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FREE-RANGING DOMESTIC DOGS (*CANIS FAMILIARIS*) IN CENTRAL POLAND: DENSITY, PENETRATION RANGE AND DIET COMPOSITION

ABSTRACT: The aim of this study was to assess the density and diet composition of free-ranging dogs in Poland. The study was conducted in a field and forest mosaic in the central part of the country in the years 2005–2011. The density of the free-ranging dogs was assessed during night counts along repeated transect routes. The number of dogs seen and the feasible observation area were recorded to calculate density index for each control. The day and night counts captured data on group composition and penetration range. Diets were studied through scat analyses. The dog density ranged from 2.2–3.1 ind. km^{-2} depending on the area. Most dogs were observed alone, and 40% formed groups of 2 to 5 dogs. Most groups were recorded close to buildings, but the group organisation changed (especially during the daytime) with increasing distance from the buildings: 35% of dogs in the village were in groups, but 55% of dogs formed groups at a distance of more than 100 m from the buildings. The night proportion of dogs in groups was approximately 50%, regardless of the distance. Their scats contained mostly cereal given by farmers. The prey remains were game species: roe deer (1.3% of occurrences in summer and 12% in winter), brown hare (3–4%), small mammals (5–9.5%) and birds (approx. 1.5%). The study demonstrated that the abundance of dogs in the rural areas of central Poland may play an important role in the ecosystem.

KEY WORDS: rural areas, distances from buildings, group composition, predation, habitat exploration

1. INTRODUCTION

The anthropogenic predators: domestic dogs (*Canis familiaris)* and cats (*Felis catus)* are among the most common carnivores in the world (Liberg *et al.* 2000, Vanak and Gompper 2009). A number of studies have investigated cat predation, activity patterns, interactions with other carnivores or hybridization problems in Europe, including in Poland (e.g., Pielowski 1976, review in: Fitzgerald and Turner 2000, review in: Liberg *et al.* 2000, review in: Wayne and Brown 2001, Daniels *et al.* 2001, Woods *et al.* 2003, Pierpaoli *et al.* 2003, Bíro *et al.* 2005, Goszczyński *et al.* 2009, Krauze-Gryz *et al.* 2012a, b). However, only a few studies have considered non-urban dog interactions with wildlife in Europe (Pielowski 1976, Boitani 1983, Romanowski 1985, Boitani and Ciucci 1995, Boitani *et al.* 1995, Okarma *et al.* 1995, Krauze-Gryz *et al.* 2012b). Free-ranging dogs can act as predators, prey, competitors, disease reservoirs and vectors (Vanak and Gompper 2009). Hy-

bridisation with dogs may pose an important threat to wild canids (Wayne and Brown 2001). Dogs are also perceived dangerous to humans, i.e., in Italian survey, personal safety from dogs was stated as the most common fear (Slater *et al.* 2008). Dog attacks on livestock can create financial problems, but damages caused by dogs may be attributed to wolves (Kossak 1998). We expect numerous direct and indirect effects on wildlife in central Poland due to the highly fragmented environment and free-ranging dogs. This situation results in an influx of domestic dogs in the remaining natural areas. An increased dog presence on the edges of natural reserves can be perceived as an edge effect (Lacerda *et al.* 2009). Dogs as a dominant species are known to interact with other carnivores, i.e., Indian foxes (*Vulpes bengalensis)* (Vanak and Gompper 2010), maned wolves (*Chrysocyon brachyurus)* (Lacerda *et al.* 2009) and chilla foxes (*Lycalopex griseus)* (Silva-Rodríguez *et al.* 2010). Dogs in rural areas of central Poland influenced red fox (*Vulpes vulpes*) space utilization (Krauze-Gryz *et al.* 2012b). They were reported to kill red foxes, raccoon dogs (*Nyctereutes procyonoides*), badgers (*Meles meles*) and polecats (*Mustela putorius*) (Goszczyński and Skoczyńska 1996, Goszczyński 2004, Gryz *et al.* 2011). Free-ranging and feral dogs may compete with wolves for food and range in Italy (Boitani 1983) but dogs can be killed by wild predators, e.g., leopards (*Panthera pardus)*, lions (*Panthera leo)*, hyenas (*Crocuta crocuta*), coyotes (*Canis latrans)* or wolves (Vanak and Gompper 2009). Such contact between dogs and wild predators creates circumstances advantageous for disease transmission (Butler *et al.* 2004). Most dog populations are free-ranging and unvaccinated, and rabies and canine distemper have resulted in severe population declines in several endangered carnivores near high-density dog populations (Vanak and Gompper 2009). In Poland, dogs make regular contact with foxes (Goszczyński *et al.* 2008) because the foxes come close to buildings (Krauze-Gryz *et al.* 2012a). Dogs additionally make contact with other scavenging species while sharing the same carcasses (Selva *et al.* 2005).

