



ENVEROS

ENVIRONMENTAL EDUCATION THROUGH  
ROADKILL OBSERVATION SYSTEMS

Wildlife-vehicle collisions:

## CAUSES & SOLUTIONS

## EnVeROS info

The project is being carried out by four partners from three European countries

### Website

[www.enveros.eu](http://www.enveros.eu)

### Locations

Cyprus  
Bolzano, Italy  
Czech Republic

### Duration

24 months  
(1.10.2018 – 30.9.2020)

### Objectives

Raise awareness on wildlife-vehicle collisions (WVC)  
Support WVC learning in formal and non formal education  
Mobilize social and environmental groups  
Create WVC database for citizen-science data

### Partners / Budget

Open University of Cyprus	55,857	CDV – Transport Research Centre	34,178	<b>TOTAL</b>
Eurac Research	37,197	Terra Cypria	38,463	<b>165,695 €</b>

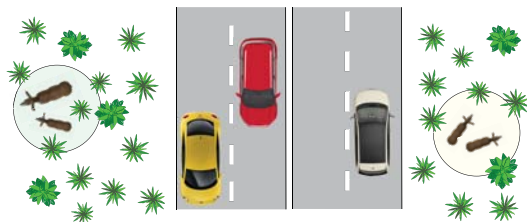




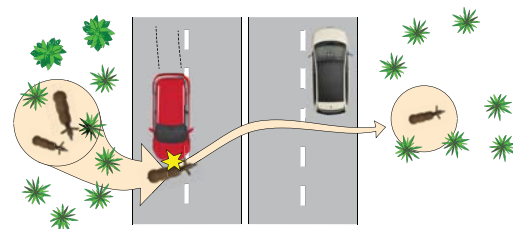
## Animal-human conflict on roads

High traffic volumes on roads deter animals from crossing. Roads, when fenced, have even more significant effect on population connectivity. Certain species can be endangered due to low gene exchange among the separated populations.

### Road traffic separates population



Certain populations living close to roads can be endangered by high roadkill rates. Some species do not perceive traffic and individual cars as a danger. Significant reduction of the population size can therefore be a result in such cases.



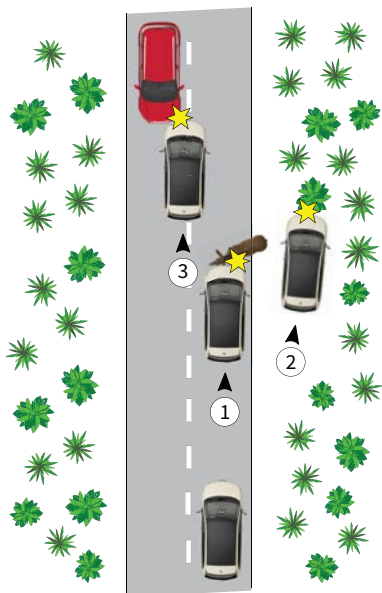
Roadkill reduces population size

## Wildlife-vehicle conflict in Europe

Thousands of wildlife animals are killed every day on European roads. This issue is widespread and will be more intensive in the near future as both road network construction and traffic are increasing. Wildlife-vehicle crashes also pose a traffic safety issue. People can be killed or severely injured when cars collide with large mammals (1). Cars are often driven off roads when drivers are trying to avoid collisions. Crashes with trees rank among the collisions with the most severe outcomes (2). Avoiding a collision with an animal can also result in a head-on crash with an oncoming vehicle with serious consequences (3).

**5%** of WVC with injured people

**thousands** of animals killed on roads every day



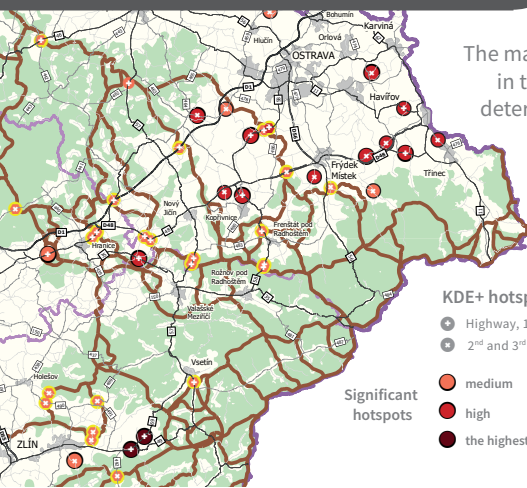


## When and where do WVC occur?

WVC distribution on an average day reflects animal activity. The higher the frequency of road crossings, the higher the chance for WVC.

