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Nematodes as bioindicators of soil conditions at *Mauremys rivulata* nesting sites in Croatia

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ABSTRACT

The aim of this preliminary research was to assess the potential of soil nematode communities as bioindicators of soil condition at nesting sites of the Balkan terrapin, *Mauremys rivulata*, on agricultural land in southern Croatia. Soil was sampled at nine confirmed nesting sites in 2023 and 2024. Nematodes were extracted from soil, identified to genus level, classified into feeding groups, and their communities were characterised using nematological indices. Nematode indicators were compared with physicochemical analysis and recorded land use. Nematode abundance, genus richness, feeding-group composition, and soil food-web structure varied among sites with different land-use and vegetation characteristics and between sampling years. Natural grassland and abandoned sites with overgrown vegetation supported more diverse and structured soil food webs, whereas organic enrichment and cultivation at certain sites were associated with shifts in nematode community structure. Analysis of nematode communities can provide valuable complementary information on soil conditions at turtle nesting sites, particularly when interpreted in combination with soil physicochemical properties and land-use characteristics.

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INTRODUCTION

Nematodes occupy different positions in the soil food web, and according to their feeding strategy, they are divided into bacterivorous, fungivorous, plant-parasitic, predatory and omnivorous (Yeates et al., 1993). Since individual groups respond differently to food availability, due to their feeding habits and life strategies, organic matter intake and soil disturbances, the composition of the nematode community can serve as a bioindicator of soil condition (Bongers, 1990; Ferris et al., 2001; Neher, 2001; Gašparović Pinto et al., 2026). Bacterivorous nematode species respond quickly to increased bacterial activity and the uptake of readily degradable organic matter, and an increase in their proportion indicates soil cultivation or the occurrence of other activities that temporarily increase the availability of nutrients for plants. Fungivorous nematode species demonstrate the importance of the fungal pathway of organic matter decomposition. Predatory nematode species feed on other small organisms in the soil, while omnivorous nematode species have a longer life cycle and are more sensitive to environmental changes, and their presence indicates a more complex food web, which develops gradually and is maintained in soils that have not been intensively cultivated, polluted or otherwise disturbed for a long time (Bongers, 1990; Yeates et al., 1993; Ferris et al., 2001). Plant-parasitic nematodes parasitise plant roots. Their higher abundance in agricultural soils may indicate increased pressure on cultivated plants, but in grasslands and other areas with dense roots they may not necessarily indicate poor soil condition, and accordingly, their contribution should be interpreted together with vegetation cover, other food groups and land use patterns (Yeates et al., 1993; Ferris and Bongers, 2006). The nutritional composition of a nematode community describes the abundance of individual food

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groups, while nematological indices allow for the assessment of the development of the soil food web. Therefore, indices of soil nematode abundance are valuable bioindicators of change due to different soil uses and status. The maturity index (MI) shows whether the community is dominated by opportunistic nematodes, which multiply rapidly in altered or nutrient-enriched soil, or by more sensitive groups associated with more stable conditions. The maturity index without terminal opportunistic colonisers (MI 2–5) allows for the assessment of a community without groups that are the first to react to soil enrichment or disturbance (Bongers, 1990). The plant-parasitic index (PPI) describes the structure of a plant-parasitic nematode community. The decomposition channel index (CI) shows the relative importance of bacterial and fungal pathways for the decomposition of organic matter. The enrichment index (EI) describes the response of a food web to increased availability of food sources, while the structure index (SI) shows its development and the presence of nematodes at higher positions in the food web. The basal index (BI) describes the presence of groups adapted to unfavourable or depleted conditions (Ferris et al., 2001). At loggerhead turtle nesting sites, higher nematode diversity was associated with greater hatching success, whereas a larger nematode metabolic footprint was associated with dead hatchlings. Comparable evidence is currently unavailable for freshwater turtles (Tsiafouli et al., 2020). The Balkan terrapin, *Mauremys rivulata* (Valenciennes, 1833), is one of two protected freshwater turtle species in Croatia under the Ordinance on Strictly Protected Species (Official Gazette of the Republic of Croatia, 144/13, 73/16), and four populations in Croatia (in Konavle Field, Ston Field, Majkovi and Prljevići) form the northwestern edge of its distribution range. Pressures on the species in Croatia include habitat loss and overgrowth, pollution, land use changes and mortality of individuals (Jelić et al., 2015), and species protection is organised through the implementation of species and habitat management plans within the Natura 2000 ecological network areas (Official Gazette of the Republic of Croatia, 80/19, 119/23, 87/25; Štih Koren, 2024). Although it spends most of its life in water, *M. rivulata* lays eggs in communal nesting sites on land, and approximately 40% of its habitats are grasslands and cultivated or abandoned and overgrown agricultural sites (Štih Koren, 2024). The choice of nesting site affects egg development, as do soil properties, temperature, humidity, sunlight, and vegetation cover (Refsnider and Janzen, 2010; Topping and Valenzuela, 2021; Kiss et al., 2024), so the preservation of suitable nesting sites near aquatic habitats is an important part of species management. The impact of succession and the implementation of mechanical, chemical, and biological agrotechnical measures, as well as other anthropogenic activities on *M. rivulata* nesting sites has not yet been systematically investigated (European Commission, 2026), but it is known that there is a low risk of exposure to environmental contaminants in the surface soil layer at *M. rivulata* nesting sites in Croatia (Tariba et al., 2026). Freshwater turtles contribute to the functional connectivity of aquatic and terrestrial food webs by facilitating the transfer of nutrients and energy across the aquatic–terrestrial interface (Lovich et al., 2018). Their impact on increasing the biodiversity of aquatic habitats has been extensively studied (Lindsay et al., 2013), while the impact on trophic webs in terrestrial parts of the habitat has been investigated from the aspect of the transfer of assimilated energy and nutrients to the biomass of predators of higher trophic levels (Congdon and Gibbons, 1989; Vitt and Caldwell, 2009).

