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Short Report

Daily Activity of Drosophilid Flies in the Arctic Summer[1]

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Abstract A preliminary record on the daily activity of drosophilid flies in the arctic summer is reported. Two different patterns of daily periodicity are observed, bimodal in *Drosophila athabasca* and unimodal in *D. rellima* and *D. subquinaria*. The former results from the inactivity under the bright light condition in early afternoon, while the latter from the coincidence of the active peak with the daily thermal maximum. The dim light condition around midnight suppresses the activity of all flies. The species-specific requirements for physical environment are deduced from meteorological records at the time of collections.

The continuous daylight condition of the arctic summer has called attentions of many investigators interested in the daily rhythm of animal activity (4). As for drosophilid flies, however, almost nothing has been observed under such a peculiar condition, except for a single report from Finnish Lapland (3). A preliminary survey on this subject was made at Inuvik (68°22′N, 133°45′W), Arctic Canada, in August, 1980.

Method

Six open traps baited with fermented banana were set on the ground of birch (*Betula papyrifera*) forest floor at a gentle southern slope. Collections were made periodically, though not at constant intervals, from 8 : 00 a. m., Aug. 5 to 6 : 00 a. m., Aug. 6 by sweeping an insect net over the bait. At collection, air temperature and relative humidity were measured by an Assman's psychrometer, and light intensity by a lux-meter.

Results and Discussion

In total, 126 specimens of five drosophilid species were obtained, which are arranged in the descending order of abundance as *Drosophila athabasca*, *D. rellima*, *D. subquinaria*, *Chymomyza costata* and *D. putrida*. The daily periodicity curves of the first three species are given in Fig. 1, together

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with the daily change of meteorological conditions. The general weather (Fig. 1, top) was fine and calm throughout the survey period. But the season was not in the true continuous daylight condition. The sun disappeared for a while around midnight to drop the light intensity down to less than 100 Lx. The traps on the forest floor were partly insolated through the forest canopy from 11 : 00 to 21 : 00.

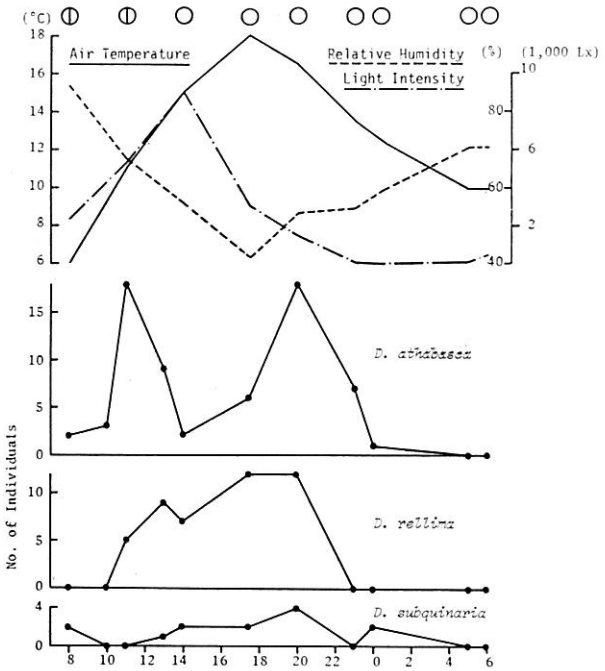

Fig. 1. Daily change of drosophilid activity and meteorological conditions

The patterns of daily periodicity varied among the species. *D. athabasca* showed a bimodal pattern with two peaks around noon and in late afternoon. Its activity is considered to have been suppressed by low temperature in morning and by high intensity of light in early afternoon. On the other hand, the activity of *D. rellima* was reinforced by higher afternoon temperature, having resulted in a unimodal pattern with the peak at the thermal maximum in late afternoon. Although the pattern of *D. subquinaria* was somewhat obscured by the small sample size, it is regarded to be unimodal as in *D. rellima*. As for the remaining two species, two males of *Ch. costata* were collected at 14 : 00 and at 17 : 30 around the time of thermal maximum, and one female of *D. putrida* at 13 : 00. The coincidence of the active peak with the daily thermal maximum was also reported in *Ch. costata* from Finnish Lapland (3). The dim light condition around midnight suppressed the activity of all drosophilids. The relative humidity was irrelevant to the activity pattern of any species, as mentioned by other investigators (2, 3).

