LIFE DINALP BEAR
Population level management and conservation of brown bears in northern Dinaric Mountains and the Alps

LIFE13 NAT/SI/000550

ACTION PLAN FOR THE IMPLEMENTATION OF THE MITIGATION MEASURES FOR REDUCING ROAD MORTALITY OF BROWN BEAR IN SLOVENIA

Action A.4: Impact of bear-vehicle collisions on brown bear population, determination of black spots and preparation of action plan of mitigation measures

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LIFE DINALP BEAR

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Velenje, 30 June 2015

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1 INTRODUCTION

Traffic-related mortality is one of the most important negative anthropogenic factor that affect brown bear population and its survival rate. It is one of the most important factors of bear mortality and in some areas may even create the sink of bear population; moreover, it can reduce bear migration potential and gene flow, hamper the dispersal of the bears and thus also limits spatial expansion of the species. The later may considerably decrease perspectives for establishing a viable, well connected Alpine-Dinaric bear population in the south-central part of Europe.

Mortality of bears on roads and railways is one of the major risk factor for bears in Slovenia. Indeed, in some regions of Slovenia along bear corridors, which connect Dinaric Mountains with Alps, bear-vehicle collisions apparently represent the main cause of mortality and act as a local population sink.

The realization of this action (A.4: Impact of bear-vehicle collisions on brown bear population, determination of black spots and preparation of action plan for mitigation measures) with the selection of the most problematic sections of main state roads, highways and railways to be protected with different mitigation measures is a prerequisite for the realization of the Action C.4.: Decrease of traffic-caused beer mortality.

2 TRAFFIC RELATED BEAR MORTALITY IN SLOVENIA

Traffic-related bear mortality in Slovenia and Croatia was analysed in detail in the Life DinAlp Bear report (A4: Poročilo o vplivu smrtnosti medvedov v prometu na slovensko-hrvaško populacijo in njeno razširjenje proti Alpam). Here we present the summary of results and main conclusions for Slovenia.

Traffic-related mortality represents important cause of bear mortality in Slovenia with an average of 16 bears killed in vehicle collisions every year. Among the database of 870 bears removed from the population in 2004-2012, traffic was cause for 15 % of all detected bear mortality and was after hunting the second most important mortality cause (Table 1). Majority of traffic mortality occurred on local and regional roads (50 %; N=71), followed by railway collisions (43.7 %; N=62) and traffic mortality on the highways (6.3 %; N=9.) During the study period, traffic mortality was highest in 2012 (17.6 % of all traffic mortality). We noted seasonal variation in bear-vehicle collision patterns. For road casualties (all road types combined) there was a single peak in autumn (September, October), while bear-railway collisions had two peaks: in late spring (May, June) and autumn (September, October).

When comparing bear sex and age structure, we observed higher traffic mortality for males (overall proportion of males: 57 %; N=81), especially on highways (78 %; N=7) and railroads (61 %; N=38). On the other hand, sex ratio was almost even for traffic mortality on local and regional roads (51 %; N=36). Median age of male bears killed in traffic was 1.3 years and was considerably lower than for females (2.6 years). In respect to the dispersal, the highest frequency of traffic-related mortality was observed in pre-dispersal period. Also when considering seasonal patterns of traffic mortality, we did not observe that bear-vehicle collisions would be connected with bear dispersal movements.

Table 1: Overview of bear mortality causes in in Slovenia for 2004-2012.

	Number of bears removed	%
Legal hunting	700	80,6
Other	28	3,22
Traffic mortality	**142**	**16,32**
Roads	*80*	*9,2*
Railways	*62*	*7,12*
TOTAL	870	100

Figure 1: Photos of sections along the main road Ljubljana-Kočevje, which will be protected by acoustic deterrents (upper left: between Nove Lozine in Kobljarji; upper right: in the vicinity of Gornje Lozine; bottom left: in the vicinity of Ortnek; bottom right: between Laporje and Rašica) (photo by: Z. Pavšek, 2015).

3 OBJECTIVES AND ACTIONS

3.1 STRATEGIC VISION/OBJECTIVES

The main objectives of this action plan are as follows: (i) to define black spots of traffic-related beer mortality in Slovenia; (ii) to select the most problematic sections along state roads, railways and highway to be protected by different mitigation measures; (iii) to enable decrease of the traffic-caused mortality of brown bear by implementation of the Action C.4; (iv) to contribute to the vitality of Alpine-Dinaric brown bear population in the south-central part of Europe.

3.2 ACTIONS FOR IMPLEMENTATION OF MITIGATION MEASURES

3.2.1 Efficiency of the use of different mitigation measures for decreasing deer vehicle collisions

Several mitigation measures have been used so far for preventing, reducing, temporally or spatially orientating of wildlife crossings over roads. The most researches related to traffic-caused mortality were performed for decreasing number of deer-vehicle collisions, therefore we present findings related to the mitigation measures for deer (reviewed in Langbein *et al*., 2011). Positive results have been reported in Slovenia, where effectiveness of three types of acoustic deterrents installed along 23 different road sections (22 km in total) was tested between July – December 2006 (Pokorny and Poličnik, 2008). In total, the number of road-killed deer (primarily roe deer) decreased in that first six months after the installation by 106 individuals (83%) in comparison either with the equivalent period in the year before the trial or with the average value for the equivalent periods in years 2002–2005. On the contrary, change in deer-vehicle collisions (DVC) calculated for an equivalent number of control sections averaged a fall of only 16% (in comparison with the equivalent period in 2005) or 3% (in comparison with average values in the period 2002-2005), and was statistically insignificant. Comparable results confirming effectiveness of acoustic deterrents for reducing number of collisions with large game (and free-ranging ungulates in particular) were also obtained by up-following studies in Slovenia (reviewed in Jelenko *et al*., 2013).

In order more directly to investigate the true effect of acoustic deterrents on deer behaviour when crossing roads, Langbein (2007) employed periods of remote 24hr day-night video surveillance at the roadside in two regions of England (with the presence of fallow deer and red deer) over an 18-month period following installation of deterrents during autumn 2005. During a total of 93 day/night filming periods undertaken mostly simultaneously at deterrent and control for each road 393 groups of deer (c. 1100 individual animals) were filmed at the roadside, including over 273 groups (c. 741 individuals) actually seen crossing the roads within the cameras' field of view. For fallow deer crossing the road at night, the median delay after the last vehicle passed before the animals entered the road lay between 20-30 seconds both in the control sections as well as sections fitted with deterrents. Many fallows were also recorded crossing the road during day-light with on average even shorter delays after traffic. Red deer were only rarely recorded crossing the test road in day-light, and at night the median time interval before crossing was 30-60 seconds after traffic in sections with acoustic reflectors and in control areas. A significant reduction in deer accidents was recorded during the two years post-installation of acoustic reflectors only at the red deer site, but was of similar magnitude in both control and deterrent sections (Langbein, 2007).

Similar video observations were replicated in Slovenia during autumn 2006 on four road sections affected by mostly red deer collisions. In 63 days of surveillance (of which c. 1/3 filmed before and 2/3 after deployment of deterrents at the same locations) 369 individual red deer crossing the road were filmed (Pokorny et al., 2008). Here animals were noted to spend shorter duration of time on the roadway itself after the installation of deterrents in comparison with the period earlier in autumn when acoustic deterrents were not yet activated or had not yet been implemented (30 sec *vs.* 35 sec). The researchers found also that after installation of deterrents red deer in Slovenia appeared to 'escape' somewhat sooner in advance of approaching traffic, but stressed that the trial period was very short and extended only to one species. However, the comparable results (i.e. prolongation of escaping time after the implementation of acoustic deterrents) were obtained also in the up-following periods of filming in 2008/09, 2010/11, and 2012/13, respectively (Jelenko *et al*., 2013).

By filming at the bait stations Langbein (2007) tried to recognise direct response of roe deer, fallow deer and red deer when exposed to the ultrasonic and low frequency audible signals, and he revealed very fast habituation of all three species to the acoustic signals. However, it should be stressed that in his experiment animals are countered a stable source of signal on the place of very high attractiveness (baiting stations) therefore habituation of animals exposed to rather sporadic noise in the phase of road crossing is expected to be much slower.

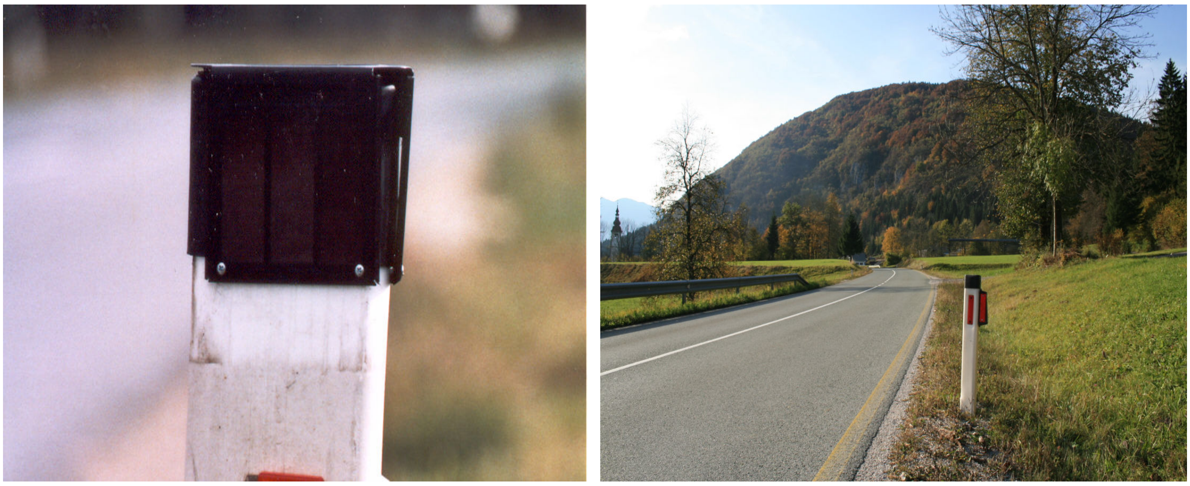

Figure 2: Two types of acoustic deterrent that have been used so far in Slovenia.

Various types of enhanced signage, temporary signs, dynamic message boards and animal activated warning systems have been developed to increase the likelihood that road users will take note of them (Huijser and McGowen, 2003; Huijser *et al*., 2006; Mastro *et al*., 2008). Enhanced signs should be used only to warning of known and regular wildlife-crossing points along a roadway. Driver habituation might also be reduced if signs were only exposed at particular times or seasons where accidents are known to be more frequent (Iuell *et al*., 2003). For example, Sullivan *et al*. (2004) reported some success with temporary enhanced signs erected only during autumn and spring migration of mule deer, resulting in a fall in the percentage of speeding vehicles from 19% to 8%, and decrease in DVCs estimated at 50%.

Dynamic sign systems have been developed further by coupling to sensors capable of detecting animals approaching the roadway. Such signs are thus activated only in direct response to animals present or approaching the carriageway, using a variety of sensors based on heat detection, seismic ground vibrations, or breaking of laser or infrared beams along the verge. The sensors trigger fibre-optic display enhanced wildlife warning signs and can also be combined with alternative speed detection and display of speed limit signs. Numerous differing versions of such systems have now been installed in Europe and North America. As in the case of other deterrents, firm data on their effectiveness at reducing wildlife-vehicle collisions remains scarce (Huijser *et al.*, 2006), although Mosler-Berger and Romer (2003) reported a fall in DVCs by near 80% for a series of infrared activated systems in Switzerland, and several other studies have demonstrated that drivers do slowdown in response to activated systems (Gordon *et al.*, 2003; Hammond and Wade, 2004).

Langbein *et al.* (2011) concluded in the most up-to-date reviewed paper on problematic of wildlife-vehicle collisions that the ‘dynamic signage’ has some potential as wildlife mitigation – although it remains unclear what may be the actual cost-effectiveness of animal-sensitive devices versus cheaper and often more reliable devices that are triggered by driver speed so as to simply enhance warnings against speeding at known hot spots. Fuller review of differing types of dynamic or animal-detection and driver-warning deployed in Europe and North America is offered by Huijser *et al.* (2006) and Hardy *et al.* (2006).

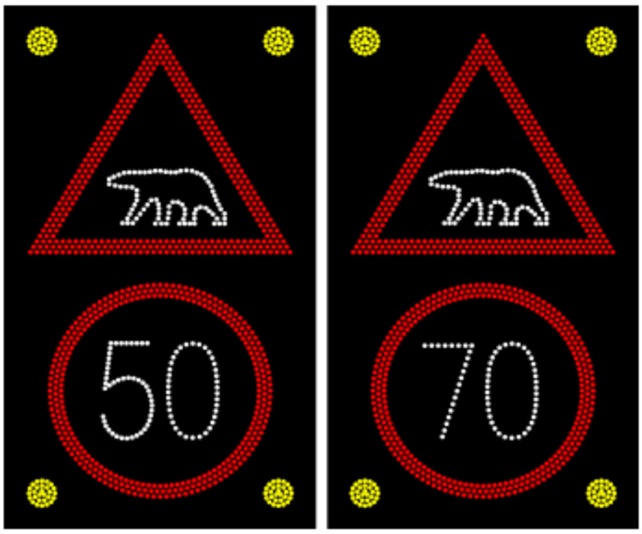

Figure 3: An example of a dynamic sign for decreasing traffic-related beer mortality.

