CAUSES AND EFFECTS OF ROAD ACCIDENTS INVOLVING ANIMALS

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Abstract- The sharp development of transport infrastructure during recent years is causing a significant fragmentation of habitats, the occurrence of the barrier effect and increased mortality rate of wild animals on roads. This is very dangerous both for drivers and for animals.
The most common tool used on Polish roads is a set of A-18 signs "Warning: wild animals" with a plate stating the length of the dangerous section. This sign is now largely dismissed as having no real benefits.
Whether we can use other solutions such sites warning? The author analyzed the situation in Poland and abroad.

Key words- Accidents Involving Animals, Speed, Accidents, Animals.

I. INTRODUCTION

Constantly increasing traffic intensity combined with the development of the Polish road network (which is by all means a positive and desired process) is also one of the main causes of the fragmentation of the natural environment. The construction of new roads irreversibly divides existing ecosystems and cuts wildlife corridors (including migration corridors). At the same time, the implemented technical solutions, such as mounds, digging, protective fences, noise barriers and traffic barriers increase the fragmentation of the environment and promote the emergence of barrier effect.
Add to that the fact that we are in constant hurry and routinely exceed speed limits and also that the tolerance of the amount by which we exceed these limits is increasing, and you get an accumulation of many different factors in one road cross-section which results in very dangerous events - collisions/road accidents involving animals.

II. SPEED, ECOLOGICAL BARRIER, ANIMAL ON THE ROAD

Excessive speed makes it much more difficult for drivers to control their vehicles. They have less time to correctly identify, evaluate and react to the situation on the road, the vehicle's braking distance is increased, it becomes more likely that the driver will lose control over the vehicle, and other road users have less time to avoid accident. [1].

The most popular model describing the relationship between the change in average traffic speed and the change in the amount of accidents, fatalities and injuries is the so called "Powder Model", developed by Goran Nilsson, a Swedish scientist from the VTI institute. According to that model, the relationship between speed and road accident factor is not linear, but exponential. a 1% change in the average actual driving speed (assuming that all other factors remain unchanged) leads to a 4% increase in the fatality factor, 3% increase in the severe accident factor and 2% increase in the number of road accidents. These dependencies have been verified in the course of numerous studies. For example, it has been proven that the strength of the relationship between speed and road accident probability can be modified by the road environment. In urban areas (speed limit 50 km/h) the relationship between speed and the risk of accident is the strongest (an increase of the actual driving speed by 1 km/h causes the increase of accident amount by 4%), and outside urban areas (speed limit 120 km/h) a similar increase in speed causes an increase of accident amount only by 2%. European Transport Safety Council (E.T.S.C.) therefore estimates that a decrease in the average actual speed by every driver in Europe would lead to a decrease in fatalities by 2200 persons annually (1100 fatalities less in urban areas, 1000 outside urban areas and 100 on motorways) [1].

The influence of roads and road traffic creates a barrier effect for animals. This concerns mainly wildlife corridors and other locations where local animal migration may occur.

A (road-related) ecological barrier is defined [2] as a complex effect of mortality rate, physical restrictions, environmental transformation and impact limiting the given species' ability to cross the road, which affects its range, distribution and population. One mitigating factor might be the construction of animal passages, –most often employed on motorways and expressways.

Ecological barriers have several negative ecological effects and also are one of the causes of road accidents. Despite the implemented measures, i.e.:

a) measures intended for the increase in the observance of speed limits (constructing automatic speed control systems, information

campaigns, increasing penalties for excessive speed, losing driving licence for 3 months),

b) traffic calming measures (roundabouts, traffic islands for decreasing speed upon entry to built-up areas),

c) positive changes in the behaviour of drivers,excessive speed is, unfortunately, still a big problem.

III. POLAND AS COMPARED TO ITS NEIGHBOURS

Poland takes one of the notorious last places in terms of fatalities. Moreover, the Lubelskie province is one of the fastest in Poland [3].

