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Distribution of species-specific wildlife–vehicle accidents on Lithuanian roads, 2002–2007

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Abstract. The number and spatial distribution of wildlife–vehicle accidents (WVA) in Lithuania in 2002–2007, as registered by the Lithuanian Police Traffic Supervision Service, were analysed. The analysis revealed dangerous roads, most of which were situated in the eastern part of the country. The main factors that influenced the number of WVA involving moose, roe deer, and wild boars registered on Lithuanian roads were the volume of traffic load and the number of vehicles, especially heavy ones, in the country, as well as wildlife population numbers. The observed correlations between the number and spatial distribution of WVA and recorded wildlife inventory data strongly suggest that WVA can be used for indirectly measuring the distributions and populations of wildlife species found in Lithuania.

Key words: wildlife–vehicle accidents, distribution, Lithuania.

INTRODUCTION

The number of wildlife–vehicle accidents (WVA) is quite high in various countries over the world and continues to grow (Lavsund & Sandegren, 1991; Lehnert et al., 1996; COST, 2003; Seiler, 2004, 2005). Approximately 0.5 million collisions occurred annually in the USA with deer (Stout et al., 1993; Romin & Bisonette, 1996) and in Europe with various wildlife species (Groot Bruinderink & Hazebroek, 1996; Putman, 1997). About 300 deaths are registered in Europe yearly, with damage costs totalling approximately 1 billion US dollars (Groot Bruinderink & Hazebroek, 1996).

In Sweden, the number of WVA with moose was up to 5000 and with roe deer up to 25 000 annually in the 1990s (Seiler, 2004), but due to unregistered WVA this number was possibly twice as high (Seiler et al., 2004). Ungulates are the main concern, as they are responsible for more than 60% of the accidents registered by police (Seiler, 2004). In Sweden, the moose is the most problematic wildlife species (Lavsund & Sandegren, 1991).

We failed to find WVA numbers for Poland, but a lot of information is available on the ecological consequences of roads due to fragmentation of habitats, counter-measure planning and implementation, ecological corridors, etc. (Jędrzejewski et al., 2004, 2006; Perzanowska et al., 2005; Strategia, 2007; Protection, 2008).

While traffic safety is obviously a problem in the Baltic States and retains a high priority (Lama et al., 2006), data on WVA are not underlined. We also failed to find any data on WVA from Latvia. From Estonia there is one older published source of traffic accidents with animals (Mardiste, 1992), cited in a more recent work on the prediction of WVA and passage planning (Klein, 1999). The prediction of possible collision areas is also important in Sweden (Seiler, 2005).

In Lithuania, the number of WVA was growing in the last years, from 219 in 2002 to 913 in 2007. The fencing of highways started in 2004 and the building of underpasses in 2005, but neither of the two measures diminished total WVA numbers. An evaluation of existing wildlife underpasses was done as a preliminary investigation and showed a positive local influence (Balčiauskas & Balčiauskienė, 2007).

Only a few highway stretches with the traffic volume of over 5000 vehicles per day are characteristic of Lithuania (Traffic, 2008). However, roads with lower volumes of truck traffic may also have high WVA probability. Moreover, accidents involving smaller animals go unregistered. In a 100 km stretch of the Vilnius–Kaunas highway, the number of unregistered dead mammals found from April 2000 to May 2001 was 120 (12 species of wild mammals), with hedgehogs (*Erinaceus concolor*) being the dominant species (Paulauskas, 2005). In a 26 km long stretch of the Vilnius–Dūkštos road of local importance, 44 killed mammals and 333 killed amphibians were registered during a 1.5-year period, from November 2004 to May 2006 (Papečkienė, 2006).

Computerized WVA reporting in Lithuania started in 2002. Data are stored at the Lithuanian Police Traffic Supervision Service and are available upon official request. Wildlife population data are available at the Ministry of Environment. More data on Lithanian roads are available at the Lithuanian Road Administration under the Ministry of Transport and Communications (Traffic, 2008).

Speed limits on the Lithuanian roads were the following: 110 km/h in winter and 130 km/h in summer on A2 and part of A1 (Kaunas–Klaipėda), 100 km/h on A1 Vilnius–Kaunas, and 90 km/h (unless more limited) on other roads. There are no special speed limits for night driving. Special traffic signs are used to warn drivers about the possible wildlife presence on the roads. The fencing of the highways in the period 2002–2007 was not continuous: 44.2 km of fences and 3 wildlife underpasses on A1 (Balčiauskas & Balčiauskienė, 2007) and 28.3 km of fences on A2. Roads are salted for ice control in winter.

