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Dipartimento di Biologia Animale, Università di Catania, Italy

FAUNISTIC AND ECOLOGICAL ANALYSIS OF THE SOIL NEMATODE COMMUNITY OF A HOLM-OAK WOODLAND ON ETNA

by
M.T. VINCIGUERRA and L. GIANNETTO[1]

Studies on the composition and role of soil fauna in Italy are few and mainly concern Arthropoda. In particular, little is known about Nematodes of Mediterranean biotopes, which are a quantitatively very significant component of the soil fauna. The few records mainly refer to faunistic composition (Marinari *et al.*, 1980, 1982) and there are no quantitative studies on the nematocenosis structure.

As a first attempt in this direction we carried out a study of the faunistic and ecological composition and of the vertical distribution of nematode populations in the litter and upper layers of soil in a *Quercus ilex* woodland, a typical Mediterranean ecosystem whose dynamics are so far little known. The chosen woodland is located on the Etna volcano (Sicily, Italy) at about 1000 m above sea level, on the slopes of a small crater (Monte Minardo). In this area of the volcano most of the woods have been subjected to cutting for many years and are actually coppices, but in the last decades many coppices have remained uncut and are being allowed to return to forests. In the sampled area the trees had not been cut for about twenty years. The soil was rather homogeneous and covered with litter, whose thickness varied from 0.5 to 7 cm, depending on the density of the trees. The soil profile (from Alicata *et al.*, 1974) is illustrated in fig. 1. Soil pH was 6.7. Our research concerns the horizons A_{00} and A_0 and the purpose of the investigation was to establish the distribution pattern and faunistic and ecological composition of nematodes.

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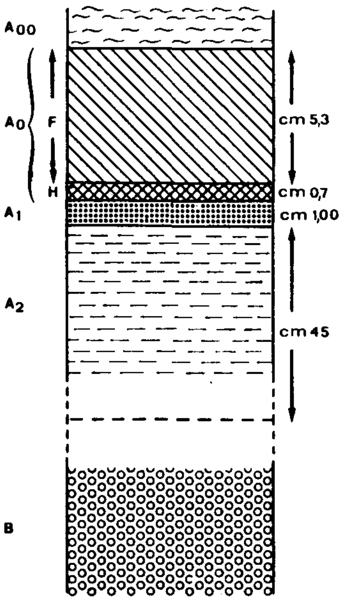

Fig. 1 - Soil profile in the holm-oak woodland studied.

Materials and Methods

Samples were taken in March 1977 at two stations (A and B), which differed from each other in the structure of the wood. In the station A the coppice, uncut for many years, was very thick, bush-like, consisting almost exclusively of holm-oaks; the litter was 4 to 7 cm thick. In the station B the coppice was returning to forest, the wood was not as thick as in A, the floristic composition was far richer and the litter was 0.5 to 1 cm thick.

At each station 9 samples were taken by means of a 5 cm diameter corer at 80 cm apart and at least 1 m distant from any tree, so as to avoid the influence of roots on the nematode composition. Each sample consisted of the litter layer (L) and 6 cm of soil, corresponding to the horizon A_0. The latter was subdivided into two subsamples (S_1 and S_2), each 3 cm deep, for investigation of the vertical distribution of nematode species. Nematodes were extracted from soil (20 g per subsample) using a Baermann funnel; they were extracted from litter (18 g per sample) by the same method, after trituration of the leaves. Nematodes were fixed in F.A.G. and mounted in dehydrated glycerin by Seinhorst's slow method.

Results and Discussion

Qualitative and quantitative analysis of the nematofauna

Table I lists the number of species, number of specimens and the variety index for each layer at the two stations. The total number both of specimens and species did not differ greatly between the two stations: the greater number of species and the greater variety index in the station B probably depend upon the greater number of herbaceous species present in this area of the wood. However, when considering the single layers, a much higher variety index and a much lower number of specimens were found in S_1 of station B compared with station A, perhaps due to the different thickness of the overlying litter. The total number of nematodes was higher in the litter layer, at both stations, than in either of the soil layers (S_1, S_2), while the variety index was higher in the soil (Table I).

The species found in the woodland are listed in Table II and Figs 2 and 3 (some species could not be fully identified either because of the low numbers present or the absence of adults). Of the 64 species found, 38 were present in both stations, 11 were exclusive to station A and 15 to station B; however, when a species was found only at one station there were usually few specimens, and thus they do not necessarily represent the evidence of a marked faunistic difference between the two stations.

Most of the species present in the woodland, especially the dominant ones, are very common and eurytopic. Nevertheless, some of them such as *Malenchus sulcus* and *Xiphinemella globilabiata* seem to be more frequent in woodlands, the latter species having been found only in some beech forests in Italy. *Discolaimus paramajor*, present only in station A but in relatively high numbers, had previously been found only in a coffee plantation in the Congo[1].

At station A there was a wide group of dominant species (*Tylencholaimus mirabilis, Acrobeles ciliatus, Aporcelaimellus obscurus, M. sulcus, Aporcelaimellus amylovorus*) each of which represented about 10% of the total number of individuals (fig. 2). At station B *A. obscurus* was the dominant species (14% of total nematodes), followed by *Plectus cirratus* (10.6%) and *X. globilabiata* (6%) (Fig. 3).

[1] This species may have a wider distribution, but it has possibly been identified as the more common and very similar *D. major*.

