

Supplementary Material - Spatio-temporal hotspots of wildlife-vehicle collisions in Poland: How congruent are mammals, birds, reptiles and amphibians?

Table S1. List of animal species recorded in wildlife-car collision events in Poland, extracted from the PROS database from January 2000 until December 2022, with number of records, percentage from the total database, number of individuals and rate individuals/records for each species. The list is presented by the group, and ordered by decreasing values of the number of records. The (few) cases not accurately identified at the species level, are indicated by the generic name plus “sp”. Less than 5.8% of records of wildlife-vehicle collisions were classified as live animals.

Group	Species	Records	Percentage	Individuals	Rate individuals/records
Amphibians	<i>Bufo bufo</i>	913	4.405	6725	7.366
Amphibians	<i>Rana temporaria</i>	75	0.362	717	9.560
Amphibians	<i>Bufo viridis</i>	72	0.347	382	5.306
Amphibians	<i>Pelophylax esculentus complex</i>	58	0.280	110	1.897
Amphibians	<i>Pelobates fuscus</i>	31	0.150	334	10.774
Amphibians	<i>Rana sp.</i>	31	0.150	74	2.387
Amphibians	<i>Rana arvalis</i>	26	0.125	46	1.769
Amphibians	<i>Lissotriton vulgaris</i>	20	0.096	33	1.650
Amphibians	<i>Salamandra salamandra</i>	8	0.039	12	1.500
Amphibians	<i>Triturus cristatus</i>	8	0.039	21	2.625
Amphibians	<i>Pelophylax esculentus</i>	5	0.024	5	1.000
Amphibians	<i>Hyla sp.</i>	4	0.019	4	1.000
Amphibians	<i>Bufo calamita</i>	3	0.014	3	1.000
Amphibians	<i>Pelophylax ridibundus</i>	3	0.014	23	7.667
Amphibians	<i>Bombina bombina</i>	2	0.010	10	5.000
Amphibians	<i>Lissotriton montandoni</i>	1	0.005	1	1.000
Birds	<i>Columba livia</i>	1101	5.312	1114	1.012

Birds	<i>Turdus merula</i>	501	2.417	505	1.008
Birds	<i>Passer domesticus</i>	381	1.838	412	1.081
Birds	<i>Columba palumbus</i>	221	1.066	223	1.009
Birds	<i>Corvus monedula</i>	178	0.859	179	1.006
Birds	<i>Buteo buteo</i>	176	0.849	178	1.011
Birds	<i>Passer sp.</i>	162	0.782	169	1.043
Birds	<i>Streptopelia decaocto</i>	154	0.743	154	1.000
Birds	<i>Turdus philomelos</i>	154	0.743	155	1.006
Birds	<i>Erithacus rubecula</i>	149	0.719	269	1.805
Birds	<i>Turdus pilaris</i>	148	0.714	154	1.041
Birds	<i>Phasianus colchicus</i>	147	0.709	148	1.007
Birds	<i>Hirundo rustica</i>	144	0.695	154	1.069
Birds	<i>Sturnus vulgaris</i>	142	0.685	146	1.028
Birds	<i>Strix aluco</i>	132	0.637	132	1.000
Birds	<i>Garrulus glandarius</i>	116	0.560	118	1.017
Birds	<i>Passer montanus</i>	112	0.540	121	1.080
Birds	<i>Anas platyrhynchos</i>	107	0.516	115	1.075
Birds	<i>Emberiza citrinella</i>	93	0.449	93	1.000
Birds	<i>Corvus cornix</i>	80	0.386	83	1.038
Birds	<i>Fringilla coelebs</i>	80	0.386	82	1.025
Birds	<i>Corvus frugilegus</i>	71	0.343	88	1.239
Birds	<i>Parus major</i>	70	0.338	72	1.029
Birds	<i>Dendrocopos major</i>	63	0.304	64	1.016
Birds	<i>Pica pica</i>	57	0.275	58	1.018
Birds	<i>Lanius collurio</i>	54	0.261	54	1.000
Birds	<i>Chroicocephalus ridibundus</i>	50	0.241	50	1.000
Birds	<i>Asio otus</i>	49	0.236	49	1.000
Birds	<i>Larus argentatus</i>	42	0.203	42	1.000
Birds	<i>Motacilla alba</i>	39	0.188	40	1.026
Birds	<i>Perdix perdix</i>	35	0.169	37	1.057

