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*by*

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# A Report on Drosophila Collections in Nebraska[1]

David D. Williams[2] and Dwight D. Miller[3]

## Introduction

UNTIL RATHER recently little has been known of the *Drosophila* species of Nebraska. Sturtevant (1921) lists Nebraska as one of seven states from which no *Drosophila* had been reported. Patterson and Wagner (1943) show that collections of *Drosophila pseudoobscura* had been made in the vicinities of Scottsbluff and Kearney, but no other *Drosophila* species are reported from Nebraska in their publication.

It was the object of the investigations reported here to collect *Drosophila* in Nebraska, determining the species present and, inasmuch as possible, the relative frequencies of these species and variations in their frequencies. This paper is a report of collections in eastern Nebraska from 1946 through 1950 (mainly collections at Lincoln and Monroe during 1947) and of a few collections made in the western part of the state (collections of Mr. A. A. Russell near Henry in 1948 and collections at Chadron State Park in 1950). In addition, reference is made to *Drosophila* in the collection of pinned specimens of the Entomology Division of the University of Nebraska State Museum and to species collected in Nebraska in 1947 and 1950 by Professor M. R. Wheeler of the University of Texas. It is realized that these collections are rather limited and probably do not furnish a complete picture of the *Drosophila* of this

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state. They have shown, nevertheless, the presence in Nebraska of various species not previously reported, and have extended considerably the known distributions of certain of these species. Moreover, the 1947 collections give some indication of seasonal variation in the abundance of some of these forms.

Acknowledgements are due various individuals for their assistance in this investigation. Doctors H. C. Carson and H. D. Stalker of Washington University (St. Louis) kindly made available unpublished information about their *Drosophila* collections, and Dr. Stalker supplied the second author with certain specimens. Professor Th. Dobzhansky of Columbia University has made available a Brazilian strain of *Drosophila nebulosa,* which was used in experimental matings reported here. Thanks are due Dr. C. F. W. Muesebeck and his associates of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture (Washington, D.C.) for identification of certain insects associated with *Drosophila.* Dr. M. H. Muma, former Curator of Entomology, University of Nebraska State Museum, has made available pinned specimens of *Drosophilidae* collected in Nebraska prior to 1946 and has offered some very helpful suggestions concerning this publication. We are very grateful to Professors J. T. Patterson and M. R. Wheeler of the University of Texas for assistance in identifying certain specimens and for permission to refer to the unpublished results of the Nebraska collections of Professor Wheeler and his associates. Professor A. H. Sturtevant of the California Institute of Technology kindly examined some of the specimens collected during 1947. Mrs. D. T. Williams, mother of the first author, made the collections at Monroe during 1947. The following students and former students of the second author made *Drosophila* collections the results of which have been included in this report: Mr. P. Romberg, Mr. A. A. Russell (Temple Junior College; Temple, Texas), Miss J. Wolcott (Mrs. K. Fitch), and Mr. A. F. Yanders.

## Collection Methods

Collections were made largely through the use of small containers baited with fermenting banana and suspended by strings from the branches of bushes and trees (termed "lures"

by Spencer, 1950a). These lures were either half-pint milk bottles or paper cups of about the same capacity, usually the latter. Flies were generally removed from the lures by means of a large tubular collector into which the lures were inserted. This was part of the time a large cardboard tube (about 4½" by 23") with cloth fastened over one end (such a collection method was first communicated to the second author by Dr. H. D. Stalker; it has subsequently been reported in publications by Spencer, 1950a, 1950b). The collector most generally employed was of a kind devised by the first author during the 1947 collections. This consisted of a wide-mouthed glass jar of about two quarts capacity, plugged by a ring-shaped cork into which a large black paper funnel had been fastened. (Fig. 1). This was used in a manner similar to that with the card-

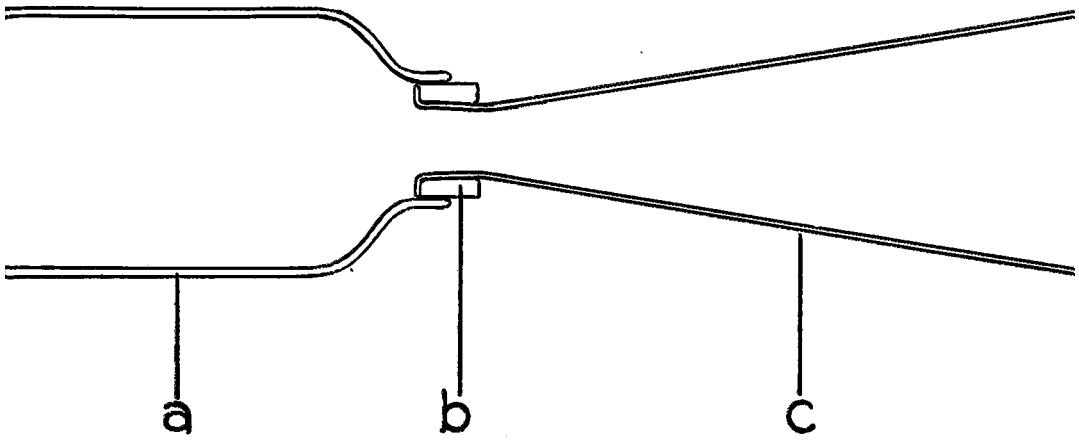


FIG. 1.—Diagram illustrating glass jar *Drosophila* collector. Labels: a. 2-quart glass jar; b. cork ring; c. black paper funnel.

