Trap survey of flies and their diel periodicity in the subarctic Kevo Nature Reserve, northern Finland

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Flies were trapped in the canyon of the Kevo River and on the east slope of a small fell in subarctic northern Finland, under conditions of continuous daylight. In all, 113 species were recorded, including two new for the Finnish fauna. Data are given on the catches at different times of the day. Diel periodicity curves of the unimodal type were commoner in the canyon than on the fell. Four species showed unimodal flight curves in the canyon, but bimodal on the fell. Bimodal diel activity predominated on the fell, where dominance was more concentrated in the morning and evening than during the rest of day, and also than during the whole day in the canyon. The diversity of the types of diel periodicity was higher in the canyon than on the fell (Shannon-Weaver indices 1.709 and 1.233, respectively), as was also the diversity of the whole catch (3.586 and 3.013, respectively). The activity of most species was restricted to the period 03—21 hrs, but some were collected throughout the day.

Introduction

The flying activity of *Helina binotata* Zett. (Muscidae) was studied in 1963 in relation to meteorological conditions and continuous daylight by trappings performed in the Kevo area in subarctic northern Finland (NUORTEVA 1965a). During these investigations, material of other fly species was obtained, too. Papers have been published on some parts of this material (NUORTEVA 1965b, 1966a), but the bulk has remained untreated. Recently, the whole material was determined by the first author and the results are reported here. No results are given for trapping locality 1, on the fell Madjokskaidi, because those specimens were partly destroyed by larvae of *Reesa vespulae* (Mill.), a serious new pest of entomological museums in Finland (MÄKISALO 1970).

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The trapping localities and methods

A full description of the study area, trapping localities and methods is given by NUORTEVA (1965a). The Kevo Nature Reserve lies in a subarctic area with extensive birch scrub and numerous fells, whose tops rise above the timber-line. The present trappings were performed at a place where the Kevo River flows due north through a steep-sided canyon between the subarctic fells Madjokskaidi and Puksalskaidi. One of the trapping localities was situated at the bottom of the canyon in fairly dense birch scrub. It was exposed to sunshine from the south and north, but was shaded in other directions by the hill walls. The other trapping locality was near the top of the western slope of Puksalskaidi, in birch scrub. Here the traps received the sun from all directions except the east.

The flies were caught with traps of a type described in an earlier paper (NUORTEVA 1959). Six traps were used at both observation points. Bait of different degrees of freshness was used in the traps, since this reduced the significance of the age of the bait as a source of error in observations on the diel periodicity of the flies.

The trapping period lasted from July 6 to 24, 1963. During the periods 10. VII. 9 hrs — 13. VII. 9 hrs and 18. VII. 12 hrs — 21. VII. 12 hrs, the diel periodicity of the flies was studied by emptying the traps every three hours. In the other periods, an idea was obtained of the numbers of flies active during days with different weather by emptying the traps at 20 hrs.

The trapping period was cloudy and cold, the mean temperature being 10.9°C, and only five days were free from rain. Such conditions are normal in this area. Besides reducing fly catches, the unfavourable meteorological conditions abolished microclimatic differences between the trapping localities, as is shown by the thermohygrograms presented in an earlier paper (NUORTEVA 1965a, Fig. 4).

The Shannon-Weaver diversity index (SHANNON & WEAVER 1949) was used in the analysis of the results,

$$H' = -\sum_j p_{ij} \ln p_{ij},$$

where p_{ij} is the probability of occurrence of the jth species in the ith sample. The measure of the evenness of the sample is

$$J' = H'/H'_{max},$$

where H'_{max} is the logarithm of the number of species, or the possible maximum diversity of the sample.

