Conference Volume	6th Symposium for Research in Protected Areas 2 to 3 November 2017, Salzburg	pages 145 - 149

Combined use of KDE+ software and empirical observation to identify animal-vehicle collisions' hotspots in South Tirol, Northern Italy

Filippo Favilli, Michal Bíl, Jiri Sedoník, Richard Andrášik, Peter Kasal, Andreas Agreiter, Lena Schober, Philip Sicher, Lothar Gerstgrasser, Thomas Streifeneder

Abstract

Animal-vehicle collisions (AVC) with red and roe deer in South Tirol, norther Italy, count some 700 cases per year, with several socioeconomic and ecological implications. For an effective and timesaving identification of AVC hotspots, we have applied a combined methodology of empirical observation of wildlife in the proximity of the road network and statistical analysis on AVC data. The integration of the results coming from different methodologies allowed for a better objective selection of significant clusters and for the risk ranking of the hotspots according to their significance and collective risks.

Keywords

Kernel density estimation, Animal-vehicle collisions, Hotspots, Bolzano, South Tirol, Italy

Introduction

Animal-vehicle collision (AVC) is a serious environmental, socioeconomic, healthy and traffic issue all over the World. Roads can affect wildlife in numerous different ways, both direct and indirectly. Habitat loss, degradation and fragmentation (EWERS et al. 2006), as well as animal mortality (ROGER et al. 2007) are acknowledged as direct effects for the reduction of permeability (BISSONETTE & ADAIR 2007). South Tirol is an Italian Province located at the northeastern corner of central-eastern Alps. Due to the high level of anthropic presence and to the size of deer population, AVC are around 700 cases per year, on all the main local, provincial and national roads.

Research Questions

How is it possible to better identify the most dangerous hotspots of AVC?
What information can be gained from AVC in order to improve local ecological connectivity?
How can we stimulate a common approach on the topic by protected areas, hunter guards, local administration and research?

Session: The different dimensions of ecological connectivity

The Province Administration is currently engaged in a detailed study on the provincial ecological network and on the effects of local roads on it. In order to identify the resolution strategies for AVC, it is fundamental to carry on an objective identification of locations on transportation networks, where AVC occur more frequently than expected (hotspots). This approach needs the cooperation of different local actors, who provide their expertise and knowledge on wildlife presence, dispersal, ecological needs and reaction to roads.

We applied the KDE+ (BÍL et al. 2013, 2016) method to AVC data, collected by the Hunters' Association of South Tirol in the entire South Tirolean road network, in order to identify AVC clusters and hotspots. Local hunters, hunting guards and wildlife managers on behalf of the Autonomous Province of South Tirol (TORNAMBÉ & HALILAJ 2015), have joined the KDE+ hotspots' results with the empirical ecological corridors identification and wildlife movements.

Methods

Study Area

South Tirol is an Italian Province located in central-eastern Alps, close to the Austrian Border (Fig. 1). The Provincial Road Network has an extension of 5016 km, which correspond to 677,8km/1000km2 (ASTAT 2012). This province shows a high presence of ungulates. Each year around 8000 roe deer and 3000 red deer are hunted in the Provincial territory (PROVINCE OF BOLZANO 2015).

Figure 1: Location of South Tirol (northern Italy)

Ecological corridors in South Tirol

Already in 2000, Gufler prepared a map of gene-flow potential and main barriers to wildlife in South Tyrol (see TORNAMBÉ & HALILAJ 2015). This was followed in 2013 by an analysis of the permeability of the South Tyrolean landscape to wildlife, in particular red deer and roe deer, based on wildlife collision statistics for these species (EISENSTECKEN 2013). In early 2016, the Department for Nature, Landscape and Spatial Development, Landscape Ecology office of the Autonomous Province of Bolzano presented a new study on ecological corridors in South Tyrol (TORNAMBÉ & HALILAJ 2015). The study comprises numerous examples of ecological corridors in South Tyrol from direct observation of wildlife behaviour and movement in proximity of the road network by hunting guards and wildlife managers.

The KDE+ Method

The KDE+ method allows for the objective selection of significant clusters and for the ranking of the hotspots. The idea behind the application of a clustering method is the existence of two fundamental causes of traffic crashes (ANDRÁŠIK & BÍL 2015; BÍL et al.. 2013 and 2016): local factors that influence the crash occurrence at a given location and global factors that influence traffic crash occurrence on regional scale.

Results

The KDE+ application to the South Tirol road network

KDE+ analysed 2368 AVC crashes, 49.5% (1092) of which were detected in 343 clusters. These clusters comprise only 0.86% of road network length. Ratio of crashes with red deer in clusters is only 35%, which comprised 0.10% of network length.