According to Polish Hunting Association between 2004 and 2010 on average 38,924 feral and 97,290 free-ranging dogs were observed in hunting grounds annually killing on average 260 domestic animals (cattle, sheep and goats), 264 red deer, 111 fallow deer, 8903 roe deer, 1,178 wild boars, and 16,135 brown hares (Zarząd Główny PZŁ, http://src.pzlow.pl). Although these statistics were based on information from hunters not a regular study, they show that free-ranging dogs can be perceived as a threat to domestic animals and game.

Legal status of free-ranging dogs in Poland has changed over years. Since 1959 they were treated as game pests and hunters were obliged to eliminate dogs found in the hunting ground (Dz.U. 1959 nr 36 poz. 226). Next, between 1995 and 1997 it was forbidden to shot dogs (Dz.U. 2005 nr 127 poz. 1066). From 1997 dogs that went feral could be killed if they were more than 200 m from the nearest human settlements and if they posed direct threat to wildlife (Dz.U. 1997 nr 111 poz. 724). Because this regulation were imprecise (i.e. it was difficult to decide if dogs were actually feral) in 2012 an amendment to this act was introduced (Dz.U. 2011 nr 230 poz. 1373). Nowadays, it is allowed to kill dogs if they pose direct threat to people or animals. Nevertheless, various organizations for animal welfare want killing free-ranging dogs to be banned absolutely.

In the light of this, our aim was to assess the density of free-ranging dogs in central Poland, analyse their diet, and discuss possible influences on wildlife.

2. STUDY AREA

Our investigation included two survey sites, Dobieszyn and Rogów, both located in central Poland in a distance of approx. 80 km. The field work was concentrated around Brzeźce village (51°40'07"N; 21°00'15"E) in Dobieszyn and Marianów Rogowski (51°49'10"N; 19°53'53"E) in Rogów (Fig. 1). These rural areas in central Poland represent a typical field-forest mosaic with a prevalence of open areas. Woods of a few hundred hectares are surrounded by a fine mosaic of patches of different crops, pastures, fallow land and groups of trees. Villages (primarily consisting of a row of settlements along a road) and single farms are evenly distrib-

uted in the area within a distance of no more than a few kilometres from each other. The Dobieszyn area includes numerous summer houses grouped in three places close to and within the village of Brzeźce. Farms in these regions are typically small (i.e., less than 10% of farms are larger than 15 ha; most are 1–10 ha big; Central Statistical Office-GUS data). The main tree species in the forest is the Scots pine (*Pinus sylvestris*), with an admixture of oaks (*Quercus* spp.).

This region is affected by the mild oceanic climate of Western Europe and the harsh and dry continental climate of Eastern Europe and Asia. The duration of the growing season is approximately 210 days. The total precipitation is as much as 600 mm per year, and the mean ambient temperature ranges from –4°C in January to +18°C in July. A door-to-door survey of cats in the area (Krauze 2008) recorded data indicating that most farms have dogs (D. Krauze-Gryz, J. Gryz, unpubl.). The free-ranging dogs (Slater *et al.* 2008) in the area have owners, but the dogs are either not confined to their owners' property or allowed to leave settlements without supervision, especially at night. Inhabitants of nearby towns and cities also abandon dogs in the villages. No large carnivores are present in the study areas; other carnivores include the red fox, pine and stone martens (*Martes martes*, *M. foina*), badger, polecat, stoat (*Mustela erminea*), least weasel (*Mustela nivalis*) and domestic cat (Gryz *et al.* 2011, Krauze-Gryz *et al.* 2012b). Ungulates are primarily represented by roe deer (*Capreolus capreolus*), whose density in Rogów numbers among the highest in Poland and Europe (17–67 ind. 100 ha^{-1}, depending on the forest complex). The density of the roe deer in Dobieszyn is a few times lower, yet, no exact data are available for the area. Other ungulates include the red deer (*Cervus elaphus*, rare in both areas), fallow deer (*Dama dama*, introduced to both areas) and, occasionally, moose (*Alces alces*) (Gryz *et al.* 2011, Krauze-Gryz D., Gryz J., unpubl. data). Brown hare (*Lepus europaeus*) is approximately four times more abundant in Dobieszyn than Rogów (Gryz and Krauze 2007).

