

DISTRIBUTION AND HABITAT SELECTION OF BADGER (*MELES MELES*) IN NORTHERN MORAVIA

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Abstract

The badger population in the Northern Moravia was studied with reference to hunting regions. The presence of badgers' setts over different altitudinal ranges, orientation of slopes, types of soils in which setts are situated and habitat selection was also investigated. A combination of questionnaires and field work was conducted in 11 districts during 1996–1998.

We found evidence for 1306 badgers, at mean density 0.18 individuals/1000 ha. The population in the Northern Moravia doubled in last 15 years. Evaluation of the population status was done according to total area and wooded area. Badgers preferred woodland, altitudes mainly between 200–700 m a. s. l., and slopes with an E – S – W orientation. There was no significant differences in soil preference.

Introduction

There are a variety of methods for estimating the size of animal populations. In the case of badgers (*Meles meles*), estimates are almost invariably based on a secondary index of abundance, notably sett surveys or game-bag data from the hunting regions (reviers) (Griffiths & Thomas 1993). In the Czech Republic, the badger has received year-round protection since 1988. The only exception is in the areas around pheasantries, where badgers still may be hunted under licence (Vyhláška MZe).

Badgers occur throughout much of Bohemia and Moravia, although the species is absent from small areas in southern and western Bohemia (Anděra 1979). Badger status and distribution are comparatively well-known (Anděra 1979, Zejda & Nesvad-

bová 1983, Anděra & Hanzal 1996), but there is little good data on densities or numbers. The size of the population can be calculated on the basis of setts according to their morphometrics and occupancy during the year (Pitt 1935, Wiertz & Vinck 1986). The badger is widespread in the whole Czech Republic. At present the badger's population is characterized as stabile or moderately increasing (Anděra & Hanzal 1996), although in some areas there was a decrease or local absence of species (Bičík & Baday 1996). Occurrence of setts depends on several factors including vegetation structure, orientation of slopes, geology, soil diggability, climate, food availability, altitude (Anděra 1979, Dunwell & Killingley 1969, Neal & Roper 1991, Neal & Cheeseman 1996, Pelikán & Vačkař 1978, Biancardi & Rinetti 1998).

A knowledge of the distribution of badgers in Central Europe is important for comparisons with populations in other parts of Europe.

Study area

The Northern Moravia region covers 11 067 km². The relief has been formed by two geologic units, the Bohemian massif and the Western Carpathians, which are separated by the Carpathian Foredeep. There is broken relief at intervals of 190–1491 m a. s. l., with an average altitude of 350–400 m. Weather conditions correspond with a contact zone of oceanic and continental climate. Podzolic and brown forest soils are the most extensive. All orientations of slopes are present in approximately equal proportions. Northern Moravia is covered by three biogeographical subprovinces (Hercynian, Polonician and Carpathian region). Woods cover 38 % of the area, while agricultural areas (arable fields, meadows, pastures, gardens) represent 50 %. Research was conducted in all 11 districts of Northern Moravia. The census unit was the “hunting regions”, which have an average area of 1400 ha. Estimation of the size of the population is calculated by using Pelikán & Vačkař's (1978) estimation of the average territory of one pair of badgers as 550 ha.

Methods

In order to establish the population and to evaluate the status of the badger, a questionnaire, in co-operation with Departments of environment in Districts offices and with Czechomoravian hunting association (ČMMJ), was issued from 1996 to 1998. Test questionnaires were distributed in 1996 in one district and data questions were subsequently updated. We then sent it to all Departments of environment of districts in Northern Moravia. We believe the data derived from these questionnaires to be reliable. Respondents were asked to state the occurrence of badgers (permanent, occasional, negative), characteristics of setts and habitat. We determined four type of setts: main (M), subordinate (S), temporary (T) and abandoned (A) (Tab. 1). In 1998 the enquiry was repeated in several hunting regions. We validated the reported presence of setts in about 20 % of the positive answers.

Tab. 1. Characteristics of setts

Type of sett	Entrances	Area (m ²)	Presence of badgers	Presence of cubs	Marks of occupy
Main	> (3) 4	> 100	permanent all the year-round	often	big heap of soil, footprints, hay, faeces, pathways, playground
Subordinate	2–4	10–100	permanent and regular temporary (IV.–X.)	occasionally	less heap of soil, footprints, faeces
Temporary	1–2	< 10	temporary, irregular (X.–IV.)	negative	obscure heap
Abandoned	various	various	negative	negative	heap covered by vegetation

We evaluated the occurrence of badgers as permanent (M, S, T setts), occasional (hunting regions without setts but with migratory badgers) and negative. We calculate the size of the population as the average of three numbers: registered and estimated number of badgers by hunters and coefficients for the type of setts after Wiertz & Vinck (1986).

