THE ECOLOGICAL MEANING OF RELATIVE EGG SIZE IN SOIL AND FRESHWATER NEMATODES

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Data from the literature were used to compute the relationship between egg and body volume for 463 species of soil and freshwater nematodes. The regression line was calculated. Departures from this line for each species are considered to be an "egg index". The index is negative for r-strategist and pollution indicator species and positive for K-strategist and clean habitat species. Results are given for average data for 35 genera and 4 suborders. Rhabditina and Diplogastrina have very negative egg indices. The meanings of the index are discussed.

Keywords: egg volume, nematode volume, r-strategists, K-strategists, pollution index, nematode ecology.

The nematode communities of organic-rich and organic-polluted habitats were examined by Micoletzky (1917); Paesler (1946); Völk (1950); and Hirschmann (1952). Zullini (1976a) found a good correlation between the percentage of class Secernentea in a river and organic pollution expressed as chemical oxygen demand (COD) and dissolved oxygen in the water. He suggested using percentage of Secernentea as a pollution index. The correlation was confirmed in other studies by Tsalolichin (1976), Zullini (1976b, 1977), Zullini & Pacchetti (1985) and by Eder & Kirchengast (1982).

Heyns (1976) suggested that plant parasitic Tylenchida occupy a different ecological niche and that they must therefore be excluded from pollution indices. Thus, we propose the percentage of individuals of the order Rhabditida, in the total non-Tylenchida nematodes, as a nematological pollution index (following the classification of Andrássy, 1984).

There are some exceptions to the ecological correlations just described. Fictor ficlor (Diplogastrina) has been observed in clean water only, and therefore was excluded from the pollution indicator species (Zullini, 1976a). While Heyns (1976) found that species of Tobrilus and Monhystera (Adenophorea), are typical of polluted water, Zullini (1976a) showed that species of these genera are frequent in lightly polluted waters. Zullini (1976a) found that suborder Rhabditina are far more abundant in heavily polluted habitats.

With this as background, it is clear that an objective criterion is required to assess the ecological role of each species. We consider that reproductive strategy is closely correlated with the pollution gradient, since it results from
ecological factors. We therefore consider r-strategist nematodes to be opportunistic, colonizing species, probably well adapted to bacteria-rich substrates typical of polluted habitats and conversely, K-strategist nematodes, which are persistent species that live in clean habitats containing less organic matter, have a lower rate of reproduction [see Pianka (1970) for an account of r- and K-strategies].

Methods for evaluating and separating the nematodes into two such categories are not easy because few species have been raised in the laboratory to study their reproductive effort, physiology and ecology. We have tried to overcome this lack of data by an indirect and morphological method. Since r-strategists produce numerous and therefore small eggs, and K-strategists behave in the opposite way, the ratio of egg volume to nematode volume may provide a useful means of categorizing nematodes into these two groups.

METHODS

Descriptions of nematodes seldom contain egg dimensions. All the available data concerning soil and freshwater nematodes provided 534 sets of egg measurements from 463 species. Some of them are average values quoted by a single investigator.

If L and W are the length and width of an egg, the shape of an egg can be taken as a cylinder with radius (W/2) and height (L-W) plus two hemispheres at each extremity, each with radius (W/2). Thus:

\[
\text{egg volume} = \left(\frac{W}{2}\right)^2 \pi (L-W) + \frac{4}{3} \pi \left(\frac{W}{2}\right)^3
\]

The volumes of the nematodes were calculated from the female body size given by the same investigators, using the formula of Andrássy (1956).

The relation between these volumes was calculated by regression. The distance of selected groups from this regression line was calculated to see which species are above and which are below the line and what their distance from the line is. The following calculation:

\[
\text{(egg volume)} - \text{(theoretical egg volume)}
\]

for each species gives these measurements.

RESULTS

The correlation between egg volume (y) and body volume (x), both on a logarithmic scale, is shown in Fig. 1. The regression line is

\[
\log y = 2.39 + 0.58 \log x
\]

Correlation coefficient \( r = 0.81 \) (significant at 99.9\% for \( n = 463 \)). Comparison of data for the different species with the egg volumes expected (indicated by the line \( y = 0 \)) for given body volumes is given in Fig. 2. Points below the line have negative values and represent species with relatively small eggs (i.e., r-