Overlapping empirical detected corridors with AVC clusters – a case study

According to their collective risks, the highest risk of AVC with Red and Roe deer is in the same locations identified by local hunting guards, hunters and wildlife managers as ecological corridors (TORNAMBÉ AND HALILAJ 2015). Figure 2 focuses on the clusters 69 and 116, located, respectively, in Ultimo Valley, and on the motorway Merano-Bolzano (MeBo), inside of the identified corridors, in the Adige Valley. The Adige valley, a densely populated and intensively used valley by irrigated agriculture, hosting a motorway, several provincial and local roads and a railway, has already been addressed as one of the greatest barriers for wildlife dispersal (Kohler et al. 2008; Peters et al. 2015).

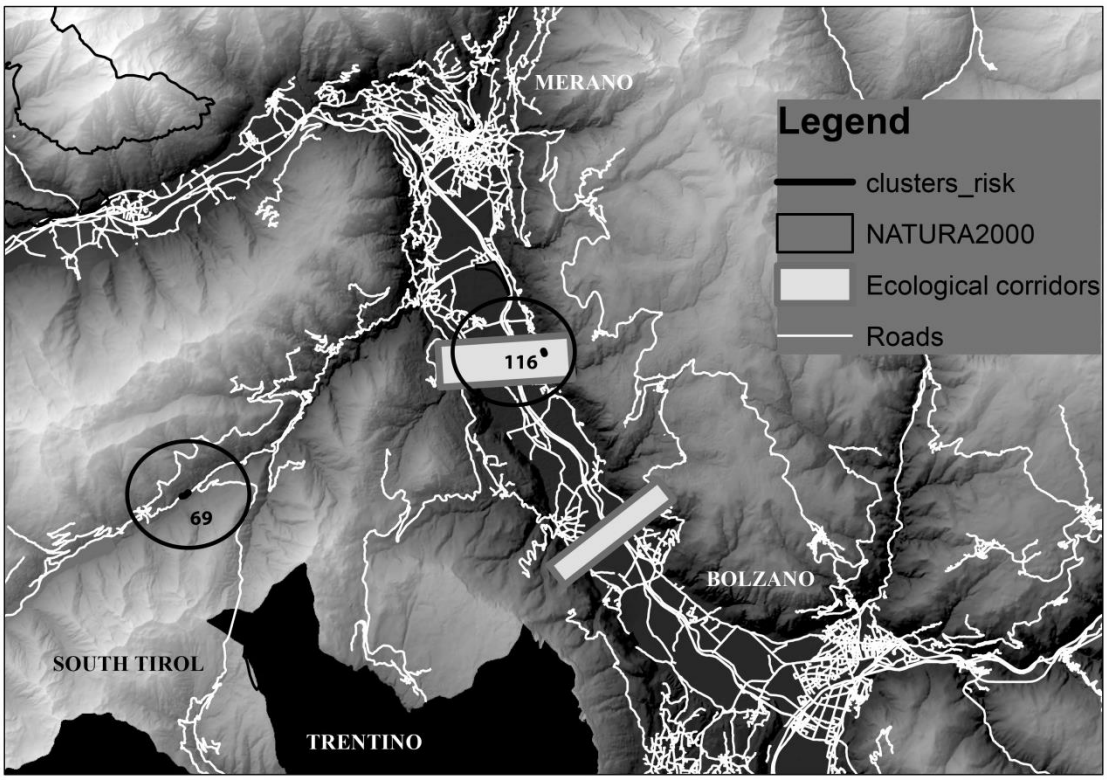

Figure 2: The two clusters with the highest collective risk in South Tirol

The Ultimo Valley is one of the most remote valleys of South Tirol; it belongs to the Merano hunting district and shows one of the highest concentrations of Red Deer populations (Fig. 3).

