Surveillance programmes for terrestrial and aquatic animals in Norway
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The surveillance programme for *Echinococcus multilocularis* in red foxes (*Vulpes vulpes*) in Norway in 2014

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Echinococcus multilocularis *was not detected in any of the 523 red foxes (*Vulpes vulpes*) examined during the licensed hunting season in 2014.*

Introduction

Echinococcus multilocularis is endemic in large parts of the northern hemisphere, including eastern and central parts of Europe (1, 2). In 1999, *E. multilocularis* was detected in Denmark (3) and on the high-arctic Norwegian islands of Svalbard (4).

There was no evidence that this parasite had established in mainland Fennoscandia (5) prior to its detection in Sweden in February 2011 (6).

E. multilocularis has yet to be detected in mainland Norway, and anthelmintic treatment of dogs, prior to import, is compulsory to prevent introduction of the parasite from endemic EU regions. However, according to the EU Directive 998/2003/EC on pet movement, the maintenance of this national regulation post 2008 requires documentation of an *E. multilocularis* - free status within Norway.

Aim

The aim of the programme is to document freedom of *E. multilocularis* in mainland Norway.

Material and methods

Faecal samples collected from red foxes shot during the licensed hunting season in 2014 (from January to mid-April and mid-July to late December) were included in this report.

All regions (north, south, east, west, central) and 16 out of 19 counties in Norway were represented in the sampling regime. Hunters were invited to participate based on a list of registered fox hunters. A standard form that included information on where and when the fox had been hunted, as well as the sex (male or female) and presumed age of the animal (juvenile or adult), was completed by each hunter.

The DNA-fishing method combined with realtime PCR detection, was used for the detection of *E. multilocularis* in the faecal samples. This involves magnetic capture DNA extraction from samples by applying specific DNA-hybridisation, followed by extraction using streptavidin coated magnetic beads and finally detection using a realtime PCR (7, 10). The DNA-fishing method is also capable of detecting DNA from adult worms, in addition to eggs. These methods are targeted for use during the patent phase of the intestinal infection, more precisely when DNA from the eggs will be shed in the faeces. This period constitutes roughly two-thirds of the total infection period. The combination of these methods were shown to be more sensitive than the previously used method (8); egg isolation using physical sieving followed by detection of parasite DNA using a multiplex PCR (7).

A total of 530 samples were run individually (3 g faeces examined per sample). Realtime PCR detection was performed in duplicate on all samples. We assumed a test sensitivity of 63 % (7) and a fox population of 151.000 (Olav Hjeljord, Norwegian University of Life Sciences, personal communication). However, the true test sensitivity is probably higher and probably close to the Swedish method (88% test sensitivity) (7, 10).The apparent prevalence and corresponding confidence interval were estimated using the function epi.prev in package epiR performed in R version 2.6.2 (9). The conservative 63% sensitivity and a specificity of 1 were used for calculating the apparent prevalence.

Results

A total of 590 samples were collected in 2014 of which 523 were suitable for examination (Figure 1). All samples were negative for *E. multilocularis* giving an estimated apparent prevalence of 0% (0 – 0.7%, 95% confidence interval). In the years 2002 - 2014, a total of 3946 red fox faecal samples from mainland Norway have been tested for *E. multilocularis* (Table 1).

Table 1. Number and county of the red foxes sampled and examined for *Echinococcus multilocularis* in Norway during the red fox licensed hunting season in 2014 (January to mid-April and mid-July to late December) and corresponding numbers between 2002 and 2014.

County	Number of red foxes sampled		
	2002-2013	2014	Total 2002-2014
Østfold	332	105	437
Akershus	399	56	455
Oslo	68	14	82
Hedmark	486	147	633
Oppland	241	25	266
Buskerud	124	18	142
Vestfold	56	1	57
Telemark	129	32	161
Aust-Agder	85	1	86
Vest-Agder	62	0	62
Rogaland	80	0	80
Hordaland	137	6	143
Sogn og Fjordane	201	10	211
Møre og Romsdal	104	11	115
Sør-Trøndelag	309	18	327
Nord-Trøndelag	255	44	299
Nordland	117	0	117
Troms	141	24	165
Finnmark	90	11	101
Total	**3 416**	**523**	**3 939**

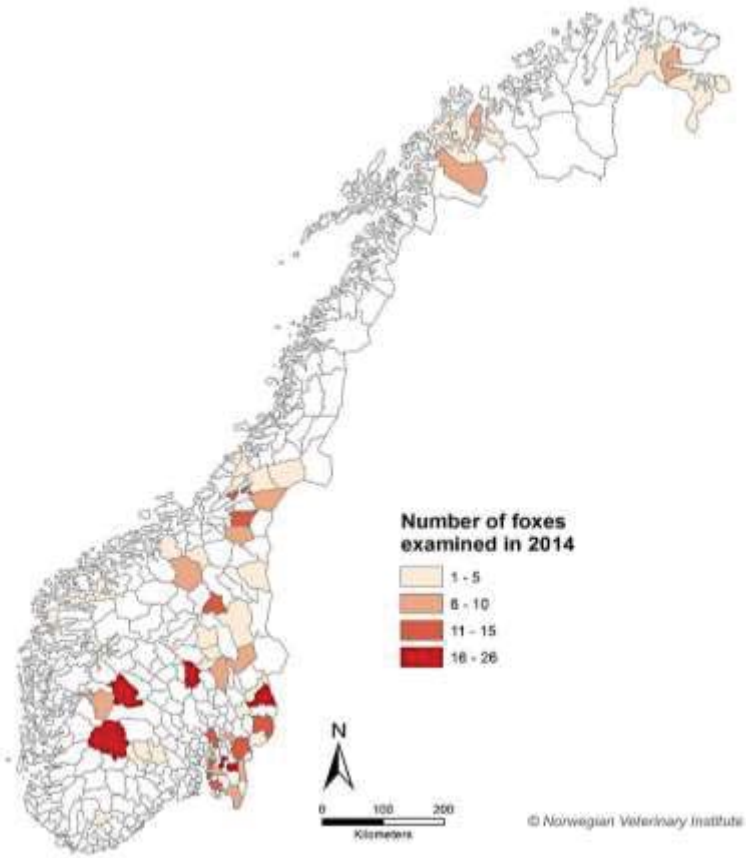

Figure 1. Map of Norway showing numbers and hunting municipality of red foxes sampled and examined for *Echinococcus multilocularis* during the red fox licensed hunting period in 2014.

Discussion

The result from 2014 is in agreement with the results from previous years with no positive samples detected. A requirement in Annex II to Regulation (EU) No 1152/2011 is that the pathogen-specific surveillance programme shall be designed to detect a prevalence of not more than 1 % at confidence level of at least 95 %.

The number of samples collected in Norway in 2014 was sufficient to document that the prevalence was lower than 1%.

The detection of *E. multilocularis* in Sweden since 2011 (11) and recently also in a new region in Denmark (12) have increased the risk of introduction of the parasite to Norway. As a consequence, an annual surveillance programme is necessary to document a continuous disease free status. Our findings support the maintenance of the national regulation for compulsory anthelmintic treatment of imported dogs to minimise the risk of *E. multilocularis* introduction to Norway.

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