The aim of this publication is to give an overview of the officially registered wildlife–vehicle accidents in Lithuania in 2002–2007, including spatial distribution of accidents, animal species composition, and yearly dynamics.

MATERIAL AND METHODS

The data on WVA in 2002–2007 obtained from the Lithuanian Police Traffic Supervision Service were computerized into MS Access and verified (accidents with domestic animals were removed).

Table 1. Official wildlife population numbers in Lithuania in 2000–2007 (source: Ministry of Environment)

	2000	2001	2002	2003	2004	2005	2006	2007
Moose	5 439	4 828	4 458	4 092	3 860	3 897	4 222	4 825
Red deer	15 181	12 663	11 098	10 584	11 202	11 195	14 400	15 912
Roe deer	68 571	68 680	69 276	72 945	75 886	81 241	86 362	91 949
Wild boar	23 171	22 810	24 050	26 079	32 059	29 490	32 419	35 935

The data on Lithuanian roads and transport were taken from the Lithuanian Road Administration under the Ministry of Transport and Communications (Map, 2008; Traffic, 2008). The data on wildlife were official survey numbers from the Ministry of Environment (Table 1).

The data were analysed via standard MS Access queries. Pearson's correlation and Student's *t*-statistics for the means were used. The data were processed using the software package Statistica for Windows, version 6.0 (StatSoft, 2004).

RESULTS AND DISCUSSION

According to the Lithuanian Road Administration under the Ministry of Transport and Communications, the Lithuanian road network includes 1785 km of main roads (highways), 4947 km of national roads, and 14 625 km of regional roads (Road, 2008). From 2000 to 2007, traffic volumes on Lithuanian roads went up 1.61 times. The total number of vehicles increased from 1.29 million in 2000 up to 1.97 million in 2007. The number of vehicles per 1000 population was 340 in 2002, 365 in 2003, 384 in 2004, 427 in 2005, 471 in 2006, and 473 in 2007 (Traffic, 2008).

During 2002–2007, the number of registered WVA on Lithuanian roads was continuously growing: 259 in 2002, 316 in 2003, 423 in 2004, 499 in 2005, 648 in 2006, and 913 in 2007. The number of roads on which WVA were registered was 340. The most WVA-affected roads were national roads, although the number of WVA on the main roads on the list is also high (Table 2). Throughout the period of 2002–2007, the number of WVA on national roads increased 3.9 ± 0.4 (1.7–6) times and on main roads 4.6 ± 0.8 (1.5–10) times; thus the difference was not significant. On other roads the increase was up to 20 times. The composition of animal species involved in WVA, as well as yearly, seasonal, and daily WVA dynamics were already analysed earlier (Balčiauskas & Balčiauskienė, 2008).

A network of roads with a high probability of WVA covered almost all the country (Fig. 1). It was found that the total annual number of registered WVA highly correlated with the traffic load ($r = 0.99$, $p < 0.001$), number of trailers and semitrailers registered in the country ($r = 0.98$, $p < 0.001$), number of vehicles per 1000 population ($r = 0.94$, $p < 0.001$), and the total number of cars registered in the country ($r = 0.93$, $p < 0.001$).

Table 2. Twenty Lithuanian roads with the highest number of WVA registered in 2002–2007

