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A Note on Overwintering in *Drosophila melanogaster*

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Although the fruit fly, *Drosophila melanogaster*, has been intensively studied in the laboratory, relatively little is known of the life history of wild populations. Each fall in Minnesota enormous local populations of *melanogaster* appear, far outnumbering in the traps all of the other species of *Drosophila* combined. However, the evidence to be presented, though indirect, suggests that even though *D. melanogaster* is a highly successful species during the summer in this area, it is still essentially a tropical species unable to overwinter out-of-doors during the relatively long, severe winters. Three types of information support this conclusion: a study of lethal frequencies, the types of visible mutants observed, and the time of appearance of this species at traps in the spring.

All of the flies were collected at one location in a residential area on the outskirts of St. Paul, Minnesota in the fall of 1954 and in the spring and fall of 1955. The spring of 1955 was warm for Minnesota and quite dry. Traps were put out early in May, but few *Drosophila* of any species appeared at first, and even after flies began to frequent the cups, *melanogaster* was at first absent and then relatively rare. It took from June 15 to June 30 to collect all of the males desired for testing. Thus, there was a lag in the appearance of adult *melanogaster* at the traps in comparison with other *Drosophila* species. Moreover, the onset of warm weather in the spring of 1955 preceded the appearance of *melanogaster* by considerably more than the time needed for eggs or larvae to have completed development. Since compost piles and decaying fruit were present in the immediate vicinity of the traps, it seems reasonably clear that *melanogaster* had been unable to avail themselves of these potential overwintering sites.

To get individual chromosomes in the homozygous condition for the lethal analysis, a single wild male was crossed to *Cy/Pm ds^{33k}; H/In(3R)Mo, Sb sr* females, and a single *F₁* male carrying wild second and third chromosomes balanced against the marked chromosomes was back-crossed to females of the *Cy/Pm; H/Sb* stock. The *Cy/+; Sb/+* males and females among progeny of this cross were interbred, and the *F₃* generation examined to determine the effect of the chromosomes in the homozygous condition. The expected *F₃* ratio was 4 *Cy S b* : 2 *Cy* : 2 *Sb* : 1+. If no *Cy* flies appeared, a lethal was present on the third chromosome; absence of *Sb* flies indicated a lethal on the second. The number of *F₃* flies examined per male tested averaged 124.9 for fall 1954, 73.1 for spring 1955, and 100.2 for fall 1955. The data in Table 1 separate lethal from non-lethal chromosomes. No attempt has been made to distinguish viability differ-

ences among the non-lethal chromosomes since relatively few flies were counted. It may be noted that among the 270 males analyzed, 10 carried lethals on both chromosomes tested. If the presence of a lethal on II is independent of the presence of a lethal on III, the expected number of such males is 10.9. It seems reasonable to conclude that no correlation exists. The samples taken in the spring and fall of 1955 do not differ significantly in lethal frequency. However, the overall frequency of lethals was significantly higher in 1954 than in 1955.

TABLE I. Frequency of lethal chromosomes in wild populations of *Drosophila melanogaster*.

	Males Tested	% Lethal Chromosomes	
		II	III
Fall 1954	56	33.9	23.9
Spring 1955	90	18.9	16.7
Fall 1955	124	21.8	13.7

That the populations differed is further indicated by the character of the visible mutants which were observed. Because of the subjective element involved in the recognition of visibles, no stress was placed on their detection, but those noticed were recorded with the data. Therefore, it is of interest that several visible mutants observed in the sample for spring 1955 were also found in the fall 1955 sample, but that none of the visible mutants identified in 1954 was observed in the 1955 samples.