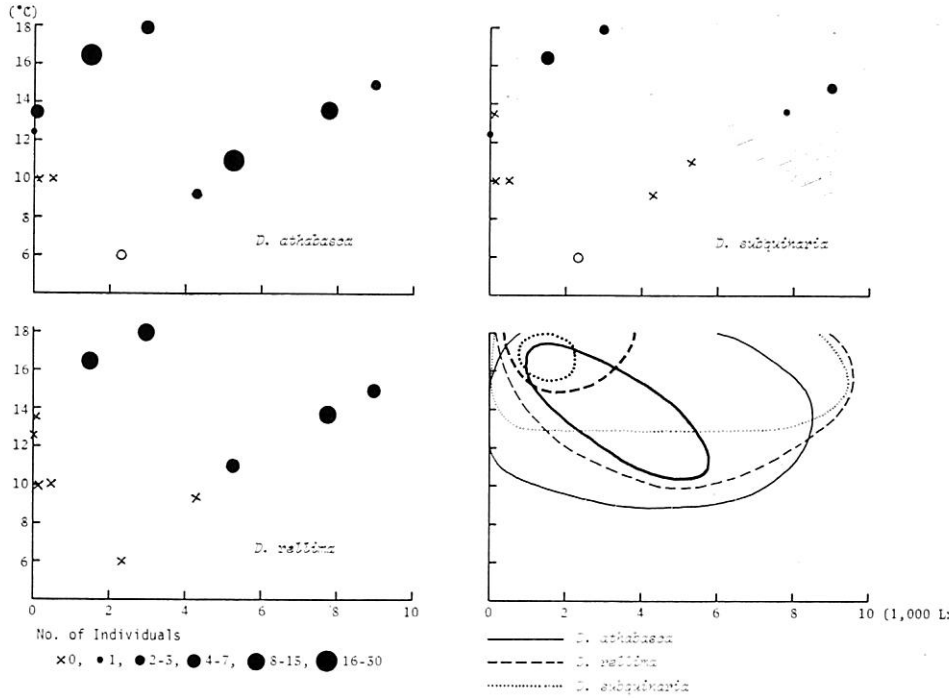

Fig. 2. Physical environmental requirements of feeding activity of drosophilid flies, with the hypothetical mode in each species (right-below). Ordinate: air temperature, abscissa: light intensity. Open circle: sporadic collection record of specimens supposed having stayed overnight at traps. Thick line: optimum range, thin line: threshold.

As mentioned above, each species shows a specific requirement for physical environmental conditions. To demonstrate this aspect more clearly, collection records with indication of individual numbers were plotted in a bidimensional space of air temperature and light intensity, for each species separately (Fig. 2). From the figure was the hypothetical mode of physical environmental requirement deduced for each species, though the data were still insufficient. Presumably, there is a difference in physical environmental requirements between the bimodally active species and those with unimodal activity. The range of optimum temperature is relatively low in the former, *D. athabasca*, and its activity is severely suppressed under the bright light condition with intensities higher than about 9,000 Lx. On the other hand, the optimum condition in the latter, *D. rellima* and *D. subquinaria*, is of relatively high temperature and low light intensity, but their activity is not so seriously influenced by bright light, provided temperature is high enough.

These patterns in the arctic summer, especially the unimodal one, are regarded comparable to those in temperate autumn, in which two peaks become closer together and eventually fuse into a midday peak (1, 5, 6). Such a pattern in autumn is governed by temperature condition rather than light intensity, which is the main controlling factor in summer (1). But

there is a difference in the length of active period within a day between arctic summer and temperate autumn. The longer active period in the former may ensure the bimodal pattern controlled in part by light intensity, as observed in *D. athabasca*.

Acknowledgments

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