Results

The numbers of specimens caught in the two localities, and the observations on the diel periodicity are given in Table 1. Flies belonging to the families Phoridae, Syrphidae, Dolichopodidae, Empididae and Chloropidae were excluded, because they occurred only in small numbers and were difficult to identify. The total fly catches were nearly the same in the canyon (2192) and on the fell (1976), as were also the numbers of species (97 and 89, respectively). But diversity and evenness differed about twice as much between the two places. The index

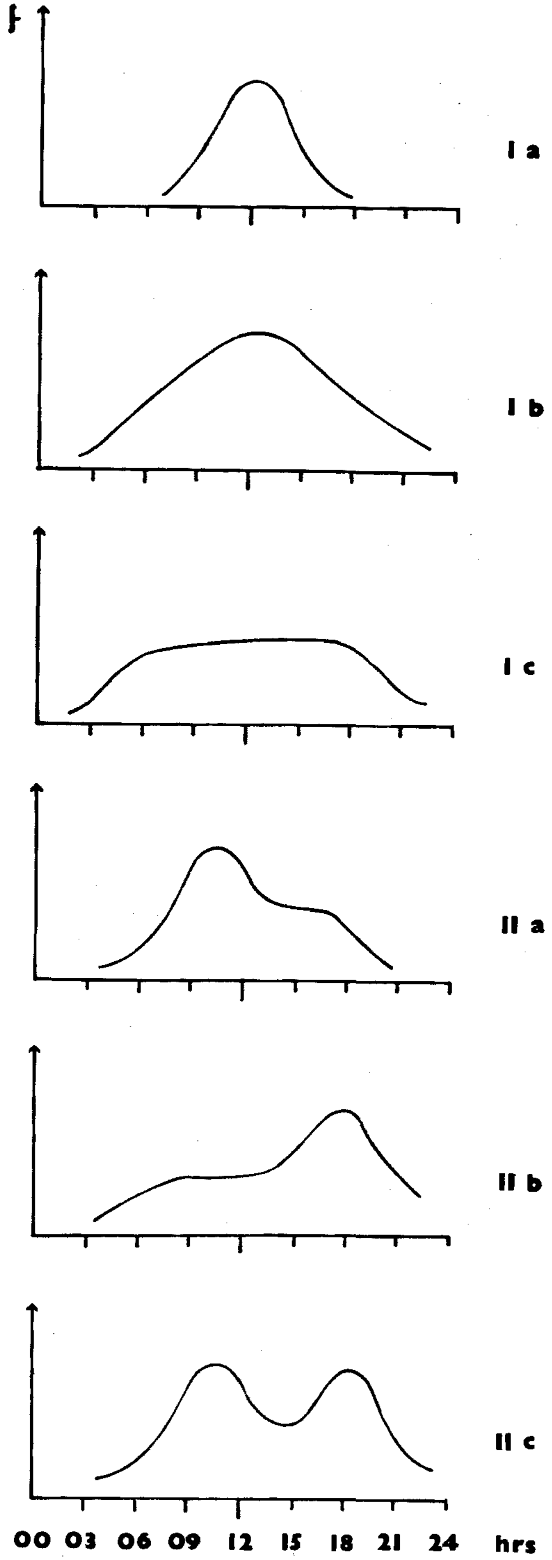

Fig. 1. The different types of diel periodicity curves and their symbols.

of diversity was 3.586 in the canyon and 3.013 on the fell, and that of evenness was 0.784 in the canyon, but only 0.671 on the fell. This means that the dominance was more concentrated on the fell than in the canyon.

The type of diel periodicity curve is shown with symbols in Table 1 for species for which at least 20 specimens were caught at one of the trapping localities during the times that diel periodicity were studied. The symbol I is used for the unimodal type of diel flight curve and the symbol II for the basically bimodal type. Subtypes, designated by the letters a—c, were distinguished as illustrated in Fig. 1. It was necessary to use this classification, because that of Lewis & Taylor (1965) was not applicable to the present exceptional subarctic conditions, including the continuous daylight.

Table 1. The numbers of fly specimens trapped in the canyon of the Kevo River and on the western slope of the fell Puksalskaidi on July 6 to 24, 1963. The symbols for the types of diel periodicity are explained in Fig. 1.

