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Some Preliminary Data on the Frost Tolerance of Enchytraeidae

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In the course of my ecological investigations, conducted now for some years, I have established that *Stercutus niveus* MICH., 1888, is the dominant Enchytraeid species during the winter months (December, January) in the forest type Quercetum petreae cerris representing a widely distributed forest type in Hungary. After having studied this type regularly for some years, I found the same situation obtaining in recent years also in the forest types Quercetum Carpinetum, Querceto luzuletum and Fagetum silvaticae. This species reaches the maximum of its abundance also in this very period I have also established that this animal occurs in 80–90% during the period November–February in the litter layer and feeds on decaying litter leaves, thus playing a considerable role in the decomposition of litter during winter. The data imply that the species favours low temperatures. In accordance with her continental climate, the daytime temperature of Hungary frequently sinks below 0° C in the winter months. If there is a snow cover over the forest litter, the temperature below the snow is, according to my observations, is 0 + 1°—even if the atmospheric temperature is —10 —15° C—and that this situation agrees with the requirements of Stercutus niveus. However, it is equally well-known that there is frequently no snow cover, and that the whole litter layer, indeed, the uppermost soil layer, also freeze through. What happens then with the Enchytraeids?

Literature mentions a number of data relating to the detection of Oligochaeta, and among them of Enchytraeids, frozen into the ice—specimens, which had revived after its thawing, but perishing in their majority (LEIDY, 1886; REEKER, 1896; SEKERA, 1896; BRETSCHER, 1903). We also know of a special Enchytraeid peculiarly adapted to cold, namely *Mesenchytraeus solifugus*, collected by BRYANT on the Malaspina glacier in Alaska and described by EMERY (1898) and MOORE (1899), an animal which comes up to the surface of the snow during the night and digs itself in under the snow in the morning. As an experiment, MICHAELSEN let some *Enchytraeus albidus* HEINE be frozen in water in a watch-glass at —5° C, kept them there for a quarter of an hour, and then found, after a slow thawing out, that the specimens moved as lively as if nothing had happened (after KORSCHELT, 1913–14). KORSCHELT also made some experiments (1914–15) concerning the freeze resistance of various animals, without, however, extending them to Enchytraeids.

I have already referred to *Stercutus niveus* favouring cold, but that it tolerates also frost is indicated by the fact that out of the hard-frozen litter leaves, collected in the free and brought into laboratory conditions, I was able to obtain living animals in the best condition. Contrary to the majority of literature data, these specimens not only revived but lived for a long time (some months) in the laboratory vessels.

I thought it, however, necessary to prove also experimentally, in laboratory conditions, that this species does in fact tolerate temperatures below 0° C. I used exemplars obtained from frozen litter collected in the field in January, 1972. The freezing experiments were conducted several times, until the end of March. Wet litter leaves, free of Enchytraeids, were placed in small plastic vessels, together with a determined amount (10–20 specimens) of worms. Then the material was gradually cooled in a refrigerator to 0° C and deeper, and kept for various periods on —4, —6, —9, —10° C, and subsequently—and just as slowly and gradually—heated to +10° C.

It could be proved without doubt that *Stercutus niveus* actually does tolerate the frozen state rather well. They have survived in 100 per cent in a frozen state at —4 —5° C for 24 hours on every occasion. Any deeper temperatures (—6 —7° C for 24 hours) were tolerated by 70% on one occasion, and in 15% in another case. The cause of the different rates of survival lies probably in the fact that the resistance against frost changes by the lapse of time, since the latter datum refers to an experiment made at the end of March when there are no strong frosts any more on the soil surface in the free. An experiment involving a freezing at —9 —10° C for 16 hours in February gave a 13 per cent survival rate. I have also found during samplings in the winter that during this period, when *Stercutus niveus* dominates in the litter layer, almost no *Fridericia* species could be found. I set up experiments therefore with two further species. Concurrently with the experiments with *Stercutus niveus*, and under the same laboratory conditions, I cooled 20 specimens each of also *Fridericia galba* (Hoffmeister, 1843) and *F. hegemon* (Vejdovsky, 1877), to —4 and —5° C for 24 hours. A hundred per cent death was experienced with both species. Therefore, they cannot tolerate winter frosts, and must accordingly retreat to deeper soil layers or perish. The experiments have therefore also proved that the several Enchytraeid species do not tolerate temperatures below 0° C equally well, and this is surely the reason of the winter minimum obtaining in the Enchytraeid populations in some places, attributed to cold also by Nurminen (1967).

I should like to note yet that the results of the experiment depend to a great rate on the graduality of cooling and heating, especially in the critical interval between —1° C and 0° C. I therefore consider the present results preliminary only, and propose to conduct further investigations allowing a more detailed and precise interpretation of the phenomena involved.

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