landrum, C. T. Lester, O. Milner and E. G. McLeroy (Vanderbilt U.). 1952. Ultrasonic velocity in some alkyl aryl ketones. *Jour. Amer. Chem. Soc.*, 74:1602.

Livingston, Robert S. (ORNL). 1952. The Oak Ridge 86-inch cyclotron. *Nature*, 170:221.

Livingston, Ralph (ORNL). 1952. Pure quadrupole spectra: Alphiatic chlorine compounds. *Jour. Chem. Phys.*, 20:1170.

Lloyd, E. Alon, and David G. Doherty (ORNL). 1952. 2,4-dinitrophenylhydrazones of some hexoses and pentoses. *Jour. Amer. Chem. Soc.*, 74:4214.

Lorch, Lee (Fisk U.). 1952. Lebesgue constants for (E, 1) summation of Fourier series. *Duke Math. Jour.*, 19.

Nielsen, A. H., T. G. Burke, P. J. Woltz and Ernest A. Jones (Univ. Tenn. and Vanderbilt U.). 1952. Infra red and Raman spectra of F_2CO_3, FClCO and Cl_2CO. *Jour. Chem. Phys.*, 20:596-604.

Patten, John A. (MTSC). 1952. The life cycle of *Conspicuum icteriodorum* Denton and Byrd, 1951, (Trematoda: Dicrocoeliiae). *Jour. Parasit.*, 38:165-182.

Pearson, D. E., and C. J. Ross (Vanderbilt U.). 1952. A possible explanation of the anomalous substitution behavior of iodine monobromide. *Jour. Amer. Chem. Soc.*, 74:2933.

Pomper, Seymour (ORNL). 1952. A pH-sensitive, multiple mutant of *Saccharomyces cerevisiae*. *Jour. Bact.*, 64:353.

Pomper, Seymour (ORNL). 1952. Purine-requiring and pyrimidine-requiring mutants of *Saccharomyces cerevisiae*. *Jour. Bact.*, 63:707.

Redfearn, Paul L. (Univ. Tenn.). 1952. The Bryophytes of Central and Southern Florida. *Bryologist*, 55:193-210.

Roe, W. P., Jr., and W. P. Fishel (Vanderbilt U.). 1952. Gamma loop studies in the iron-titanium, iron-chromium and iron-titanium-chromium systems. *Trans. Amer. Soc. Metals*, 44:1030-1040.

Russell, W. L. (ORNL). 1951. X-ray-induced mutations in mice. *Cold Spring Harbor Symposia*, Vol. 16.

Schwartz, Drew (ORNL). 1952. The effect of oxygen concentration in x-ray-induced chromosome breakage in maize. *Nat. Acad. Sci., Proc.*, 38:490.

Shanks, Royal E. (Univ. Tenn.). 1952. Notes on woody plant distribution in Tennessee. *Castanea*, 17:90-96.

Stapleton, G. E., Daniel Billin, and A. Hollaender (ORNL). 1952. The role

(Continued on page 52)