Species	Kevo canyon		Puksalskaidi		"Diel niche" width, *H'*	Time of day								Diel periodicity type
	♂	♀	♂	♀		00—03	03—06	06—09	09—12	12—15	15—18	18—21	21—24	
Lonchaeidae														
Lonchaea laxa Collin	—	32			1.618	—	—	1	4	2	8	3	4	IIb
			—	37	1.344	—	—	3	1	1	10	11	1	IIb
Sepsidae														
Nemopoda cylindrica Fabr.	—	—	—	2		—	—	—	—	—	2	—	—	
Piophilidae														
Liopiophila varipes Meig.	2	37			1.556	—	5	—	8	3	5	4	1	Ic(?)
			—	34	1.629	—	—	3	7	4	9	2	2	IIc(?)
Stearibia nigriceps Meig.	—	—	—	1		—	—	—	1	—	—	—	—	
Allopiophila calceata Duba	—	1	—	1		—	1	—	—	—	—	—	—	
A. vulgaris Fall.	11	57			1.749	2	1	2	15	8	13	9	2	IIc
			21	33	1.505	—	—	8	20	6	6	4	1	IIa
Mycetaulus bipunctatus Fall.	—	—	—	2		—	—	—	—	1	—	—	—	
Amphipogon spectrum Wahlb.	—	—	—	1		—	—	—	—	—	—	—	—	
Psilidae														
Chamaepsila rosae Fabr.	—	—	—	1		—	—	1	—	—	—	—	—	
Sciomyzidae														
Tetanocera ornatifrons Frey	1	2	—	—		—	—	1	1	—	—	1	—	
Dryomyzidae														
Dryomyza senilis Zett.	—	1	—	—		—	—	—	1	—	—	—	—	
D. decrepita Zett.	1	1	—	—		—	1	—	1	—	—	—	—	
Helomyzidae														
Suillia inornata Loew	—	2	—	1		—	—	—	—	—	—	—	—	
S. nemorum Meig.	1	—	1	—		—	—	—	1	—	—	—	—	
S. bicolor Zett.	2	4	—	1		—	1	1	—	1	—	2	1	
Tephroclamys flavipes Zett.	—	2	—	1		—	—	1	1	—	—	—	—	
Neoleria inscripta Meig.	27	53			1.758	—	3	14	15	10	5	14	2	IIc
			2	21	1.525	—	—	—	3	4	3	2	1	
N. prominens Becker	11	37			1.566	—	1	11	12	7	2	11	—	IIc
			1	19	0.794	—	1	—	10	—	1	1	—	

