Animal mortality on Polish roads in 2015.

Annual report of the "Polish Roadkill Record System". http://zwierzetanadrodze.pl

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1. Introduction

"Polish Roadkill Record System" is a platform for recording and exchanging information on collisions of vehicles with animals. It is addressed to all Polish roads users. The document is the first summary of collected data, embracing observations recorded in 2015, i.e. the first year of the platform operation. It was started up, and the access was provided for first users in 2015.

Purpose of the annual report is regular presentation of active users (observers) involvement in development of the database, as well as demonstration of the issues of road collisions with animals to a wider group of road users and persons interested in road infrastructure impact on the national fauna.

The report includes basic statistics related to the collected material together with short comments. They discuss among other the dependence of collision size on the road surroundings, season, road category and the main group of victims. Regarding that the number of observations related to amphibians and reptiles is still limited, we resigned from detailed analyses referring to those groups of animals.

The synthesis was carried out on the basis of the number of incidents, not the number of animals (victims). Bearing it in mind that road incidents with some groups of animals (amphibians and reptiles) are frequently of a mass nature, consideration of the number of animals may distort a statistical image of the phenomenon. Therefore, the figures relating to individual animals are exploited only for the purpose of demonstrating the total number of victims for a given species (Tab. 2).

Authors intend to develop similar reports annually, covering results from a given year as well as all previous materials. Hence, the first document considers mainly the data from 2015, but also archive observations (dated from 2000), which were incorporated into the register in 2015. It must be stressed that the presented analysis does not reflect the phenomenon in a scale of the whole year, as majority of data come from the second half of 2015, i.e. after the date, when the Record System was launched.

2. General results

Generally, until the end of 2015, the Record System registered 1623 observations related to 2053 individual animals from 116 species, including 248 observations from the period between 2000 and 2014 (Tab. 1). Majority of observations regarded collisions with individual animals, as incidents with a greater number of victims were recorded several times, mainly in case of amphibians and reptiles. The most sizable accident embracing at least 100 victims (common toad) was reported within the area of the "Stawy Milickie" Nature Reserve on 11/5/2015.

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Tab. 1. The number of observations and victims registered to 2015.

Year	Observations	Victims
2015	1375	1636
2000-2014	248	417
Total	**1623**	**2053**

Animals that were reported most often as victims of road accidents were mammals - hedgehogs and foxes (Tab. 2), afterwards representatives of herpetofauna - grass snakes and common toads. In case of hedgehogs, 91% of entries only included information about its kind, what is caused by a difficulty to specify properly both national species, i.e. eastern hedgehog - *Erinaceus roumanicus* - and wester hedgehog - *E. europaeus.* Among 30 hedgehogs specified in terms of species, most common was the eastern hedgehog (25 cases), what reflects distribution of both species in Poland, as well as a smaller number of entries from the western part of the country.

Tab. 2. A list of accidents victims in terms of species, according to the number of individual animals (N=2053).

Speciec/Genus	No.	Species	No.
Hedgehog *(Erinaceus sp.)*	315	Mole *(Talpa europaea)*	9
Red Fox *(Vulpes vulpes)*	255	Yellowhammer *(Emberiza citrinella)*	9
Grass Snake *(Natrix natrix)*	208	Common Chaffinch *(Fringilla coelebs)*	8
Common Toad *(Bufo bufo)*	158	Starling *(Sturnus vulgaris)*	8
Red Squirrel *(Sciurus vulgaris)*	78	Black Thrush *(Turdus merula)*	8
Rock Dove *(Columba l. f. urbana)*	47	Muskrat *(Ondatra zibethicus)*	7
Beech Marten *(Martes foina)*	50	Magpie *(Pica pica)*	7
Marten *(Martes sp.)*	49	Mallard *(Anas platyrhynchos)*	6
Badger *(Meles meles)*	46	Grey Partridge *(Perdix perdix)*	6
Roe Deer *(Capreolus capreolus)*	40	Herring Gull *(Larus argentatus)*	6
Hare *(Lepus europaeus)*	39	Striped Field Mouse *(Apodemus agrarius)*	6
Racoon Dog *(Nyctereutes procyonoides)*	37	Common Pheasant *(Phasianus colchicus)*	6
House Sparrow *(Passer domesticus)*	32	Grey Wagtail *(Motacilla alba)*	6
Polecat *(Mustela putorius)*	30	Jay *(Garrulus glandarius)*	6
Wild Boar *(Sus scrofa)*	29	Fieldfare *(Turdus pilaris)*	5
White-breasted Hedgehog *(E. roumanicus)*	25	European Hamster *(Cricetus cricetus)*	5
Barn Swallow *(Hirundo rustica)*	22	Robin *(Erithacus rubecula)*	5
Western Jackdaw *(Corvus monedula)*	20	Hedgehog *(Erinaceus europaeus)*	5
Tawny Owl *(Strix aluco)*	16	Great Woodpecker *(Dendrocopos major)*	5
Otter *(Lutra lutra)*	16	Adder *(Vipera berus)*	4
Tree Sparrow *(Passer montanus)*	15	Elk *(Alces alces)*	4
Wood Pigeon *(Columba palumbus)*	15	Long-eared Owl *(Asio otus)*	4
Pine Marten *(Martes martes)*	14	Common Shrew *(Sorex araneus)*	4
Sparrow *(Passer sp.)*	14	Nuthatch *(Sitta europaea)*	4
Common Frog *(Rana temporaria)*	14	Rook *(Corvus frugilegus)*	3
Red-backed Shrike *(Lanius collurio)*	13	Green Frogs *(Pelophylax e. complex)*	3
Common Buzzard *(Buteo buteo)*	12	House Martin *(Delichon urbicum)*	3
Song Thrush *(Turdus philomelos)*	11	Black-headed Gull *(Ch. ridibundus)*	3
Brown Rat *(Rattus norvegicus)*	11	Great Grey Shrike *(Lanius excubitor)*	3
Collared Dove *(Streptopelia decaocto)*	10	Beaver *(Castor fiber)*	3
Slow Warm *(Anguis fragilis)*	10	Nightjar *(Caprimulgus europaeus)*	3
Least Weasel *(Mustela nivalis)*	10	Grey-headed Woodpecker *(Picus viridis)*	3
Great Tit *(Parus major)*	9	Spadefoot *(Pelobates fuscus)*	3

