

ON THE DISTRIBUTION, ECOLOGY AND BIOLOGY OF *CAMPYDORA DEMONSTRANS* COBB, 1920 (ENOPLIDA, CAMPYDORIDAE)

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Summary. For *Campydora demonstrans*, which had previously been reported from Greece, Italy, Hungary, Slovakia, Serbia, Moldova, Georgia, Switzerland, Germany, The Netherlands, Poland, Spain and the Azores in Europe, from India in Asia and from the USA in the Americas, new records are added for Slovakia, the Canary Islands, Iran, Yemen, Vietnam, USA and particularly for Germany, where *C. demonstrans* has been found at a total of 49 sites. The nematode was found in a wide range of habitats, with the majority being meadows and other grassland sites. It prefers light sandy or loamy soils, but shows no preference for warm or cold regions. Males were rarely found. The feeding habits are largely unknown, but *Campydora* is considered to be at least a “particle-feeder”.

Keywords: Feeding, Germany, habitat, males, occurrence.

The genus *Campydora* Cobb, 1920, with the only recognised species *C. demonstrans* Cobb, 1920, is among the most peculiar free-living nematodes. Its systematic position within Nematoda has long been uncertain. Previously, most authors placed the genus in the order Dorylaimida or close to it. Recent studies, mainly based on molecular data, finally assigned this enigmatic nematode to the order Enoplida and taking a basal position within the entire phylum Nematoda (Mullin *et al.*, 2003; Van Megen *et al.*, 2009). Despite *Campydora* gaining increasing interest recently, data on this remarkable nematode are still rather scant.

The objective of the present paper is to compile knowledge on geographical distribution and ecology of *Campydora* based on published information and completed by my own observations and data.

MATERIALS AND METHODS

Soil samples containing *Campydora* specimens were collected in Germany, Slovakia, the Canary Islands, the Azores, Yemen, Iran, Vietnam and the USA. The nematodes were extracted from soil and fixed by various methods commonly used for soil-inhabiting nematodes. Permanent microscope slides with voucher specimens are deposited in the German Nematode Collection (DNST) at the Julius Kühn-Institut (formerly: Biologische Bundesanstalt), Münster, Germany. Results of morphological studies will be published separately (Ahmad and Sturhan, in preparation).

GEOGRAPHICAL DISTRIBUTION

Europe. Cobb (1920) described *C. demonstrans* from Corfu, Greece. Altherr (1950) reported it from Switzer-

land, and Meyl (1960) found it in Italy. For Spain, Peña Santiago *et al.* (1989) recorded *C. demonstrans* from the Jaen province in the north and Jimenez Millan and Gomez Barcina (1998) from the south of the country. In The Netherlands this nematode is also present but rare (Faunaeuropaea.org). From Poland, there are records from different parts of the country by Brzeski (1963), Wasilewska (1994) and Winiszewska (2001). Andrassy (1955, 1973) observed *C. demonstrans* twice in Hungary, Lišková and Ěerevková (2005) in meadows in Slovakia. Krnjaic (1998) found it in Voivodina, Serbia, and Lisetskaya (1971) and Nesterov (1979) reported it for the Republic of Moldova. Eliava *et al.* (2002) found *C. demonstrans* in the region of Tbilisi in Georgia.

My European records are from the Slovak Republic (river bank vegetation and adjoining meadow at Trebejov near Košice), from the Canary Islands (island La Palma, Caldera de Taburiente, rhizosphere of *Aeonium* sp. growing on a slope) and the Azores (island Faial, roadside vegetation with planted *Ulmus procera* near Capelo; Sturhan, 1973 and unpubl.).

In Germany, *C. demonstrans* was first reported by Ebert (1966) from meadow soil near Erlangen and subsequently by Sturhan (1970) and Ludwig and Sturhan (1998). The number of records for Germany has now increased to a total of 49, with findings in various regions of the country but with the majority of records being from southern Germany (Fig. 1).