Time of day occurrence:  
around *sunrise and sunset*

WVC are concentrated in *hotspots*



The map depicts the WVC hotspots in the NE of the Czech Republic determined by the KDE+ method.

[www.kdeplus.cz](http://www.kdeplus.cz)

**KDE+**

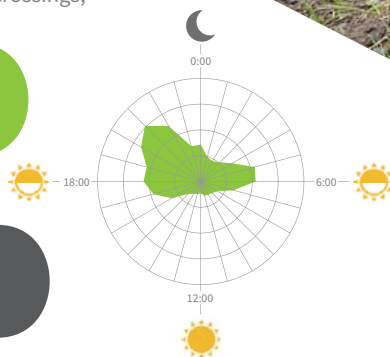
### KDE+ hotspots

- Highway, 1<sup>st</sup> road class
- 2<sup>nd</sup> and 3<sup>rd</sup> road class

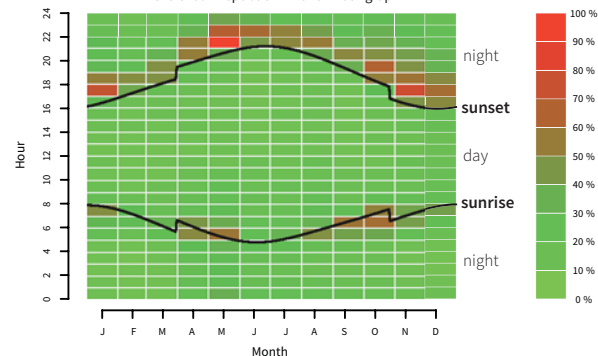
Significant hotspots

- medium
- high
- the highest

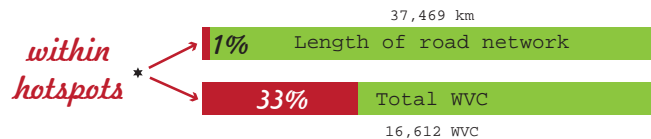
- Hotspot at intersections between the green and transport infrastructure



Temporal distribution of wildlife-vehicle collisions in the Czech Republic in month-hour graph



WVC concentrate at certain places called hotspots. Hotspots are relatively short parts of a road network where a high proportion of WVC take place. Clustering methods, such as KDE+, are being used to determine the hotspots.

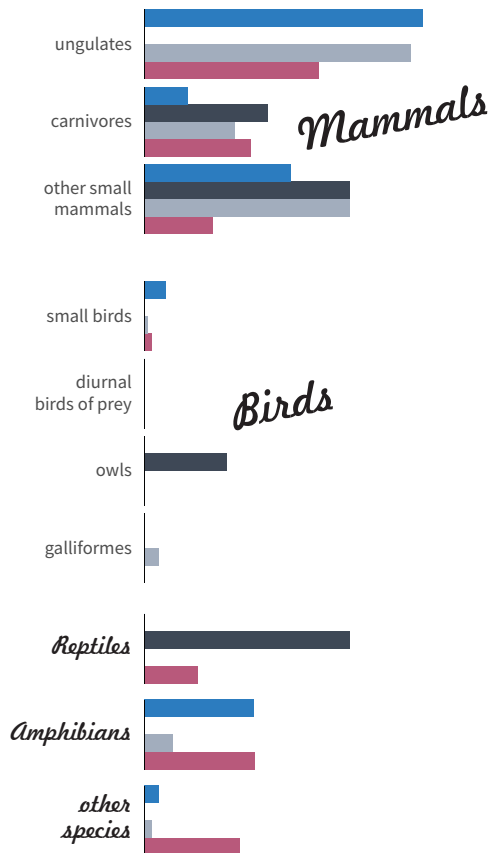


★ Bil, M., Andrášik, R., Svoboda, T., Sedonik, J., 2016. The KDE+ software: a tool for effective identification and ranking of animal-vehicle collision hotspots along networks. Landscape Ecology 31, 231–237.

