RELATIONSHIP BETWEEN OXYGEN CONSUMPTION AND BODY SIZE OF THE AMPHINOMID POLYCHAETE *EURYTHOE COMPLANATA* (*)

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The oxygen consumption of young and adult specimens of the polychaete *Eurythoe complanata* was determined in relation to body size. The equation $Y = 0.086W^{0.40}$, $r^2 = 0.76$ (P<0.0l) was obtained from polychaetes with body sizes ranging from 0.15-4.74 g, al 20.0 ± 1ºC and 3.2 % salinity. The Q_{10} value (mean ± SD) determined between 20.0 ± 1ºC and 28.4 ± 1ºC was 2.57 ± 1.07. Tile metabolic rate obtained for *E. complanata* was lower than expected for an errant species, reflecting the more sedentary mode of life of the polychaete, and adaptation to an environment in which the animal may la exposed to low oxygen availability.

Key words: oxygen consumption, polychaete, *Eurythoe complanata.*

A series of internal factors (species, size, sexual maturation, daily activity rhythm) and external factors (temperature, salinity, oxygen tension) produce significant variations in oxygen consumption among different animals. Shumway (1) showed that metabolic rate of the annelid polychaetes is related to mode of life, with errant species having a metabolic rate 2.4 times greater than sedentary species. This, however, cannot be considered to be a general rule. *Aphrodite aculeata* and *Hermodice carunculata* exemplify two exceptions. These species are taxonomically grouped with errant polychaetes but, due to their rather sluggish mode of life, they can be grouped metabolically with sedentary and tube-dwelling worms (1).

***Eurythoe complanata* is an errant amphinomid polychaete, frequently found in the intertidal region beneath large pebbles on muddy sand beaches along the Brazilian coast. Compared to other errant polychaetes, *E. complanata* has a more sedentary way of life, being photophobic, cryptic, non-predator, with a nocturnal activity rhythm. The objective of the present study was to measure the oxygen consumption of young and adult specimens of *E. complanata*, determine how this parameter is affected by body size, and compare the data for metabolic rate with the mean values presented by Shumway (1) for errant and sedentary species, in order to determine to which of the metabolic groups the polychaete should be assigned.**

Young and adult specimens of *Eurythoe complanata* (0.15-4.74 g) were collected in São Sebastião, São Paulo coast, Brazil and maintained in aquaria with seawater (3.2 %) under adequate aeration at 25.0 ± 1ºC. The polychaetes were acclimatized to 20.0 ± 1ºC and 3.2 % salinity, 24 h prior to the experiments, and were then individually confined in 100-ml respirometers with seawater equilibrated with air, under continuous mild agitation provided by a magnetic stirrer. Oxygen consumption was measured with a Dm-1/Dm-2 Digimed diluted oxygen meter, whose oxygen electrode was attached to the top of the respirometer. Oxygen consumption is reported as ml O_2/h and the mass specific oxygen consumption rate as ml $O_2\ h^{-1}g^{-1}$. The oxygen consumption of another group of young polychaetes weighing 0.30-0.55 g was determined at 28.4 ± 1ºC and compared with the values obtained at 20.0 ± 1ºC for animals with the same range of body mass. The Q_{10} value was calculated using the following equation (2):

$$Q_{10} = \frac{K_1}{K_2}^{\left(\frac{10}{t1-t2}\right)}$$

The experiments were performed at the same time of day, from 17:00 to 20:00 h in the presence of dim homogenous room illumination.

Figure 1

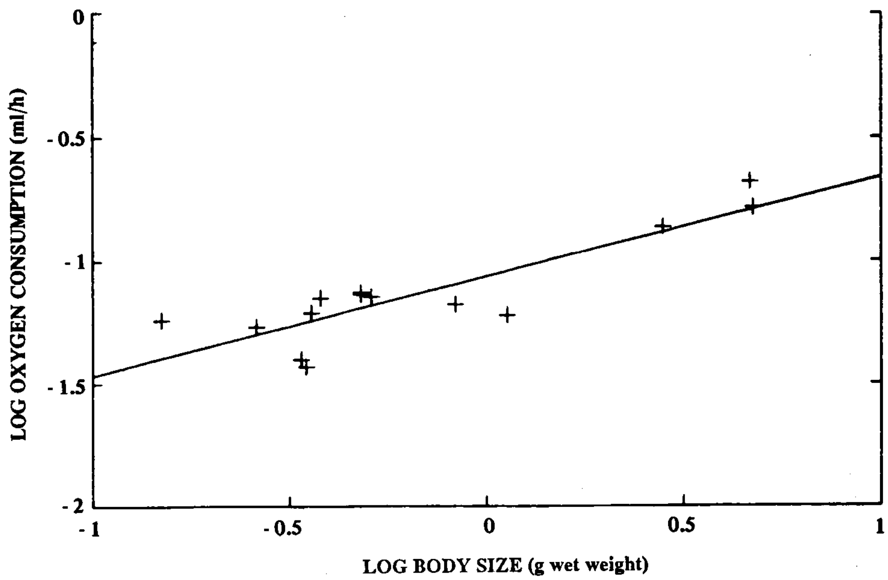

Figure 1 - Relationship between *Eurythoe complanata* oxygen consumption and body size. The measurements were made at 20 ± 1°C and 32°/oo salinity on 14 polychaetes weighing 0.15-4.74 g wet weight. The regression equation is MR = $0.086.W^{0.40}$, r^2 = 0.76, P<0.01.

