

SEASONAL CHANGES OF SOIL NEMATODE
COMMUNITY AND INFECTIVE STAGES OF
STEINERNEMATIDAE IN AN OAK FOREST IN
SOUTH BOHEMIA

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NEMATODES are the **most abundant multicellular animals** on the Earth and probably the second most diverse, as species number concerns, after insects. Soils of **deciduous forests** in temperate climate are inhabited by about **100 or more nematode species** of various trophic groups (bacterivores, fungivores, root-fungal feeders, plant parasites, omnivores, and predators).

The **predators**, sensu lato, are also nematodes that attack various animals and have changed their free-living mode of life to parasitic inside body cavity of a prey. In nematode collections from forest soils there are frequently found infective stages of the nematode families **Heterorhabditidae** and **Steinernematidae**. Nevertheless, their distribution, population changes and relationships to free-living nematodes are still insufficiently known.

During a long-term research program aimed at study of primary and secondary successions of soil nematodes was found that a sub-climax **oak forest in South Bohemia** had relatively high population densities of infective stages of ***Steinernema intermedium*** (Poinar, 1985). Moreover, this species showed prominent seasonal fluctuations and distinct vertical distribution, and also year to year fluctuations.

STUDY SITE

- Czech Republic, **South Bohemia**, Netolice village, 49°04'N, 14°11'E, **486 m a.s.l.**
- Long-term mean annual temperature **7.3°C**, precipitation **602 mm**
- Silt-loam **cambisol** on gneiss, mean pH(H₂O) about 5, mean C_{ox}(%) ranging from 12 to 0.5 down to soil profile and variations in the top 0-5 cm
- Dominant tree *Quercus robur* 60-70-year old in 1986
- Sampling period 1: **January 1986 – April 1989** (understorey vegetation mainly *Oxalis acetosella*, *Sanicula europaea*, *Viola reichenbachiana*, *Veronica chamaedrys*)
- Sampling period 2: **March 1997 – January 1999** (understorey vegetation mainly *Poa nemoralis*, *Oxalis acetosella*, *Veronica chamaedrys*, *Milium effusum*)