North American Racoon *(Procyon lotor)*	2	Smooth Newt *(Lissotriton vulgaris)*	1
Sparrowhawk *(Accipiter nisus)*	2	Willow Warbler *(Phylloscopus trochilus)*	1
White Stork *(Ciconia ciconia)*	2	Mute Swan *(Cygnus olor)*	1
American Mink *(Mustela vison)*	2	Middle Woodpecker *(Dendrocopos medius)*	1
Edible Frog *(Pelophylax esculentus)*	2	Serotine Bat *(Eptesicus serotinus)*	1
Tree Pipit *(Anthus trivialis)*	2	Green Toad *(Bufotes viridis)*	1
Great Crested Newt *(Triturs cristatus)*	2	Marsh Tit (Poecile palustris)	1
Sand Lizard *(Lacerta agilis)*	2	Siskin *(Carduelis spinus)*	1
Reed Warbler *(Acrocephalus scirpaceus)*	2	Common Moorhen *(Gallinula chloropus)*	1
Black Redstart *(Phoenicurus ochruros)*	2	Egyptian Goose *(Alopochen aegyptiaca)*	1
Coot *(Fulica atra)*	2	Corn Bunting *(Emberiza calandra)*	1
Hooded Crow *(Corvus cornix)*	2	Whinchat *(Saxicola rubetra)*	1
Moor Frog *(Rana arvalis)*	2	Brown long-eared Bat *(Plecotus auritus)*	1
Sand Martin *(Riparia riparia)*	1	Common Swift *(Apus apus)*	1
Yellow Wagtail *(Motacilla flava)*	1	Tree Frog *(Hyla arborea)*	1
Bison *(Bison bonasus)*	1	Bat *(Chiroptera)*	1
Red Deer *(Cervus elaphus)*	1	Bittern *(Botaurus stellaris)*	1
Bullfinch *(Pyrrhula pyrrhula)*	1	Corn Crake *(Crex crex)*	1
Bearded Ridling *(Panurus biarmicus)*	1	Thrush Nightingale *(Luscinia luscinia)*	1
Boreal Owl *(Aegolius funereus)*	1	Goldcrest *(Regulus regulus)*	1
Greenfinch *(Chloris chloris)*	1	Water Shrew *(Neomys fodiens)*	1
Woodlark *(Lullula arborea)*	1	Barn Owl *(Tyto alba)*	1
Marsh Frog *(Pelophylax ridibundus)*	1	Common Whitethrout *(Sylvia communis)*	1
Red-footed Falcon *(Falco vespertinus)*	1	Long-tailed Tit *(Aegithalos caudatus)*	1
Wood Mouse *(Apodemus sylvaticus)*	1	Golden Jackal *(Canis aureus)*	1
Viviparous Lizard *(Zootoca vivipara)*	1	Ermine *(Mustela erminea)*	1
Common Linnet *(Carduelis cannabina)*	1		

Some publications suggest that amphibians (Orłowski 2007) and small rodents (Orłowski i Nowak 2006) are the animals that die on Polish roads most often. A relatively small share of those animals in the presented comparison results from their small sizes, what causes that they are hardly noticeable and quickly smashed. Furthermore, majority of data in the database are related to the second half of the year, therefore share of amphibians in the observations is insignificant. Usually, the greatest number of amphibians die during the breeding period, in spring (Orłowski 2007). The issue of being hardly noticeable and easily smashed is also the reason of a relatively small share of birds. The most often observed victims in this groups are rock pigeons, sparrows and barn swallows, what coincides with another analysis carried out for the whole country (Borowska 2015).

In case of big mammals, the most often observed animals were roes, then boars (40 and 29 individual animals, respectively), what also corresponds to previous information (Borowska 2015). It was interesting that the record system included individual incidents with large mammals, moose and European bison, as well as a species that is new for our fauna - golden jackal.

A list of observers, who provided their observations embraces 79 persons (the list of persons is available in the further part of the study). Distribution of observations within the country is not even (Fig. 1), as western areas of the state are almost totally deprived of data. When it comes to the administrative division, data from the Masovian voivodeship prevail, and share of observations from remaining voivodeships is differentiated (Fig. 2). Distribution of the previously registered collisions reflects rather the activity of particular observers than actual differences in collisions intensity on national roads.