## Species the most involved in WVC

Questionnaire survey during  
EnVerOS among experts in:

■ Bolzano (14)
 ■ Czechia (57)
 ■ Cyprus (5)
 ■ Europe (27)



The overall number of animals killed on roads is not known. Only estimation, which vary significantly among species, exist. Numbers related to large mammals and game animals in particular are usually available and the underreporting is thus low. Despite this fact, the **under-reporting** of these species can be between 20 – 50%. Ungulates are the most commonly involved species in WVC across Europe. Crashes with **roe deer** and **wild boar** dominate throughout Europe. The situation with small animals is even worse. Only rough estimations exist of how many small mammals, amphibians, reptiles or birds are killed.

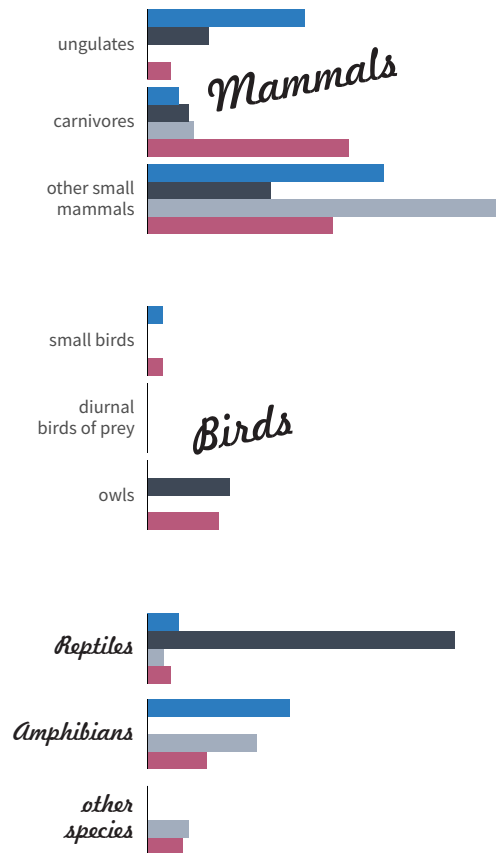




## Species endangered due to roadkill

Questionnaire survey during  
EnVerOS among experts in:

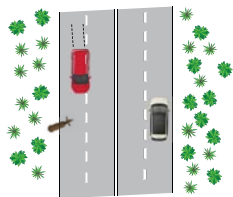
■ Bolzano (14)    ■ Czechia (57)  
■ Cyprus (5)    ■ Europe (27)



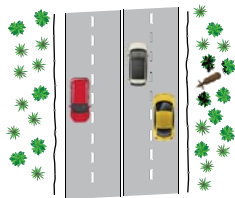
Species which occur in low numbers are particularly endangered by additional loss due to roadkill. Certain carnivores, such as **European lynx**, are among the species endangered by roadkill in some European countries. The same is true for the **Eurasian otter**. **Hedgehogs** are killed frequently on urban roads. Their specific behavior when in danger makes them particularly vulnerable. **Barn owls** rank among the most endangered birds due to roadkill.



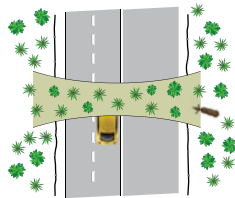
## Mitigation of WVC on primary roads



Primary roads are important veins of modern society. Maintaining uninterrupted traffic flow is therefore crucial. WVC present a threat to smooth traffic.



Fences are highly effective measures in reducing WVC. Movement of large mammals across roads is blocked.



The landscape should be permeable for large mammals. Fences effectively block their movement, however. They should therefore be accompanied by over- and underpasses.







## Mitigation of WVC on secondary roads



© Molly Grace

### Warning to drivers



© CDV

Research suggests that the most effective measures, for lowering the number of WVC on secondary roads, are related to car speed management. The lower the car speed, the better the reaction time and, if a crash takes place, the lower the crash energy. Dynamic warning signs are being tested around the world.

Wild animals, specifically ungulates, are informed about possible danger from incoming vehicles by roadside reflectors. These measures reflect light from motor vehicles to the road side. Experiments with the reflectors' color and design were conducted recently, but scientific evidence about their effectiveness in prevention of WVC is rather weak.



