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Activity and exploration range of house cats in rural areas of central Poland

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Abstract. Domestic cats are the most numerous predators in Poland. They are commonly kept at farms but hardly controlled, so penetrate freely wide range of habitats. The work aimed at determining the range of greatest impact of cats by identifying patterns of their activity and area searching, over daily, monthly and annual cycles. The density index, estimated from transect counts, performed along standard routes, proved to be dependent on temperature, precipitation and time of the day. In spring and summer, cats presented a two-peaked activity pattern, while in cold seasons it was more stable throughout the day. In warm months cats were registered at a further distance from the buildings than in colder ones. The animals were much less active when rain was falling. Cats' responses on noticing an observer showed that the further they were from the edges of settlements the more timid and cautious they became. The results showed that the potential pressure that cats may exert on their prey is the biggest around dawn and dusk and in summer. During a daytime it is confined to the immediate vicinity of build-up areas.

Key words: density index, transect counts, cats' impact, behavioural reaction

Introduction

Cats are the most common predators in Poland and their density exceeds that of other wild animals of similar body size, i.e. foxes *Vulpes vulpes*, martens *Martes* spp. or badgers *Meles meles* (Krauze & Gryz 2006). Although a few cats observed may be feral, most of them are to varying extents dependent on human beings and attached to households. These animals are encountered in both rural and urban areas, roaming freely, and penetrating a wide variety of habitats: woods, field and forest mosaics, grasslands and agrocenoses (Romanowski 1988, Langham 1992). They are versatile opportunistic predators, hunting for invertebrates, amphibians, reptiles, birds and mammals, and responding to prey density and availability in terms of diet (Liberg 1984, Pearre & Maass 1998, Molsher et al. 1999, Woods et al. 2003). Their exploration of given areas may change in terms of both intensity and pattern, in relation to the abundance of potential prey, the season of the year and weather conditions (Liberg 1980, Langham & Porter 1991, Barrat 1997, Hall et al. 2000, Edwards et al. 2001). Being eurytrophic and euryphagic predators commonly present in natural ecosystems, cats may influence mortality among, and effect reductions in the sizes of populations of small rodents, lagomorphs and birds (Ryszkowski et al. 1973, Goszczyński 1977, Erlinge et al. 1983, Liberg 1984, Churcher & Lawton 1987, Hansson 1988).

The work detailed in this study has aimed at identifying patterns of activity and area searching among cats, over daily, monthly and annual cycles, on the assumption that the parameters to the said activity would change in line with weather conditions and distance from the nearest buildings . The relevant studies carried out hitherto had been predominantly radiotelemetric (i.e. K o n e c n y 1987, L a n g h a m 1992, A l t e r i o & M o l l e r 1997, M o l s h e r et al. 2005), but knowledge on patterns of activity in domestic cats might improve yielding results more consistent on a larger scale of time. We envisaged a project run for three years, that would allow for the screening out of changes of an incidental nature, and those dependent on the seasons. As the potential prey species of cats often include species classed as rare or enjoying legal protection, it is thought crucial that the range of greater impact of cats be determined in the interests of conservation practice, e.g. the establishment of protected areas for birds and reptiles, and the distributing of bird nestboxes and bat shelters.

Study Area

Work was done in rural areas of east-central Poland representing the typical field-forest mosaic with a prevalence of open areas. Woods of a few hundred hectares are surrounded by other habitats i.e. fields, pastures and orchards. Villages and single farms are evenly distributed in the area within a distance of no more than a few kilometres from each other.

Climate in Poland is moderate with both maritime and continental elements. The average annual temperature in Poland ranges from 6 to 9 ˚C. Poland has four distinct seasons. Summers are generally warm, with average temperatures between 20 °C and 27 °C. Winters are cold, with average temperatures around 3 °C and –8 °C. Hot days, when the temperature exceeds 25˚C, occur from May to September. Sub-zero temperatures are recorded between November and March. Mean precipitation rate is about 600 mm and it falls throughout the year, although winter is drier than summer.