We calculated and compared densities in districts. The scale by Griffiths & Thomas (1993) and densities per wooded area by Štollmann (1967) were used to evaluate badger status (Tab. 2).

In this study we took account of information about altitude, orientation of slope, type of soil, and mainly habitat in which badgers setts were situated. To show the distribution of the badger, we processed digital data from questionnaires to a GIS application.

Tab. 2. Evaluation of badger's status

Griffiths & Thomas (1993) per 1000 ha total area		Štollmann (1967) per 1000 ha wooded area	
density	status	density	status
< 1.0	low	< 1.00	very low
		1.00–2.00	low
1.0–10.0	moderate	2.01–4.00	moderate
> 10.0	high	4.01–6.00	good
		> 6.00	very good

Results

Occurrence of setts

We sent questionnaires to all hunting regions (789) in the Northern Moravia. Most of them were completely filled-out (72 %). In some there was an absence of some data, for instance elevation above sea-level of locality, orientation of slope or type of soil. When data was absent, especially about habitat, we requested completion.

In the Northern Moravia 499 main setts were reported (Tab. 3). Subordinate setts (43.7 %) were prevailed. The ratio of sett types differed among districts. Main setts were mostly found in the districts of Frýdek–Místek, Nový Jičín, Olomouc and Šumperk. In other districts there were predominantly subordinate setts.

Average density of setts was 0.45/ 1000 ha (1.19 setts per 1000 ha wooded area). The highest density of setts was in the district of Frýdek–Místek, the lowest in Bruntál. The number of entrances of one sett varied between 1 to 17 (district of Opava). Size (area) of setts varied from 1 (OL) – 1500 (FM) m². The greatest number of setts was situated from 200 to 700 m a. s. l. (Fig. 1). The lowest sett was in the district of Ostrava, the highest was recorded in the district of Frýdek–Místek (860 m a. s. l.). The setts were situated in all slopes, but most often they were orientated to east, south and west. The least number of setts was on north-east slopes (Fig. 2). Badgers used all types of soil for digging their setts (Fig. 3).

