

*Short note*

# Proposed changes of c-p classification for nematodes

Tom Bongers<sup>\*</sup>, Ron G. N. de Goede<sup>\*\*</sup>, Gerard W. Korthals<sup>\*</sup> and Gregor W. Yeates<sup>\*\*\*</sup>

<sup>\*</sup>Nematology Department, Wageningen Agricultural University, PB 8123 NL-6700 ES, Wageningen, the Netherlands.

<sup>\*\*</sup>Biological Station of the Wageningen Agricultural University, Kampsweg 27, NL-9418 PD, Wijster.

<sup>\*\*\*</sup>Landcare Research, Private Bag 11052, Palmerston North, New Zealand.

Accepted for publication 25 January 1995

Increasingly nematodes are being used in environmental studies. One method used to detect and interpret changes in nematode community structure is the Maturity Index (MI), which is based on changes in the proportions of taxa with time (Bongers, 1990). The index was developed by allocating nematode taxa to five groups: from 'colonizers' with a value 1 through intermediate values to 'persisters' with a value 5. The MI is the weighted mean for the c-p values of the taxa in a given sample and can range from 1, under 'food-rich' conditions, to a maximum recorded value of approximately 4 under more stable and more 'food-poor' conditions. Colonizers are opportunists characterized by, for example, their rapid reproductive rate.

Recently, it was reported (De Goede et al., 1993) that a distinction between 'enrichment opportunists' and 'general opportunists', as proposed by Pearson and Rosenberg (1978), also can be applied to nematodes. Pearson and Rosenberg (1978) considered general opportunists as 'the initial colonizers' of any denuded area irrespective of the richness of the substratum, whereas, 'enrichment opportunists' are those initial colonizers which only colonize organically rich areas. Thus, these authors considered enrichment opportunists as a subgroup of the general opportunists. In our opinion, these groups should be used in a complementary manner for nematodes.

De Goede et al. (1993) used the classification of the nematode fauna into enrichment opportunists (c-p

1), general opportunists (c-p 2) and persisters (c-p 3/5) to detect changes in nematode community structure which are not directly expressed in the Maturity Index. An equilateral triangle was used to graphically present the relative abundances of these three groups. Changes can be interpreted referring to enrichment, stress and succession or recovery, based on shifts in relative abundance between these three groups.

A rectangular variant of a c-p triangle is displayed in Figure 1 in which percentage abundance for appropriate c-p groups are plotted for enrichment, expressed by a shift to the upper left, stress to the lower left and natural succession or recovery to the right (Fig. 1).

A slight increase in microbial activity can also stimulate general opportunists (c-p 2) without stimulating 'enrichment opportunists'. In such cases enrichment-induced shifts might be incorrectly ascribed to 'stress' although the absolute number of persisters does not increase.

Following the redefinition of c-p 1 as enrichment opportunists it is necessary to evaluate the original c-p scaling of nematodes taxa as defined by Bongers (1990) and Bongers et al. (1991). To correctly interpret the MI and c-p triangle, two consequent changes have to be made.

1. Monhysteridae were originally scaled as extreme colonizers (c-p 1) based on their tolerance to pollutants and survival under extreme conditions.

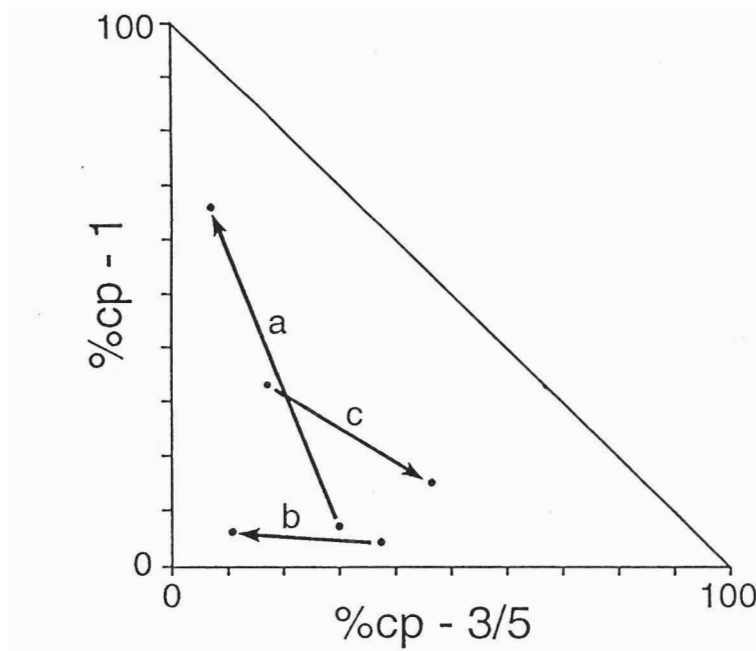


Fig. 1. C-p triangle showing shifts during a) eutrophication, initial situation and 2 weeks after adding powdered cow-dung (Ettema & Bongers, 1990; Table 2); b) artificial acidification of coniferous forest soil (Hyvönen & Persson, 1990; Table 3) and c) recovery, 33 and 44 weeks after organic manuring (Ettema & Bongers, 1990; Table 2).

However, if c-p 1 is defined as 'enrichment opportunists', monhysterids have to be transferred to the group of general opportunists (c-p 2). These nematodes also occur under food-poor conditions and do not form dauer larvae.

2. Myolaimidae which occur in decaying organic material (Andrassy, 1984) were originally scaled in c-p 2 but are better referred to 'enrichment opportunists'. Their systematic relationship with panagrolaimids, diplogasterids and rhabditids, scaled in c-p 1, supports this proposal.

Wasilewska (1994) proposed transferring some of the most tolerant taxa in c-p 2 to c-p 1. *Paratylenchus* and *Acrobeloides* occur under 'food-poor' conditions therefore, according to the adapted definition, we prefer to consider them as 'general opportunists' and thus they remain in c-p 2. The proposed changes for Myolaimidae and Monhysteridae, and the earlier down-grading of Leptolaimidae (Bongers et al., 1991) represent a minimal influence to published MI - values.

## REFERENCES

- Andrassy, I. 1984. *Klasse Nematoda. Bestimmungsbücher zur Bodenfauna Europas*. Lieferung 9. Akademie-Verlag, Berlin. 509 pp.
- Bongers, T. 1990. The maturity index: an ecological measure of environmental disturbance based on nematode species composition. *Oecologia* 83: 14-19.
- Bongers, T., Alkemade R. & Yeates, G. W. 1991. Interpretation of disturbance-induced maturity decrease in marine nematode assemblages by means of the Maturity Index. *Marine Ecology Progress Series* 76: 135-142.
- Ettema, C. H. & Bongers, T. 1990. Characterization of nematode colonization and succession in disturbed soil using the Maturity Index. *Biology and Fertility of Soils* 16: 79-85.
- Goede, R. G. M. de, Bongers, T. & Ettema, C. H. 1993. Graphical presentation and interpretation of nematode community structure: c-p triangles. *Mededelingen Faculteit Landbouwkundige en toegepaste biologische wetenschappen Universiteit Gent* 58/2b: 743-750.
- Hyvönen, R. & Persson, T. 1990. Effects of acidification and liming on feeding groups of nematodes in coniferous forest soils. *Biology and Fertility of Soils* 9: 205-210.
- Pearson, T. H. & Rosenberg, R. 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. *Oceanography and Marine Biology Annual Review* 16: 229-311.
- Wasilewska, L. 1994. Maturity and diversity of nematodes versus long-term succession after stress. *Abstracts 22nd International Nematology Symposium, August 1994, Gent*: 134.