The aim of this study was to determine the abundance and diversity of nematode genera, the nutritional composition of their communities, and the values of nematological indices in the soil of agricultural land plots with confirmed nesting sites of *M. rivulata*. Nematological indicators were analysed during 2023 and 2024 on land plots with different uses. The purpose of this preliminary characterisation was to examine the possibility of using nematode analysis as a bioindicator in monitoring terrestrial areas of the species habitat, and to determine the nematode composition in freshwater turtle nesting sites in the soil trophic network on agricultural land. Nematological indicators were compared with chemical soil analyses at the same locations and in the same sampling years (Tariba et al., 2026), and with the recorded surface condition.

MATERIALS AND METHODS

Study area

The study was conducted at confirmed nesting sites of *M. rivulata* in Dubrovnik-Neretva County. In 2023, six selected localities were sampled, while in 2024, the same sites were monitored and three new sites were included where nesting was subsequently confirmed. Their location, surface condition, inclusion in the Natura 2000 ecological network, and sampling years are shown in Table 1.

Soil sampling

In mid-October 2023 and 2024, one sample weighing approximately 500 g was taken from the 0–30 cm soil layer at each site using a soil probe. The labelled samples were transported to the laboratory within 48 hours, in a portable refrigerator at a temperature of 4°C.

Nematological analysis

Nematodes were isolated from 100 g soil using the Baermann funnel method (Baermann, 1917). The isolated individuals were counted and determined to the genus level using the appropriate determination keys (Mai and Lyon, 1975; Andrássy, 1984, 1988, 1993; Hunt, 1993; Bongers, 1994). The identified genera were classified into bacterivorous, fungivorous, plant-parasitic, omnivorous and predatory nematodes according to Yeates et al. (1993), and the representation of each group was expressed as a proportion of the total number of nematodes in each sample.

The indices MI, MI 2–5, PPI, CI, EI, SI and BI were calculated. MI and PPI values were calculated according to Bongers (1990), and CI, EI, SI and BI values according to Ferris et al. (2001).

Data collected

Physicochemical soil data, including heavy metal concentrations, were obtained from Tariba et al. (2026) for the same sites and sampling years. In that study, soil samples were composed of 15-20 subsamples collected from the 0–30 cm layer and prepared according to ISO 11464 (ISO, 1994b).

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Table 1. Location, label used in Tariba et al. (2026), designation of the Natura 2000 area, GPS coordinates, land use, and sampling year for each study site.

Site	Designation in Tariba et al. (2026)	Location	Natura 2000	GPS coordinates	Site condition and land use	Sampling years
1	a1	Mihanići, Konavle Field	HR2000946	42.554860, 18.324740	Pasture and horse paddock	2023, 2024
2	b8	Mihanići, Konavle Field	HR2000946	42.551326, 18.323882	Natural grassland maintained by occasional mowing and mulching	2024
3	c9	Mihanići, Konavle Field	HR2000946	42.551829, 18.324220	Cultivated vineyard	2024
4	d2	Ston Field	HR2001364	42.832667, 17.683592	Abandoned garden overgrown with spontaneous vegetation; occasional wild boar rooting	2023, 2024
5	e3	Ston Field	HR2001364	42.834892, 17.681101	Grassland converted into a cultivated garden	2023, 2024
6	f7	Ston	HR2001364	42.832527, 17.686568	Abandoned agricultural land overgrown with dense spontaneous vegetation	2024
7	g4	Gornji Majkovi	HR2000947	42.773698, 17.909892	Abandoned olive grove and garden overgrown with spontaneous vegetation	2023, 2024
8	h5	Prljevići	HR2000555	42.757013, 17.899575	Uncultivated former garden with olive trees	2023, 2024
9	i6	Prljevići	HR2000555	42.756873, 17.899208	Fenced, formerly cultivated garden; wild boar rooting recorded	2023, 2024

Soil reaction was determined according to EN ISO 10390 (ISO, 1994a), humus using the dichromate method, total nitrogen according to ISO 11261 (ISO, 1995), plant-available phosphorus and potassium using the AL-method (Egner et al., 1960), and metals after aqua regia extraction were determined by atomic absorption spectrometry according to ISO 11047 (ISO, 1998).