3. METHODS

Day and night counts were conducted on repeated census routes (Fig. 1) (Krauze 2008, Goszczyński *et al.* 2009). They were established randomly and run along local, field and forest roads through a mosaic of different habitats (typical for the study areas) and villages. The transect route length was approximately 30.7 km in Rogów and 19.9 km in Dobieszyn. The route passes by the vicinity of 180 and 100 farms in Rogów and Dobieszyn, respectively. The possibility of counting the same individual twice during the same night was slight owing to transects' length and their distribution in the study area. If, however, the same individual was

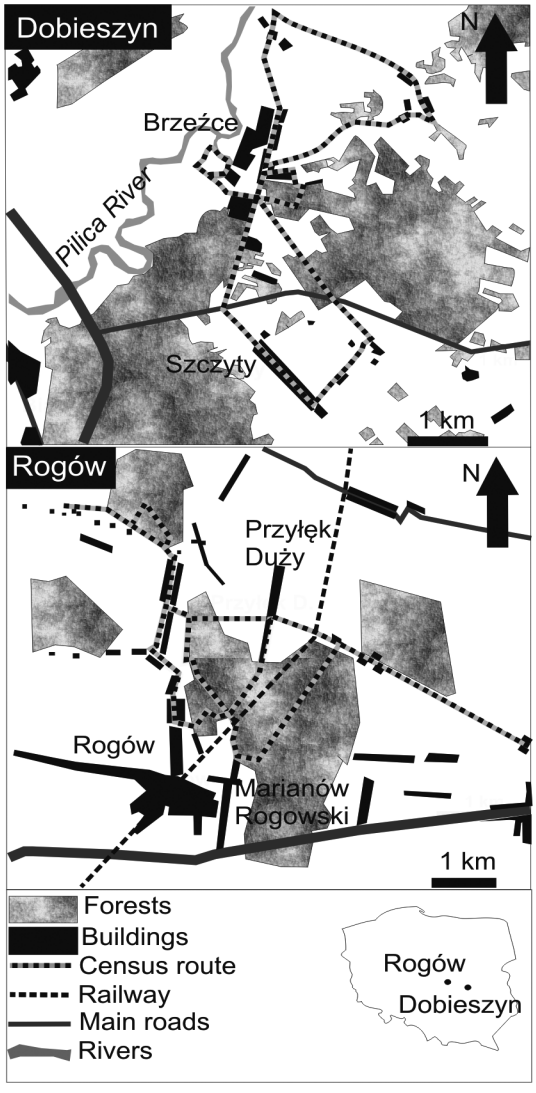

Fig. 1. Localisation of census routes in the study areas.

registered twice during one control it was not included into analyses. The daytime counts were primarily conducted on foot (by one or two observers at the same time) and thus, the entire route in each site was divided into three parts (of 5.8 to 9.5 km) that were easily covered at one time. The counts were conducted for five to six days per month at each study site during different times throughout the day. The night counts were accomplished with a spotlight from a car (always two observers were engaged at the same time) driving at an average speed of less than 20 km hour^{-1} (Krauze 2008). The maximum beam range was estimated at 100 m, but the actual range changed with vegetation development, necessitating empirical adjustment during each census (see below). The night counts were conducted once monthly in each study site. Each count covered the entire transect route in the study site. We attempted to choose days with clear weather because rain, snow or fog diminished visibility (Goszczyński *et al.* 2009). The counts were conducted from *ca*. 9 p.m. until midnight, and one count took *ca*. two hours.