Species	Kevo canyon ♂	Kevo canyon ♀	Puksal-skaidi ♂	Puksal-skaidi ♀	"Diel niche" width, H'	Time of day 00—03	03—06	06—09	09—12	12—15	15—18	18—21	21—24	Diel periodi-city type
Drosophilidae														
Drosophila transversa Fall.	—	1	—	—		—	1	—	—	—	—	—	—	
Drosophila sp.[1]	1	—	—	—		—	—	—	—	—	—	—	—	
Copromyza fimetaria Meig.	1	4	—	2		—	—	—	2	1	1	1	1	
Scatophagidae														
Megaphthalmoides unilineata Ringd.	2	—	—	—		—	—	—	—	1	—	—	—	
Scatophaga suilla F.	1	—	—	1		—	—	—	1	1	—	—	—	
S. furcata Say	52	59			1.816	—	3	14	13	14	13	14	3	Ic
			47	65	1.813	2	7	19	18	11	17	14	—	IIc
Microprosopa haemorrhoidalis Meig.	—	—	—	1		—	—	—	—	1	—	—	—	
Muscidae														
Spilogona contractifrons Zett.	8	9	1	1		—	—	4	5	2	—	1	—	
S. tornensis Ringd.	—	2	—	—		—	—	1	—	1	—	—	—	
Helina laetifica R.D.	27	100			1.694	—	4	18	22	23	10	8	1	Ib
			43	236	1.723	—	8	31	38	20	38	39	1	IIc
H. obscurata Meig.	—	1	—	—		—	—	1	—	—	—	—	—	
H. subvittata Seguy	—	7	—	9		—	—	1	1	1	1	1	—	
H. veterana Zett.	1	—	—	—		—	—	—	—	—	—	—	—	
H. laxifrons Zett.	—	1	—	1		—	—	—	—	1	—	1	—	
H. fulvisquama Zett. ♂♂	2	—	—	—		—	—	—	—	—	—	—	—	
H. luteisquama Zett. ♂♂	2	—	2	—		—	—	—	—	—	—	1	—	
H. fulvisquama & *luteisquama* ♀♀	—	52			1.358	—	2	3	—	4	3	—	—	
			—	57	1.645	—	1	2	3	4	4	7	—	IIb
H. flavisquama Zett.	—	3	—	5		—	—	1	2	2	2	—	—	
H. quadrimaculata Fall.	—	5	—	1		—	—	—	—	1	—	1	—	
H. fratercula Zett.	—	—	—	1		—	—	—	—	—	1	—	—	
H. pubiseta Zett.	—	—	—	1		—	—	—	—	—	—	—	—	
H. denudata Zett.	4	7	5	5		—	—	—	2	1	4	2	—	
H. binota Zett.[4]	21	319			1.816	1	4	17	35	25	20	27	7	IIa
			25	558	1.735	2	19	49	35	19	61	86	4	IIc
Myiospila meditabunda Fabr.	—	1	—	2		—	—	—	1	—	—	—	—	
Mydaea pagana Fabr.	—	—	1	—		—	—	—	1	—	—	—	—	
M. discimana Mall.	—	1	1	—		—	—	—	—	—	—	—	—	
M. ancula Zett.	4	107			1.662	—	4	9	23	13	9	9	—	IIa
			5	51	1.528	—	1	9	10	6	1	4	—	IIa
M. deserta Zett.	23	123			1.679	—	9	22	30	13	12	2	3	IIa
			6	74	1.592	—	—	11	12	6	7	3	1	IIa
M. bengtssoni Ringd.	—	—	1	—		—	—	—	—	—	—	1	—	
M. palpalis Stein.	—	1	—	—		—	—	—	—	—	—	1	—	
M. soot-ryeni Ringd.	—	6	—	—		—	—	—	—	1	1	—	—	
M. orichalcea Zett.	—	—	2	—		—	—	—	—	—	—	1	—	
Hebecnema umbratica Zett.	3	—	—	—		—	—	2	—	—	1	—	—	
H. nigricolor Fall.	1	3	—	—		—	—	1	—	1	—	—	—	
Azelia macquarti Staeg.	1	1	—	1		—	—	—	—	—	1	—	—	