3.2.2 Description of mitigation measures, which will be implemented along the most problematic sections of main state roads, highways and railways

The main state road Ljubljana – Kočevje

Acoustic deterrents (ultra- and infrasound emitting electronic devices coupled with sensors activating the sound by the approaching vehicle) will be placed directly into the roadside trafficators/pillars along the 'black-spots' considering bear-vehicle collisions along the main road Ljubljana – Kočevje (Figures 20-24). Deterrents will be implemented on the distance of 30 to 50 m, i.e. into each or every second pillar. In total, app. 6 km of roads will be protected by 240 acoustic deterrents. Additional 120 deterrents are planned for up-following maintenance of protected sections till the end of the project.

Moreover, two animal activated warning systems will be employed at the most often used bear crossing points along this road. Each system will include two dynamic signs placed at both sides of the road before the dangerous road section. These dynamic signs will be coupled to sensors capable to detect large animals approaching the roadways. In the case of an approaching bear (or ungulates), the signs will light on and send the message to the driver that an animal is approaching the road. Since these systems/sensors are not bear-specific, they will provide also higher road-safety considering collisions with other large mammals, particularly ungulates. The last is very important also for conservation of brown bear and some other protected animal species, since free-ranging ungulates are the most important prey species for large carnivores, and hence a decrease in their road-mortality will increase food availability for predators.

The highway Ljubljana – Postojna

Electric fence will be installed along both sides of the problematic motorway section Ljubljana – Postojna regarding bear mortality. In total, up to 15 km (up to 30 km considering both sides) of three wired (different heights) electric fence will be installed on the already existing strong and high wire mesh protecting fence (Figures 25, 26). This will prevent bears to enter the highway (climb over the fence).

The Railway Ljubljana – Postojna – Koper

Acoustic deterrents in pillars will be placed along the most problematic railway sections considering bear-train collisions. Deterrents will be placed at one verge of railway in the reciprocal distance of 50 m. A part of the following sections of railways will be equipped with the acoustic deterrents: Ljubljana – Postojna and Postojna – Koper, respectively (Figures 27, 28). In total, app. 8 km of railways will be protected by 160 acoustic deterrents placed in special pillars, and additional 80 deterrents are planned for up-following maintenance of protected sections till the end of the project.

3.2.3 Selection of the black spots along the most problematic sections of main state roads, highways and railways

Black spots were selected according to the reported (registered) collisions with brown bears, which were collected by Slovenia Forest Service, Slovenian Road Agency and Slovenian Railways Company (Table 2).

Table 2: Registered brown bear-vehicle collisions (with mortality of the bear) at the selected black spots in the period between 2004 and 2014.

No. of black spot	Location	Date of bear-vehicle collision
STATE ROAD : LJUBLJANA – KOČEVJE		
1	Ljubljana – Kočevje (Rašica)	15.12.2006; 30.7.2007; 18.10.2012; 1.10.2014
2	Ljubljana – Kočevje (Gorenje, Podpoljane)	29.10.2006; 11.8.2007; 4.3.2012
3	Ljubljana – Kočevje (Žlebič)	17.8.2005; 5.10.2009; 27.6.2010; 19.9.2012; + one collision without the date
4	Ljubljana – Kočevje (roads around village Rakitnica)	10.12.2004; 31.7.2005; 18.10.2006; 11.11.2006; 15.12.2006
5	Ljubljana – Kočevje (Dolenja vas – Slovenska vas)	25.10.2006; 19.2.2007; 21.10.2009; 26.10.2012
6	Ljubljana – Kočevje (Nove Ložine)	27.10.2006; 21.9.2012; 18.9.2014; 7.10.2014
HIGHWAY: LJUBLJANA – NOVO MESTO; LJUBLJANA – POSTOJNA		
7	Ljubljana – Novo mesto (Višnja Gora – Ivančna Gorica)	28.9.2007; 12.9.2009
8	Ljubljana – Postojna (Lom)	18.4.2004; 10.5.2014
11	Ljubljana – Postojna (Rakek – Postojna)	30.3.2005; 19.3.2006; 30.8.2014; 2.9.2014
RAILWAY: LJUBLJANA – POSTOJNA – PIVKA		
9	Ljubljana – Postojna (between exit Logatec and Unec)	17.4.2004; 12.9.2005 (three individuals in one collision); 18.9.2005; 30.9.2005; 5.9.2008; 17.5.2012
10	Ljubljana – Postojna (Rakek)	20.2.2010; 14.10.2010; 10.9.2011; 24.2.2012; 16.6.2012
12	Postojna – Pivka (Postojna – Prestranek, Stara vas)	25.9.2010; 2.6.2012; 8.9.2012; 14.10.2013
13	Postojna – Pivka (Postojna – Prestranek, Matejna vas)	27.6.2004; 6.6.2012; 12.6.2012 (two individuals); 24.6.2012; 27.5.2013; 28.4.2014 (two individuals); 14.5.2014; 29.4.2014

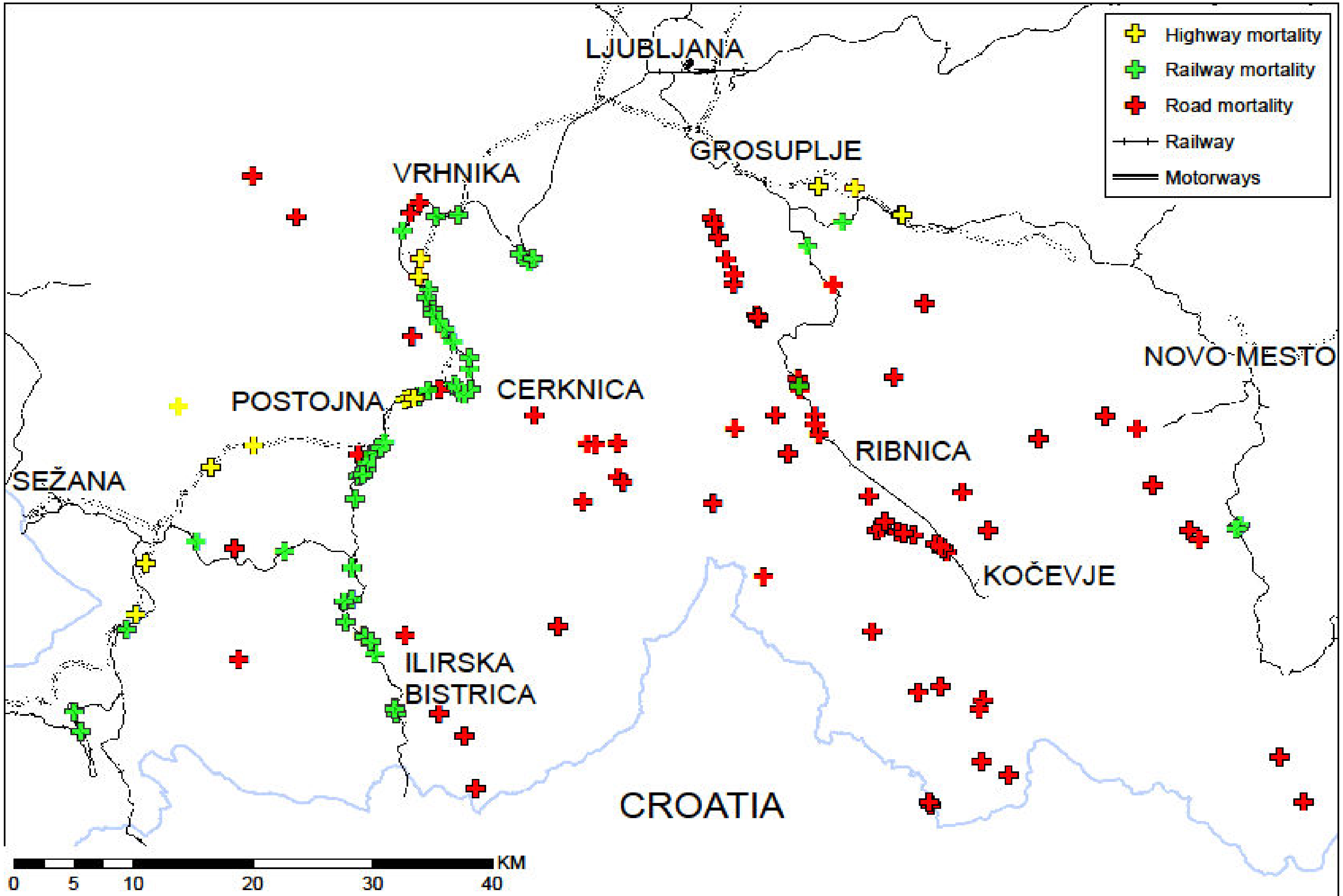

Figure 4 : Map of registered cases of the mortality of brown bear at the main roads, railways and highways in Slovenia in the period 2004–2014.

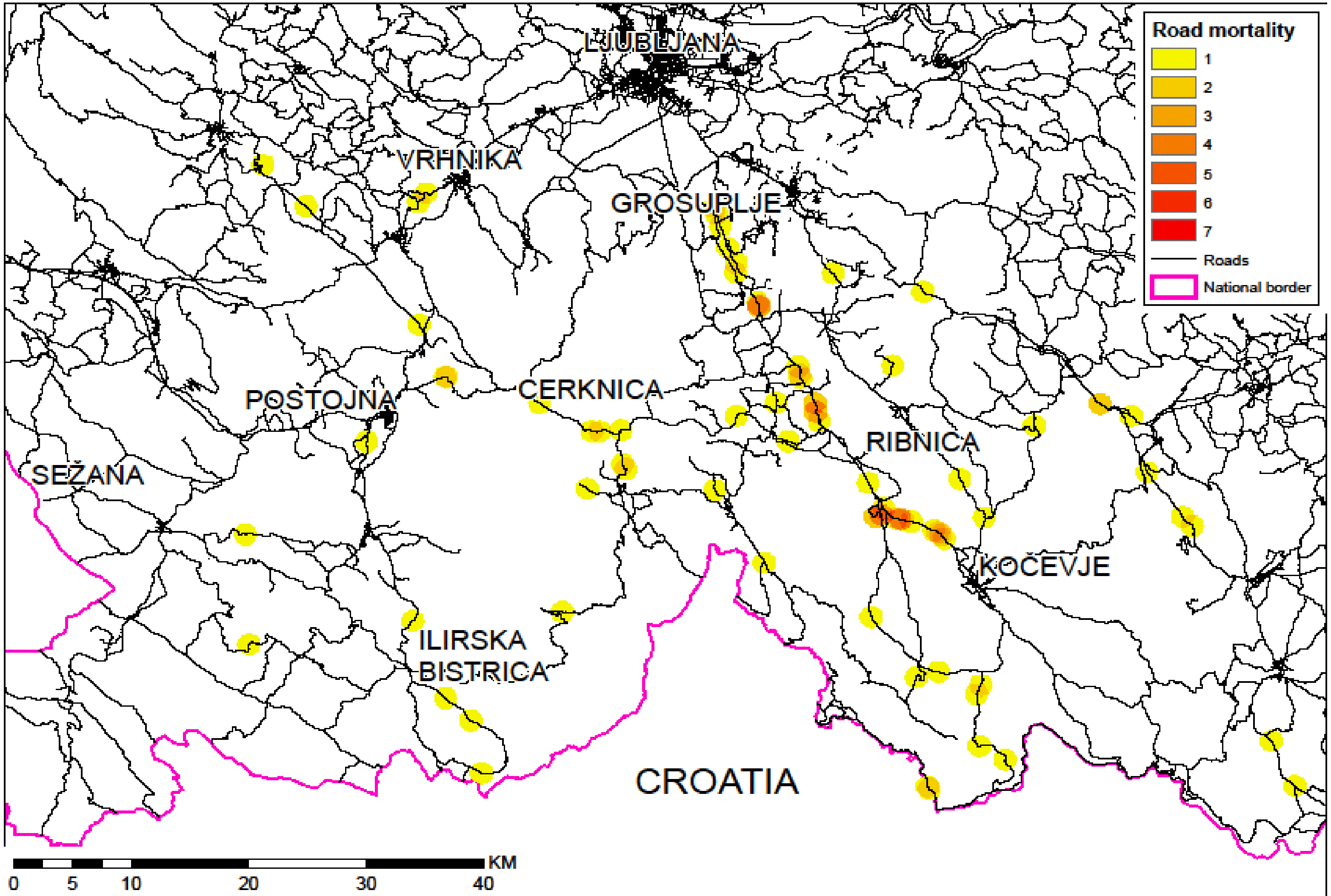

Figure 5: Map of micro locations with the number of cases related to the main road mortality of brown bear in Slovenia in the period 2004–2014.