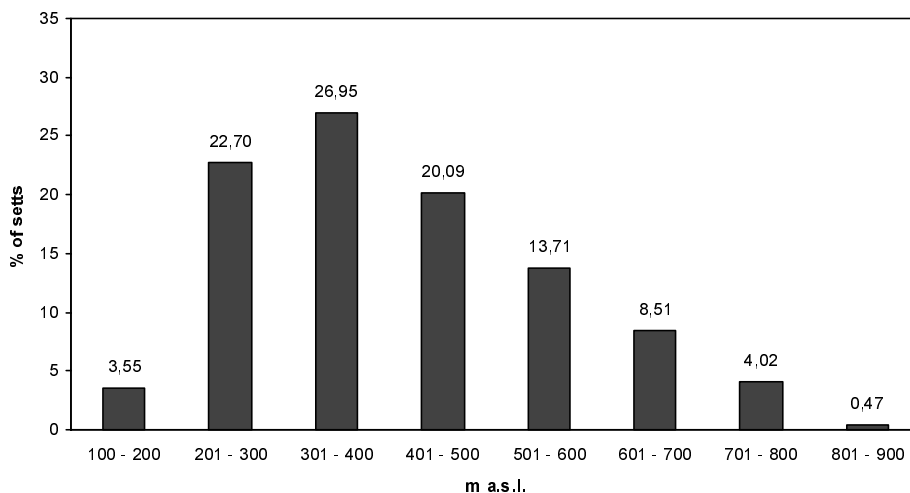


Fig. 1. Setts of badgers in altitudes

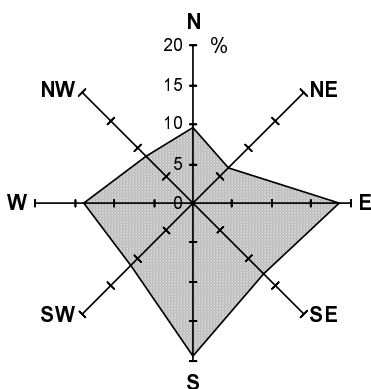


Fig. 2. Orientation of setts

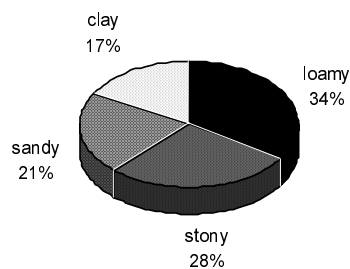


Fig. 3. Soil type

Tab. 3. Occurrence of setts in the Northern Moravia

District	Area (km ²)	Number of hunting regions			Type of setts				Density of setts (1000 ha)
		Total	P	O	M	S	T	A	
Bruntál (BR)	1658.76	110	18	11	10	11	3	0	1.45
Frýdek–Místek (FM)	1272.91	93	53	5	35	45	18	4	8.01
Jeseník (JE)	718.80	45	20	9	9	11	3	0	3.20
Karviná (KI)	347.30	24	9	4	3	8	1	0	3.46
Nový Jičín (NJ)	917.99	77	31	10	29	17	3	0	5.34
Olomouc (OL)	1451.31	85	39	8	27	25	17	1	4.82
Opava (OP)	1143.60	90	12	2	3	12	4	0	1.66
Ostrava (OV)	214.23	10	7	0	2	5	1	0	3.73
Přerov (PR)	883.90	70	20	4	16	17	6	0	4.41
Šumperk (SU)	1315.41	93	47	8	34	33	8	1	5.78
Vsetín (VS)	1143.20	92	54	12	27	34	15	1	6.74
Northern Moravia (NM)	11067.41	789	310	73	195	218	79	7	4.51

P = with permanent occurrence of badgers. O = with occasional occurrence of badgers. M = main, S = subordinate, T = temporary, A = abandoned

Occurrence of badger and its population size

The occurrence of badgers were reported from 383 hunting regions (it is in 48.5 % of study area). Permanent occurrence was reported from 310 hunting regions, occasional occurrence from 73. In other hunting regions (406) neither presence of setts, nor occasional occurrence of badger was reported (Fig. 4). Most badgers was in the districts of Frýdek–Místek, Šumperk, Nový Jičín and Vsetín. There were altogether 1306 badgers in the Northern Moravia (Tab. 4).

Tab. 4. Evaluation of badger's population in the Northern Moravia

District	Badgers	Griffiths & Thomas (1993)		Štollmann (1967)	
		density	status	density	status
BR	66	0.40	low	0.84	very low
FM	223	1.75	moderate	3.49	moderate
JE	59	0.82	low	1.29	low
KI	39	1.12	moderate	7.42	very good
NJ	182	1.98	moderate	8.87	very good
OL	159	1.10	moderate	3.98	moderate
OP	46	0.40	low	1.29	low
OV	23	1.07	moderate	8.31	very good
PR	89	1.01	moderate	5.11	good
SU	208	1.58	moderate	3.28	moderate
VS	212	1.82	moderate	3.37	moderate
NM	1306	1.18	moderate	3.12	moderate

