Density estimation, family group size and recruitment in a badger population near Rogów (Central Poland)

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Density estimation, family group size and recruitment in a badger population near Rogów (Central Poland).– During a 16-year period the density of badgers in Central Poland increased from 1.6 individuals per km² of forest area in 1979 to 2.6 in 1995. This increase was associated with formation of new families. The mean number of young per breeding female was estimated at three, and the annual recruitment of young at 0.68 per adult animal. The average family size was approximately 3.5 (young and adults) or 2.1 (only adults) individuals.

Key words: Central Poland, *Meles meles*, Density, Recruitment, Group size.

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Introduction

The badger *Meles meles* (Linnaeus, 1758) is believed to be among the most numerous carnivore species in Poland. Unfortunately, the density estimations for this mammal are based on rough assessments, because of lack of study and also lack of mention in hunting statistics, as hunters are not particularly interested in this species.

The badger is an opportunistic predator and scavenger eating a vast variety of foods (Andersen, 1955; Skoog, 1970; Ibáñez & Ibáñez, 1980; Henry, 1983; Martín-Franquelo, 1984; Stocker & Lüps 1984; Pigozzi, 1991). It is also considered to be tolerant of habitat changes, such as significant variations in the tree cover in the neighbourhood of its burrows (Sumiński, 1989). It is widely believed that its population density has

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increased in Poland following a reduction in hunting pressure. However, the effects of other mortality factors, both natural and anthropogenic, such as roads kills, poaching and pollution of the habitat, have not been assessed for the badger population. The assumption of an increase in badger density thus requires verification. Furthermore, whereas in western and northern Europe the ecology of the badger has been extensively studied (NEAL, 1977; KRUUK, 1986; KRUUK & PARISH, 1982; AARIS-SØRENSEN, 1995), little is known about parameters such as litter size, spatial distribution, group size and recruitment of young in Poland (SUMIŃSKI, 1989; SUMIŃSKI et al., 1989).

Study of the badger in Central Poland was therefore undertaken to assess these parameters as well as the validity of the hypothesis of an increase in badger density in recent years.

Material and methods

Study area

The study was carried out in an area of 89.2 km² near Rogów (41°48' N, 19°53' E) in Central Poland. The study area consisted of a mosaic of woodland, cultivated fields and orchards (fig. 1).

Woodlands covered 17% of the study area and were used by badgers for shelter, as locations for their breeding setts (dens) and as foraging grounds. Small cultivated fields, which were usually less than 1 ha in area, and orchards together formed 72.3% of the study area, and provided badgers with food in summer and autumn.

Grasslands, which are important foraging areas for badgers in western Europe, occupied less than 5% of our study area. Small towns, villages, roads and waste land formed the rest (10.7%) of the mosaic.

Other predator species present in the area were foxes *Vulpes vulpes* (Linnaeus, 1758), racoons *Nyctereutes procyonoides* (Gray, 1834), pine martens *Martes martes* Linnaeus, 1758, stone martens *Martes foina* (Erxleben, 1777), polecats *Mustela putorius* Linnaeus, 1758, stoats *Mustela erminea* Linnaeus, 1758 and weasels *Mustela nivalis* Linnaeus, 1758. Foxes, badgers, weasels and both species of martens were abundant in the area, whereas racoons, polecats and stoats occurred in low numbers.

Small game species such as hare, partridge and pheasant were moderately abundant (WASILEWSKI, 1986; DUDZIŃSKI, 1988). The density of rodents fluctuated on an annual basis, from fewer than ten individuals to approaching one hundred animals per hectare (GOSZCZYŃSKI, 1985).

Methods

Estimation of population density and number of cubs per litter

A survey was made of setts (dens) occupied by badgers in the spring. No setts were found in fields. The number of badgers was estimated during observations at dens in the evening and at night by counting the adult animals leaving and returning. The number of cubs was determined at the beginning of the fourth week of May, when they started to appear at the surface. Young of the year (cubs) were distinguished in spring and in summer by body size and behaviour. The observations were generally made from platforms constructed on trees near the dens. An attempt was made to observe each sett long enough to count all cubs inhabiting it. In case of doubt, counting was repeated. In the few cases where cubs could not be satisfactorily counted, the average litter size for the year was assumed for the dens concerned. The estimation of badger density was conducted between 1979-80, 1984-86, 1989-92 and 1995. Badger censuses were performed each year in the minimum forested area (9.2 km²). In some years the counts included more woodlands (up to 15.1 km²).

Due to the fact that in some years the density estimations were conducted only in the study area, the density for each year was calculated as a number of individuals/km² of forested area.

Recruitment of young

Recruitment was expressed as the mean number of young (> 6 weeks old) per adult badger. This index was calculated for each year separately, and for the study period as a whole.