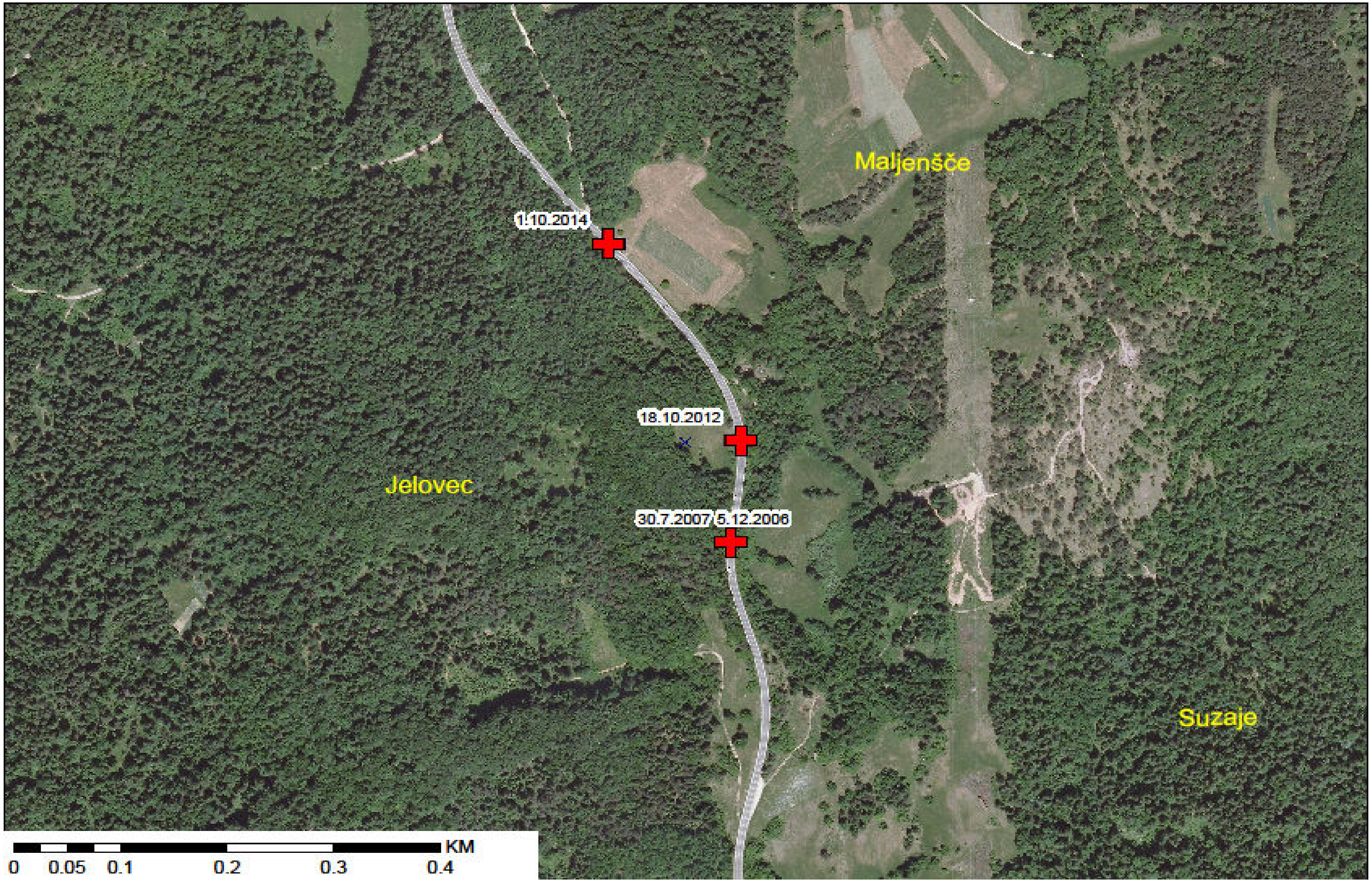

Figure 6: Main road Ljubljana-Kočevje (northern of Rašica) with micro locations of the traffic-related bear mortality and the date of collisions (black spot no.1).

Figure 7: Main road Ljubljana-Kočevje (Gorenje Podpoljane) with micro locations of the traffic-related bear mortality and the date of collisions (black spot no. 2).

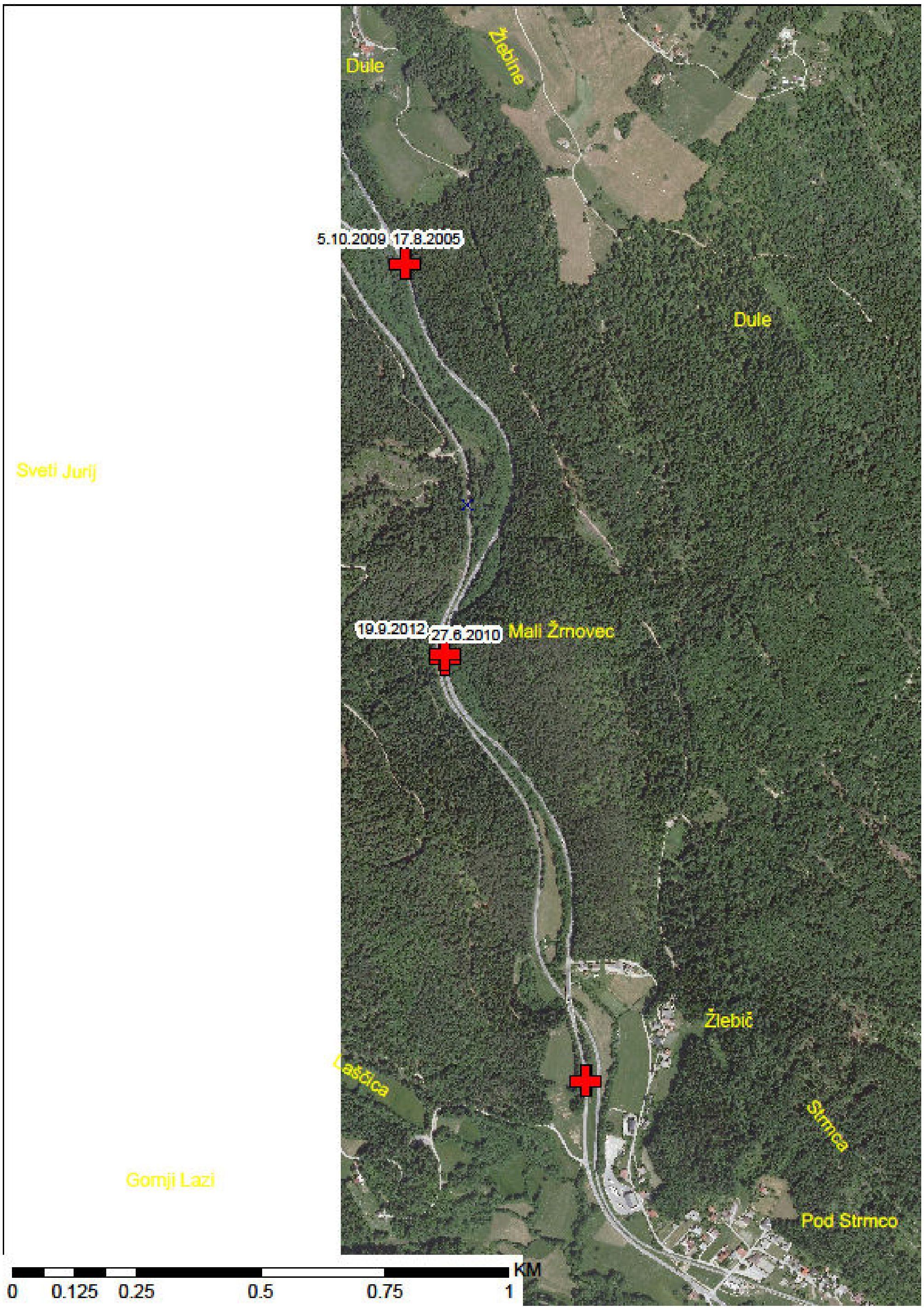

Figure 8: Main road Ljubljana-Kočevje (Žlebič) with micro locations of the traffic-related bear mortality and the date of collisions (black spot no. 3).

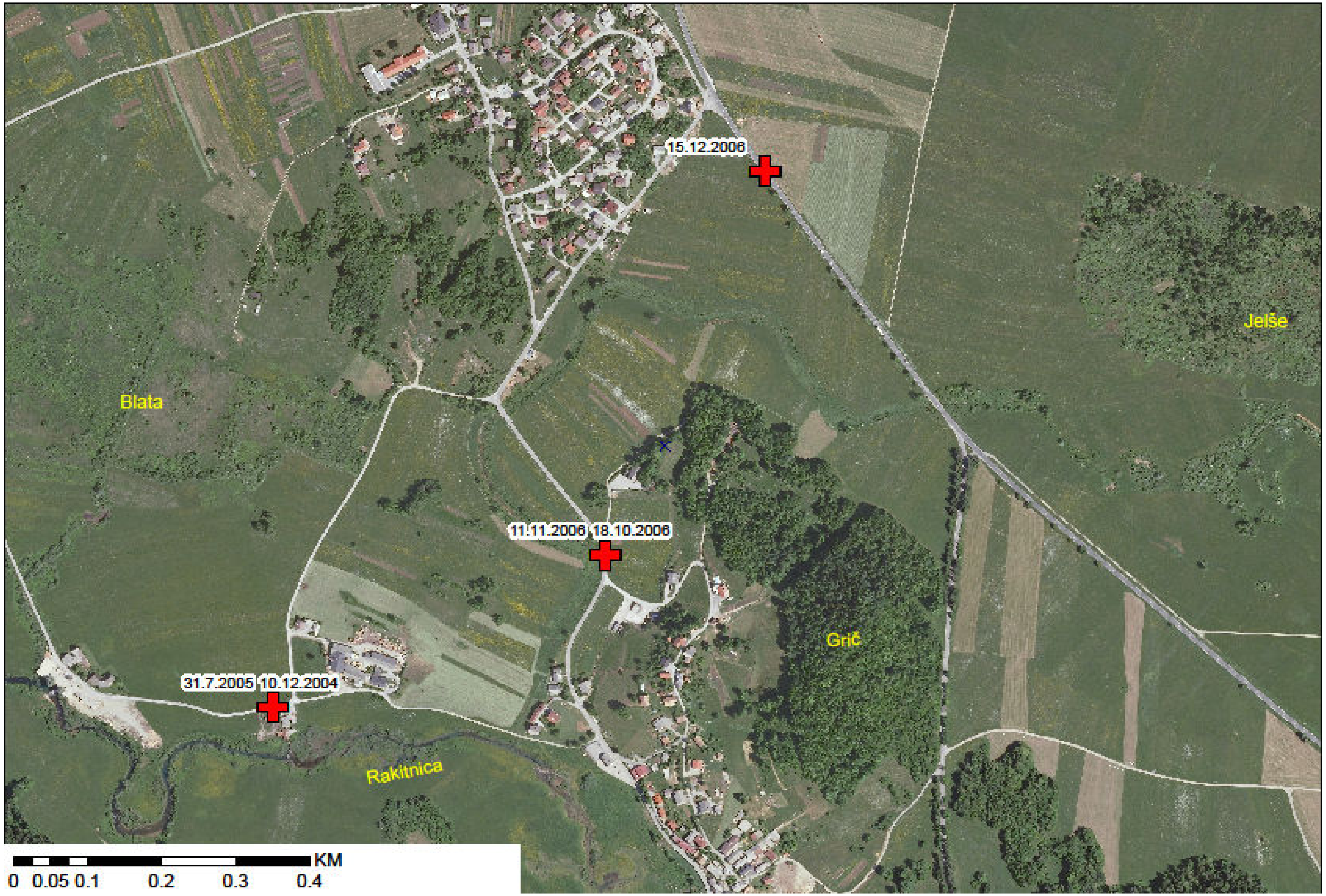

Figure 9: Roads around village Rakitnica with micro locations of the traffic-related bear mortality and the date of collisions (black spot no. 4).

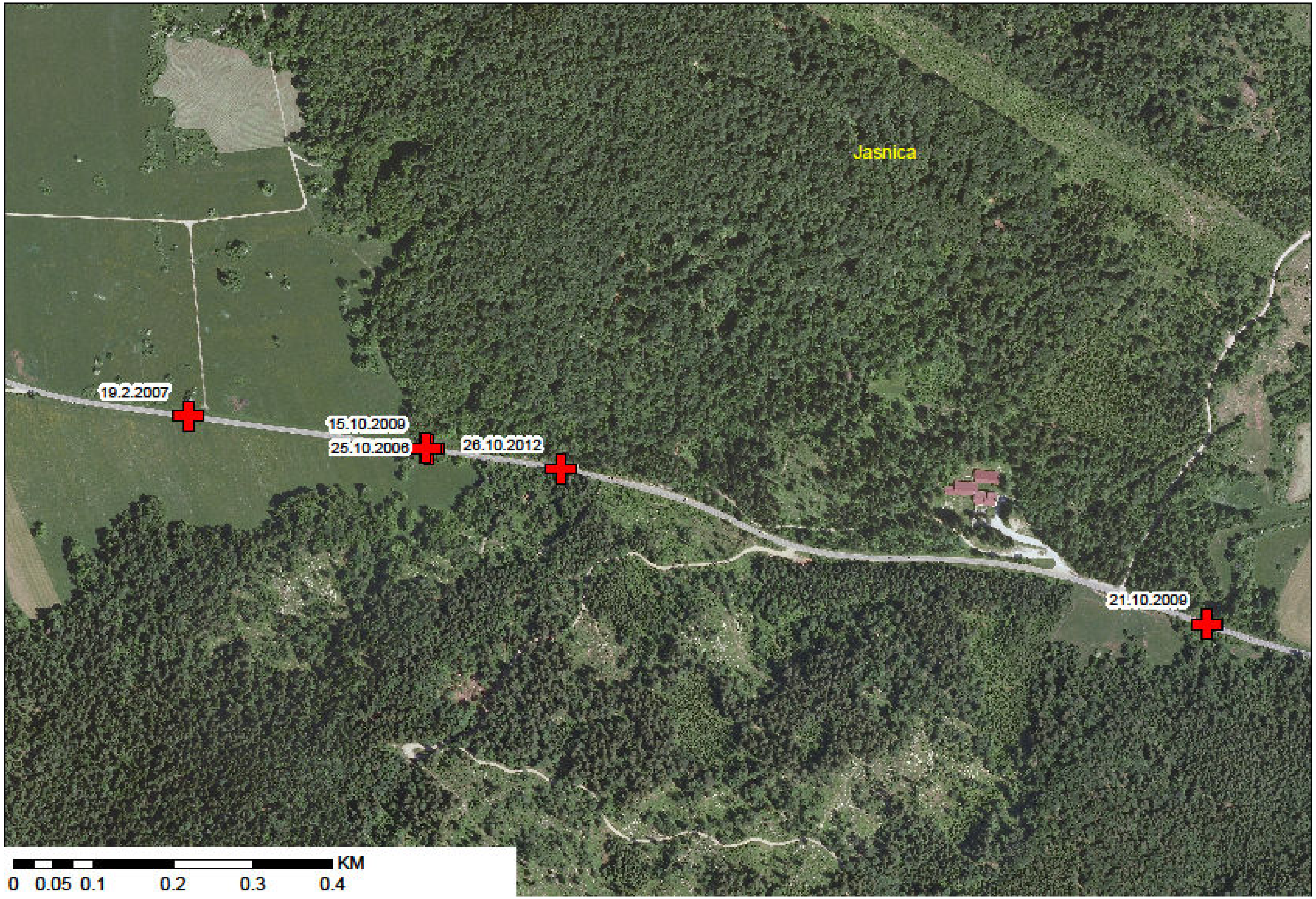

Figure 10: Main road Ljubljana-Kočevje (between Dolenja vas and Slovenska vas) with micro locations of the traffic-related bear mortality and the date of collisions (black spot no. 5).

