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Vedoucí katedry: Doc. Dr. Bořivoj Novák, CSc.

DIURNAL ACTIVITY OF YOUNG INDIVIDUALS OF THE SPECIES NECROPHORUS GERMANICUS (COL. SILPHIDAE)

NADĚŽDA ŠPICAROVÁ

(Handed in on August 15th 1973)

INTRODUCTION

In the present contribution the author publishes the results of experiments with individuals of the species *Necrophorus germanicus L.*, which had been begun in spring 1972 and evaluated in the late summer of the same year. The experiments brought new notions of the diurnal activity of the species in question, whose representatives were bred during their metamorphosis in isolators and after leaving the soil medium were collected by means of automatic earth traps. The author resumed thus partly her previous investigations during which she had under similar conditions studied the diurnal activity of the species *Necrophorus vespillo (L.)* — Špicarová (1972).

Ecological papers concerned with burying beetles which had been published by B. Novák (1961, 1962, 1964, 1965, 1965a) or by Petruška (1968), mention a frequent occurrence of the species *Necrophorus germanicus* in the fields of the Valley of Upper Moravia and especially in warmer localities with loess soils. On such places active imagoes that had hibernated are found already in April. Their mobility reaches its summit in the second half of May, in June they bury perished vertebrates and the females lay eggs after copulation. The larval development is quick analogically to other species of burying beetles so that individuals of the filial generation emerge from the soil as early as in July and August. After a short period of feeding activity they look for winter shelters in September and October.

Both quoted authors have pointed to the interspecific competition of burying beetles in which the robust individuals of the species *Necrophorus germanicus* easily win over the imagoes of less fit species of burying beetles, especially if they meet under the perished vertebrates. This competition can be reconstructed from the catching of burying beetles in earth traps by means of decaying meat, if the collection takes place on the same spot every year — see B. Novák (1965) or Petruška (1968).

The fictive and actual oscillation of the sexual index in populations are shown

in the papers by B. Novák (1961), Petruška (1968) and especially by Špicarová (1969). Furthermore the influence of the trophic factor on the progenies of filial generations of burying beetles has been studied — Špicarová (1971, 1973) and a method of breeding burying beetles under outdoor as well as laboratory conditions has been elaborated — Špicarová (1969). Data on the species *Necrophorus germanicus* can be found in both of the above mentioned papers.

The literature concerned with the diurnal activity of burying beetles was reviewed in the author's paper: The Emergence of Burying Beetles from the Soil after Their Metamorphosis and Its Dependence on Day Light (Col. Silphidae). This contribution together with the present paper the first exact determination of the rhythms of the diurnal activity of burying beetles.

MATERIAL AND METHODS

The author started the rearing of burying beetles *Necrophorus germanicus* (with individuals that had been caught near Náklo) in the garden of the Olomouc observatory on Jun. 8th 1972. Each of the 7 experimental couples was given 15 dkg of meat into the isolator. When checking the breeds at the beginning of August the author found in earth cradles well developed pupae and moved them together with the isolators into the laboratory. A short corridor of wire network connected the separate

