Habitat fragmentation and fauna mortality caused by traffic in the Czech Republic

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Abstract. An intensive research program connected with physical controls of all highway bridges over the whole Czech Republic was carried out between 1998-2003. A large number of sectors (70%), significant for roe deer migration, remain completely impassable. Many sectors of highways and motorways present an entirely impassable barrier for large animals such as red deer and moose. Seven sections on the highway network of the Czech Republic were identified as critical for big mammals.

Key words: highway network, fauna mortality, habitat fragmentation, fauna passages, Czech Republic

1. Introduction

Busy overland roads, especially highways and motorways, create barriers for migration of wild animals, causing fragmentation of their habitat and populations. Isolated populations are unstable and an increasing density of highway network is becoming the chief risk factor for the existence of some species. There are about 900 km of highways in the Czech Republic and their density will increase rapidly in near future.

A large study concerning the habitat fragmentation due to highway network was carried out during last 8 years. A new study on the fauna traffic mortality starts this year. Our research was focused on following questions:

- What is the permeability of existing highway network for different species?
- What are the minimum parameters for fauna passages for different species?
- What is the optimal density of fauna passages?
- Is it possible to identify ‚critical sections' on the existing highways?
- Which species can be endangered by traffic mortality?

2. Review of results

2.1. Permeability of existing highway network

An intensive research program connected with physical controls of all highway bridges over the whole Czech Republic was carried out between 1998-2003. 850 highway bridges were checked during this study, each bridge was sorted out into one of the following four categories:

- permeable for all species including red deer, moose and big carnivores
- permeable for small and medium size mammals like roe deer
- permeable only for small mammals (fox, badger, otter etc.)
- impermeable bridges.

The conclusions of this research indicate that the present highway and high-speed road network does not represent a significant barrier for animals of the size of fox, badger or otter. For animals of the size of roe deer the highway network is permeable in 40% of its total length. A large number of sectors, significant for roe deer migration, remain completely impassable. Many sectors of highways and motorways present an entirely impassable barrier for large animals such as red deer and moose. The total extent of impassable sectors for this category of animals represents about 70% of the entire length of these roads.

2.2. Parameters of fauna passages

The determination of minimum parameters of fauna passages was carried out on a sample of 100 bridges during the period 1999-2001: 93 underpasses 5-60 m wide, six overpasses 6-8 m wide and one overpass 70 m wide. Snow tracking and "sand bed" methods were used in this research. The observations confirmed that the best parameter for the expression of the suitability of underpasses was the *index i* (Table 1).

Table 1. Parameters of fauna passages

%	Description	Roe Deer		Wild Boar		Red Deer	
		i	example	i	example	i	example
80-100	Ideal stage	> 30	$\frac{60 \times 15}{30}$	> 30	$\frac{60 \times 15}{30}$	> 40	$\frac{80 \times 15}{30}$
60-80	Functional optimum	7-30	$\frac{30 \times 7}{30}$	7-30	$\frac{30 \times 7}{30}$	8-40	$\frac{30 \times 8}{30}$
40-60	Average	1.5-7	$\frac{15 \times 3}{30}$	2-7	$\frac{20 \times 3}{30}$	4-8	$\frac{30 \times 4}{30}$
20-40	Functional minimum	0.65-1,5	$\frac{6.6 \times 3}{30}$	1-2	$\frac{10 \times 3}{30}$	1.7-4	$\frac{10 \times 5}{30}$
0-20	Functionles	Up to 0.65		Up to 1		Up to 1.7	

index $i = \dfrac{\text{Width x Height}}{\text{Length}}$ % - Number of animals, which will use the passage (% of all animals coming to the passage)

A map of categorization of the territory of the Czech Republic was prepared to recommend the optimal density of fauna passages (Fig. 1). See also on the Table 2.