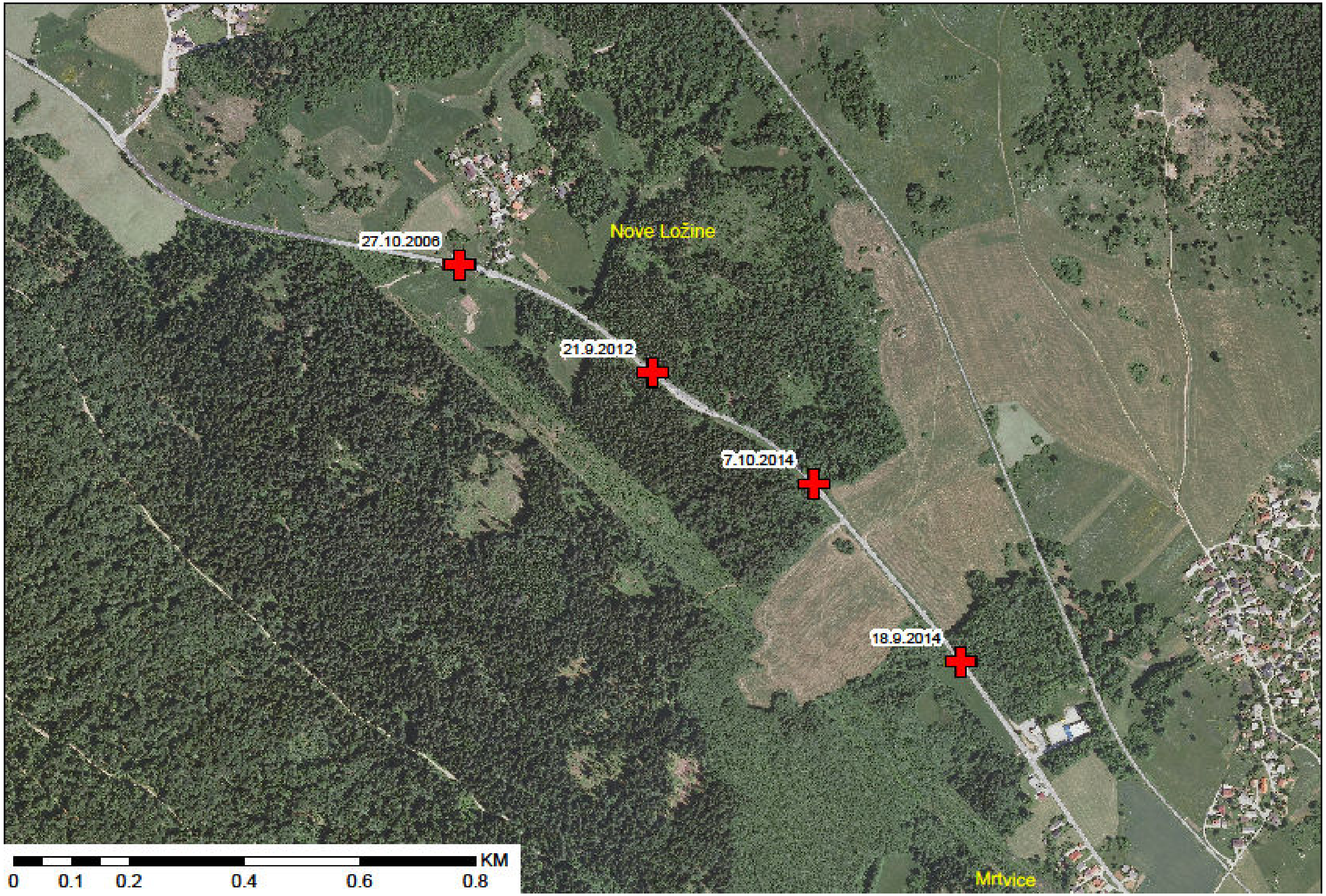

Figure 11: Main road Ljubljana-Kočevje (Nove Ložine) with micro locations of traffic-related bear mortality and the date of collisions (black spot no. 6).

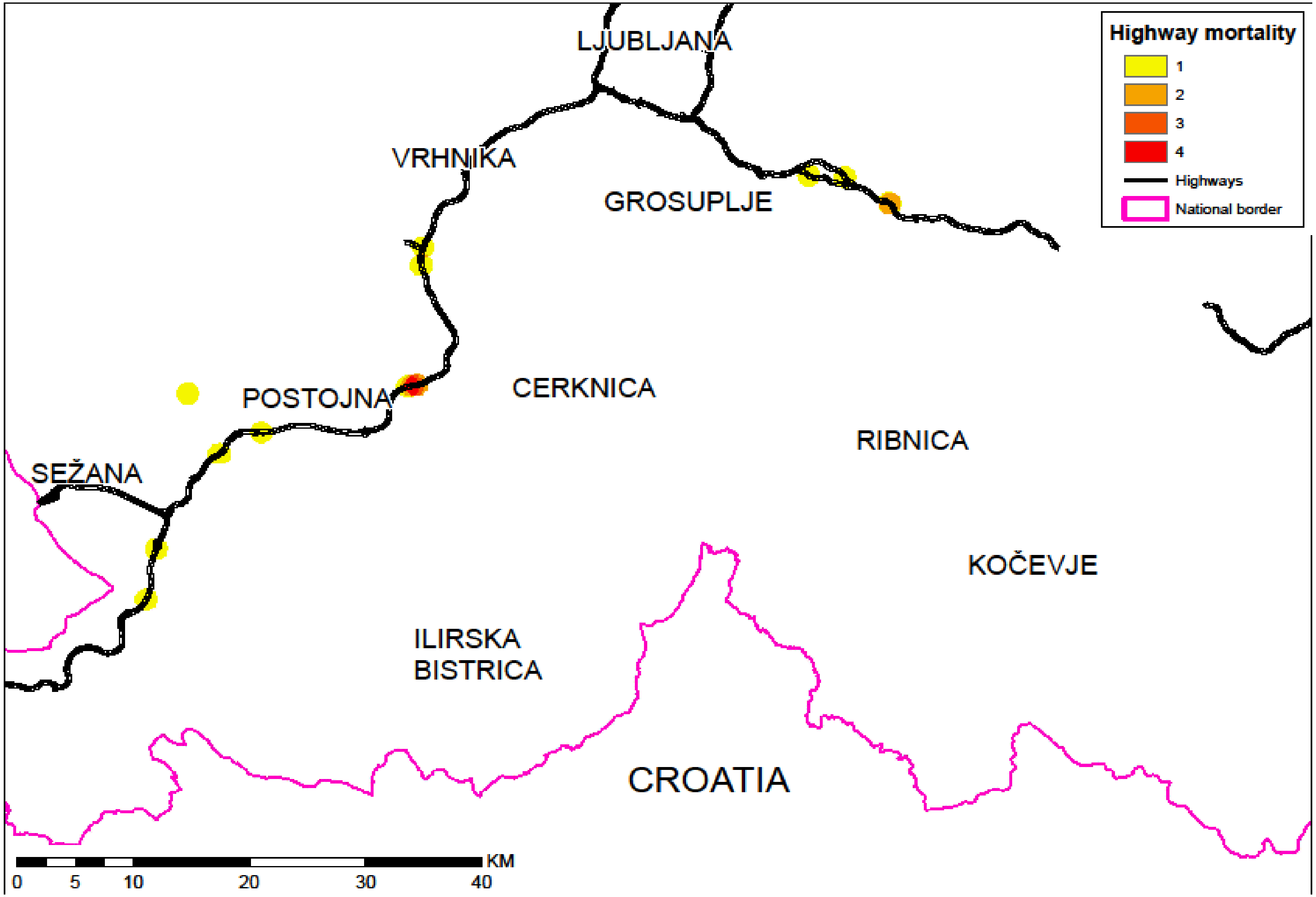

Figure 12: Map of micro locations with the number of cases related to the highway mortality of brown bear in Slovenia in the period 2004–2014.

Figure 13: Highway Ljubljana-Novo mesto (between Višnja Gora and Ivančna Gorica) with micro locations of the traffic-related bear mortality and the date of collisions (black spot no. 7).

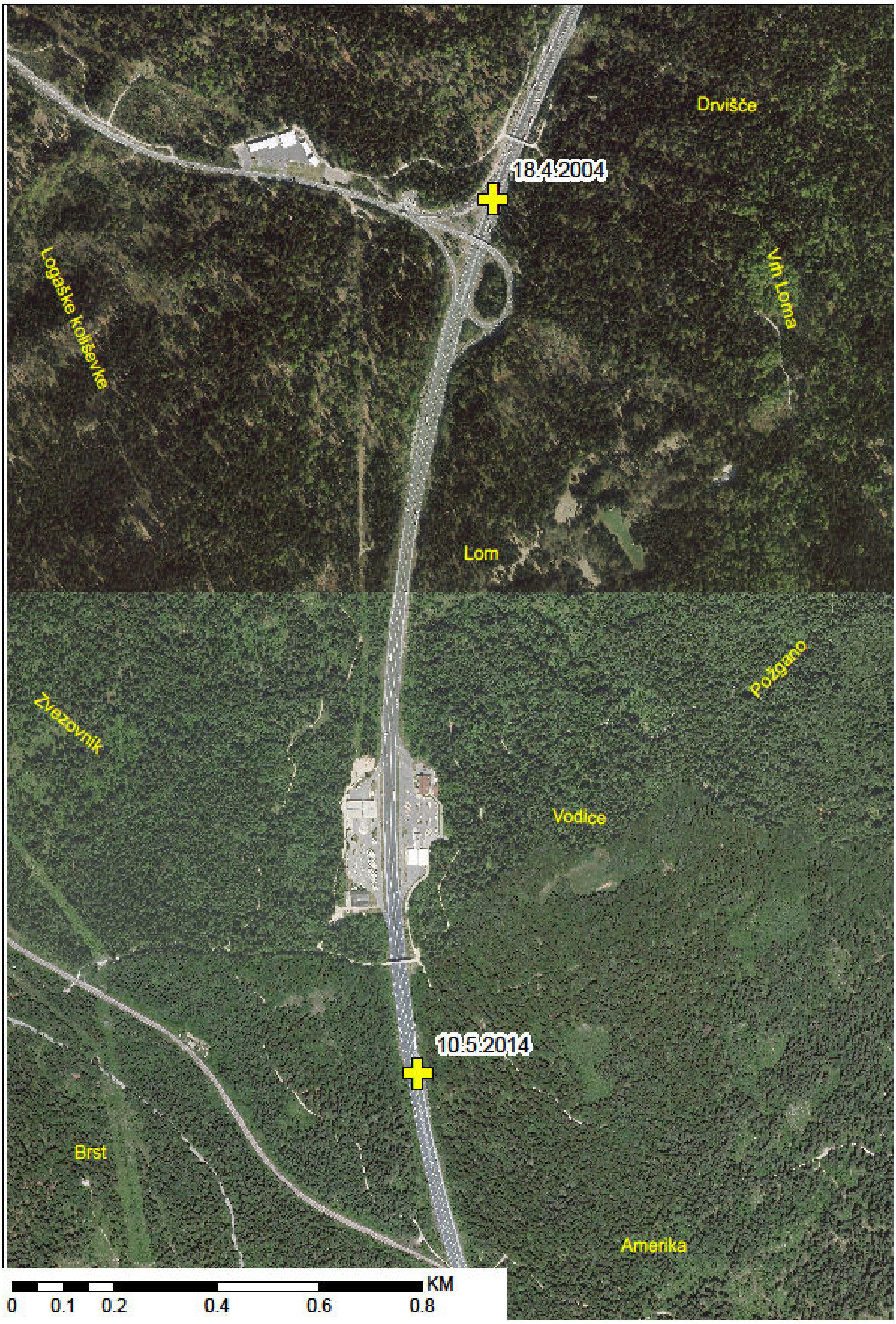

Figure 14: Highway Ljubljana-Postojna (Lom) with micro locations of the traffic-related bear mortality and the date of collisions (black spot no. 8).