From the available information it appears that the fall 1955 population is descended from the spring 1955 population but unlikely that the spring 1955 population is directly descended from the population living in this neighborhood in the fall of 1954. Instead the 1955 population was probably derived from migrants spreading from an indoor overwintering site some distance away (See Ives 1945, 1947 and Spencer 1941). This lack of continuity in the population is in contrast to the findings of Ives (1945) in Massachusetts. There the presence of the infrequent visible mutant, *cardinal*, in collections taken over a period of eight years is good evidence for continuity of the population during this period. This difference, however, does not necessarily reflect a fundamental difference in population structure or climate between the two regions. It may merely be due to the fact that Ives collected his samples near a permanent overwintering site (the farm buildings near which his samples were taken) and that the populations reported here had migrated into the area from different overwintering sites on successive years.

In summary, the differences in lethal frequency and in types of visible mutants observed in 1954 and 1955 plus

the late appearance of *D. melanogaster* in the traps in the spring as compared to other *Drosophila* species all suggest that this species does not overwinter out-of-doors in Minnesota.

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ZOOLOGY

The Fish Fauna of the Mississippi River above St. Anthony Falls as Related to the Effectiveness of this Falls as a Migration Barrier

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INTRODUCTION: At St. Anthony Falls, in Minneapolis, the Mississippi River drops 70 feet from the pool above to the pool below. This waterfall has been in existence and has probably been an effective barrier to upstream migration of fish for about 10,000 years. It originated at an erosion escarpment of glacial River Warren, near present Fort Snelling, following the withdrawal of the last (Mankato) continental ice sheet. Since then, this falls has retreated about eight miles to its present site by wearing away and undercutting the Ordovician strata over which the Mississippi flows (Sardeson, 1916). It is likely that the total height of this falls has always been about the same, although the sheer drop has at times been broken by cataracts.

The effectiveness of St. Anthony Falls as a fish migration barrier is borne out by a comparison of the fish faunas above and below. There are 123 species of fish known from Minnesota and contiguous Wisconsin waters below the falls but only 64 known from the extensive drainage area above. Many species that are common and characteristic below the falls are lacking above it. Obviously, the indigenous species now above the falls must either be: (1) fishes that have somehow circumvented the barrier of the falls or (2) fishes native to part of the upper basin before the last glaciation that survived in areas that were not covered by the two lobes of the last ice sheet. In addition to burial and alteration of pre-existing topography, aquatic habitat conditions must also be considered as possible barriers to migration; especially past and present water temperatures. Melt water from the glacial ice would be suited to cold-water but not to warm-water species. Under the present climate, however, many species of fish not found in the upper Mississippi drainage above the falls occur farther north in

the St. Croix drainage and in the Red River arctic drainage. The former at present connects with the Mississippi below St. Anthony Falls and the latter was once also connected with the lower Mississippi through glacial River Warren and glacial Lake Agassiz.

It appears, therefore, that the predominant features of fish distribution above St. Anthony Falls are ancient and can best be related to the immediate post-Pleistocene history of Minnesota, and also that St. Anthony Falls was an important factor in limiting the northward distribution of many species in the Mississippi drainage.

A likely connecting water by which St. Anthony Falls may have been bypassed in immediate post-Pleistocene time was glacial Lake Grantsburg. This lake formed behind a finger-like and eastward projecting sublobe of the Mankato ice and impounded water from the precursor of the present upper Mississippi River. For a time there was drainage around the edge of this Grantsburg sublobe into the St. Croix River and it is likely that free passage of fish was possible between the two drainages (Underhill 1957). It is possible also that this glacial lake and the waters feeding it contained fishes, especially cold-water fishes, that had survived in adjacent areas from the preceding inter-glacial period. Pollen and macrofossils from a site near the margin of the Grantsburg sublobe indicate that the climate was only slightly colder and probably drier than at present in the upper Mississippi drainage in late Mankato time (Fries, Wright, and Rubin, 1961).

For the past 50 years pollution of the Mississippi River at Minneapolis and St. Paul has caused low oxygen in the water as far downstream as Hastings, thus imposing a chemical barrier to upstream fish migration. This chemical barrier, however, seems to have been of little consequence in the general fish distribution pattern.

DISCUSSION OF FISH DISTRIBUTION: Only two species

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