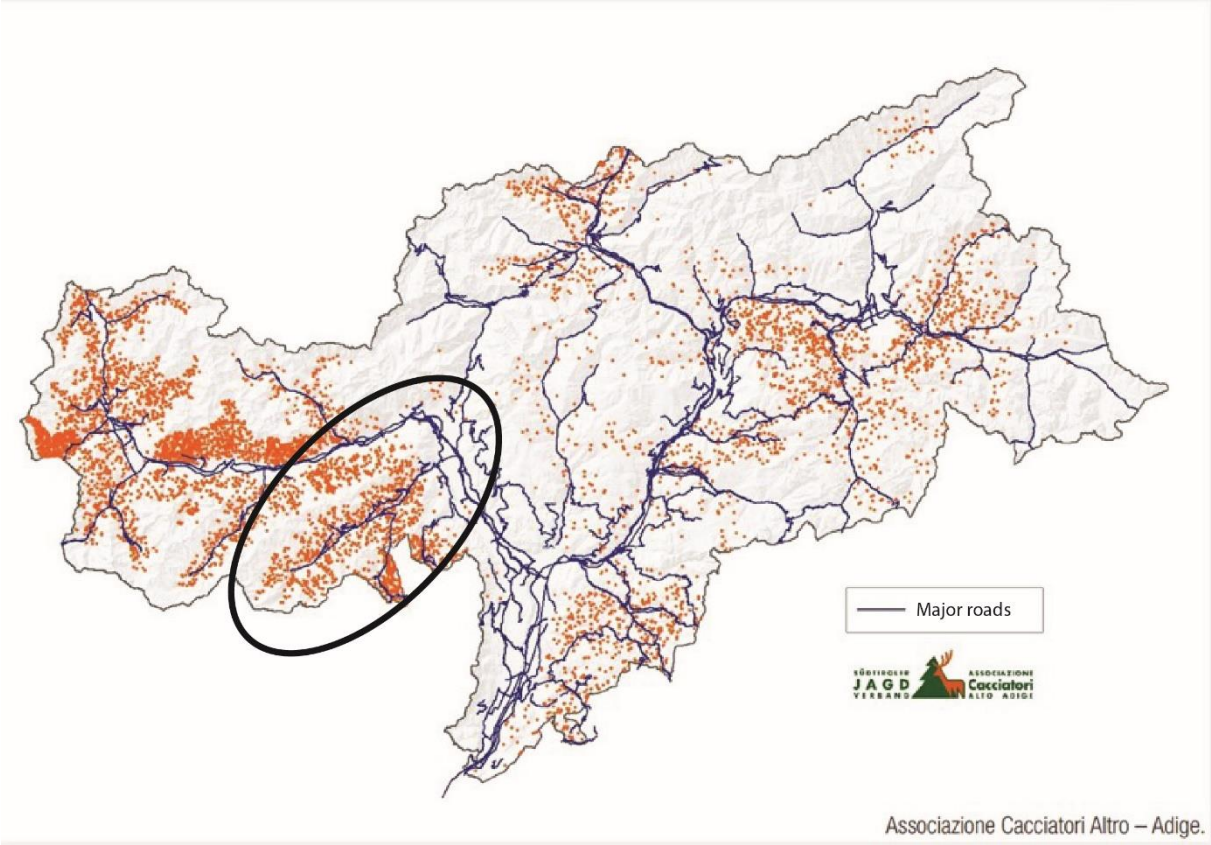

Figure 3: Location of the Ultimo Valley, with presence data from Red Deer census of 2013 (modified from http://www.provincia.bz.it/foreste/fauna-caccia/caccia-alto-adige.asp).

Discussion

We analysed traffic crashes with roe and red deer in the South Tirol Province in the period 2012 – 2014, using an integrative approach of KDE+ analysis and direct observation. The amount of crashes, their temporal and spatial patterns appear to be caused by an interaction of factors related to the drivers' behaviour, the animals' activities and the characteristic of the sites. In the top collective risk hotspots, local factors can be referred to the familiarization of drivers to the local roads, to the traffic flow, which has been attested between 28.000 and 37.000 vehicles/d on the MeBo (ASTAT 2016), and to landscape and ecological factors. Ecological factors are due to intensive activities (moving) due to feeding, dispersal movements of sub adult bucks, as well as establishing of territories of adult bucks. This approach enabled the identification of the most risky places of AVC, which is an important knowledge for all the local actors dealing with wildlife, ecological connectivity and road administrations. Effective mitigation of hotspots can save lives of both drivers and animals (BÍL ET AL., 2016).

Final Consideration and recommendations

Further studies will be required to distinguish between the contributions of different factors, without limiting primarily to animal-related factors, such as population and dispersal, but accounting for site characteristics, drivers' behaviour, traffic intensity and people's awareness. The present work wish to contribute to the reduction of human-wildlife conflicts in South Tirol due to road infrastructures, aiming at the continuation and deepening of the research on mitigation and prevention systems for AVC, currently on going in the provincial territory. The paper wants to highlight part of the interferences occurring between humans and mobile wildlife species in a mountainous and highly anthropic environment like South Tirol, in order to improve humans' and wildlife's safety and the general human-wildlife coexistence.