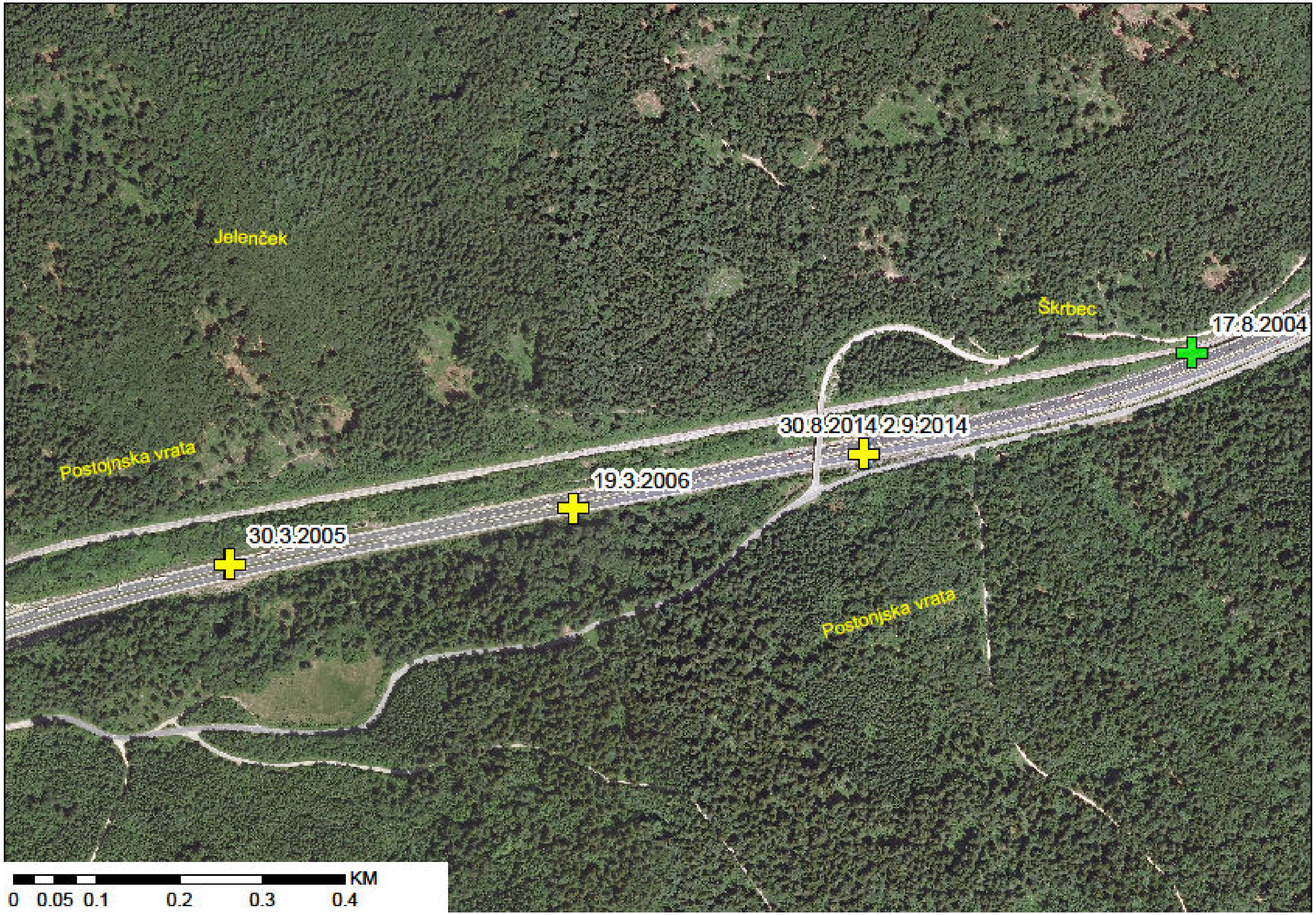

Figure 15: Highway Ljubljana-Postojna (between Rakek and Postojna) with micro locations of the traffic-related bear mortality and the date of collisions (black spot no. 9).

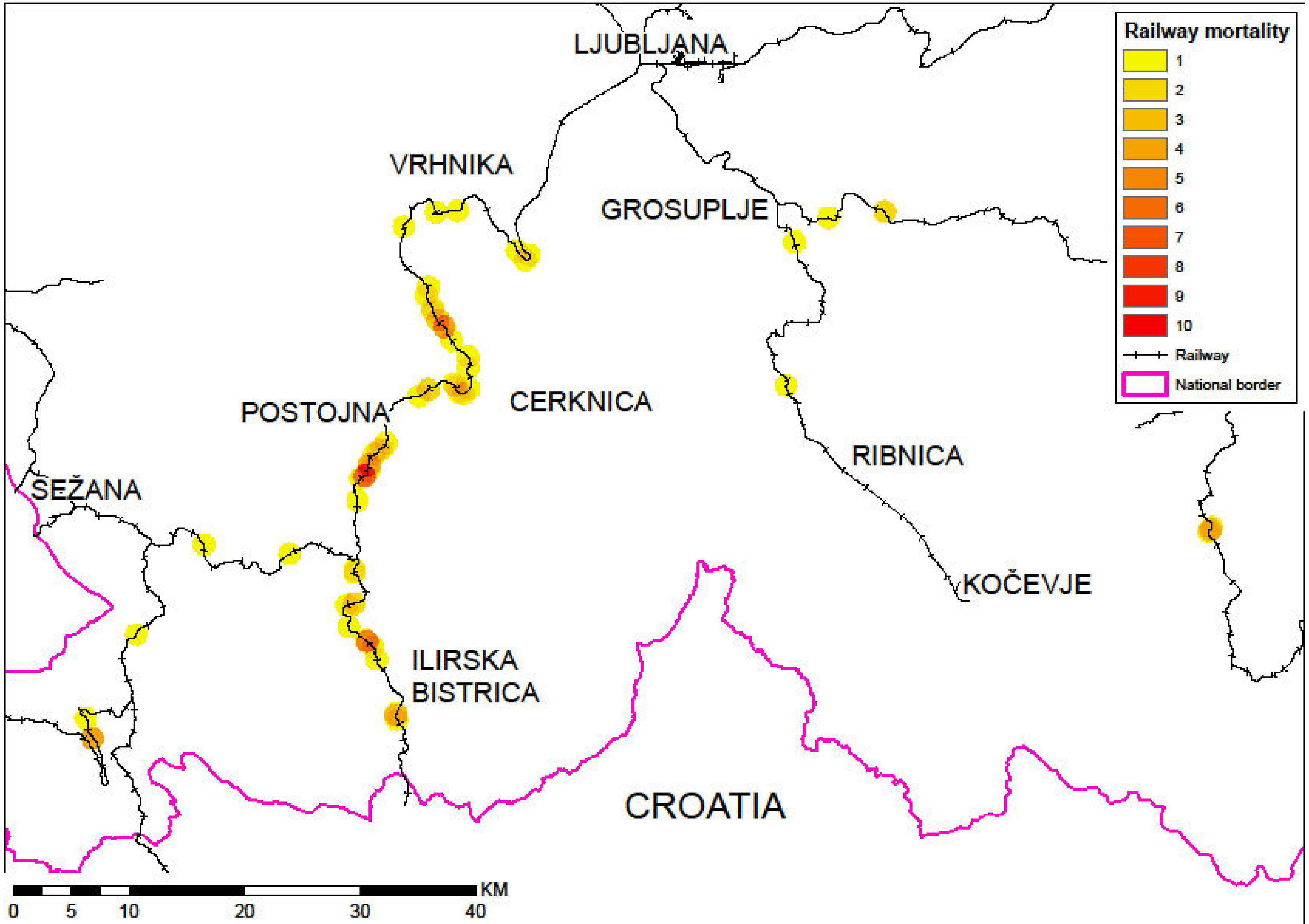

Figure 16: Map of micro locations with the number of cases related to the railway mortality of brown bear in Slovenia in the period 2004–2014.

Figure 17: Railway Ljubljana-Postojna (between Lom and Logatec) with micro locations of the traffic-related bear mortality and date of collisions (black spot no. 9)

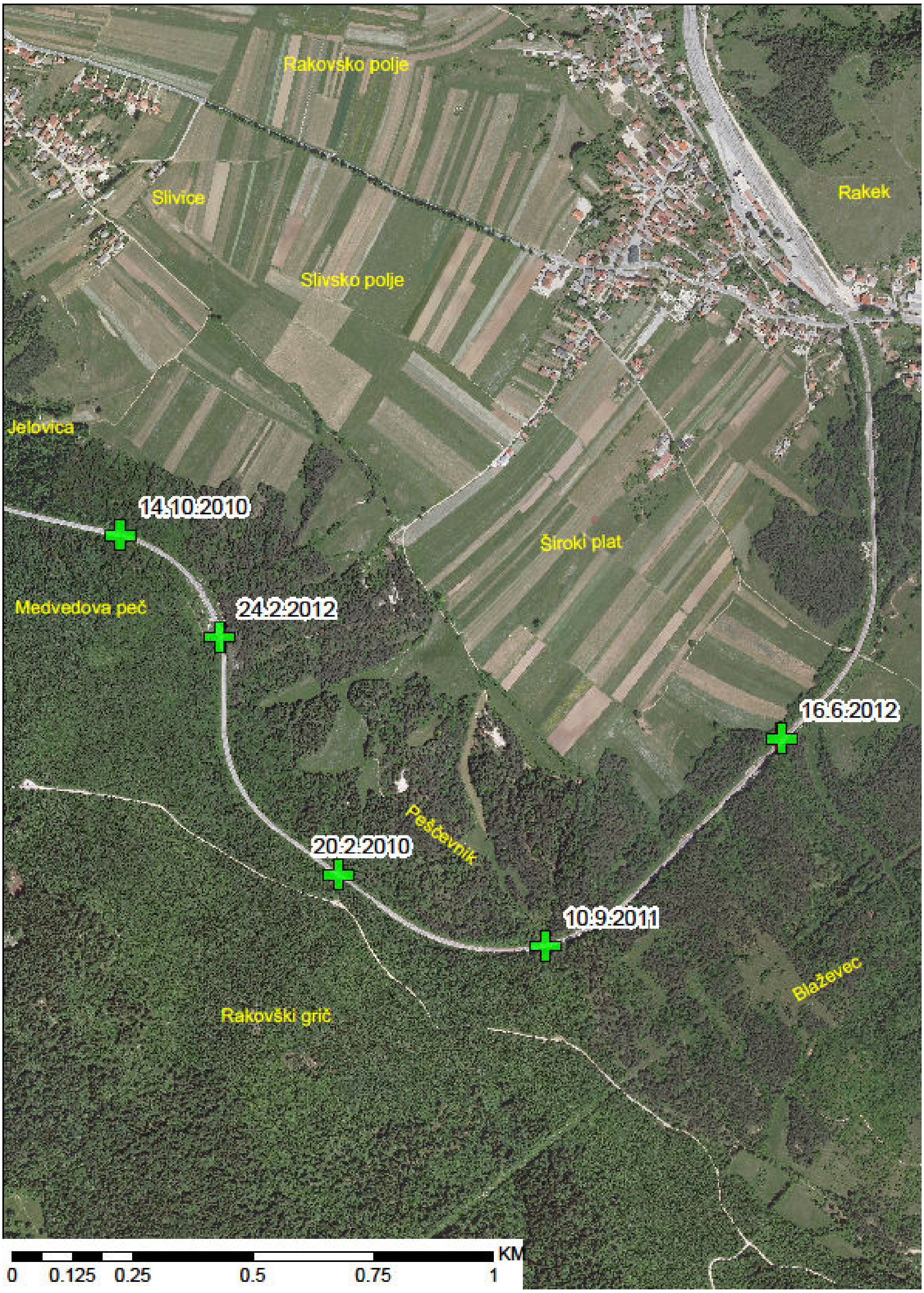

Figure 18: Railway Ljubljana-Postojna (Rakek) with micro locations of the traffic-related bear mortality and the date of collisions (black spot no. 10).