SOIL SAMPLING METHODS AND ISOLATION OF NEMATODES

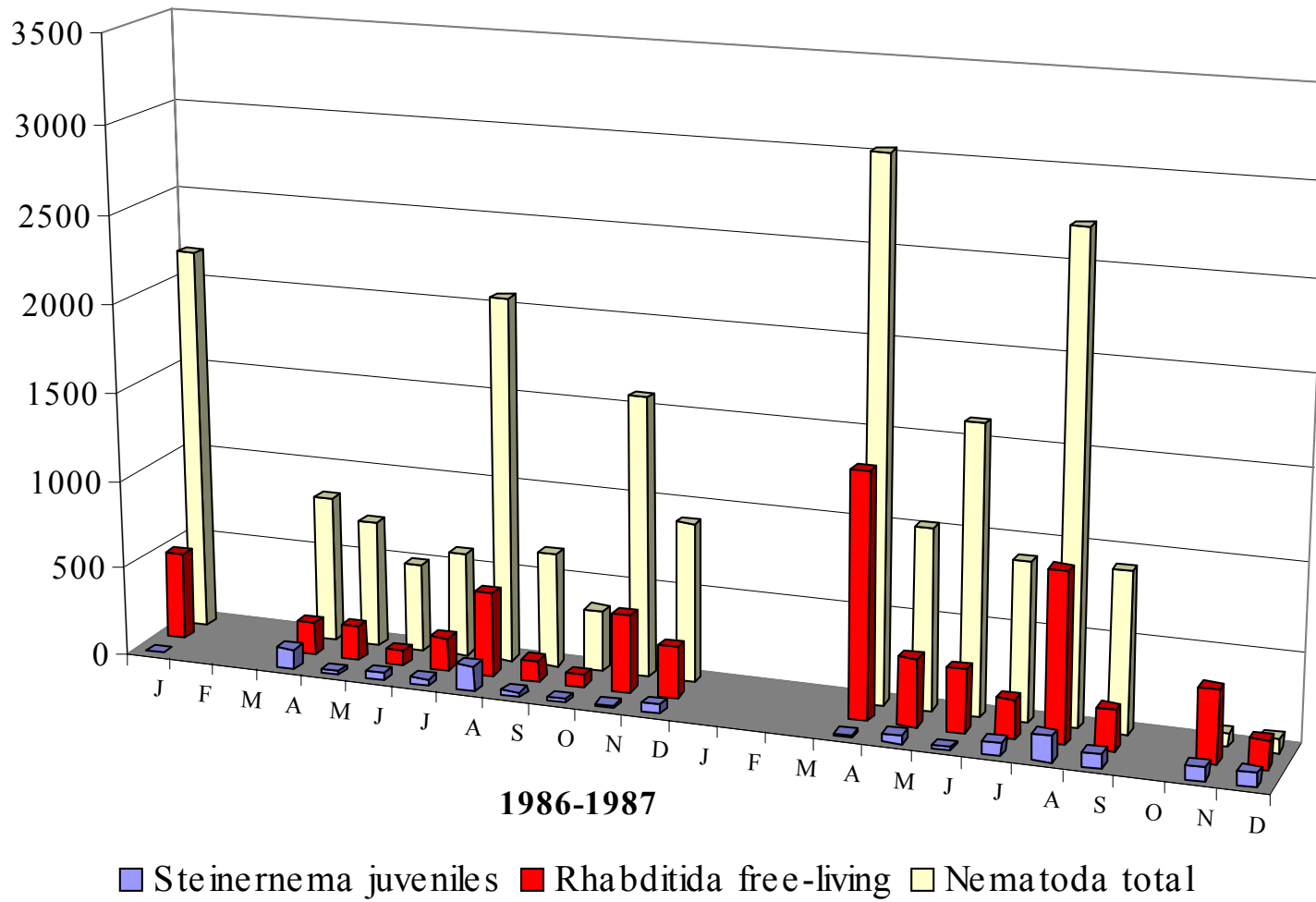
- **January 1986 – December 1987**: cylindrical corer of an area 1 cm² in 10 replicates from 0-5 cm and 5-10 cm of soil profile, all nematodes counted and determined
- **April 1988 – April 1989**: soil core 50x50 cm down to 35 cm of soil profile, four sub-samples taken from each 5 cm of soil profile, nematodes counted and determined from 30 ml of mixed soil for each layer
- **March 1997 – January 1999**: five pairs of cores of an area of 10 cm² from 0-10 cm, each pair mixed and ten grams of mixed soil used for nematode counts and determination.
- Modified **Baermann funnels**, glycerine slides

Details in:

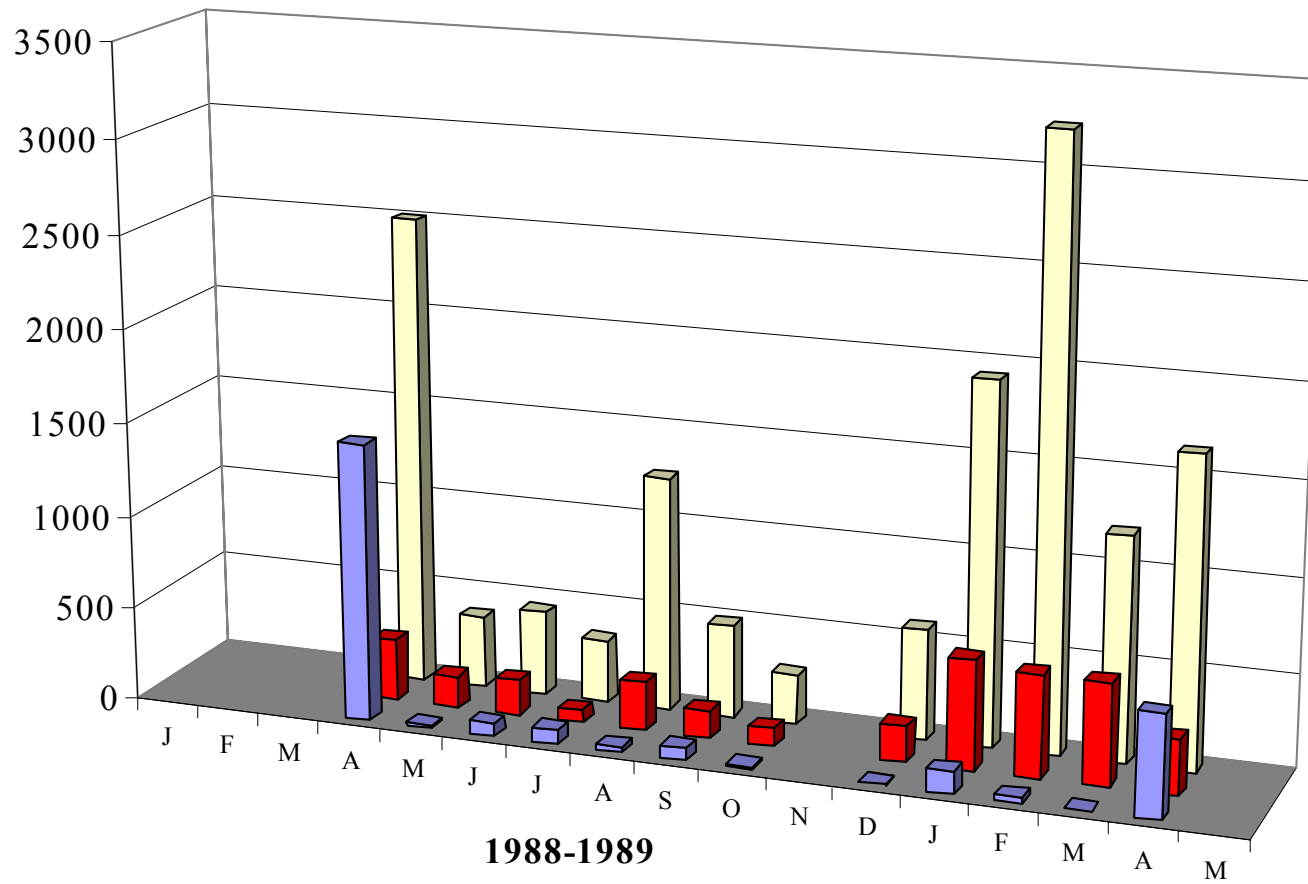
Háněl, L., 1994: Composition and seasonal changes of soil nematode community in a Central European oak forest. Acta Soc. Zool. Bohem. 58: 177-188.

Háněl, L., 1997: Vertical distribution of soil nematode diversity and abundance in a Central European oak forest. Acta Soc. Zool. Bohem. 61: 97-112.