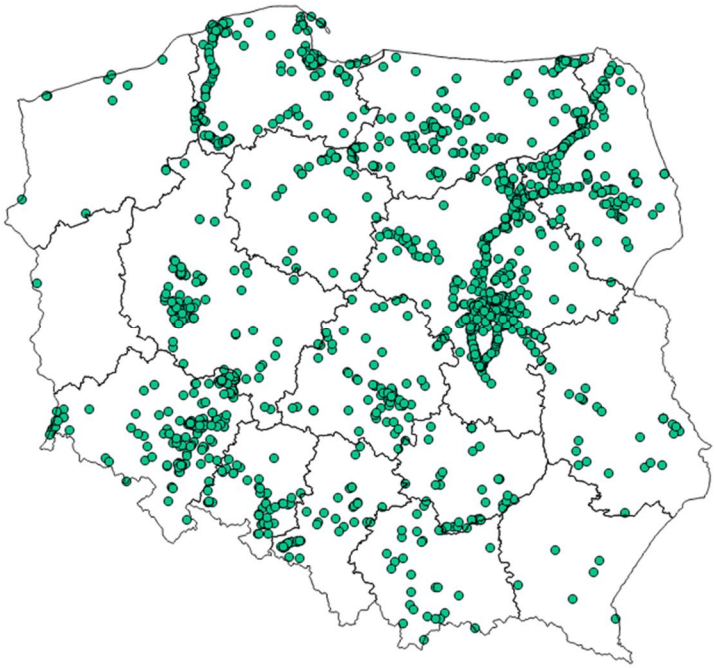

Fig. 1 Distribution of road collisions with animals in Poland, entered into the Record System until the end of 2015 (N=1623).

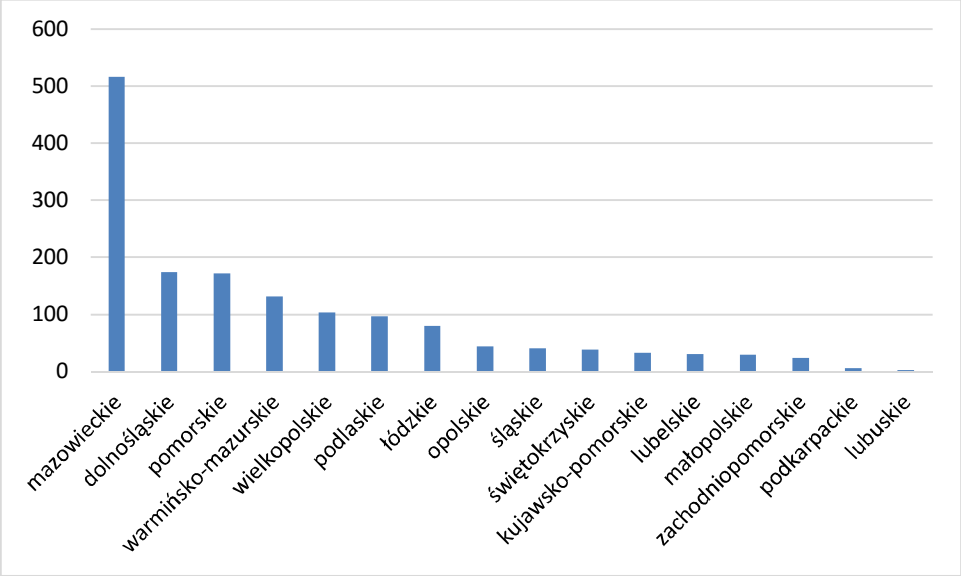

Fig. 2 The number of observations in particular voivodeships (N=1520).

3. The number of collisions regarding the type of road surroundings

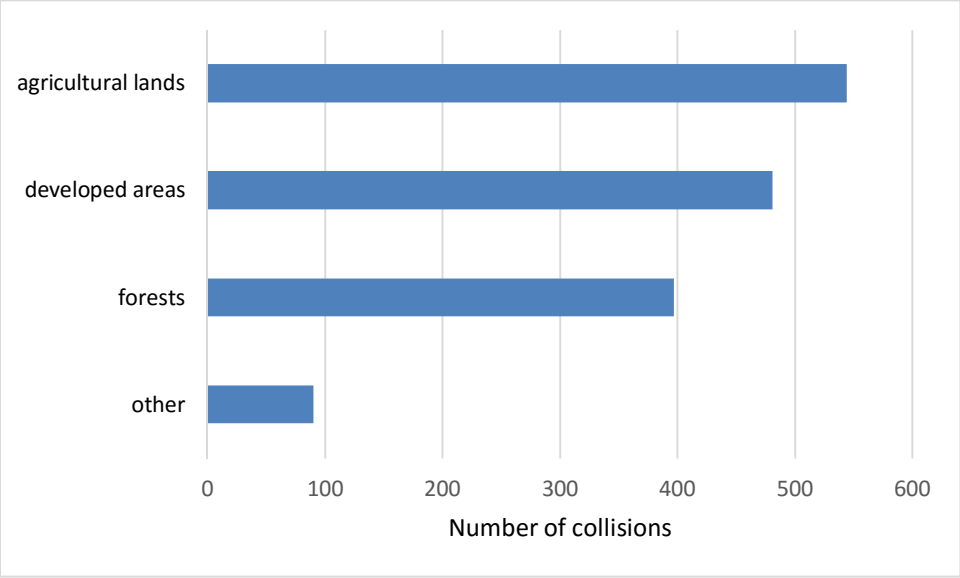

Fig. 3 The total number of collisions in particular surroundings (N=1512).

