BIOLOGIJA. 2014. Vol. 60. No. 1. P. 9–15

Raccoon dog (*Nyctereutes procyonoides*) and native predators infection pathogens and parasites comparison

Zenonas Janulaitis[1],

Simona Juknelytė[2],

Loreta Griciuvienė[2],

Algimantas Paulauskas[2]*

[1] *Kaunas Forestry and Environmental Engineering College, Liepų str. 1, Girionys, LT-53101 Kaunas, Lithuania*

[2] *Faculty of Natural Sciences, Vytautas Magnus University, Vileikos str. 8, LT-44404 Kaunas, Lithuania*

Invasive raccoon dog (*Nyctereutes procyonoides*) and native predators red fox (*Vulpes vulpes*) and Eurasian badger (*Males males*) are an important vector for many diseases like rabies, *Trichinella* spp. and mange. The mange and trichina situation between predators occurring in the burrows in three different Lithuanian regions located in the western (Telšiai), central (Raseiniai) and eastern (Rokiškis) districts of Lithuania were compared. The analysis showed that the raccoon dog is a very important vector of sarcoptic mange but red foxes are the most common reservoirs of trichinellosis. Eurasian badger plays a minor role in transmission of these pathogens and parasites.

Key words: raccoon dog, red fox, Eurasian badger, *Trichinella* spp., sarcoptic mange

INTRODUCTION

Red fox (*Vulpes vulpes*), raccoon dog (*Nyctereutes procyonoides*) and Eurasian badger (*Males males*) are medium-sized predators living in the burrows. In contrast to the red fox and Eurasian badger they are native species, raccoon dogs were introduced from the Far East and are currently among the most common wild carnivores in the Baltic countries (Kowalczyk, 2006). Invasive species, like raccoon dog, have many ecological effects and may threaten biological diversity (e. g. Ebenhard, 1988; Hulme, 2007; Vilà et al., 2010). Moreover, alien species may alter habitat, and predate on or compete with native fauna or be important vectors of diseases and parasites. Raccoon dogs may also compete with native medium-sized carnivores, such as the Eurasian badger and the red fox (Jędrzejewska and Jędrzejewski, 1998; Kowalczyk et al., 2008). Therefore, it is important

* Corresponding author. E-mail: a.paulauskas@gmf.vdu.lt

to assess the impact of raccoon dogs for native predator species.

First of all the raccoon dog and other predators are an important vector for many diseases like rabies, *Trichinella* spp. and mange (Kauhala et al., 2007). Rabies is a lethal form of encephalitis. It is induced by neurotropic viruses of the *Lyssavirus* genus (Warrell et al., 2004). Recent experimental studies have shown that the main epidemiological cycle of rabies in wildlife animals in Europe is maintained by the red fox and another by the raccoon dog (Zienius et al., 2007). Lithuanian raccoon dogs remain one of the main natural rabies sources (Bourhy et al., 2005). We also analyzed rabies epidemiological situation in Lithuania, but in the last decade the rabies was suppressed in Lithuania, because vaccination was effective in reducing the prevalence of rabies in the predators (Zienius et al., 2004; 2007). Therefore the analysis of this situation is irrelevant.

Trichinella spp. are parasitic nematodes that cause trichinellosis (Gottstein et al., 1997). The disease is common in carnivores, especially scavengers, all over the world. Foxes are the most common reservoirs of sylvatic trichinellosis in Europe, although in Finland the raccoon dog is another important reservoir (Pozio, 1998; Oivanen et al., 2002).

Sarcoptic mange is a worldwide, highly contagious, parasitic skin disease of mammals. The etiologic agent is the burrowing mite *Sarcoptes scabiei*, which also causes scabies in humans. Many wild species, including the red fox, develop extensive skin lesions and eventually die (Bornstein et al., 2001).

The aim of this study was to compare the mange and trichina situation between invasive raccoon dog and native red fox and Eurasian badger populations in three different Lithuanian regions.

MATERIALS AND METHODS

The study was performed in three different study sites located in the western (Telšiai), central (Raseiniai) and eastern (Rokiškis) districts of Lithuania. During 1994–2002 in these areas foxes, raccoon dogs and badgers epidemiological situation has been assessed on the basis of the veterinary services and hunt statistics. Raccoon dogs and other predators were hunted by shooting, trapping or lying in wait to cave with dogs. Also samples have been taken in the following cases: a) assuming that the animal is infected with rabies or other diseases, b) the animal came into the house and settled in, c) a sudden death of the animal, d) a dead beast found.