Data analysis

For each sample, the total abundance of nematodes, number of identified genera, nutritional composition of the community, and values of nematological indices were compared with the soil chemical analyses and site conditions and land use. Changes between 2023 and 2024 were descriptively compared at the six sites monitored during both years.

RESULTS AND DISCUSSION

Changes in the total number of genera, nematode abundance, MI, SI, MI 2–5, PPI, CI and BI at the investigated sites in 2023 and 2024 are shown in Figure 1. The feeding composition of the communities of all samples is shown in Figure 2, and their position in the EI–SI food web profile in Figure 3.

At site 1, used as pasture and horse run, nematode abundance decreased from 788 individuals in 2023 to 428 individuals in 2024, and the total number of genera from 20 to 17. The proportion of bacterivorous nematodes increased from 10.4% to 40.5%, MI decreased from 2.79 to 2.29, SI from 75.47 to 50.76, and BI increased from 20.58 to 37.07 (Figures 1–3). Such a community change indicates a higher prevalence of opportunistic nematodes and a simplification of the food web in 2024. Physicochemical soil analyses showed higher humus and potassium levels in 2024, while the plant-available phosphorus level changed only slightly (Tariba et al., 2026). The presence of horses may have contributed to these changes (Haynes and Williams, 1993). The increased availability of organic matter may stimulate bacterial activity, which corresponds to the increase in the proportion of bacterivorous nematodes obtained by analysis (Ferris et al., 2001; Ferris and Bongers, 2006).

Site 2 is a natural meadow with low and relatively uniform native vegetation, maintained by occasional mowing and mulching. In 2024, 190 individuals from a total of 19 genera were identified. Omnivorous nematodes made up 29.6% and predatory nematodes 13.0% of the community. SI values of 90.72, BI of 7.00, MI of 3.00 and MI 2–5 of 3.44 indicate a complex and well-structured food web (Figures 2 and 3). Moderate mowing represents less disturbance than frequent mowing and may be beneficial for maintaining the diversity and structure of the nematode community (Zhao et al., 2021). Soil analysis classified the site as moderately supplied with humus, very low in plant-available phosphorus, and moderately supplied with plant-available potassium (Tariba et al., 2026), which corresponds to a meadow area without intensive fertilisation.

At site 3, a cultivated vineyard, a total of 468 nematode individuals from 11 genera were determined in 2024. Among the three sites included in the study for the first time in 2024, the smallest number of genera was found here. The share of predatory nematodes of 25.6% and SI of 79.69 show that some elements of a more complex food web were preserved. Conversaly, the small number of genera and the very low proportion of omnivorous nematodes of 1.2% can be associated with more intensive tillage (Bongiorno et al., 2019). These indicators are shown in Figures 2 and 3. A CI of 100 indicates a distinct predominance of the fungal degradation pathway. Soil analysis showed a low humus content, a very low concentration of plant-available phosphorus, and a moderate concentration of plant-available potassium. Concentrations of Cu, Cd, Ni and Cr were 139, 5.19, 241 and 224 mg/kg, respectively (Tariba et al., 2026). Copper can accumulate in vineyard soils due to long-term use of copper-based plant protection products (La Torre et al., 2018; Droz et al., 2021).