While comparing observations of all taxonomic groups (amphibians, reptiles, birds and mammals), the greatest number of collisions was recorded on roads surrounded by agricultural lands (36%), developed areas (32%) and forests (26%) (Fig. 3). These results reflect population and environmental selectiveness of the main species of victims, but also the share of particular surroundings - agricultural lands pose 60% and forests pose 30% of the Polish territory. Great share of collisions within residential areas, occupying only about 2% of the Polish territory, is related to the highest activity of observers and identifiability of animals in that zones.

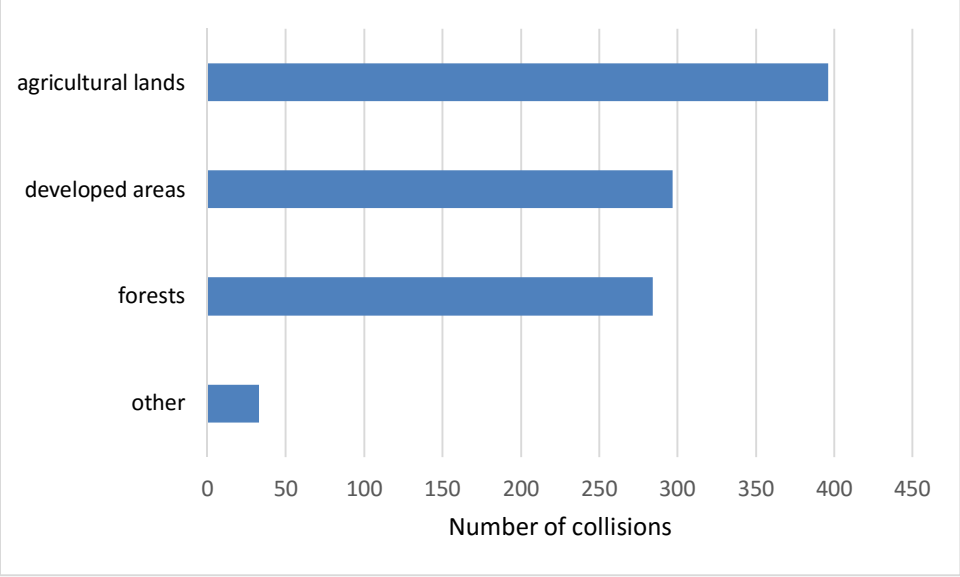

Fig. 4 The number of collisions with mammals in particular environments (N=1012).

Hit mammals were most often observed on roads running through agricultural lands (39%) (Fig. 4). In case of developed lands and forests, the number of identified mammals was slightly lower, and almost identical, amounting to 29% and 28% respectively.

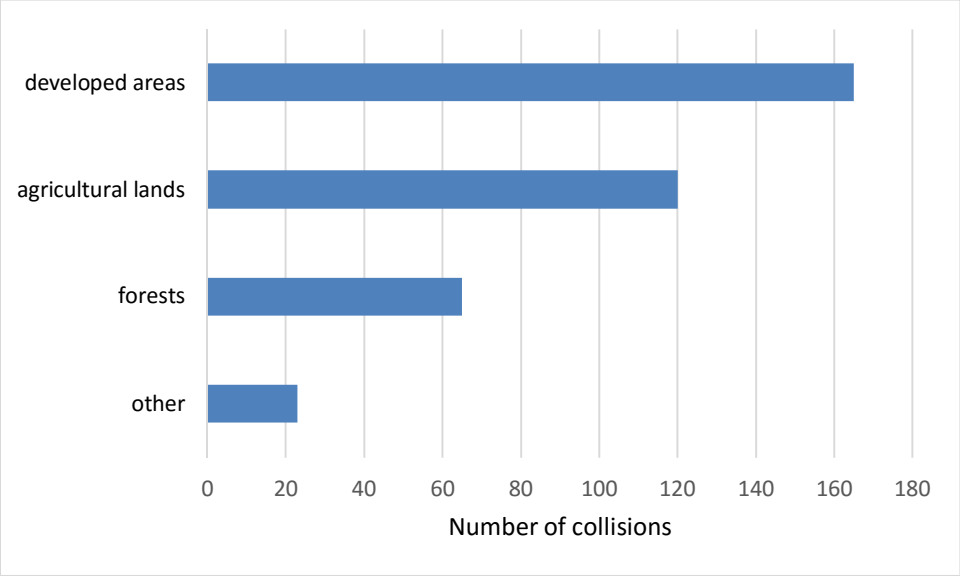

Fig. 5 The number of collisions with birds in particular environments (N=374).

Bird victims of collisions dominated within developed areas (44%) and agricultural lands (32%) (Fig. 5). A significant difference in the number of collisions between those environments is caused by a great - amounting to 10% - share of rock pigeon in the pool of birds observed in cities.

Results of analysis limited to three types of environments identified most often - developed areas, agricultural lands and forests - do not deviate significantly from the general results (Fig. 6-8).