Asia. The only previous record of *C. demonstrans* for an Asian country is from India by Jairajpuri (1964, 1983) and Ahmad and Jairajpuri (1982) for Kashmir; Ahmad (pers. comm.) found it at additional sites and Bilgrami *et al.* (1986) mentioned observations on *Campydora* as a prey of mononchs in India.

I isolated this nematode from soil samples collected at four sites in Iran: West of Qazvin, on the northern

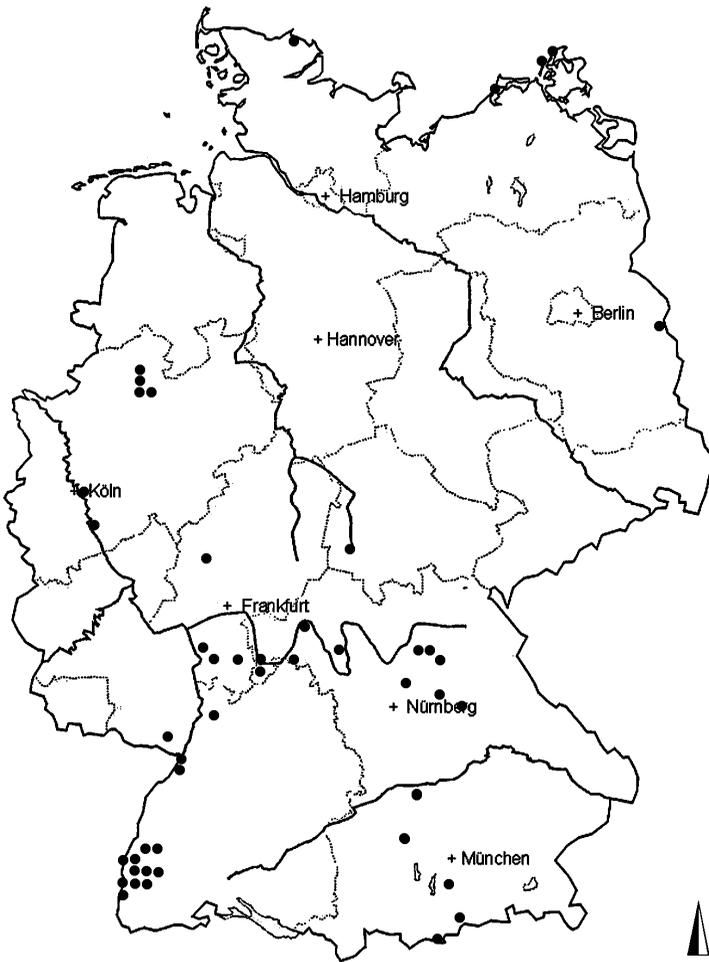


Fig. 1. Known distribution of *Campydora demonstrans* in Germany.

slopes of the Albourz Mountains ca. 1500 m above sea level, under grasses and various herbs; Mashad, in a strawberry field and, at another site, in a lucerne field; south of Khorramabad, in a wheat field. In Vietnam, I identified *C. demonstrans* among nematodes isolated from a soil sample from Cat Ba National Park, province of Thai Binh in the north of the country. In Yemen, I found *C. demonstrans* in a soil sample from a citrus grove and a sample from a sweet potato field at Madinat-ash-Shirq, a sample from the rhizosphere of a fig tree at At-Turbah and on a rocky mountain slope in an area never in agricultural cultivation between Hodeidah and Sanaa, at an elevation of approximately 2000 m.

America. There are only records for the USA: Thorne (1939) reported *C. demonstrans* from two sites in Utah, Orr and Dickerson (1966) and Mullin *et al.* (2003) from Kansas, and Mullin (http://nematode.unl.edu/Campydora_demonstrans.htm) also from Nebraska. I found this nematode in a soil sample collected in a *Pinus-Juniperus* forest at the southern rim of the Grand Canyon, Arizona.