board tube (Spencer, 1950b). That is, the jar was held in a slanting position towards some light source (e.g. direct sunlight) while a lure was thrust up into the black funnel and shaken about against the wall of the funnel. Under these conditions the flies which had been attracted to the lure flew up into the glass jar. Flies were later removed following etherization within the collector. Etherization was effected by replacing the cork ring and funnel by a cork with ether-soaked cotton on its inner surface. The glass jar collector was found to have

the advantage of making the flies easily visible as they accumulated in the collector and while they were being etherized.

## Results of Collections

SOUTHEASTERN NEBRASKA, 1946.

Collections were made in Lincoln (Lancaster County) and at a few other places in southeastern Nebraska (Cass, Saline, and Seward counties). These were made by the second author and two of his students (Mr. Romberg and Miss Wolcott) during the period from September 11th through October 25th. In a series of rather small collections (totaling 462 specimens plus individuals hatching out of old, exposed lures), the following *Drosophila* species were represented: *D. affinis, D. algonquin, D. busckii, D. funebris, D. melanogaster, D. putrida, D. robusta,* and *D. simulans.* In addition, there was obtained an unidentified species of the *D. repleta* group.

LINCOLN, 1947.

The collections were made by the first author on the City Campus of the University of Nebraska. Collecting was conducted from April 18th through November 8th. During the early part of this period, the number of lures exposed and the number of collections per day were rather variable, although no fewer than six lures were exposed at one time and collections were made at least once a day, with few exceptions. Starting August first, 30 lures were maintained continuously, and there were nearly always two collections per day and never less than one.

These collections yielded 33,050 *Drosophila* and 224 flies of related genera. The *Drosophila* included at least 18 species, and there were three other genera (with four species) of the *Drosophilidae* represented. A tabulation of the results of these collections is given in Table 1. Here there are two cases in which different species are grouped together; females of the "*affinis* subgroup" were not identified as to species, and it seems probable that more than one species of the "*repleta* group" were represented. Intraspecific variation was observed in *D. putrida,* with both light- and dark-bodied individuals appearing in the collections. According to Professor J. T. Patterson (personal communication), this color variation

within *D. putrida* has also appeared in his collections. A single *Drosophila* collected in May appeared similar to *D. alabamensis* Sturtevant 1916; however, because of the uncertainty of its identification, it is listed as "*D. alabamensis*-like." As may be seen, all species collected in 1946 were obtained again in 1947; moreover, as was determined subsequently by the second author, all forms that were recognizable among the pinned specimens of the University of Nebraska State Museum Division of Entomology (*D. melanogaster, D. quinaria,* "*repleta* group," "*funebris* group," and *Chymomyza amoena*) were also represented here.

MONROE, 1947.

Monroe is located in Platte County about 65 miles northwest of Lincoln. Collections were made in a yard in the residential district. These employed four half-pint milk bottle lures, and collecting was continued daily from the first of June until November first. The collections yielded 9469 *Drosophila* and 7 flies of an other genus (*Aulacigaster,* 6 specimens in June and one in August). The *Drosophila* species and the numbers of specimens of each are presented in Table 2.

COLLECTIONS IN 1948 and 1949.

In a few very small collections (totaling 125 specimens), the second author obtained the following species at Lincoln in May and June of 1948: *D. affinis, D. algonquin, D. athabasca, D. busckii, D. funebris, D. melanica, D. melanogaster, D. pseudoobscura,* a "*repleta* group" species, and *D. robusta.* Besides these *Drosophila, Aulacigaster* was collected. As may be seen, *D. athabasca,* which was represented by three males, was the only form not previously reported here.

During June and July of 1948, Mr. A. A. Russell collected *Drosophila* at Huskerville (Lancaster County, about 8 miles northwest of Lincoln). In a total of 2943 specimens, Mr. Russell obtained the following species: *D. affinis, D. algonquin, D. athabasca, D. busckii, D. funebris, D. macrospina, D. melanica, D. melanogaster, D. melanura, D. pseudoobscura, D. putrida* (both light and dark), *D. robusta, D. victoria,* and a *D. virilis* group species. It may be observed that *D. melanura* and the *D. virilis* group species, which were represented by a single male specimen each, were new in the collections of this region.

