Landbouwhogeschool, Wageningen, Netherlands
and
Institut Zaštitu Bilja, Beograd, Yugoslavia

CARCHAROLAIMUS BANATICUS N. SP. (NEMATODA: DISCOLAIMIDAE) AND ITS ECOLOGY

by
D. KRNJAIC and P. A. A. LOOF

During the study of nematodes in a vegetation succession in Deliblato Sands, Banat, Yugoslavia, an undescribed species of *Carcharolaimus* was found. This species is described here, together with some data on ecology. The nematodes were extracted by the Oostenbrink elutriator and killed and processed by the Seinhorst method.

Carcharolaimus banaticus n.sp. (Figs 1 and 2)

Dimensions:

Females (n = 36): L = 1.57 mm (1.23-1.76); a = 40 (30-46); b = 3.5 (2.9-4.0); c = 71 (57-82); V = 50.5 (47-54); G_1 = 7-12; G_2 = 6-13; odontostyle = 18 µm (17-19); odontophore = 26 µm (23-28); spear = 44 µm (42-47).

Female, holotype: L = 1.63 mm; a = 41; b = 3.6; c = 71; V = $^{8}49^{9}$; odontostyle = 19 µm; odontophore = 26 µm; spear = 45 µm.

Males not found.

Body straight, outstretched, when relaxed; tapering only slightly, the width at vulva being x 1.0-1.1 width at base of oesophagus and 1.4-1.7 anal body width; width at base of oesophagus about x 1.5 width of lip region. Cuticle with thin outer layer, the inner layer

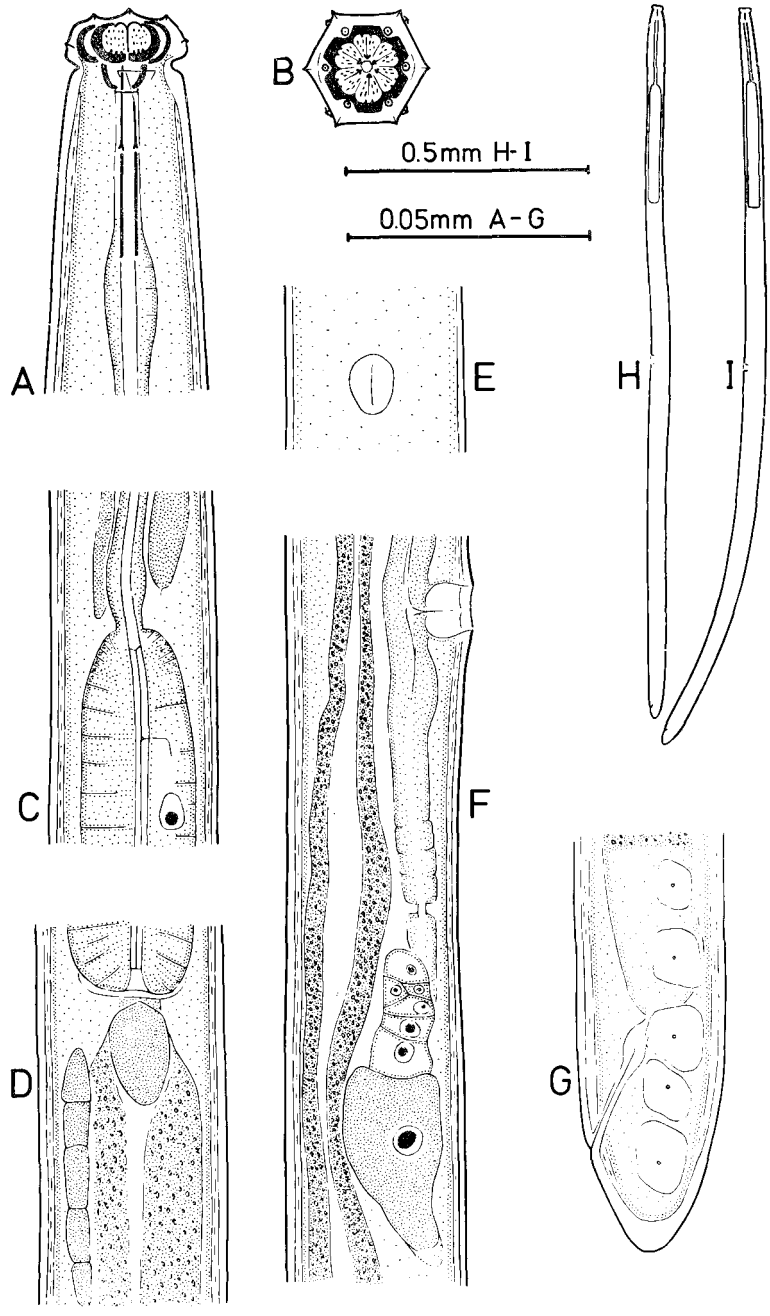
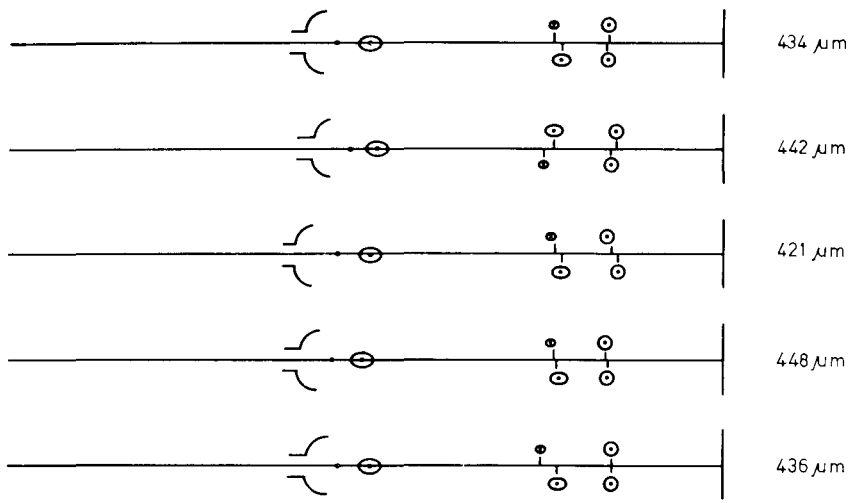