Birds	<i>Carduelis cannabina</i>	31	0.150	33	1.065
Birds	<i>Sylvia atricapilla</i>	31	0.150	31	1.000
Birds	<i>Carduelis carduelis</i>	27	0.130	28	1.037
Birds	<i>Cyanistes caeruleus</i>	26	0.125	27	1.038
Birds	<i>Picus viridis</i>	26	0.125	26	1.000
Birds	<i>Chloris chloris</i>	25	0.121	26	1.040
Birds	<i>Ciconia ciconia</i>	22	0.106	22	1.000
Birds	<i>Phoenicurus ochruros</i>	21	0.101	22	1.048
Birds	<i>Sylvia communis</i>	18	0.087	18	1.000
Birds	<i>Delichon urbicum</i>	17	0.082	23	1.353
Birds	<i>Sylvia curruca</i>	16	0.077	16	1.000
Birds	<i>Alauda arvensis</i>	14	0.068	14	1.000
Birds	<i>Larus canus</i>	14	0.068	14	1.000
Birds	<i>Accipiter nisus</i>	13	0.063	13	1.000
Birds	<i>Apus apus</i>	12	0.058	12	1.000
Birds	<i>Coccothraustes coccothraustes</i>	12	0.058	12	1.000
Birds	<i>Scolopax rusticola</i>	12	0.058	12	1.000
Birds	<i>Caprimulgus europaeus</i>	11	0.053	11	1.000
Birds	<i>Larus sp.</i>	11	0.053	11	1.000
Birds	<i>Cygnus olor</i>	10	0.048	10	1.000
Birds	<i>Falco tinnunculus</i>	10	0.048	10	1.000
Birds	<i>Emberiza calandra</i>	9	0.043	10	1.111
Birds	<i>Phoenicurus phoenicurus</i>	9	0.043	9	1.000
Birds	<i>Turdus viscivorus</i>	9	0.043	9	1.000
Birds	<i>Fulica atra</i>	8	0.039	8	1.000
Birds	<i>Motacilla flava</i>	8	0.039	8	1.000
Birds	<i>Sitta europaea</i>	8	0.039	8	1.000
Birds	<i>Spinus spinus</i>	7	0.034	7	1.000
Birds	<i>Troglodytes troglodytes</i>	7	0.034	9	1.286
Birds	<i>Acrocephalus palustris</i>	6	0.029	6	1.000

Birds	<i>Alcedo atthis</i>	6	0.029	6	1.000
Birds	<i>Jynx torquilla</i>	6	0.029	6	1.000
Birds	<i>Poecile palustris</i>	6	0.029	6	1.000
Birds	<i>Riparia riparia</i>	6	0.029	12	2.000
Birds	<i>Saxicola rubetra</i>	6	0.029	6	1.000
Birds	<i>Aegithalos caudatus</i>	5	0.024	5	1.000
Birds	<i>Botaurus stellaris</i>	5	0.024	5	1.000
Birds	<i>Ficedula hypoleuca</i>	5	0.024	5	1.000
Birds	<i>Gallinula chloropus</i>	5	0.024	5	1.000
Birds	<i>Muscicapa striata</i>	5	0.024	5	1.000
Birds	<i>Phylloscopus trochilus</i>	5	0.024	5	1.000
Birds	<i>Tyto alba</i>	5	0.024	5	1.000
Birds	<i>Vanellus vanellus</i>	5	0.024	5	1.000
Birds	<i>Acrocephalus schoenobaenus</i>	4	0.019	4	1.000
Birds	<i>Corvus corax</i>	4	0.019	4	1.000
Birds	<i>Lullula arborea</i>	4	0.019	4	1.000
Birds	<i>Serinus serinus</i>	4	0.019	4	1.000
Birds	<i>Acrocephalus arundinaceus</i>	3	0.014	3	1.000
Birds	<i>Dryocopus martius</i>	3	0.014	3	1.000
Birds	<i>Ixobrychus minutus</i>	3	0.014	3	1.000
Birds	<i>Lanius excubitor</i>	3	0.014	3	1.000
Birds	<i>Regulus ignicapilla</i>	3	0.014	3	1.000
Birds	<i>Regulus regulus</i>	3	0.014	3	1.000
Birds	<i>Accipiter gentilis</i>	2	0.010	2	1.000
Birds	<i>Acrocephalus scirpaceus</i>	2	0.010	2	1.000
Birds	<i>Anthus trivialis</i>	2	0.010	2	1.000
Birds	<i>Ardea cinerea</i>	2	0.010	2	1.000
Birds	<i>Athene noctua</i>	2	0.010	2	1.000
Birds	<i>Coturnix coturnix</i>	2	0.010	2	1.000
Birds	<i>Dendrocopos minor</i>	2	0.010	2	1.000