Table I - *Number of species (S) and specimens (N) and variety index (d) per layer at the two stations.*

	STATION **A**			STATION **B**			Species present in **A** and **B**
Layers	Species	Specimens	$d=\frac{S}{\sqrt{N}}$	Species	Specimens	$d=\frac{S}{\sqrt{N}}$	
L	34	649	1.33	42	652	1.64	26
S_1	36	555	1.53	37	356	1.26	26
S_2	29	398	1.45	33	369	1.72	23
$L+S_1+S_2$	49	1602	1.22	53	1377	1.43	38

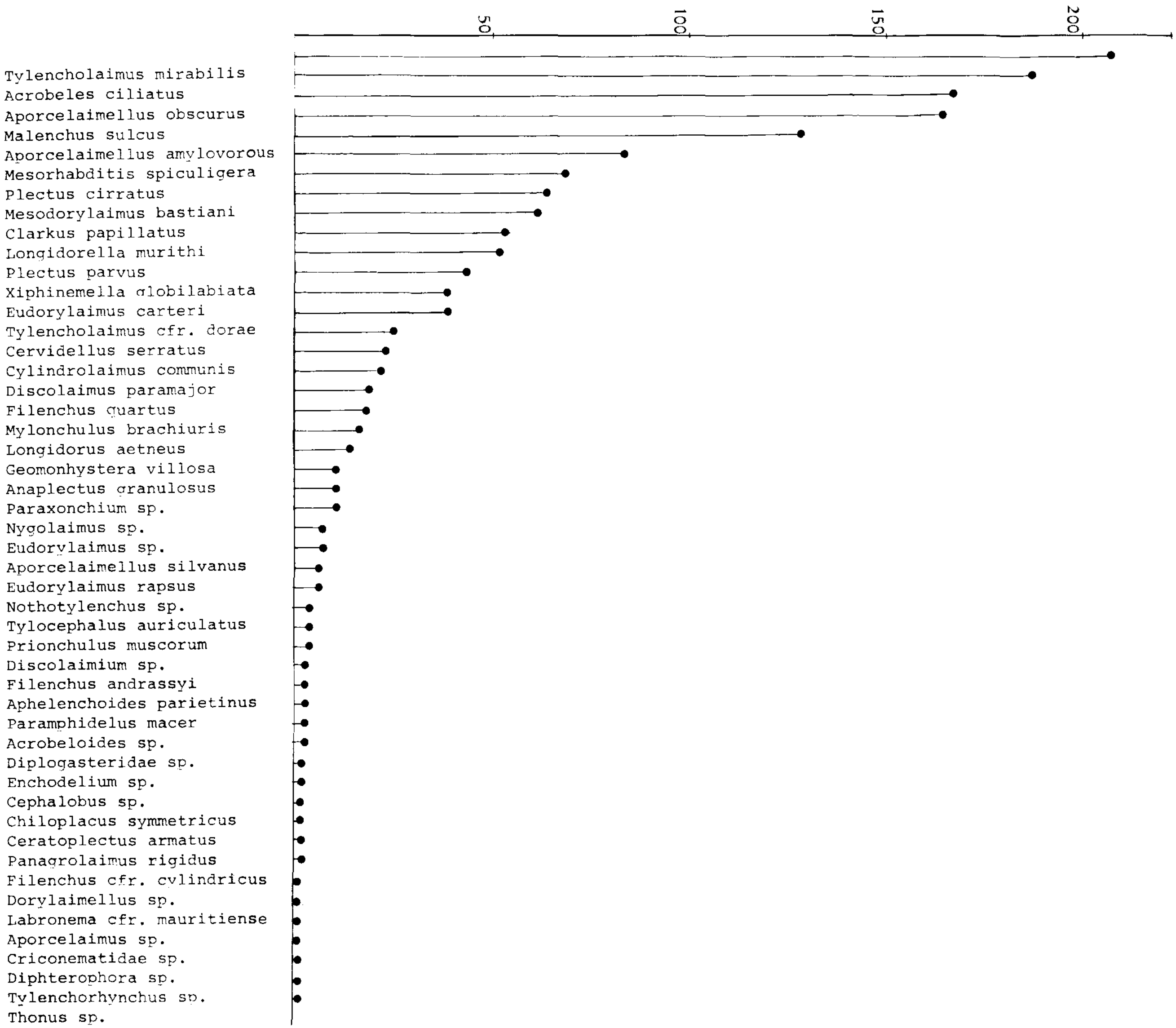

Fig. 2 - Station A. Number of specimens per species.

