Echinococcus multilocularis (Cestoda, Taeniidae) in Red foxes (Vulpes vulpes) in northern Belgium.

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Abstract
This paper describes the first record of the tapeworm *Echinococcus multilocularis* (Cestoda, Taeniidae) in Red foxes (*Vulpes vulpes*) in northern Belgium. Between 1996 and 1999, 237 dead foxes were examined for the presence of this tapeworm using the intestinal scraping technique. Four foxes (1.7%) were found to be infected with *E. multilocularis* and showed medium to very high parasitic burdens. Three infected foxes originated from the south of the study area and the fourth animal came from the north of the study area near the border with The Netherlands. These findings are discussed in relation to the high endemicity of *E. multilocularis* in southern Belgium and to the increased distribution of the Red fox (*Vulpes vulpes*) in northern Belgium during the last two decades.

Keywords: *Echinococcus multilocularis*, *Vulpes vulpes*, alveolar echinococcosis, epidemiology, Belgium

Introduction
*Echinococcus multilocularis* is a small endoparasitic tapeworm belonging to the family of the Taeniidae (Eckert et al., 2001; Thompson and Lymbery, 1995). The typical life cycle is sylvatic with foxes (genera *Vulpes* and *Alopex*) and coyotes (*Canis latrans*) as final hosts, and rodents, particularly those of the family *Arvicolidae*, as intermediate hosts. Less frequently other species of the families Canidae and Felidae are final hosts, including the domestic dog (*Canis lupus f. familiaris*) and domestic cat (*Felis sylvestris f. catus*) (Petavy et al., 2000; Petavy et al., 1991, Eckert et al., 2001). The presence of *E. multilocularis* does not seem to cause major symptoms to its final host, in contrast to the infection with metacestodes in intermediate and aberrant hosts that may
cause severe and lethal disease. Humans are an aberrant host that may become infected by ingesting or inhaling eggs. After infection the metacestode stage develops. This is characterised by an infiltrative and destructive growth of the larval stage causing serious disease, i.e. alveolar echinococcosis, with is usually fatal. Alveolar echinococcosis is not only one of the most dangerous autochthonous parasitic zoonosis in central Europe, but also one of the most costly to treat (Eckert et al., 2001; Eckert et al., 2000; Thompson & Lymbery, 1995).

*E. multilocularis* is distributed in the northern hemisphere where it is endemic in several regions in central Europe, most of northern and central Eurasia and parts of north America (Eckert et al., 2001). In central Europe the known geographic range of the parasite includes regions in Austria, Switzerland, France, Germany, Liechtenstein, Luxembourg, Belgium, The Netherlands, Poland, Czech Republic, Slovak Republic, Denmark, and the Norwegian Islands of Svalbard (Eckert et al., 2001; van der Giessen et al., 2002; van der Giessen et al., 2001; Eckert et al., 2000; Dubinsky et al., 1999; Kolarova, L., 1999; Romig et al., 1999; van der Giessen et al., 1999; Tackman et al., 1998; Losson et al., 1997; Eskens, 1997; Kolarova et al., 1996; Lucius and Bilger, 1995; Schantz et al., 1995; Brochier et al., 1992).

The first record of *E. multilocularis* in Belgium was reported by Brochier et al. (1992), who found in south-eastern Belgium (i.e. the province of Luxembourg, a hilly region with maximum altitude 700 meters above sea level) a 15.3% (13/85) prevalence in Red foxes. In 1997, Losson et al. reported a 51.0% (74/145) prevalence of *E. multilocularis* in Red foxes in the same area, and in 2002 the presence of this tapeworm was detected for the first time in other regions in Wallonia (B. Losson and B. Brochier, pers. comm.). In 2002 the first human autochthonous case of alveolar echinococcosis was described in Belgium (Delbecque et al., 2002) and since 1999 (Y. Carlier, pers. comm.) six human cases of
multilocular echinococcosis have been diagnosed in Belgium, the infection being most
probably acquired locally.

Because of the lack of historical information on the occurrence of this parasite in Belgium,
it is impossible to determine whether these records reflect a recent range extension of the
parasite, or whether its presence had not be detected. For northern Belgium there are no
previous data available on the occurrence of this tapeworm.

The aim of this study was to determine if *E. multilocularis* could be found in Red foxes in
northern Belgium, given its presence in the south of the country and in the neighbouring
countries Germany, France and The Netherlands. The results are discussed in relation to the
increase in numbers and distribution of the Red fox (*Vulpes vulpes*) in northern Belgium
during the last two decades.