Seasonal changes of abundance x 1000 per square metre

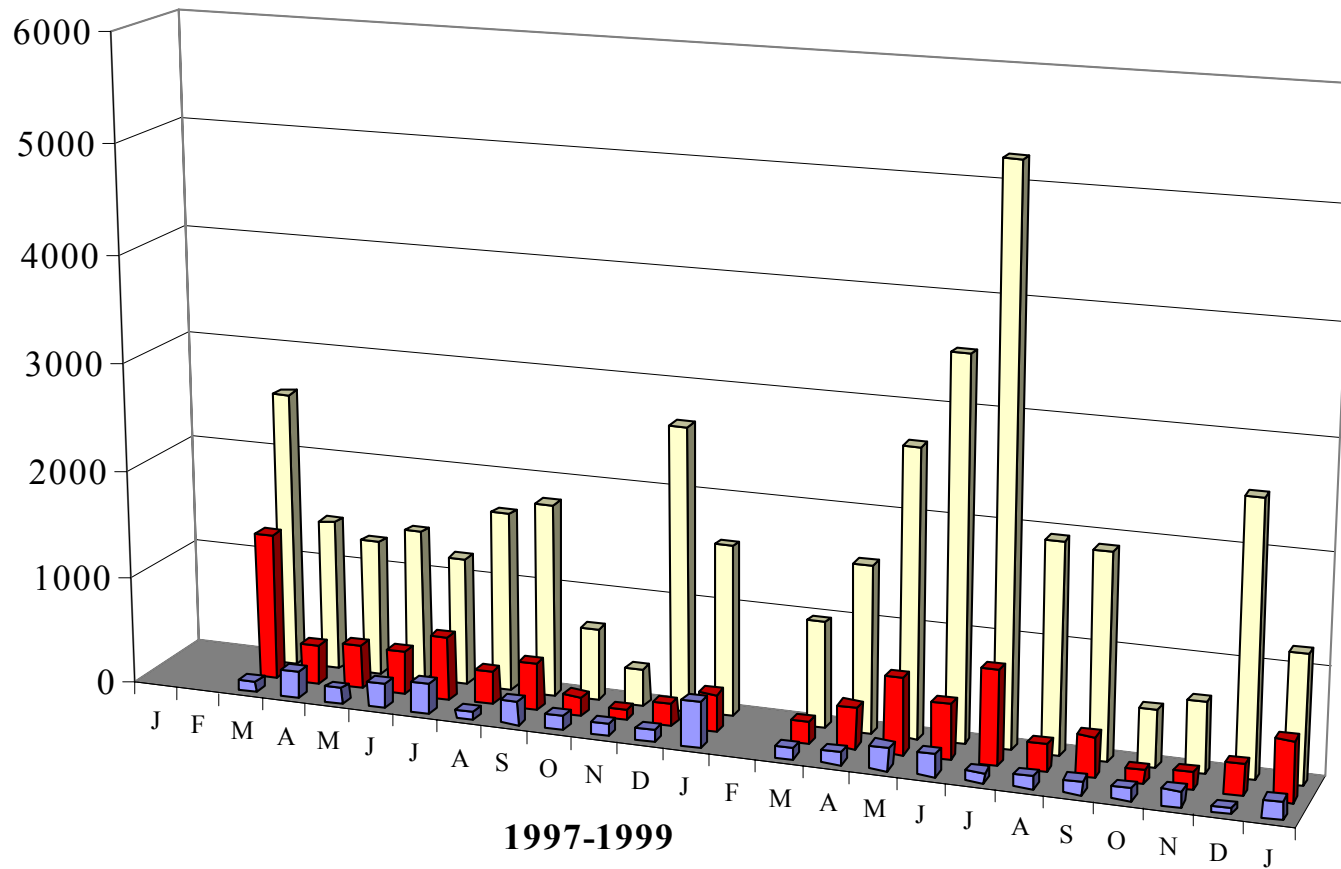


Seasonal changes of abundance x 1000 per square metre



■ Steinernema juveniles ■ Rhabditida