

Predatory soil nematodes (Nematoda: Mononchida) in major land-use types across Ireland

Aidan M. Keith^{a,b*}, Christine T. Griffin^b and Olaf Schmidt^a

^aSchool of Biology and Environmental Science, University College Dublin, Belfield, Dublin 4, Ireland; ^bInstitute of Bioengineering and Agroecology, Department of Biology, National University of Ireland, Maynooth, Co. Kildare, Ireland

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The distribution of predatory soil nematodes (Mononchida) across Europe is well described. However, in Ireland knowledge of mononchids is limited to a single study. The CréBeo project was the first systematic survey of soil biodiversity in the major land-use types across the Republic of Ireland. Nematodes were sampled from 61 locations with an extensive geographical spread including arable, pasture, broadleaf forest, coniferous plantation, rough grazing and peatland sites. This study resulted in 11 first records of mononchid species from Ireland (of which 2 are new records for Britain and Ireland). We discuss the mononchid species found and aspects of their distribution across major land uses.

Keywords: *Anatonchus sympathicus*; biodiversity; *Jensenonchus sphagni*; species distribution; *Tigronchoides ginglymodontus*

Introduction

The first study of nematode diversity in Ireland was conducted as part of the Clare Island survey, focusing mainly on marine and littoral nematode communities (Southern 1914). Despite this early endeavour, information on terrestrial nematodes in Ireland is currently limited to the occurrence of some plant parasites of economic importance (Moore 1967), and the results of surveys targeted at entomopathogenic taxa (Griffin et al. 1991). The large size and predatory ecology of the Mononchida make them particularly charismatic amongst nematodes and hence the distribution of mononchid taxa across Europe is generally well described. However, the only mononchids recorded in Ireland to date are *Clarkus papillatus* (Bastian, 1865) and *Mononchus truncatus* (Bastian, 1865). These were named as *Mononchus papillatus* and *Mononchus macrostoma* respectively in the Clare Island nematode survey (Southern 1914). Here, we report the first records from Ireland of a number of other mononchid species and discuss aspects of their distribution across major land uses.

Materials and methods

Samples were collected as part of the CréBeo project during the first systematic survey of soil biodiversity in the major land-use types across the Republic of Ireland. Sites were chosen from the pool of 1310 locations of the National Soils Database

*Corresponding author. Email: aidan.keith@ucd.ie

(NSD) (Fay et al. 2007) using a stratified random selection with the constraints of a proportional representation of the major land-use and soil types and an extensive geographical spread. Altogether, 61 sites were sampled: 14 arable, 21 pasture, 5 broadleaf forest, 5 coniferous plantation, 8 rough grazing and 8 peatland (Figure 1).