Mr. Russell also collected *Drosophila* near Henry (Scottsbluff County) during August, 1948, obtaining *D. affinis* there.

During the summer of 1949 Mr. A. Yanders collected at Peru and Falls City (Nemaha and Richardson counties respectively), obtaining *D. affinis, D. melanogaster,* and *D. robusta.*

## COLLECTIONS DURING 1950

From the 22nd of June through the 31st of July the second author collected *Drosophila* in Lincoln. The following species were represented among 354 specimens: *D. affinis, D. algonquin, D. busckii, D. funebris, D. melanica, D. melanogaster, D. putrida, D. quinaria, D. robusta,* a form similar to *D. transversa,* and *D. victoria.* As may be noted, with the possible exception of "*D. transversa*-like," none of these species was new to the collections.

Collections were made by the second author at Chadron State Park (Dawes County) from the 7th of August through August 27th. These were conducted in groves of trees near Chadron Creek and not far from the park entrance. A total of 925 *Drosophila* (plus a few *Aulacigaster*) were obtained. The species represented in these collections were: *D. affinis, D. algonquin, D. athabasca, D. americana, D. busckii, D. funebris, D. hydei, D. macrospina, D. melanica, D. melanogaster, D. nebulosa, D. pseudoobscura, D. putrida, D. robusta, D. suboccidentalis,* and *D. victoria.* Forms not previously reported in our collections were *D. americana, D. hydei, D. nebulosa,* and *D. suboccidentalis.* However, it is probable that *D. americana* was the *D. virilis* group species collected by Mr. Russell in 1948, and *D. hydei* was almost certainly represented among the *D. repleta* group species collected earlier in southeastern Nebraska. Moreover, as is reported in the next section, *D. americana, D. hydei,* and *D. suboccidentalis* had already been obtained in Nebraska by Professor Wheeler.

During the course of the Chadron State Park collections it was observed that certain small wasps sometimes frequented the lures along with the *Drosophila,* and on the morning of August 25th two of the wasps were taken into the collector with the flies. While in the collector these wasps were seen to attack and feed on several of the *Drosophila,* and when the

insects were removed from the collector, the remains of a partly eaten *Drosophila* male (probably *D. pseudoobscura* or one of the "*affinis* subgroup" species) were recovered. The wasps were preserved in alcohol and later sent to Dr. C. F. W. Muesebeck of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture (Washington, D. C.) for identification. These were identified as specimens of *Mellinus rufinodus* Cr. (Sphecidae) (determination of K. V. Krombein). European species of this genus have been reported to provision their nests with adult Dipterans (but not *Drosophila*), according to Hamm and Richards (1930). It is quite possible that this species is a natural predator of *Drosophila*, though the observation reported here shows predation only in the unusual environment of the glass jar collector.

Among the elm trees growing near Chadron Creek several were found to have regions of slimy exudate (slime flux) on the bark and in places where the limbs had been broken. Since it had previously been reported by Carson and Stalker (1949) that certain *Drosophila* had been found breeding in slime flux, it was thought likely that these trees might represent breeding sites for some of the species that were being collected. Samples of slime flux were taken from three of these trees and kept in half-pint bottles. From one taken on August 16th there eventually hatched out several specimens of *D. robusta* and *D. victoria* as well as some of *Aulacigaster* and a small gnat-like form identified later as *Mycetobia divergens* Walk. (Sylviculidae) (sent to Dr. C. W. F. Muesebeck, determined by Alan Stone). Another sample taken from the same tree on August 20th also yielded *D. victoria, Aulacigaster,* and *Mycetobia divergens* (but not *D. robusta*). Besides these insects, the slime flux from this tree was observed to contain numerous nematodes. Both *D. robusta* and *D. victoria* had been reported by Carson and Stalker (1949) from slime flux collected in the vicinity of St. Louis.

## COLLECTIONS OF THE UNIVERSITY OF TEXAS

During the summer of 1947 Professor M. R. Wheeler and Mr. Cowan collected *Drosophila* near Columbus (Platte County) and Chadron (Dawes County). In the summer of 1950 Professor Wheeler and Mr. Stephens collected near Chad-

ron, Oakdale (Antelope County), Hastings (Adams County), and Haigler (Dundy County). These collections yielded altogether 6005 *Drosophila* specimens (along with specimens of several related genera). The species represented were: *D. affinis, D. algonquin, D. americana, D. athabasca, D. duncani, D. guttifera, D. immigrans, D. funebris, D. hydei, D. macrospina, D. melanica, D. melanogaster, D. palustris, D. pseudoobscura, D. putrida, D. robusta, D. suboccidentalis, D. transversa, D. tripunctata,* and *D. victoria.* Among these, the following had not been reported in any of the University of Nebraska collections: *D. duncani,* of which three specimens were collected at Hastings; *D. immigrans,* which appeared at both Hastings and Haigler (one specimen at each place); *D. palustris,* which appeared as two specimens near Chadron in 1947; and *D. tripunctata,* of which three specimens were obtained at Hastings.