Fig. 1 - *Carcharolaimus banaticus* n.sp., female. A: Head end, lateral view; B: End-on view of stomatal cavity; C: Oesophageal expansion, lateral view; D: Cardiac region, lateral view; E: Vulva, ventral view; F: Vulva and posterior gonad, lateral view; G: tail, lateral view; H and I: Entire specimens in typical relaxed posture.

showing very fine transverse striae which are somewhat more distinct on the tail where they are also discernible on the outer layer. Thickness of cuticle 2.5 µm, increasing to 4.5 µm on tail. Amphids goblet-shaped, less than one-half corresponding body width. Lip region strongly offset, with large papillae arranged in the usual way. Walls of stomatal cavity heavily sclerotized, basket with twelve ribs, the walls covered with minute denticles, some larger teeth at the bottom. Length of odontostyle about x 0.7 width of lip region, the



Carcharolaimus banaticus ♀

Fig. 2 - Oesophageal characters.

aperture occupying one-half of its length. Odontophore linear. Guiding ring « single ». The nerve ring surrounds the oesophagus at about 30% of its length from head end. Oesophagus expanding abruptly; just anterior to the expansion is a weak oval swelling. Cardia dome-shaped, 18 x 14 µm. Oesophagus with basal shield. Near the oesophagus base are two subdorsal rows of five to eight cells, each row 60-80 µm long.

Oesophageal characters (ten females): the oesophagus expands at 41-43% of its length from head end. DO lies distinctly behind the expansion, the distance DO-DN is 17-19 μm. The two S_1N lie a very small distance apart, the anterior one is smaller than the posterior one, which is smaller than the S_2N. The latter lie far from the base of the oesophagus. Locations:

DO 45-48%;	S_1N_1 74-77%;	S_2N 84-85%;	K = 91-99;
DN 49-52%;	S_1N_2 76-78%;	S_2O 84-86%;	K' = 93-99.
DO-DN 3.8-4.6%;	dist. 0.3-2.5%;		

Vulva a longitudinal slit 8-10 μm long. Vagina shallow. Uteri without sperm. Details of uteri and oviducts in many specimens not very clear, obscured by dense contents of the mid-intestine. No eggs. Tail convex-conoid with broadly rounded tip. Rectum about as long as anal body width, prerectum 18-32 μm long or x 1.2-1.8 rectum. Lateral organs: in neck region 27-31; between oesophagus base and vulva 19-25; between vulva and anus 42-50; on tail 1-2. Total number 93-104.

Type habitat and locality: soil around roots of *Festuca vaginata* Waldst. *et* Kit., Jagoda, Deliblato Sands, Banat, Yugoslavia.

Holotype: Female on slide WT 1662 of the nematode collection of the Agricultural University, Wageningen, The Netherlands. Paratypes: 19 females (two with end-on view of head) on slides WT 1663-1670 of the same collection; five females deposited at Institut za Zastitu Bilja, Beograd, Yugoslavia; one female deposited at each of the following addresses: U.S.D.A. Agricultural Research Service, Beltsville, U.S.A.; Dr. I. Andrássy, Budapest, Hungary; Dr. J. Heyns, Johannesburg, South Africa; Dr. M. S. Jairajpuri, Aligarh, India; and Dr. M. R. Sauer, Merbein, Victoria, Australia.