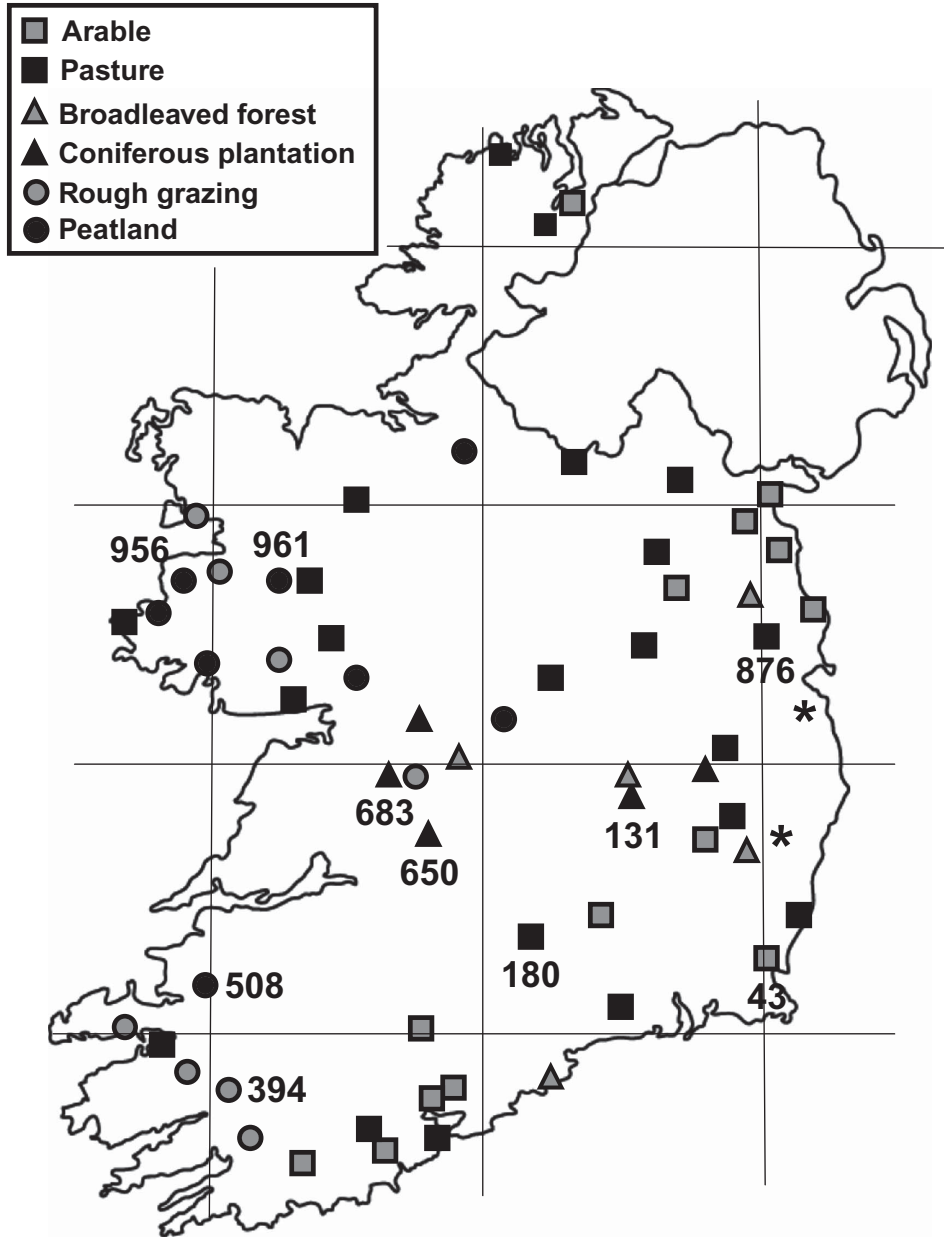


Figure 1. Distribution of sampling sites across the Republic of Ireland and their associated land-use types. Numbered sites are referred to in the text. Asterisks represent two locations of additional *A. tridentatus* records.

Rough grazing sites represent a land-use type considered intermediate between pasture and peatland, particularly in terms of soil moisture and organic matter content. Sites were sampled from late July to early September 2006 (52 sites) and in October 2007 (9 sites; plus repeat sampling of 12 sites sampled in 2006). Each sampling site was identified by a global positioning system-referenced location from the NSD Project (Fay et al. 2007). At each location, a total of 20 soil cores (20 cm depth) was taken within a 20 m × 20 m area; one core was taken every 3 m by walking a transect and “rebounding” off the edges of the area. All soil cores from one location were pooled, mixed thoroughly and 500 cm³ of soil was stored at 4°C until extraction.

Nematodes were extracted from a 100-cm³ sub-sample of soil from each site. This was suspended in water, sieved (through 600, 250, and 38 µm mesh sizes), and retained nematodes were extracted via sugar centrifugation (Southey 1986). Nematodes were killed by application of gentle heat and fixed in hot (65°C) buffered formalin:glycerine (FG 4:1). Nematodes were then processed to pure glycerine by slow evaporation and mounted in permanent mass slides for community analysis. Approximately 100 nematodes were identified for each site from these permanent slides. The remaining fixed extract from each site was also screened under a stereomicroscope to detect the presence of further predatory nematodes. Nematodes were identified using the work of Andr assy (1985, 1992, 1993) and Bongers (1988). The collection of mass slides from the Cr eBeo Project will be deposited in the National Museum of Ireland, Dublin.