In the following figure no. 1 [4] Poland, Norway, Finland, Romania, Bulgaria, Croatia and Luxembourg are marked in red. This means that in comparison with other countries which joined the programme of reducing fatalities on roads they take the last places.

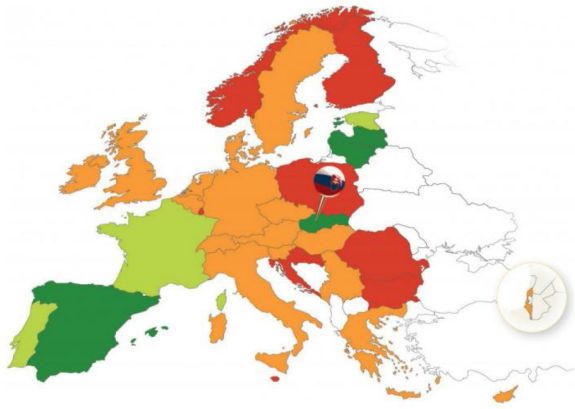


Fig. 1. 9th Annual Road Safety Performance Index (P.I.N.) Report, June 18, 2015 [4]

In 2010, the European Union renewed its commitment to improving road safety by setting a target of reducing road deaths by 50% by 2020, compared to 2010 levels. Slovakia (-37%) tops the ranking for reduction in road deaths between 2010 and 2013, followed by Spain, Greece and Portugal with reductions of more than 30%.Slovakia (-24%) and Switzerland (-21%) achieved the best reductions in 2013 compared to 2012 (Fig. 2). Austria, Lithuania, Cyprus, Portugal, the Czech Republic, the Netherlands, Spain, Greece and France recorded reductions of more than 10%. [**4**].

In Switzerland, the country of Alpine Roads, famous for its extremely strict traffic law, but also for being one of the safest countries in the world, in January 2013 regulations were made even more strict, and imprisonment was introduced, depending on the class of the road on which the offence was committed and the noted speed of the vehicles.

E.T.S.C.'s Swiss member B.F.U. has called for an increase in the number of speed controls outside of urban areas. 98% of speed controls in Switzerland are carried out by fixed safety cameras, the remaining 2% by non-automatic cameras placed in special locations or in vehicles. B.F.U. says the impact on driver behaviour is biggest when automatic and non-automatic controls are combined in the same region and drivers are informed about the purpose and results of the checks[5].

IV. ACCIDENTS INVOLVING ANIMALS IN POLAND IN THE YEARS 2002-2014

Police statistics indicate that the months with the largest count of accidents involving animals are May, October and November due to the increased migration of animals, the search of new territories necessary for survival and the migration of maturing animals. February is the month with the least accidents.

Animals migrate to look for new feeding and breeding grounds - this requires them to cross communication routes on which they often die. Statistics show that the number of accidents involving animals is constantly increasing. Fig. 2 shows a practically constant annual increase in the number of accidents involving animals.

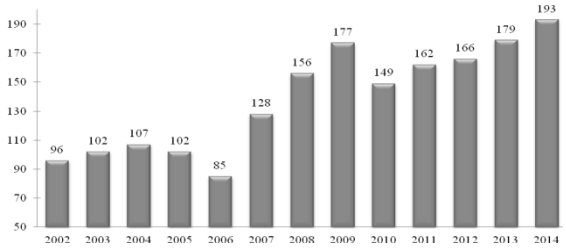


Fig. 2 The number of accidents involving animals in Poland in the years 2002-2014 [6].

Fig. 3 presents the number of fatalities resulting from accidents involving animals. The summary below does not allow us to discern a characteristic pattern or tendency. Apart from the tragic collisions between vehicles– and animals, it can be inferred that each such event causes loss of property as well. One very important problem in accidents– involving animals, apart from loss of property, is the ever increasing number of injuries – Fig. 4.