free-living ■ Nematoda total

Seasonal changes of abundance x 1000 per square metre

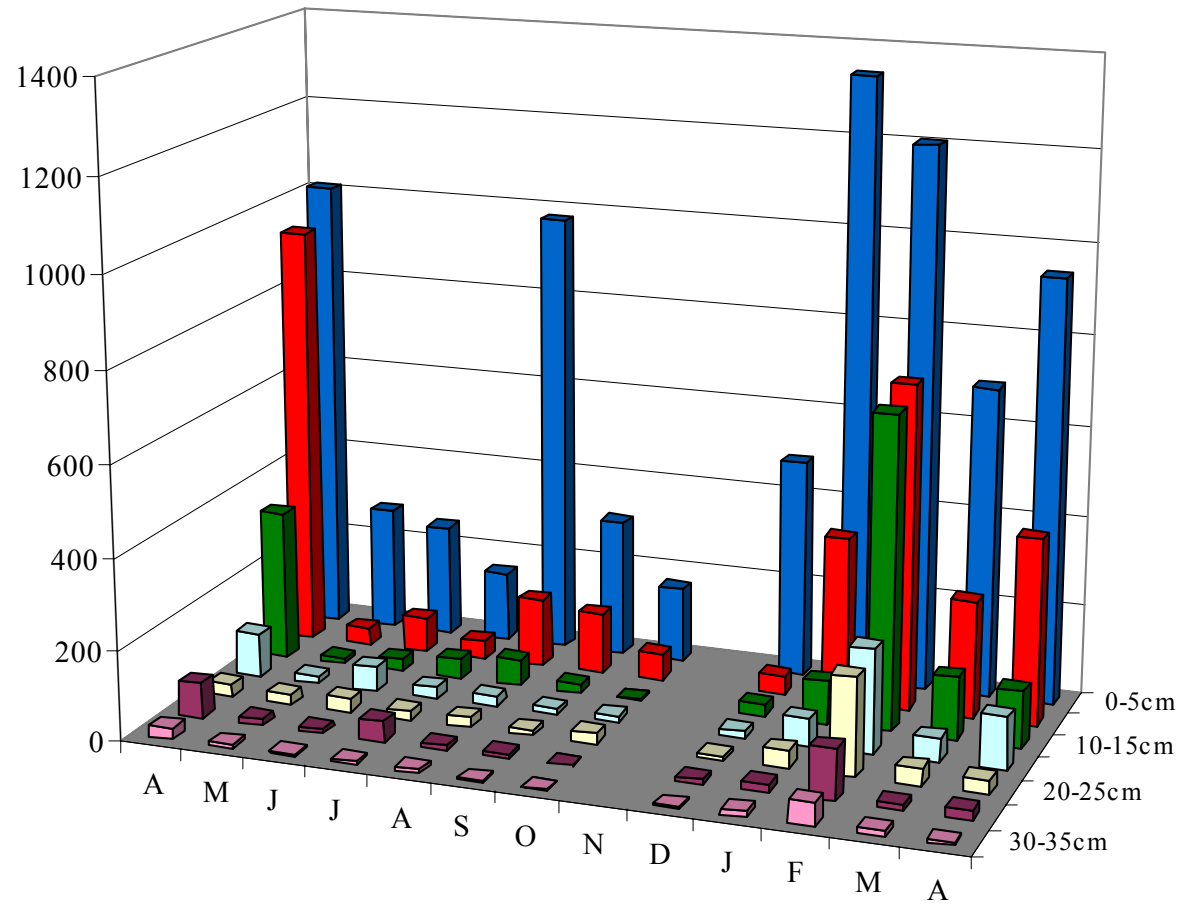


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