

ALTITUDINAL DISTRIBUTION OF SPECIES OF THE
GENUS *DROSOPHILA* (DIPTERA) ON UNAKA
MOUNTAIN, TENNESSEE-NORTH CAROLINA

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INTRODUCTION

During the months of June, July, August, and September, 1950, collections of *Drosophila* were made at various elevations on Unaka Mountain. This mountain forms a portion of the boundary of Unicoi County, Tennessee, and Mitchell County, North Carolina, and is included in the Cherokee National Forest. These collections were made in an effort to establish breeding stocks of several species of *Drosophila*, for use in population studies at the genetics laboratory of The University of Tennessee.

METHODS

The flies were collected from paper cups, as described by Spencer (1950), and from ten-gallon cans, as described by Patterson (1943), using yeasted banana mash as bait. The traps were visited at least once daily during the monthly collecting periods, and as the flies were taken by net from the cans they were placed into shell vials containing a quantity of agar-yeast medium. Upon return to the laboratory the flies were etherized, identified as to species, and counted. Records were kept of the number of individuals of each species taken at each collecting station. Most of the collecting was done between the hours of 10 A.M. and 4 P.M., although on several occasions collections were made before 9 A.M. and at about sunset.

The approximate elevations of the collecting sites were determined from topographical maps of the area, obtained from the Tennessee Valley Authority. Benchmarks were sometimes indicated on the maps, but in most cases these could not be located because of dense undergrowth.

The traps were placed at various localities in an area covering some twenty square miles and ranging in elevation from approximately 2200 feet to 4800 feet above sea level. This area affords a wide range of ecological conditions, from densely forested areas with numerous streams and springs at the lower elevations to wind-swept slopes on which are found bare rocks with few sources of water and scant vegetation. These higher slopes are now in a process of succession following an extensive fire which swept the area some 40 years ago. At some localities, such as Beauty Spot Gap (elevation

4000 feet), a subclimax condition may be developing. Here there are extensive meadows which are being grazed at this time.

An attempt was made to select as collecting stations those sites which presented similar ecological conditions—damp woodlands near a source of water and having similar cover. This was not always possible, however, because of the scarcity of water and cover at some of the higher elevations, and also because of the fact that in many cases those sites which might have given a better yield of flies were inaccessible.

COLLECTION SITES

Station 1. Elevation 2200 feet, on Tennessee State Highway 107, 2.5 road miles east of Unicoi. Flies were collected here from traps placed in a dark, damp clearing in a forest of hemlock, *Rhododendron*, red maple, mulberry, magnolia, dogwood, and an undergrowth of stinging nettle. Other traps were placed about 0.5 mile distant among a growth of sycamore, blue beech, red maple, yellow poplar, northern red oak, and *Rhododendron*. In both sites there are small streams flowing through the stations.

Station 2. Rock Creek Park, a recreation area 3.4 miles east of Erwin, Tennessee, at about 2500 feet. No traps were placed here, but large numbers of flies were collected from trash cans containing melon rinds, banana peels, and other food scraps left by picnickers. The vegetation includes hemlock, birch, and *Rhododendron*. The area is well supplied with small streams and springs.

Station 3. On the Appalachian Trail, 1.3 miles from the junction of the Trail and Tennessee State Highway 107, at an elevation of 3000 feet. Birch, *Rhododendron*, black locust, northern red oak, yellow poplar, and blue beech are common. The cans were placed on the banks of Murray Creek, a swift mountain stream.

Station 4. On Clear Fork Creek, 1.75 miles above station 3, at an elevation of 3500 feet. Traps were placed within three feet of the stream, in birch, hemlock, and *Rhododendron*.

Station 5. Elevation 3760 feet, 0.5 mile above station 4, on the right prong of Clear Fork Creek. The vegetation includes birch, fire cherry, and *Rhododendron*.

Station 6. Elevation 4000 feet, 6 miles above the junction of Highway 107 and the Appalachian Trail, in a secondary growth of red maple, northern red oak, hemlock, chestnut, and witch hazel. There is no stream nearby.