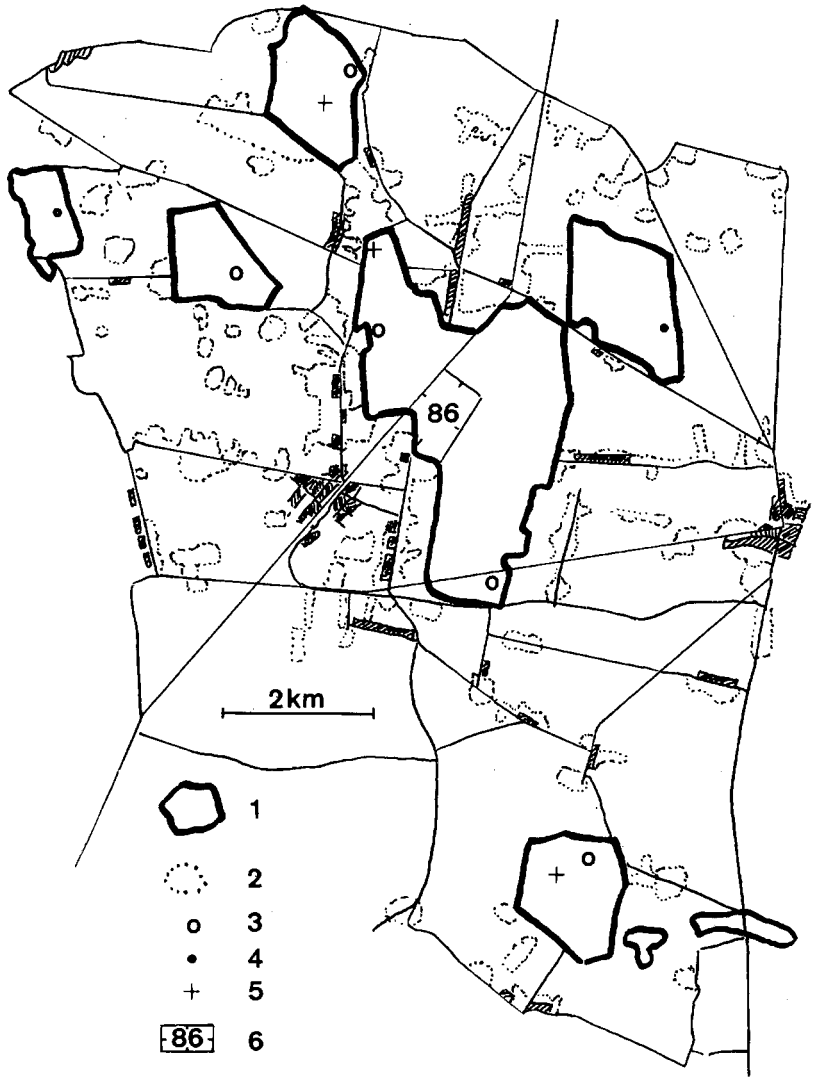

Fig. 1. Distribution of badger dens between 1986 and 1995: 1. Boundaries of woodland; 2. Orchard area; 3. Setts used regularly by groups in 1986 and in 1995; 4. Setts used occasionally by one individual in 1986 and regularly by a group in 1995; 5. Setts unused in 1986 and in regular use by group in 1995; 6. Part of woodland not controlled in 1986.

Distribución de madrigueras de tejón en 1986 y 1995: 1. Límites del bosque; 2. Huertas. Madrigueras de cria utilizadas: 3. Regularmente por grupos en 1986 y 1995; 4. Ocasionalmente por un individuo en 1986 y regularmente por un grupo en 1995; 5. No utilizadas en 1986 y regularmente en 1995. 6. Zona de bosque no controlada en 1986.

Distribution of family groups

All badger setts, both those used regularly by families and those used only temporarily by some individuals, were mapped in each forest area. Determining their location yielded maps of spatial distribution of badgers and made it possible to relate changes in distribution to the changes in the population density.

Results and discussion

During the 16-year period the badger density steadily increased, the mean density rising from 1.6 individuals/km^2 of forested area in 1979 to 2.6 in 1995. The density in 1995 was thus 63% greater than at the beginning of the study (table 1). A significant correlation (Spearman Rank test) was found between the year of the study and the annual density ($n = 10$, $r_s = 0.88$, $0.001 < p < 0.01$). A significant correlation was also found between the year of the study and the density of adult badgers ($n = 10$, $r_s = 0.68$, $0.02 < p < 0.05$). These data support the hypothesis of an increase in density of the population studied. Shooting of badgers was very rare in the study area as in the remainder of the country. In total, 10 badgers were killed by hunters in the study area during the period of these observations. Other mortality factors were: road kills (three cases) and deaths from fights with foxes and dogs (two cases). Mortality from these factors was thus similar to that from hunting. Although not all cases of death could be recorded, it is evident that the mortality from all sources was lower than recruitment.

Table 1. Density, recruitment and group size in badger population in Central Poland.

Densidad, reclutamiento y tamaño del grupo en una población de tejón de Polonia central.