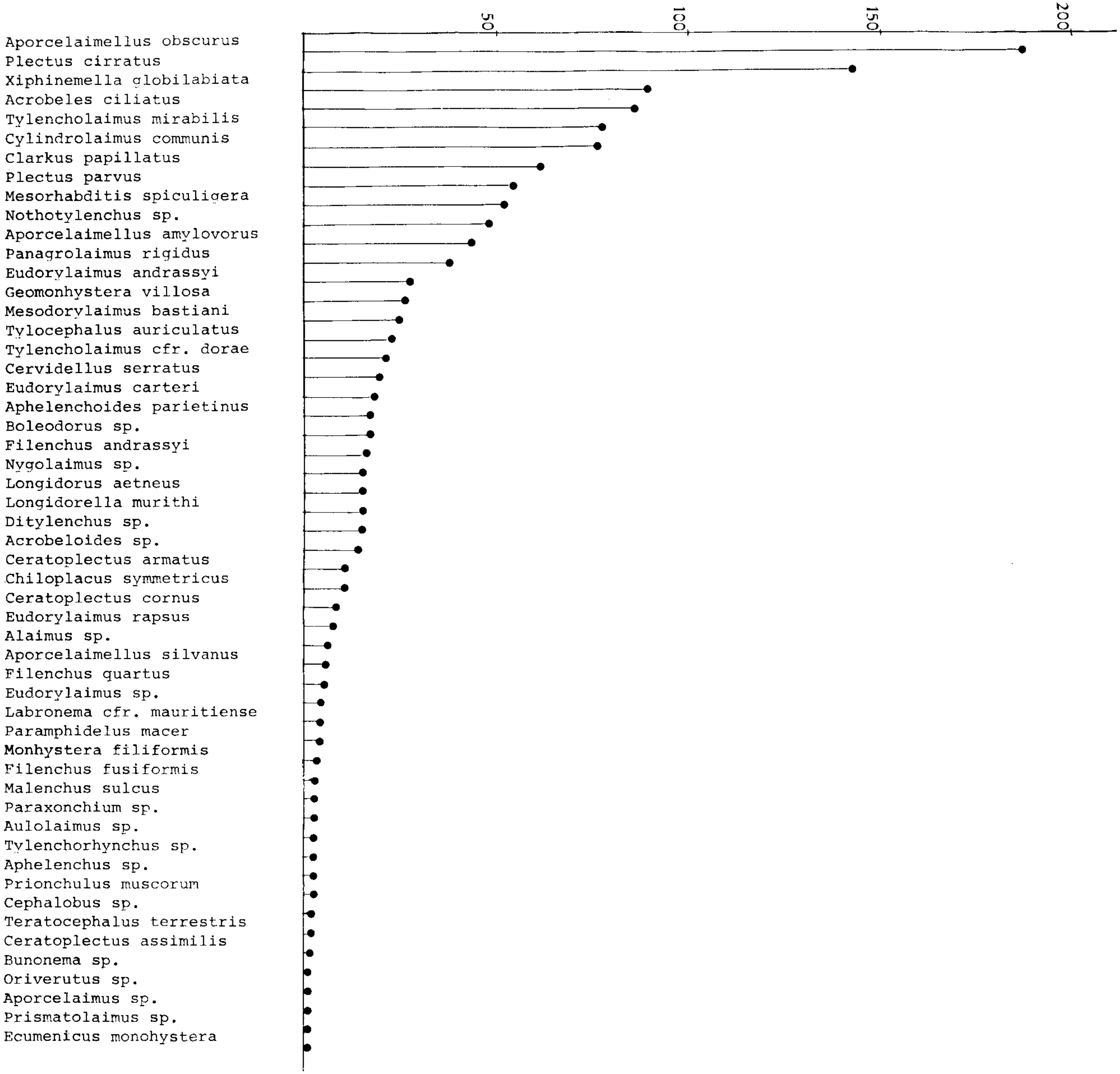

Fig. 3 - Station B. Number of specimens per species.

The dominance of *T. mirabilis* and *A. ciliatus* in a woodland soil is remarkable as Nielsen (1949) considered both species stenotopic and typical of sandy soil and Wasilewska (1970) reported that *A. ciliatus* was present in high numbers only in sand dunes and was absent or rare in woodland. However, Vinciguerra (1986a) found *T. mirabilis* well represented in beech forests in Italy and in coniferous woodlands in the Dolomites (1986b).

A comparative analysis of the per cent abundance of the species common to both stations (fig. 4) shows that the species dominant in one station also are generally abundant in the other, with the major exception of *M. sulcus* which constituted 10.2% of the total number of individuals at station A and only 0.2% at station B.

The comparative analysis of the per cent abundance for each layer (figs. 5, 6, 7) shows that at station A there was a group of dominant species in the litter: *M. sulcus*, fungal feeder, *Mesorhabditis spiculigera*, bacterial feeder, *A. amylovorus*, miscellaneous feeder, and others, while in the litter at station B a single species was clearly dominant: *P. cirratus*, bacterial feeder.

T. mirabilis, probably fungal feeder, and *A. ciliatus*, bacterial feeder, were the dominant species in S_1 at station A and *T. mirabilis* was dominant in S_2. At station B, *A. obscurus* was dominant in S_1 and very abundant in S_2, where the dominant species was *X. globilabiata*.

Vertical distribution

Fig. 8 shows the per cent distribution in the three layers of the most abundant species common to the two stations. Some species (*Mesodorylaimus bastiani, Plectus parvus, Eudorylaimus carteri, M. spiculigera, P. cirratus*) were present only or mainly in the litter, others (*X. globilabiata, T. mirabilis, Longidorus aetaneus, Nygolaimus sp.*) only or mainly in the soil. All the other species did not show any particular affinity for any layer. Almost all of the species, however, were similarly vertically distributed at both stations, with few exceptions like *Neotylenchus sp.*, which was mostly present in the soil at station A, but more abundant in the litter at station B, and *Filenchus quartus*, which was evenly distributed in the litter and in the soil, especially in S_1, at station A, while at station B it was present mostly in the litter and with a few individuals in S_2. Most of the species mainly present in the soil were abundant in S_1 at station A and in S_2 at station B, this distribution perhaps relating to the different