© Michael Migos

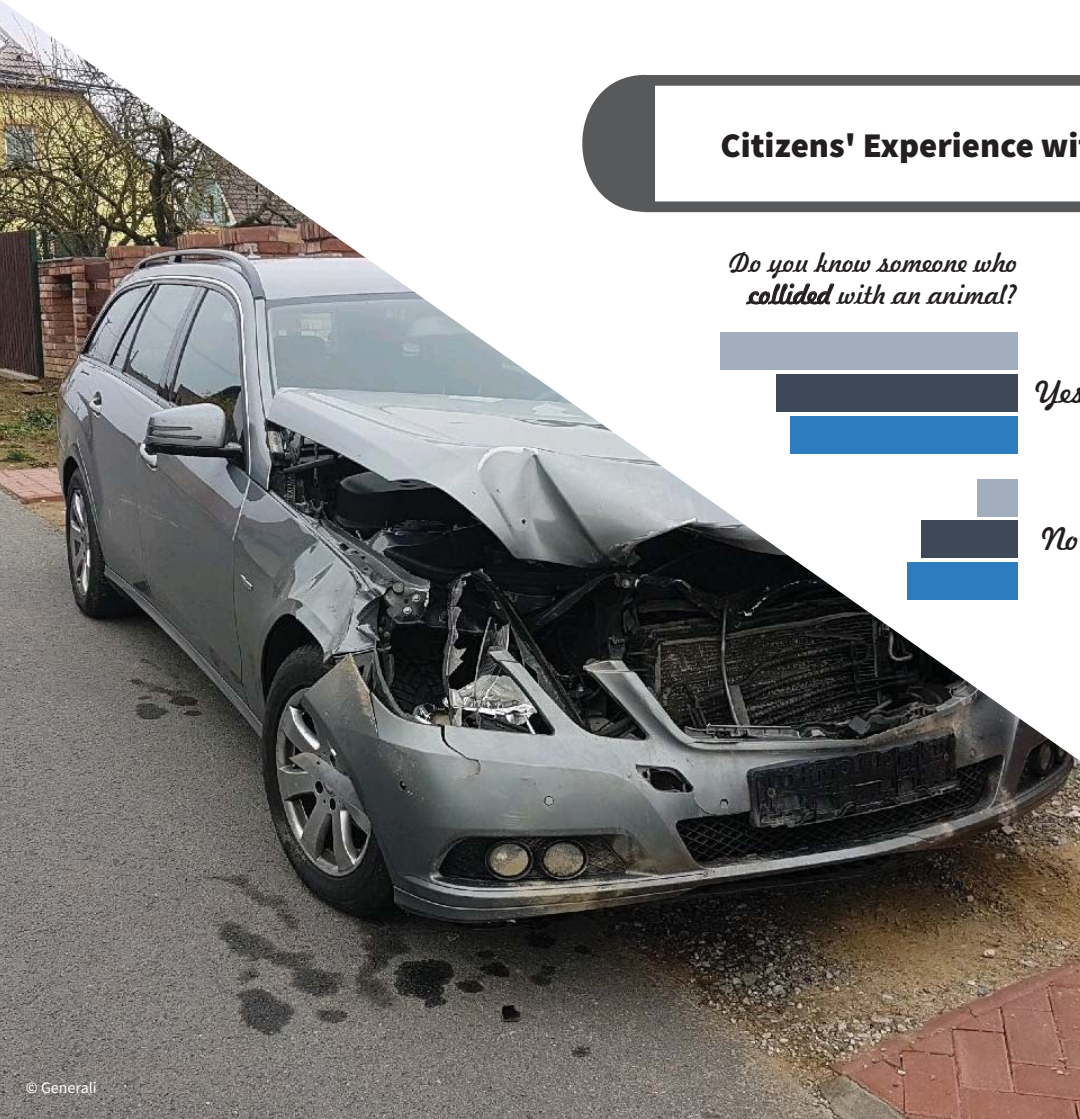
### Warning to animals

Static warning signs should inform drivers about WVC risk at places where WVC have often been recorded. These warning signs were found to be, however, less effective in WVC prevention than the dynamic ones.

Olfactory repellents, i.e., foam containing various odors, are also sometimes placed along secondary roads. Research results related to their effectiveness in prevention of WVC are ambiguous.