For the comparison of independent variables Student's *t* and U tests were used. All analyses were performed by STATISTICA and the results were expressed as mean values and their confidence intervals (CI) ($p < 0.05$).

RESULTS AND DISCUSSIONS

In this study the diseases like mange and trichina in three species of medium-sized predators were analyzed: invasive raccoon dog, native red fox and Eurasian badger. The analyses of mange and trichina are summarized in Tables 1, 2 and 3.

Investigation of sarcoptic mange epidemiological situation in the eastern (Rokiškis) and western (Telšiai) part of Lithuania from 1994 till 2002 showed (Figs. 1 and 2) that 119 raccoon dogs (Fig. 3), 75 red foxes and 4 Eurasian badgers were mange-positive. In 1994–2001, 1 270 raccoon dog samples of mange suspected cases were examined in the eastern part of Lithuania and mange was confirmed in 7.0% (Table 1). In 2000–2002, 30 raccoon dogs from 238 analyzed samples (12.6%) were mange positive in the western part of Lithuania (Table 2). From 1994 till 2002, the prevalence of mange cases in raccoon dogs increased from 4.2% to 12.7% in the eastern and from 5.9% to 26.2% in the western part, respectively. The highest prevalence of mange cases was registered in the western part in 2000 (22 positive samples out of 84) and the lowest in the eastern part of Lithuania in 1995 (2 positive samples out of 47). Concerning red fox, in 1994–2001 1703 samples of mange

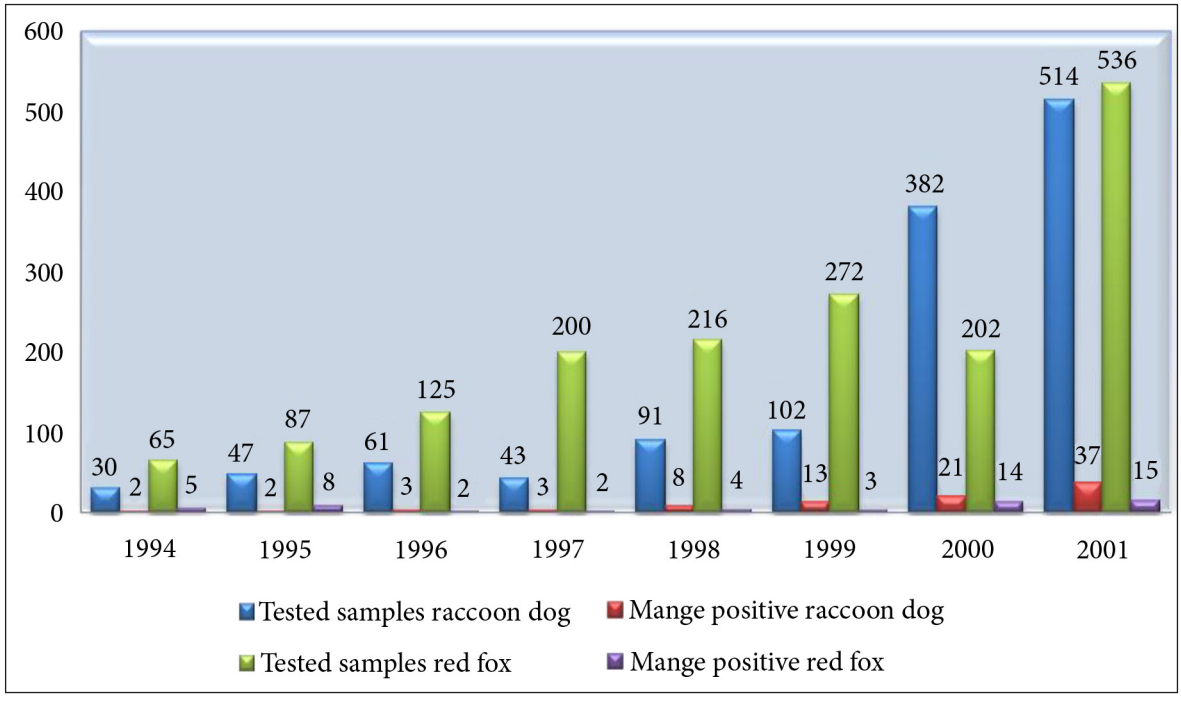

Fig. 1. Investigation of mange epidemiological situation (cases per year) in eastern part of Lithuania