Results and discussion

A total of 13 mononchid nematode species was recorded in this survey, of which 11 are the first records for the island of Ireland (2 are also the first records for Britain and Ireland; Table 1). The most widespread species was *Anatonchus sympathicus* (Andr assy, 1993), being recorded in 30 sites distributed extensively across Ireland, and in all land-use types except “rough grazing”. Generally, *A. sympathicus* was associated with agricultural habitats; it was present in all arable sites and over half of the pasture sites (Table 1). Andr assy (1993) described this species, noting its presence in Germany and Hungary; it has also been recorded since in Spain (Pe na-Santiago et al. 2006). It is distinguished from *Anatonchus tridentatus* (de Man, 1876) by its shorter body, smaller buccal cavity, longitudinal vulva, and fewer and differently shaped eggs in the mature female. While *A. sympathicus* was prevalent in this survey, we found *A. tridentatus* in only one pasture site (site 180 in Figure 1; Table 1). More recently we have also recorded *A. tridentatus* from grass turf at the University College Dublin campus and a pasture site in Co. Wicklow (asterisks in Figure 1; A.M. Keith, unpublished data). Boag et al. (1992) recorded *A. tridentatus* in over 40% of arable and pasture sites across Britain. Given that *A. sympathicus* was described after publication of the paper by Boag et al. (1992), and the similarity of its distribution in agricultural habitats, it seems probable that this species is also present in Britain, and that some of these records of *A. tridentatus* may be *A. sympathicus*. In a further four arable and three pasture sites only juvenile anatonchids were recorded, suggesting that *A. sympathicus* and *A. tridentatus* may be even more widespread.

C. papillatus and *Mylonchulus sigmaturus* (Cobb, 1917) were also relatively common being recorded in 21 and 22 sites, respectively (Table 1). Their distribution across land-use types followed a similar pattern to that of *A. sympathicus*, although *M. sigmaturus* was also found in three “rough grazing” sites. Nevertheless, both of

Table 1. Predatory nematode species (Mononchida) across 61 sites in the Republic of Ireland, and the number of sites in which they were recorded within major land-use types.

Family/Species	Arable (14 sites)	Pasture (21 sites)	Broadleaf (5 sites)	Coniferous (5 sites)	Rough grazing (8 sites)	Peatland (8 sites)
Anatonchidae						
<i>Anatonchus sympathicus</i> (Andrássy, 1993)**	14	12	1	2	0	1
<i>Anatonchus tridentatus</i> (de Man, 1876)*	0	1	0	0	0	0
<i>Tigronchoides ginglymodontus</i> (Mulvey, 1961)**	0	1	0	0	0	0
<i>Truxonchus dolichurus</i> (Ditlevsen, 1911)*	1	0	0	0	1	3
Iotonchidae						
<i>Jensenonchus sphagni</i> (Brzeski, 1960)*	0	0	0	3	0	0
Mononchidae						
<i>Clarkus papillatus</i> (Bastian, 1865)	7	9	2	2	0	1
<i>Coomansus parvus</i> (de Man, 1880)*	2	0	0	1	0	0
<i>Mononchus aquaticus</i> (Coetsee, 1968)*	0	2	0	0	1	0
<i>Mononchus truncatus</i> (Bastian, 1865)	0	0	1	0	0	0
<i>Priotonchulus muscorum</i> (Dujardin, 1845)*	0	0	1	0	0	0
<i>Priotonchulus punctatus</i> (Cobb, 1917)*	1	0	1	0	0	0
Mytonchulidae						
<i>Mytonchulus sigmaturus</i> (Cobb, 1917)*	9	7	2	1	3	0
<i>Mytonchulus striatus</i> (Thorne, 1924)*	1	1	0	1	0	0

*New records for island of Ireland; **new record for Britain and Ireland.

these species are cosmopolitan and are known from a range of soil types and habitats (Bongers 1988).