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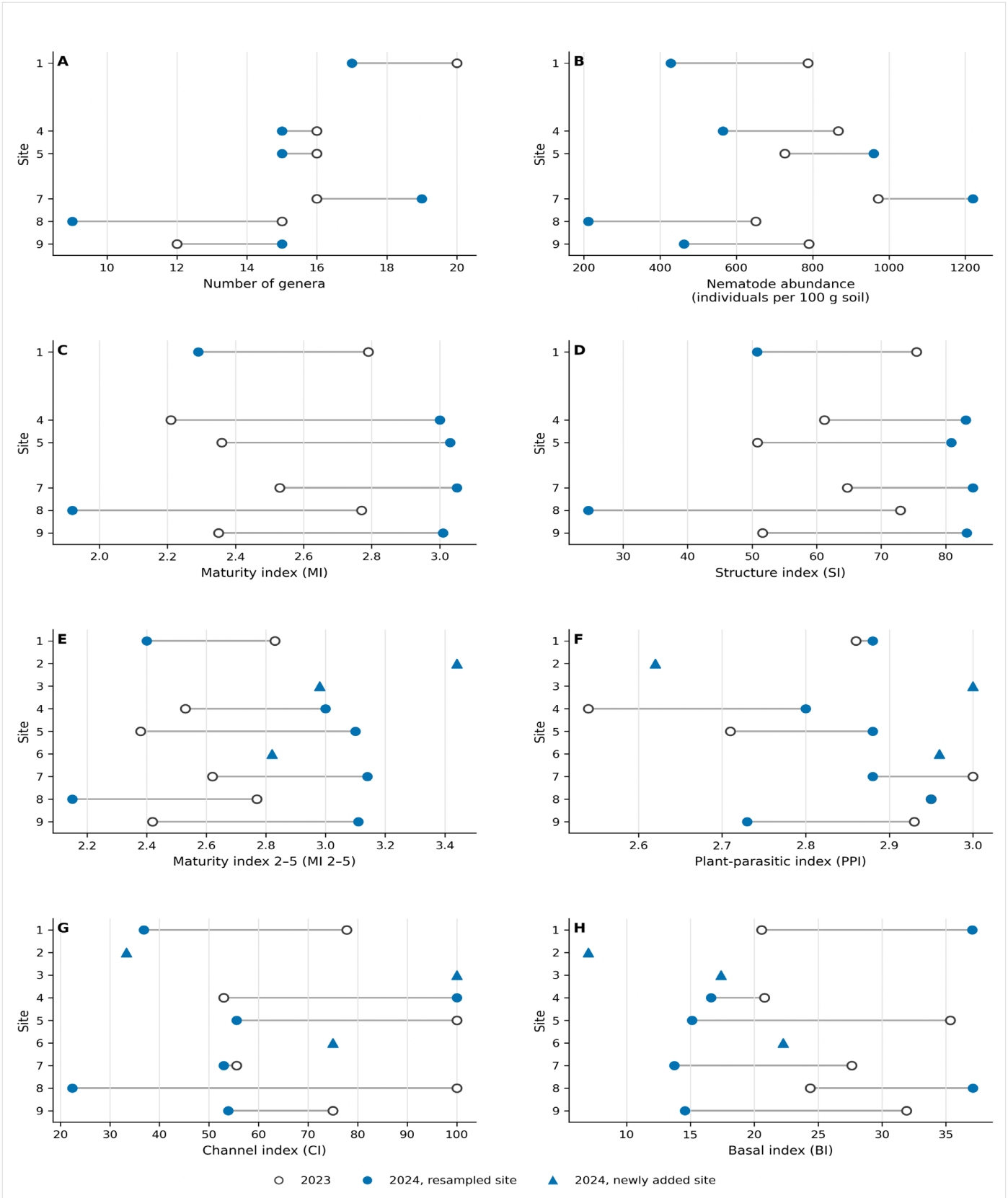


Figure 1. Number of genera, nematode abundance per 100 g soil, maturity index (MI), structure index (SI), maturity index excluding c–p 1 enrichment opportunists (MI 2–5), plant-parasitic index (PPI), channel index (CI) and basal index (BI) at the investigated sites in 2023 and 2024. Panels A–D compare the six sites sampled in both years. Panels E–H also include sites 2, 3 and 6, which were sampled for the first time in 2024. Open circles indicate 2023; blue circles indicate sites resampled in 2024; blue triangles indicate sites sampled for the first time in 2024.

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The origin of the measured cadmium concentrations cannot be reliably determined from their total concentration in a single sample, and may originate from natural and anthropogenic sources, which requires additional research. Geochemically determined patterns of nickel and chromium have been reported in Croatian karst soils (Prohić et al., 1997; Kubier et al., 2019), and were also confirmed in the Konavle area (Tariba et al., 2026).

Site 4 is an abandoned garden overgrown with spontaneous vegetation, occasionally entered by wild boars. The abundance of nematodes decreased from 867 individuals in 2023 to 565 individuals in 2024, and the total number of genera from 16 to 15. MI increased from 2.21 to 3.00, SI from 61.19 to 83.12, BI decreased from 20.80 to 16.60, and omnivorous nematodes appeared in 2024 with a share of 4.9% (Figures 1–3). Such changes indicate a more complex and stable soil food web. Its development may have been favoured by the absence of regular cultivation and developed vegetation cover. Occasional rooting by wild boars contributes to the mixing of organic matter and can increase carbon and nitrogen content and microbial biomass, and alter the composition of the nematode community (Wirthner et al., 2012; Sun et al., 2024). Physicochemical soil analyses showed increases in humus content and in the concentrations of plant-available phosphorus and potassium between 2023 and 2024 (Tariba et al., 2026).