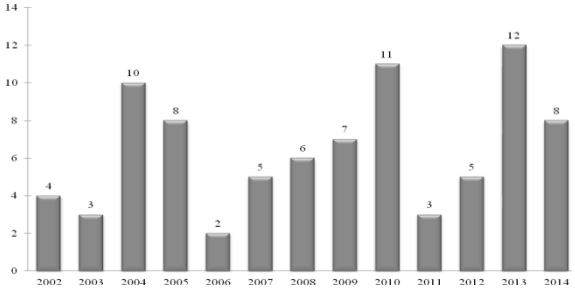


Fig. 3. The number of fatalities in accidents involving animals in the years 2002-2014 [6].

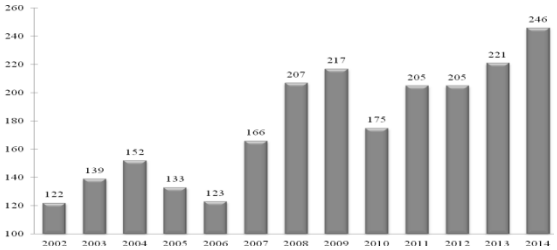


Fig. 4. The number of injuries in accidents involving animals in the years 2002-2014 [6].

It is symptomatic however, that the largest total number of accidents in the years 2010–2014 has been noted on county and national roads – Fig. 5. a detailed summary of the number of accidents for individual years for four road categories is presented in Fig. 6.

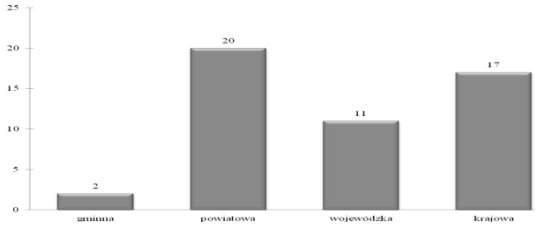


Fig. 5. The number of accidents involving animals in Poland in the years 2010-2014 in the Lubelskie province depending on road category [7].

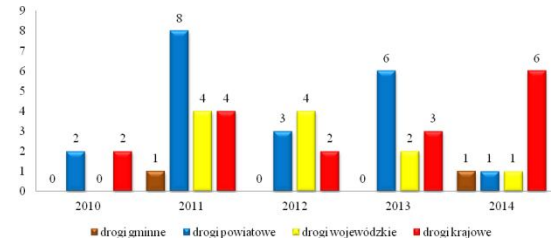


Fig. 6. The number of accidents involving animals in Poland in the years 2010-2014 in the Lubelskie province depending on road category [7].

The summary in Fig. 6 shows the number of injuries sustained during accidents involving animals. The most injuries happened on county and province roads.

From what we can gather, only some of the newly built national roads have fences which could stop animals from entering the road. The lack of appropriate solutions for animals, especially in migration corridors, results in accidents happening both on county roads with less intensive traffic, and on roads of higher categories.

V. METHODS OF LIMITING COLLISIONS AND ANIMAL MORTALITY RATE

The most common methods of limiting collisions and animal mortality rate involve setting a vertical road sign informing of wild animals; apart from that Mr Rafał Kurek [8] states that the following methods are also used:

1) Protection and guiding fences
2) Animal passages
   a) landscape passages
   b) upper and lower passages for large and medium animals
   c) lower passages for small mammals and amphibians
   d) combined passages

3) Traffic management (roads without protective measures)
   a. permanent speed limit on selected sections
   b. active speed limiting systems
   c. temporary closing of local roads