## Discussion

### *DROSOPHILA* SPECIES COLLECTED IN NEBRASKA

Table 3 summarizes the *Drosophila* collections with regard to species obtained. Doubtful forms (e.g. "*D. alabamensis*-like") are not listed; hence this constitutes a minimum species list. Forms represented by no more than five specimens in any one collection are here arbitrarily designated "rare."

With regard to the known geographical distributions of these species, a distinction may be made between three main groups: cosmopolitan species—i.e. those found in all the main faunal regions of the world (Nearctic, Neotropical, Palaearctic, Ethopian, Oriental, and Australian); those found in the Nearctic Region and one or more (but not all) of the others; and those restricted (i.e. endemic) to the Nearctic Region. Of the species represented here, the following are known to be cosmopolitan (Patterson and Wheeler, 1949): *D. busckii, D. funebris, D. hydei, D. immigrans, D. melanogaster,* and *D. simulans.* Three of the species, though not cosmopolitan, are also found outside the Nearctic Region. These are: *D. pseudoobscura,* which, although found extensively in the western part of the Nearctic, extends into the Neotropical Region in Mexico and Guatemala (Dobzhansky, 1939); *D. nebulosa,* which is found mainly in the Neotropical Region but which has pre-

viously been reported within the Nearctic in southern Texas (Patterson and Wagner, 1943); and *D. transversa,* which has been found in the Palaearctic and Oriental Regions as well as the Nearctic (Patterson and Wheeler, 1949). The remaining species (18 of them) have been reported only from the Nearctic Region. Among these, some restrictions of range within the Nearctic are also known (as well as for some not entirely restricted to this region). Of particular interest here are those species reported to be largely eastern and those reported to be largely western. Examples of eastern Nearctic species are: *D. affinis, D. algonquin, D. americana, D. guttifera, D. putrida, D. quinaria, D. robusta,* and *D. tripunctata.* In addition, *D. transversa* is apparently confined to the eastern Nearctic. *D. suboccidentalis* is an example of a western Nearctic species, and *D. pseudoobscura* is also confined to the western part of the Nearctic. Purposely omitted here have been those species which, although possibly largely eastern or western, are know to range widely both to the east and west of Nebraska (e.g. *D. melanica*), and those species which have been collected but little elsewhere, so that their distributions are scarcely known at all (e.g. *D. pseudomelanica*).

A rather surprising feature of the Chadron State Park collections was the appearance of two specimens suggesting *D. nebulosa* (one specimen on each of the 14th and 24th of August, 1950). This species is found largely in South and Central America and the West Indies, although it approaches and extends into the Nearctic Region in northern Mexico and southern Texas (Patterson and Wagner, 1943; Patterson and Mainland, 1944). This form is apparently rather common in the Mexican state of Tamaulipas, in which it was the most common *Drosophila* species in collections reported by Patterson (1943). However, although it was collected at various places in southern Texas, its frequency there was never very high (reaching 14% at Uvalde), and it was not collected north of the 32nd parallel (Patterson and Wagner, 1943). The two specimens collected at Chadron State Park were females, and fortunately one or both of them were fertile so that it was possible to establish a laboratory stock. Although the descendants of these females were very similar to *D. nebulosa,* further checking of their species status was made through matings between

the Nebraska stock and a strain of *D. nebulosa* which had originated in Brazil (Belem). Both reciprocal crosses yielded abundant offspring with no apparent abnormalities, and these offspring proved to be fertile among themselves. There seems little doubt that the Chadron State Park specimens should be considered members of *D. nebulosa*. Concerning the significance of encountering this species in northwestern Nebraska, little can be said at the present, considering the fact that but few *Drosophila* collections have been reported between Nebraska and the region where this species has previously been collected (aside from northern Texas). It seems rather unlikely that a species confined so largely to the tropics and subtropics should be permanently established out-of-doors in the latitude of northern Nebraska. A relatively recent introduction and/or a close association with man (e.g. overwintering indoors) would seem more likely.

Patterson and Wagner (1943) refer to the 99th meridian as a line of replacement for some of the western and eastern Nearctic species of *Drosophila* in Texas. The 99th meridian also passes through Nebraska (e.g. cutting across the Platte River just east of Kearney). Consequently, it is not surprising to find that Nebraska also has a mixture of eastern and western *Drosophila,* although the collections reported here do not clearly establish the position of a zone of replacement. Some of these species might well be expected to have distribution limits either within Nebraska or not far away. An interesting result of these collections is the observation that some of the eastern forms are distributed as far as the western borders of Nebraska and at least one of the western species (*D. pseudoobscura*) as far as eastern Nebraska. The collections in northwestern Nebraska show that the eastern species *D. affinis, D. algonquin, D. americana, D. putrida,* and *D. robusta* all extend close to the western boundary of this state. Of the western species, *D. suboccidentalis* is at least present in the extreme western part of Nebraska. It was collected near Chadron by Wheeler and Cowan in 1947 and again by Wheeler and Stephens and by the second author in 1950. This species is distributed mainly in the Rocky Mountains. Spencer (1950a) reports *D. suboccidentalis* to be the dominant *Drosophila* species in the Jackson Hole area of Wyoming. *D. pseudoobscura* has been