Road	Length, km	Number of accidents							Average WVA/km
		2002	2003	2004	2005	2006	2007	Total	
A1 (Vilnius–Kaunas–Klaipėda)	311.4	27	29	53	42	55	70	276	0.87
A2 (Vilnius–Panevėžys)	135.92	14	25	33	45	47	69	233	1.71
120 (Radiškis–Anykščiai–Rokiškis)	85.57	18	12	16	26	29	30	131	1.53
122 (Daugpilis**–Rokiškis–Panevėžys)	107.62	8	13	18	18	28	44	129	1.20
A6 (Kaunas–Zarasai–**Daugpilis)	185.4	5	8	17	26	26	28	110	0.59
A14 (Vilnius–Utena)	95.6	9	4	18	16	23	24	94	0.98
102 (Vilnius–Švenčionys–Zarasai)	162.94	6	6	8	14	18	30	82	0.50
A12 (Ryga**–Šiauliai–**Kaliningradas)	186.09	4	10	16	16	18	18	82	0.44
167 (Smiltynė–Nida**)	50.98	5	10	10	9	21	18	73	1.43
A8 (Panevėžys–Aristava–Sitkūnai)	87.86	10	13	8	10	13	15	69	0.79
123 (Biržai–Pandėlys–Rokiškis)	66.75	3	8	12	8	14	18	63	0.94
164 (Mažeikiai–Plungė–Tauragė)	142.15	5	4	5	11	13	19	57	0.40
A11 (Šiauliai–Palanga)	146.85	5	7	6	7	10	22	57	0.39
118 (Kupiškis–Utena)	53.63	5	7	7	6	13	16	54	1.01
129 (Antakalnis–Jieznas–Alytus–Merkinė)	80.87	3	6	4	12	13	12	50	0.62
141 (Kaunas–Jurbarkas–Šilutė–Klaipėda)	228.92	4	7	5	10	12	11	49	0.21
128 (Valkininkų g.st.***–Daugai–Alytus)	46.0	5	2	7	6	8	17	45	0.98
121 (Anykščiai–Troškūnai–Panevėžys)	57.0	3	7	5	1	13	12	41	0.72
A10 (Panevėžys–Pasvalys–**Ryga)	66.1	3	5	4	3	8	15	38	0.57
A4 (Vilnius–Varėna–**Gardinas)	134.46	1	3	5	13	3	10	35	0.26

Note: A in the road name denotes main roads, ** – roads connecting neighbouring countries. Road length given according to (Valstybės, 2005).

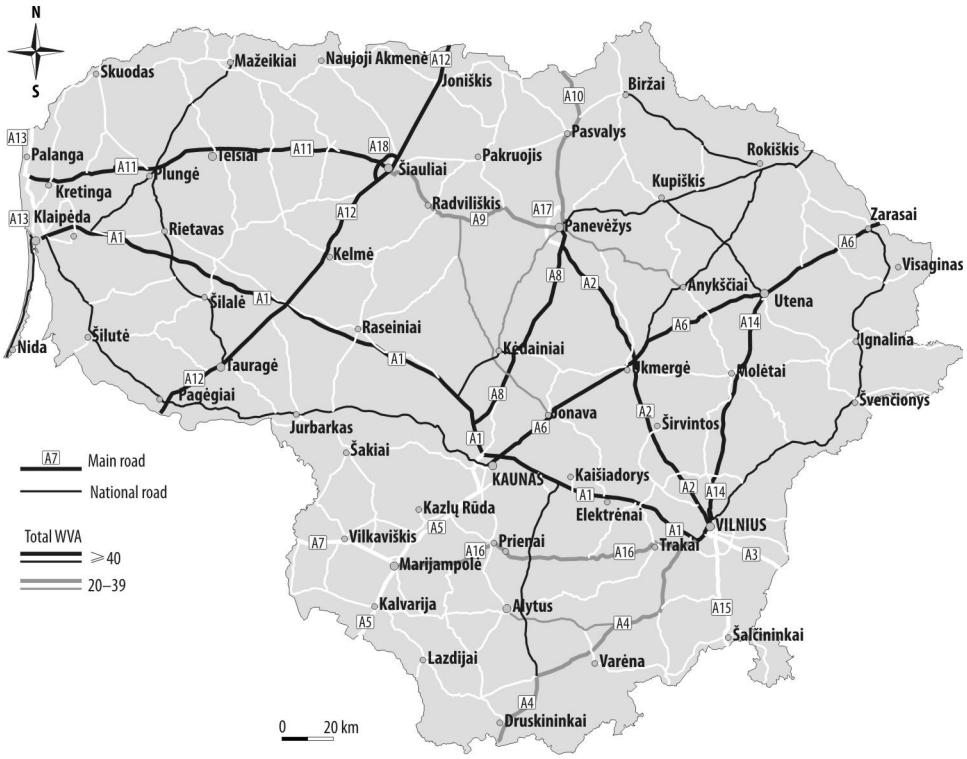

Fig. 1. Number of wildlife–vehicle accidents on Lithuanian main and national roads in 2002–2007.