Material and Methods

E s t i m a t i o n o f c a t d e n s i t y

Density was estimated from transects following four standard census routes: Dębe Wielkie (52˚11'N, 21˚26'E)-Mińsk Mazowiecki (52˚10'N, 21˚34'E), Mińsk Mazowiecki-Kotuń (52˚10'N, 22˚06'E), Kotuń-Broszków (52˚11'N, 22˚06'E), Broszków-Siedlce (52˚09'N, 22˚16'E). The counts were done along railways from a slow train and from the car driving local roads (an average speed of vehicles was no more than 40 km/hour). Additionally cats were counted while walking on local roads and paths in the vicinity of Broszków. Transect routes did not coincide with each other and their distribution within the study area minimised possibility of counting the same individuals along different routes.

Studies were conducted monthly during the three-year period November 2002-October 2005 (except in March 2005) over randomly selected eight to nine days. Each month's data derived from the crossing of some 20 observation transects, at different times of the day (between dawn and dusk) and in various weather conditions. When a cat was noticed, the exact time of the event was registered. Also, an approximate distance from the nearest settlements was measured to check whether animals' distribution in the study area was even or whether their density decreased with the distance from human settlements.

The strip of land surveyed was maximally 100 m wide (a width arrived at empirically), with a view to excluding the possibility of cats being mistaken for other animals of similar size (foxes, dogs *Canis familiaris* or brown hares *Lepus europaeus*). Observation conditions and hence the detectability of animals within the observation strip differed markedly in relation to the weather (e.g. the presence or absence of snow), vegetation cover and the dates of onset of work in fields like ploughing, harvesting and haymaking. To account for this, two or three times a month, in the vicinity of Broszków, detailed assessments of the actual area feasible for observations were done. The route was walked along and the width of the observation strip (adjusted to actual visibility and possibility of noticing a cat) within various habitats (i.e. arable lands, meadows, fallow lands) was assessed. Only these areas where the vegetation cover made cat noticing possible were included. Similar assessments were done along railway routes by walking selected sections. Indeed, as in one of the routes (Dębe Wielkie – Mińsk Mazowiecki) the area over which observation proved feasible was found to vary considerably through each year, being smallest in late spring and summer and largest in winter and early spring (Fig. 1). Over the three years of study, the area covered by observations extended to 294 km^2, with similar annual figures of 91 to 103 km^2.

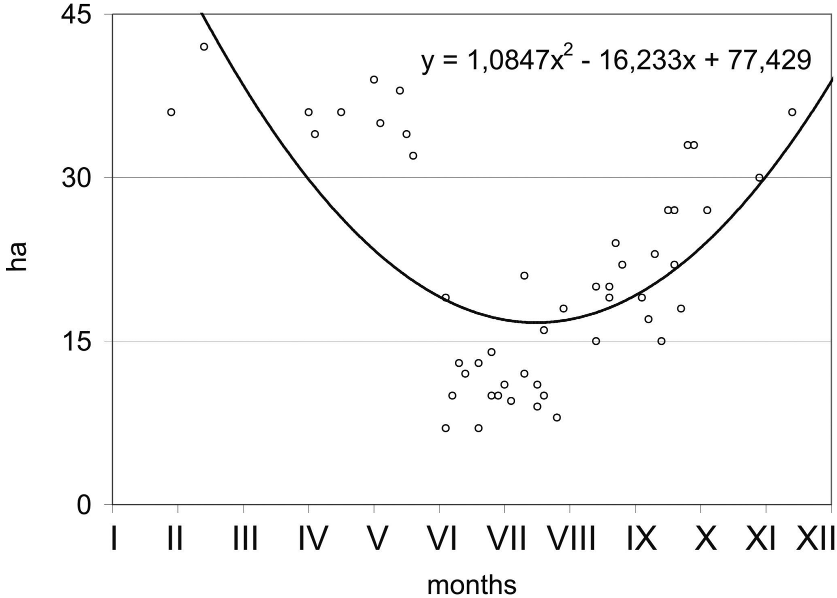

Fig. 1. Changes of an observable area throughout a year on a transect route between Dębe Wielkie and Mińsk Mazowiecki. Each spot represents one visibility control along the route.