collected as far east as Lincoln in Nebraska. Patterson and Wagner (1943) show that this species occurs approximately as far east in Texas. It is probable that the eastern limit of the distribution range of this species in the United States lies not far from the eastern boundary of Nebraska. However, Drs. H. C. Carson and H. D. Stalker (personal communication) have reported collecting a single *D. pseudoobscura* male in the vicinity of St. Louis in April, 1947 (out of about 48,000 specimens collected over three years).

Several of the species collected in the Lincoln area are ones which have been reported nowhere else in very large numbers or have been reported in only a few localities outside Nebraska. *D. cinerea* has been taken as a single specimen at each of two localities in Texas (Patterson and Wheeler, 1942). *D. melanura* was collected at Rochester, New York, (Miller, 1944), Guarette, Maine, (listed by Hsu, 1949), and by Dr. H. D. Stalker in the vicinity of St. Louis (collected in 1950 and sent to the second author). *D. pseudomelanica* was described by Sturtevant (1916) on the basis of specimens collected in Maryland and Virginia. It had apparently not been obtained again until its appearance in Lincoln in May and June of 1947 (e.g. it is not mentioned in the reports of extensive collections listed in the publications of Patterson, 1943, and Patterson and Wagner, 1943). Because of the paucity of records of these forms, little can be said about their distributions. However, judging from the rather widely scattered reports, each of these species (especially the latter two) must have a rather wide distribution.

## SEASONAL VARIATION AT LINCOLN AND MONROE (1947)

The records of collections at Lincoln and Monroe during 1947 (Tables 1 and 2) show marked month-to-month variations in the numbers of individuals of the different *Drosophila* species. To illustrate further the change in the character of the collections that took place during the season, Table 4 has been prepared, listing the five most common species for each of the months in the orders of their frequencies. For the Lincoln collections, this table includes the 11 most common forms ("*affinis* subgroup" and "*repleta* group" treated as single

forms) of the entire collection plus *D. simulans,* which ranked 13th (Table 1). For the Monroe collections, the 8 most common forms of the whole collection are included here. In addition, monthly precipitation totals and mean temperatures are given in Table 4 (obtained from U.S. Weather Bureau Climatological Summaries). Concerning these climatological data, the following features are outstanding. The rainfall of June was unusually high, the 9.95 inches of precipitation at Lincoln being the highest in 34 years. The months of August and October were extraordinarily hot, the mean temperatures for these months at Lincoln (84.5° F. and 65.0° F. respectively) being the highest in 61 years of record.

The species data of Table 4 suggest seasonal trends in frequency and rank for some of the forms. A striking feature is the increase of *D. melanogaster* from rather low frequencies in the early months (e.g. this species had a frequency of 4% at Lincoln in May and ranked sixth) to very high ones later on (from August to the end of the season frequencies exceeded 50% and no other species was half as frequent). The "*affinis* subgroup" species, on the other hand, were relatively common early in the season (constituting the most common form at Lincoln in May and July and at Monroe in July), but they were reduced to very low frequencies by the season's end (less than 1% in October and November). Among some of the less common species the observed variations are also suggestive of seasonal trends. The following species showed downward trends during the first three months (May-July): *D. pseudoobscura, D. busckii, D. putrida,* and *D. pseudomelanica.* Particularly striking among these are *busckii,* which was the most common of all species at both collecting stations in June, and *pseudomelanica,* which disappeared completely following May and June. Trends of rising frequencies during the last three months (September-November) are apparent for *D. melanica* and the "*repleta* group" species.

Evaluation of seasonal changes in the collection frequencies of these *Drosophila* species is difficult in the absence of much knowledge of their ecological relations. Nevertheless, there is some basis for speculation. The varying weather conditions must have greatly influenced the collections. These must have affected both the numbers of individuals of the various