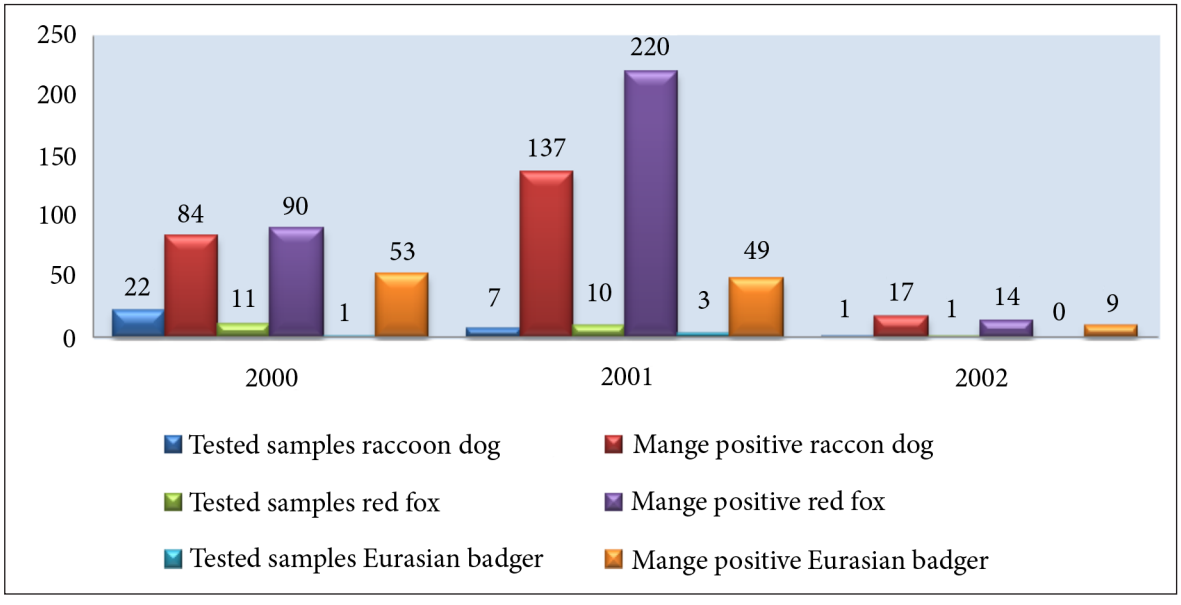

Fig. 2. Investigation of mange epidemiological situation (cases per year) in western part of Lithuania

suspected cases were examined in the eastern part and 324 cases in the western part. The prevalences of positive cases in the eastern and western part of Lithuania red foxes were 3.1% and 6.8% respectively. From 1994 till 2002, the prevalence of mange cases in red foxes decreased from 1.0% to 9.2% in the eastern part and from 4.5% to 12.2% in the western part. The highest prevalence of mange cases was registered in the western part of Lithuania in 2000, when among 90 mange suspected samples tested 11 positive red fox (12.2%)

Fig. 3. Raccoon dog with sarcoptic mange

Table 1. Investigation of sarcoptic mange epidemiological situation in the eastern part of Lithuania

Years	Raccoon dog			Red fox		
	Tested samples	Positive, n	Positive, %	Tested samples	Positive, n	Positive, %
1994	30	2	6.6	65	5	7.7
1995	47	2	4.2	87	8	9.2
1996	61	3	4.9	125	2	1.6
1997	43	3	6.9	200	2	1.0
1998	91	8	8.8	216	4	1.8
1999	102	13	12.7	272	3	1.1
2000	382	21	5.5	202	14	6.9
2001	514	37	7.2	536	15	2.8
Total	1270	89	7.0	1703	53	3.1

* Eurasian badger not tested in Rokiškis

Table 2. Investigation of sarcoptic mange epidemiological situation in the western part of Lithuania

Years	Raccoon dog			Red fox			Eurasian badger		
	Tested samples	Positive, n	Positive, %	Tested samples	Positive, n	Positive, %	Tested samples	Positive, n	Positive, %
2000	84	22	26.2	90	11	12.2	53	1	1.9
2001	137	7	5.1	220	10	4.5	49	3	6.1
2002	17	1	5.9	14	1	7.1	9	–	0
Total	238	30	12.6	324	22	6.8	111	4	3.6

were found. The lowest prevalence of mange cases (1.0%) was registered in the eastern part in 1997 (2 positive samples out of 200). In 2000–2002 in the western part 4 mange positive Eurasian badgers out of 111 mange suspected samples (3.6%) were also registered.