Reaction to seeing a human being

Encounters with cats in the course of walks along the standard transects in the vicinity of Broszków or accidentally along other routes (mainly in the neighbourhood of Rogów 51˚49'N, 19˚53'E and Białobrzegi 51˚59'N, 20˚56'E (central Poland), were subject to an assessment of the animals' reactions to human presence. We registered the way in which cats responded to the sight of the observer, or else, if the person remained unnoticed, to a quiet "miaow" sound. Reactions were classified as: approach, lack of reaction, lurking or an attempt to hide and an escape. As it was usual for the initial reaction to lead into another one (i.e. with cats usually escaping after the first attempt to hide), it was the initial reaction only that was registered. Our own as well the owners' observations showed that cat's reaction to human presence (also its owner) may be dependent on the distance from its home. Therefore, it was assumed that animals would by more cautious when further from the buildings. To test this assumption, distance from the build-up area was also noted on each occasion. A total of 212 observations of this kind were obtained.

Results

Monthly and annual changes in cat activity

A total of 257 encounters with cats were noted (involving 82–101 individuals each year). Monthly data averaged over the three years reveal a high level of variability to density indexes (number of cats per 1 km^2 of the observed area) from month to month. The fewest cats were observed from November to March, the most in June, July and August (Fig. 2). Analyses carried out for eleven averaged monthly density indexes (excluding March for which data in two years only were obtained) revealed significant differences ($F = 7.34$, $P < 0.01$, df = 10, one-way ANOVA). The density index correlated positively with average monthly temperature ($r = 0.9059$, $P < 0.001$, n = 12) and with day-length ($r = 0.802$, $P < 0.01$, n = 12). However, partial correlations showed that, when the photoperiod was stabilised, density was correlated significantly with temperature – something that was not the case when temperature was held steady. Variability in average monthly temperatures explains about 50% of the observed variation in the density index.

The values assumed by monthly indexes in the three consecutive years were similar (Fig. 3); significant correlations with average monthly temperatures being noted ($r = 0.792$, $P < 0.001$, n = 35).

In some months density indexes calculated for rainy and rainless days were compared, if only counts performed in rain encompassed 0.5 km^2 or more. Activity was found to be subject to the weather, the mean density being only around a quarter as high when rain was falling

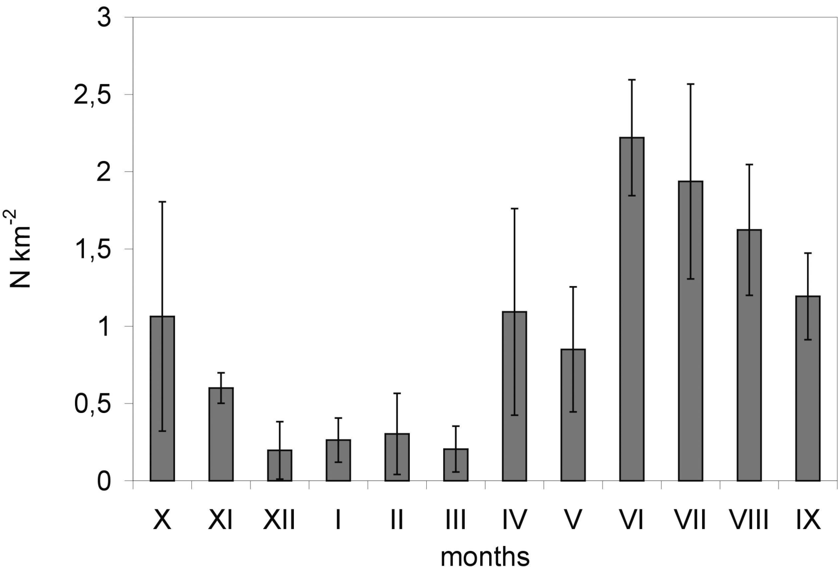

Fig. 2. Monthly changes in cat density index.