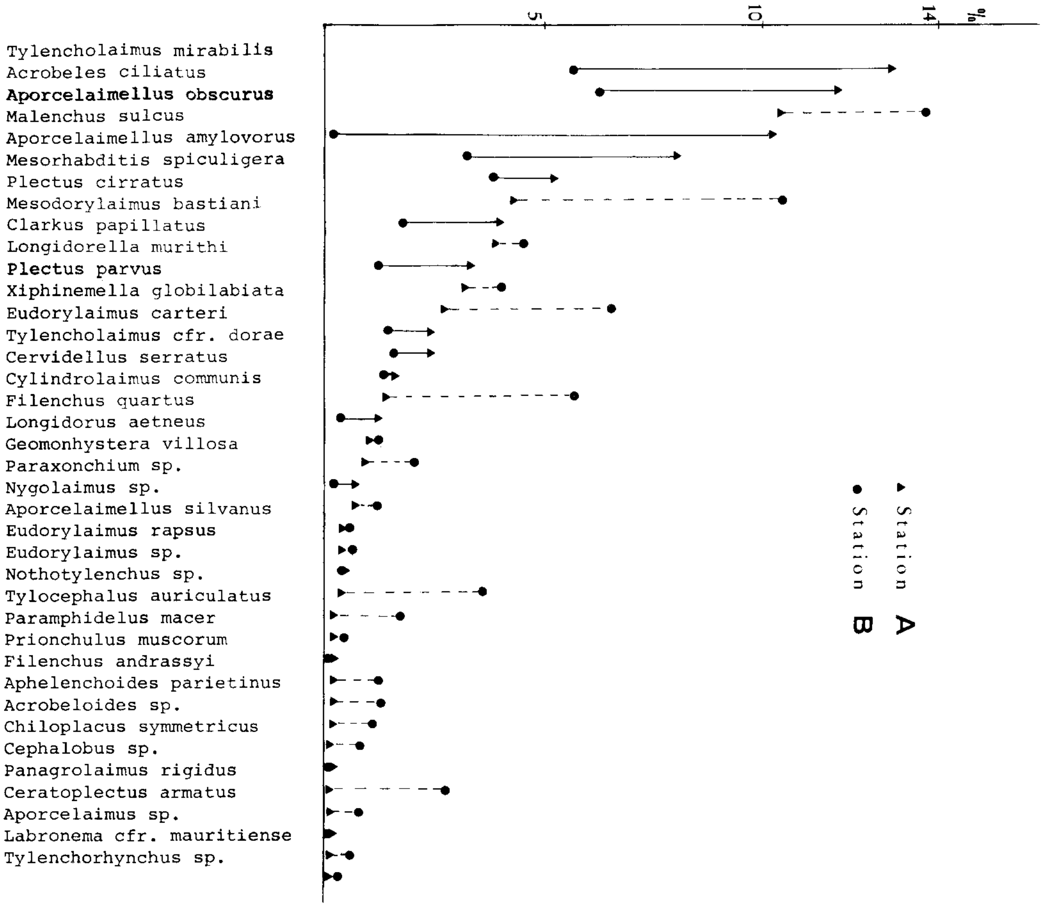

Fig. 4 - Per cent abundance of the species present in both stations.

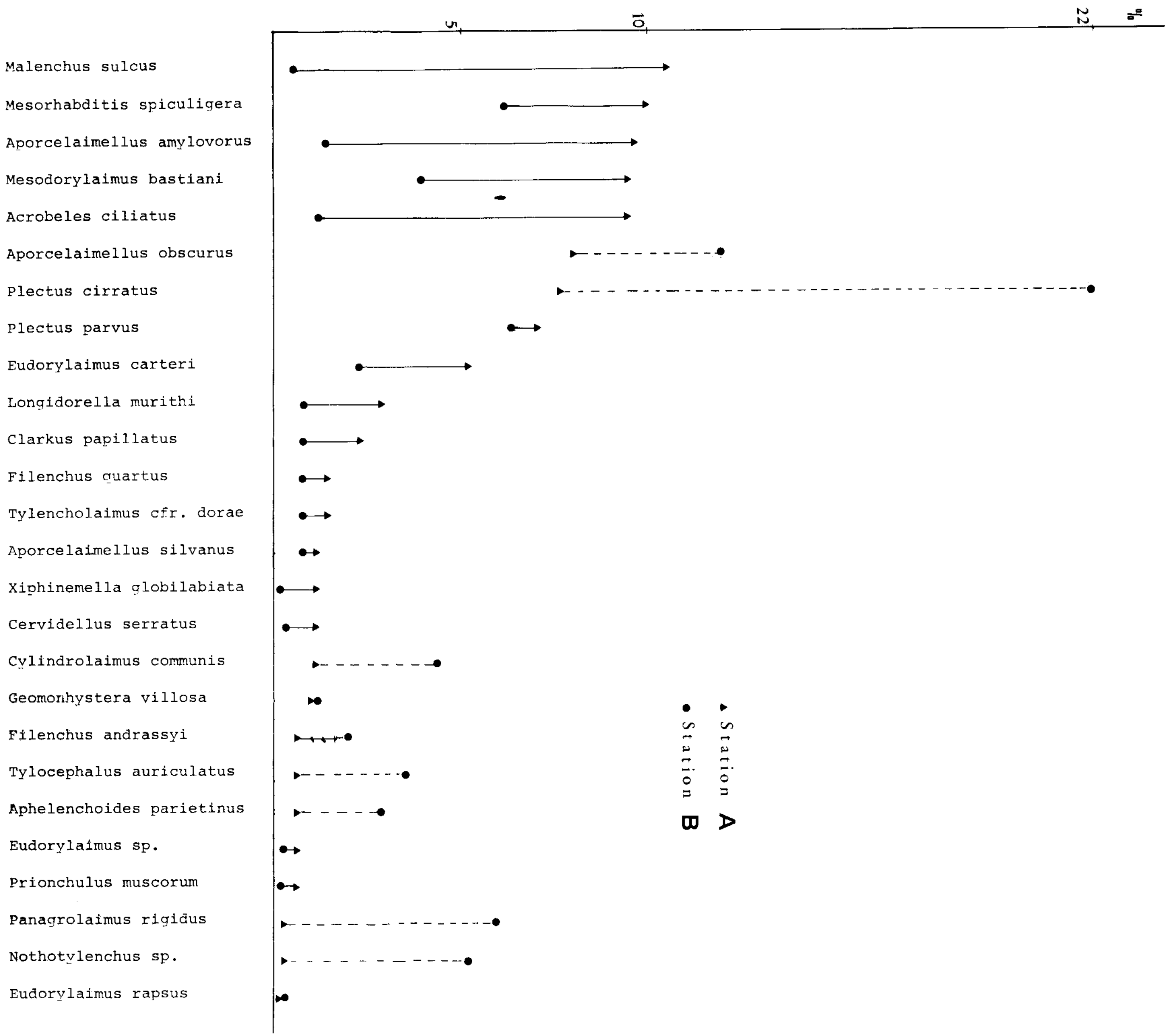

Fig. 5 - Per cent abundance of the species present in the litter of both stations.