Our results indicate that in three different Lithuanian regions the invasive raccoon dog is the most important vector of mange

Table 3. Investigation of trichinellosis epidemiological situation (cases per year) in the central and western parts of Lithuania

Years	Raseiniai		Telšiai		
	Raccoon dog	Red fox	Raccoon dog	Red fox	Eurasian badger
1994	1	2	–	–	–
1995	–	5	–	–	–
1996	1	11	–	–	–
1997	–	19	–	–	–
1998	–	20	–	–	–
1999	–	6	–	–	–
2000	–	2	–	–	–
2001	–	–	–	1	1
2002	–	–	–	–	–
Total	2	66	0	1	1

among wild animals. Furthermore, raccoon dogs can stay in the foreign burrows and can infect foxes and badgers with scabies. The role of the raccoon dog as a vector of mange may further increase in Europe, because the raccoon dog population is still growing and spreading (Ansorge and Stiebling, 2001; Drygala et al., 2008a, b). Only in Lithuania the hunting statistics (http://www.am.lt) shows that more than 10 300 raccoon dogs were hunted in 2010–2011. Therefore *S. scabiei* is an important mortality factor of raccoon dogs both in native and introduced ranges. Raccoon dogs may also transmit the parasite to other animals including foxes and Eurasian badgers (Mörner et al., 2005). Moreover, the occurrence of infected raccoon dogs in the area may increase the risk of serious epizootics among foxes, because both species may use badger sets as den sites (Kauhala et al., 2006; Kowalczyk et al., 2008). Badgers may be infected on rare occasions (Collins et al., 2010).

The analysis of trichinellosis epidemiological situation in the central part of Lithuania in 1994–2001 showed that 2 raccoon dog and even 66 red fox cases were diagnosed (Table 3). It demonstrated that foxes are the most common reservoirs of trichinellosis in Lithuania. The same results were confirmed in other studies (Pozio, 1998; Oivanen et al., 2002). Merely one Eurasian badger trichinellosis case was diagnosed in the western part of Lithuania.

A field study in Finland concluded that raccoon dogs together with red foxes were the most important reservoir hosts for *Trichinella* spp. (Airas et al., 2010). A similar study of raccoon dogs and red foxes in Lithuania has revealed that *Trichinella* spp. (46.6%) was highly prevalent among foxes while raccoon dogs had lower prevalence (Bruzinskaitė-Schmidhalter et al., 2011). This is reflected in our studies when 3 raccoon dog and even 66 red fox cases were diagnosed in the central and western part of Lithuania. Recent experimental studies have shown that in Lithuania the diet of raccoon dogs mainly involves amphibians whilst red foxes prefer rodents (Baltrūnaitė, 2002). Therefore, it is not surprising that more red foxes than raccoon dogs were infected with trichinellosis.

However, our study showed that the raccoon dog is a very important vector of sarcoptic mange but red foxes are the most common reservoirs of trichinellosis and Eurasian badger plays a minor role in transmission of these pathogens and parasites.

ACKNOWLEDGEMENT

This study was partially supported by the Research Council of Lithuania (Grant no. LEK-14/2012).

Received 15 December 2013
Accepted 19 March 2014

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USŪRINIŲ ŠUNŲ IR VIETINIŲ PLĖŠRŪNŲ UŽSIKRĖTIMO PATOGENAIS IR PARAZITAIS PALYGINIMAS

Santrauka

Invaziniai usūriniai šunys (*Nyctereutes procyonoides*) ir vietiniai plėšrūnai rudoji lapė (*Vulpes vulpes*) bei barsukas (*Males males*) yra svarbūs pasiutligės, trichineliozės ir niežų vektoriai. Palyginus niežų ir trichineliozės epidemiologinę situaciją trijose skirtingose Lietuvos vietovėse, nustatyta, kad invaziniai usūriniai šunys, dažnai apsigyvendami barsukų ir lapių urvuose, yra pagrindiniai niežų nešiotojai, o lapės yra pagrindinis trichineliozės šaltinis.

Raktažodžiai: usūriniai šunys, rudosios lapės, barsukai, trichineliozė, niežai