**Material and Methods**

Between 1996 and 1999, 237 foxes were collected as hunting and road casualties in
northern Belgium. The animals were individually labelled with an identification number
and information about the exact locality, date and cause of death. The carcasses were
transported in sealed plastic bags and were stored at –20°C. The animals were kept at –
80°C for at least seven days before necropsy. At necropsy the animals were sexed and
divided into two age classes (juveniles, adults). Age was determined by the extent of
teeth abrasion: foxes younger than circa eight months were considered as juveniles (J)
and older ones as adults (A). The small intestines were isolated and ligatured at both ends,
wrapped in plastic bags and frozen at –20°C until examination. Before parasitological
examination the intestines were frozen for a second time at –80°C for seven days. The
intestinal scraping technique was used to detect *E. multilocularis* (Eckert et al., 2001;
Delplazes et al., 1996). The small intestine was placed on a plastic sheet, divided in five equal parts and each part was opened in full length with scissors. After removal of coarse material (stones, bones) and large parasites (nematodes, *Taenia* spp.) deep mucosal scrapings were made using microscopic slides. The mucosal material adhering to the slide was transferred to a plastic petri-dish and squashed to a thin layer by means of pressure on the slide. A mucosal scraping was taken at the proximal, middle and posterior third of each of the five parts of the small intestine (i.e. a total of 15 scrapings per intestine). The mucosal squashes were then examined under a stereoscopic microscope. The adult tapeworms were identified and estimates of the infection rates per intestine were grouped as follows: low: 1-50 worms; medium: 51-100 worms; high: 101-1000 worms; very high >1001 worms.

Data on the occurrence and density of foxes in Flanders in 1981 and 1995 were provided by the Ministry of the Flemish Community. The distribution data were cartographically processed with GIS ArcView software (1996).

**Results**

Because of varying cooperation of hunting and nature associations, the map with the geographic spread of the analysed Red foxes shows that the fox sampling is spatially irregular. Therefore the parasitological results will not be discussed according to different natural regions in northern Belgium.

The parasitological analysis revealed that two adult male and two adult female foxes (1.7%) were infected with adult tapeworms. The origins of the infested foxes were Kalmthout, Ophasselt, Halle and Edingen (figure 1). The four infected foxes harboured medium to very high parasitic burdens (table 1).

The cartographically processed distribution data of the Red fox in northern Belgium
showed a spectacular increase of this predator's geographic range during the last two decades (figure 2 & 3).

**Discussion**

As in most European countries (Romig et al., 1999), a spectacular increase in the distribution and density of the Red fox (*Vulpes vulpes*) occurred in northern Belgium over the last two decades. A comparison of the distribution maps from 1981 and 1995 (figures 2 & 3) illustrates that in the early eighties foxes were only present in the middle and southern part of the provinces Vlaams-Brabant, Limburg and the northern and eastern part of Antwerpen. In 15 years time the fox population density increased over its 1981 range and the whole territory of northern Belgium was colonised. The legal restriction on fox hunting, reduced mortality due to changes in rabies control programs (use of vaccine baits), nature conservation measures and the opportunistic behaviour (adaptation) of the fox are all plausible reasons for its explosive population growth.

Considering the rapid increase in numbers and the geographical spread of the Red fox in northern Belgium, and given the presence of the parasite in southern Belgium and surrounding countries (Germany, France, The Netherlands), the occurrence of *E. multilocularis* in northern Belgium could be expected. As historical data are lacking it is impossible to determine whether the present prevalence of 1.7% reflects a recent range extension of the parasite or whether this prevalence is just the first identification in a previously unnoticed infected area. However, given the high prevalence of the parasite in southern Belgium (Brochier et al., 1992; Losson et al., 1997; B. Losson et al., unpublished data), the relative small distances between southern and northern Belgium and the high mobility of Red foxes, the finding of three infected foxes in the south of the
study area (i.e. middle of Belgium: Ophasselt, Halle and Edingen) can be assumed to reflect the presence of a sylvatic cycle of *E. multilocularis*. Concerning the positive fox in the north of the province of Antwerpen, there is no endemic region in the surroundings that overlap, and at this point no conclusions can be made whether this is a single case due to a recent introduction of *E. multilocularis* in this area or the first indication of a sylvatic cycle of the parasite. A recent study in The Netherlands (van der Giessen et al., 1999) showed a similarly patchy distribution of a positive foxes near the southeastern border of the country. The very low prevalence and patchy distribution of *E. multilocularis* in foxes in the north of Belgium and the southeast of The Netherlands is likely to be due to a recent range extension of the parasite in these areas. To validate these hypotheses, we recommend that a study be conducted to measure the prevalence of this parasite in the final and intermediate hosts in the two areas in northern Belgium where infection of Red foxes with *E. multilocularis* has been detected.

Considering the extremely high human population density in northern Belgium, the spectacular increase of the Red fox population in this region and the presence of this potentially highly pathogenic zoonotic parasite, an intensive monitoring and control programme is desirable.

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References


Table 1

Adult Red foxes (*Vulpes vulpes*) infected with *Echinococcus multilocularis* in northern Belgium.

<table>
<thead>
<tr>
<th>Locality</th>
<th>sex</th>
<th>weight (kg)</th>
<th>burden <em>E. multilocularis</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ophasselt</td>
<td>%</td>
<td>6.90</td>
<td>101-1000</td>
</tr>
<tr>
<td>Edingen</td>
<td>&amp;</td>
<td>7.25</td>
<td>&gt;1001</td>
</tr>
<tr>
<td>Halle</td>
<td>%</td>
<td>7.25</td>
<td>101-1000</td>
</tr>
<tr>
<td>Kalmthout</td>
<td>&amp;</td>
<td>7.75</td>
<td>51-100</td>
</tr>
</tbody>
</table>
Figure 1

Geographic spread of the 237 analysed Red foxes (*Vulpes vulpes*) in northern Belgium and prevalence of *E. multilocularis*.
Figure 2

Figure 3