species in nature and the likelihoods of these flies' coming to the lures. It is probable that the season of abundance of *Drosophila* was unusually prolonged due to the relatively high temperatures of early fall. Another factor of importance must have been the fact that these collections were made close to inhabited areas. Certain of the *Drosophila* species are known to be closely associated with man (the "domestic" species of Patterson and Wagner, 1943), living in buildings and dwellings and on food made available by man. Of the species reported here, the ones found to be largely domestic (50% or more) by Patterson and Wagner (1943) are *D. melanogaster* (and *D. simulans*), *D. funebris,* and *D. busckii.* Of these species, *D. melanogaster* and *D. simulans* have been suspected of having been introduced into the United States from the tropics within relatively recent times and of depending on domestic habitats for their survival through the winter (Sturtevant, 1921). With such overwintering in sheltered places, one might expect rather low frequencies of these species at the beginning of the season of warm weather followed by rapid rises in frequency as the species become well established out of doors (as has been suggested elsewhere, e.g. Spencer, 1940). The variation of *D. melanogaster* in these collections is consistent with this idea. The low frequency of *D. simulans* in the Nebraska collections (about 0.1% at Lincoln in 1947) and the fact that this species was found only in the latter part of a rather warm season (collected only in September through November) are in agreement with observations reported by Patterson (1943), who points out that *simulans* seems to have a preference for high temperatures, having been more common in collections in the southern states than in those farther north (where frequencies comparable to the one reported here have been observed) and tending to have a population maximum later in the season than *melanogaster.* With regard to the species not so closely associated with man (the "wild" species of Patterson and Wagner, 1943), seasonal fluctuations in their natural food material (e.g. certain fungi) might be expected to be an important factor in determining their changes of abundance. Some of these species are known to feed on fleshy fungi. An example of these is *D. putrida* (Sturtevant, 1921). Although the natural breeding site of

this species was not determined in these localities, the restriction of this species to the early part of the collecting season (May through July at Lincoln, into August at Monroe) may be suspected of having been due to the relative abundance of such plant material at that time of year.

## SUMMARY

*Drosophila* collections in Nebraska during the years 1946 through 1950 are reported. At least 27 species were obtained, 8 of these with only very low frequencies. Of the species present, several are cosmopolitan (*busckii, funebris, hydei, immigrans, melanogaster,* and *simulans*). Of the remaining, three extend into other faunal regions besides the Nearctic (*nebulosa, pseudoobscura,* and *transversa*). With regard to distribution within the Nearctic Region, both eastern and western forms were collected, some of the two kinds overlapping virtually the length of the state (e.g. the western *pseudoobscura* extended to eastern Nebraska, the eastern *affinis* extended to the western part of the state). Seasonal variation in the frequencies of some of the species was suggested by the results of collections at Lincoln and Monroe in 1947. For example, *D. melanogaster* rose from relatively low frequencies in May and June to very high ones in the latter part of the collecting season, while the "*affinis* subgroup" species had rather high initial frequencies but declined to very low ones towards the end of the season.

## References

**Carson, H. L., and H. D. Stalker.** 1949. Natural breeding sites for *Drosophila robusta* (Abstract). Records Genetics Soc. Amer. 18: 80.

**Dobzhansky, Th.** 1939. Genetics of natural populations. IV Mexican and Guatemalan populations of *Drosophila pseudoobscura*. Genetics 24: 391-412.

**Hamm, A. H., and O. W. Richards.** 1930. The biology of the British fossorial wasps of the families Mellinidae, Gorytidae, Philanthidae, Oxybelidae, and Trypoxylidae. Trans. Ent. Soc. London LXXVIII: 95-131.

**Hsu, T. C.** 1949. The external genital apparatus of male Drosophilidae in relation to systematics. Univ. Texas Publ. 4920: 80-142.

**Miller, D. D.** 1944. *Drosophila melanura*, a new species of the melanica group. Jour. New York Ent. Soc. 52: 85-97.

**Patterson, J. T.** 1943. The Drosophilidae of the southwest. Univ. Texas Publ. 4313: 7-216.

**Patterson, J. T., and G. B. Mainland.** 1944. The Drosophilidae of Mexico. Univ. Texas Publ. 4445: 9-101.

**Patterson, J. T., and R. P. Wagner.** 1943. Geographical distribution of species of the genus *Drosophila* in the United States and Mexico. Univ. Texas Publ. 4313: 217-281.

**Patterson, J. T., and M. R. Wheeler.** 1942. Description of new species of the subgenera *Hirtodrosophila* and *Drosophila*. Univ. Texas Publ. 4213: 67-109.

————. 1949. Catalogue of described species belonging to the genus *Drosophila*, with observations on their geographical distribution. Univ. Texas Publ. 4920: 207-233.

**Spencer, W. P.** 1940. Levels of divergence in *Drosophila* speciation. Amer. Nat. 74: 299-311.

————. 1950 a. The *Drosophila* of Jackson Hole, Wyoming—a taxonomic and ecological survey. Amer. Midland Nat. 43: 79-87.

————. 1950 b. Collection and laboratory culture. Chap. 7 of "Biology of *Drosophila*" (ed. by M. Demerec), John Wiley and Sons: 535-590.

**Sturtevant, A. H.** 1916. Notes on North American Drosophilidae, with descriptions of twenty-three new species. Ann. Ent. Soc. Amer. 9: 323-343.

————. 1921. The North American species of *Drosophila*. Carnegie Inst. Wash. Publ. No. 301.

