# Nematode Diversity and Distribution in Different Forest Soil Habitats

**Tochi S. Panesar**

Research Associate, Department of Soil Science, University of British Columbia
Vancouver, B.C.

**Valin. G. Marshall**

Adjunct Professor, Department of Soil Science, University of British Columbia
Vancouver, B.C.
Research Scientist, Pacific Forestry Centre
Victoria, B.C.

## Introduction

Forestry activities in British Columbia in the past have included one or more of the following: clearcutting of old-growth forests, burning of residues, replanting with single species trees, fertilization, use of herbicides, and periodic thinning. In recent years, concern over impoverishment of biological diversity resulting from these practices has grown. At the same time, there is increasing awareness and consensus that the long-term sustainability of forest resources will depend largely on conserving overall biodiversity in these ecosystems (Boyle 1992). Recent research in coastal northwest forests has pointed to differences in plant and vertebrate species diversity between old-growth and managed and natural second-growth forests (e.g., Hansen *et al.* 1991). Parallel information on invertebrate diversity in forest ecosystems of these regions is essentially lacking.

Among the diverse groups of invertebrates that inhabit forest soils, nematodes are the most abundant. A forest soil may contain over 100 nematode species, and several million individuals per surface square metre. Their trophic and other interactions with cohabiting soil bacteria, protozoa, fungi, and microarthropods have important influences on essential soil processes and plant growth. Relationships of nematode taxa in forest soils to tree species or soil characteristics are indicated. Sensitivities of nematode taxa to soil conditions make them useful biological indicators, of, for example, site stability, the restoration capacity of soil ecosystems following anthropogenic or natural disturbances, and the presence of certain pedological conditions. Nematodes in at least two families have emerged as important biological control agents of soil-inhabiting insects. All these aspects of nematodes were reviewed in a previous report by Panesar and Marshall (1992).

In managing for conservation of soil fauna diversity, the first logical step is to produce good inventories of the species present. While our aim is to compare nematode diversity and distribution in a full suite of seral stages of forest development in each of three chronosequence sites, we present here results of our preliminary investigations at the old-growth seres at two sites (Table 1).

## Methods

Soil is defined here in its broader sense, that is, the substrate in which vegetation takes root, including the dead organic material in and upon the mineral structure. Therefore, soil refers here to the "soil-rhizosphere" complex for species of trees, understory vegetation, and moss (Table 1). Five replicate samples were obtained for each complex by means of a 5 cm diameter metal corer. Each sample was divided into its organic and inorganic horizon, and each horizon was considered as a "habitat." The five samples for each habitat were bulked to eliminate nematode aggregative effect. For tree species, coring was done at "bare spots" under the canopy to minimize rhizosphere influence of understory vegetation. For understory plants, coring was done after the above-ground parts were clipped. In the case of moss on logs, the moss mat covering decayed logs and the substrate (i.e., the decayed log complex) were considered as two separate organic horizon habitats. Baermann funnels were used to extract nematodes from a single subsample, of known weight and volume, from the bulked sample for each habitat. Nematodes in three aliquots were counted to obtain a mean count that was used to express nematode abundance per gram of oven dry weight (ODW) of the habitat. Nematodes were fixed in FA 4:1 fixative, and processed and mounted in glycerine.

TABLE 1. Nematode abundance and moisture content for organic and inorganic horizon (OH, IH) habitats of the rhizospheres of species of trees, understory vegetation, and moss, at two old-growth forest sites (GVWS, MBCK[a]). Abundance = number of nematodes per gram of ODW of a habitat sample (s, w = summer, winter sampling).

