MORTALITY OF LARVAE OF PTEROSTICHUS OBLONGOPUNCTATUS (FABRICIUS) COL., CARABIDAE AND PHILONTHUS DECORUS (GRAVENHORST) (COL., STAPHYLINIDAE) 

by

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ABSTRACT

A description is given of a number of experiments, in the field as well as in the laboratory, in which the mortality of larvae of Pterostichus oblongopunctatus and Philonthus decorus was investigated. Mortality during the larval stage was found to be very high. This applied, at least in Pterostichus, to all three instars. In Philonthus significantly more larvae survived when they were able to find their first meal shortly after hatching. The same tendency was found in Pterostichus. Survival of larvae is strongly influenced by their density and by the availability of food. Probably many larvae do not succeed in finding enough food and die from starvation.

Larvae of both species are cannibalistic. Although this cannibalism is reduced when alternative food is available, it does not disappear entirely. Cannibalism occurs even at very low densities (for example in Pterostichus at a density of 15–20 larvae per m²), so it is very likely that under natural conditions (3–8 adults in our study area) cannibalism is an important factor in the regulation of the density of both species.

INTRODUCTION

In ecological research on carabid and staphylinid beetles attention has been focussed primarily on adult beetles. Only in some studies have pre-adult stages been investigated. The reason we know so much about adult beetles and so little about pre-adult stages is that adult beetles can often easily be trapped whereas it is difficult to sample eggs, larvae and pupae. It is (almost) impossible to measure in the field the densities of the inactive stages, namely egg and pupa. Pitfall traps can be used to estimate the relative density of surface-active larvae. Sorting litter samples, especially for species that are not active on the surface of the litter, gives absolute estimates.

A Berlese/Tullgren funnel can be used or the litter samples can be sorted by hand, but this is a very laborious method. The patchy distribution of the animals increases the problems; for most species it is extremely difficult to establish changes in density in the course of a season.
In this study two species were investigated, the carabid beetle *Pterostichus oblongopunctatus* (Fabricius) and the staphylinid *Philonthus decorus* (Gravenhorst). Both are common species of the forest floor, reproduce in spring and summer and hibernate as adults (Brunsting, 1981).

From catches in pitfalls it can be concluded that larvae of *Philonthus decorus* are more active on the surface of the litter than those of *Pterostichus oblongopunctatus*, because larvae of the latter species are seldom found in pitfall catches (our observations).

We do not have exact data on the natural food of the larvae. Their method of feeding is extra-intestinal, so serological methods, although very laborious, are probably the only way to investigate the natural food. In this way FRANK (1967) found that larvae as well as adults of *Philonthus decorus* are important predators of the pupae of the winter moth (*Operophtera brumata*) (see also KOWALSKI, 1976, 1977).

Mortality patterns of the larvae of *Pterostichus oblongopunctatus* and *Philonthus decorus* have been described earlier. GRUM (1975) investigated the population ecology of some carabid species, including *Pterostichus oblongopunctatus*. For another spring-breeding species, *Carabus nemoralis*, Grüm determined the mortality pattern of the larvae from the decrease in the abundance of succeeding instars captured in a constant number of pitfalls. Assuming that all spring breeders follow the same pattern, the mortality pattern of *Pterostichus oblongopunctatus* (no larvae of which were captured) was derived from the pattern of *C.nemoralis*. By estimating the number of eggs produced (2228 eggs/100 m²) and by determining the number of young adults that emerged from these eggs in the following autumn and spring (236 adults/100 m²) he found the total mortality to be 89.4%.

The mortality of larvae of *Philonthus decorus* was studied by KOWALSKI (1976). He took a series of litter samples in the course of the year and determined the number of larvae by hand-sorting the litter. The larval density of *Philonthus* was estimated to be 6.6 per m² for the first instar and 6.4 per m² for second and third instar larvae. From these data KOWALSKI (1976) inferred that the mortality of immature stages occurs quite early during the first instar stage.

Both in the study of Grüm and in that of Kowalski there is a lack of reliable data on the number of eggs produced; such data are needed to calculate total mortality (see also HEESSEN, 1980). In both cases the data on the duration of development of the different stages in the field were also insufficient.

Both GRUM (1975) and KOWALSKI (1976) conclude that larval mortality must be severe, especially for larvae that have just hatched. They suppose that this may be caused by the failure of the larvae to find a first meal quickly after hatching. According to Grüm mortality of eggs and pupae can be neglected whereas the mortality of the larvae cannot.