From the total of 3058 registered roadkilled wildlife individuals, the roe deer (*Capreolus capreolus*) accounted for 56.1%, wild boar (*Sus scrofa*) for 9.8%, moose (*Alces alces*) for 6.0%, European hare (*Lepus europaeus*) for 4.1%, and red deer (*Cervus elaphus*) for 1.3%. The share of other mammals, that is red fox (*Vulpes vulpes*), raccoon dog (*Nyctereutes procyonoides*), beaver (*Castor fiber*), wolf (*Canis lupus*), and badger (*Meles meles*), as well as roadkilled birds was negligible. In 622 cases (20.3%), the species of wild animals remained unidentified.

Seasonally, moose were most frequently killed from May to October, red deer from August to December, roe deer from April to July and then from October to January, and wild boars from September to January. The largest number of foxes were killed on the roads from October to January, hares from April to July, although in the latter species the seasonality of roadkills was expressed quite weakly. Generally, the number of WVA is the highest in April–May, and then in October–December (Balčiauskas & Balčiauskienė, 2008).

About 64% of all accidents with moose were registered in the eastern part of Lithuania (Fig. 2), especially on the roads connecting district centres Rokiškis and Zarasai (roads with a single moose–vehicle accident are not marked on the map). Such distribution corresponds to the spatial distribution of the moose population in Lithuania: eastern districts are the most numerous in moose. Nine accidents

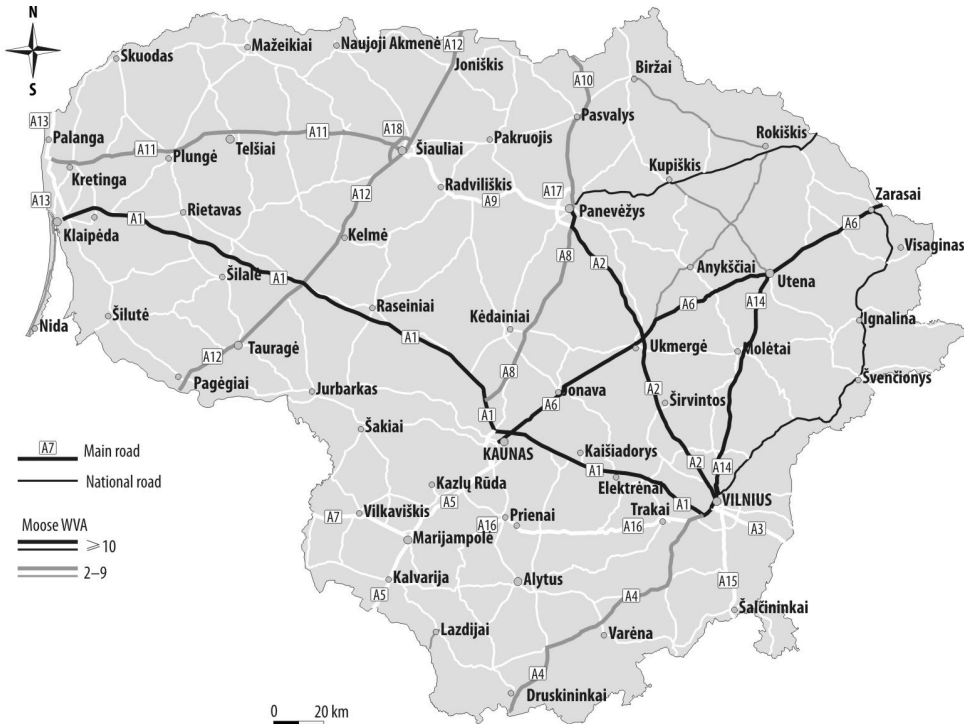

Fig. 2. Number of moose–vehicle accidents on Lithuanian roads in 2002–2007.

with moose were registered on the road across the Kuršių Nerija Spit. This very special narrow belt of land between the Baltic Sea and the Curonian Lagoon is divided into two parts by road No. 167 Smiltynė–Nida further leading to Kalinigrad Region. The high number of accidents on this road is due to its configuration (narrow roadsides), forest proximity, and high number and fearless behaviour of ungulates. On 36 roads, single moose–vehicle accidents were registered. The numbers of accidents with moose clearly reflect the population status of this species in the country: the moose population is now recovering from a critical decline in the year 2000. The reason of the decline was not WVA, but over-hunting and poaching (Baleišis et al., 2003; Balčiauskas, 2004). The correlation between moose numbers and moose–vehicle accidents is high ($r = 0.71$).