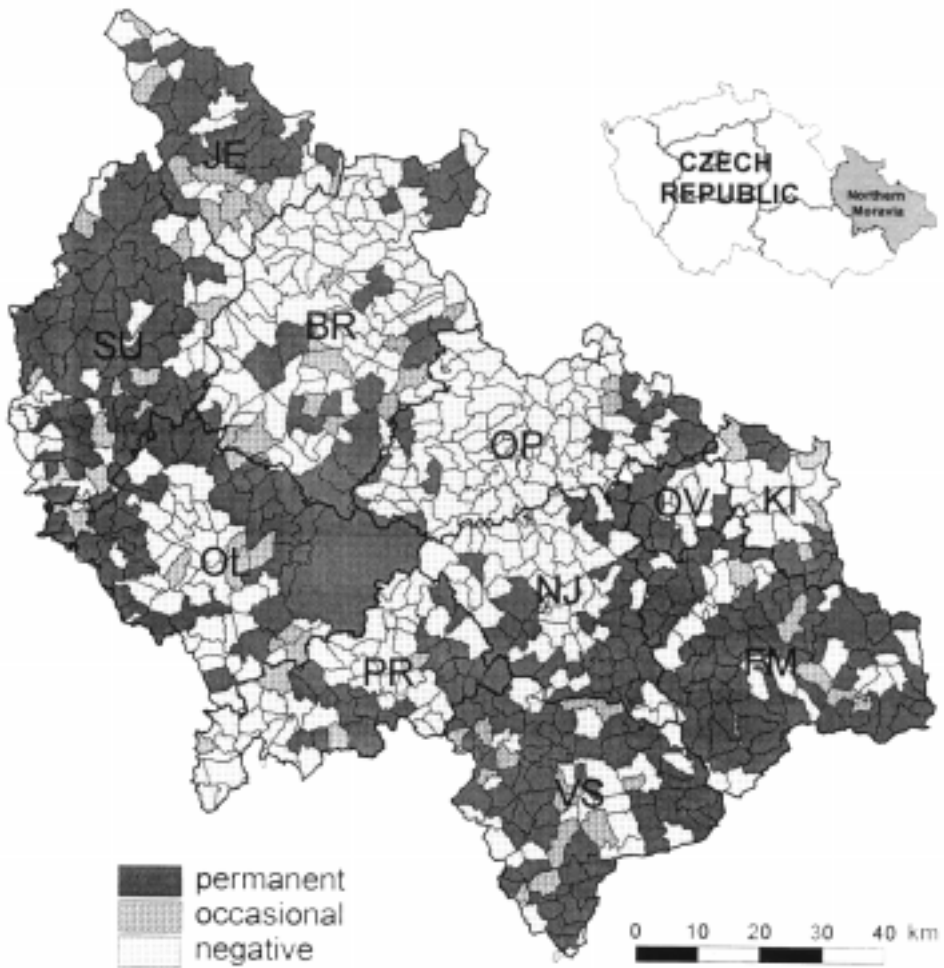


Fig. 4. Occurrence of badger in the Northern Moravia

The mean density of badgers per total area was 1.18/1000 ha and 3.12/1000 ha of wooded area. Both values represent an moderate population density. This figure is considerably lower in comparison to the cross European mean density (c. 10 individuals/1000 ha).

In all districts we calculated the average density of badgers per total and wooded area (Tab. 4). With respect to wooded area of districts we can state that the highest density of badgers are in the districts of Karviná, Nový Jičín and Ostrava. The districts of Karviná and Ostrava are extremely industrialized, where there are a few suitable habitats. Nevertheless, number of badgers is relatively high here. On the contrary in

the districts of Bruntál and Jeseník there is a relatively small number of badgers. The lowest number of badgers was recorded in the district of Opava, which is an agricultural area. The density of badgers in the hunting regions is shown in Fig. 5.