Station 7. Elevation 4200 feet, 1.3 miles above station 5, in a nearly pure stand of young birch, with a forest floor of rotting logs and leaves. This is a very damp area, although there is no stream nearby.

Station 8. Elevation 4400 feet, 8 miles above the junction of highway and trail. A rather dry area of northern red oak, wild cherry, and birch.

Station 9. Elevation 4700 feet, 10 miles above Rock Creek Park on the Appalachian Trail. This is a dry area with fire cherry and *Rhododendron*.

Station 10. Rattle Snake Ridge, elevation 4800 feet, the highest point of the Trail on Unaka Mountain, 8.2 miles above Highway 107. This is a wind-swept point on which the dominant vegetation includes birch, mountain ash, red maple, and *Rhododendron*.

RESULTS

It has been pointed out by Spencer (1950) and others that the best collections of *Drosophila* are generally made shortly after sunrise and before sunset, but this study does not agree with that observation. It was found that, since most of the traps were placed in deep woods

or in well-shaded places, the time of collecting was of little significance. If anything, collecting was somewhat more rewarding dur-

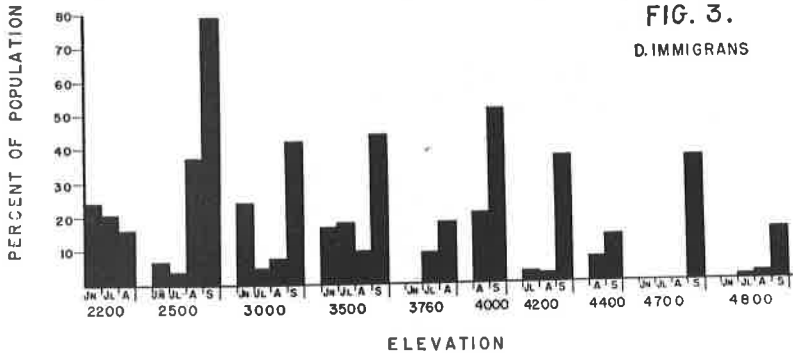
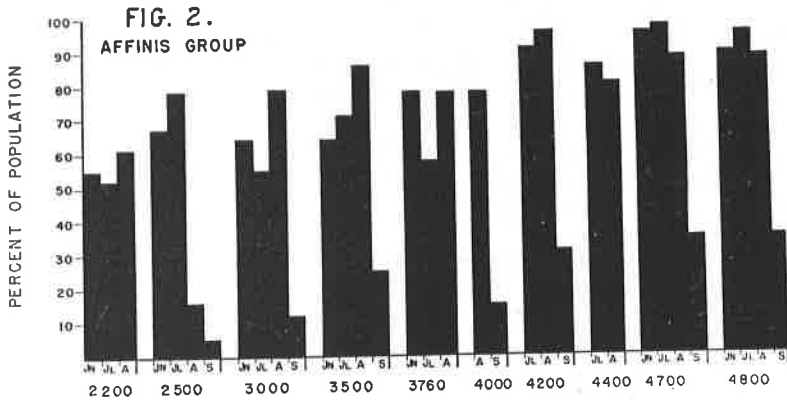
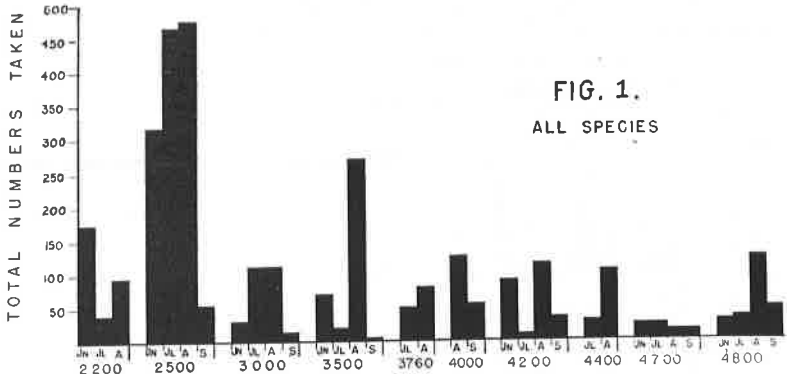


