



Hosts and habitats of *Trichinella spiralis* and *Trichinella britovi* in Europe

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ABSTRACT

Trichinella spiralis and *Trichinella britovi* are the two most common species of *Trichinella* circulating in Europe. Based on data provided to the International *Trichinella* Reference Centre over the past 20 years (data referring to 540 isolates of *T. spiralis* and 776 isolates of *T. britovi*), we describe the host species and habitat characteristics for these two pathogens in Europe. A Geographical Information System was constructed using administrative boundaries, a Corine Land Cover (CLC) map, and an elevation map. In most countries, *T. britovi* is more widespread (62.5–100% of the isolates) than *T. spiralis* (0.0–37.5%), although in Finland, Germany, Poland and Spain, *T. spiralis* is more prevalent (56.3–84.2% of the isolates). *Trichinella britovi* is more widespread than *T. spiralis* in sylvatic carnivores (89% versus 11%), whereas *T. spiralis* is prevalent in both wild boars (62% versus 38%) and domestic swine (82% versus 18%), as well as in rodents (75% versus 25%). *Trichinella spiralis* and *T. britovi* circulate in the same environments: 41.1% and 46.0%, respectively, in agricultural areas, and 45.5% and 46.6% in forested and semi-natural areas. Although both pathogens can be transmitted by domestic and sylvatic cycles, their epidemiology is strongly influenced by the higher adaptability of *T. spiralis* to swine and of *T. britovi* to carnivores. These results are important because they include information on the countries at risk for these pathogens, the role played by specific species as reservoirs, the role of the pathogens in domestic and sylvatic cycles, and the role of the habitat in their circulation. The results can also be used to identify the most suitable animal species for the monitoring of these pathogens in Europe.

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1. Introduction

In Europe, wildlife represents the most important reservoir of worms belonging to the genus *Trichinella*, which makes eradication impossible and explains why the parasites continue to circulate, even though the prevalence in wildlife can be very low for many years (Rafter et al., 2005; Hars et al., 2007). Wild animals also represent the most important source of infection for domestic pigs, which in turn are the main source of infection for other reared animals (e.g., horses), as well as for humans (Pozio and Murrell, 2006).

According to current European Union (EU) legislation on the control of *Trichinella* spp. in meat, Member States must implement a monitoring programme for susceptible host species (European Community, 2005). When applying for *Trichinella*-free status for a pig herd, the wildlife in the region of the herd must also be monitored. Thus, information on factors that can favour the circulation of *Trichinella* spp. in nature is funda-

mental (e.g., the characteristics of the habitat and the host species), so that the risk for domestic animals can be assessed and managed.

In Europe, up to 60–61° latitude north, *Trichinella spiralis* and *Trichinella britovi* are the most widespread etiological agents of *Trichinella* infection in wild and domestic animals (Pozio, 1998, 2007). The other two etiological agents circulating in Europe, *Trichinella nativa* and *Trichinella pseudospiralis*, play a secondary role as pathogens for domestic animals, since *T. nativa* infects almost exclusively sylvatic carnivores of arctic and subarctic regions (the isotherm –4 °C in January seems to be the southern border of their distribution), but not domestic or sylvatic swine. The available information on *T. pseudospiralis* is still too limited to provide a complete understanding of its circulation in nature (Pozio and Murrell, 2006; Pozio, 2007).

Since 1988, the International *Trichinella* Reference Centre (ITRC, www.iss.it/site/Trichinella/index.asp) has identified most of the *Trichinella* spp. isolates collected in Europe and is thus an important source of information for evaluating the occurrence of infection. The objective of the present study was to provide detailed information on the hosts of *Trichinella* and their habitat in a large

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part of Europe, based on the information recorded in the ITRC database over the past 20 years.