Table 2. Maximum recommended distances of passages for different mammal categories in different areas of importance

Categories of areas		Mammal category		
Category	Area	Red Deer	Roe Deer	Red Fox
I	Most important areas	3-5	1.5-2.5	1
II	High important areas	5-8	2-4	1
III	Important areas	8-15	3-5	1
IV	Less important areas	N	5	1
V	Areas without any importance	N	N	1-3

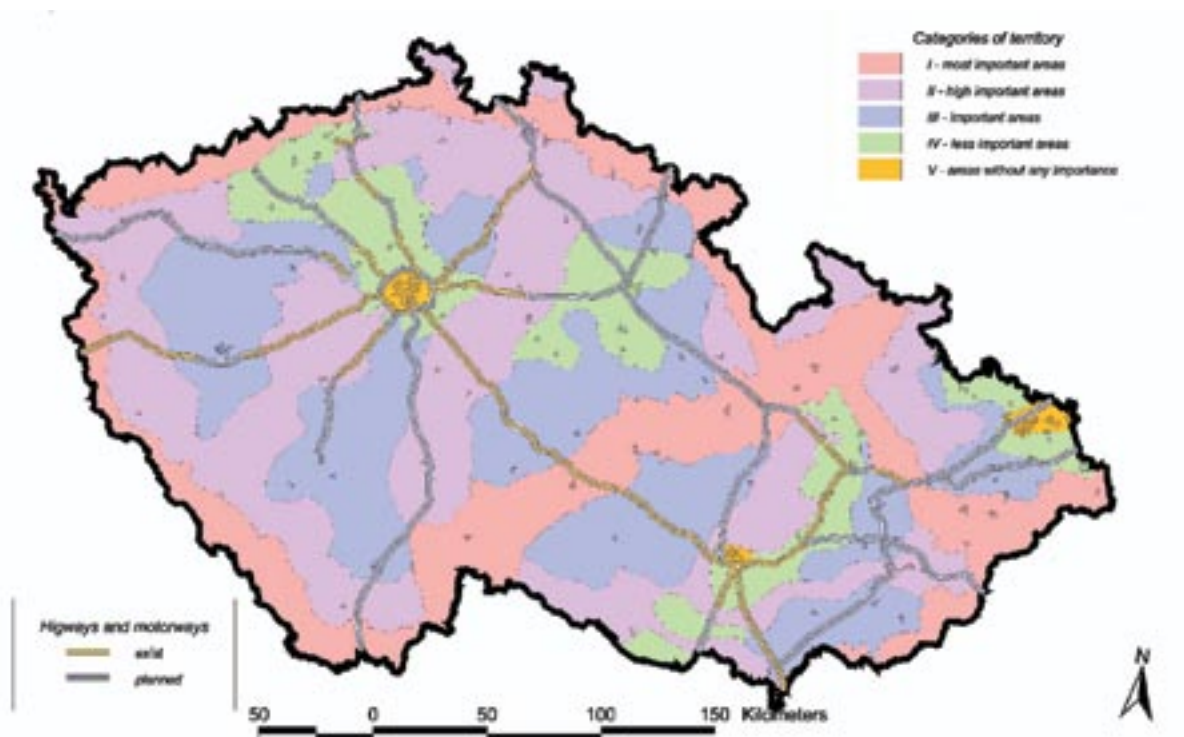Remark: all data presented in km; N – no passages are needed

Fig. 1. Categorization of the territory of the Czech Republic according to the distribution and migration of big mammals
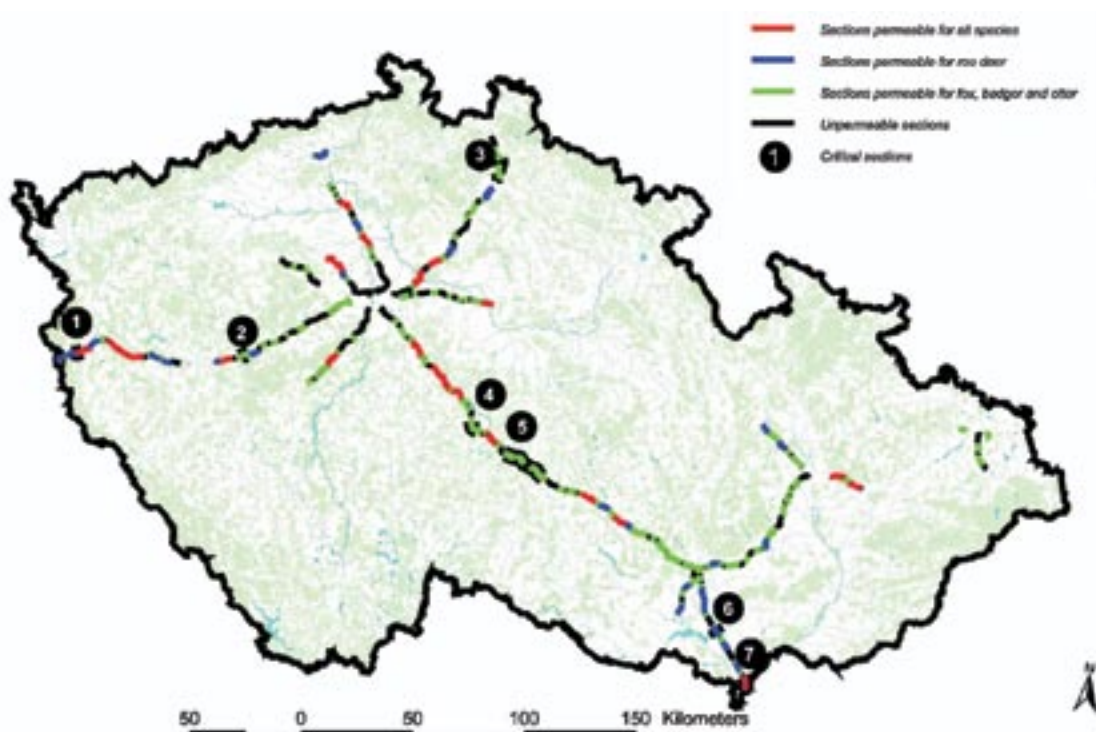