Species	Kevo canyon ♂	Kevo canyon ♀	Puksalskaidi ♂	Puksalskaidi ♀	"Diel niche" width, *H'*	Time of day 00—03	03—06	06—09	09—12	12—15	15—18	18—21	21—24	Diel periodicity type
Fannia manicata Meig. & *monilis* Hal.[2])	—	48			1.557	—	1	4	14	14	1	6	2	Ib
			—	44	1.497	—	—	3	11	11	8	4	—	Ib
F. ciliata Stein.	—	5	—	5		—	—	2	5	1	—	1	—	
F. scalaris Fabr. & *incisurata* Zett.	—	1	—	6		—	—	2	1	2	2	—	—	
F. mutica Zett.	—	1	—	—		—	—	—	—	—	—	1	—	
F. hirticeps Stein.	—	—	—	1		—	—	—	1	—	—	—	—	
F. aerea Zett.	—	9	—	3		—	—	1	4	2	2	1	—	
F. sociella Zett.	—	1	—	—		—	—	—	—	—	—	—	—	
F. serena Fall.	1	112			1.911	1	10	15	23	9	9	19	9	IIc
			—	61	1.365	—	—	12	13	1	3	8	—	IIc
F. postica Stein.	1	33			1.856	—	5	6	6	6	3	1	6	Ic
			—	16	1.532	—	—	2	2	5	2	3	—	
F. serena & *postica*[3])	2	211	—	118		1	23	55	66	34	23	47	25	
Hydrotaea dentipes Fabr.	2	27			1.258	—	—	2	9	7	4	—	—	Ia
			1	14	1.040	—	—	—	6	3	3	—	—	
H. bispinosa Zett.	—	5	—	6		—	—	3	4	—	1	1	—	
H. ringdahli Stein.	—	—	—	2		—	—	—	1	—	—	—	—	
H. armipes Fall.	—	1	—	—		—	—	—	—	1	—	—	—	
H. militaris Meig.	—	1	—	1		—	—	—	1	—	—	—	—	
H. irritans Fall.	—	1	—	1		—	—	1	—	—	—	1	—	
H. pandelléi Stein.	—	13	—	2		—	—	2	4	4	1	3	—	
H. scambus Zett.	—	10	—	5		—	—	1	2	4	2	4	—	
Lophosceles cinereiventris Zett.	—	1	—	—		—	—	—	—	—	—	—	—	
L. frenatus Holmgr.	1	2	1	—		—	—	—	1	1	—	1	—	
Thricops hirsutulus Zett.	21	10			1.709	—	1	4	5	2	1	1	1	
			7	21	1.352	—	—	4	13	—	5	4	1	IIc
T. nigritellus Zett.	1	—	—	1		—	—	—	1	—	1	—	—	
T. innocuus Zett.	6	7			1.295	—	1	—	1	6	—	1	2	
			1	10	1.471	—	—	2	1	1	2	4	—	
T. coquilleti Mall.	3	9	—	—		—	2	3	1	1	1	1	—	
Phaonia hybrida Schnabl.	1	—	—	—		—	—	—	—	—	—	—	—	
P. errans Stein.	13	48			1.554	—	2	2	8	5	1	2	—	Ia
			5	10	1.475	—	1	—	3	1	1	1	—	
P. vagans Fall.	—	2	—	—		—	—	—	—	1	—	—	—	
P. aeneiventris Zett.	—	1	—	—		—	—	—	—	—	1	—	—	
Morellia hortorum Fall.	—	—	2	—		—	—	—	1	—	—	—	—	
Muscina assimilis Fall.	1	—	1	7		—	—	—	3	1	3	1	—	
Hypodermodes mystacea L.	1	2	—	1		—	—	—	—	—	1	1	—	
Muscidae spp.[1])	1	21	—	8		—	3	7	5	4	4	1	—	
Anthomyiidae														
Paraprosalpia silvestris Fall.	1	—	—	—		—	—	—	—	—	—	—	—	
Hylemyza lasciva Zett.	1	1	—	1		—	—	—	2	—	—	—	1	
Acrostilpna latipennis Zett.	—	—	—	1		—	—	—	—	—	—	—	—	
Nupedia dissecta Meig.	1	4	—	—		—	—	—	—	—	—	1	—	
N. pseudodissecta Ringd.	1	6	—	2		—	1	1	1	—	—	—	1	
Opsolasia eriophthalma Zett.	—	38			1.715	—	1	2	5	8	3	3	1	Ib
			1	40	1.371	—	—	—	6	7	8	5	—	Ib(?)
Paragle radicum L.	2	6	—	1		—	—	1	2	1	1	1	—	