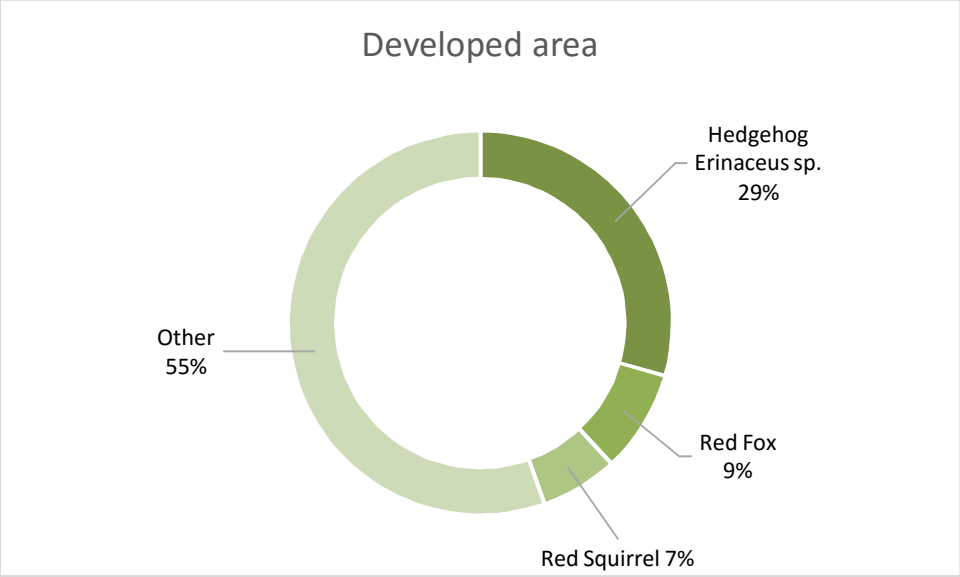

Fig. 6 Share of the main collisions victims within developed areas (N=628).

Mammals that were most frequent collisions victims within developed areas were hedgehogs (*Erinaceus* in total). These animals often occur in urban residential areas and in cities, especially within the suburban zones, in detached houses districts or garden plots zones. The second most frequently identified species within the developed areas was fox - but still significantly less often than the hedgehog. A certain surprise was a high share of squirrel among the road accidents victims - 78 individual animals in total, 7% of victims within the developed areas. Squirrel is a species related to various wooded areas, such as forests or woodlands nearby agricultural lands, but it is also often encountered in city parks. A significantly high mortality

rate suggests that roads also pose a considerable threat for that species, despite its agility and mostly arboreal life habits.

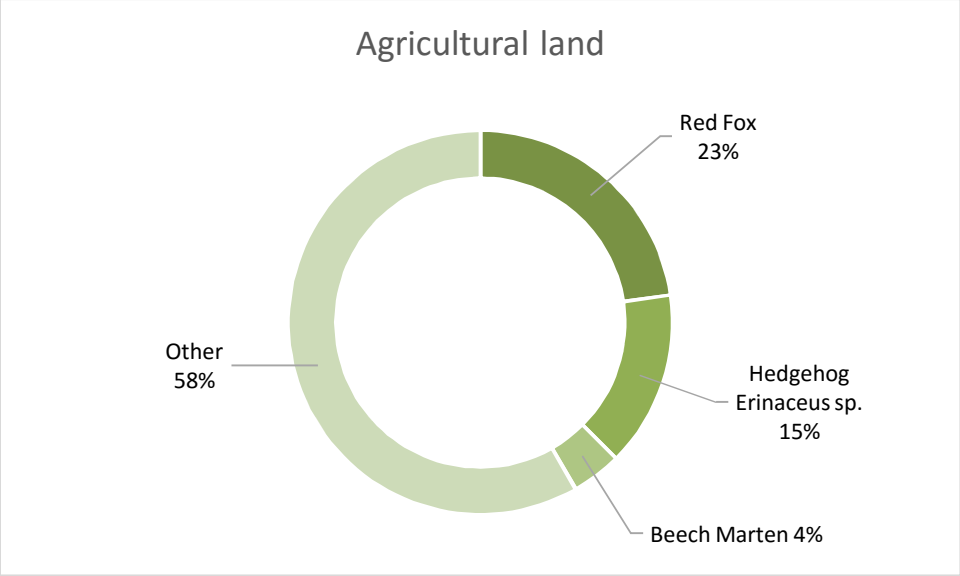

Fig. 7. Share of the main collision victims within agricultural lands (N=731).

The most frequent victim within agricultural lands was a fox (Fig. 7). Such a result reflects its habitat preferences, as this species is encountered most often in agricultural landscapes.

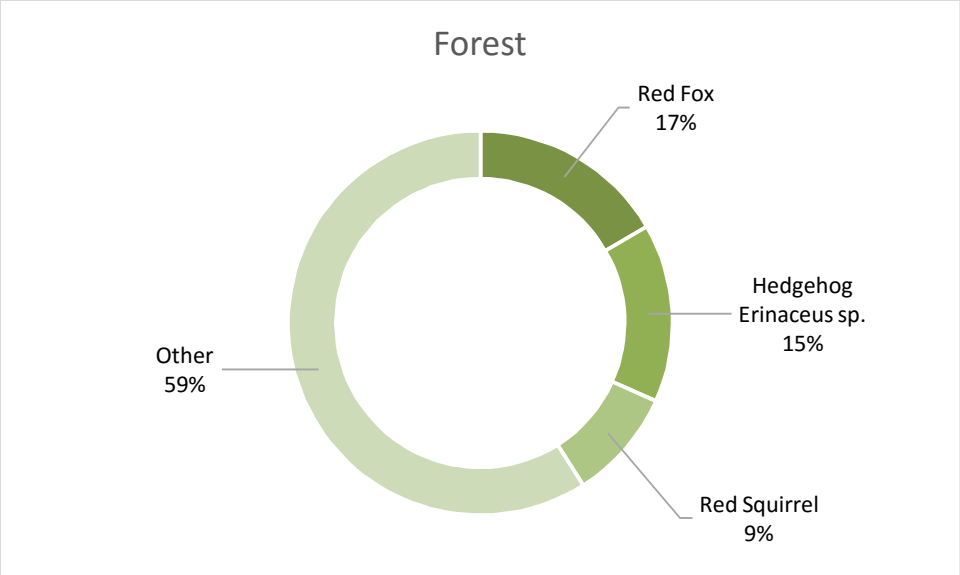

Fig. 8. Share of the main collision victims in forests (N=534).