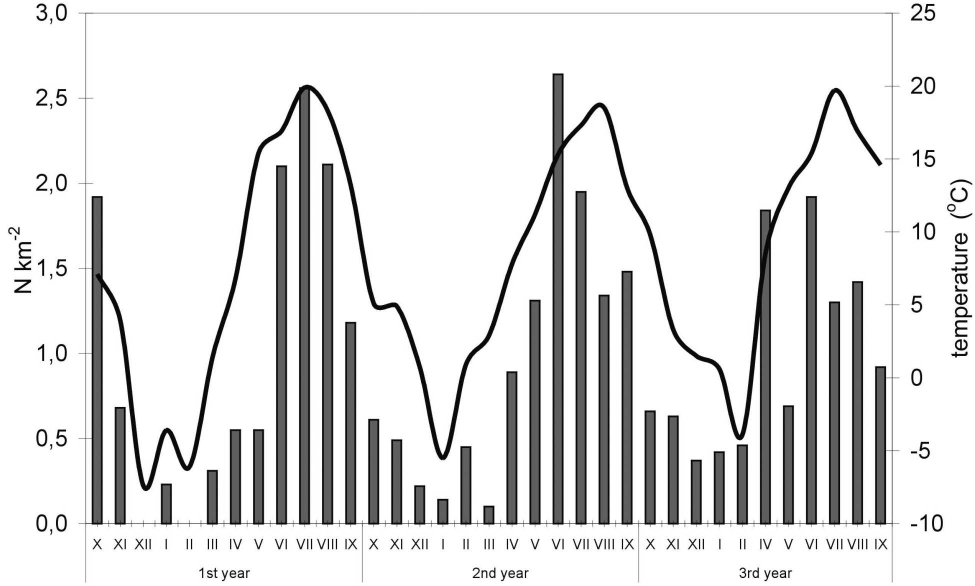

Fig. 3. Annual display of monthly changes of cat density indexes in relation to mean temperature.

as when it was not (mean = 0.34, SD = 0.48, n = 11 and mean = 1.19, SD = 0.48, n = 11 for rainy and rainless weather respectively). This difference achieved statistical significance (t = 3.44, $P < 0.01$, t-paired test).

Seasonal changes in daytime activity

For every time of the day, in each season, the surveyed surface area and numbers of cats spotted were calculated. The density index was similarly low in winter and autumn (below 1 individual per km^2) and quite constant between times of the day. In contrast, in spring and summer, values for the index were distinctly higher, with cats displaying a two-peaked activity pattern (Fig. 4). The first peak coincided with the first few hours after dawn, the second with dusk. Coefficients of variance (CV), calculated for the hours with total area of road counts of 0.5 km^2 or more, were lower in winter (64.93%) and autumn (41.08%). In spring and summer they amounted to 85.17% and 86.98% respectively, attesting to more varied daily activity among cats in these seasons of the year.

In the case of the spring and summer data, density indexes were calculated for three times of the day, i.e. the morning hours (06–11), midday and the early afternoon (11–15) and the evening hours (15–19). The respective figures obtained were 1.13 (SD = 0.41), 0.44 (SD = 0.39) and 2.20 (SD = 1.37). The midday density was thus significantly lower than that obtained for either morning (t = 3.39, $P < 0.01$, df = 16) or evening (t = 3.27, $P < 0.01$, df = 14). Equally, the evening density was significantly higher than the morning (t = 2.22, $P < 0.05$, df = 16).