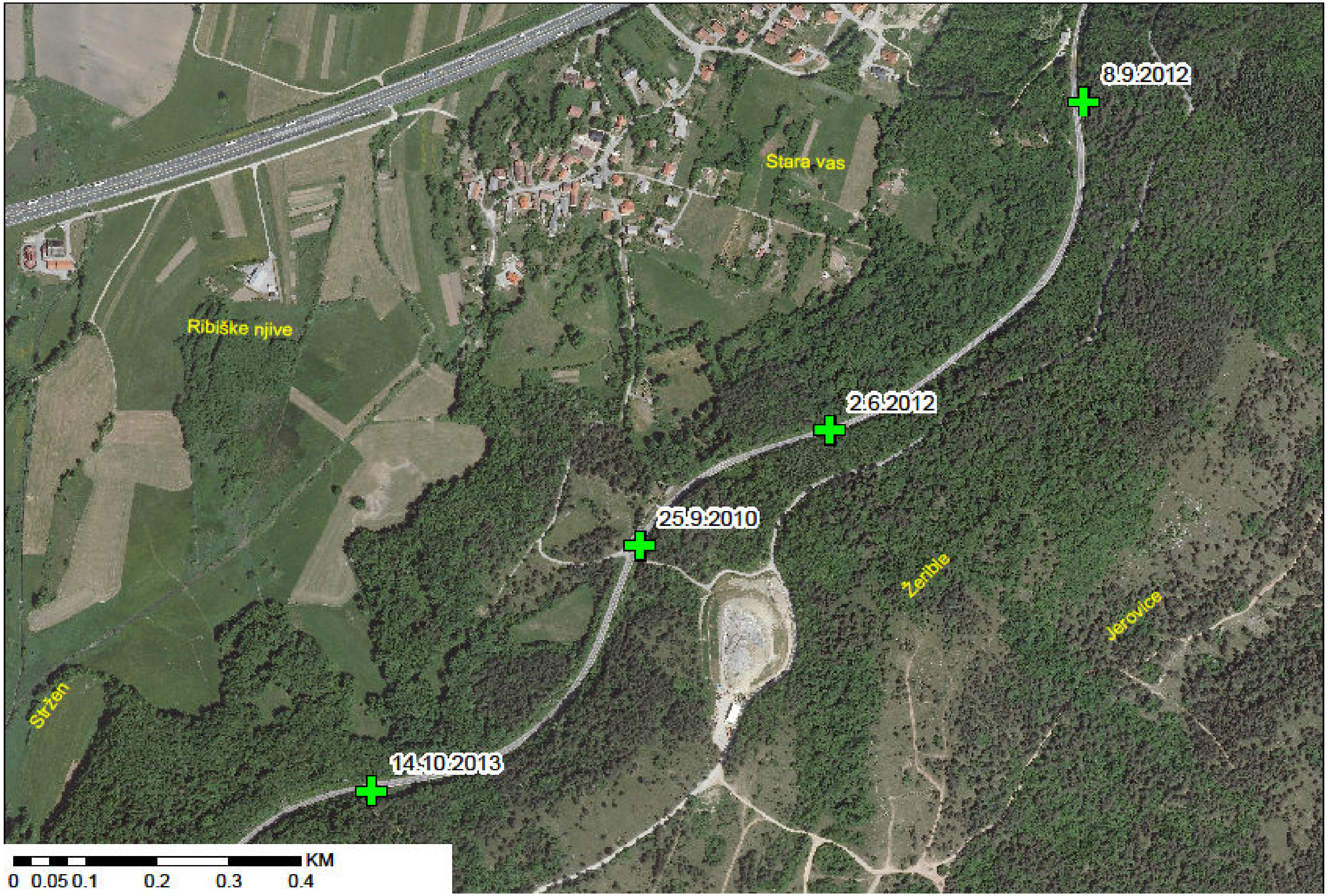

Figure 19: Railway Postojna-Pivka (between Postojna and Prestranek, Stara vas) with micro locations of the traffic-related mortality and the date of collisions (black spot no. 12).

Figure 20: Railway Postojna-Pivka (between Postojna and Prestranek, Matejna vas) with micro locations of the traffic-related bear mortality and the date of collisions (black spot no. 13).

3.2.4 Selection of the most problematic sections of main state roads, highways and railways to be protected by mitigation measures to reduce brown bear mortality

On the basis of the frequency of bear-vehicle collisions, resulting in brown bear mortality, the following sections of roads, highways and railways were selected in the first phase for further evaluation and field inspection: (i) four sections of the state road Ljubljana-Kočevje (Figures 21-24); (ii) two sections along the highway Ljubljana-Postojna (Figure 25, 26); and (iii) two sections of railways, one along the railway Postojna-Pivka (Figure 27) and other along the railway Ljubljana-Postojna (Figure 28), respectively.

In the second phase, we made the final selection of the most problematic road (including micro locations for dynamics signs), highway and railway sections to be protected by mitigation measures according to the field inspection and our previous experiences regarding implementation of mitigation measures for reducing wildlife-vehicle collisions.

The selected sections of all three infrastructure types for the implementation of mitigation measures are as follows:

- **Main roads**: 6 km of the state road Ljubljana-Kočevje – in detail:
  -1.8 km (106/0263 + 13.6 km and 106/0236 + 15.4 km) between Koblarji and Nove Lozine (see Figure 21);
  -1.4 km (106/0263 + 10.7 km and 106/0263 + 12.2 km) in the vicinity of Gornje Lozine with dynamics signs (micro locations: 106/0263 + 10.7; 106/0263 + 11.1 km) (see Figure 22);
  -1.5 km (106/0262 + 9.5 km and 106/0262 + 11.0 km) between Ortnek in Žlebič with dynamics signs (micro locations: 106/0262 + 9.8; 106/0262 + 10.3 km) (see Figure 23);
  -1.3 km (106/0261 + 14.2 km and 106/0261 + 15.5 km) between Turjak and Rašica (see Figure 24).
- **Highways**: 5 km of the highway Ljubljana-Postojna between Ravbarkomanda and Unec exit (see Figure 25) and 10 km of the highway Ljubljana-Postojna between Unec exit and Logatec exit (see Figure 26).
- **Railways**: 5 km of the railway Postojna-Pivka between Prestranek and Postojna (see Figure 27) and 3 km of the railway Ljubljana-Postojna in the vicinity of Rakek (see Figure 28).

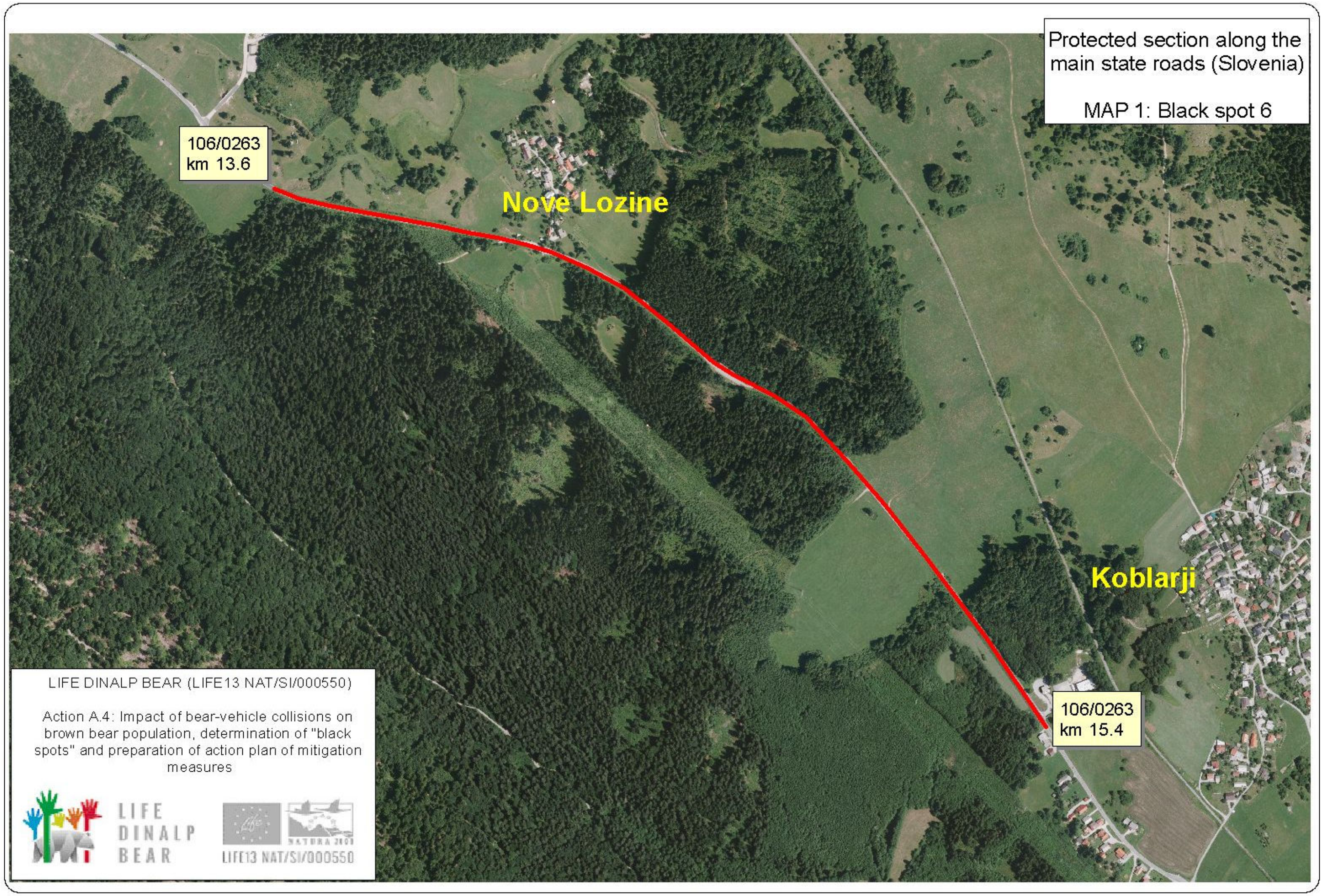

Figure 21: First selected road section along the main road Ljubljana-Kočevje, which will be protected by acoustic deterrents.

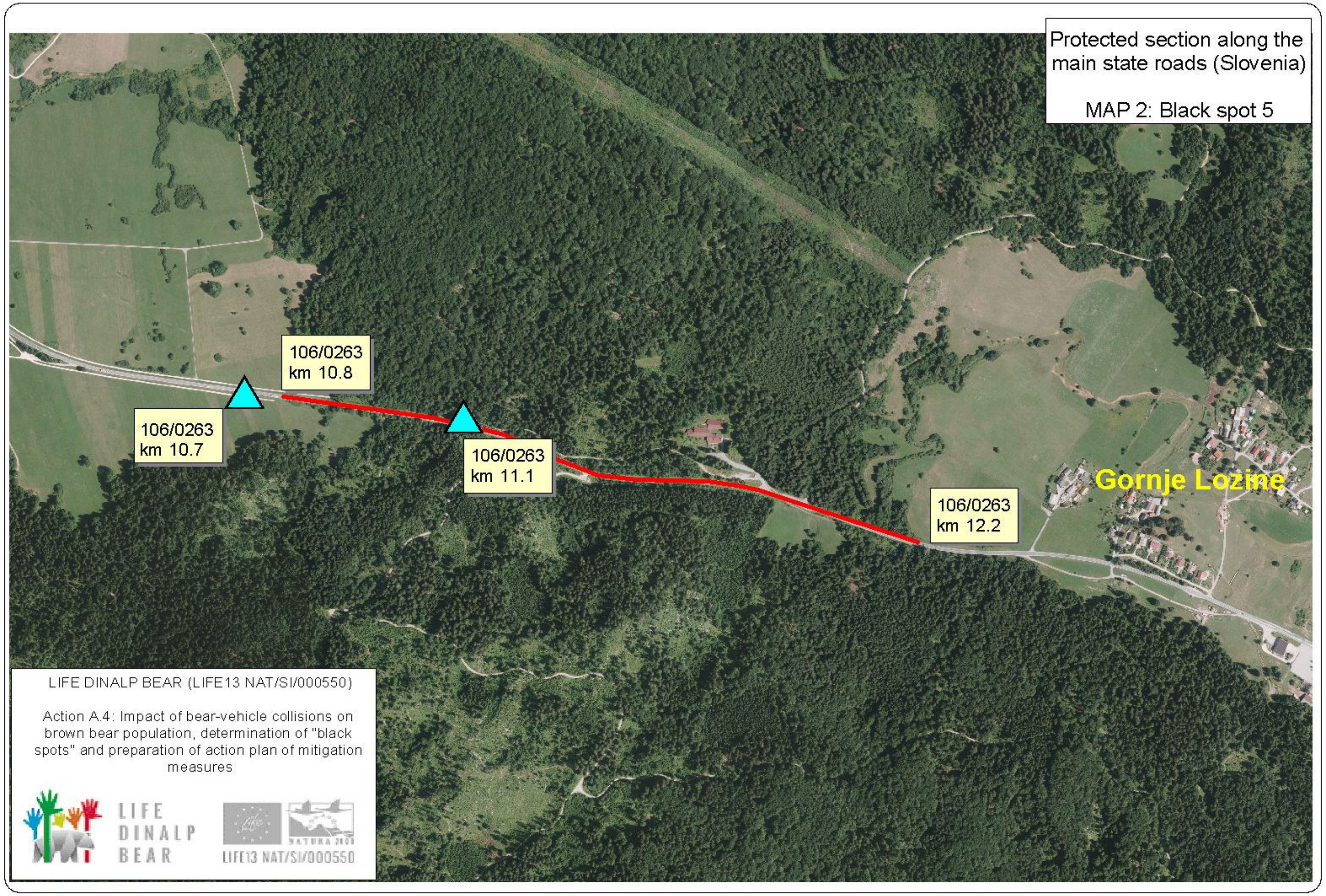

Figure 22: Second selected road section along the main road Ljubljana-Kočevje, which will be protected by acoustic deterrents and locations of dynamic signs.