Birds	<i>Falco vespertinus</i>	2	0.010	2	1.000
Birds	<i>Fringilla montifringilla</i>	2	0.010	18	9.000
Birds	<i>Luscinia megarhynchos</i>	2	0.010	2	1.000
Birds	<i>Merops apiaster</i>	2	0.010	2	1.000
Birds	<i>Phylloscopus collybita</i>	2	0.010	2	1.000
Birds	<i>Pyrrhula pyrrhula</i>	2	0.010	2	1.000
Birds	<i>Rallus aquaticus</i>	2	0.010	2	1.000
Birds	<i>Tetrastes bonasia</i>	2	0.010	2	1.000
Birds	<i>Actitis hypoleucos</i>	1	0.005	1	1.000
Birds	<i>Aegolius funereus</i>	1	0.005	1	1.000
Birds	<i>Aix galericulata</i>	1	0.005	1	1.000
Birds	<i>Aix sponsa</i>	1	0.005	1	1.000
Birds	<i>Alopochen aegyptiaca</i>	1	0.005	1	1.000
Birds	<i>Anser fabalis</i>	1	0.005	1	1.000
Birds	<i>Bombycilla garrulus</i>	1	0.005	1	1.000
Birds	<i>Buteo lagopus</i>	1	0.005	1	1.000
Birds	<i>Columba oenas</i>	1	0.005	1	1.000
Birds	<i>Crex crex</i>	1	0.005	1	1.000
Birds	<i>Cuculus canorus</i>	1	0.005	1	1.000
Birds	<i>Dendrocopos medius</i>	1	0.005	1	1.000
Birds	<i>Emberiza hortulana</i>	1	0.005	1	1.000
Birds	<i>Emberiza schoeniclus</i>	1	0.005	1	1.000
Birds	<i>Erythrura erythrura</i>	1	0.005	1	1.000
Birds	<i>Falco peregrinus</i>	1	0.005	1	1.000
Birds	<i>Galerida cristata</i>	1	0.005	1	1.000
Birds	<i>Grus grus</i>	1	0.005	1	1.000
Birds	<i>Larus fuscus</i>	1	0.005	1	1.000
Birds	<i>Larus marinus</i>	1	0.005	1	1.000
Birds	<i>Loxia curvirostra</i>	1	0.005	1	1.000
Birds	<i>Luscinia luscinia</i>	1	0.005	1	1.000

Birds	<i>Lymnocyptes minimus</i>	1	0.005	1	1.000
Birds	<i>Mergus merganser</i>	1	0.005	1	1.000
Birds	<i>Oenanthe oenanthe</i>	1	0.005	1	1.000
Birds	<i>Oriolus oriolus</i>	1	0.005	1	1.000
Birds	<i>Panurus biarmicus</i>	1	0.005	1	1.000
Birds	<i>Picus canus</i>	1	0.005	1	1.000
Birds	<i>Podiceps cristatus</i>	1	0.005	1	1.000
Birds	<i>Prunella modularis</i>	1	0.005	1	1.000
Birds	<i>Saxicola torquata</i>	1	0.005	1	1.000
Birds	<i>Strix uralensis</i>	1	0.005	1	1.000
Birds	<i>Sylvia nisoria</i>	1	0.005	1	1.000
Birds	<i>Tadorna tadorna</i>	1	0.005	1	1.000
Birds	<i>Turdus iliacus</i>	1	0.005	1	1.000
Birds	<i>Upupa epops</i>	1	0.005	1	1.000
Mammals	<i>Erinaceus sp.</i>	3872	18.681	3966	1.024
Mammals	<i>Vulpes vulpes</i>	1983	9.567	2009	1.013
Mammals	<i>Capreolus capreolus</i>	972	4.690	1397	1.437
Mammals	<i>Sciurus vulgaris</i>	822	3.966	825	1.004
Mammals	<i>Lepus europaeus</i>	566	2.731	579	1.023
Mammals	<i>Martes foina</i>	539	2.600	542	1.006
Mammals	<i>Meles meles</i>	526	2.538	533	1.013
Mammals	<i>Felis catus</i>	473	2.282	476	1.006
Mammals	<i>Martes sp.</i>	464	2.239	466	1.004
Mammals	<i>Sus scrofa</i>	350	1.689	728	2.080
Mammals	<i>Nyctereutes procyonoides</i>	221	1.066	222	1.005
Mammals	<i>Martes martes</i>	159	0.767	160	1.006
Mammals	<i>Erinaceus roumanicus</i>	142	0.685	150	1.056
Mammals	<i>Mustela putorius</i>	129	0.622	130	1.008
Mammals	<i>Rattus norvegicus</i>	114	0.550	115	1.009
Mammals	<i>Talpa europaea</i>	112	0.540	118	1.054