At site 5, converted from a meadow to a cultivated garden between the two sampling years, nematode abundance increased from 727 individuals in 2023 to 960 individuals in 2024, while the total number of genera decreased from 16 to 15. The proportion of plant-parasitic nematodes increased from 60.4% to 76.9%, and the proportion of fungivorous nematodes decreased from 24.2% to 3.8%. The proportion of predatory nematodes increased from 2.0% to 6.9%, and omnivorous from 4.0% to 5.4%. MI increased from 2.36 to 3.03, SI from 50.84 to 80.86, and BI decreased from 35.34 to 15.12 (Figures 1–3). The increase in the proportion of plant-parasitic nematodes after conversion to a garden is consistent with the change in vegetation cover (Yeates et al., 1993; Ferris and Bongers, 2006). The simultaneous increase in MI and SI and the decrease in BI indicate that the food web was more developed in 2024. Soil analyses showed increases in humus content and in the concentrations of plant-available phosphorus and potassium between the years, while copper remained within the range reported for Ston topsoil (Tariba et al., 2026). These changes coincided with the recorded conversion from meadow to cultivated garden.

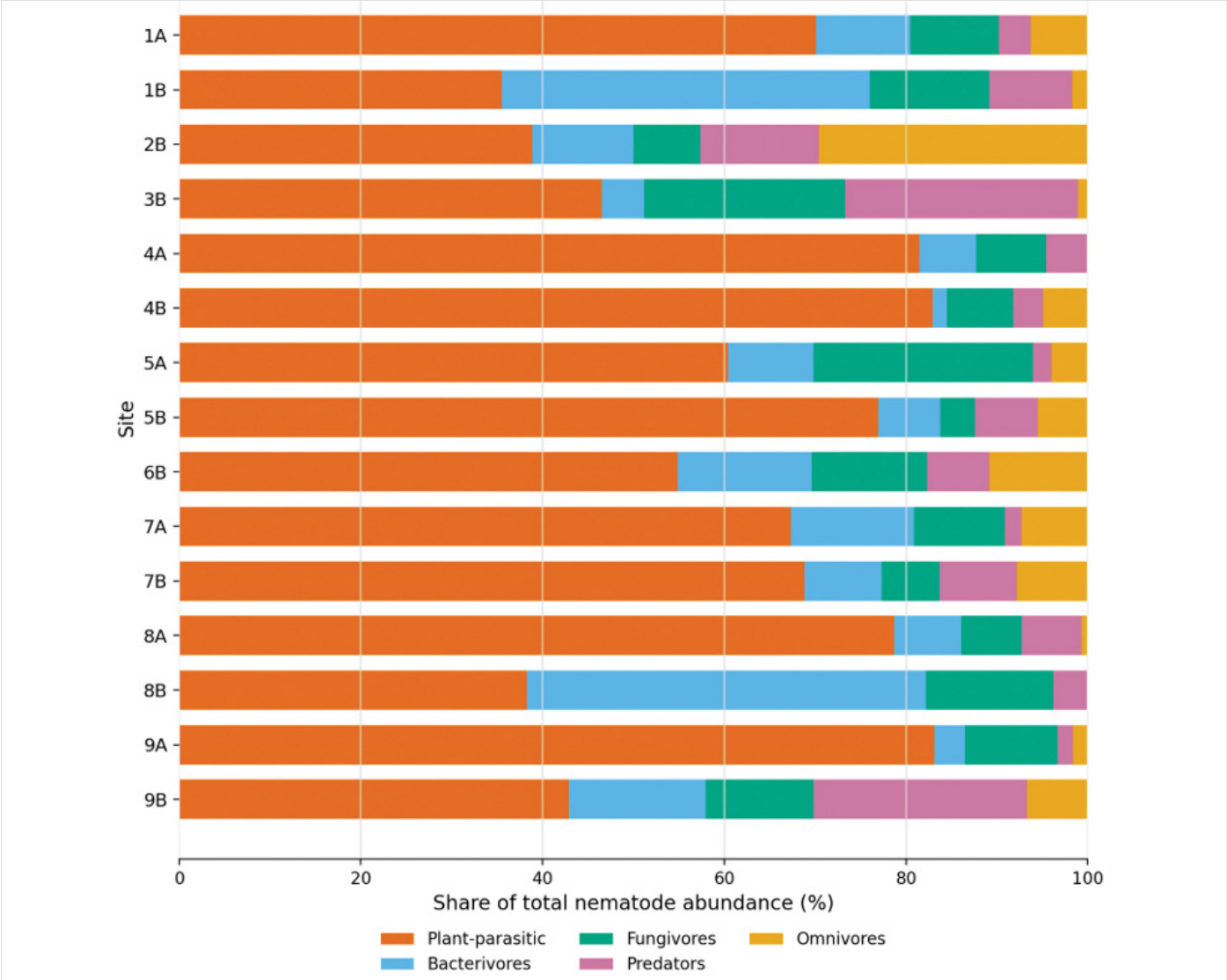


Figure 2. Relative abundance of plant-parasitic, bacterivorous, fungivorous, predatory, and omnivorous nematodes at the study sites. A indicates 2023, and B indicates 2024. Sites 2, 3, and 6 were first sampled in 2024.