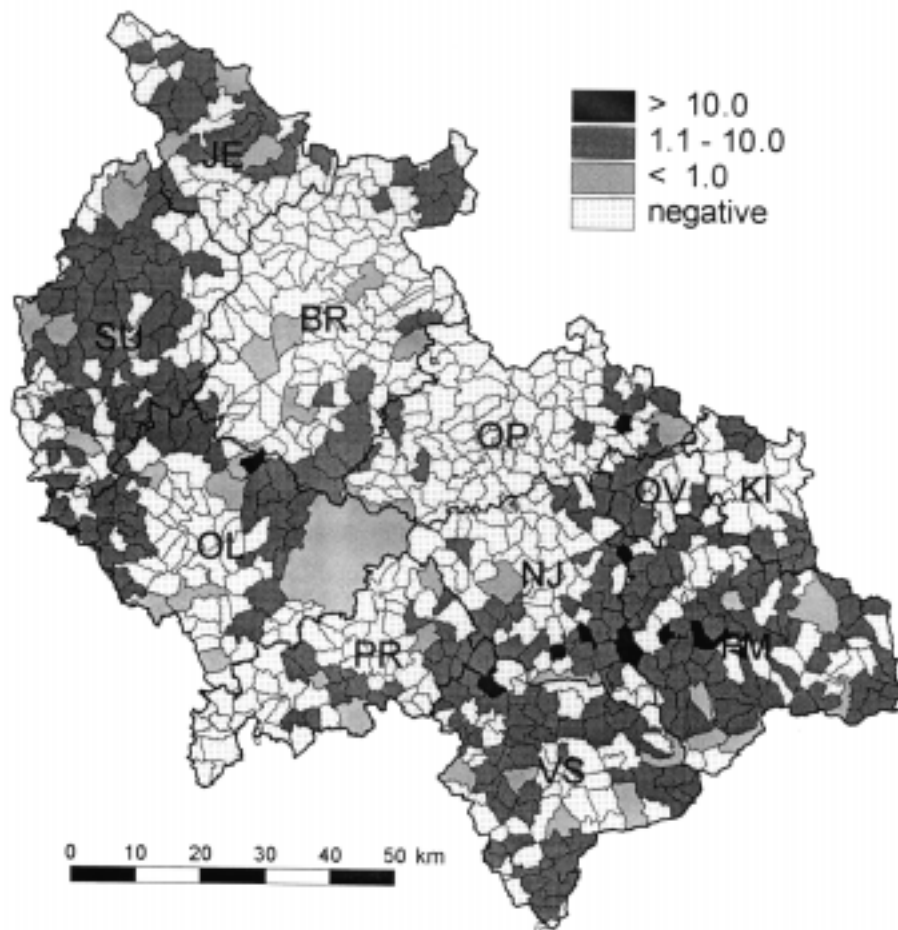


Fig. 5. Density of badger on the hunting areas

Habitat selection of badger's setts

An understanding of the habitat selection for setts is useful in determining the species ecological requirements (Thornton 1988, Skinner *et al.* 1991, O'Corry-Cröwe *et al.* 1993, Virgós & Casanovas 1999).

We found that 75 % of setts are situated in wooded areas (33.07 % mixed forests, 26.05 % coniferous and 16.23 % deciduous). Badgers often prefer quarries and rocks. Some setts were in fields, meadows, gardens and hedgerows (Fig. 6). Other habitats represented sand-pits, cellars of destroyed buildings, field drainage ditches, waste

Tab. 5. Habitats of badger's setts in the Northern Moravia

District	Number of setts	Mixed		Coniferous		Deciduous		Quarry, rock		Field		Meadow		Garden		Hedgerow		Other	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
BR	24	10	41.66	6	25.00	3	12.50	3	12.50	1	4.17	0	0	1	4.17	0	0	0	0
FM	102	33	32.35	30	29.42	16	15.68	11	10.78	5	4.91	3	2.94	4	3.92	0	0	0	0
JE	23	7	30.43	3	13.04	6	26.09	4	17.39	0	0	2	8.70	0	0	0	0	1	4.35
KI	12	6	50.00	0	0	2	16.66	3	25.00	0	0	0	0	0	0	0	0	1	8.34
NJ	49	14	28.58	9	18.37	11	22.44	5	10.20	5	10.20	0	0	1	2.04	1	2.04	3	6.13
OL	70	22	31.43	16	22.85	12	17.14	8	11.43	7	10.00	2	2.86	2	2.86	0	0	1	1.43
OP	19	11	57.88	2	10.53	2	10.53	2	10.53	2	10.53	0	0	0	0	0	0	0	0
OV	8	3	37.50	0	0	3	37.50	1	12.50	0	0	0	0	0	0	0	0	1	12.50
PR	39	11	28.21	7	17.95	9	23.07	3	7.69	4	10.26	0	0	0	0	1	2.56	4	10.26
SU	76	23	30.26	33	43.42	6	7.89	8	10.52	3	3.95	0	0	0	0	2	2.63	1	1.33
VS	77	25	32.47	24	31.17	11	14.29	7	9.07	2	2.60	3	3.90	2	2.60	1	1.30	2	2.60
NM	499	165	33.07	130	26.05	81	16.23	55	11.02	29	5.81	10	2.00	10	2.00	5	1.00	14	2.82

banks etc. (Tab. 5). In such localities temporary setts were recorded mainly, which badgers used for only part of the year.

