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# Diel periodicity of activity in Chymomyza costata (Zett.) (Diptera, Drosophilidae) in the subarctic

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The diel periodicity of the drosophilid *Chymomyza costata* (Zett.) was examined in the subarctic by trapping with malt-fruit baits. In the continuous daylight prevailing on 17. VII the species exhibited only one activity peak in the afternoon. In a shady locality this peak coincided with the diel thermal maximum but in an open field it occurred considerably later. It is suggested that low temperature and bright sunshine inhibit the activity of *C. costata*, whilst low relative humidity does not seem to be inhibitory.

The diel periodicity curves of different drosophilids show specific differences and seasonally shifting patterns. Mostly these scotophilic insects have bimodal diel activity curves, but unimodality with peak activity at noon may develop in autumn. However, there are no observations on the diel periodicity of drosophilids in subarctic conditions. The purpose of the present paper is to describe the diel periodicity patterns of *Chymomyza costata* (Zett.) and some other drosophilids in Inari (68° 55′ N, 27° 1′ E), Finnish Lapland, on 17. VII. 1969, when practically continuous daylight still prevailed, but considerable changes occurred in the temperature.

## Method and trapping localities

The experiment was performed using jars with a bait processed from barley malt according to the method of LAKOVAARA *et al.* (1969). 200 ml of the fermenting bait porridge and half an apple were put in each three-litre jar used in the experiments.

Five jars were placed in each of three localities in the church village of Inari. The jars were kept in the same places for several days before the diel periodicity was examined. The localities were the following:

1. A Salix–Betula scrub by the river Juutua. The experimental jars were shaded by the bushes. There was one inhabited house about 400 m from the jars.

2. An open field some hundred metres from the nearest inhabited houses. There was no shade for these jars.

3. The centre of the church village, consisting of scattered wooden and stone houses with about 300 permanent inhabitants. The jars were quite close to the houses and were placed in their shade.

The drosophilids were collected from the jars at intervals of three hours. The jar to be inspected was first rapidly covered with an insect net, the end of which was held in a vertical position to collect all drosophilids trying to escape. Those not in flight were collected with tweezers. The continuous daylight made it possible to dispense with artificial light.

Temperatures and relative humidities were recorded at loc. 1 with a Lambrecht thermohygrograph placed on the ground under a transparent roof protecting it from rain. The results thus obtained (Fig. 1) are not comparable to the records of meteorological stations. The data obtained for the same day at the Sodankylä/Muddusjärvi meteorological station, 8 km from the trapping area, are as follows:

*Temperature*: maximum 18.8° C, minimum 2.8, 8 hrs 10.°4, 14 hrs 16.8°, 20 hrs 18.1°, mean for the day 12.1°; *relative humidity*: maximum 97 %, minimum 33 %, 8 hrs 62 %, 14 hrs 38 %, 20 hrs 33 %, mean for the day 44 %; *cloudiness* (scale 0 – 8): 2 hrs 0, 8 o'clock 1, 14 hrs 1, 20 hrs 1; *hours of sunshine*: 21. 1. No rain.

## Results

The numbers of drosophilids trapped during the different diel periods at the three localities are given in Table 1. Fig. 1 shows the diel periodicity curves for the most abundant species, *Chymomyza costata*, and also gives the temperature and relative humidity at ground level, as registered by the thermohygrograph, which was not protected against insolation.