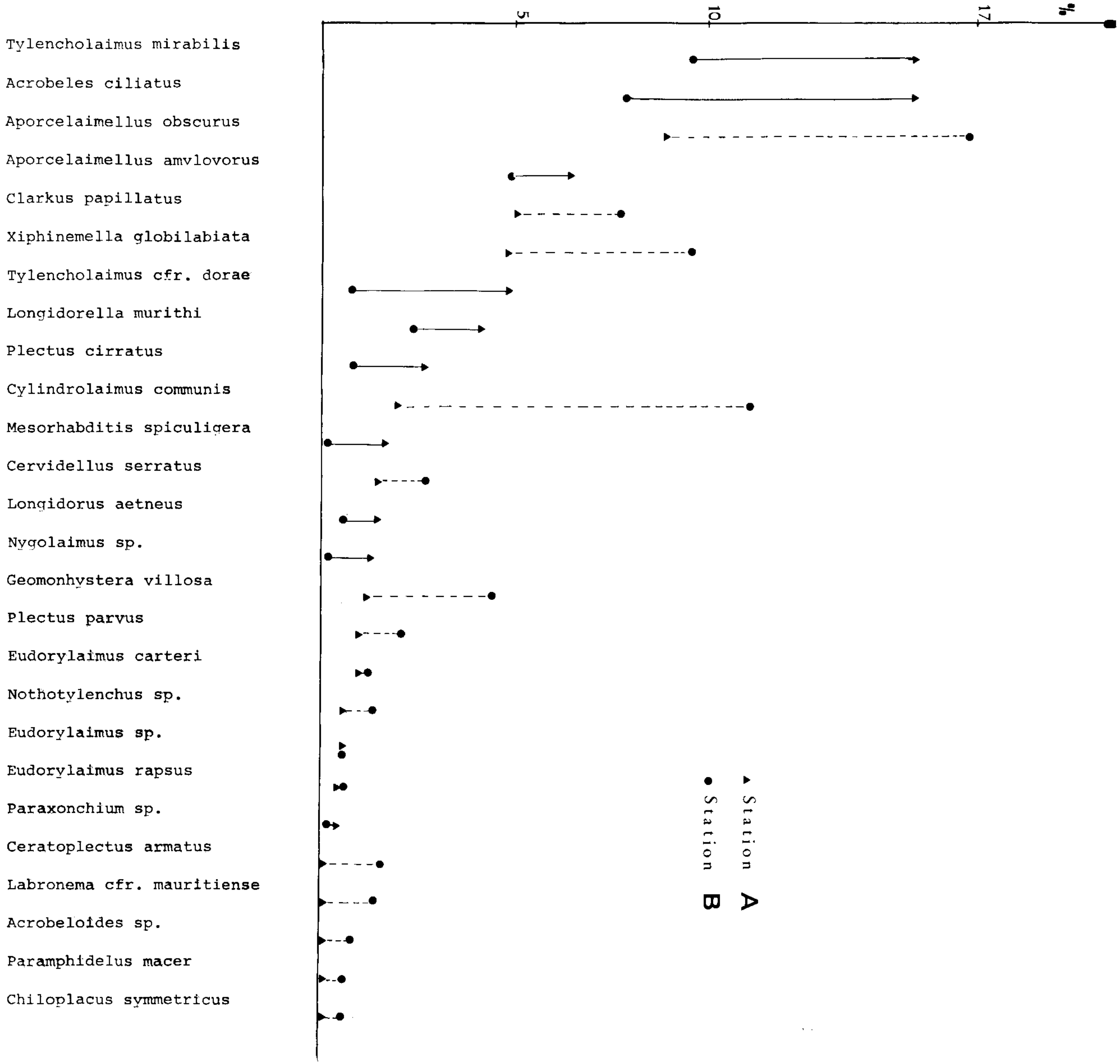

Fig. 6 - Per cent abundance of the species present in the layer S_1 of soil of both stations.