The strip of land surveyed was a maximum of 100 m wide. This distance let us distinguish dogs from other medium mammals present in the area. The observation conditions and animal detection within the observation strip differed markedly depending on the weather (e.g., the presence or absence of snow), vegetation cover and the dates of the onset of field work, such as ploughing, harvesting and haymaking. To account for this variation, we conducted detailed monthly assessments of the actual area feasibility. We assessed the routes alongside and across the width of the observation strip (adjusted to the actual visibility and possibility of noticing a dog) within various habitats (i.e., arable lands, meadows, fallow lands). We only included the areas where the vegetation cover made dog sighting possible. The area with feasible observations considerably varied throughout each year; the area was smallest in summer (June–July) and largest in winter and early spring (December–March) (Goszczyński *et al.* 2009). Dog density was assessed on the basis of night counts, when many dogs are unleashed and are allowed to run free. The number of dogs seen and the feasible observation area were recorded during each observation so a density index could be calculated from each control (Goszczyński *et al.* 2009).

When a dog was noticed, we noted whether it was in a village or, if not an approximate distance from the nearest settlements was measured. We recorded the dog size and whether it was alone or in group. We sorted dogs into three size categories: small (i.e., dachshund), medium (i.e., cocker spaniel) and large (i.e., German shepherd); however, most of the dogs were mongrels. If a person (and potential dog owner) was nearby, we did not take the dog observation into account. However, dog walkers were only observed sporadically in a part of the Dobieszyn area, close to Brzeźce village. Only dogs outside properties were counted.

In Dobieszyn, day counts were conducted from December 2005 to April 2007 and night counts from January 2005 to December 2007 and November and December 2010. In Rogów, day counts were conducted between January 2006 and November 2007 and May 2011 and night counts from January 2005 and December 2007 and December 2008, November 2009 and October 2010.

Data on the number of dogs shot by hunters and the red fox hunting bags in Rogów were taken from the Forest Experimental Station in Rogów (such data was not available for Dobieszyn).

Data on feral dogs that breed in the wild were obtained from random observations in Rogów from 2001–2008. The data are from previous systematic forest penetration during other research (Goszczyński *et al.* 2005, Gryz *et. al.* 2011). Additionally, a study focused on red foxes that included a den search was conducted in Rogów from 1999–2006 (Goszczyński *et al.* 2008).

Scats were collected along the same census routes during daytime transects from November 2005 to March 2008. Only samples found outside villages were included. We did not collect samples in the area where dog walkers were observed. In the laboratory, the scats were sieved under water, and the main components were identified. We recorded items belonging to different categories, summed the total occurrences, and calculated the percentage share for each category (Romanowski 1985, Litvaitis 2000).

We also recorded cases of dogs chasing or killing animals during fieldwork for this or other studies in the study areas.

4. RESULTS

We conducted 40 controls on the standard routes at night and 98 during the day in Rogów, while the respective numbers for Dobieszyn were 37 and 115. In Rogów, 67 dogs were registered at night in a total area of 3,328 ha, with an average night density of 2.2 ind.km^{-2} (SE=0.4). In Dobieszyn, we observed 71 dogs in 2,316 ha, with an average density of 3.1 ind.km^{-2} (SE=0.4). In both study sites, the highest densities were obtained in the spring (3 ind. km^{-2}, SE=1.0 in Rogów and 4.4 ind. km^{-2}, SE=1.2 in Dobieszyn), the lowest densities in Rogów were recorded in the winter (1.3 ind. km^{-2}, SE=0.4) and in the autumn in Dobieszyn (2.1 ind. km^{-2}, SE=0.6) (Fig. 2) but no significant difference was found between seasons (one-way ANOVA, P> 0.05).

Of the 407 dogs observed during both the day and night, most were observed alone (238 individuals), but 169 individuals formed groups that contained 2 to 5 individuals (Table 1). Because most of the dogs were mongrels, we did not classify their pedigree and only assigned them to one of three body size classifications (small, medium or large); small dogs were most frequent in the rural areas of our study sites (Table 1).