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At site 6, a neglected area covered with dense wild vegetation that was first sampled in 2024, 202 nematode individuals from a total of 19 genera were identified. All feeding groups were recorded, including 10.8% omnivorous and 6.9% predatory nematodes (Figure 2). The large number of genera, presence of higher trophic levels, and index values (MI 2.78, SI 74.19 and BI 22.27) indicate a preserved and diverse food web (Figure 3). Natural overgrowth of agricultural areas can result in a gradual increase in the diversity and maturity of the nematode community as a more permanent root system develops and plant debris accumulates (Háněl, 2003). Soil analysis showed a humus content of 3.23%, 24.6 mg P_2O_5/100 g soil and 46.0 mg K_2O/100 g soil (Tariba et al., 2026). The developed vegetation cover and accumulation of plant residues may have contributed to the diversity and structure of the nematode community (Ferris et al., 2001; Háněl, 2003).

At site 7, in a neglected olive grove and garden, the abundance of nematodes increased from 972 individuals in 2023 to 1220 individuals in 2024, and the total number of genera from 16 to 19. The proportion of predatory nematodes increased from 1.8% to 8.5%, and the proportion of omnivorous nematodes from 7.3% to 7.8%. MI increased from 2.53 to 3.05, SI from 64.75 to 84.21, and BI decreased from 27.63 to 13.74 (Figures 1–3). Such a community composition indicates the development of a more complex and stable food web. This could be facilitated by the absence of regular cultivation, developed vegetation and accumulation of plant residues. During the natural overgrowth of agricultural areas, the diversity and maturity of the nematode community can gradually increase (Háněl, 2003). Soil analyses showed increases in humus content and plant-available phosphorus and potassium levels between 2023 and 2024 (Tariba et al., 2026). Nematological indicators and soil analysis results indicate a more favourable soil condition in 2024.

At site 8, an uncultivated old olive grove, the number of nematodes decreased from 651 individuals in 2023 to 212 individuals in 2024, and the total number of genera from 15 to 9. The share of bacterivorous nematodes increased from 7.4% to 43.9%, while omnivorous nematodes were not detected in 2024. MI decreased from 2.77 to 1.92, SI from 72.97 to 24.62, and BI increased from 24.39 to 37.12 (Figures 1–3). These results indicate the simplification of the food web and the predominance of opportunistic nematodes that quickly respond to increased food availability. Soil analyses showed increases in humus content and plant-available phosphorus and potassium levels, with a marked increase in copper concentration (Tariba et al., 2026). The greater availability of organic matter could have stimulated bacterial activity and thus favoured the increase in the proportion of bacterivorous nematodes (Ferris et al., 2001; Ferris and Bongers, 2006).