Plate I. The relation of the numbers of individuals of *Drosophila* to elevation, Fig. 1. The relation of the total numbers of all species collected to elevation, Fig. 2. The percent of the population collected at various elevations that belonged to the *affinis* group, Fig. 3. The percent of the population collected at various elevations that belongs to *D. immigrans*.

ing the middle part of the day. During the early morning hours there is generally a heavy dew, and frequently there are thick fogs, while in the late afternoon there generally occurred a rather sudden drop in temperature. It was frequently necessary to place the collecting vials directly over the flies as they fed on the bait, and at

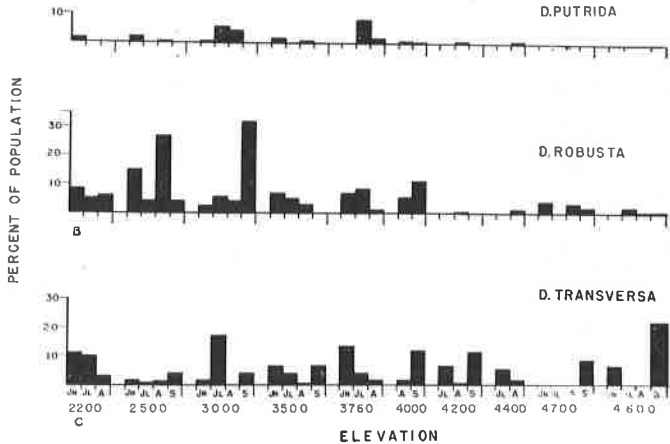


FIG. 4.

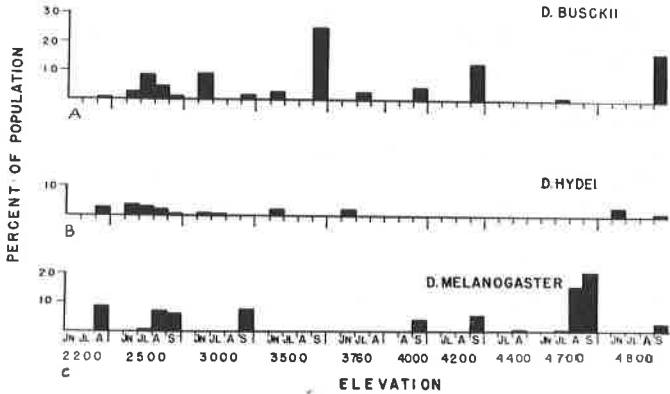


FIG. 5.

Plate II. The percent of the population collected at various elevations that belongs to various species of *Drosophila* as follows: Fig. 4. *D. putrida*, *D. robusta*, and *D. transversa*. Fig. 5. *D. busckii*, *D. hydei*, and *D. melanogaster*.

times it was even necessary to prod the flies into the vials before they could be taken.

As may be seen from plate 1, figure 1, the actual numbers of flies collected varied from month to month during the collecting period with the largest numbers occurring in June at 2200 feet, in July and August at 3000 feet, in August at 2500, 3500, 3760, 4000, 4200, 4400,

and 4800 feet. At 4700 feet the numbers remained fairly constant throughout the summer. There were also seen at all elevations except 4700 feet marked fluctuations involving primary and secondary peaks.

The *affinis* group of species (Plate 1, Fig. 2), represented largely by *Drosophila affinis*, composed the largest segment of all populations during most of the summer. At most stations, however, there occurred a sharp decline in actual numbers, as well as in percentages, of this species-complex during September.

As the percentage of the *affinis* group decreased there occurred a corresponding increase in several other species, notably in *D. immigrans* (Plate 1, Fig. 3). This species reached its percentage peak in June at 2200 feet, and in September at all other elevations. At 4700 feet the first specimens of *D. immigrans* were collected in September, and at 4800 feet the take had been very scant before September, at which time it represented about 15 percent of the population.