2. Materials and methods

2.1. Sources of information for *Trichinella* spp. isolates

All isolates of *T. spiralis* and *T. britovi* identified and registered at the ITRC from 1988 to 2007 were included in this study, as were mixed isolates (i.e., isolates containing both *T. spiralis* and *T. britovi* or one of the two species and *T. nativa* or *T. pseudospiralis*). Over the years, different methods have been used to identify *Trichinella* isolates at the species level, in particular: using allozymes on a pool of larvae (11.4% of the isolates) (La Rosa et al., 1992); random amplified polymorphic DNA analysis performed on single larvae (17.0%) (Bandi et al., 1995); PCR on single larvae (2.0%) (Wu et al., 1998); and multiplex PCR on single larvae (69.6%) (Pozio and La Rosa, 2003). We only considered those isolates for which the following information was available: the longitude and latitude of the location from which the infected animal originated; the scientific name of the host; and the *Trichinella* species identified (Tables 1 and 2). Of the 1316 isolates that fulfilled the above criteria, 540 belonged to *T. spiralis* and 776 to *T. britovi*. These isolates originated from 22 of the 27 EU countries; for the remaining five EU countries, no information was available; in particular, in Greece, no ad hoc studies have been conducted (Pozio, 2007); in Denmark, *Trichinella* sp. is extremely rare (Enemark et al., 2000); and in Cyprus, Luxembourg and Malta, these pathogens seem to be absent (Pozio,

2007). The isolates also originated from eight other countries in Europe (i.e., Croatia, Macedonia, Norway, Republic of Belarus, Russia, Serbia, Switzerland and the Ukraine).

2.2. Home range of hosts

To acquire information on the environmental characteristics of the areas of origin of the sylvatic animals, the size of the home range of each species was evaluated, based on data from the literature, irrespective of age, sex, region and season (Table 3). For domestic animals, the size of the home range was arbitrarily set at a radius of 0.3 km, based on the home range of the brown rat, which can transmit infection to domestic animals.

2.3. Geographical information system (GIS) and land cover

A Geographical Information System (GIS, ArcGIS version 9.2, ESRI, Redlands, CA, USA) for Europe was constructed using data layers on the following environmental features: administrative boundaries, land cover and elevation. Furthermore, the coordinates (longitude and latitude) of the points from which the infected animals originated were inserted in the GIS (geo-referenced).

The buffer generation analysis function of GIS was used to generate circular “buffer zones” around each geo-referenced point. The radius of the “buffer zone” was established based on the specific home range of the host species (Table 3).

To acquire information on the land cover of the buffer zone identified with the GIS, we used the Corine Land Cover (CLC)

Table 1
Trichinella spiralis and *Trichinella britovi* isolates tested in Europe, by country of origin and host

Country	<i>Trichinella</i> isolates tested								Total
	<i>Trichinella spiralis</i>				<i>Trichinella britovi</i>				
	Domestic pigs and brown rats	Wild boars	Sylvatic carnivores	Other animals ^a	Domestic pigs and brown rats	Wild boars	Sylvatic carnivores	Other animals ^b	
Austria	–	1	–	–	–	–	1	–	2
Belarus	–	–	–	–	–	1	–	–	1
Belgium	–	–	–	–	–	1	–	–	1
Bulgaria	16	1	8	5	7	15	24	4	80
Croatia	38	–	1	–	1	1	–	–	40
Czech Republic	–	–	–	–	–	1	3	–	4
Estonia	1	–	–	–	2	4	39	6	52
Finland	39	2	9	2	–	–	4	–	56
France	–	2	5	1	8	3	15	–	34
Germany	2	10	4	–	–	–	3	–	19
Hungary	–	1	1	–	–	2	8	–	12
Ireland	–	–	4	–	–	–	–	–	4
Italy	–	–	1	–	14	10	114	9	148
Latvia	–	–	–	–	–	4	19	–	23
Lithuania	4	9	–	–	–	26	–	–	39
Macedonia	–	–	–	–	1	–	–	–	1
Netherlands	–	–	–	–	–	–	11	–	11
Norway	–	–	–	–	–	–	1	–	1
Poland	17	76	12	–	2	23	58	–	190
Portugal	–	–	–	–	–	–	7	–	7
Romania	26	–	3	–	4	5	22	1	61
Russia	–	–	–	–	–	–	–	1	1
Serbia	3	–	1	–	–	–	–	–	4
Slovak Republic	1	–	4	–	–	13	182	1	201
Slovenia	–	–	1	–	–	–	1	–	2
Spain	43	167	10	1	5	56	11	–	293
Sweden	2	–	3	–	–	1	8	–	14
Switzerland	–	–	–	–	–	–	2	–	2
United Kingdom	–	–	1	–	–	–	–	–	1
Ukraine	1	–	–	–	1	1	8	–	11
Total	194 (14.7%)	269 (20.4%)	68 (5.2%)	9 (0.7%)	46 (3.5%)	167 (12.7%)	541 (41.1%)	22 (1.7%)	1316

^a Stray dog, domestic cat, field mouse, black rat.

^b Farmed blue fox, stray dog, domestic dog, domestic cat, field mouse, black rat.

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