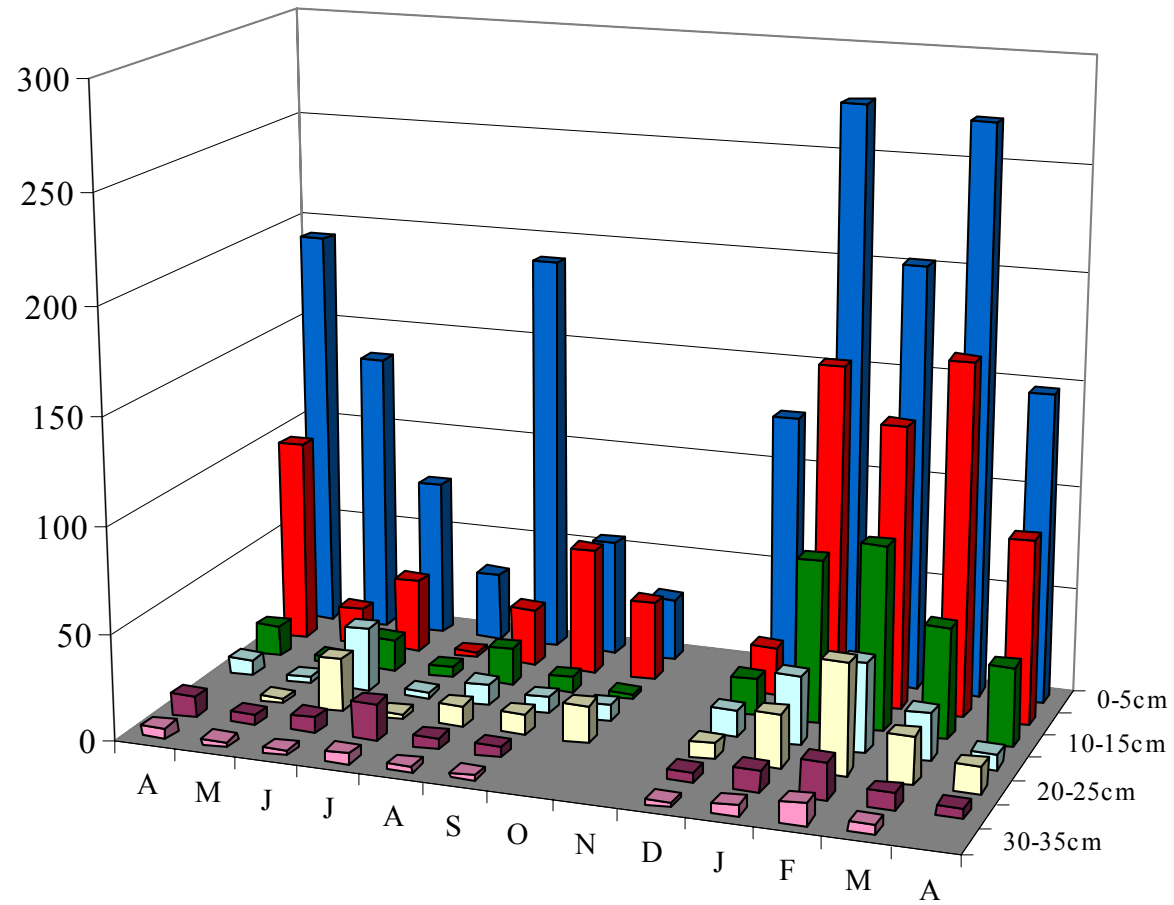
Mean abundance of nematodes (x 1000 ind. per square metre) and Pearson correlation coefficient between seasonal changes of individual groups of nematodes

