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DWARF FORMS OF BURYING BEETLES AND THE CAUSES OF THEIR DEVELOPMENT (Col. Silphidae)

ZAKRSLÉ FORMY HROBAŘÍKŮ A PŘÍČINY JEJICH VÝVOJE (Col. Silphidae)

NADĚŽDA ŠPICAROVÁ

(Předloženo dne 1. září 1970)

In more numerous collections of whatever of our species of the genus *Necrophorus F.* we find a great variability in the vigour of males and females. In richer collections of burying beetles (which material has been conserved in alcohol) it is e. g. possible to range them according to the weights of imagos from very robust individuals to dwarf imagos in a declining row. There is, however, an incontinuity in the continously sloping down curve of weights immediately before we come to the inconsiderable weights of dwarf individuals — and it is this wery gap without any transient values which attracts our attention and requires a more meticulous approach to the investigation of the conditions under which the development of dwarf individuals takes place. At first glance it might seem that the nanosomic forms develop when the couple of parents has burried only a small carrion, i. e. if the larvae are in want of food.

The author has originally not had the intention to deal with this problem. She succeeded, however, quite accidentally to raise in two cases dwarf imagos of the species *N. vespillo L.* in more numerous series of experimental breedings. Yet the conditions, under which the illusory dependence: „the smaller the carrion — the less fit the progeny" is not valid, are for the development of nanosomic individuals of burying beetles so remarkable that she had to devote them a special paper.

SOME OBSERVATIONS TO THE METHOD

The separate parents' couples of burying beetles were kept in isolators made of 4 litre bottomless glass jars and of wirenetting and were given different quantities of meat (Špicarová 1969). In order to register the divergence in size of individuals immediately in the first filial generation the author opened the isolators when the larvae became pupae. The weight of the pupae changes namely during the development only insignificantly and negligibly.

The author of the present paper has found that there is a great time divergence in the development of the progeny of the separate parents' couples. In some isolators opened in the same span of time from the beginnings of the experiments there were only pupae, in others together with the pupae there were also larvae spinning a cocoon.

The larvae and pupae were weighed immediately after having been taken out from the cradles with an accuracy of 0.01 g. Then the larvae were put one by one into glass test-tubes with moist cotton at the bottom, closed by a stopper of moistened cotton. After having spun a cocoon they were weighed anew.

The results of the analysis from two isolators, in which there were besides normal pupae also dwarf ones or dwarf larvae are presented in a Table and their weights are graphically illustrated in Figure 1. The marked difference between the size of normal imagos and the nanosomic individuals is evident from the photographs (see Fig. 2).