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**Table 1.** The occurrence of drosophilids on malt-fruit baits during different diel periods on 17. VII. 1969 in three localities in Inari.

| | | 21 – 0 | 0 – 3 | 3 – 6 | 6 – 9 | 9 – 12 | 12 – 15 | 15 – 18 | 18 – 21 | 21 – 24 | Σ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Locality 1, Salix-birch scrub*** | | | | | | | | | | | |
| *Chymomyza costata* (Zett.) | ♂ | – | – | – | – | 2 | 2 | 30 | 10 | 8 | 52 |
| | ♀ | – | – | – | – | 5 | 3 | 22 | 6 | 5 | 41 |
| *Drosophila obscura* Fall. | ♂ | – | 1 | – | 1 | – | – | – | 1 | – | 3 |
| | ♀ | – | – | 1 | – | – | – | – | 1 | – | 2 |
| *D. littoralis* Meig. | ♂ | – | – | – | – | – | – | – | 1 | 1 | 2 |
| | ♀ | – | – | – | – | – | – | 2 | – | – | 2 |
| *D. subarctica* Hackman | ♀ | – | 1 | – | – | – | – | 1 | 1 | 1 | 4 |
| *D. transversa* Fall. | ♂ | – | – | 1 | – | 2 | – | – | 2 | – | 5 |
| Escaped specimens | | – | – | – | 1 | – | 3 | 9 | – | 1 | 14 |
| Σ | | – | 2 | 2 | 2 | 9 | 8 | 64 | 22 | 16 | 125 |
| ***Locality 2, open field*** | | | | | | | | | | | |
| *C. costata* | ♂ | 11 | – | 1 | – | 2 | 9 | 17 | 41 | 14 | 95 |
| | ♀ | 11 | – | – | – | 1 | 9 | 15 | 50 | 12 | 98 |
| *D. obscura* | ♂ | – | – | – | – | 1 | – | – | – | 1 | 2 |
| | ♀ | – | – | – | – | 1 | – | – | – | – | 1 |
| *D. bifasciata* Pomini | ♀ | – | – | – | – | 1 | – | – | – | – | 1 |
| *D. littoralis* | ♂ | – | – | – | – | – | – | – | – | 1 | 1 |
| *D. subarctica* | ♀ | – | 1 | – | 1 | 1 | – | – | – | 2 | 5 |
| *D. transversa* | ♂ | – | – | – | – | 1 | – | – | – | – | 1 |
| Escaped specimens | | – | – | 2 | 1 | 2 | 7 | 20 | 3 | – | 35 |
| | | 22 | 1 | 3 | 2 | 10 | 25 | 52 | 94 | 30 | 239 |
| ***Locality 3, village*** | | | | | | | | | | | |
| *C. costata* | ♂ | 2 | 1 | – | 1 | – | 20 | 38 | 23 | 2 | 87 |
| | ♀ | 3 | 1 | 2 | 1 | 2 | 20 | 22 | 26 | 4 | 81 |
| *D. obscura* | ♂ | – | 1 | – | – | – | – | 1 | 1 | 1 | 4 |
| | ♀ | 1 | 1 | – | – | 1 | – | 2 | 2 | 2 | 9 |
| *D. bifasciata* | ♂ | 1 | – | – | – | – | – | – | – | – | 1 |
| *D. silvestris* Basden | ♀ | – | – | 1 | – | – | – | – | – | – | 1 |
| *D. littoralis* | ♂ | – | – | 1 | 1 | 1 | 1 | – | – | 5 | 9 |
| | ♀ | – | – | – | – | – | – | – | 1 | 1 | 2 |
| *D. subarctica* | ♀ | 1 | – | – | 1 | – | 2 | 2 | 3 | – | 9 |
| *D. funebris* Fabr. | ♂ | – | – | – | – | – | 1 | – | – | 1 | 2 |
| *D. transversa* Fall. | ♂ | – | – | – | – | – | – | – | – | 1 | 1 |
| Escaped specimens | | – | – | 1 | 3 | 3 | 39 | 25 | – | 2 | 73 |
| | | 8 | 4 | 5 | 7 | 7 | 83 | 90 | 56 | 19 | 279 |