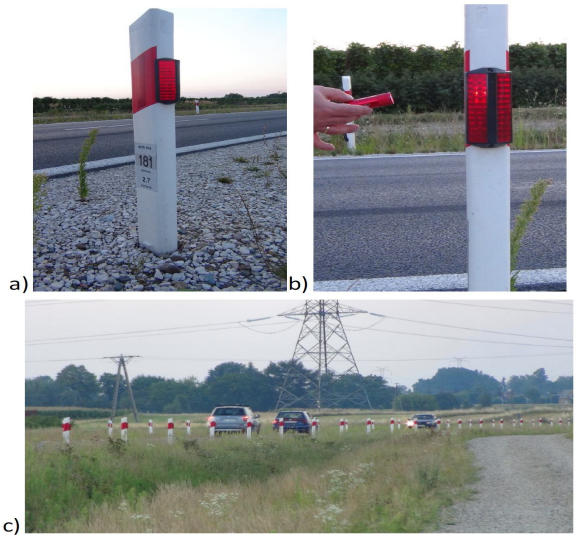
4) Vegetation belts
5) Securing transparent noise barriers
6) Modifying road lighting
7) Light-based deterrents (reflectors, mirrors, 'wolf eyes')
8) Chemical (scent-based) repellents
9) Sound-based deterrents

The most common tool used on Polish roads is a set of A-18 signs "Warning: wild animals" with a plate stating the length of the dangerous section shown in picture no. 1. This sign is now largely dismissed as having no real benefits. It is, however, a great security measure for the road manager. If there is an accident on a road marked in such a way, the manager does not suffer any negative consequences of such an event.



Pic. 1. The most popular solution implemented by Polish road managers [9]

If there is no possibility of constructing an animal passage, other solutions can be used, which are getting more and more common in Eastern Poland and are already well established in Sweden. The solution implemented in Poland for the instances of a migration corridor being crossed by a newly built road is positioning thickly packed road posts with 'wolf eyes' as shown in pictures 2 a, b and c. The reflectors were designed with the aim to minimise road accidents involving wild animals. Beams from the lights of an approaching vehicle are reflected by the reflectors to the side (forest) areas, which creates an optical barrier for animals. Reflectors activate the light from as far as 100 m, which gives the animal more than enough time to stop or turn back.



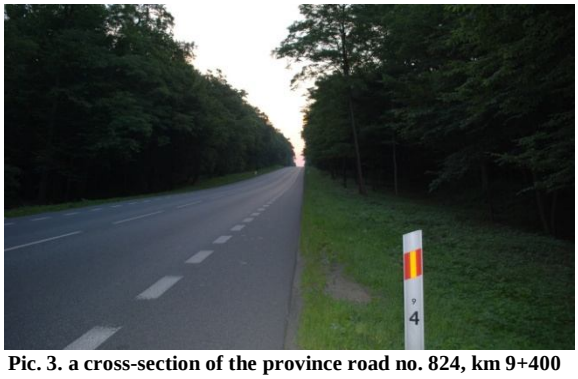
Pic. 2. Wolf eyes along a newly built road. [10]

VI. ANALYSIS OF THE PROVINCE ROAD NO. 824 AT THE SECTION FROM ŻYRZYN TO PUŁAWY

Province road no. 824 presented in Fig. 7 is currently under the supervision of GDDKiA (General Directorate for National Roads and Motorways). a large part of the road crosses forest areas belonging to the Puławy Forest District. The road cross-section is track-like, including single carriageway and two lanes, which encourages driving at high speeds. Picture no. 3 shows the cross-section of the analysed road. The selected junctions include traffic segregation in the form of left turn or right turn islands. The road is characterised by large traffic intensity and a very high number of trucks.



Fig. 7 Analysed province road no. 824, section from Żyrzyn to Puławy. [11]



Pic. 3. a cross-section of the province road no. 824, km 9+400 [12]

Almost the entire road section, except for those parts which run through towns, is marked with the A-18 sign set "Warning: wild animals". It is unsettling that during the last 8 years along a 10 km section there were 82 collisions and 2 accidents involving animals. [13]

The largest number of collisions happens at dawn between 6 a.m. and 7 a.m. and from 5 p.m. to midnight.