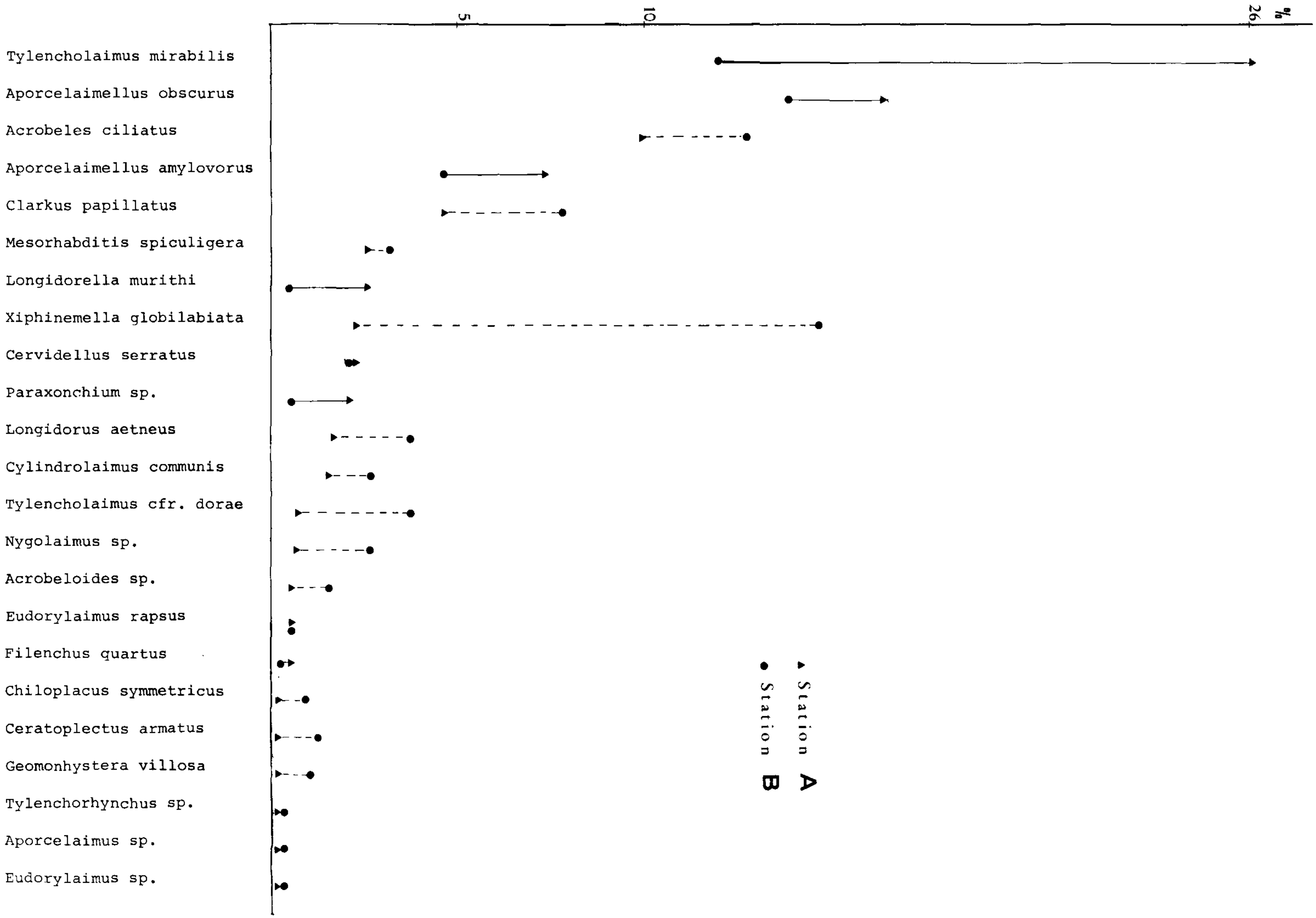

Fig. 7 - Per cent abundance of the species present in the layer S_2 of soil of both stations.

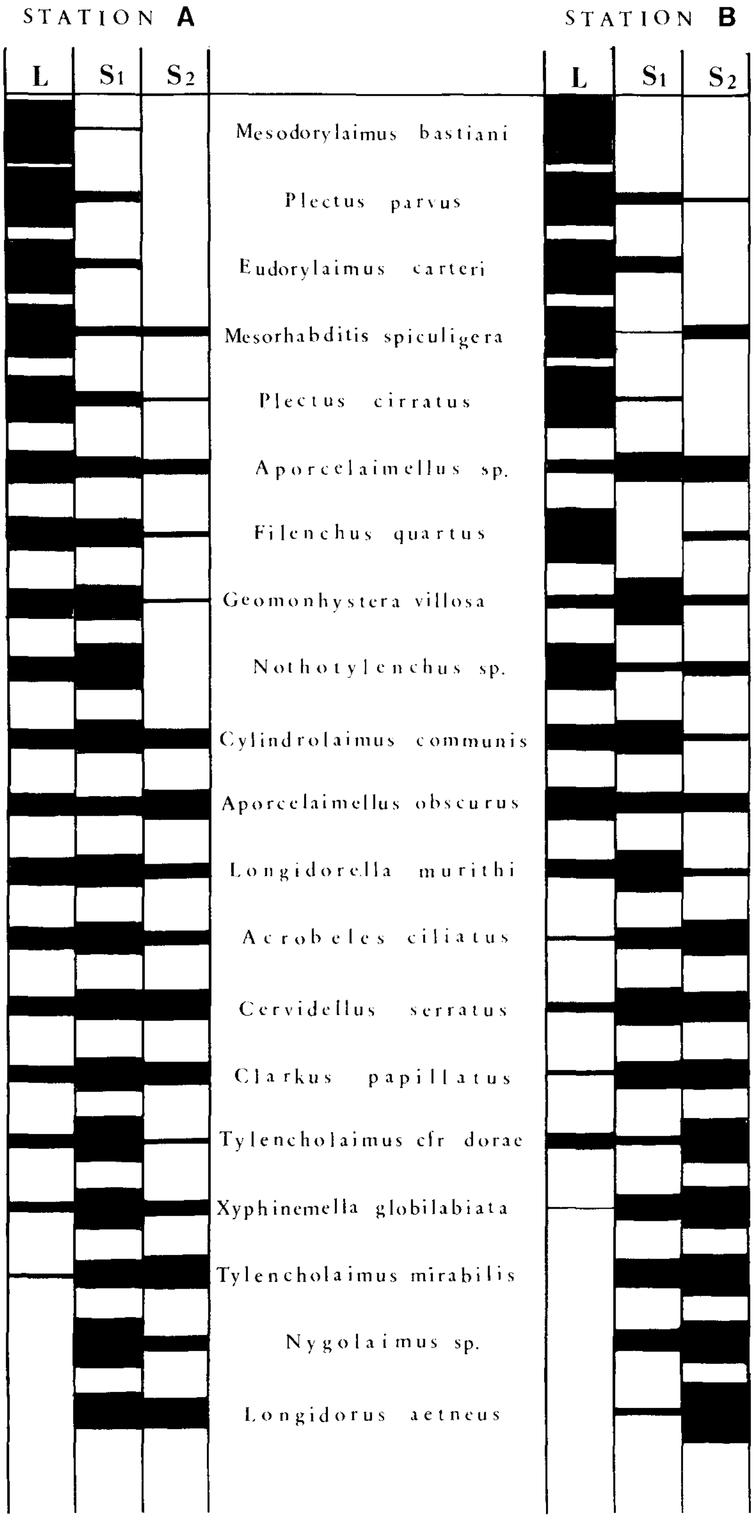

Fig. 8 - Per cent distribution in the three layers of the most abundant species present in both stations.

superficial soil moisture associated with the different thickness of the litter.