**Table 1.**—Collections at Lincoln in 1947.

A. *Drosophila* species.

| *Species* | *Apr.* | *May* | *June* | *July* | *Aug.* | *Sept.* | *Oct.* | *Nov.* | *Season* |
|---|---|---|---|---|---|---|---|---|---|
| *D. Melanogaster* | .. | 25 | 115 | 2098 | 5721 | 7771 | 6054 | 309 | 22093 |
| *D. affinis* ♂♂ | .. | (87) | (46) | (1087) | (679) | (81) | (21) | (1) | ..... |
| *D. algonquin* ♂♂ | .. | (114) | (14) | (287) | (270) | (177) | (48) | ..... | ..... |
| *"aff.* subgp." ♀♀ | .. | (42) | (47) | (892) | (613) | (146) | (47) | ..... | ..... |
| *"affinis* subgroup" | .. | 243 | 107 | 2266 | 1562 | 404 | 116 | 1 | 4699 |
| *D. funebris* | .. | 26 | 39 | 1033 | 353 | 235 | 38 | 4 | 1728 |
| *D. melanica* | .. | 31 | 5 | 3 | ..... | 380 | 1110 | 99 | 1628 |
| *D. pseudoobscura* | .. | 122 | 75 | 355 | 11 | 81 | 2 | ..... | 646 |
| *D. busckii* | .. | ..... | 277 | 297 | 17 | 13 | 33 | 2 | 639 |
| *"repleta* group" | .. | 2 | 1 | 13 | 31 | 225 | 341 | 18 | 631 |
| *D. robusta* | .. | 2 | 9 | 180 | 40 | 117 | 71 | 3 | 422 |
| "dark" *putrida* | .. | (123) | (20) | ..... | ..... | ..... | ..... | ..... | ..... |
| "light" *putrida* | .. | (4) | (39) | (56) | ..... | ..... | ..... | ..... | ..... |
| *D. putrida* | .. | 127 | 59 | 56 | ..... | ..... | ..... | ..... | 242 |
| *D. quinaria* | .. | ..... | 1 | 63 | 46 | 2 | ..... | ..... | 112 |
| *D. transversa* | .. | ..... | 4 | 69 | 10 | ..... | ..... | ..... | 85 |
| *D. simulans* | .. | ..... | ..... | ..... | ..... | 22 | 17 | 4 | 43 |
| *D. pseudomelanica* | .. | 36 | 2 | ..... | ..... | ..... | ..... | ..... | 38 |
| *D. victoria* | .. | ..... | ..... | 3 | 12 | 7 | 3 | ..... | 25 |
| *D. macrospina* | .. | 6 | 1 | 8 | ..... | 1 | ..... | ..... | 16 |
| *D. guttifera* | .. | ..... | ..... | ..... | 1 | ..... | ..... | ..... | 1 |
| *D. cinerea* | .. | ..... | ..... | ..... | 1 | ..... | ..... | ..... | 1 |
| *"D. alabamensis*-like" | .. | 1 | ..... | ..... | ..... | ..... | ..... | ..... | 1 |
| | 0 | 623 | 695 | 6444 | 7805 | 9258 | 7785 | 440 | 33050 |

B. Other Drosophilidae.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Chymomyza amoena* Loew 1862 | 3 | 96 | 31 | 26 | 22 | 12 | 10 | ..... | 200 |
| *Aulacigaster sp.* Macquart 1835 | .. | 10 | ..... | ..... | 4 | ..... | ..... | ..... | 14 |
| *Scaptomyza graminum* Fallen 1823 | .. | ..... | ..... | 5 | 4 | ..... | ..... | ..... | 9 |
| *Chymomyza procnemis* Williston 1896 | .. | ..... | ..... | ..... | ..... | 1 | ..... | ..... | 1 |
| | 3 | 106 | 31 | 31 | 30 | 13 | 10 | 0 | 224 |

**Table 2.**—Collections at Monroe in 1947.

| *Species* | *June* | *July* | *Aug.* | *Sept.* | *Oct.* | *Season* |
|---|---|---|---|---|---|---|
| *D. melanogaster* | 9 | 144 | 708 | 3373 | 3104 | 7338 |
| *D. funebris* | 29 | 60 | 277 | 428 | 371 | 1165 |
| *D. affinis* ♂ ♂ | (6) | (98) | (59) | (26) | (6) | ..... |
| *D. algonquin* ♂ ♂ | (1) | (25) | (47) | (22) | (4) | ..... |
| "*aff.* subgp." ♀ ♀ | (8) | (91) | (51) | (24) | (7) | ..... |
| "*affinis* subgroup" | 15 | 214 | 157 | 72 | 17 | 475 |
| *D. busckii* | 54 | 108 | 15 | 7 | 57 | 241 |
| *D. robusta* | 9 | 39 | 49 | 10 | 3 | 110 |
| "*repleta* group" | .... | 2 | 11 | 18 | 33 | 64 |
| *D. pseudoobscura* | 24 | 9 | ..... | ..... | 1 | 34 |
| *D. melanica* | .... | ..... | 1 | 18 | ..... | 19 |
| *D. putrida* ("light") | .... | 10 | 3 | ..... | ..... | 13 |
| *D. transversa* | .... | 2 | 4 | ..... | ..... | 6 |
| *D. victoria* | .... | ..... | ..... | 3 | ..... | 3 |
| *D. quinaria* | .... | ..... | ..... | 1 | ..... | 1 |
| | 140 | 588 | 1225 | 3930 | 3586 | 9469 |