Accidents with roe deer also most frequently occurred in the eastern part of Lithuania (approximately 50% of all accidents). In 2002–2007, the number of roe deer–vehicle accidents on nine roads was higher than 40 accidents per road and on thirteen roads, 20–40 accidents were registered per road (Fig. 3). On 239 roads, lower numbers of roe deer–vehicle accidents were registered: 17 roads with 10–19 accidents per road, 28 roads with 5–9, 36 roads with 3–4, and 158 roads with 1–12 accidents per road. The correlation between roe deer population numbers in the country and roe deer–vehicle accidents was extremely high ($r = 0.98$, $p < 0.001$).

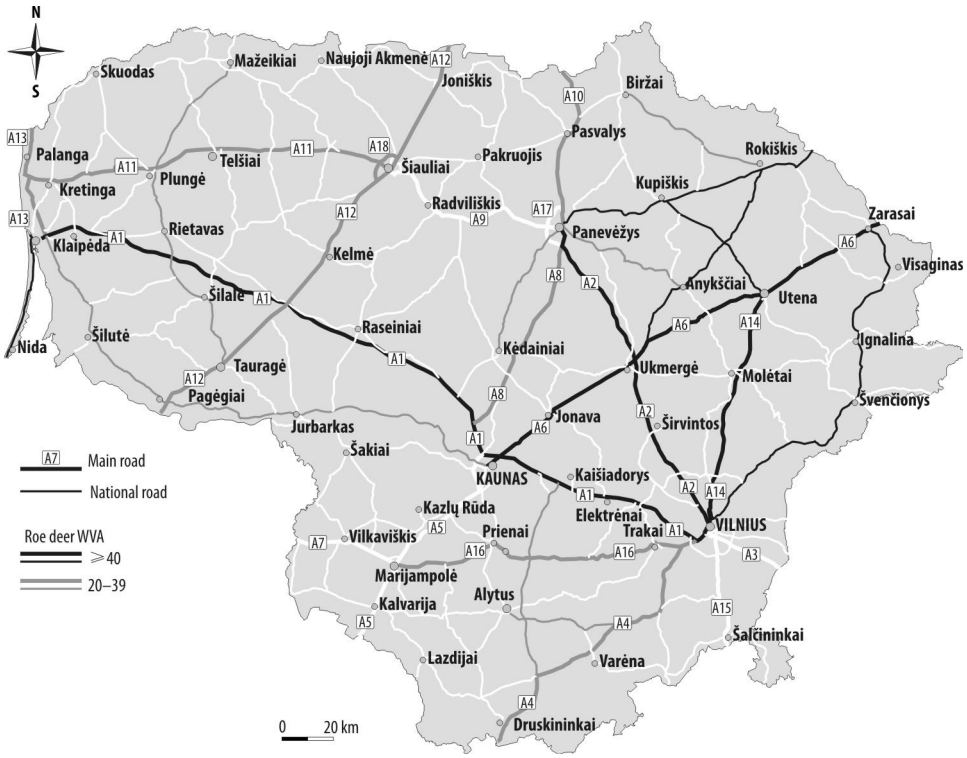

Fig. 3. Number of roe deer–vehicle accidents on Lithuanian roads in 2002–2007.

Wild boar–vehicle accidents were distributed more or less equally across the country. Despite high population counts – about 30–35 thousand during 2002–2007 – the number of accidents was moderate compared to the proportion of roadkilled moose or roe deer. Wild boar–vehicle accidents were registered on 98 roads. On six roads, including four main roads, more than 10 accidents per road were registered, and on eight roads 5–9 accidents per road were recorded (Fig. 4). The number of roads with 3–4 accidents was 14, 20 roads had two accidents per road, and each of the remaining 50 roads were characterized by a single accident. Based on the game survey data from the State Forest Survey Service (http://www.lvmi.lt/vmt/index.php), the correlation between wild boar population numbers and wild boar–vehicle accidents was very high in the country ($r = 0.93$, $p = 0.007$). According to the Ministry of Environment, wild boar numbers in 2004 were less than 30 000, and the correlation was even higher ($r = 1.00$, $p < 0.001$).

The cases of unregistered roadkills of wild boars and roe deer (Balčiauskas, unpubl.) as well as published facts (Paulauskas, 2005) suggest that the actual number of accidents with these two species was higher. This is especially evident on road No. 167 Smiltynė–Nida, where roadkilled wild boars and roe deer are often removed from the place of accident by drivers themselves, and only blood of the animal removed is left on the road (Neringa traffic officers, pers. comm.).