Dominating collision victims were foxes and hedgehogs also in forests (Fig. 8), and again - squirrels. It confirms habitat flexibility of the first two species, expressing a strict connection of the squirrel with wooded lands, and results from commonness of those animals in Poland. Despite this, a reverse analysis, showing where most of the victims were killed, i.e. the hedgehogs and foxes, confirms an uneven distribution of statements, according to the expectations: the hedgehogs were found most often within developed areas (Stolarz et al. 2001, Orłowski 2004), and the foxes on agricultural lands (Fig. 9-10). It is interesting that according to the materials, collisions with foxes within the developed areas were relatively scarce (9% of

cases), while pursuant to previous research from the Lower-Silesia region (Orłowski and Nowak 2006), the foxes were most often killed within the developed areas.

In case of all of the three discussed environment, the group of three most sizable species of victims presented in total a large and approximated share of 41-45%. It is interesting that the dominating species are animals with relatively sizable bodies, what could cause overstatement of their share when compared to other, especially small species.

The list of remaining victims is long - in case of developed areas it embraces 45 species, agricultural lands 60 and forests 53. Shares of those species represent the qualities of fauna in discussed environments in a better manner than the dominating species. Comparison and percentage share of dominating species in particular environments is presented in the list below (Tab. 3).

Tab. 3. Comparison and percentage share of dominating species in particular environments

	Developed areas	**%**	**Agricultural lands**	**%**	**Forests**	**%**
1.	Hedgehog (*sp.*)	29	Red Fox	23	Red Fox	17
2.	Red Fox	9	Hedgehog (*sp.*)	15	Hedgehog (*sp.*)	15
3.	Red Squirrel	7	Beech Marten	4	Red Squirrel	9
4.	Rock Dove	6	Badger	4	Common Toad	5
5.	House Sparrow	4	Racoon Dog	3	Grass Snake	4
6.	Beech Marten	3	Grass Snake	3	Badger	4
7.	Polecat	3	Hare	3	Racoon Dog	4
8.	Barn Swallow	2	Roe Deer	3	Roe Deer	3
9.	Jackdaw	2	Red Squirrel	2	Wild Boar	2
	Total	**65%**		**60%**		**63%**

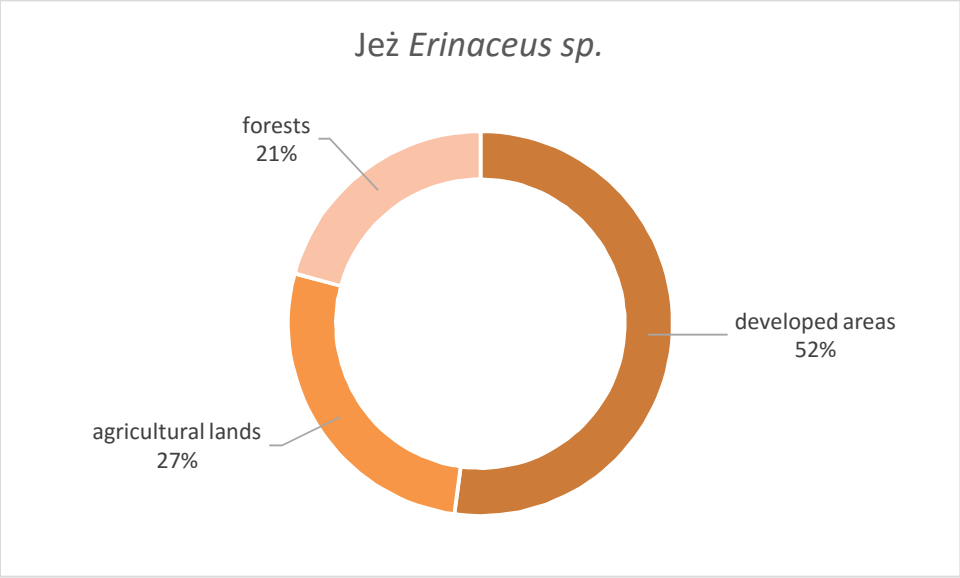

Fig. 9. Road collisions with *Erinacus* hedgehogs divided according to specified habitats (N=303).