The regression line relating *Euiythoe* oxygen consumption at 20°C and 3,2 % salinity to body size (0.15-4.74 g) is shown in Figure 1. The regression equation MR = aW^b calculated was MR = $0.086.W^{0.40}$, $r^2 = 0.76$ (P<0.01) (N = 14), where MR is the metabolic rate and W is the body mass in grams, b is the slope of the plot of logarithm oxygen consumption *vs* the logarithm of body mass, and a (intercept) is a proportionality constant. The calculated Q_{10} for a group of young polychaetes weighing 0.30-0.55 g was 2.57 ± 1.07 (N = 7) at 3,2 % salinity.

According to Hemmingsen (3), the standard metabolism of all poikilotherms is proportional to the 0.75 power of body mass. The values for the exponent b in polychaetes lie in the 0.41-0.79 range, with a simple arithmetic mean of 0.61 t 0.11(1), not significantly different from the Hemmingsen value of 0.75. The b value 0.40 obtained in the present study for *Eurythoe* is at the lower limit of the b value range for polychaetes, and is equal to that obtained for the other errant amphinomid polychaete *Heritiodice carunculata* (26°C; 3,5 % S) (4).

Errant polychaetes have a mean a value of 0.344 ± 0.024 and sedentary polychaetes have a mean a value of 0.144 ± 0.047 (1). The value of a = 0.086 obtained for *Eurythoe* in the present study is lower than expected for an errant polychaete. This small a value suggests that the metabolic requirements of *Eurythoe* are similar to those of sedentary worms. In fact, despite being an errant species, *Eurythoe* does not show bursts of activity and spends most of its time under the rocks. However, it exposes parts of its body, and even leaves its refuge to forage for food. Furthermore, it is interesting to note that small b values reflect small differences in the metabolic rate of the same animal as it grows in size. Thus, the oxygen demand of young and adult species should not be very different. In the case of *Eurythoe,* the low value obtained for b agrees with the sluggish nature of the animal and would be compatible with its gregarious mode of life, with adult and young polychaetes sharing the same space and oxygen in a habitat where they can be subjected to low oxygen availability.

Polychaetes living in habitats similar to that of *Eurythoe,* such as the sedentary species *Cirinformia tentaculata* which commonly lives in blackened sediments beneath stones in the intertidal zone, have been extensively studied (5-8). *C. tentaculata,* like *Eurytltoe,* can face two situations during tide cycles: as the tide retreats worms are left in a film of slowly flowing seawater which is relatively well oxygenated, or, in the other situation, the water will gradually dram away leaving isolated pools of stagnating water around and under the rocks. Field measurements suggest that the total absence of oxygen does not occur naturally, but hypoxia will gradually increase during exposure (6). *C. tentaculata* is well adapted to survive temporary hypoxia. With increasing hypoxia, the animal can gradually switch from aerobic energy metabolism to anaerobic energy metabolism, with accumulation of alanine and succinate (6,8). *C. tentaculata* also has low rates of oxygen consumption (5,6), reflected in its sluggish mode of life. Its erythrocruorins (extracellular hemoglobins) show high oxygen affinity, a pronounced Bohr shift, and non-cooperativity, thus being able to transport and store oxygen under conditions of extreme hypoxia (5,7).

This ability to use both aerobic and anaerobic metabolism for energy production, which enables the animal to adapt to extremes of oxygen availability, might also be a characteristic of *Eurythoe.* However, this remains to be demonstrated. A recent study of the extracellular hemoglobin of *Eurythoe* has shown that this hemoglobin presents weak cooperativity and almost no Bohr effect (9). The absence of a pronounced Bohr effect suggests that *Eurythoe* hemoglobin is not as specialized as *C. tentacutata* hemoglobin, losing its oxygen transport capacity during hypoxia, when the pH decreases as a result of the accumulation of the by-products of anaerobic metabolism. Further studies are needed to clarify this and other aspects of the metabolic adaptations of *Eurythoe.*

The results indicate that *Eurythoe complanata* is another exception to Shumway's (1) metabolic classification system for errant and sedentary polychaetes. Although taxonomically grouped among the errant polychaetes, its metabolic rate is closer to that of sedentary polychaetes.

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