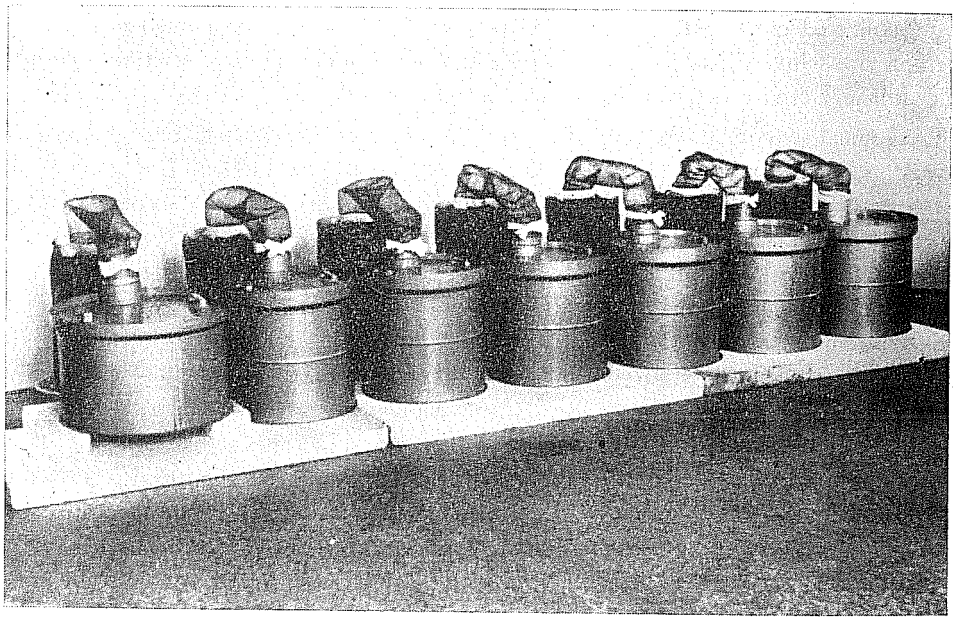

Fig. 1 — Automatic devices for the study of the diurnal activity in insects. The cylindrical vessels with collecting devices are connected by a wire net corridor with isolators from which metamorphosed burying beetles gradually emerge.

isolators with the automatic collectiong device (Fig. 1). The upper glass part of the isolator had already earlier been filled with earth up to the brim so that the hatched imagoes could easily creep over the wire network into the automatic trap. The earth in the lower cylindrical part of the isolator made of wire network had been moistened with water according to need either by water from above or by pouring it down the walls.

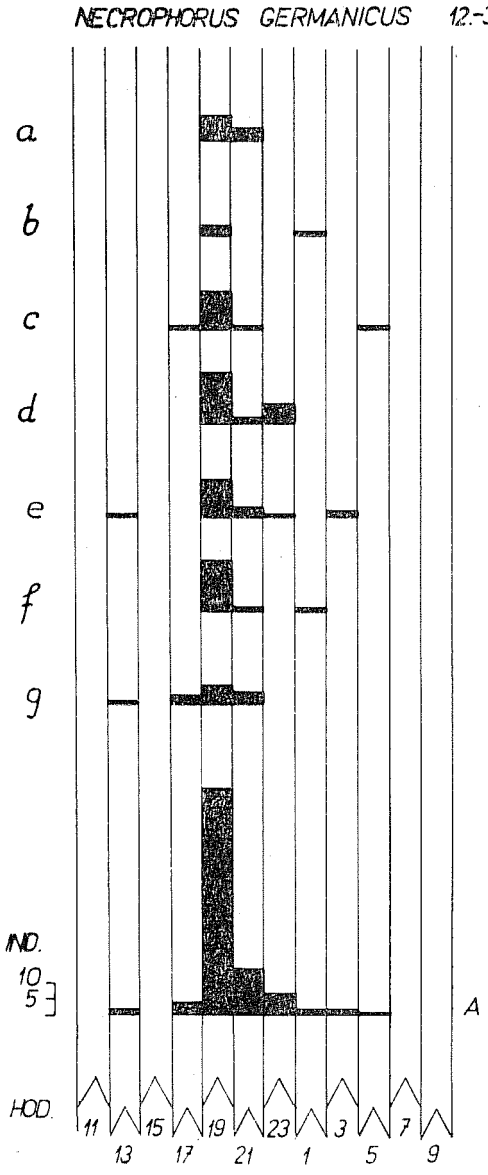

Fig. 2 — Daily activity of the individuals of the species *Necrophorus germanicus:* a — g = progenies of the separate parental couples, A = total activity. Below the two hours'time intervals.

RESULTS

Table 1 shows how the young individuals gradually left the isolators. On the whole 106 imagoes gradually liberated themselves from 7 isolators. The first imagoes have left the isolator denoted with letter »a« already on Aug. 12th, the last crept out of the isolator labelled »b« on Aug. 29th. The greatest number of individuals always crept through the connecting corridor into the traps on the 4th or 5th day after the day when the first imago had been registered. The room temperature during the experiment oscillated between 20° and 26 °C.

Further results are presented in Table 2 and Fig. 2. From the total number of 106 caught individuals the author determined 56 ♂♂ and 50 ♀♀. Both the Table and the Graph show a great concentration of the emerging of imagoes from the soil in the hours ranging from dusk to early night. From the total number of caught individuals 77.4% fell into the traps between 6 p. m. and 8 p. m. Between 8 p. m. and 10 p. m. only 15 individuals (i. e. 15.9%) left the earth in the 7 isolators and in the next two hours of the night only 7 individuals (i. e. 7.4%) of the total number emerged. Not a single imago had fallen into the trap during day light, viz. between 6 a. m. and noon. Only in isolated cases imagoes left the isolators in the early afternoon hours and between midnight and 6 a. m. The daily activity rhythm in males did not significantly differ from that in females.