We registered most of the dogs during the day and night (χ^2=2.6, df=2, P> 0.05) in the villages or close to human properties (Table 1). However, the organisation of the dogs changed with increasing distance to buildings. In the village, most of them were observed individually (35% formed groups). When the distance increased to 100 m from the nearest human settlements, the number of dogs in groups increased (46%). When the distance was greater than 100 m, 55% of dogs were grouped (χ^2=11.27, df=2, P <0.005). This pattern was more obvious during the day (χ^2=12.29, df=2, P <0.005), while the proportion of dogs in groups at night was approximately 50%, regardless of distance (χ^2=1.01, df=2, P> 0.05) (Fig. 3). The disproportion between day and night was more visible in the vicinity of the buildings. More than 50% of dogs were observed in groups at distance of 100 m or more during both the day and night (Fig. 3).

Four cases of breeding in the wild were registered in the area of Rogów (distances from the nearest human settlements are given in brackets):

Table 1. Dog population characteristics (group composition, body size, and distance to buildings) in central Poland in the years 2005–2011.

Group size (n of ind.)	N of groups	% of groups
2	57	77.03
3	14	18.9
4	2	2.7
5	1	1.3
Total	74	100.0
Body size category	**N of dogs**	**% of dogs**
small	165	47.7
medium	99	28.6
large	82	23.7
Total	346	100.0

Distance to buildings	Observed dogs			
	Day		Night	
	N	%	N	%
in the village	160	58.0	79	60.3
≤100 m	54	19.6	31	23.7
>100 m	62	22.5	21	16.0
Total	276	100.0	131	100.0

- in 2003, a female with three juveniles was observed in a self-dug den in a forest (780 m),
- in 2005, three big, adult dogs that lived in an old badger sett in a forest were killed by hunters; all the dogs were in very good condition, and the tracks of pups were recorded at the den a few months earlier (530 m),
- in 2006, a female bred three or four juveniles in the cereal crops (250 m),
- in 2011, we found an old badger sett that was occupied by a group of dogs, although breeding was not confirmed in this case (520 m).

In Dobieszyn, two litters were bred in 2009 (4 juveniles) and 2010 (5 juv.) in a den located in a dense group of spruces on an abandoned property.

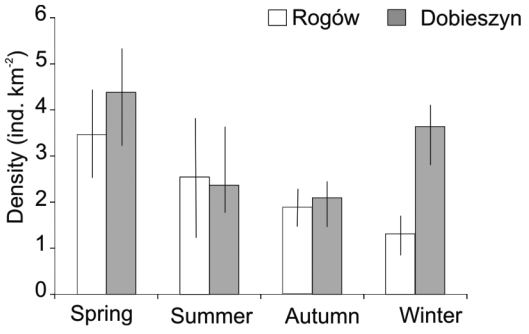

Fig. 2. Indices of dogs' density (±SE) on the basis of nightime counts on repeated census routes in central Poland in the years 2005–2010 (one-way ANOVA, $P > 0.05$).

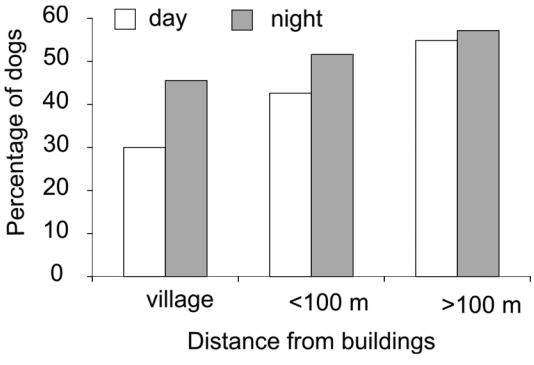

Fig. 3. Percentage of dogs that formed groups during day (χ^2=12.29, df=2, P <0.005), and night (χ^2=1.01, df=2, P> 0.05, chi-square test) with an increasing distance to buildings in central Poland in the years 2005–2011.

Each year from 2003–2006, hunters shot 27 to 66 dogs in the Rogów hunting district (in total 130.6 km^2).

Diet analyses were based on 417 scats (Table 2). We most frequently recorded remains of different plant origins in both areas (43 and 46% of total occurrences for winter and summer, respectively). These remains primarily included cereal (oats and less often maize), seeds (sunflower, pea and acorns) or fruit (apples or pears). All total cereal occurrences constituted an average of 23% in summer compared to 30% in winter. Among animals, small mammals (rodents and less often soricomorphs) were represented by *ca*. 5% of all items in winter and *ca*. 9% in summer. Birds were recorded infrequently (*ca*. 1%), and insects were only present in scats from the summer (more often in Dobieszyn – 13%, than in Rogów – 2%). Game remains included roe deer, recorded mostly in winter (12% of occurrences), and brown hare, which accounted for *ca*. 3 to 4% of all remains in both winter and summer. The rest were organic and inorganic parts (e.g., coal, wood, plastic, strings and pieces of fabric) and other material that were not identified.