References

ANDRÁŠIK R, BÍL M (2015) Traffic accidents: Random or pattern occurrence? Safety and Reliability of Complex Engineered Systems. Podofiliny et al. (Eds.), ISBN 978-1-138-02879-1

ASTAT (2012). Mobilità e traffico in Alto Adige – 2011. http://astat.provincia.bz.it/it/mobilita-turismo.asp. Accessed 30 March 2017.

ASTAT (2016) Annuario statistico 2016. http://astat.provincia.bz.it/downloads/JB2016_K18(1).pdf. Accessed 21 April 2017.

BÍL M, ANDRÁŠIK R, JANOŠKA Z (2013). Identification of hazardous road locations of traffic accidents by means of kernel density estimation and cluster significance evaluation. Accident Anal. Prev. 55: 265 – 273

BÍL M, ANDRASIK 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.

BISSONETTE JA, ADAIR W (2007) Restoring Habitat Permeability to Roaded Landscapes with Isometrically-Scaled Wildlife Crossings. Biological Conservation 141: 482-488. http://dx.doi.org/10.1016/j.biocon.2007.10.019

EISENSTECKEN K (2013) Wie durchlässig ist Südtirol für wandernde Wildtiere? Diplomarbeit / Masterarbeit - Institut für Wildbiologie und Jagdwirtschaft (IWJ). (University of Natural Resources and Life Sciences, 2013).

EWERS RM, KLISKEY AD, WALKER S, RUTLEDGE D, HARDING JS, DIDHAM RK (2006) Past and Future Trajectories of Forest Loss in New Zealand. Biological Conservation, 133: 312-325. doi: http://dx.doi.org/10.1016/j.biocon.2006.06.018

KOHLER Y, PLASSMANN G, ULLRICH A, GÖTZ A, SCHEURER T, HÖLSCHER S, SAVOIA S (2008) The Continuum Project. Mountain Research and Development 28:, 168-172. Doi: http://dx.doi.org/10.1659/mrd.1010. Accessed 12th April 2017.

PETERS, W., HEBBLEWHITE, M., CAVEDON, M., PEDROTTI, L., MUSTONI, A., ZIBORDI, F., GROFF, C., ZANIN, M., CAGNACCI, F. 2015. Resource selection and connectivity reveal conservation challenges for reintroduced brown bears in the Italian Alps. Biological Conservation 186, 123–133.

PROVINCE OF BOLZANO (2015) Hunting and Fishing Office, Hunting Statistics 2015. http://www.provincia.bz.it/foreste/fauna-caccia/statistiche-prelievo.asp. Accessed 30 March 2017.

ROGER E, LAFFAN SW, RAMP D (2007) Habitat Selection by the Common Wombat (Vombatus ursinus) in Disturbed Environments: Implications for the Conservation of a Common Species. Biological Conservation, 137: 437-449. Doi: http://dx.doi.org/10.1016/j.biocon.2007.03.001

TORNAMBÉ L, HALILAJ E (2015) Corridoi Ecologici. Casi studio nella Provincia di Bolzano. Ripartizione Natura, Paesaggio e sviluppo del Territorio. Ufficio Ecologia del Paesaggio, Provincia Autonoma di Bolzano 2015.

Contact

Filippo Favilli, Thomas Streifeneder
filippo.favilli@eurac.edu;
Thomas.Streifeneder@eurac.edu
EURAC Research
Institute for Regional Development
Viale Druso 1
39100 Bolzano
Italy

Michal Bíl, Jiri Sedoník, Richard Andrášik
michal.bil.cz@gmail.com; jiri.sedonik@gmail.com;
CDV – Transport Research Centre
Líšeňská 33a
63600 Brno
Czech Republic

Peter Kasal
Peter.Kasal@provinz.bz.it
Autonomous Province of Bolzano Administration
Department for Nature
Landscape and Spatial development
Via Renon 4
39100 Bolzano
Italy

Andreas Agreiter, Lena Schober
Andreas.Agreiter@provinz.bz.it;
Lena.Schober@provinz.bz.it
Autonomous Province of Bolzano Administration
Office for Hunting and Fishery Control
Via Brenneo 6
39100 Bolzano
Italy

Philip Sicher
Philipp.Sicher@provinz.bz.it
Autonomous Province of Bolzano Administration
Office for Road Administration
Piazza Silvius Magnago 10
39100 Bolzano
Italy

Lothar Gerstgrasser
lothar.gerstgrasser@jagdverband.it
Hunting Association of South Tirol
Via Macello 57
39100 Bolzano
Italy