© ČTK



## Citizens' Experience with WVC

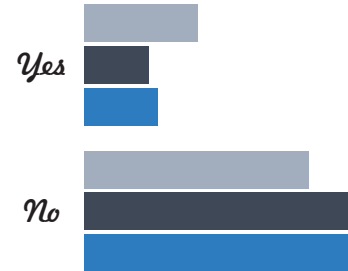
Questionnaire  
survey among  
citizens in:

Czechia (167)
Cyprus (218)
Bolzano (123)

*Do you know someone who  
collided with an animal?*



*Have you ever had  
an accident with a wild animal?*



*Yes*

*No*

*Do you know  
what to do?*

In the majority of European countries,  
calling the police is the only recommended  
step when a driver kills an animal on the road.





## Situation in the Czech Republic

The Czech road network ranks among the densest in the world. Recently, land use change and intensive agriculture have favored the increase in the ungulate population. These facts, together with a lack of fences along the majority of primary roads, have resulted in the increase of WVC numbers.

Registered WVC  
2012 – 2018: **65,355**

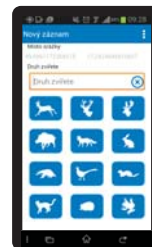
Involved (registered)  
mammal species:

<b>60%</b>		<b>3%</b>	
<b>11%</b>		<b>3%</b>	



external sources

Mobile application



hunters, foresters,  
environmentalists,  
drivers, general public

DATA  
IMPORT



WEB MAP  
Visualisation of  
WVC & HOTSPOTS



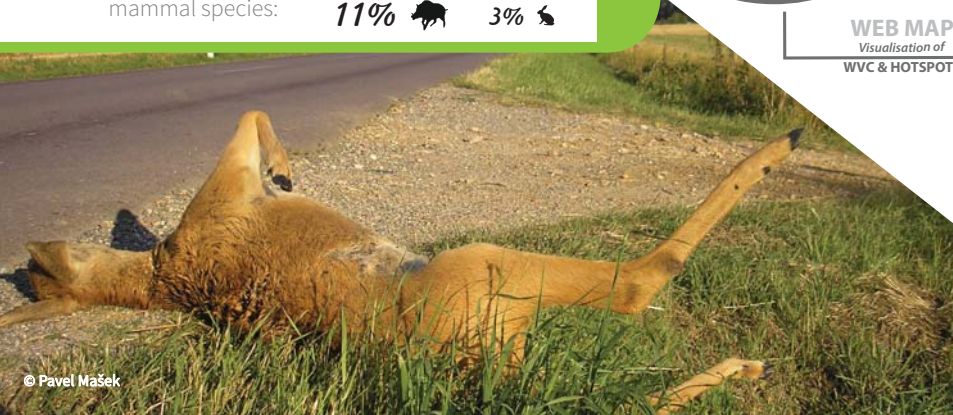
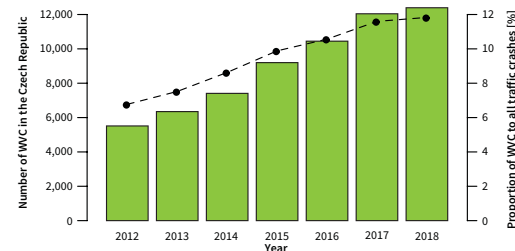
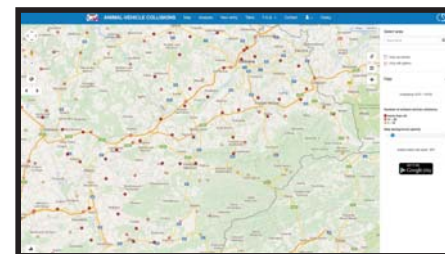
[www.srazenazver.cz](http://www.srazenazver.cz)

Srazenazver.cz is a state-wide database where all available information on both WVC and carcasses is stored. This system is freely open to anyone.