**Table 3.**—*Drosophila* species collected in Nebraska.

1. *D. affinis* Sturtevant 1916
2. *D. algonquin* Sturtevant and Dobzhansky 1936
3. *D. americana* Spencer 1938
4. *D. athabasca* Sturtevant and Dobzhansky 1936
5. *D. busckii* Coquillett 1901
6. *D. cinerea* Patterson and Wheeler 1942*
7. *D. duncani* Sturtevant 1918*
8. *D. funebris* Fabricius 1787
9. *D. guttifera* Walker 1849*
10. *D. hydei* Sturtevant 1921
11. *D. immigrans* Sturtevant 1921*
12. *D. macrospina* Stalker and Spencer 1939
13. *D. melanica* Sturtevant 1916
14. *D. melanogaster* Meigen 1830
15. *D. melanura* Miller 1944*
16. *D. nebulosa* Sturtevant 1916*
17. *D. palustris* Spencer 1942*
18. *D. pseudomelanica* Sturtevant 1916
19. *D. pseudoobscura* Frolowa 1929
20. *D. putrida* Sturtevant 1916
21. *D. quinaria* Loew 1865
22. *D. robusta* Sturtevant 1916
23. *D. simulans* Sturtevant 1919
24. *D. suboccidentalis* Spencer 1942
25. *D. transversa* Fallen 1830
26. *D. tripunctata* Loew 1862*
27. *D. victoria* Sturtevant 1942

* "rare" (i.e. never more than five specimens per collection).

**Table 4.**—*Drosophila* collections at Lincoln and Monroe in 1947: the five most common forms for each of the collection months.

A. Lincoln

| Month | Species (and groups) according to rank: First | Second | Third | Fourth | Fifth | Climatol. data: Precip. | Mean Temp. |
|---|---|---|---|---|---|---|---|
| May | "*aff.* subgp." (39%) | *putrida* (20%) | *pseudoob.* (20%) | *pseudomel.* (6%) | *melanica* (5%) | 3.37″ | 59.0° |
| June | *busckii* (40%) | *melanog.* (17%) | "*aff.* subgp." (15%) | *pseudoob.* (11%) | *putrida* (8%) | 9.95″ | 68.8° |
| July | "*aff.* subgp." (35%) | *melanog.* (33%) | *funebris* (16%) | *pseudoob.* (6%) | *busckii* (5%) | 3.06″ | 76.6° |
| Aug. | *melanog.* (73%) | "*aff.* subgp." (20%) | *funebris* (5%) | *quinaria* (1%) | *robusta* (1%) | 2.13″ | 84.5° |
| Sept. | *melanog.* (84%) | "*aff.* subgp." (4%) | *melanica* (4%) | *funebris* (3%) | "*repl.* gp." (2%) | 1.72″ | 71.0° |
| Oct. | *melanog.* (78%) | *melanica* (14%) | "*repl.* gp." (4%) | *robusta* (1%) | *funebris* (<0.5%) | 2.67″ | 65.0° |
| Nov. | *melanog.* (70%) | *melanica* (23%) | "*repl.* gp." (4%) | (*funebris* & *simulans*) 4 specimens each (1%) | | 1.15″ | 36.0° |

B. Monroe (climatological data for Genoa, about 8 miles west)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| June | *busckii* (39%) | *funebris* (21%) | *pseudoob.* (17%) | "*aff.* subgp." (11%) | *melanog.* *robusta* 9 specimens each (6%) | 10.23″ | 68.1° |
| July | "*aff.* sbgp." (35%) | *melanog.* (24%) | *busckii* (18%) | *funebris* (10%) | *robusta* (7%) | 0.87″ | 74.6° |
| Aug. | *melanog.* (58%) | *funebris* (23%) | "*aff.* subgp." (13%) | *robusta* (4%) | "*repl.* gp." (1%) | 1.22″ | 80.8° |
| Sept. | *melanog.* (86%) | *funebris* (11%) | "*aff.* subgp." (2%) | ("*repl.* gp." & *melanica*) 18 specimens each (<0.5%) | | 1.89″ | 68.6° |
| Oct. | *melanog.* (87%) | *funebris* (10%) | *busckii* (2%) | "*repl.* gp." (1%) | "*aff.* sbgp." (<0.5%) | 0.93″ | 61.2° |