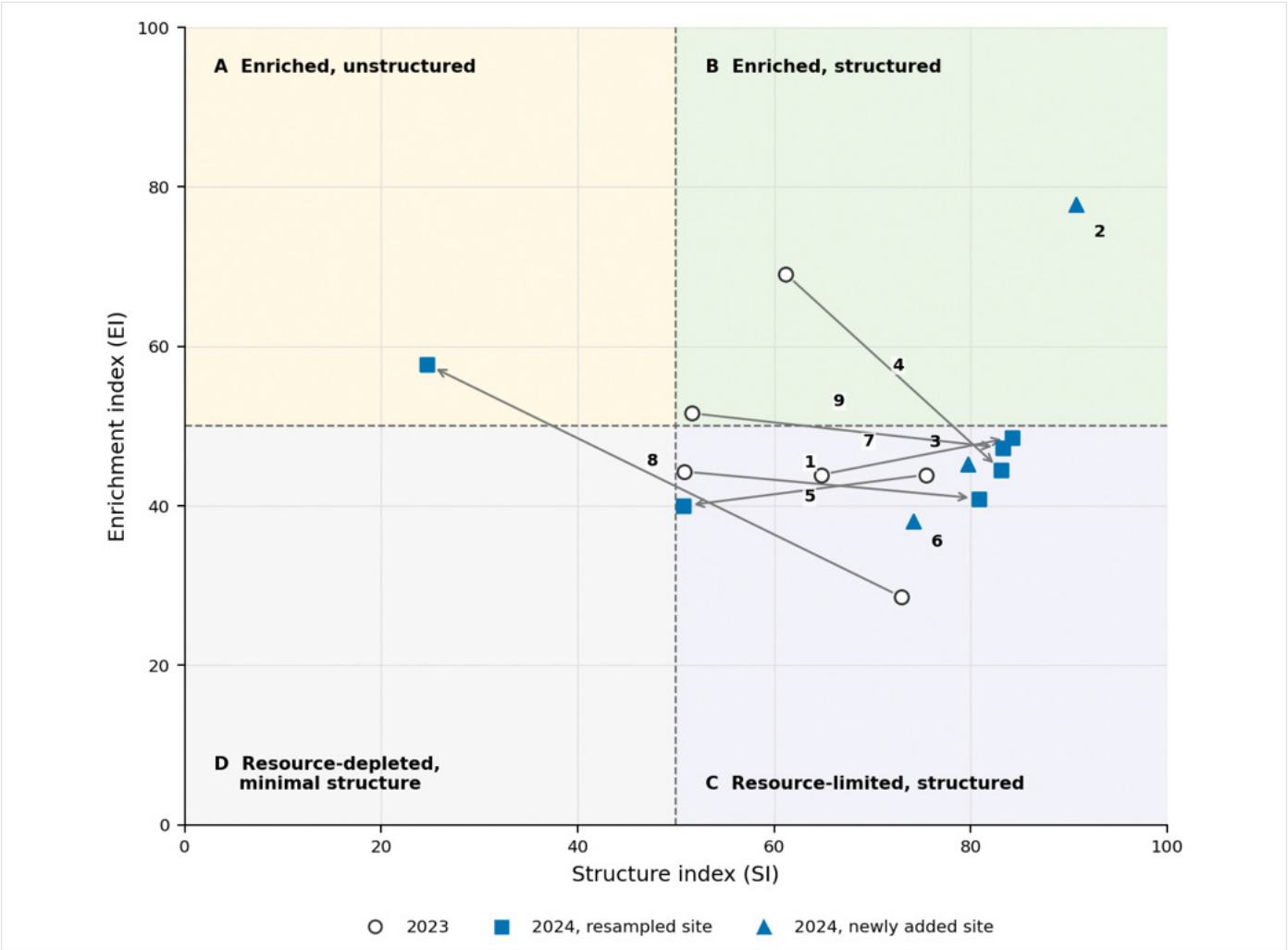


Figure 3. Relationship between enrichment index (EI) and structure index (SI) of nematode communities at surveyed sites in 2023 and 2024. Open circles indicate 2023; blue squares indicate sites resampled in 2024; blue triangles indicate sites sampled for the first time in 2024; arrows indicate changes between sampling years. Numbers next to the arrows indicate the site number.

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At site 9, a fenced garden cultivated prior to the 2023 sampling, with wild boar intrusion and soil rooting recorded in 2024. The number of nematodes decreased from 790 individuals in 2023 to 463 individuals in 2024, whereas the total number of genera increased from 12 to 15. The proportion of predatory nematodes increased from 1.7% to 23.5%, and the proportion of omnivorous nematodes increased from 1.7% to 6.7%. MI increased from 2.35 to 3.01, SI from 51.61 to 83.24, and BI decreased from 31.91 to 14.57 (Figures 1–3). Although total nematode abundance decreased, the increase in genus richness and in the proportions of predatory and omnivorous nematodes indicates a more structured soil food web in 2024. Between 2023 and 2024, soil analyses showed increases in humus, total nitrogen contents, and plant-available phosphorus and potassium levels. Total Cd also increased but remained within the range reported for Majkovi topsoil (Tariba et al., 2026). The concurrent changes in Cd concentration and nematological indices do not indicate a beneficial effect of Cd since nematode responses depend on the mobile metal fraction, soil properties and taxon-specific sensitivity rather than on total metal concentration alone (Šalamún et al., 2012).

Observed overall, the natural meadow at site 2 and the neglected areas with developed vegetation cover at sites 6 and 7 had a large number of genera and a higher representation of omnivorous and predatory nematodes. Between the years, a more favourable development of the food web, visible from the increase of MI and SI and the decrease of BI, was recorded at sites 4, 5, 7 and 9, while at these indicators changed in the opposite direction at sites 1 and 8 (Figures 1 and 3). The absence or reduction of tillage intensity, recorded at sites 4, 7 and 9 may favour the development of a more complex soil nutrient network, as confirmed by long-term studies of European agricultural soils (Bongiorno et al., 2019). However, surface neglect was not always associated with more favourable indicators, as is evident at site 8. Differences between sites indicate that the state of the food web depends on the combined effects of vegetation cover, organic matter availability, maintenance methods, and other soil disturbances (Ferris et al., 2001; Neher, 2001).

Changes between years

The results showed pronounced differences in the abundance, diversity and nutritional composition of nematode communities in the study area. At sites 1, 4, 8 and 9, the total abundance decreased between the two sampling years, though the change in the number of genera and indicators of the food web differed. The clearest example is site 9, which showed a lower abundance, but more genera and a greater presence of predatory and omnivorous nematodes (Figures 1–3). In contrast, at site 8, both the abundance and the number of genera decreased, with an increase in bacterivorous nematodes and less favourable values of MI, SI and BI (Figures 1–3).