Species	Kevo canyon		Puksal-skaidi		"Diel niche" width, H'	Time of day								Diel periodicity type
	♂	♀	♂	♀		00—03	03—06	06—09	09—12	12—15	15—18	18—21	21—24	
Pegohylemyia fugax Meig.	—	8	—	3		—	—	—	2	2	1	3	2	
P. profuga Stein.	—	—	—	1		—	—	—	1	—	—	—	—	
P. rutilifrons Ringd.	—	—	—	1		—	—	—	—	—	—	1	—	
Delia nuda Strobl	—	—	—	1		—	—	—	—	—	—	—	—	
Pegomyia solitaria Stein.	—	8	1	4		1	1	—	—	1	1	4	—	
P. incisiva Stein.	7	27			1.592	—	—	5	2	8	5	2	1	Ib
			3	17	0.918	—	—	—	6	—	1	5	—	
P. rufipes Fall.	4	8	—	3		—	1	5	1	—	1	2	—	
P. tenera Zett.	1	6	3	3		—	—	2	—	—	—	1	—	
P. pilosa Stein.	5	4	—	1		—	—	2	—	1	2	1	—	
P. flavipalpis Zett.	—	1	—	—		—	—	—	—	—	1	—	—	
Pegomyiella lunatifrons Zett.	1	1	—	1		—	—	1	1	—	—	1	—	
Hydrophoria conica Wied.	1	155			1.844	—	6	13	18	22	16	9	6	Ib
			1	112	1.715	2	2	8	17	11	21	17	—	IIc
Acroptena zetterstedti Ringd.	—	1	—	—		—	—	—	—	—	—	—	—	
Anthomyiidae spp.[1]	—	26	—	17		—	—	4	8	8	10	5	4	
Calliphoridae														
Pierretia frenata Pand.	—	—	—	1		—	—	—	—	—	—	—	—	
Parasarcophaga scoparia Pand.	—	2	—	—		—	—	—	—	—	1	—	—	
Calliphora uralensis Vill.	13	18			0.803	—	—	1	4	10	—	—	—	
			5	13	1.427	—	—	2	1	1	4	1	—	
C. loewi Enderl.	1	43			1.367	—	—	2	8	11	7	1	—	Ia
			4	22	1.352	—	—	1	4	5	1	1	—	
C. erythrocephala Meig.	—	1	—	—		—	—	—	—	—	—	—	—	
C. genarum Zett.	2	12	3	9		—	—	—	—	—	1	—	—	
C. alpina Zett.	—	3	—	1		—	—	—	—	—	—	—	—	
Phormia terrae-novae R.D.	6	6	1	1		—	—	—	—	6	—	—	—	
Cynomyia mortuorum L.	9	7	1	12		—	—	1	2	4	3	—	—	
Lucilia fuscipalpis Zett.	—	2	1	8		—	—	—	—	7	—	—	—	
Anisopodidae														
Rhyphus zetterstedti Edw.	—	—	—	1		—	—	—	—	—	—	—	—	
specimens	319	1873	206	1770										
species (at least)	97		89											
diversity *(H')*	3.586		3.013											
evenness *(J')*	0.784		0.671											

[1] badly damaged specimens that could not be identified to species.

[2] includes both species.

[3] includes specimens that could not be identified to species.

[4] NUORTEVA (1965a) had a lower number for this species, because he excluded many specimens with weakly developed colour characteristics.

Table 2 shows that diel periodicity curves of the unimodal type (I a—c) were clearly commoner in the canyon (11 species) than on the fell (2 species), whereas curves of the bimodal type (II a—c) were commoner on the fell (12 species) than in the canyon (8 species). Five

Table 2. The distribution of species by diel periodicity curve in the canyon and on the fell. Notes: (a) The number of species in the canyon that did not occur on the fell and (b) vice versa. (c) The number of species that occurred in both places with the same type of flight curve (I or II). (d) Upper figure = the number of species having type I in the canyon but type II on the fell, and lower figure vice versa. Only those species are included for which at least 20 specimens were caught at a single trapping locality during the times that diel periodicity was studied. [1] see Fig. 1.