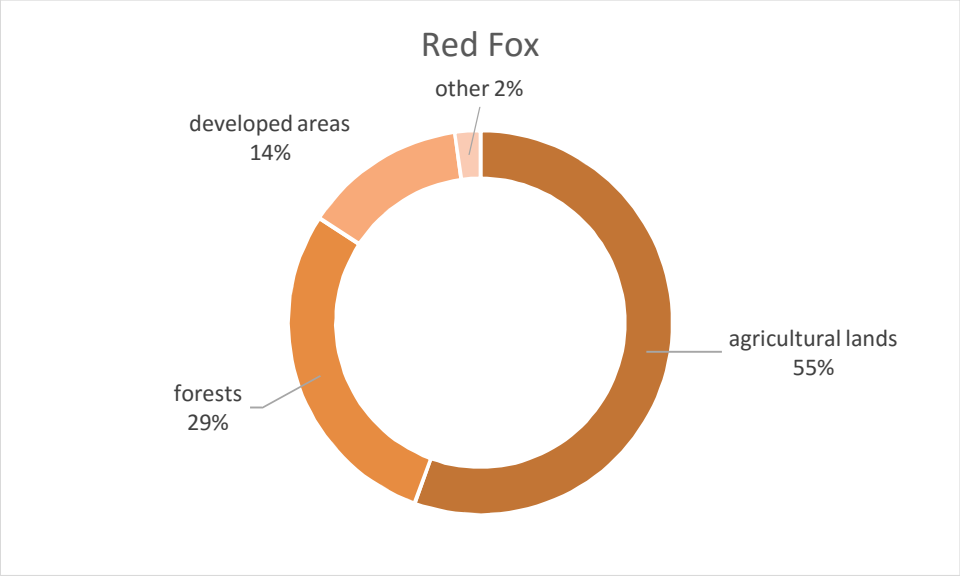

Fig. 10. Fox share in particular habitats (N=234).

4. Influence of other variables on intensity of collisions with animals

4.1. Season

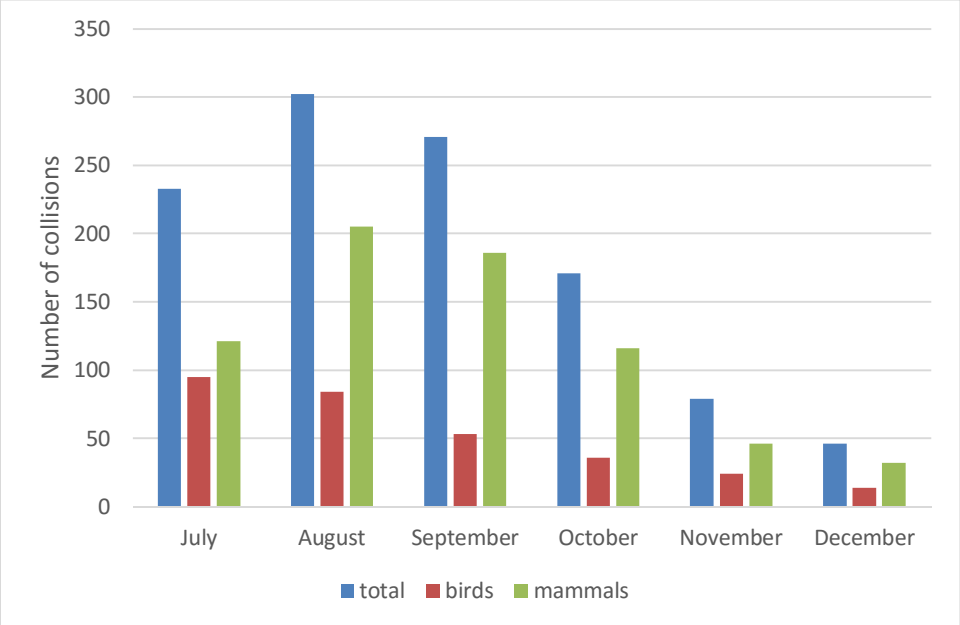

Fig. 10. The number of collision in particular months for all taxonomic groups in total, and for birds and mammals (2015; N=1102).

In a year cycle, the phenomenon of road collisions with animals has two peaks - spring and autumn (Borowska 2010), and a minimum during the winter period. The spring peak is caused by greater mobility of animals, related to migrations, breeding period, feeding of young animals and their appearance itself, especially when it comes to birds. Amphibians are mainly responsible for the spring peak (Orłowski 2007) and birds (own observations). In autumn numerous mammals die regarding the reproductive period of some species, as well as occurrence and dispersion of young animals (Orłowski 2007, Borowska 2010, Borowska 2015).

The report is based on data from the Record system, which was launched in July, so the results are related only to the second half of the year. Despite this, uneven distribution of collision, with the peak in August-September and a minimum in late autumn and winter is visible. Such a distribution was created mainly by collisions with mammals. In case of birds, the greatest number of collisions was recorded in July, with an even downward trend in the remaining months of the year. The July peak might have been related to the end of the birds breeding period and temporary appearance of numerous young animals within the populations.

2. Road category

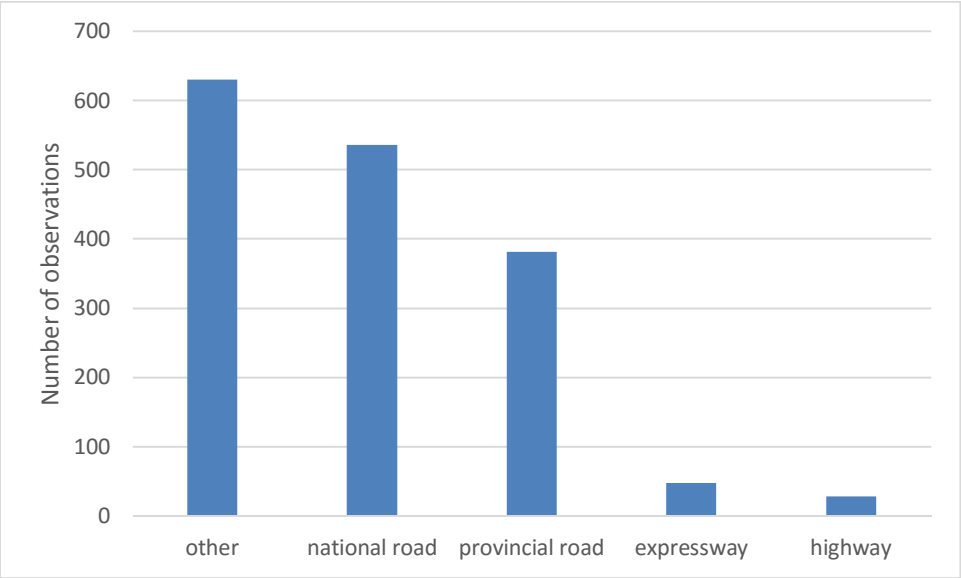

Fig. 11. The number of observations according to the road category (N=1623).