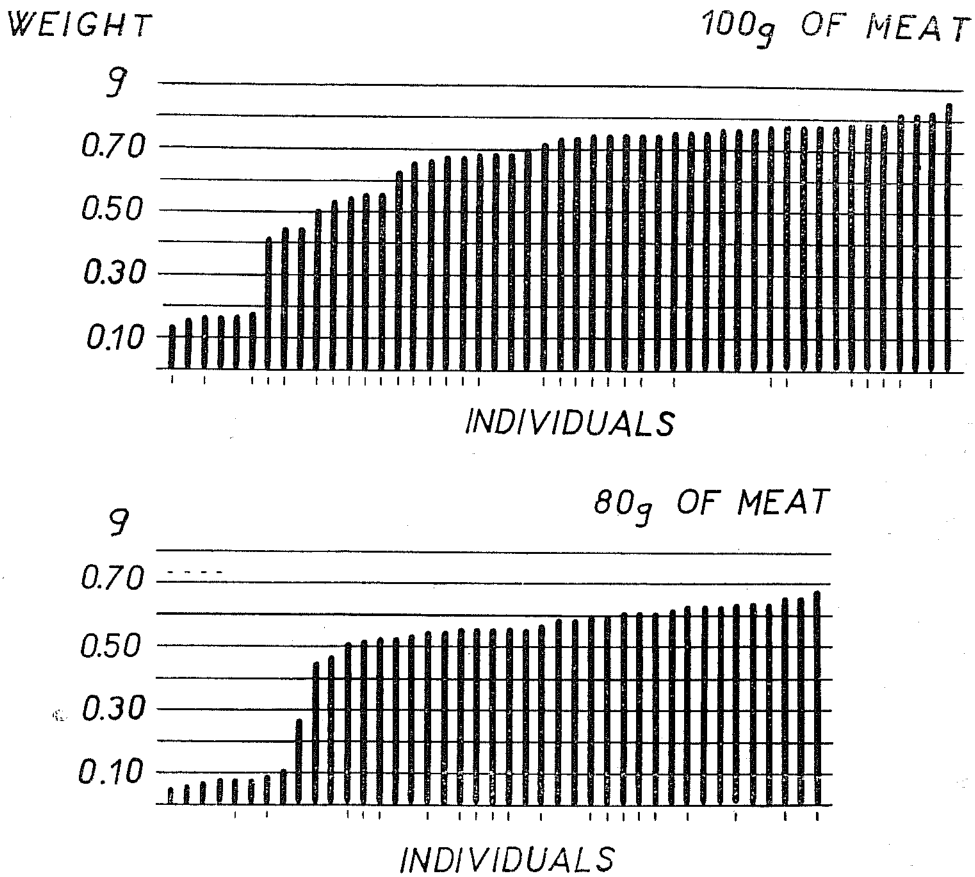

Fig. 1. Graphical illustration of weights of larvae and pupae of the species *N. vespillo* in the first filial generation (doses of meat = 100 g, 80 g). Strong perpendicular lines = weights of individuals. — = larva, without mark = pupa, / = ♂, without mark = ♀.

Table 1. The offsprings of the first filial generation of two parents' couples of the species *N. vespillo*

The progeny of the first parent's couple. Weights of pupae in g, dose of meat 100 g		*The progeny of the second parents' couple. Weights of larvae and pupae in g, dose of meat 80 g*	
Pupae		*Larvae*	
+0.14	0.74		
+0.16	0.74	+0.05	
+0.17	0.75	+0.06	
+0.17	0.75	+0.07	
+0.17	0.75	+0.08	
+0.18	0.75		
0.42	0.75	*Pupae*	
0.45	0.76		
0.45	0.76	+0.08	0.57
0.51	0.76	+0.08	0.59
0.54	0.77	+0.09	0.59
0.55	0.77	+0.11	0.60
0.56	0.77	0.27	0.60
0.56	0.78	0.45	0.61
0.63	0.78	0.47	0.61
0.66	0.78	0.51	0.61
0.67	0.78	0.52	0.62
0.68	0.78	0.53	0.63
0.68	0.79	0.53	0.63
0.69	0.79	0.54	0.63
0.69	0.79	0.55	0.64
0.69	0.82	0.55	0.64
0.70	0.82	0.56	0.64
0.72	0.83	0.56	0.66
	0.86	0.56	0.66
		0.56	0.68
		0.56	

*) *nanosomic individuals*

DISCUSSION OF THE RESULTS

It is evident from the values given in the Table and the Diagram in Figure 1 that the variability in the vigour of pupae (larvae) is of two different sorts. We can observe a gradual variability between the normal and dwarf individuals, on the other hand, however, both of these groups are separated by a marked decline without transient values which had already been mentioned above. Both of these phenomena (the gradual variability and its sudden discontinuity) have evidently different reasons.

The reasons of normal declining variability in the weights of pupae are to be seen in the rivalry of larvae as to food, namely the food which the female divides directly among the larvae (because at first the female feeds them) and further in the hereditary components in every individual etc. However, the very phenomenon of the sudden decline in the weights, i. e. the rise of nanosomic individuals, has its source in the retardation of the development of larvae. At the time the isolators had been opened the group of more vigorous pupae was evidently more advanced in their development, which was obvious from their firmer and somewhat darker body covers, whereas the nanosomic individuals were found in the stage of larvae or only fresh cocoons. The first group of pupae produced burying beetles which were in their development roughly a week ahead in comparison with the group of nanosomic individuals.

We may thus come to the first conclusion that the dwarf individuals come from the secondary egg-batch layed by the female after a span of time elapsed from the oviposition of the primary egg-batch. Further we may say with certainty that the dwarf forms occurred in two isolators in which the parents and larvae had a surplus of food (80 g to 100 g). That means that the nanosomic larvae develop at the time when the food has already been impaired by the development of elder larvae and was evidently in a more advanced decay. The author of the present paper could not find out, whether the maturing elder larvae and the larvae hatched from freshly layed eggs lived for a certain time together on the source of food. This would render it impossible or at least make it much more difficult for the female to feed the young larvae. It may even be that this mother instinct (i. e. the direct feeding of offsprings) — so rare among beetles — vanishes with the raising of elder larvae and that the female does not feed the young larvae of the secondary egg-batch any more. And finally there is a possibility that the eggs of the secondary egg-batch may be different with regard to the potency of development from the eggs of the primary egg-batch (e. g. the haploid number of chromosomes in unfertilized eggs etc.). With the exception of the delayed development of the larvae from the secondary egg-batch, all these opinions given are of course only hypotheses and open questions, to which answers should be found in further series of experiments in cytological studies.

Even in nature it certainly comes sometimes to the rise of very small individuals in such a case that the burying beetles have buried a carrion of a bigger vertebrate that is when the larvae have at first a surplus of food and the female lays eggs twice subsequently.

CONCLUSIONS

The development of dwarf individuals of burying beetles of the species *N. vespillo* occurs sometimes in outdoor conditions in such cases when the couple of parents burries a bigger vertebrate for their larvae. This is evidently generally valid even for other species of *Necrophorus F.*

The nanosomic individuals develop from the secondary egg-batch and their larvae are thus hatched in delay after the larvae from the primary egg-batch.