Diagnosis: This species stands very close to *C. mujtabai* Jairajpuri, 1968, from which it differs by: dentate walls of stomatal cavity; more slender body (a = 30-46 against 31-34); lower number of lateral organs (93-104 against 120-126); shorter odontostyle (17-19 μm against 20-21 μm); location of DO (45-48% against 41-44%) and of oesophageal expansion (41-43% against 38-40%). Three more *Carcharolaimus* species have denticles on the stomatal walls: *C. dentatus* Thorne, 1939 and *C. formosus* Lordello, 1957 which are much longer animals (over 2 mm), and *C. lucidus* Sauer, 1967, which has a shorter odontostyle (13-15 μm), possesses cardiac glands, and in which males are common and functional.

Ecological data

Carcharolaimus banaticus n.sp. was found in a number of habitats, ranging from a barren sand dune (habitat I) over pioneer plant communities on movable sand (II) to plant communities on semi-aggregated sand (III and IV), as well as within stands of *Robinia pseudoacacia* L. (VI) (Table I). In the sandy desert vegetation type (II, III and IV) the abundance of *Carcharolaimus* increases in proportion to the increase in complexity of the plant community, so that it reaches its highest density, highest constancy and highest prevalence (1) in association IV, the Festucetum vaginatae deliblaticum muscetosum (Stjepanovic-Veselicic, 1953). Unexpectedly, the species was not found in the steppic vegetation type (Chrysopogonetum-Pannonicum typicum, Stjepanovic-Veselicic, 1953), though this is the most abundant trophic association with the most favourable microclimate; the cause of this is unknown.

Table I - *Number of individuals, relative abundance, dominance and costance of* Carcharolaimus banaticus *in different habitats.*

Habitat	I	II	III	IV	V	VI
Number of plant species	0	26	36	40	86	
Number of nematode individuals	3	25	60	143	0	37
Relative abundance	2.75	3.03	1.90	4.07	0	0.80
Dominance	II	II	III	II	0	IV
Constance	I	III	IV	IV	0	III

I: Bare dune sand; II: Assoc. Coryspermeto-Polygonetum arenariae; III: Assoc. Festucetum vaginatae deliblaticum-fumanetosum; IV: Assoc. Festucetum vaginatae deliblaticum-muscetosum; V: Assoc. Chrysopogonetum Pannonicum typicum; VI: Comm. *Robinia pseudoacacia.*

Constancy is expressed by grades O (absent) to IV (present in samplings all the months of the year). In four of the five habitats where it was found there are periods during the year when samples did not contain this species. Generally, in associations with higher constancy the density is higher (Tab. I). In the most favourable

(1) Density means absolute number, constancy the presence in the nematode community throughout the year, prevalence the percentage within the nematode community (classes of prevalence after Tischler in Stanković, 1962).

habitat (IV) it occurs all the year round (Tab. II). Seasonal activities, vertical distribution and other characters may therefore best be studied in this association. The species reaches its maximum density in the late spring and early summer (Tab. II). During the warm and dry summer months, as well as during the winter, the species declines in numbers or even disappears completely.

Seasonal variations in the species density within plant associations of various complexity can be related to environmental changes in each of them in the course of the year. Though it is hard to find out how the activity of a certain environmental factor reflects on an association, certain relations suggest themselves. The maximum density of *Carcharolaimus banaticus* is reached in the period of the most luxurious vegetation of sandy desert, i.e. in spring. During summer, most annual plants become dry, so that the trophic capacity

Table II - *Seasonal fluctuations of* C. banaticus *in four habitas. Habitat designations as in Table I.*

Habitat	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
II	1	—	2	3	14	1	—	3	1	—	—	—
III	2	—	4	8	3	12	10	9	3	4	2	2
IV	3	3	5	7	23	51	13	16	4	9	6	3
VI	1	4	3	7	3	—	15	5	—	—	—	1

of the habitats decreases and microclimatic conditions deteriorate, which results in decline of the species. Decline of density within the more complex associations, or occasional disappearance within scarce plant associations and on barren dune during the winter may be more intimately connected with actual conditions of the habitat and their seasonal variation.

Similarly to seasonal dynamics, vertical distribution of *C. banaticus* can be closely connected with condition of the habitat, i.e. with vertical distribution of trophic niches and microclimatic conditions therein. In the barren dune, as an extremely unfavourable

habitat, there is a very low number of individuals in the surface layer. With increasing complexity of the habitats, the number of individuals and the penetration into deeper layers increase (Tab. III). The fact that *C. banaticus* is found in such different habitats on Deliblato Sands (barren dune, sandy desert vegetation, and *Robinia* forest) suggests its having a wide ecological valence. On the other hand, its seasonal discontinuity and its absolute prevalence in the surface layer point to the existence of a powerful factor of dispersion. Earlier investigations (D. Krnjaic *et* S. Krnjaic, 1970) showed that the wind transported, beside other materials, individual specimens of the species from one locality to another on Deliblato Sands. The local southeast wind (Kosava) may, potentially or actually, during the whole year transport individual specimens over more or less great distances (Krnjaic, 1971). Species that, like *C. banaticus*, in-