Mammals	<i>Canis familiaris</i>	93	0.449	104	1.118
Mammals	<i>Alces alces</i>	88	0.425	97	1.102
Mammals	<i>Mustela nivalis</i>	72	0.347	75	1.042
Mammals	<i>Lutra lutra</i>	70	0.338	70	1.000
Mammals	<i>Cervus elaphus</i>	67	0.323	125	1.866
Mammals	<i>Castor fiber</i>	45	0.217	45	1.000
Mammals	<i>Cricetus cricetus</i>	34	0.164	34	1.000
Mammals	<i>Apodemus agrarius</i>	31	0.150	33	1.065
Mammals	<i>Rodentia</i>	29	0.140	29	1.000
Mammals	<i>Erinaceus europaeus</i>	21	0.101	21	1.000
Mammals	<i>Mustela erminea</i>	20	0.096	20	1.000
Mammals	<i>Procyon lotor</i>	20	0.096	22	1.100
Mammals	<i>Dama dama</i>	18	0.087	31	1.722
Mammals	<i>Mustela vison</i>	17	0.082	17	1.000
Mammals	<i>Canis lupus</i>	16	0.077	16	1.000
Mammals	<i>Sorex araneus</i>	16	0.077	20	1.250
Mammals	<i>Ondatra zibethicus</i>	10	0.048	10	1.000
Mammals	<i>Apodemus flavicolis</i>	9	0.043	9	1.000
Mammals	<i>Chiroptera</i>	9	0.043	9	1.000
Mammals	<i>Soricomorpha</i>	7	0.034	8	1.143
Mammals	<i>Glis glis</i>	5	0.024	5	1.000
Mammals	<i>Bison bonasus</i>	4	0.019	4	1.000
Mammals	<i>Neomys fodiens</i>	4	0.019	4	1.000
Mammals	<i>Apodemus sylvaticus</i>	3	0.014	3	1.000
Mammals	<i>Eptesicus serotinus</i>	3	0.014	3	1.000
Mammals	<i>Oryctolagus cuniculus</i>	3	0.014	3	1.000
Mammals	<i>Pipistrellus sp.</i>	3	0.014	3	1.000
Mammals	<i>Sorex minutus</i>	3	0.014	3	1.000
Mammals	<i>Arvicola amphibius</i>	2	0.010	2	1.000
Mammals	<i>Microtus arvalis</i>	2	0.010	2	1.000

Mammals	<i>Muscardinus avellanarius</i>	2	0.010	2	1.000
Mammals	<i>Myodes glareolus</i>	2	0.010	2	1.000
Mammals	<i>Nyctalus noctula</i>	2	0.010	2	1.000
Mammals	<i>Ovis ammon</i>	2	0.010	5	2.500
Mammals	<i>Canis aureus</i>	1	0.005	1	1.000
Mammals	<i>Lynx lynx</i>	1	0.005	1	1.000
Mammals	<i>Micromys minutus</i>	1	0.005	1	1.000
Mammals	<i>Mus musculus</i>	1	0.005	1	1.000
Mammals	<i>Myotis daubentonii</i>	1	0.005	1	1.000
Mammals	<i>Myotis mystacinus</i>	1	0.005	1	1.000
Mammals	<i>Pipistrellus pipistrellus</i>	1	0.005	1	1.000
Mammals	<i>Plecotus auritus</i>	1	0.005	1	1.000
Mammals	<i>Spermophilus citellus</i>	1	0.005	1	1.000
Mammals	<i>Ursus arctos</i>	1	0.005	1	1.000
Reptiles	<i>Natrix natrix</i>	516	2.490	996	1.930
Reptiles	<i>Anguis fragilis</i>	145	0.700	162	1.117
Reptiles	<i>Lacerta agilis</i>	45	0.217	45	1.000
Reptiles	<i>Vipera berus</i>	40	0.193	40	1.000
Reptiles	<i>Zootoca vivipara</i>	15	0.072	18	1.200
Reptiles	<i>Coronella austriaca</i>	8	0.039	9	1.125
Reptiles	<i>Emys orbicularis</i>	2	0.010	2	1.000
Reptiles	<i>Zamenis longissimus</i>	1	0.005	1	1.000

Figure S1. Spatial distribution of full dataset of wildlife-car collision events by animal group (amphibians, birds, mammals and reptiles) from 2000 to 2022, and 10 x 10 km squares grid covering the whole country of Poland.