Of the other species of *Drosophila* collected during this period, none approached the actual numbers of the *affinis* group and *D. immigrans*. *D. putrida* (Plate 2, Fig. 4, A) showed a very spotty distribution and always occurred in small numbers. This species reached its maximum in July at the 3000- and 3760-foot stations. *D. putrida* was never present in collections made above 4400 feet.

D. robusta (Plate 2, Fig. 4, B) was found at all stations during most of the summer and reached its peak at 3000 feet in September. *D. transversa* (Plate 2, Fig. 4, C) occurred at all stations. This species showed marked fluctuations, particularly at the stations above 3500 feet.

D. busckii, *D. hydei*, and *D. melanogaster* (Plate 2, Fig. 5) were extremely spotty in distribution and all showed wide fluctuations from month to month.

Several species occurred in extremely small numbers, at one or a few stations, and in some cases were taken only once or during a single collecting period. *D. colorata*, for example, was collected only during the July period at elevations below 4000 feet, and it never represented more than 2.25 percent of any population. *D. funebris* was taken only once, at 2500 feet in July. *D. magnafumosa* was found at 3760 feet in July, *D. melanica* at 2500 and 3000 feet in July and August, and *D. nigromelanica* at 2500 feet in July. *D. testacea* was collected in July at 3000 and 3760 feet. *D. tripunctata* occurred at all elevations but generally in very small numbers. In July, however, at 2200 feet it represented nearly 13 percent of the flies collected. Nowhere else at any time did it compose more than 6 percent of the populations.

In addition to these fifteen species of the genus *Drosophila*, there were occasionally found members of other genera of the family Drosophilidae. Species of the genus *Chymomyza* were collected at 2500 and 3760 feet in July, and at 4400 feet in August. *Leucophenga* was taken at 4800 feet in September, and *Scaptomyza* at 3000 and 4200 feet in September, and at 4200 feet in July.

DISCUSSION

That wild populations of *Drosophila* and related genera undergo marked fluctuations in numbers from month to month is evident from this and similar studies. The collection records further show that when one species decreases in numbers there is frequently a corresponding increase in the numbers of individuals of one or more other species. A number of factors are no doubt at work in this phenomenon.

The ecological factors which influence fluctuations in natural *Drosophila* populations are not well defined. Light, temperature, moisture, and the availability of food are no doubt important factors. That each species is affected in a different manner is suggested by the lack of uniformity in the fluctuations of individual species in a given population.

The significance of altitude as a factor is not made clear from this

TABLE 1. Number of species of *Drosophila* taken at each elevation, and the average number of flies per collection at each station on Mt. Unaka during the summer of 1950

ELEVATION IN FEET	NUMBER OF SPECIES OF DROSOPHILA	AVERAGE NUMBER OF FLIES PER COLLECTION
2200	9	103
2500	13	327
3000	11	95
3500	9	92
3760	11	65
4000	8	93
4200	9	67
4400	7	81
4700	7	20
4800	9	55

preliminary study. Whether a given set of conditions exists because of the altitude was not determined. The fact that much of the mountain had been denuded by fire must be considered, and in this case that condition may be more significant than the altitude factor. That fewer species of *Drosophila* do occur at higher altitudes has been observed by Stalker and Carson (1948) and by Spencer (1950). The present study does not agree entirely with these observations, as indicated in table 1. The discrepancies here are probably due to the absence of ecological gradients at the selected collecting sites. This deficiency in turn might be due to the burned condition of much of the mountain.

It is indicated by this study that there is a need for further investigations into the ecology of natural populations of *Drosophila*. Such studies would no doubt contribute to an understanding of population dynamics in general.

ACKNOWLEDGEMENTS

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SUMMARY

A preliminary study has been made of the altitudinal distribution of species of the genus *Drosophila*, on Unaka Mountain, Tennessee-North Carolina. In general, it was found that there occurred a decrease in the number of species with an increase in elevation. There was also noted a marked fluctuation in the numbers of species and in the numbers of individuals within a single species from month to month, and from station to station. The factors involved in these changes have not been determined, but it is suggested that there is at work an interaction of genetic and ecologic factors.

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