When analogous analyses were carried out for the autumn and winter months, the density indexes computed for the consecutive times of day were: 0.46 individuals per km^2, SD = 0.29 (morning), 0.51, SD = 0.29 (afternoon) and 0.40, SD = 0.19 (evening). These values were similar enough to ensure that statistical comparisons revealed no significant differences ($t < 1.0$, $P > 0.05$ for all calculations).

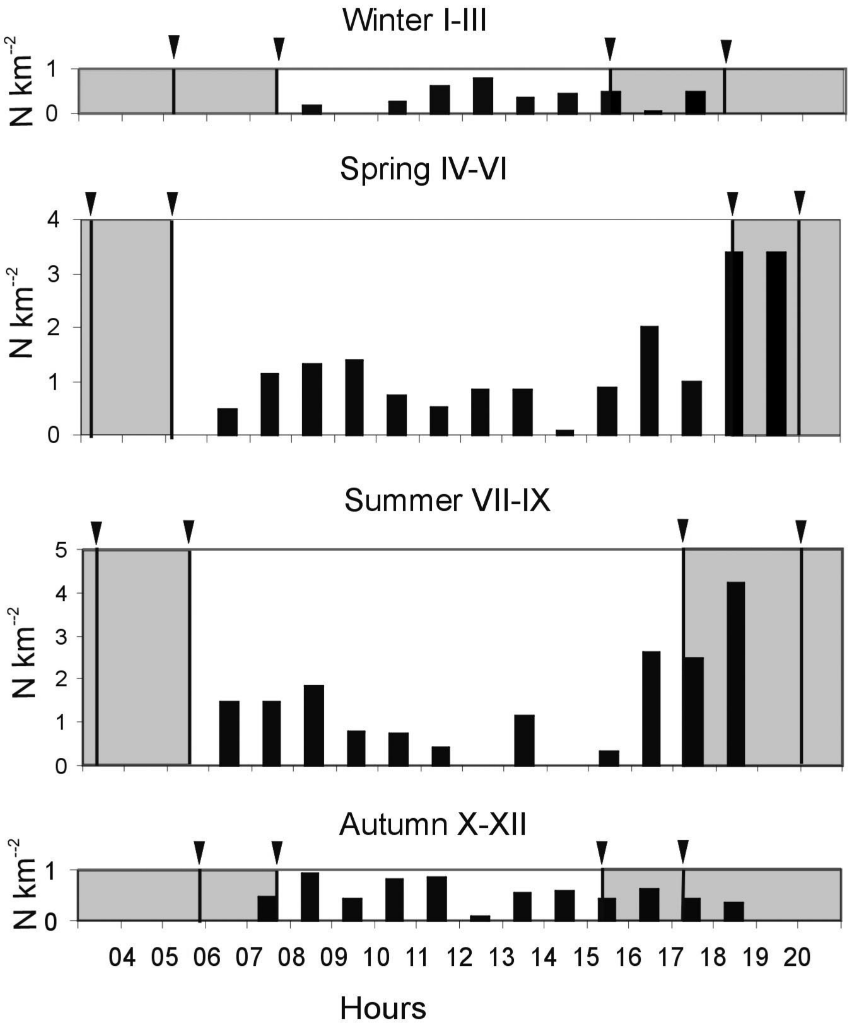

Fig. 4. Seasonal changes of daytime activity (the earliest and the latest dawn and dusk times in the seasons are indicated by black arrows).

Distances away from buildings

Cats were registered at distances of between 10 and 1 500 m from the nearest human settlements (mean 133.1 m, SD = 180.5). Nevertheless, numbers of observations of cats were lower with greater distances from built-up areas. Most animals (around 66%) were seen at up to 100 m from the closest buildings.

In cold months with average temperatures below 5 ˚C (i.e. November-March), cats were encountered at average distances only half as great as in the warm months (mean = 77.3 m, SD = 81.0, n = 17 and mean = 141.7 m, SD = 189.8, n = 111 for the cold and warm months respectively). Log-transformed data showed significant differences between cold and warm months (mean = 3.81, SD = 1.05, n = 17 and mean = 4.45, SD = 1.01, n = 111 for cold and warm months respectively, $t = 2.42$, $P < 0.05$).