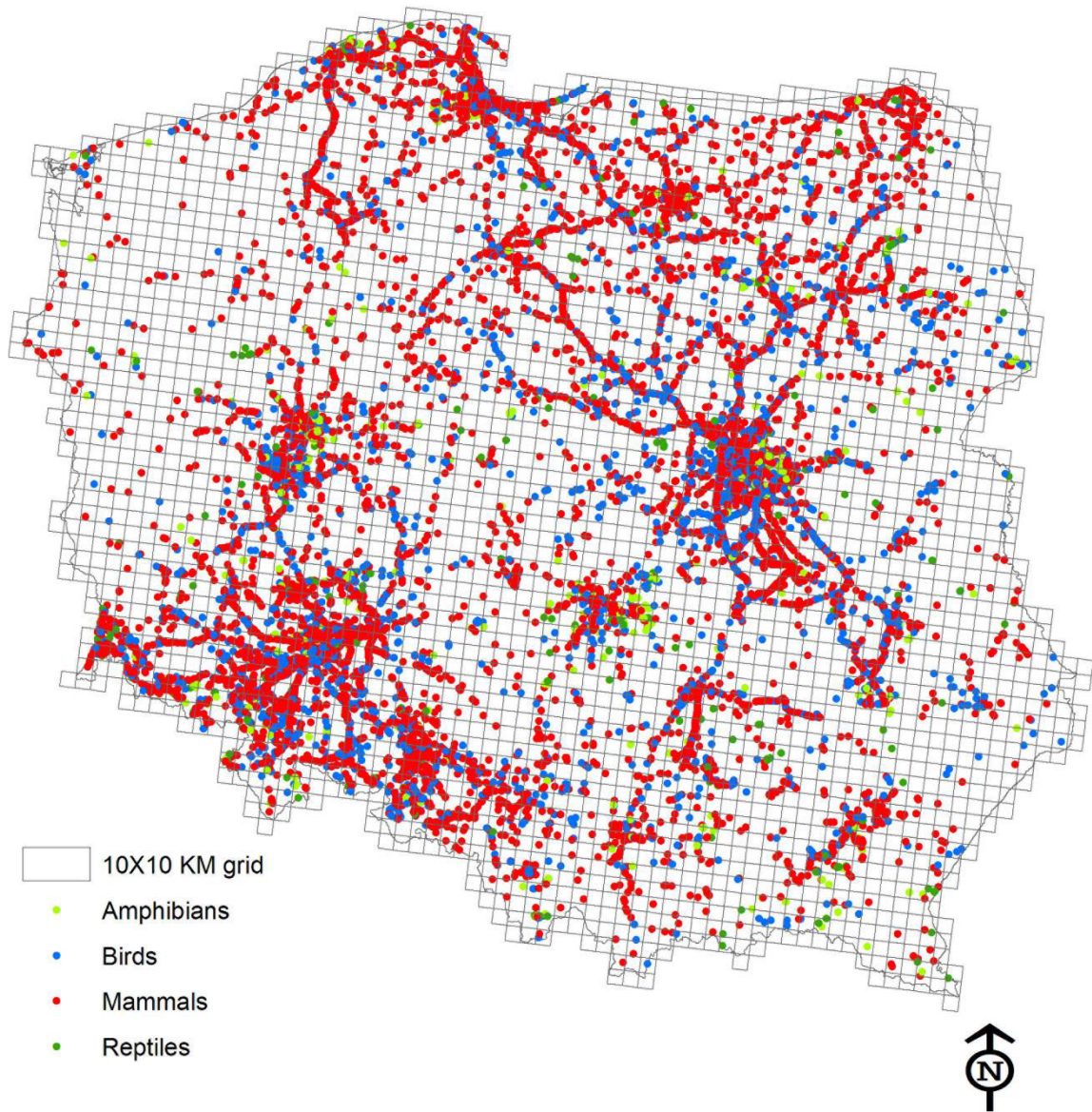


Figure S2. Temporal changes in the spatial distribution of wildlife-vehicle collisions (roadkills) in Poland during 2015-2022. Maps are based on the kernel density of overall WVC incidents (amphibians, reptiles, birds and mammals), considering the number of individuals involved. The values of kernel density are presented in a coloured gradient from lower (dark green), moderate (yellow) to higher (dark red).