Fig. 2. Permeability of existing highways and identification of critical sections

The critical sections were identified on the base of compiled data on animal distribution and migration, fauna traffic mortality, traffic accidents caused by animals and the permeability of existing highway net (Fig. 2).

Seven sections on the highway network of the Czech Republic were identified as critical for big mammals. As the permeability of these sections is crucial for future existence of big mammals pop-

ulations, a plan for restoration of permeability for all target species is being prepared at present.

A study concerning traffic mortality is being worked out at this time. This research started in April 2006 and is planned for next two years. Its aim is to estimate numbers of animal species which are killed by traffic in the Czech Republic per year. Chosen sections of different roads (highways, first class roads, local roads) in different types of the landscape are checked periodically and all dead vertebrates are recorded. The checks are made on foot walking along both sides of the road (that means, that each control is made by two people or by one patrolman going there and back).

The calculation of numbers of killed animals has a lot of methodical problems. It is important to estimate the percentage of cadavers which are possible to find on the road and roadsides of the number of all killed animals. (Many cadavers of small animals completely disappear just after the accident.) Another problem is how long the scraps of animals stay determinable on the road and roadsides. There are many factors, which can influence the results, like for example: size of the animals, the traffic density, the place (road or roadside), climatic conditions, influence of predators etc. During first five months 482.6 km of roads were checked and during this period 1054 of killed animals in 98 species of vertebrates were found (Table 3).

Table 3. The length of checked sections and numbers of killed animals found

	highway	motorway	1st class	2nd class	3rd class	total
The total lenght of roads in the CR (km)	564.4	322.3	5 831.4	14 667.5	34 124.1	55 509.8
Checked sections during April-June 2006 (km)	103.4	4.7	123.5	116.5	134.5	482.6
Numbers of killed animals (vertebrates)	326	32	281	238	177	1054

As most frequent mammal species were found hare (*Lepus europaeus*) – 140 cases, hedgehog (*Erinaceus europaeus* and *E. concolor*) – 54 cases and stone marten (*Martes foina*) – 28. The most frequent birds were blackbird (*Turdus merula*) – 25, finch (*Fringilla coelebs*) – 19 and yellowhammer (*Emberiza citrinella*) – 13. To rare species found during first three months belonged otter (*Lutra lutra*) – 2, barn owl (*Tyto alba*) – 1 or barred warbler (*Sylvia nisoria*) – 1.

The preliminary results are of course insufficient for making conclusions concerning total mortality of different species on the roads. But they show clearly, that the traffic mortality is a very important factor which can affect the development of populations of some species. Final results of this study will show important data for clarification of this problem

4. Conclusion

The real impact of habitat fragmentation and traffic mortality on different species has not been clarified well till now. As the density of traffic and the density of transportation infrastructures grow very fast, it is necessary to pay high attention to monitoring, to next research and to preparation of measures which will eliminate negative effects of traffic.