Soil food web structure

The results confirm the usefulness of nematodes as bioindicators of soil condition through differences in soil properties and changes in nematode communities on the study plots sampled in both years. Changes in the number of genera, nutritional composition and nematological indices showed differences between natural, neglected and cultivated areas. In this case, the biological condition of the soil cannot be assessed only by the total number of nematodes, but also requires consideration of the number of genera, nutritional composition and nematological indices (Ferris et al., 2001; Neher, 2001).

Site 2 had a highly structured nematode trophic network with high proportions of omnivores and predators, low levels of available nutrients and no indicators of intensive fertilisation. Site 6 was in advanced secondary succession, with a high number of genera and presence of higher trophic levels that indicated a preserved and diverse food web. Sites 4, 7 and 9, where regular cultivation was absent or reduced, showed the development of a more complex food web, evident from the increase in MI and SI and the decrease in BI between the years (Figures 1–3). A trophic network simplified due to organic matter intake was recorded at sites 1 and 8, while a network with noticeable anthropogenic pressure through elevated copper concentrations was found at sites 3 and 8. High SI values, together with higher proportions of omnivorous and predatory nematodes, indicate a more developed and structured soil food web, though these characteristics cannot be considered as specific indicators of favourable freshwater turtle nesting sites (Ferris et al., 2001). Future studies should compare sites with similar soil properties and management but differing nest abundance and hatching success to determine whether particular nematode communities or ecological indices are consistently associated with favourable freshwater turtle nesting conditions.

CONCLUSIONS

Nematode communities have proven to be useful bioindicators of the biological condition of the soil, but for a comprehensive assessment of the site condition, they should be supplemented with physicochemical soil analysis and a description of the above-ground condition of the site at the time of sampling. Such monitoring can help to identify changes in the sites and select appropriate management measures, particularly since the nesting sites included in this study were situated on private agricultural land, where the land use can change independently of the species protection objectives. By simultaneously monitoring nematode communities, soil chemical properties and above-ground condition of the site, it is possible to recognise changes in the condition of the nesting site in a timely manner and use the obtained data when agreeing on appropriate management measures with landowners. Further monitoring should link soil condition with nest characteristics, incubation conditions and hatching success.

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CRediT AUTHORSHIP CONTRIBUTION STATEMENT

BT: Conceptualization (equal); Methodology (equal); Data curation (equal); Formal analysis (supporting); Writing – original draft (equal); Writing – review and editing (supporting). MB: Methodology; Formal analysis (lead); Visualization (lead); Writing – original draft (equal). DŠ: Conceptualization (equal); Data curation (supporting); Writing – original draft (supporting); Writing – review and editing (lead); Funding acquisition (lead); Supervision.

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ETHICS AND PERMIT APPROVALS

Not applicable.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no competing interests.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are stored in the LIFE for *Mauremys* project data storage and are available from the corresponding author upon reasonable request.

AI USE STATEMENT

The authors used InstaText and Grammarly for language editing purposes. No AI tool was used for generating scientific content, data analysis, interpretation of the results or drawing conclusions. All scientific content, analysis and conclusions remain the sole responsibility of the authors.

SAŽETAK

Nematode kao bioindikatori stanja tla na mjestima gniježđenja vrste *Mauremys rivulata* u Hrvatskoj

Cilj ovog preliminarnog istraživanja bio je procijeniti potencijal zajednica nematoda kao bioindikatora stanja tla na mjestima gniježđenja riječne kornjače, *Mauremys rivulata*, na poljoprivrednom zemljištu u južnoj Hrvatskoj. Uzorci tla prikupljeni su na devet potvrđenih mjesta gniježđenja tijekom 2023. i 2024. godine. Nematode su izdvojene iz tla, determinirane do razine roda, razvrstane u hranidbene skupine, a njihove zajednice opisane su primjenom nematoloških indeksa. Pokazatelji temeljeni na zajednicama nematoda uspoređeni su s rezultatima fizikalno-kemijskih analiza tla i podacima o načinu korištenja zemljišta. Brojnost nematoda, bogatstvo rodova, sastav hranidbenih skupina i struktura hranidbene mreže tla razlikovali su se među lokalitetima s različitim načinima korištenja zemljišta i obilježjima vegetacije, kao i između godina uzorkovanja na lokalitetima koji su višekratno istraživani. Prirodni travnjaci i pojedini napušteni lokaliteti s obraslom vegetacijom podržavali su raznolikije i strukturiranije hranidbene mreže tla, dok su organsko obogaćivanje i obrada tla na pojedinim lokalitetima bili povezani s promjenama ili pojednostavljenjem strukture zajednice nematoda. Analiza zajednica nematoda može pružiti vrijedne dopunske informacije o stanju tla na mjestima gniježđenja kornjača, osobito kada se tumači zajedno s fizikalno-kemijskim svojstvima tla i obilježjima korištenja zemljišta.

Ključne riječi: *Mauremys rivulata*, nematode, bioindikatori, stanje tla, upravljanje staništima

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