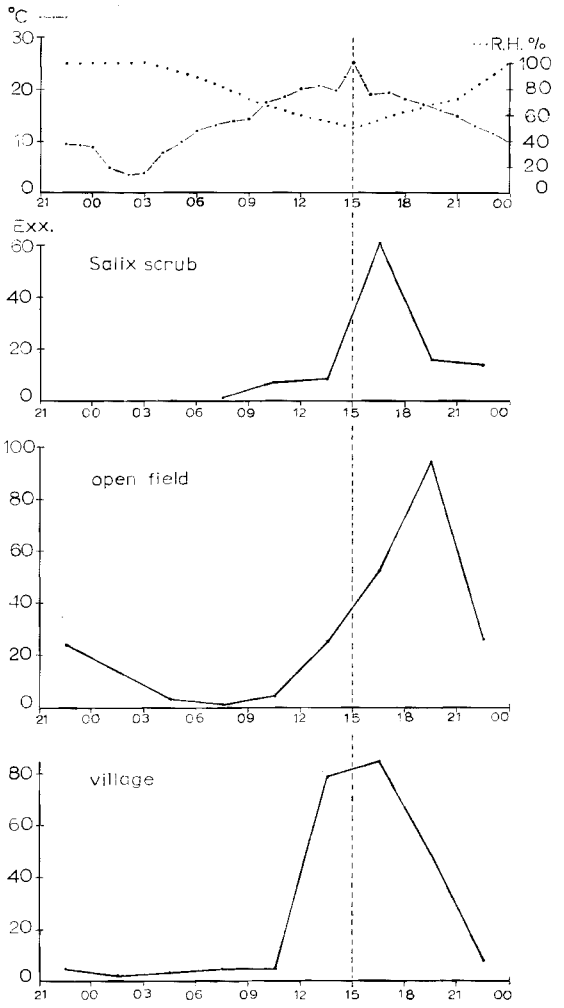


**Fig. 1.** The diel periodicity of *Chymomyza costata* according to malt-fruit bait catches at three localities in Inari on 17. VII. 1969. The values for temperature and relative humidity are thermohygrograph readings from ground level. Ordinary meteorological records are given on p. 267.

## Discussion

*Chymomyza costata* was the only trapped drosophilid species whose numbers were sufficient to give a reliable picture of its diel periodicity. It showed only one peak of activity, which coincided with or followed immediately after the diel thermal maximum (about 15 hours) in the shady localities (1 and 3), but occurred considerably later in the open field (loc. 2). Evidently *C. costata* has a tendency to fly during the hottest period of the day, which is inhibited by its scotophily in localities with bright sunshine. A similar tendency to avoid the brightest sunshine has been demonstrated for the bulk of the flies in this subarctic area (NUORTEVA 1965a, 1966a), whereas blowflies can fly at elevated temperatures in bright sunshine as well (REMMERT 1965, NUORTEVA 1965b, 1966b – d, SYČEVSKAJA & ŠAIDUROV 1966). The absence of the morning peak of the bimodal flight curve, usually occurring in drosophilids (see e.g. LEWIS & TAYLOR 1965), is probably due to the low temperatures of the early part of the morning and the bright sunshine of the later part. In the present subarctic area on July 17 the sunshine is already quite bright at 9 hrs. Only the dense shade of houses seems to allow full activity before and immediately after noon. In the shade of scrub the activity maximum occurs about 5 hours after noon and in an open field about 8 hours after noon.

Low relative humidity does not seem to inhibit the flying activity of *C. costata*, because peaks of activity occurred when the relative

humidity was lowest. TAYLOR & KALMUS (1954) suggested that in *Drosophila subobscura* Coll. increased visual efficiency is the principal factor in the adaptation to its bimodal diel activity rhythm, although humidity has been the real factor requiring bimodality. The situation may be similar in the case of *C. costata*.

The absence of the morning peak for *C. costata* in conditions in which many other flies show bimodal activity (cf. NUORTEVA 1965) may be a sign of poor adaptability to activity at temperatures as low as those generally prevailing in the subarctic. The drosophilids are, of course, a group mainly occurring at more southern latitudes.

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