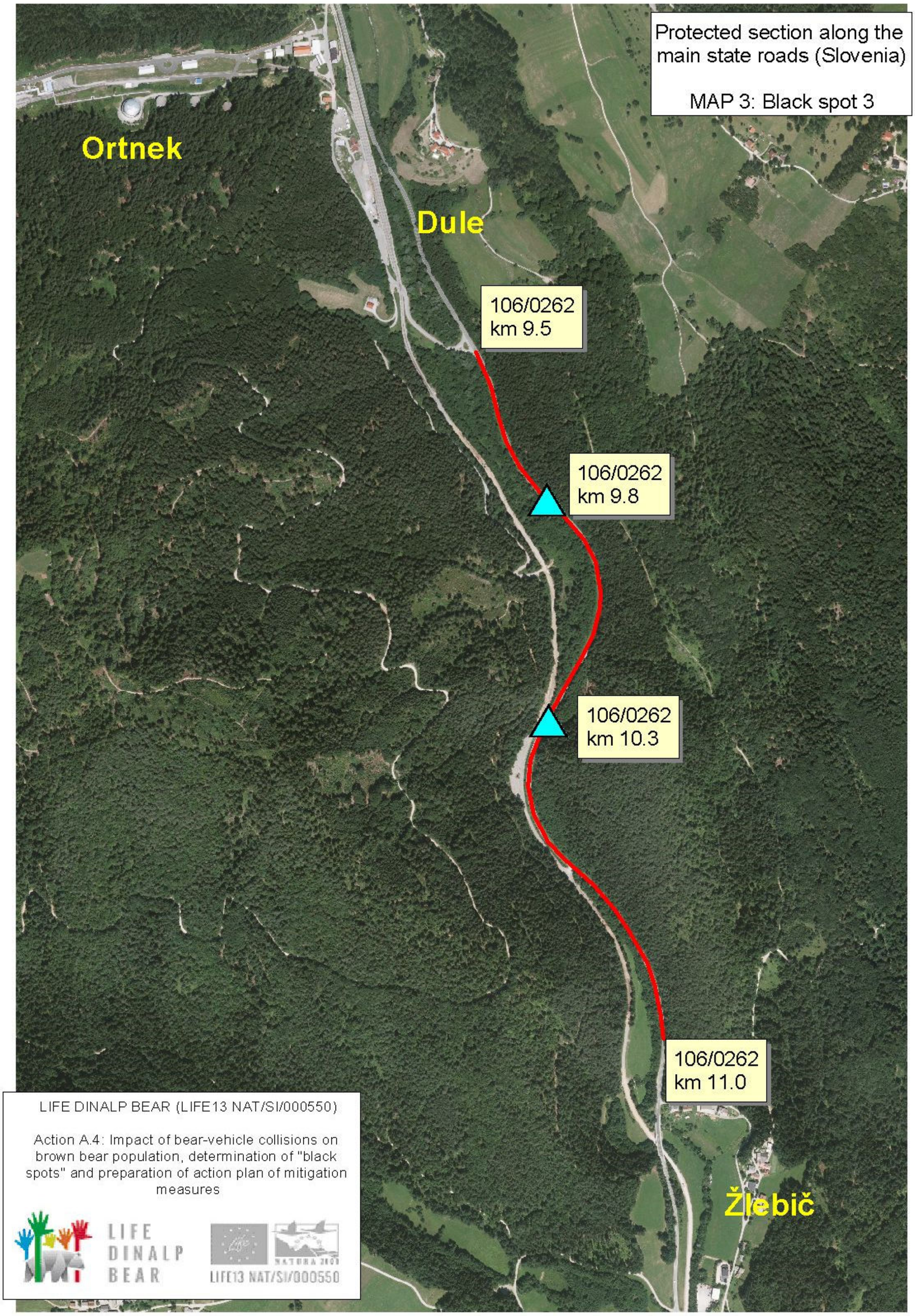

Figure 23: Third road section along the main road Ljubljana-Kočevje and locations of dynamics signs.

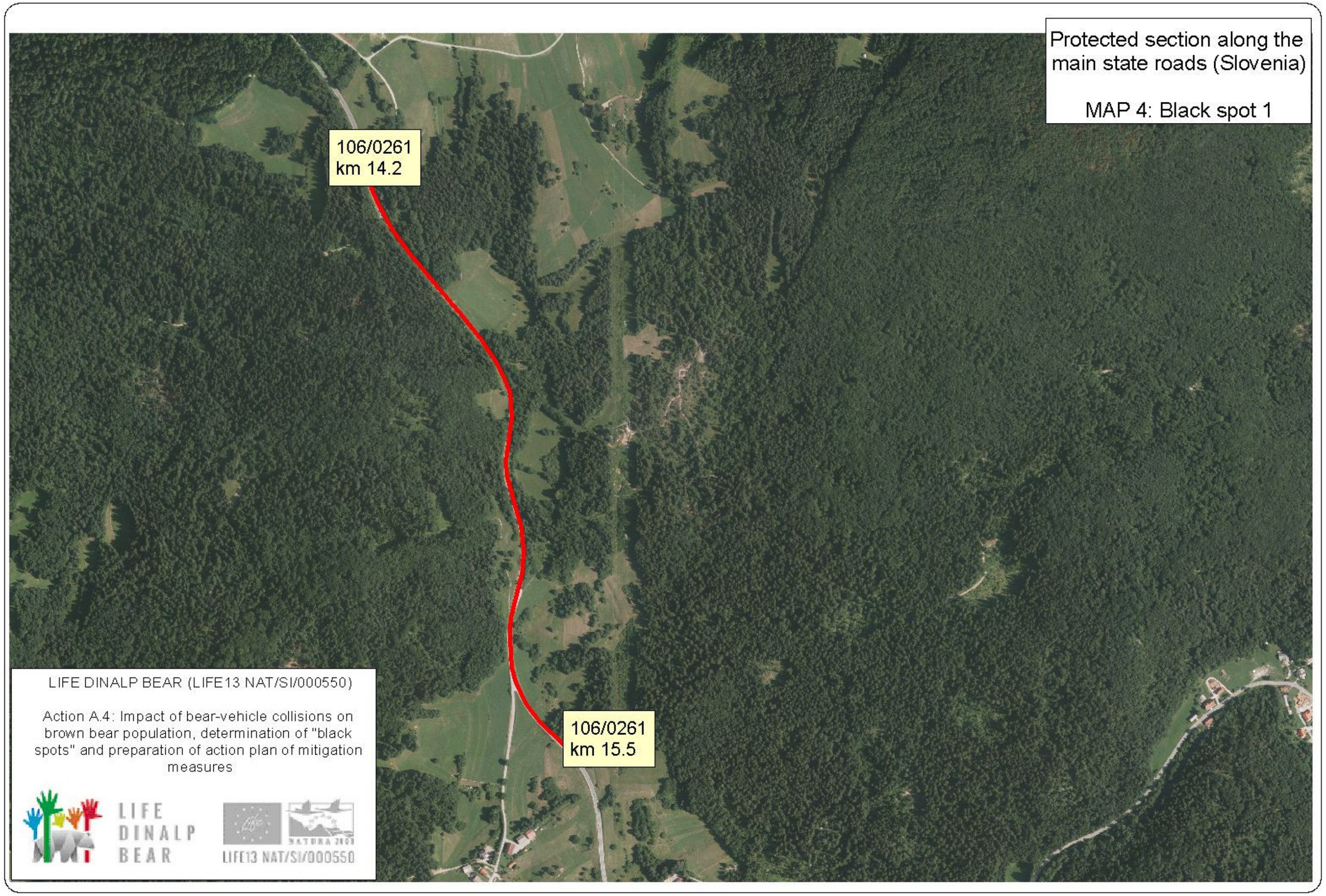

Figure 24: Fourth road section along the main road Ljubljana-Kočevje.

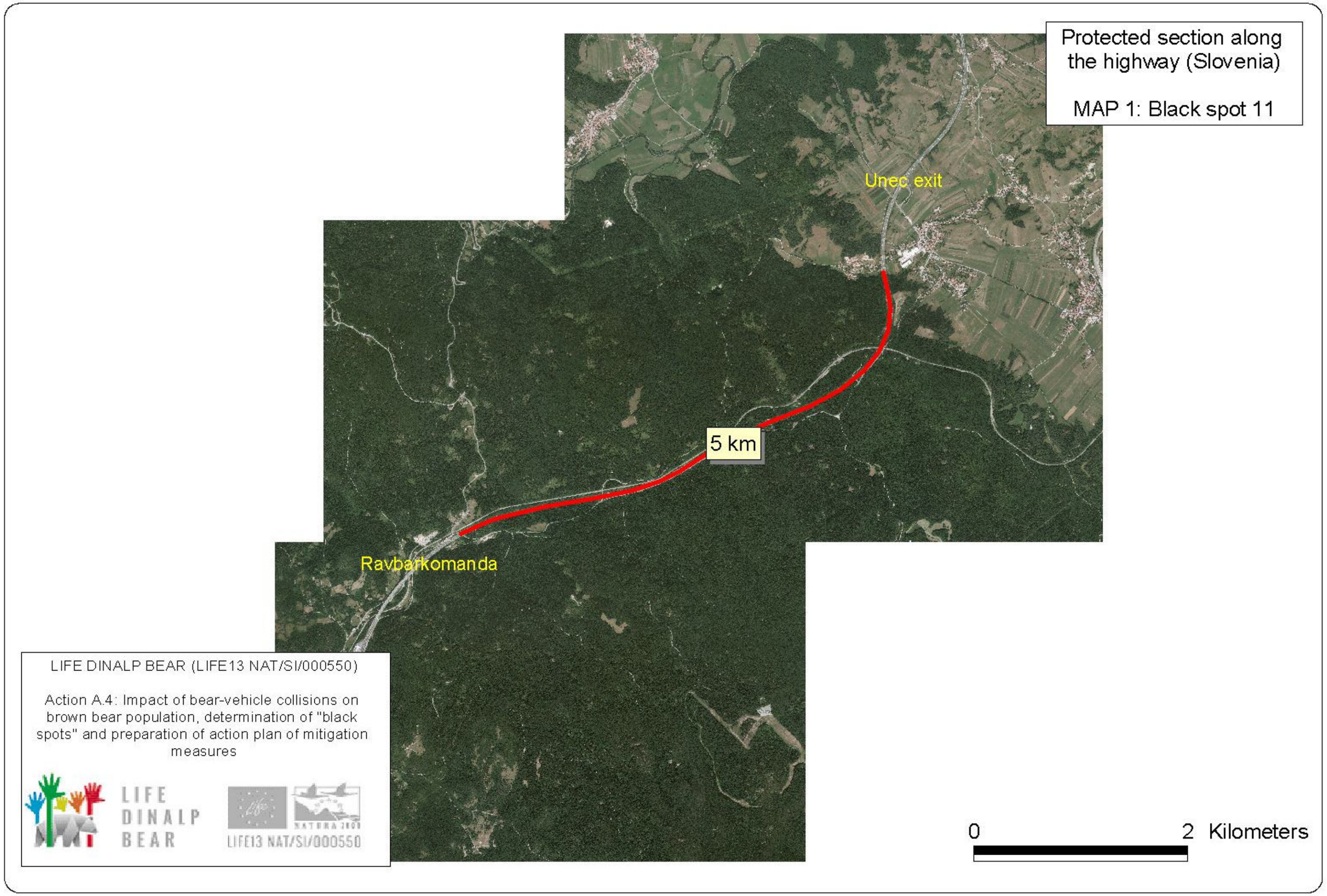

Figure 25: First selected section of the highway Ljubljana-Postojna, which will be protected by electric fence.

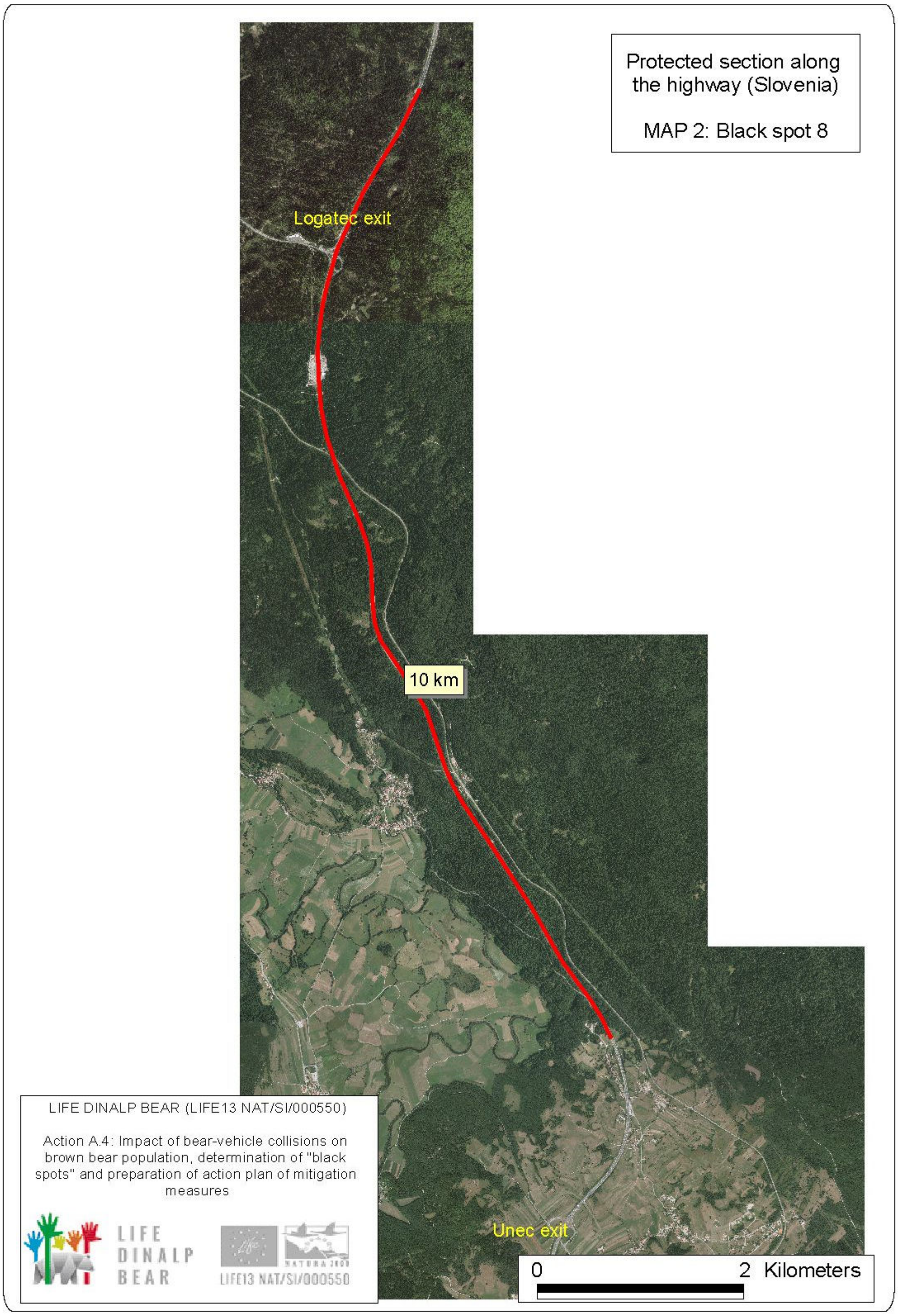

Figure 26: *Second selected section of the highway Ljubljana-Postojna, which will be protected by electric fence.*

