

INVESTIGATION INTO SOME RESPIRATION-DETERMINING ECOLOGICAL FACTORS ON LARVAE OF PALINGENIA LONGICAUDA OLIV. (EPHEMEROPTERA)

KATALIN HALASY

*Department of Zoology, Attila József
University, Szeged*

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Abstract

From among the respiration-determining environmental factors of the may-fly larvae we have investigated the effect of substratum, water temperature, and development. The presence of substratum is absolutely necessary in case of larvae with burrowing way of life. With rising temperature, particularly in a younger age, oxygen consumption increases. The oxygen consumption of younger larvae falling on body-weight unit, is always a multiple of that of older ones.

Introduction

The respiratory organs of the may-fly larvae with burrowing way of life, the tracheal gills, are considerably accommodated to the utilization of the oxygen dissolved in water and are very sensitive to the quantitative change in this. In addition the intensity of the respiration of animals is considerably affected by other abiotic factors (presence or missing, quality of a substratum, water temperature, light conditions) and biotic factors (e. g. development in the larval age), as well. The knowledge of the effect of the different ecological factors determining respiration, is absolutely necessary to the bioenergetic research work, coming into prominence in our days. In case of aquatic insect larvae (Plecoptera, Ephemeroptera) these were investigated by several researchers. ERIKSEN (1968) emphasizes the role of the substratum and water. He establishes that a substratum of a quality characterizing the species and the same water, in which the animal is to be found under natural conditions must be used in the experiments. According to FELDMETH (1970) in case of rheophilous species we only obtain real values of oxygen consumption if they are measured in flowing water. In Kamler's experiments (1970) the size of body, development, quantity and quality of food, the respiratory movements are all factors influencing oxygen consumption.

The methods of measuring respiration are very varied. KAMLER (1969) investigated both Plecoptera and Ephemeroptera larvae in a measuring machinery of a closed system, with and without flowing water, and she constructed together with KLEKOWSKI (1968) a respirometer founded on the principles of polarography. CSOKNYA (1973) measured the oxygen consumption of *Palingenia* larvae with Warburg's manometric process. Nagell's apparatus (1973) in which he investigated into

four different Plecoptera and Ephemeroptera species, is an open system with flowing water, and the oxygen consumption is registered by a drop electrode.

Similarly to the mentioned apparatuses we have constructed a respiration machinery and investigated under laboratory conditions some factors affecting the respiration of may-fly larvae.

Methods

Our measuring instrument is an apparatus of closed system, making waterflow with a speed of 4 litre/min. (CSOKNYA and HALASY, 1975). It registers the quantitative changes of the dissolved oxygen in an electrochemical way, with the help of a voltametric sensing electrode (a construction of the Measuringtechnical Central Research Laboratory). The obtained values of current intensity can be reckoned over into a dissolved oxygen/ml water quantity by means of a calibration curve.

The experimental animals, collected from the Tisza and Maros rivers, were ranged into five groups according to their development. In every weight group oxygen consumption was measured at 5—10—15—20—25 °C temperatures, carrying out three parallel measurements in each. The duration of each measurement was two hours.

Results

Two experimental series were carried out. In the first one no substratum was applied, in the second some tubes made of plastiline served as a substratum. Results of the two experimental series were compared in a graph in each group (Figure 1, I—V). On the horizontal axis of these the temperature, on their vertical axis the oxygen consumption taken for 1 mg dry weight are indicated.

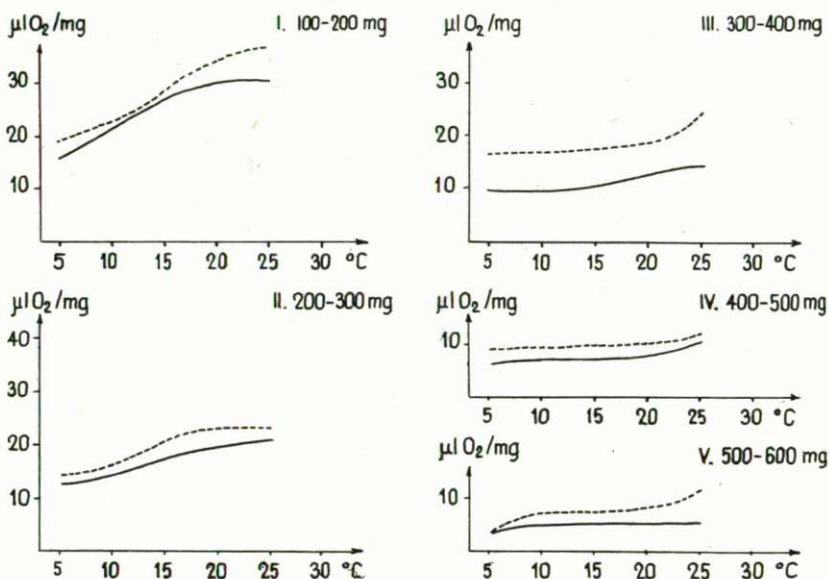


Fig. 1. Values of oxygen consumption related to dry weight and divided according to weight groups (— with substratum; - - - without substratum)

It appears from our results that from among the abiotic factors, the presence of the substratum making burrowing possible has a decisive role. The experiments carried out with a substratum, resulted namely in a lower oxygen consumption in every weight group and at any temperature, than those without any substratum. The explanation of this is that in the plastiline tubes the test animal got under conditions that are closer to natural, i.e. to the state of rest.

The younger larvae respond livelier to the rise in water temperature. This manifests itself so that the intensity of their respiration increases stronger than in the older groups (e. g., while the 10 °C change between 5—15 °C in groups III, IV and V changes almost nothing in oxygen consumption, in groups I and II the oxygen consumption considerably increases).

Knowing the natural living conditions of larvae as well as in our preliminary experiments, we have ascertained that light has a disturbing effect because of the negative phototaxis of larvae. We have, therefore, already taken care in both experimental series that they should be placed in total darkness.

The only biotic factor, taken into consideration by us, was the development of larvae. The weight of animals was taken as a measurement of this. Corresponding to the higher intensity of metabolism of the younger animals, the oxygen consumption of the younger animals — larvae of smaller weight — (Fig. 1; I and II) proved to be considerably higher than that of the older ones (Fig. 1; III, IV, V).

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Address of the author:
Dr. KATALIN HALASY
Department of Zoology, A. J.
University, H-6701 Szeged,
P. O. Box 428. Hungary