Ecological composition

The species can be grouped into five ecological categories on the basis of their prevailing feeding habits: plant feeders, fungal feeders, bacterial feeders, predators and miscellaneous feeders. The last category refers to species that feed on living animals, eggs or algae and their preferred food is rarely known, but it is significant as a group as it is rather homogeneous for other ecological characteristics, such as biological cycle, life span, etc. In this category all Dorylaimina were included, excepted the species of *Tylencholaimus*, Longidoridae and Nygolaimidae. The species of Tylenchidae, Neotylenchidae and Aphelenchidae, often included among the plant feeders, are here considered to be fungal feeders; the species of *Tylencholaimus* were included in the same group; the other species of Tylenchida and those of Longidoridae were regarded as plant feeders; Mononchina and Nygolaimidae were regarded as predators; all the other species were considered to be bacterial feeders.

Fig. 9 represents the per cent ratio among the feeding groups of nematodes (based on number of individuals and species, respectively) in the three layers at the two stations. Bacterial, fungal and miscellaneous feeders constituted the bulk of the community of nematodes. The low number of plant feeders is not surprising, as only the most superficial layers of soil were sampled, where plant roots were absent. The number of predators is generally low in all the nematocenoses, but their presence becomes more significant if calculated in terms of biomass. Moreover, many predaceous species are included among the miscellaneous feeders.

At station A the bacterial feeders (28.7% of the total number of individuals) and the fungal feeders (29.3%) were equally abundant; at station B the fungal feeders were relatively fewer (18.7%) than the bacterial feeders (40.3%). Even when the number of species is considered, the ratio between bacterial and fungal feeders is greater at station B. The different ratio is probably related to the different degree of decomposition of the litter at the two stations. At both stations the bacterial feeders were mainly abundant in the litter, where the decay processes are very active, in terms of population density, but the number of species was similar in the three layers.

The fungal feeders were more abundant in the soil than in the litter at station A, but the number of the species was higher in the litter. At

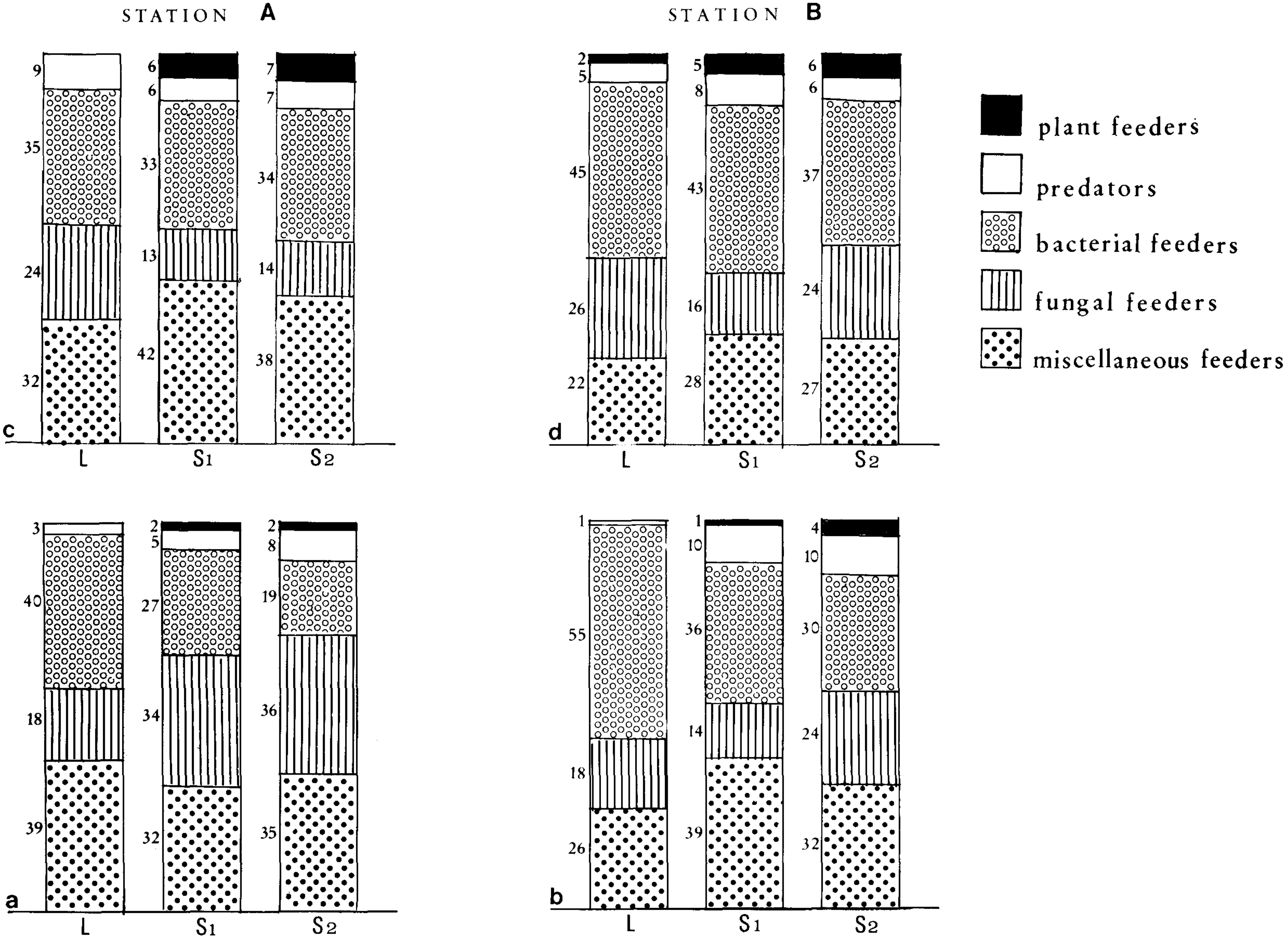

Fig. 9 - Per cent ratio of the feeding groups in the three layers of the two stations based on number of individuals (a, b) and species (c, d).

station B the largest populations were in S_2 and the lowest in S_1, in which the number of species was also lowest.