DISCUSSION

In contrast to the species *Necrophorus vespillo (L.)* the individuals of which were under analogical conditions most active in the first hours after noon — Špicarová (1972) — the motor activity of young individuals of the species *Necrophorus germanicus L.* reached its summit at dusk and in the early hours of the night. From the 9th to the 19th August the official dusk begins at 4.03 p. m. and ends at 8.8 p. m.; from the 19th to 29th August dusk begins at 4.19 p. m. and ends at 7.48 p. m. If we take the end of dusk for the beginning of the night we can denote the species *Necrophorus germanicus* as a dusk and night species with the maximum of diurnal activity at about the end of official dusk. Many individuals obviously leave the shelters already before the end of dusk which indicates a negative camouflage of activity. It means that such a population waits already in the late afternoon in the surface layers of the soil for the convenient intensity of light and as soon as this sets in leaves the shelters in crowds.

The mutual isolation of the separate species of burying beetles in space and time as it has been described by B. Novák (1964) is advantageous for the individuals of the species that generally looses the battle for the carrions, i. e. for example for the females of the species *Necrophorus vespillo* in their competition with the females of the species *Necrophorus germanicus*. As the author has found in her studies con-

Tab. 1 — Time dispersion in the hatching of filial generations of the species *Necrophorus germanicus L.*

Isolátor	August																			On the whole
	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	
a	2	–	1	1	3	3	1	–	1	–	–	–	–	–	–	–	–	–	–	12
b	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	1	–	4
c	–	–	–	–	1	1	–	1	3	–	1	2	2	2	2	–	–	–	–	15
d	–	–	–	–	–	1	3	6	3	9	1	1	–	–	–	–	–	–	–	24
e	–	–	–	–	–	1	2	4	4	5	1	2	–	–	–	–	–	–	–	19
f	–	–	–	–	–	–	–	–	1	1	–	8	1	5	1	–	1	–	–	18
g	–	1	–	–	2	1	–	3	5	2	–	–	–	–	–	–	–	–	–	14
On the whole	2	1	1	1	6	7	6	14	17	17	3	13	3	7	6	–	1	1	–	106
Temperature °C	25	24,5	25	26	25,5	25	25	24	23	21,5	21	21	20,5	20	20	20	20	20	20	

Tab. 2 — Results of collecting the burying beetles into automatic traps (collections every 2 hours during 24 hours from Aug. 12th to 30th)

N. germanicus	10–12		12–14		14–16		16–18		18–20		20–22	
1972	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀
12. VIII.	–	–	–	–	–	–	–	–	1	1	–	–
13. VIII.	–	–	–	–	–	–	1	1	–	–	–	–
14. VIII.	–	–	–	–	–	–	–	–	1	–	–	–
15. VIII.	–	–	–	–	–	–	–	–	–	–	1	–
16. VIII.	–	–	1	–	–	–	–	–	2	1	1	1
17. VIII.	–	–	–	–	–	–	1	1	1	–	3	1
18. VIII.	–	–	–	–	–	–	–	–	2	3	–	–
19. VIII.	–	–	–	–	–	–	1	1	3	2	2	1
20. VIII.	–	–	–	–	–	–	1	1	6	5	1	3
21. VIII.	–	–	–	–	–	–	–	–	5	11	–	–
22. VIII.	–	–	–	–	–	–	–	–	1	2	–	–
23. VIII.	–	–	1	–	–	–	–	–	4	6	–	–
24. VIII.	–	–	–	–	–	–	–	–	–	3	–	–
25. VIII.	–	–	–	–	–	–	–	–	4	2	1	–
26. VIII.	–	–	–	–	–	–	–	–	5	1	–	–
27. VIII.	–	–	–	–	–	–	–	–	–	–	–	–
28. VIII.	–	–	–	–	–	–	–	–	1	–	–	–
29. VIII.	–	–	–	–	–	–	–	–	–	–	–	–
30, VIII.	–	–	–	–	–	–	–	–	–	–	–	–
On the whole	–	–	2	–	–	–	4	4	36	37	9	6