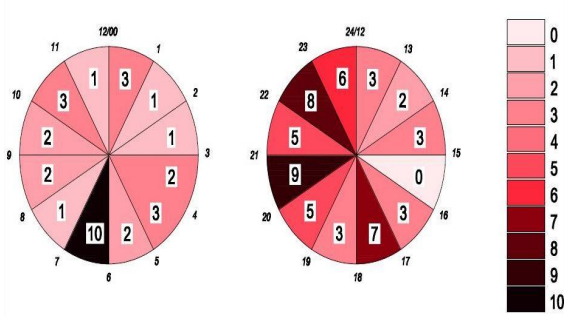


Fig. 8 The number of accidents/collisions involving animals by event time on the Province Road no. 824 from Żyrzyn to Puławy. [13]

In a report published in 2010 Sylwia Borowska [14] mentions that one good solution would be to post an "Accident Blackspot" plate before the identified dangerous location where the probability of animal collision is high. Fig. 9 shows that such a plate would have to be posted at the beginning of the forest area.

It is noticeable that most collisions happen in the forest area and around it - as shown in Fig. 9. The road section from km 6+500 to km 10+500 is characterised by the largest collision risk; it is there, at km 9+400, that on 09.07.2015 a photocell detected a small roe deer by the road, in a month with a small number of animal collisions as shown in picture no. 4

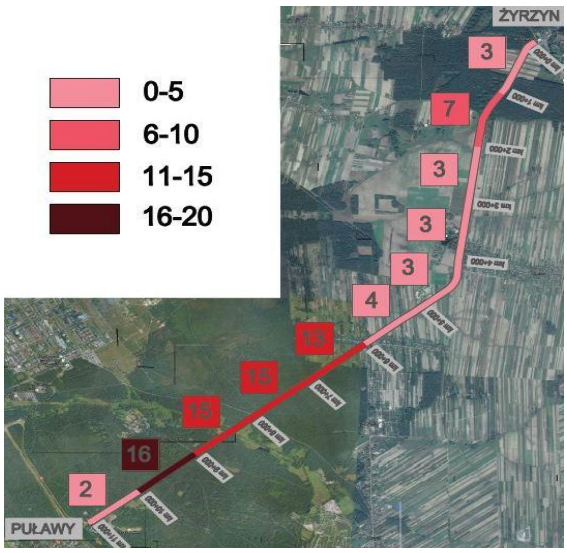


Fig. 9. The number of collisions involving animals on the Province Road no. 824 in Puławy in the years 2007-2015 (July). [13]



Pic. 4. Picture taken on 9 July 2015 on the Province Road no. 824 with a Bushnell photocell [12]

CONCLUSIONS

Accidents involving excessive speed in Poland result from: bad driver behaviour caused by the lack of express roads, which makes it impossible to traverse large distances quickly; treating exceeding speed limits as a socially acceptable practice; small detectability of offences and the lack of a sense of inevitability of punishment.
Considering the circumstances and causes of road accidents in Poland it was observed that at night the probability of accident is more than 60% higher that during the day. Also, the risk of accidents consisting in a vehicle hitting an obstacle is also increased [15].

The most common types of fatal accidents related to excessive speed are: hitting a tree or signpost (43% of fatalities), head-on collision (18% of fatalities), the vehicle falling over (11% of fatalities) [15]. This leads to another conclusion: the areas surrounding roads in Poland are still dangerous.
It cannot be precluded that some of the mentioned events may result from the driver reacting to an animal running across the road.
The sharp development of transport infrastructure during recent years is causing a significant fragmentation of habitats, the occurrence of the barrier effect and increased mortality rate of wild animals on roads. This is very dangerous both for drivers and for animals.
It is very important that the road planning and designing processes be conducted by designers, planners, road managers who are informed about the animal migration routes, forest districts and environmental specialists from the fields related to animal protection. It is also necessary to collect detailed data on collisions and accidents involving animals.
A very good practice is to utilise other countries' experience, solutions which have already been proven to be effective. The conducted analyses and studies should identify effective methods of protecting both road users and animals. Unfortunately, it is very unsettling that statistically only one driver in four reports a collision to the relevant authorities.

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