| | No. of nematodes | | | | % Moisture content | | | |
|---|---|---|---|---|---|---|---|---|
| | OH | | IH | | OH | | IH | |
| | s | w | s | w | s | w | s | w |
| **GVWS:** | | | | | | | | |
| Douglas-fir | 29 | 46 | 6 | 5 | 29 | 57 | 19 | 16 |
| Cedar | 46 | 82 | 3 | 6 | 37 | 54 | 8 | 20 |
| Hemlock | 27 | 68 | 3 | 4 | 32 | 62 | 12 | 22 |
| Alder | 29 | 42 | 2 | 6 | 50 | 61 | 8 | 24 |
| Bracken fern | 16 | 13 | 4 | 7 | 42 | 57 | 15 | 54 |
| Sword fern | 23 | 41 | 2 | 4 | 39 | 58 | 17 | 23 |
| Oregon grape | 44 | 47 | 3 | 8 | 32 | 48 | 16 | 21 |
| Salal | 22 | 26 | 1 | 3 | 37 | 59 | 19 | 19 |
| Step moss on ground | 23 | 72 | 10 | 9 | 38 | 65 | 24 | 22 |
| Step moss on log | 49 | 50 | 25 | 39 | 45 | 61 | 74 | 69 |
| **MBCK:** | | | | | | | | |
| Douglas-fir | 26 | 64 | 6 | 3 | 29 | 64 | 13 | 23 |
| Cedar | 60 | 26 | 13 | 23 | 61 | 43 | 54 | 27 |
| Hemlock | 51 | 91 | 6 | 17 | 42 | 69 | 11 | 34 |
| Alder | 37 | 53 | 3 | 5 | 58 | 70 | 12 | 35 |
| Bracken fern | 18 | 5 | 9 | 11 | 44 | 44 | 13 | 23 |
| Sword fern | 12 | 65 | 6 | 7 | 16 | 71 | 31 | 23 |
| Oregon grape | 19 | 54 | 2 | 9 | 50 | 53 | 15 | 24 |
| Salal | 12 | 31 | 1 | 2 | 41 | 53 | 15 | 23 |
| Step moss on ground | 38 | 84 | 9 | 23 | 48 | 75 | 12 | 44 |
| Step moss on log: | | | | | | | | |
| moss mat | 23 | 34 | – | – | 59 | 67 | – | – |
| decayed log | 23 | 6 | – | – | 58 | 57 | – | – |

[a] GVWS: Greater Victoria Watershed South, near Shawnigan Lake.
MBCK: MacMillan Bloedel's Cowichan-Koksilah holding, near Duncan.

## Results and Discussion

Nematode abundance and % moisture content for the various forest soil "habitats" are shown in Table 1. Since the replicate samples for each habitat were bulked before subsampling, for reasons given above, the following comparisons are not based on statistical analysis. Moreover, the main objective of the preliminary work was to test field and lab methods, and produce a provisional list of nematode taxa. Even so, certain trends are evident:

1. Nematode abundance was in general higher in winter than in summer.
2. At least one factor for this variation appears to be the consistently higher "habitat" moisture levels in winter.
3. Nematode abundance was generally much higher in organic than in inorganic horizons of most habitats.
4. Rhizospheres of particular species of trees or understory vegetation constitute more favourable habitats for nematodes than do the rhizospheres of others.
5. Moss cover on ground and on logs is consistently a rich source of nematodes.

A composite list of 25 nematode genera identified to date from representative habitats consists of: *Achromadora, Acrobeles, Acrobeloides, Aphelenchoides, Aphelenchus, Aporceliamellus, Cephalobus, Cephalenchus, Chronogaster, Clarkus, Cryptonchus, Dorylaimus, Eudorylaimus, Iotonchus, Labronema, Miconchus, Mononchus, Monhystera, Paraphelenchus, Plectus, Prionchulus, Prismatolaimus, Pungentus, Teratocephalus*, and *Tylencholaimellus*. Many other families are represented in the collection. The number of genera is expected to increase several-fold as identification work progresses. Specific identification of the old-growth forest soil nematodes is currently the most important aspect of this study. This baseline information will allow diversity analyses and comparisons to be made with other successional stages of forest development.

### References


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