22–24		24–02		02–04		04–06		06–08		08–10		On the whole	
♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀
–	–	–	–	–	–	–	–	–	–	–	–	1	1
–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	1	–
–	–	–	–	–	–	–	–	–	–	–	–	1	–
–	–	–	–	–	–	–	–	–	–	–	–	4	2
1	–	–	–	–	–	–	–	–	–	–	–	5	2
1	–	–	–	–	–	–	–	–	–	–	–	3	3
2	1	–	–	–	1	1	–	–	–	–	–	8	6
1	–	–	–	–	–	–	–	–	–	–	–	8	9
–	–	–	–	1	–	–	–	–	–	–	–	6	11
–	–	–	–	–	–	–	–	–	–	–	–	1	2
1	–	1	–	–	–	–	–	–	–	–	–	7	6
–	–	–	–	–	–	–	–	–	–	–	–	–	3
–	–	–	–	–	–	–	–	–	–	–	–	5	2
–	–	–	–	–	–	–	–	–	–	–	–	5	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	1	–
–	–	–	1	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–
6	1	1	1	1	1	1	–	–	–	–	–	56	50

cerned with the diurnal activity of burying beetles, the imagoes of the species *Necrophorus vespillo* also avoid the direct clashes with the individuals of the night species *Necrophorus germanicus* by burying perished vertebrates still by daylight. It is possible for them, because the burying of a tiny rodent or bird into the soil can be done in a couple of hours. Literary data indicating that females of the species *Necrophorus germanicus* seek only for bigger carrions have probably not yet been exactly proved. The author of the present paper has demonstrated in her experiments that parental couples of the species *Necrophorus germanicus* had buried even small doses of meat — Špicarová (1973). These doses were sufficient for the development of a filialgeneration, which, however, responded by a small number of individuals to the small quantity of food for the larvae. It is therefore quite possible that there is a competition between the two species of burying beetles as to the perished vertebrates of a smaller size and that this competition is moderated by interspecific time differences in the rhythms of diurnal activity.

SUMMARY

The author has studied under laboratory conditions the diurnal activity of the species *Necrophorus germanicus L.* By means of an automatic trap she caught imagoes that emerged from the soil after their metamorphosis and left the isolators in which they had been bred.

By catching 106 imagoes she demonstrated that the individuals of the species *Necrophorus germanicus* are active at dusk and by night. At room temperature and during the August photoperiod their activity reached its summit at the beginning of the night, was very small after midnight and minimal during daylight except for a short period of time before the end of dusk. It is probably a case of camouflaged activity which depends on the photoperiod and is favoured in its active phase by advantageous temperatures.

The interspecific differences of the diurnal rhythms of activity in the separate species of burying beetles can moderate the interspecific competition for perished vertebrates, especially among the females.

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DIURNÁLNÍ AKTIVITA MLADÝCH JEDINCŮ DRUHU NECROPHORUS GERMANICUS L. (COL. SILPHIDAE)

NADĚŽDA ŠPICAROVÁ

Souhrn

Autorka studovala za laboratorních podmínek aktivitu druhu *N. germanicus*. S pomocí automatického odběrového zařízení zachycovala imaga, která po proměně vylézala z půdy a opouštěla isolátory, v nichž byla odchována.

Odchytem 106 imag zjistila, že jedinci druhu *N. germanicus* jsou aktivní za soumraku a v noci. Za pokojového teplotního cyklu a za srpnové fotoperiody vrcholila jejich aktivita začátkem noci, byla velmi nízká po půlnoci a minimální ve světelné fázi dne s výjimkou krátkého časového úseku před koncem občanského soumraku. Jde tedy velmi pravděpodobně také o negativní maskování aktivity závislé na fotoperiodě a oživované v aktivní fázi příznivými teplotami.

Interspecifické diference v diurnálních rytmech aktivity jednotlivých druhů hrobaříků mohou zmírňovat mezidruhovou soutěž o uhynulé obratlovce, zejména mezi samicemi.

ДИУРНАЛЬНАЯ АКТИВНОСТЬ МОЛОДЫХ ИНДИВИДОВ ВИДУ NECROPHORUS GERMANICUS L. (COL. SILPHIDAE)

НАДЕЖДА ШПИЦАРОВА

Резюме

Статья разобрает ритмы в диурнальной активности молодых индивидов виду *Necrophorus germanicus L.* Автор использовала автоматические ловушки и установила, что *N. germanicus* является сумрачным и ночным видом. Подвижность кульминировала между 18-ым и 22-ым часом.