B e h a v i o u r a l   r e a c t i o n s

Analyses of cats' responses on noticing an observer showed that reactions were adjusted in line with ever-greater distances beyond the edges of settlements. While some animals not far from buildings ignored an observer, or even started to approach, those further out were more and more liable to be cautious and timid. At distances of over 500 m from buildings, cats always either escaped immediately, or tried to hide (Table 1). These distance-related differences proved significant when the "approach" and "no reaction" categories were taken together ($\chi^2 = 23.79$, $P < 0.001$).

Table 1. Reaction to seeing a human being in different distance from the nearest buildings.

Distance from the nearest buildings (m)	Reaction (%)			
	Escape (n = 119)	Hiding (n = 27)	No reaction (n = 60)	Approaching (n = 6)
0–199 (n=164)	48.8	12.2	35.4	3.6
200–499 (n=33)	75.8	18.2	6.1	
≥ 500 (n=15)	93.3	6.7		

Explanations: n, number of observations

Discussion

Our study indicates that both the cat activity and density indexes are very much subject to weather conditions (especially temperature). This influence is reflected in both the numbers of cats hunting beyond buildings and the distances over which exploration was taking place. Californian studies carried out by H a l l et al. (2000) also showed differences in habitat use in the dry and wet seasons. Heavy rainfall encouraged cats to seek the shelter providing the best protection from inclement weather (i.e. buildings or habitats with ample cover) . In other studies, cats were more active in dry than wet weather (H a r p e r 2007) and predation rate was found to depend on weather conditions, being higher when it was dry (C h u r c h e r & L a w t o n 1987). We in turn demonstrate that patterns and ranges to areal exploration are different in the warm and cold seasons, a trend applying in each of the three years of studies. Low and rather constant winter and autumn densities contrasted with a high and double-peaked density pattern for spring and summer. Earlier studies had already found similar bimodal activity patterns, with peaks near dawn and dusk and lows near midday, for either the warm season of the year (J o n e s & C o m m a n 1982), or for areas with warm, stable weather conditions year-round (K o n e c n y 1987). The four-year assessments made by J o n e s & C o m m a n (1982) also showed relative abundance being subject to seasonal changes, with summer maxima and winter or spring minima. In turn, W e b e r & D a i l l y (1998) demonstrated that winter home ranges were smaller than those in the other seasons. A similar pattern was obtained by R o m a n o w s k i (1988), cats being shown to be most active in late summer and spring, and least so in winter.

According to previous studies, night-time movements from shelters involved significantly greater distances than diurnal ones (B a r r a t 1997). There may be a linkage between these data and our observations of cats' reactions. While the greater the distance from human shelter, the more cautious and apprehensive cats become, it is possible that enhanced nocturnal security encourages hunting at greater distances from buildings. Comparative daytime and night-time abundance assessments show that numbers of cats in built-up areas are greater during the day and only a quarter as high at night. In turn, the abundance of cats in open areas is seen to increase at night (Romanowski 1988). Many studies point to the avoidance by cats of large open areas, as well as to a tendency for them to keep to places providing good cover (i.e. long grass, walls, thickets, arboreal shelter belts and rocky hills (Panam 1981, Genovesi et al. 1995, Edwards et al. 2001). Cats that are not closely attached to a house (being either feral or on farms) are seen to avoid human or canine interference, in that they mainly leave shelter at dusk or during the night (Langham 1992, Barrat 1997).

Overall, the results presented point to rather limited distances from built-up areas being explored. In consequence, the pressure that domestic cats may potentially exert on their prey, especially day-active animals (like most birds and reptiles) or those to be considered more vulnerable (e.g. bats at rest in anthropogenic roosts), would rather tend to be confined to the immediate vicinity of built-up areas.

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