Type[1]	Kevo canyon	Puksalskaidi	group (a)	(b)	(c)	(d)
I	11	2	5	—	2	4
II	8	12	2	2	6	—
Σ	19	14	7	2	8	4

of the species with unimodal flight curves in the canyon occurred only sparsely (less than 20 exx) on the fell, but the two species with such curves on the fell were also common in the canyon. Three species with unimodal curves in the canyon had bimodal curves on the fell, namely, *Scatophaga furcata* Say, *Helina laetifica* R.D. and *Hydroporia conica* Wied. *Liopiophila varipes* Meig. may belong to this group, too.

The diversity of the diel periodicity types at the two localities was examined by calculating Shannon-Weaver indices. The diversity was higher in the canyon (1.709) than on the fell (1.233). The "utilization" of different times of the day within a species was also generally more effective in the canyon than on the fell (Table 1). No differences in diel activity were found between the sexes. Table 3 gives the numbers of species and specimens and the diversity and evenness indices at different times of the day in the two localities. Both the numbers of species and the numbers of specimens have a unimodal pattern in the canyon and a bimodal one on the fell. The diversity and evenness indices are also presented in Fig. 2. The diversity of the flies that came to the traps is higher in the canyon than on the fell at every time of the day, but the diel pattern is nearly the same. On the other hand, the evenness is fairly uniform in the canyon, but has a bimodal curve on the fell. There are two periods of considerable con-

Table 3. The number of species (N), the number of specimens (exx), and the (Shannon-Weaver) diversity and evenness of the fly catch in the canyon and on the fell at different times of the day.

	00—03	03—06	06—09	09—12	12—15	15—18	18—21	21—24
Kevo canyon:								
N	4	24	40	40	51	36	40	20
exx	5	70	197	310	272	165	172	56
exx/N	1.25	2.92	4.93	7.75	5.33	4.58	4.30	2.80
diversity	1.33	2.86	3.15	3.15	3.42	3.08	3.07	2.71
evenness	0.96	0.90	0.85	0.85	0.87	0.86	0.83	0.90
Puksalskaidi:								
N	3	10	27	51	29	41	36	8
exx	6	42	182	274	142	242	243	12
exx/N	2.00	4.20	6.74	5.37	4.90	5.90	6.75	1.50
diversity	1.10	1.65	2.53	3.18	2.93	2.82	2.51	1.91
evenness	1.00	0.72	0.77	0.81	0.87	0.76	0.70	0.92

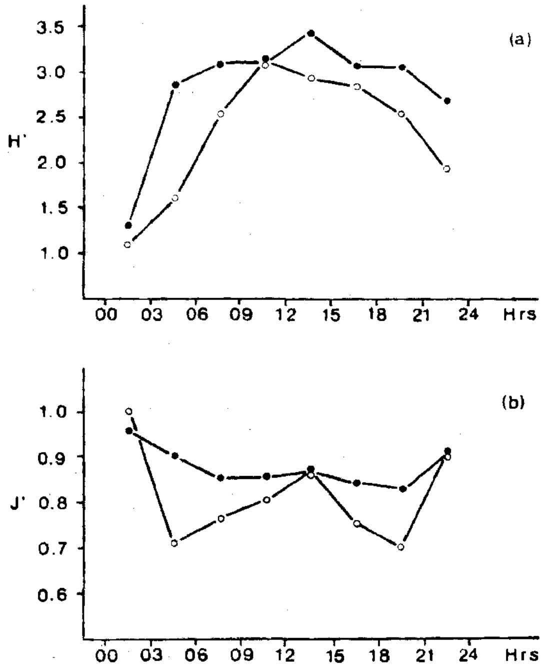

Fig. 2. The diversity *(H')* of the fly catch at different times of the day (a) and the corresponding evenness *(J')* (b) in the canyon (line with filled circles) and on the fell (line with open circles).

centration of dominance, i.e. low evenness, one in the morning and the other in the evening.

Discussion

Owing to the cloudiness during the trapping period, there were practically no microclimatic differences between the two trapping localities. Thus the differences in the diel periodicity of the flies at the two localities must be chiefly attributed to differences in light intensity and the inherited reaction norms of the fly species, rather than to microclimatic variation.