The reasons of this nanosomism may be inferior food, its shortage (because the food are so to say the left-overs of the food which the larvae of the primary egg-batch did not consume for their development). Even an impaired care of the female for the newly hatched larvae or the development of unfertilized eggs with a haploid number of chromosomes cannot be totally excluded.

For the present it is not even possible to answer the question why only a smaller number of normal and fit individuals develop on small quantities of meat (e. g. 10 g) and no dwarf individuals. It may be that in such a case the number of eggs is small, because a small quantity of meat stimulates only a small number of cells to ripen in the ovarioles of the female. On the other hand a bigger quantity of meat is accompanied by an oviposition of a greater number of eggs, layed sometimes even in two successive periods of time. Thus the number of eggs layed might be somehow regulated by the reaction of the female to the quantity of meat at hand (the size of the carrion). Otherwise it may be that the rivalry because of food on an insufficient quantity of meat (small carrion) becomes among the larvae more and more acute and that some of the larvae perish in this fight and only the fittest larvae accomplish their development.

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SOUHRN

K vývoji trpasličích jedinců hrobaříků druhu N. vespillo dochází ve venkovních podmínkách v některých případech tehdy, zahrabe-li rodičovský pár pro své larvy mršinu většího obratlovce. Obecně to platí zřejmě i pro jiné druhy našeho rodu Necrophorus F.

Nanosimičtí jedinci se vyvíjejí z donůšky vajec a jejich larvy se tedy líhnou opožděně za larvami pocházejícími z hlavní snůšky vajíček.

Příčinou nanosomismu může být méně hodnotná potrava, její nedostatek (jde vlastně o zbytek potravy, který nespotřebovaly za svého vývoje larvy pocházející z hlavních snůšek). Zcela nelze vyloučit ani zhoršenou péči samice o nově vylíhlé larvy nebo vývoj z neoplozených vajíček s haploidním počtem chromosomů.

Zatím nelze odpovědět ani na otázku, proč se na malých dávkách masa (např. 10 g) vyvíjí jen menší počet normálně zdatných jedinců a nikoliv jedinci zakrslí. Možná, že počet vajíček je v tomto případě jen malý, že malá dávka potravy podněcuje k dozrání jen malý počet buněk v ovariolách samice. Naopak větší dávka masa je doprovázena vykladením většího počtu vajíček, kladených někdy i ve dvou posloupných časových úsecích. Množství vykladených vajíček by tedy mohlo být nějak regulováno následkem reakce samice na předložené množství masa (velikost mršiny). Jinak je možné, že konkurence o potravu na nedostatečné dávce masa (malá mršina) se mezi rostoucími larvami stále přiostřuje, některé larvy v ní zanikají a vývoj dokončí jen larvy nejzdatnější.

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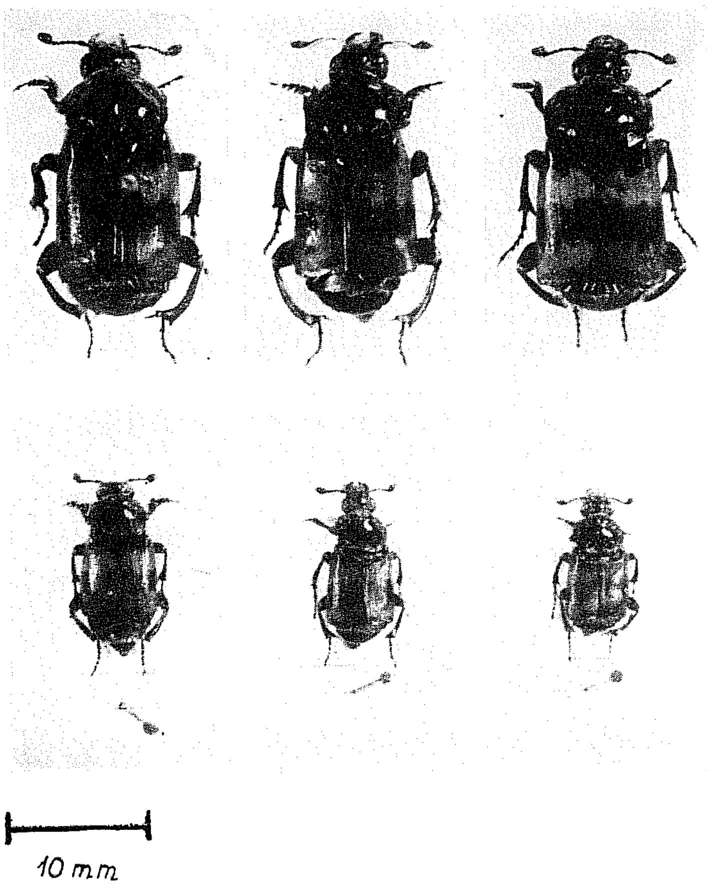

Fig. 2. Imagos of the species *N. vespillo* of normal and dwarf growth.