Nematode abundance	1986	1987	1988-9	1997	1998-9
Nematoda total	1036	1515	1192	1494	2019
Rhabditida free-living	253	513	286	436	398
<i>Steinernema</i> juveniles (all) as percentage of Nematoda	46 4.5%	67 4.4%	204 17.1%	166 11.1%	156 7.7%
(in 0-5 cm)	17	30	39	n.d.	n.d.
(in 5-10 cm)	29	37	107	n.d.	n.d.
(in 10-35 cm)	n.d.	n.d.	58	n.d.	n.d.
Correlation between seasonal changes of	1986	1987	1988-9	1997	1998-9
Nematoda and Rhabditida	0.97	0.96	0.77	0.55	0.82
Rhabditida and <i>Steinernema</i>	0.17	-0.10	0.09	0.02	0.09
<i>Steinernema</i> and Nematoda	0.22	-0.04	0.47	-0.18	-0.09
n	10	8	12	10	12

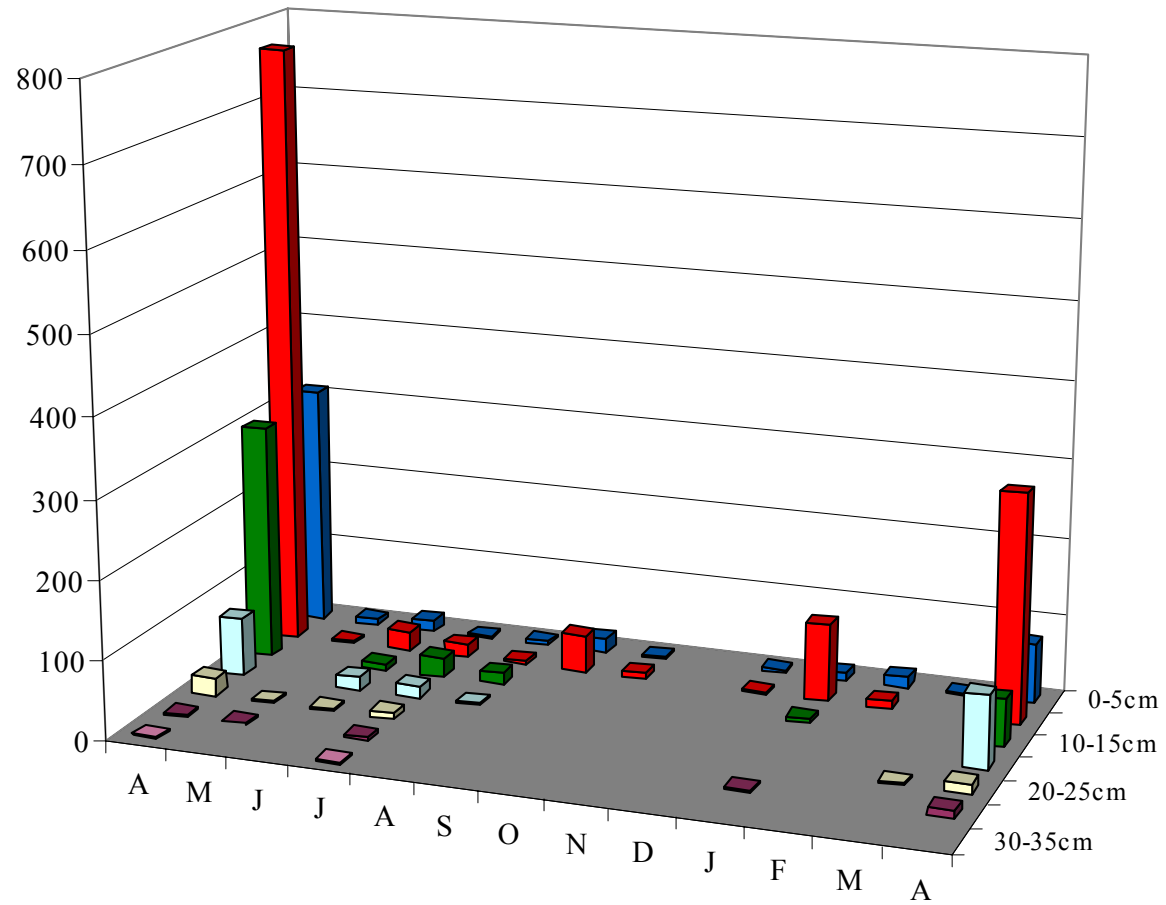
Seasonal changes of the total nematode abundance x 1000 ind. per square metre in individual soil layers during 1988-1989



Seasonal changes of the free-living Rhabditida x 1000 ind. per square metre in individual soil layers during 1988-1989



Seasonal changes of the *Steinernema* juveniles x 1000 ind. per square metre in individual soil layers during 1988-1989



CONCLUSIONS

- The abundance of juvenile infective stages of *Steinernema intermedium* in the soil of oak forest varied from about $1 \times 10^3 \text{ind.m}^{-2}$ to $1485 \times 10^3 \text{ind.m}^{-2}$ in individual months (periods January 1986 – April 1989, March 1997 – January 1999) and preferred the soil layer 5-10 cm.
- Mean annual abundance of *Steinernema* juveniles varied from $46 \times 10^3 \text{ind.m}^{-2}$ to $204 \times 10^3 \text{ind.m}^{-2}$, which represented 4.4-17.1% of all individuals in soil nematode community. The total mean abundance of nematodes was 1036-2019 $\times 10^3 \text{ind.m}^{-2}$.
- The seasonal changes of the abundance of free-living Rhabditida were significantly correlated with those of the total nematode community. The seasonal changes of *Steinernema* juveniles were correlated neither with the free-living Rhabditida nor with the total nematode populations.

- Seasonal changes of free-living Rhabditida, as well as greater part of other free-living nematodes, appeared to be associated with soil microbial activity. **Direct effects of soil moisture and temperature** on monthly abundance of free-living nematodes as well as **on *Steinernema* juveniles were indistinct.**
- The data suggest that the occurrence of juvenile infective stages of *Steinernema intermedium* in the forest studied was weakly connected with an overall biological activity in soil and moisture-temperature factors. **The factor determining the abundance of *Steinernema* juveniles in soil may be variations in the abundance of insect hosts and both may undergo cycles longer than one year.**