Online traffic information data



112 – Police, Fire Brigade, Ambulance  
Road administrators, Public administrators



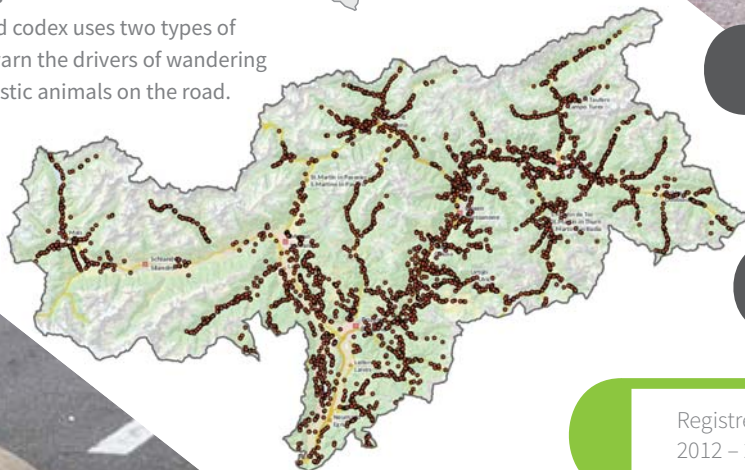
## Situation in the Autonomous Province of Bolzano – Alto Adige (Northern Italy)

- Most northern province of Italy
- Surface area: 7,398.38 km<sup>2</sup>
- 64.4% of the territory located higher than 1,500 m a.s.l.
- High variety of ecosystems from 207 m to 3,905 m a.s.l.



### Warning signs

The Italian road codex uses two types of road signs to warn the drivers of wandering wild and domestic animals on the road.



Public accessible roads: **5,076 km**

Road density: **0.69 km/km<sup>2</sup>**

Average daily traffic: **623,545 vehicles**

Registered WVC 2012 – 2018: **5,987**

Involved (registered) species:

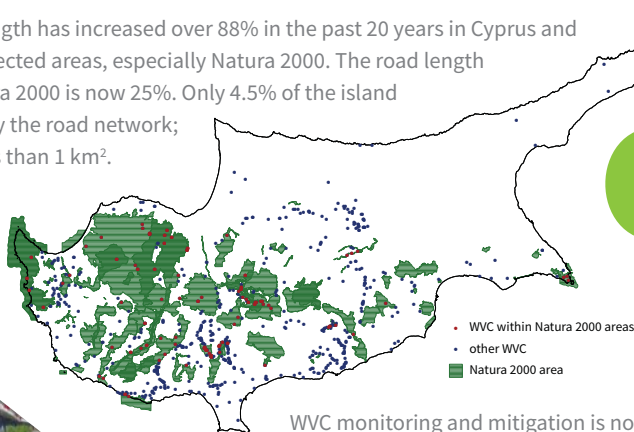
**87%**   
**12%** 

**1%**  
*chamois, badger ...*



## Situation in Cyprus

The road network length has increased over 88% in the past 20 years in Cyprus and intersects many protected areas, especially Natura 2000. The road length situated within Natura 2000 is now 25%. Only 4.5% of the island area is not covered by the road network; that is patches of less than 1 km<sup>2</sup>.



Involved species

(~1,500 records from the Public Works Department since 2013):

mainly domestic

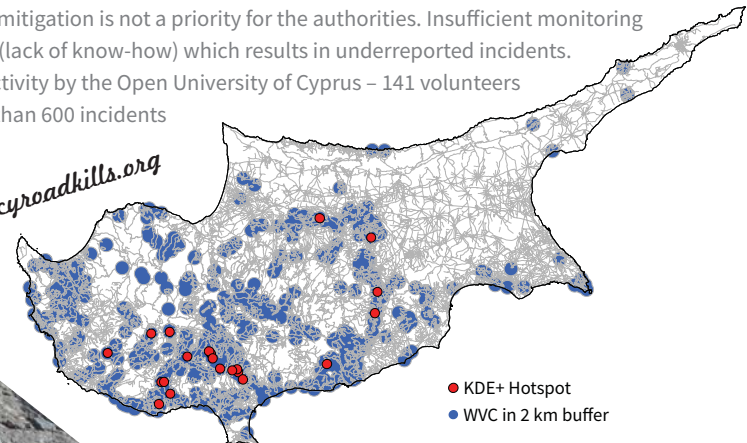
*cats, dogs and foxes*

*13% of Cyprus mouflon*

mortality attributed to WVC

WVC monitoring and mitigation is not a priority for the authorities. Insufficient monitoring and handling of WVC (lack of know-how) which results in underreported incidents. As of 2017, parallel activity by the Open University of Cyprus – 141 volunteers have recorded more than 600 incidents all over Cyprus.

[www.cyroadkills.org](http://www.cyroadkills.org)





We would like to thank the authors of the photographs for sharing.  
This booklet was created and designed by CDV – Transport Research Centre.



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