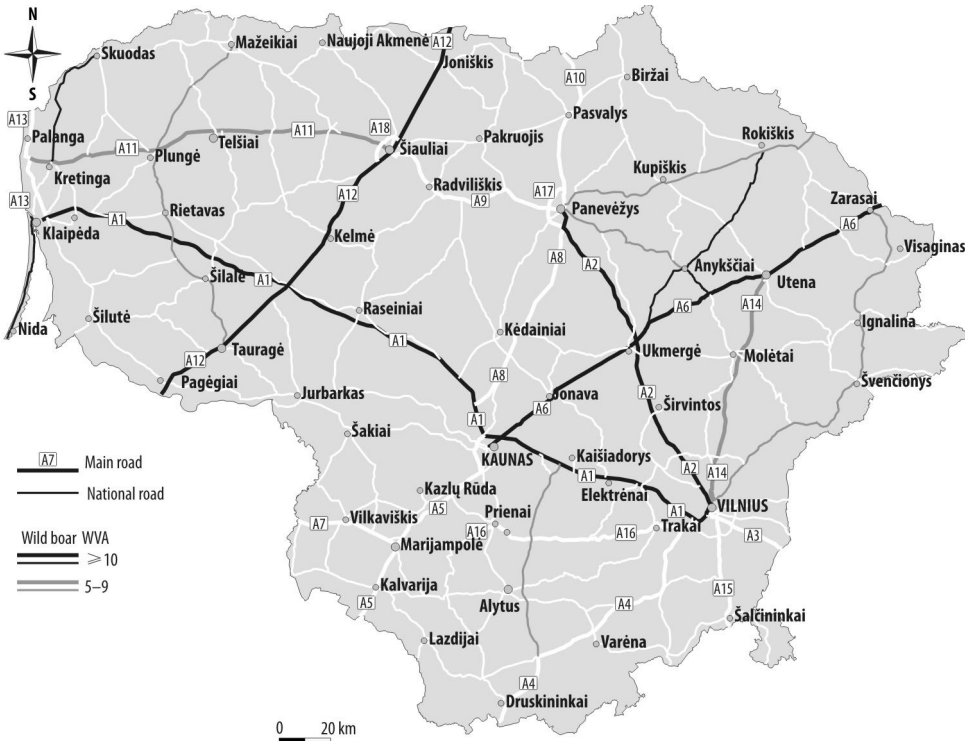

Fig. 4. Number of wild boar–vehicle accidents on Lithuanian roads in 2002–2007.

The number of accidents involving red deer was not high (4–11 per year) and relatively stable. The correlation with red deer numbers was not significant ($r = 0.64$, $p = 0.17$). Most probably, some red deer were not identified or were misidentified as roe deer or moose.

Accidents involving unknown wild animals were registered across the country, except in the southern part (Fig. 5). On six roads, the number of such accidents was over 20 per road (96 on main road A1 Vilnius–Kaunas–Klaipėda), on nine roads 10–19, on 12 roads 5–9, on 20 roads 3–4, and on 1000 roads 1–2 accidents per road. The number of accidents with unknown mammals was best correlated with the numbers of red deer ($r = 0.96$, $p = 0002$), roe deer ($r = 0.95$, $p < 0.01$), and wild boars ($r = 0.83$, $p < 0.05$). The correlation with moose numbers was not significant ($r = 0.67$, $p = 0.14$). Cervids were not always identified after WVA; most possibly, red deer and roe deer made the largest share of unidentified road-kills. Training of traffic officers can improve the situation. In Lithuania, there is no roadkill identification guide (e.g. Sielecki, 2008). Possibly, improvement of the registration protocol may have a positive influence. Lithuania is well behind the developed system of WVA registration, such as WARS (Sielecki, 2004, 2005).