The miscellaneous feeders did not show any particular trend in their vertical distribution; they were more abundant, both in density and number of species, at station A than at station B, where the bacterial feeders predominated. Their relatively high numbers at station A, where the forest had been indisturbed by man for many years, confirms the suggestion of Johnson *et al.* (1974) that in forest soils Dorylaimida are mostly abundant in little disturbed environments.

Conclusions

The tentative conclusions that may be drawn from this initial investigation may be summarized as follows:

1. The faunistic composition of nematodes of the holm-oak woodland cannot be readily characterized, since the most abundant species were mostly common, eurytopic species, but it was similar, at least for the most abundant species, in the two stations, which differed in the structure of the wood and in the depth of the litter.
2. The vertical distribution of each of the species showed a characteristical trend which was rather similar at the two stations.
3. The remarkable differences concerning the layers S_1 of the two stations seem to indicate that the thickness and the degree of decomposition of the litter noticeably affects the vertical distribution, the ecological composition and the population density of nematodes in the soil below, especially in the upper layers.

SUMMARY

A study was made of faunistic and ecological composition and of the vertical distribution of the litter and soil nematodes of a holm-oak woodland on Etna. Sampling was made at two stations (A and B), which differed in the structure of the wood. Among the 64 species found, 38 were present in both stations and most of them were common, eurytopic species. The population density, higher in the litter than in the soil, was similar at both stations, but for the upper layers of soil, whose density was lower at station B. The number of species and variety index were higher at station B, where the floristic composition of the wood was richer. Some of the species were present only or mainly in the litter and others only or mainly in the soil; the trend in the vertical distribution of the species was similar at the two stations. The analysis of the ecological composition showed a large number of bacterial, miscellaneous and fungal feeders. Bacterial feeders were more abundant in litter than in soil and relatively more abundant at station B than A, probably relating to the different degree of decomposition of the litter. The structure of the wood and the thickness of the litter seem to affect the distribution, density and ecological composition of nematodes in the soil.

Table II - *Species present in the woodland at station A and B.*

SPECIES	A	B
Acrobeles ciliatus Linstow, 1877	+	+
Acrobeloides sp.	+	+
Cervidellus serratus (Thorne, 1925)	+	+
Chiloplacus symmetricus (Thorne, 1925)	+	+
Cephalobus sp.	+	+
Panagrolaimus rigidus (Schneider, 1866)	+	+
Mesorhabditis spiculigera (Steiner, 1936)	+	+
Diplogasteridae sp.	+	+
Bunonema sp.		+
Teratocephalus terrestris (Bütschli, 1873)		+
Ceratoplectus armatus (Bütschli, 1873)	+	+
Ceratoplectus assimilis (Bütschli, 1873)		+
Ceratoplectus cornus (Maggenti, 1961)		+
Plectus cirratus Bastian, 1865	+	+
Plectus parvus Bastian, 1865	+	+
Anaplectus granulosus (Bastian, 1865)	+	
Cylindrolaimus communis (de Man, 1880)	+	+
Tylocephalus auriculatus (Bütschli, 1873)	+	+
Aulolaimus sp.		+
Geomonhystera villosa (Bütschli, 1873)	+	+
Monhystera filiformis (Bastian, 1865)		+
Prismatolaimus sp.		+
Paramphidelus macer Andrássy, 1977	+	+
Alaimus sp.		+
Clarkus papillatus (Bastian, 1865)	+	+
Mylonchulus brachyuris (Bütschli, 1873)	+	
Prionchulus muscorum (Dujardin, 1845)	+	+
Aporcelaimus sp.	+	+
Aporcelaimellus obscurus (Thorne & Swanger, 1936)	+	+
Aporcelaimellus silvanus Vinciguerra & Giannetto, 1983	+	+
Aporcelaimellus amylovorous (Thorne & Swanger, 1936)	+	+
Eudorylaimus carteri (Bastian, 1865)	+	+
Eudorylaimus rapsus Heyns, 1963	+	+
Eudorylaimus andrassyi (Meyl, 1955)		+
Eudorylaimus sp.	+	+
Thonus sp.	+	
Ecumenicus monohystera (de Man, 1880)		+
Oriverutus sp.		+
Enchodelium sp.	+	
Mesodorylaimus bastiani (Bütschli, 1873)	+	+
Labronema cfr. *mauritiense* Williams, 1959	+	+
Discolaimus paramajor Coomans, 1966	+	
Discolaimium sp.	+	
Paraxonchium sp.	+	+
Longidorella murithi Altherr, 1950	+	+
Xiphinemella globilabiata Vinciguerra & Giannetto, 1983	+	+
Tylencholaimus cfr. *dorae* Kruger, 1965	+	+
Tylencholaimus mirabilis (Bütschli, 1873)	+	+
Longidorus aetnaeus Roca *et al.*, 1986	+	+
Dorylaimellus sp.	+	
Nygolaimus sp.	+	+
Diphterophora sp.	+	
Boleodorus sp.		+
Ditylenchus sp.		+
Filenchus andrassyi (Szczygiel, 1968)	+	+
Filenchus fusiformis (Thorne & Malek, 1968)		+
Filenchus cfr. *cylindricus* (Thorne & Malek, 1968)	+	
Filenchus quartus (Szczygiel, 1969)	+	+
Malenchus sulcus (Wu, 1970)	+	+
Nothotylenchus sp.	+	+
Tylenchorhynchus sp.	+	+
Aphelenchoides parietinus (Bastian, 1865)	+	+
Aphelenchus sp.		+
Criconematidae sp.	+	

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