The number of entries related to road collisions with animals was inversely proportional to the level of road "significance", and probably the traffic intensity. The greatest number of entries referred to collisions on the other roads - poviat, commune, and the lowest number on express roads and motorways (Fig. 11). It is not known to what degree this result reflects the actual distribution of collisions, and the share of a given category of roads in our country. Majority of auxiliary roads in Poland (poviat, etc.) may cause that the total number of victims in Poland is the greatest on that kind of roads. What is more, the result is influenced by fencing of express roads, and the fact that drivers' attention is directed rather towards safe driving than recording such victims. Specification of a real distribution of collisions with animals, regarding the road type requires much broader materials and analyses that consider confounding variables.

3. Summary

The document present basic data included in the "Polish Roadkill Record System", relating to 2015, and complemented with data from previous years. During the first several months of the Record System operation, the platform was used by 79 observers, who provided data about more than 1600 collisions, described in details, often supported with photo documentation. Such a great interest proves the need and relative easiness to collect observations of road accidents with animals systematically, justifies the purpose for development of the Record

System, and at the same time, unfortunately, confirms the problem of serious mortality of animals on Polish roads.

A significant element of the Report is a table including a set of previous data, which suggests, among others, broad diversity of victims in terms of species. Apart from sizable animals, generally known as victims of road collisions, recorded by police or road services, the table also documents mortality of small animals, probably constituting the "main mass" of road victims, however usually omitted or underestimated. The group of collision victims also encompasses animals that are relatively rare in Poland and/or perceived as endangered, based on international criteria, e.g. red-footed falcon *Falco vespertinus*, a barn owl *Tyto alba*, boreal owl *Aegolius funerenus*, bearded reedling *Panurus biarmicus,* hamster *Cricetur cricetur*, European bison *Bison bonasus*. Evidence proving that traffic exerts certain impact on this group of animals, pose a significant argument for the need to search for solutions that minimize the scale of road collisions.

The present initial Report cannot be treated as a source of information that fully describes the problem of road collisions with animals. First of all, we need to be aware that the recorded number of about 2000 victims is a scant proportion of animals that were actually killed on Polish roads within past months. The presented distribution of collisions on the national map does not need to present the frequency of collisions, but rather places, in which the most active observers operate. However, these are inadequacies typical for initial analyzes and mass projects. The register is based on involvement of a group of various roads users, communicating their observations voluntarily, which are valuable despite not being collected regularly. Probably just the results from several years, much broader, collected in this manner will allow to draw measurable conclusions when it comes to the scale of road traffic influence on animals, selection of sensitive spots on the national map, with an increased risk of collisions, as well as development of recommendations minimizing this phenomenon.

Operation of the Record System and development of this summary would not be possible without involvement of a group of active Users, who devoted their time to collect and enter their observations into the Record System. Thank you a lot for this! We would like to express special gratitude towards Bartłomiej Paul, for his professionalism and unique patience while supervising the project in IT terms.

Thank you for the involvement!

Karol Kustusch
Andrzej Wuczyński
Coordinators

Wroclaw, January 2016

Users with at least one observation entered:
Bold font indicates persons with the highest numer of observations entered. Nicks or initials mean persons who did not allowed to publish their full names.

Aneta Balcerkiewicz, AG, Anna Bator, Marek Bebłot, Łukasz Berlik, Jacek Betleja, Wesoly Bimbrownik, Maciej Bonk, Małgorzata Bukowa, Ewa Burda, EC, chelifer, Andrzej Chwierut, **Dawid Cząstkiewicz**, Birdwatcher, daro2726, Joanna Duriasz, , filip filip, garrulus, Małgorzata Goc, Grzegorz Gołębniak, **Arkadiusz Gorczewski**, jason, jewiniec, Adam Juźwiak, Anna Kamilewicz, Tomasz Kalinowski, KM, Antoni Knychała, Aleksandra Kolanek, Agnieszka Konowalik, Kamil Konowalik, Agnieszka Kosicka, Alicja Kowalczyk, zwierzorek, Joanna Kowalska, Karol Kustusch, **Agnieszka Labudda**, Stanisław Łubieński, Łukasz, Łukasz, LeszekM, maciek, Magda, Maksool, Konrad Marczewski, Tomasz Maszkało, Hubert Mateuszczyk, **Krzysztof Matyjasik**, Sebastian Menderski, md, MG, MK, MK, MT, MU, **Błażej Nowak**, p333, Bartek Paul, **Barbara Rutkowska**, Justyna Rybak, Saszka, Jarosław Słowikowski, **Bartosz Smyk**, **Przemysław Stolarz**, Anna Struczewska, Paweł Szczepaniak, Anna Szpara, **Hanna Sztwiertnia**, TK, Katarzyna Turzańska, Jacek Udolf, Ela Urbaniak, Wacek, Klaudia Wala, **Marcin Wężyk**, WJ, Andrzej Wuczyński, Robert Wróblewski.

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