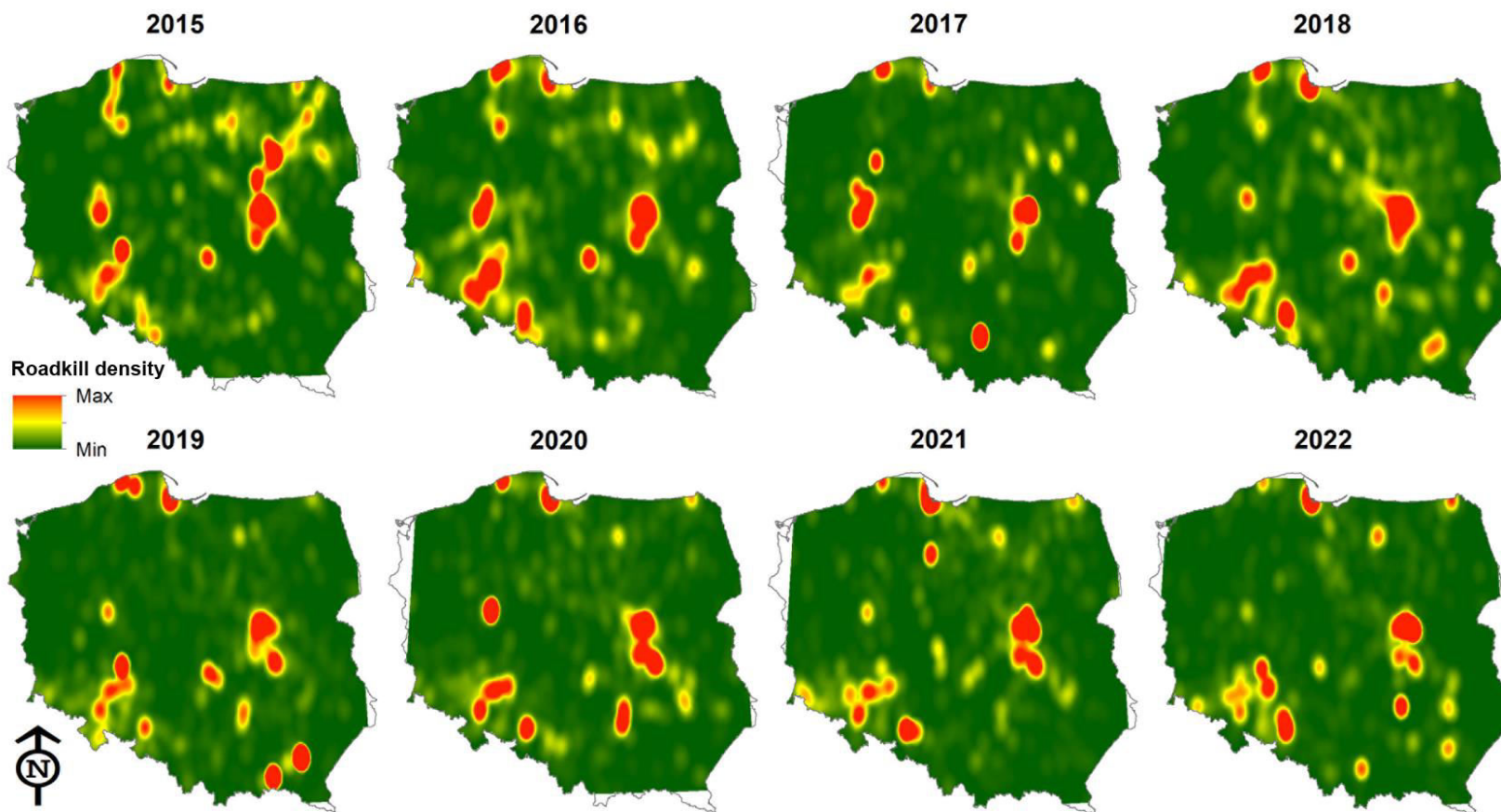


Figure S3. The number of individuals involved in wildlife-car collision events (log-transformed), concerning the type of dominant environment, by animal groups. The yellow dot in the middle of the boxplots represents the mean values.