The results indicate that the unimodal type of diel periodicity is an adaptation to life in the canyon, with dense shady vegetation, whereas bimodal diel periodicity is better suited for life on the fell, with sparse vegetation. Here in the subarctic, the sunshine is obviously never too strong in the dense vegetation of the canyon, whereas it may have adverse effects on the more open fell. It is also possible that the stronger wind usually prevailing on the fell is responsible for the differences in modality between the two places. The lower diversity of the different types of flying activity on the fell also indicates that it is not possible for the fly fauna to use the fell environment effectively at all times of the day. There is, of course, no such total interruption of flying activity during the hottest time of the day as has been noted in warmer climates, but it is rather surprising that bimodality exists at all in these subarctic conditions, where the temperature is rather seldom sufficiently high for insect flight (cf. NUORTEVA 1965a—b, 1966b—d, REMMERT 1965, NUORTEVA & HACKMAN 1970). Acclimatization to the low temperatures of the subarctic has evidently considerably reduced tolerance of the heat of insolation in most of the flies, although blowflies and some others are able to make full use of the insolation.

Information about the fly fauna of the subarctic Kevo Reserve is rather scanty. The paper of HACKMAN (1963) on the dipterous fauna of rodent burrows is the only more extensive faunistic study. In addition, there are papers on the flying activity of some flies (NUORTEVA 1965a—b, 1966a) and some scattered observations. The present list of 113 species is thus the most extensive yet published, but it too is very far from complete, even for the flies normally attracted by the traps used in this experiment. Two species listed, *Helina veterana* Zett. and *Rhyphus zetterstedti* Edw., are new for the Finnish fauna.

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References

Hackman, W. 1963. On the dipterous fauna of rodent burrows in Northern Lapland. — Notulae Ent. 43, 121—131.

Lewis, T. & Taylor, L. R. 1965. Diurnal periodicity of flight by insects. — Trans. R. Ent. Soc. London. 116, 393—479.

Mäkisalo, I. 1970. A new pest of museums in Finland — Reesa vespulae (Mill.) (Col., Dermestidae). — Ann. Ent. Fenn. 36, 192—195.

Nuorteva, P. 1959. Studies on the significance of flies in the transmission of poliomyelitis III. The composition of the blowfly fauna and the activity of the flies in relation to the weather during the epidemic season of poliomyelitis in South Finland. — Ann. Ent. Fenn. 25, 121—136.

— 1965a. The flying activity of Helina binotata Zett. (Dipt., Muscidae) in subarctic conditions. — Ann. Ent. Fenn. 31, 117—131.

— 1965b. The flying activity of blowflies (Dipt., Calliphoridae) in subarctic conditions. — Ann. Ent. Fenn. 31, 242—245.

— 1966a. Observations on the diel periodicity of flight by Lonchaea laxa Collin (Dipt., Lonchaeidae) in subarctic conditions. — Ann. Univ. Turkuensis A II 36. 259—260.

— 1966b. The flying activity of Phormia terraenovae R.-D. (Dipt., Calliphoridae) in subarctic conditions. — Ann. Zool. Fenn. 3, 73—81.

— 1966c. The occurrence of Phormia terra-novae R.-D. (Dipt., Calliphoridae) and other blowflies in the archipelago of the subarctic lake Inarinjärvi. — Ann. Ent. Fenn. 32, 240—251.

— 1966d. The synanthropy and bionomics of blowflies in subarctic Northern Finland. — Wiad. Parazytol. 13, 603—607.

— Hackman, W. 1970. Diel periodicity of activity in Chymomyza costata (Zett.) (Diptera, Drosophilidae) in the subarctic. — Ann. Zool. Fenn. 7, 267—269.

Remmert, H. 1965. Über den Tagesrhythmus arktischer Tiere. — Zeitschr. Morphol. Ökol. Tiere 55, 142—160.

Shannon. C. E. & Weaver, W. 1949. The mathematical theory of communication. — 117 p. Urbana, Ill.

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