Several of the mononchid species had a reasonably distinct geographical distribution. *Truxonchus dolichurus* (Ditlevsen, 1911) was recorded in one rough grazing and three peatland sites, all located in the far west of Ireland (sites 394, 508, 956 and 961 in Figure 1; Table 1). Boag et al. (1992) also found that *T. dolichurus* was generally restricted to the north and west of Britain in scrub or heathland soils, particularly those with high moisture content and low pH. Hence, this distribution on the western fringe of Ireland is almost certainly associated with the wetter, highly organic soils found here (Table 2). The exception to this trend was a record of *T. dolichurus* at one arable site (site 43 in Figure 1; Table 1) in the extreme south-west of Ireland. However, Boag et al. (1992) also recorded the limited presence of *T. dolichurus* in arable, pasture and woodland samples. It is possible that surrounding habitats could contribute to the presence of species not typical of the particular land use. *Jensenonchus sphagni* (Brzeski, 1960) was found at three coniferous plantation sites clustered in central Ireland (sites 131, 650 and 683 in Figure 1). In Britain, Peneva et al. (1998) noted that *J. sphagni* was restricted to northern Scotland, being found in semi-natural habitats with trees and heather. This somewhat agrees with our three sites since they were Sitka spruce (*Picea sitchensis*) plantations on former peatland having generally high levels of organic matter and moisture content (Table 2). *J. sphagni* was absent from the remaining two coniferous plantation sites, which were also located in the Irish midlands (Figure 1); no mononchids were recorded at one, and the other was planted into pasture. Clearly, a more extensive geographic sampling of mononchid nematodes in coniferous plantations would be needed to ascertain whether *J. sphagni* is more widely distributed. However, our record of *J. sphagni* in Ireland lends support to the suggested vicariant distribution of *J. sphagni* and *Jensenonchus vorax* (Cobb, 1917) between Europe and North America, respectively (Peneva et al. 1998).

Less can be said about the distribution of the remaining mononchid species since each was recorded in only one site, or a few sites under different land-use types (Table 1).

Table 2. Soil properties from selected sites of the National Soils Database (NSD) highlighted in the sampling map.

NSD site	Land-use type	Soil type	Gravimetric moisture content (%)	pH	Organic matter (%)
43	Arable	Gley	18.8	6.3	3.7
180	Pasture	Grey-Brown Podzol	16.8	5.5	7.2
876	Pasture	Gley	17.0	5.7	6.2
131	Coniferous plantation	Gley	33.7	5.1	18.5
650	Coniferous plantation	Brown Podzolic	344.9	3.6	91.7
683	Coniferous plantation	Gley	142.9	3.6	61.2
394	Rough grazing	Podzol	75.6	5.3	31.8
508	Peatland	Peat	427.8	4.4	93.7
956	Peatland	Peat	784.2	4.7	86.1
961	Peatland	Peat	768.3	4.0	97.2

However, all are found across Europe, and would be generally considered cosmopolitan (Bongers 1988). In addition to *A. sympathicus*, *Tigronchoides ginglymodontus* (Mulvey, 1961) is the only other mononchid species of those found in this survey that has not been recorded in the British Isles. On the continent *T. ginglymodontus* has previously been recorded from Hungary in oak forest, Romania in grassland and Serbia from around the roots of *Amorpha fruticosa* and *Vitis* spp. shrubs (Peneva et al. 1999; and references therein). In the present survey, *T. ginglymodontus* was found at one pasture site (site 876 in Figure 1; Table 1).

The CréBeo survey was the first systematic attempt to characterize biodiversity in Irish soils. However, the number of mononchid species reported here is generally low compared with other European countries (e.g. Britain: 21 spp., France: 18 spp., Germany: 27 spp., Italy: 20 spp., Poland: 24 spp.; all in Boag et al. 1992). For example, we were surprised not to find *Miconchus studeri* (Steiner, 1914) given its relative prevalence in Britain (Boag et al. 1992) and presence across Europe. Due to the relatively low number of sites examined (*cf.* 5451 samples examined by Boag et al. 1992) and small quantity of soil extracted (100 cm³ per sample) we would expect further sampling to yield more predatory mononchid species, particularly in semi-natural habitats. In turn, while many aspects of Ireland's flora and fauna are regarded as depauperate compared to other European countries (Cabot 1999), it remains to be seen whether this is also the case for the Mononchida.

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