		Number of badgers								
		Total		Young		Adults				
Year	Area (km^2)	N	N/S	N	N/S	N	N/S	Recruit.	Groups*	Mean
1979	10.9	17	1.6	8	0.7	9	0.8	0.9	7	1.3
1980	10.9	14	1.3	8	0.7	6	0.6	1.3	4	1.5
1984	14.4	22	1.5	4	0.3	18	1.2	0.2	8	2.2
1985	14.4	23	1.6	8	0.6	15	1.0	0.5	7	2.1
1986	14.4	28	1.9	9	0.6	19	1.3	0.5	7	2.7
1989	9.2	16	1.7	7	0.8	9	1.0	0.8	3	3.0
1990	15.1	31	2.1	10	0.7	21	1.4	0.5	9	2.3
1991	15.1	26	1.7	5	0.3	21	1.4	0.2	10	2.1
1992	12.8	28	2.2	13	1.0	15	1.2	0.9	8	1.9
1995	15.1	39	2.6	19	1.3	20	1.3	1.0	10	2.0
Mean			1.82		0.70		1.12	0.68		2.11
S.D.			0.39		0.30		0.27	0.36		0.50

* solitary bagders are included

It was very likely that the trend to an increase was related to changes in farming practice. Many new orchards have been established in the study area during recent years and this could improve food conditions for badgers. Our preliminary results indicated that fruit plays an important role in the badger diet but the lack of information on badger food habits in the past made such comparison impossible.

The average density for the whole period was estimated at 1.85 individuals/km² of forest area or at 0.31 individuals/km² of the total area. This value is rather low when compared to badger density in Great Britain, where it was estimated at up to 20 individuals/km² (of woodlands) (CHEESEMAN et al., 1981, 1987). However, the density recorded in our study area is similar to those reported from Western and Central Europe (STUBBE, 1965; ŠTOLLMAN, 1967; HELL & CIMBAL, 1977; ASFERG et al., 1977; ZEJDA & NESVADBOVÁ, 1983; BOUCHARDY & MOUCHES, 1986).

Important variations in density of young were observed during the study. It seems that the number of cubs weaned in a given year was not directly related to the number of adult badgers. Perhaps this also depended on the age structure of the population which, subsequently, determined the age of breeding females.

The annual recruitment varied from 0.22 to 1.33 young per adult. The average recruitment for the whole period was 0.68 cubs per adult (table 1). In England, the mean recruitment was lower (0.46 -the value calculated from data on numbers of young and adult animals provided by CHEESEMAN et al., 1987). On the other hand, recruitment assessments for the eastern parts of Germany (STUBBE, 1970) were similar to our data.

The mean number of young per one breeding female in late May and in June was equal to three and the range of litter size was one to six (table 2). The latter value is among the highest ever recorded for this species in its geographical range (BOUCHARDY & MOUCHES, 1986; NEAL, 1986). The litters most often encountered in the study area of this work were composed of 2-4 cubs (table 2).

The group size in the study area varied greatly from year to year, from 2.4 to 5.3 individuals (young and adults), and from 1.3 to 3.0 (adults only, table 1). In the study area the average group size throughout the study period was estimated at 3.5 and 2.1, for young plus adults, and adults, respectively. The latter value is rather small in comparison with values reported from Great Britain (KRUUK, 1978, CHEESEMAN et al., 1987).

Table 2. Number of cubs per litter.
Número de cachorros por camada.

Cubs/litter	Litters	Total
1	1	1
2	7	14
3	12	36
4	6	24
5	0	0
6	1	6
Total	27	81

Mean litter size = 3.0, S.D. = 1.0

Significant correlation between the number of badgers and number of groups was found ($n = 10$, $r_s = 0.78$, $0.005 < p < 0.01$ for all animals, and $n = 10$, $r_s = 0.86$, $0.001 < p < 0.005$ for adults). Thus, it seems that the increase in population density was not due to increase in the group size but to formation of new family groups. This finding was indirectly confirmed by the analysis of spatial distribution of badger setts. In recent years, additional new groups inhabiting new dens were observed in the study area (fig. 1). Although the new setts were located in the same woodland area where the old existed, during the simultaneous observation no variation in the maximum number of individuals at each sett was observed. This might indicate some degree of isolation between groups inhabiting each sett. However, future studies using radiotracking are required.

Resumen

Estimación de la densidad, tamaño del grupo familiar y reclutamiento en una población de tejón cerca de Rogów (Polonia Central)

Durante un período de 16 años, la densidad de tejones en Polonia Central (fig. 1) aumentó de 1,6 individuos/km² de bosque en 1979 a 2,6 individuos/km² en 1995 (tabla1). Este aumento estaba asociado a la formación de nuevas familias.

La media de crías por hembra reproductora se estimó en tres (tabla 2) y el reclutamiento anual de jóvenes en 0,68 por animal adulto. El tamaño familiar medio fue aproximadamente de 3,5 individuos (jóvenes y adultos) o de 2,1 (solo adultos).

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