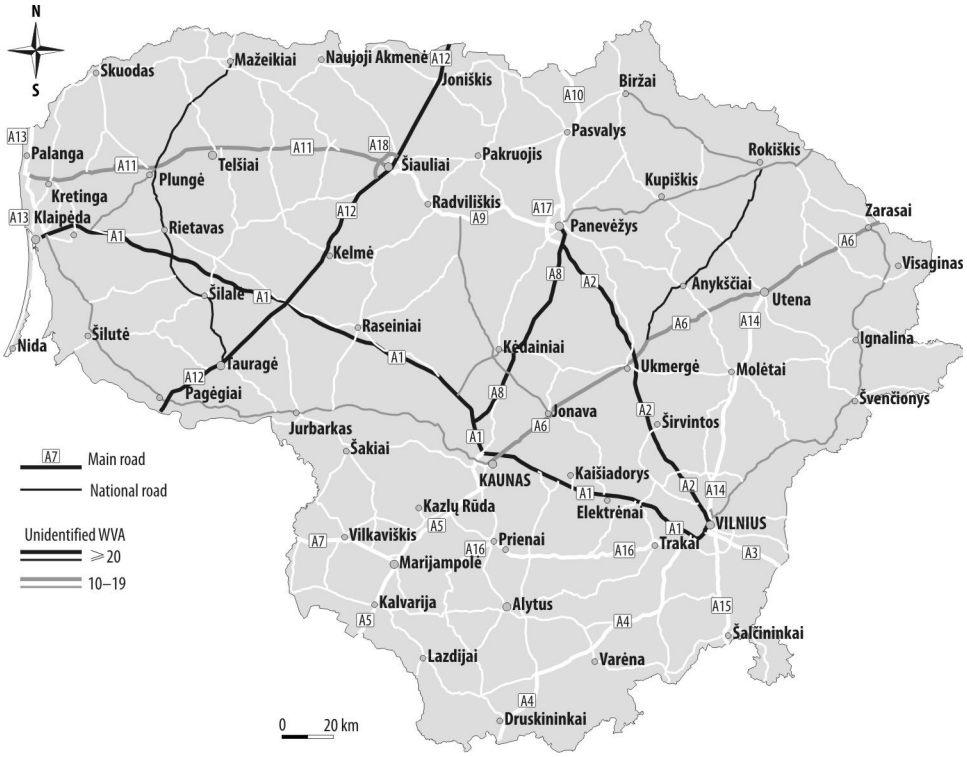

Fig. 5. Number of vehicle accidents with unidentified mammals on Lithuanian roads in 2002–2007.

Thus, in Lithuania the main animal group involved in registered WVA is ungulates (roe deer, wild boar, moose, and (less) red deer). In this aspect, the country is not different from other countries in Europe and North America (Lavsund & Sandegren, 1991; Groot Bruinderink & Hazebroek, 1996; Lehnert et al., 1996; Romin & Bisonette, 1996; Putman, 1997; Madsen et al., 1998; Seiler, 2004, 2005). Fortunately, Lithuania has not yet encountered problems with rare mammal species involved in WVA, which are faced by some other countries (Wolves, 2008). Wolves are avoiding highways (Balčiauskas, 2008). So far, two cases of roadkilled wolves, one of otter, and none WVA involving lynx were registered or known (Balčiauskas, unpubl.). We have no data on roadkills of smaller rare mammal species – bats, dormice, and ermine.

In general, the size of ungulate populations and traffic intensity are the main factors influencing the number of registered WVA on Lithuanian roads. Preliminary data on unregistered WVA covering primarily small-sized animals (Balčiauskas, unpubl.) suggest that WVA may be a suitable indirect measure of wildlife populations in Lithuania. This situation appears consistent with the findings of earlier studies in other countries (Jahn, 1959; McCaffery, 1973; Baker et al., 2004).

CONCLUSIONS

– The number of registered WVA on Lithuanian roads was highly correlated with the volume of traffic load and the number of vehicles, especially heavy ones (trucks) in 2002–2007.
– The animal population size and the number of WVA were highly correlated, especially with regard to the wild boar and roe deer (close to functional dependence); correlations for moose and red deer were not so strong and significant.
– The number of unidentified animals in WVA was high, which warrants further examination to determine causes and suggest potential solutions.

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Metsloomadega seotud liiklusõnnetuste levik Leedus aastatel 2002–2007

Linas Balčiauskas

Leedu Liikluspolitsei andmete põhjal on analüüsitud metsloomadega (põder, metskits, metssiga) seotud liiklusõnnetuste (MLÕ) levikut ja arvu Leedus aastatel 2002–2007. Analüüsi tulemusena on välja selgitatud kõige ohtlikumad teed, mis asuvad enamasti riigi idaosas. MLÕ arvu mõjutavatest teguritest on põhilised liikluse intensiivsus, sõidukite (eriti raskeveokite) arv ja loomade arvukus. Sellest lähtudes võib MLÕ arvu käsitada kui populatsiooni seisundi kaudset näitajat.