Throughout the study period (primarily in winter 2005/2006), we found 26 carcasses of roe deer with signs of dog presence in Rogów and three in Dobieszyn. We identified dog tracks indicating that at least 8 (7 in Rogów, 1 in Dobieszyn) of those individuals were killed by dogs; dogs in groups killed their prey by chasing them into fences or railway embankments. Also, in Rogów, we witnessed an organised group of dogs during a successful hunting. The group chased a hare onto a road embankment and killed it.

5. DISCUSSION

Density assessments were based on night counts because dogs are most active at this time (Scott and Causey 1973, Daniels and Bekoff 1989, Boitani and Ciucci 1995, Krauze-Gryz *et al.* 2012b). Dogs in the study area are often released and allowed to roam freely at night. The data showed that on average, dogs were less numerous than domestic cats (densities from 3.9–6.1 ind.km^{-2}, Krauze 2008) but more abundant than red foxes (0.9–1.2 ind. km^{-2}, Krauze-Gryz D.,

Table 2. Occurrence percentage of food items in dog scats from two study sites in the years 2005–2008.

Food item	Winter						Summer					
	Rogów		Dobieszyn		Total		Rogów		Dobieszyn		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Cereal	78	30.0	52	36.4	130	32.3	25	30.1	12	16.0	37	23.4
Other seeds	4	1.5	2	1.4	6	1.5	2	2.4	3	4.0	5	3.2
Fruit	4	1.5	3	2.1	7	1.7	6	7.2	7	9.3	13	8.2
Other plant remains	21	8.1	11	7.7	32	7.9	7	8.4	11	14.7	18	11.4
Roe deer	40	15.4	8	5.6	48	11.9	2	2.4	0	0.0	2	1.3
Brown hare	5	1.9	8	5.6	13	3.2	2	2.4	4	5.3	6	3.8
Small mammals	12	4.6	8	5.6	20	5.0	8	9.6	7	9.3	15	9.5
Bird	6	2.3	0	0.0	6	1.5	1	1.2	1	1.3	2	1.3
Insect	0	0.0	0	0.0	0	0.0	2	2.4	10	13.3	12	7.6
Organic indet.	81	31.2	48	33.6	129	32.0	23	27.7	18	24.0	41	25.9
Inorganic indet.	9	3.5	3	2.1	12	3.0	5	6.0	2	2.7	7	4.4
Total n of occurrences	260	100	143	100	403	100	83	100	75	100	158	100
N of scats	207		114		321		53		43		96	

Gryz J., unpubl.), the most numerous wild carnivores in central Poland (Gryz *et al.* 2011). A similar pattern was found when we considered the number of visits to tracking stations (Krauze-Gryz *et al.* 2012b). The density obtained in this study was lower compared to that in communal land in Zimbabwe (Butler *et al.* 2004) or in some rural areas in Chile (Acosta-Jamett *et al.* 2010). However, those assessments utilized a survey instead of actually recording dogs outside of properties. Our assessments should be treated as the minimum number of dogs because the data only included individuals who were outside of properties.

More than half of the dogs were observed alone, and groups were as large as 2–5 individuals. Research found similar sizes of feral dog groups in Alabama (Scott and Causey 1973), of free-ranging dog groups in Zimbabwe (Butler *et al.* 2004), and of suburban dog groups in California (Berman and Dunbar 1983). In Israel, some groups reached 8 dogs, but most of the groups were smaller (3–4, Manor and Saltz 2004). Dogs form groups when such behaviour is advantageous. In areas when food is plentiful and cooperative hunting is not necessary, dogs primarily remain solitary (Daniels and Bekoff 1989, Boitani and Cucci 1995). In our study area, the dogs primarily remained solitary when close to buildings and during the daytime. The dogs were usually observed in groups while outside the village and at night. There were no garbage dumps around villages in the study areas. When dogs left these areas, they either searched for carrion or attempted to hunt, and thus, group organisation was potentially beneficial.