Table III - *Vertical distribution of* C. banaticus *in five habitats. Habitat designations as in Table I; nematode numbers per 100 ml sand.*

Habitat	Depth in cm					
	0-10	10-20	20-30	30-50	50-70	70-100
I	2	1	—	—	—	—
II	16	5	2	1	1	—
III	17	15	18	7	3	—
IV	62	44	20	11	5	1
VI	2	6	10	14	4	1

habit the surface layer of dune soil are especially concerned here, particularly if the substrate is slightly aggregated or not covered by vegetation (associations I-III).

C. banaticus was found in the following localities in Deliblato Sands: Jagoda, Dolina, Budzak and Volovska pasa. With exception of the steppe, this species is present at all successive levels of vegetation to the *Robinia* forest stands. It is one of those rare species of nematodes which inhabit the barren sand substrate (movable sand), being present therein up to the complete aggregation (associations IV and VI).

SUMMARY

Carcharolaimus banaticus n.sp. is a monosexual species characterized by denticulate stomatal walls, longitudinal vulva, odontostyle length of 17-19 μm and almost straight body posture when relaxed. It resembles *C. mujtabai* Jairajpuri, 1968 but differs from that species by the presence of denticles on the walls of the stomatal cavity, and in some quantitative details. It occurs on Deliblato Sands, Yugoslavia, in a variety of habitats, ranging from barren sand dunes over desert vegetation to *Robinia* forest stands. There are indications that it is dispersed by wind.

RIASSUNTO

Carcharolaimus banaticus *sp. n. (Nematoda, Discolaimidae) e la sua ecologia.*

È descritto *Carcharolaimus banaticus*, una nuova specie monosessuata, caratterizzata dalla presenza di numerosi denticoli sulla parete della cavità boccale; la vulva è longitudinale e la lunghezza dell'odontostile è di 17-19 μm; la posizione del corpo degli esemplari morti è rettilinea. Questa specie assomiglia soprattutto a *C. mujtabai* Jairajpuri, 1968 che, però, non presenta denticoli sulla parete della cavità boccale ed è anche di dimensioni differenti. *C. banaticus* vive nelle sabbie di Deliblato, Iugoslavia, in diversi *habitat*: dune nude, vegetazione desertica, fino a foreste di *Robinia* e sembra diffuso dal vento.

RESUMÉ

Carcharolaimus banaticus *n. sp. (Nematoda, Discolaimidae) et son écologie.*

On décrit *Carcharolaimus banaticus*, une nouvelle espèce monosexuelle, caractérisée par la présence de nombreuses denticules sur les parois de la cavité buccale; la vulve est longitudinale, la longueur de l'odontostyle est 17-19 μm; après la mort l'attitude du corps est presque rectiligne. Elle ressemble plus à *C. mujtabai* Jairajpuri, 1968, mais cette espèce n'a pas des denticules sur les parois de la cavité buccale et diffère aussi en quelques dimensions. *C. banaticus* vive dans les sables de Deliblato, Yougoslavie, dans plusieurs habitats: dunes nudes, végétation de désert, jusqu'aux forêts de *Robinia*. Il y a quelques indications qu'elle est distribué par le vent.

LITERATURE CITED

JAIRAJPURI M. S., 1968 - Three new species of Actinolaimidae (Nematoda: Dorylaimoidea) from India. *Proc. helm. Soc. Wash.*, *35*: 96-102.

KRNJAIĆ D., 1971 - Naselja nematoda u ekoloski diferenciranim stanistima Deliblatske pescare. Thesis (unpub.), Beograd.

KRNJAIĆ D. and KRNJAIĆ S., 1972 - Dispersion of nematodes by wind. *Boll. Lab. Ent. agrar. « Filippo Silvestri » Portici*, *30*: 66-70.

LORDELLO L. G. E., 1957 - Two new nematodes found associated with soy-bean roots. *Nematologica, 2*: 19-24.

SAUER M. R., 1967 - Three new species of *Carcharolaimus* (Nematoda: Dorylaimidae). *Nematologica, 13*: 311-317.

STANKOVIĆ S., 1962 - *Ecology of animals*. Beograd, Naucna knjiga, 432 p.

STJEPANOVIĆ-VESELICIĆ L., 1953 - La végétation des Sables de Deliblato. *Serb. Acad. Sci. Monograph, 216,* 113 pp.

THORNE G., 1939 - A monograph of the nematodes of the superfamily Dorylaimoidea. *Capita zoologica, 8* (5), 261 pp.

Accepted for publication on 6 July 1975.