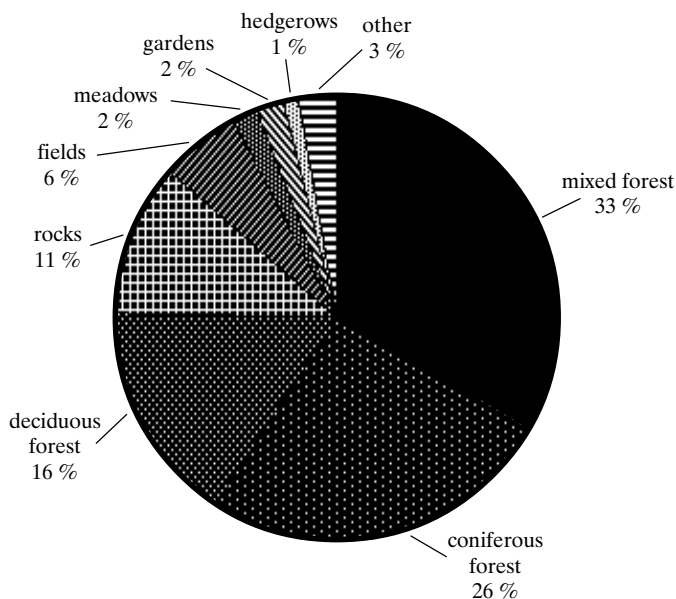


Fig. 6: Habitats of badger's setts

Discussion

The badger population appears to be either stable or increasing throughout much of Europe (Griffiths & Thomas 1993). The Czech population of badgers was previously examined by Zejda & Nesvadbová (1983). These authors estimated 17,000 animals nationally, at mean density of 0.31/km² in the hunting regions in the Czech Republic. The population of badgers in the Northern Moravia was estimated by these authors to be 737 badgers, at mean density 3.5/1000 ha in the hunting regions. Since 1983 the population has practically doubled in the Northern Moravia. A decline in the badger population was only reported in the district of Bruntál. We can find a little evidence for decline of badgers when we summarize the numbers of badgers in the districts of Šumperk and Jeseník (earlier they were united as one district – Šumperk). The districts of Karviná, Olomouc and Ostrava were not mapped by Zejda & Nesvadbová (1983). The justification of densities in their paper is difficult to interpret, because they present density only for hunting areas in which badgers were recorded. When we convert values of densities to all district areas we found, as mentioned before, that population of badgers had doubled.

The extrapolation of the acquired density of badgers in the Northern Moravia gives 9,000 – 10,000 animals, which is fewer than the estimate made by Zejda & Nesvadbová (1983).

Anděra (1979) and Zejda & Nesvadbová (1983) found that the distribution of badgers in Bohemia and Moravia is mosaic-like. Our findings support this hypothesis, but show that badgers generally inhabited most of Northern Moravia. Badgers are present in all districts now. Zejda & Nesvadbová (1983) state that the most preferred habitats for badgers are woodlands, in which there are higher population densities than in fields. Similarly to Ivanter (1974), Zejda & Nesvadbová (1983), Stubbe (1981) we consider deciduous and mixed forests as optimum habitat for badgers.

Badgers prefer wooded areas with better shelter of tree-cover. Neal (1986), Wiertz & Vinck (1986), Thornton (1988), Neal & Cheeseman (1996), Virgós & Casanovas (1999) support this conclusion. In the Northern Moravia there are many monocultures of coniferous woods and especially in higher altitudes where they are dominant. Nevertheless, mixed and deciduous forests are more common than coniferous forests, because they have better trophic resources (Neal 1986, Matyáščík 1999). Other habitats are used by badgers too and they exploit various places for occupancy (e.g. drainage, heap of materials from mining factories, anthropogenic structures such as bunkers and destroyed huts in mountains).

We found that the population of badgers is centred in certain areas, where there are particularly high densities. According to some authors, badgers reach altitudes around the upper forest limit. In the Northern Moravia we found the maximum altitude to be 860 m a. s. l. (subordinate sett), even though some hill-tops are over 1200 m. The majority of setts were situated on insolate slopes, which are warmer and drier. Biancardi & Rinetti (1998) also alluded to this ecological preference for badgers. In contrast to other authors (Dunwell & Killingley 1969, Marvin *et al.* 1971) we did not find any dependence of setts on the type of soil. This may be because soil diggability is less important for choice of setts in a low density population. As did Anděra (1979), we found some lowland areas without badgers. In these areas is a high level of overground water and they are frequently flooded. These lowlands are not so acceptable for badgers because there is little broken terrain.

Conclusions

We found badgers to occur everywhere in the Northern Moravia although their population is not evenly distributed. Local centres of occurrence are west of Šumperk, south-west of Litovel, north-east of Olomouc, around Osoblaha, Hlučín, east of Bohumín, between Nový Jičín and Rožnov pod Radhoštěm and around Valašské Meziříčí.

In evaluating the relation of setts to wooded areas (75 %) we found that badgers prefer mixed forests, where a higher density of setts was recorded. This habitat may provide a wider food spectrum and better shelter than agricultural areas. This is consistent with the hypothesis that badger setts are a limiting resource with important survival value (Neal & Roper 1991, Roper 1993, Virgós & Casanovas 1999).

The badger population in the Northern Moravia is calculated to be 1306 animals. The mean density 1.18 individuals/1000 ha total area represents a moderate status of

badgers. Badger population doubled in the Northern Moravia during last 15 years. Further research into the population sizes in other parts of the Czech Republic is necessary for a better comparison with results found by Zejda & Nesvadbová (1983), and in order to provide protection for the species and for management.

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