Cereal was the most recorded item in scats. Farmers traditionally feed dogs cooked oats and grains with animal fat and/or some leftovers (so-called *nawara*). Similarly, dogs were fed with *sadza* (maize/sorghum/millet porridge) in Zimbabwe (Butler and du Toit 2002). Domestic food (42.2%) was most important for dogs in Chile (Silva-Rodrigues *et al.* 2012). In a suburban zone of Warsaw, domestic food constituted as much as 94% of all food occurrences (Romanowski 1985), and homemade food in the rural areas of western Poland was the most common food category

present in 79% of analysed stomach contents (Pielowski 1976). Other food categories in our study were plant remains of different origins (e.g., fruit and seeds) and vertebrate and invertebrate prey. Radio-tracked dogs in Alabama similarly preyed primarily on small mammals, garbage and vegetable material (Scott and Causey 1973). Game (roe deer and brown hare) was recorded in scats, and the game frequency in the two study areas reflected differences in the abundance of these two species. The roe deer was more frequently observed in Rogów, while the brown hare was more common in Dobieszyn. Both species were found in stomach contents from western Poland, and most of the roe deer material was found during especially severe winter (Pielowski 1976). In our case, roe deer was also primarily recorded in scats during the winter, and most records of carrion with signs of being killed by dogs were found from a severe winter of 2005/2006. In the Białowieża forest, the majority of carcasses of animals killed by stray dogs was found during the winter or cold months (Okarma *et al.* 1995). Similar to our area, in Białowieża primeval forest dogs were present in most of the villages distributed along the edge of the forest and searched for wild food to supplement the food given by their owners. Groups of mongrels were sometimes observed to hunt cooperatively for wild ungulates (Jędrzejewska and Jędrzejewski 2001).

Scat analyses do not allow for differentiation between prey that was actually killed and carrion and dogs are known to use carcasses. Butler and du Toit (2002) studied the mammal carrion of both domestic and wild species and concluded that carrion constituted half of all observed meals. Moreover, dogs found more carcasses and consumed more available biomass compared to other scavengers. Carrion was additionally consumed in Chile (Silva-Rodrigues *et al.* 2010), Alabama (Cause and Cude 1980), and Poland (Selva *et al.* 2005). We suggest that the game found in dog scats was likely from carrion, but our observations (primarily during the winter) confirmed that dogs were able kill roe deer or brown hare, usually by chasing them onto some barriers like fences. In the Rogów area, 2 of 22 radiotracked adult roe deer were successfully killed by dogs (Wasilewski 2001), some brown hares that were released as a part of restocking program in another area of central Poland were also killed by dogs (Misiorowska and Wasilewski 2012).

Many investigations researched the importance of dogs as a source of mortality for ungulate neonates (white-tailed deer *Odoicoleus virginianus*) (Huegel *et al.* 1985, Nelson and Mech 1986, Nelson and Woolf 1987, Long *et al.* 1998, Ballard *et al.* 1999). Packs of feral dogs in Alabama regularly chased deer (Causey and Cude 1980) but did not prey on the adults (Scott and Causey 1973). A study by Manor and Saltz (2004) showed that dog chases can have a negative effect on the ungulate gazella *Gazella gazella*) female/kid ratio by indirectly affecting reproductive success due to the energetic costs involved in dog avoidance. On the other hand, Pielowski (1976) suggested that the real negative impact of dogs in the hunting ground is their noisy area penetration and frequent chasing rather than actual predation. Indeed, the presence of dogs on walking trails in the protected areas of Colorado correlated with altered patterns of habitat utilisation for some of the mammals indicating that dogs can elicit behavioural reactions from a potential prey even without giving chase (Lenth *et al.* 2008).

According to our observations domestic dogs in the study areas often received improper care and inadequate food. They left settlements unrestricted and often successfully preyed on wildlife. Some of individuals were recorded to breed in the wild. Overall, this research showed that dogs in rural areas of central Poland are abundant predators and because of this they may play an important role in an ecosystem mostly by chasing and sometimes successfully hunting game and other wildlife, competing with medium-sized carnivores (i.e., changing spatiotemporal space or den utilisation) or transmitting disease.

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