

## Trees in the Roadside as Factor in Road Safety in Poland

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### Abstract

Roadside-related crashes occur when vehicles run off the road. The majority of the crashes have severe outcomes, especially when an object is hit (tree, pole, supports, culvert headwall, or safety barrier). Understanding how the different road and roadside elements affect safety must be based on in-depth studies. Data from sections of Polish national and regional roads were used to building crash-predictive models quantifying effects of road design and traffic factors on and their effect on road safety measures.

### Background

Roadside trees are one of Poland's most serious road safety issues. Since 2009 more than 2800 people have been killed as a result of tree collisions. This represents about 15% of all of Poland's accident fatalities between 2009 and 2013. In some of the country's regions striking a tree caused more than 30% of all road accident fatalities. With technical policy, guidelines and practice not based on recent road safety science, roadside environments are posing a serious danger to safety. As we know from a number of studies looking at how specific road factors affect roadside safety, the roadside environment and its components are critical (trees, vegetation, shoulders, embankments, drainage ditches, poles, signs, engineering objects, etc., as per Budzynski and Kustra, 2012; AASHTO, 2010; Lee and Mannering, 1999; Viner, 1995; Zegeer and Forrest, 1995; Jurewicz and Troutbeck, 2012). There is a need to develop more precise road safety analysis tools which can inform revision of technical policy, guidelines and best practice.

### Method

Analyses of models of how roadside elements affect road safety (EASTS, 2005; Elvik, 1994; Karim et al., 2012; RISER, 2006) showed that the methodologies and data differ from model to model. Because the models focus on different factors, often dictated by the available data, each has its strengths and weaknesses. The objective of the model is to estimate the expected number of victims of accidents on national roads per kilometre of road over a specific period.

New analytical models for estimation of frequency of roadside casualty crashes (striking a tree, a barrier, hitting a utility pole or sign) and of their severity were developed to serve as comprehensive roadside safety monitoring tools Polish conditions. The methodology has potential to inform future statistical modelling in other jurisdictions including Australia and New Zealand. The design of the model was based on review and lessons learned from relevant recent international studies.

### Results

The findings demonstrated the effects of potential roadside safety treatments, focussing on the independent factors influencing density of roadside casualty crashes. The victim density model is described with the following formula:

$$GOF(Y) = \alpha \cdot Q^{\beta_1} \cdot e^{(B^{\beta_2} + S^{\beta_3} + T_1^{\beta_4} + T_2^{\beta_5} + T_3^{\beta_6} + C^{\beta_7} + P_1^{\beta_8} + P_2^{\beta_9} + P_3^{\beta_{10}})} \quad (1)$$

where:

GOF(Y) - expected number of accident victims per kilometres of road (dependent variable)

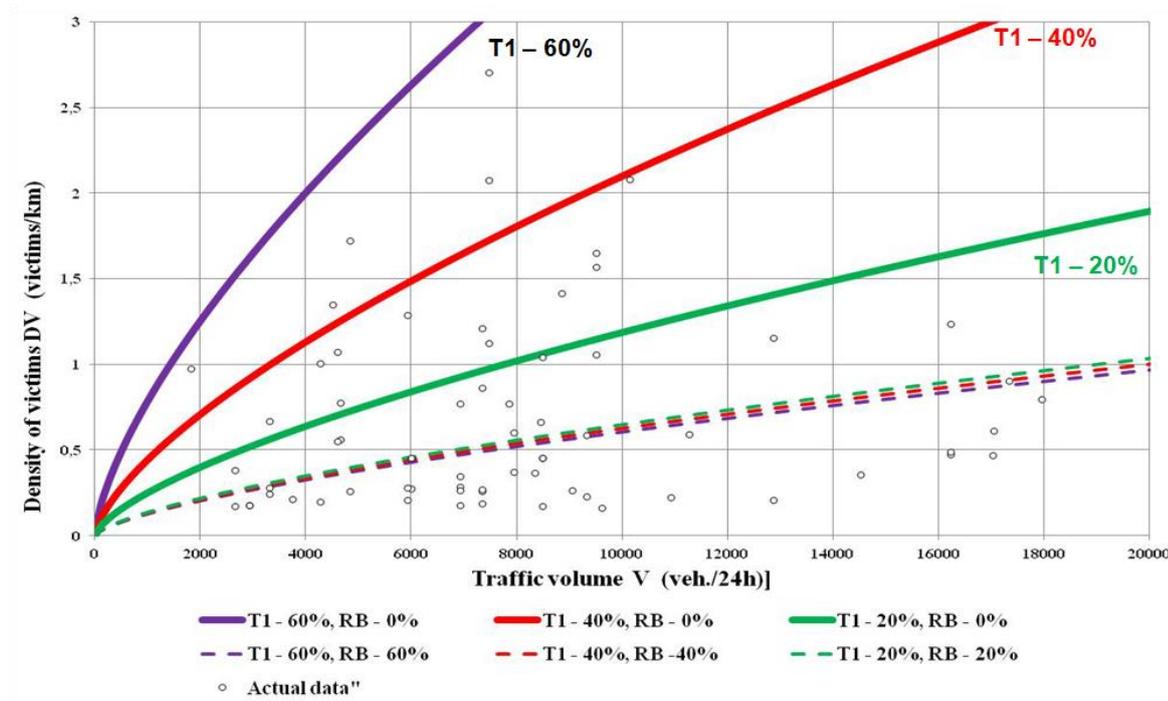
A - adjustment coefficient

Q - annual average daily traffic (AADT)

$\beta_j$  (1,2,...,n) - calculation coefficients

B,S,T1,T2,T3, C,P1,P2,P3 - factors related to the risk of an accident.

Another study conclusion is that (Fig. 1 – the effect of trees up to 3.5 m from the edge and barriers, with other parameters averaged) the length of sections with hazardous elements and their safeguards has no real effect on the number of victims. GOF results were almost identical for a 20% rate of section with trees (T1) and barriers (RB) and when both elements had a 60% coverage.



*Figure 1. Density of victims (DV) in relation to barriers and trees*

## Conclusions

The main findings discussed in the paper are:

- characterization and assessment of the safety problem associated with the environment of roads
- analysis of the impact of roads on the environment safety of their users
- modeling the impact of trees on road safety
- the potential choice of measures to improve safety

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