HABITAT AND BIOLOGY

At the type locality in Greece, *C. demonstrans* was found about the roots of citrus trees (Cobb, 1920), and from other countries the nematode has been reported from soil around roots of pomegranate, citrus, fig and apple trees (India, Yemen, Germany). Several records are from arable or garden soil (Iran, Yemen, in Germany only three of the samples). Most of the findings in Germany are from meadows and other types of grassland (ca. 60% of all sites), and most records from other countries also refer to grassland. Quite often this nematode has been found under riverbank vegetation (seven records from Germany, other reports from Slovakia, USA and India). Only exceptionally has *Campydora* been found in forest soil or at the edge of woodland or even in a forest nursery (Hungary, Vietnam, seven sites in Germany).

Most German records are from loamy sand, sandy loam or loess, a few from loam or sandy soil. The records from other countries also mostly refer to light, sandy or loamy soils.

In general, I isolated only low numbers of *C. demonstrans* from soil samples. Only in a sample from Slovakia and a sample from the Azores did I find more than 100 specimens in soil samples of about 250 ml. *Campydora* was present in soil samples collected throughout the year, including the winter months.

Males of *C. demonstrans* have only rarely been found so far. Winiszewska (2001) described a single male from Poland. I found a few males in four of the soil samples from Germany and in the sample from the Azores. The samples from Germany containing males had been collected in April and October, the sample from the Azores in June. According to the description by Winiszewska (2001) and my own observations, the reproductive system of the males is well developed and appears to be functional. Sperm-like bodies were observed in the uteri of several females from the Vietnam population.

In the intestine of females collected in Slovakia, Yemen and Vietnam roundish bacteria-like food particles of up to 2 µm in diameter and irregularly-shaped granulated bodies of up to more than 10 µm length were observed. Food particles were mostly present in the most anterior part of the intestine close to the cardia, with the posterior part of the pharynx obviously functioning as a pumping structure (Fig. 2).

CONCLUSIONS

The high number of new records supports the previous assumption that the genus *Campydora* has a wide distribution. All known records (almost 90) from a total of 18 countries and island groups are from the northern hemisphere. The high number of records for Germany and the wide distribution of *Campydora* in this country