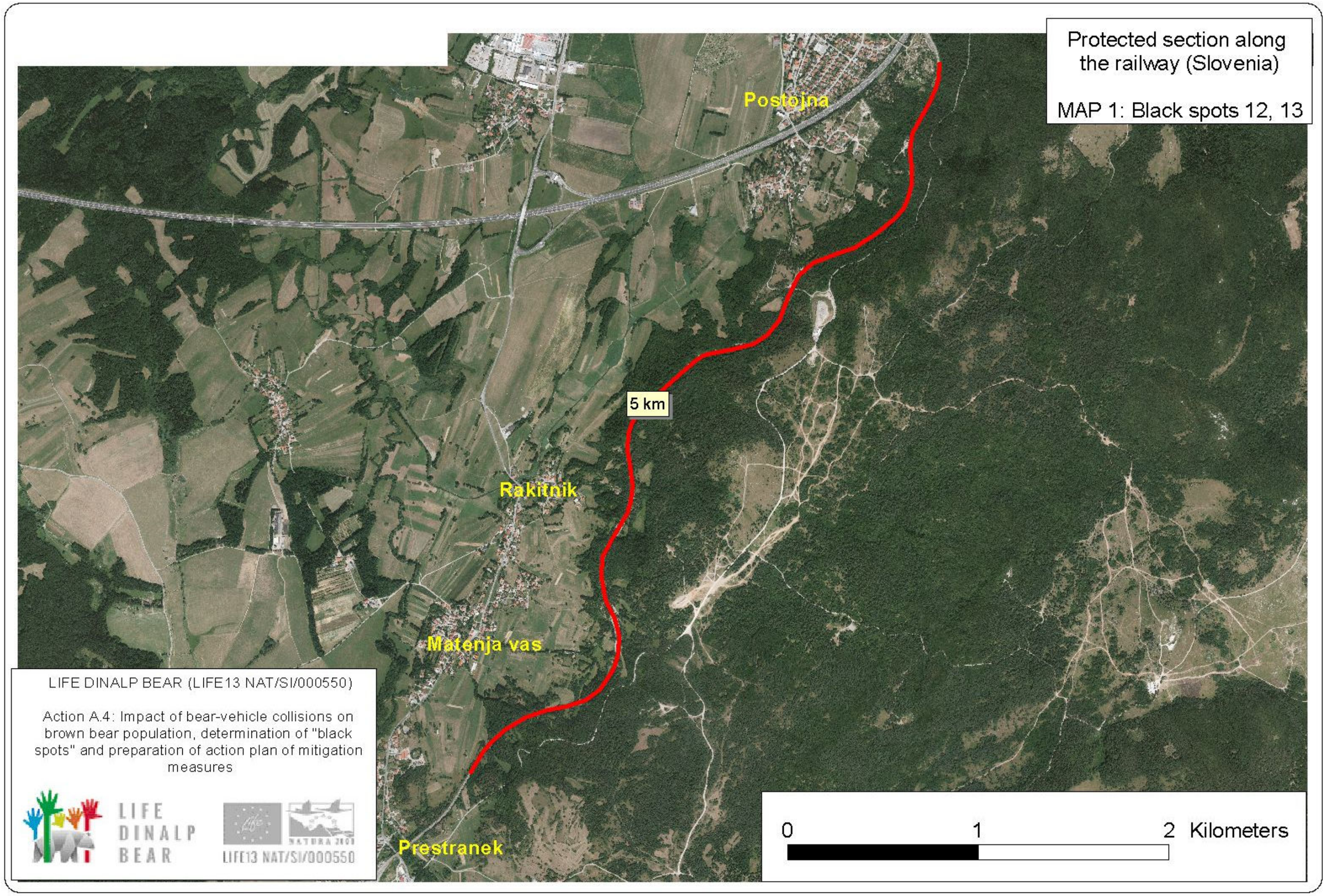

Figure 27: Selected section of the railway Postojna-Pivka, which will be protected by acoustic deterrents.

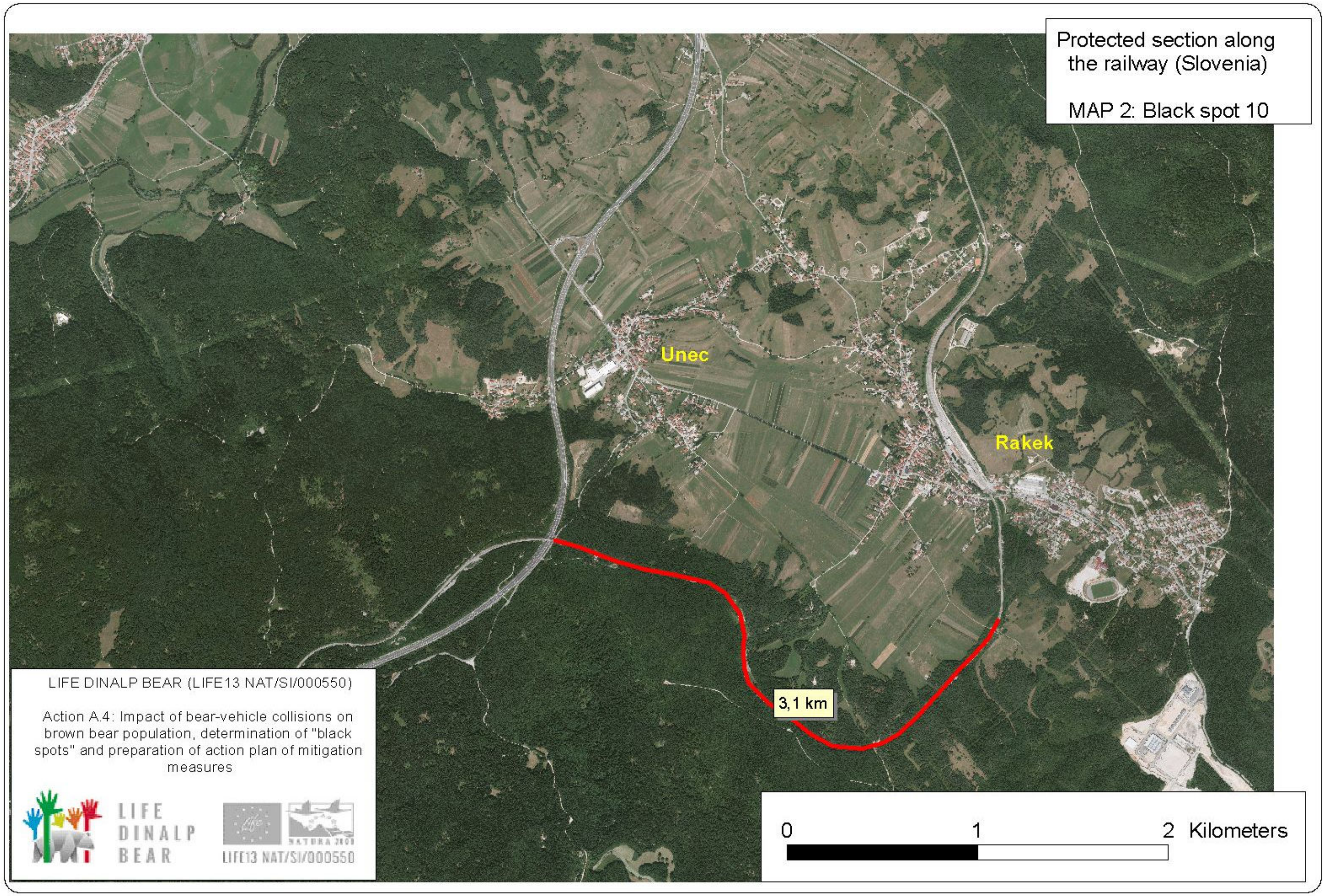

Figure 28: Selected section of the railway Ljubljana-Postojna, which will be protected by acoustic deterrents.

3.3 TIME SCHEDULE

The main activities within the Action plan for the implementation of the mitigation (technical) measures, the responsible organisations, stakeholders and the deadlines are presented in Table 3.

Table 3: Description of activities related to the Action plan for the implementation of mitigation measures for decreasing traffic-related mortality of brown bear in Slovenia.

Activities	Responsible organization	Other stakeholders involved	Deadline
Preparation activities: Determination of black spots of bear-vehicle collisions	UN	ZGS*	31.3.2015 (DONE ✔)
Preparation activities: Selection of the most problematic road, highway and railway sections for implementing mitigation measures in Slovenia	ERICo	/	30.6.2015 (DONE ✔)
Implementation of technical measures (acoustic deterrents + dynamic signs) on state road	ERICo	DRSI**	31.3.2016
Implementation of technical measures; (electric fence) on highways	ERICo	DARS***	31.3.2016
Implementation of technical measures (acoustic deterrents) on railways	ERICo	DRSI, SŽ****	30.9.2015
Monitoring of the effectiveness of mitigation measures	ERICo	/	30.6.2019

Note:
*: ZGS – Slovenia Forest Service as the main source of information on bear mortality.
**: DRSI – the Slovenian Infrastructure Agency.
**: DARS – Motorway Company in the Republic of Slovenia.
***: SŽ: – Slovenian Railway.

The most important stakeholders (besides responsible partners – institute ERICo and University of Ljubljana (UN)) are as follows: the Slovenian Infrastructure Agency (DRSI), Motorway Company in the Republic of Slovenia (DARS), Slovenian Railway (SŽ) and Slovenia Forest Service (ZGS). These institutions (with the exception of ZGS, the main source on the information on the exact locations of brown bear mortality cases) are the operators of the traffic infrastructure in Slovenia and important users of the implemented mitigation measures. Since the main expected result of the implementation of these measures is decrease of traffic-caused bear mortality, the following outcomes which are important for stakeholders as well as for broader society are foreseen: (i) higher road-safety; (ii) decrease of economic costs such as lower material damage (damage to vehicles), lower costs related to health issues (i.e. medical treatment of injured persons), and lower technical costs (e.g. due to removal of carcasses and traffic delay); (iii) increase of animal welfare due to reducing of collisions with brown bear (and other large wildlife species); (iv) higher viability of brown bear population due to lower mortality, enabling also increase in dispersal of the species.

More detailed plan of activities for reducing traffic-caused mortality is presented in Tables 4-6.

Table 4: Time schedule for implementation and monitoring of the technical measures for reducing traffic-caused brown bear mortality in Slovenia in 2015 and 2016.

	2015												**2016**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
PREPARATION ACTIVITIES / COORDINATION																								
Review of traffic related bear mortality																								
Determination of black spots		■	■																					
Determination of protected section				■																				
Coordination with Ministry of infrastructure					■	■																		
Meetings with Slovenian railways											■												■	
IMPLEMENTATION OF TECHNICAL MITIGATION MEASURES																								
The main road Ljubljana-Kočevje																								
Field inspection of selected sections						■	■																	
Selection of micro location for dynamic signs							■																	
Public tender for dynamic signs							■	■																
Implementation of dynamics signs									■															
Market enquiry for acoustic deterrents												■	■											
Implementation of acoustic deterrents															■	■								
Maintains of protected sections																					■			
The railway Postojna-Pivka and Ljubljana-Postojna																								
Field inspection of selected sections						■	■																	
Market enquiry for acoustic deterrents								■																
Implementation of acoustic deterrents									■															
Maintains of protected sections																					■			
The highway Ljubljana-Postojna																								
Field inspection of selected sections						■	■																	
Market enquiry for electric fence														■										
Implementation of electric fence															■									
MONITORING OF THE EFFECTIVENESS OF MITIGATION MEASURES																								
Video surveillance								■									■							
Reports												■												■
MILESTONES				■					■			■				■					■			■

Table 5: Time schedule for implementation and monitoring of the technical measures for reducing traffic-caused brown bear mortality in Slovenia in 2017 and 2018.

	2017												2018											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
PREPARATION ACTIVITIES / COORDINATION																								
Meetings with Slovenian railways																								
Meetings with local community, hunters																								
IMPLEMENTATION OF TECHNICAL MITIGATION MEASURES																								
The main road Ljubljana-Kočevje																								
Maintains of protected sections																								
The railway Postojna-Pivka and Ljubljana-Postojna																								
Maintains of protected sections																								
MONITORING OF THE EFFECTIVENESS OF MITIGATION MEASURES																								
Video surveillance																								
Reports																								
MILESTONES																								

Table 6: Time schedule for implementation and monitoring of the technical measures for reducing traffic-caused brown bear mortality in Slovenia in 2019.

	2019											
	1	2	3	4	5	6	7	8	9	10	11	12
PREPARATION ACTIVITIES / COORDINATION												
Meetings with local community, hunters												
IMPLEMENTATION OF TECHNICAL MITIGATION MEASURES												
Maintains of protected sections main road Ljubljana-Kočevje												
Maintains of protected sections railway Postojna – Pivka Ljubljana - Postojna												
MONITORING OF THE EFFECTIVENESS OF MITIGATION MEASURES												
Video surveillance												
Reports												
Pictures and film material for the web site and brochures												
MILESTONES												

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