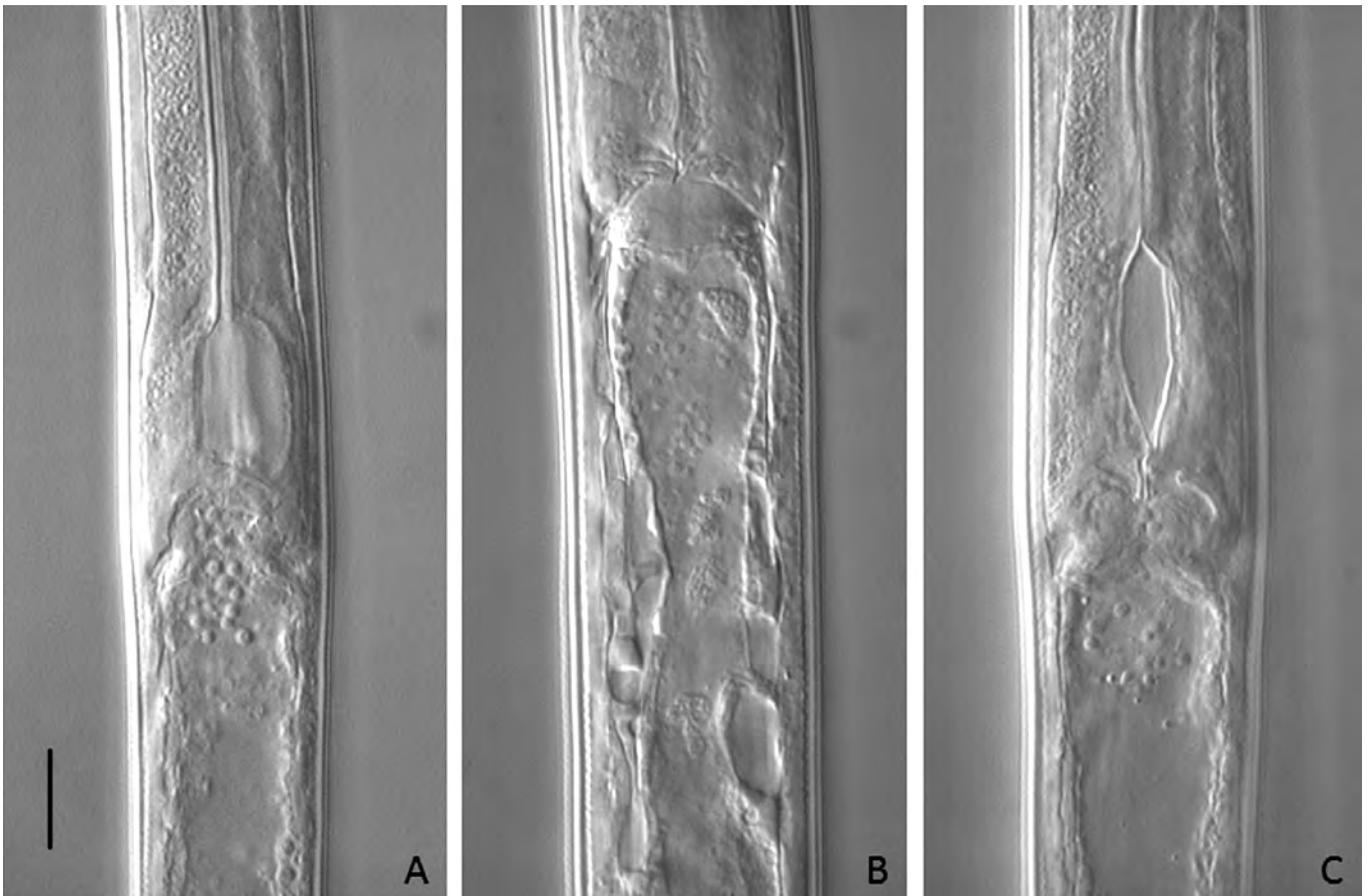


Fig. 2. *Campyldora demonstrans*. Cardia region of a juvenile and a female from Vietnam (A, C) and a female from Slovakia (B) with food particles in the anterior intestinal lumen. (Scale bar = 10 μ m).

may indicate that the nematode is often overlooked, and is most probably similarly common or widely distributed in at least the adjoining European countries. So far, there is no evidence that species other than *C. demonstrans* occur. The species *C. balatonica* (von Daday, 1894) Andrásy, 1954 described from Hungary and still listed as a distinct species by Loof (1999), is generally considered as *species inquirenda* (Mullin *et al.*, 2003; Andrásy, 2007).

Campyldora demonstrans inhabits a wide range of habitats, including agricultural and garden soil at one end of the spectrum and, at the other end, areas that have never been under any cultivation, but it seems to be rare in forest soil. As already stated by other authors, the species prefers light soils. A preference for moist soils could not be confirmed; several of the collecting sites in Germany and the sites in Iran and Yemen were quite dry. Neither the assumption of Nesterov (1979) that it is “a warm loving species”, nor the suggestion of Jairajpuri (1983) that it “prefers a colder climate”, could be confirmed.

The rare occurrence of males is remarkable. It is still an open question whether males play a role in reproduction, appear only at certain times of the year and/or have only a short lifespan. Occasional observations of sperm-like bodies in the uteri of a few females suggest that mat-

ing does occur, although Jairajpuri (1984) suggested that *C. demonstrans* reproduces by parthenogenesis.

Yeates *et al.* (1993) list *Campyldora* as probably being omnivorous, and Andrásy (2007) considered it as a predator. According to my observations it is at least a “particle-feeder”. The presence of distinct bacteria-like food particles in the anterior gut region, but only “dissolved” particles throughout the posterior part of the intestine, indicate that bacteria are not only swallowed but digested. The observed food particles in the intestine may, however, also be body contents of prey.

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