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Source: Wildlife Biology, 3(2) : 89-96

Published By: Nordic Board for Wildlife Research

URL: https://doi.org/10.2981/wlb.1997.011

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Function of multiple badger *Meles meles* setts: distribution and utilisation

Henrik Brøseth, Kjetil Bevanger & Bård Knutsen

Brøseth, H., Bevanger, K. & Knutsen, B. 1997: Function of multiple badger *Meles meles* setts: distribution and utilisation. - Wildl. Biol. 3: 89-96.

To evaluate hypotheses on why the European badger *Meles meles* uses more than one underground burrow ('sett') as a diurnal resting site, the distribution and utilisation of setts within territories were recorded for nine radio-tagged individuals in four adjacent social groups in the boreal forest of central Norway. The density of setts was low, but the mean number of setts within a territory (12) was higher than found in earlier studies in Europe. Natural setts were small, and though randomly distributed within territories the upper parts of south-west facing slopes were preferred. Between April and September individual badgers used an average of nine different setts. They moved frequently from one sett to another, except for two reproducing females which remained very faithful to one sett in spring. Random utilisation and frequent changes of setts support the hypothesis that badgers use multiple setts to avoid accumulation of ectoparasites. No indications which support the hypothesis that young badgers use multiple setts to avoid harassment from dominant conspecifics were found.

Key words: individual utilisation, Meles meles, multiple burrows, sett distribution

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Received 16 December 1996, accepted 6 May 1997

Associate Editor: Henrik Andrén

Both birds and mammals use underground burrows to increase survival and reproductive output. The creation of these sometimes huge constructions may be both time and energy-consuming, but once established they may be used for centuries and constitute an important resource for their occupants. The distribution of such resources may affect the spatial organisation of animals (Begon, Harper & Townsend 1990, Milinski & Parker 1991), and areas may remain unoccupied if places suitable for the creation of burrows are unavailable (Neal 1986, Roper 1993). Burrows seem to be most commonly used for the bearing and rearing of cubs, but some species also use them regularly for rest and refuge, e.g. European rabbit *Oryctolagus cuniculus* (Thompson & King 1994), black-tailed prairie dog *Cynomys ludovicianus* (Hoogland 1994) and European badger *Meles meles* (Kruuk 1989).

Badgers form social groups defending a territory within which shared burrows ('setts') are scattered (*cf.* Kruuk 1989, Neal & Cheeseman 1996). The territory usually holds about half a dozen setts (Neal & Roper 1991), but occasionally numbers vary between one and ten or more (Roper 1992a). Badgers use the sett(s) within their territory for several purposes: e.g. overwintering, breeding, diurnal resting, short-term nocturnal resting and emergency refuge (*cf.* Kruuk 1989, Butler & Roper 1995, Neal & Cheeseman 1996). Setts show huge variations in both size and complexity, partly determined by the length of occu-

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pancy and the texture of the soil (see review in Neal & Roper 1991). Setts are known to range from a single entrance with a few metres of tunnel and no sleeping chamber (Roper, Christian, Fee & Tait 1992), to almost 200 entrances connected by nearly a kilometre of tunnels and 50 sleeping chambers (Roper, Tait, Fee & Christian 1991).

After their night-time foraging, badgers retreat to underground resting sites where they stay until the next evening (Kruuk 1978). The site may be the same from one day to the next or it may be changed, either within one sett or to a site within another sett (*cf.* Kruuk 1989, Roper & Christian 1992). Individual utilisation of different setts as resting sites within a territory is usually highly skewed, with some setts being used frequently ('main setts') and others only occasionally ('outliers') (Kruuk 1978, 1989, Long & Killingley 1983, Kruuk & Parish 1987, Roper & Christian 1992, Sleeman & Mulcahy 1993).

Three hypotheses have been proposed to explain why badgers use multiple setts as diurnal resting sites within territories (see Roper 1992a,b). First, subdominant individuals may use additional setts to escape persecution from dominant conspecifics (Kruuk 1978). If so, we would not expect ever to find young and adult members of a group in the same sett. Secondly, badgers may change setts to avoid a build-up of ectoparasites. If so, we would expect both adult and young badgers to use several resting sites among which they frequently alternate, either within one large sett or between different small setts. Thirdly, badgers may use several setts to avoid long travel distances back to the sett at the end of their nocturnal foraging period (Roper 1992b). In order to reduce energy expenditure in connection with foraging one would expect badgers to go to the nearest sett at the end of a foraging trip.

At present little is known, however, about the way badgers use multiple setts and how these are distributed within territories. In fact, this is an aspect of badger behaviour and ecology that has been more or less ignored. Therefore, in this paper, we analyse the individual utilisation of setts within territories to evaluate the first two hypotheses on the function of multiple setts within badger territories mentioned above. We also give a general description of badger setts and their distribution in the boreal forest of central Norway, where they are somewhat different from those described in the majority of earlier badger studies.

Material and methods

Our study was carried out during 1993 in Malvik (63°20'N, 10°50'E), Sør-Trøndelag, Norway. The area, which is comprised of 60 km^2 of coniferous forest affected by agricultural activity, is situated in the mid-boreal region. Most of the area is hilly with rocky slopes, mainly situated 200-500 m a.s.l. The soil predominantly consists of moderately bleached layers of podzol. Snow covers the ground for an average of 163 days, peaking in February-March with snow depths in excess of 1 m. The mean annual temperature is 1.5°C (min. January: -5.8°C and max. July: 9.8°C), and the mean annual precipitation is 1,260 mm (min. in May and max. in September). Badgers colonised the area about two decades ago (Bevanger & Lindström 1995, pers. obs.).

In total, 10 badgers (five males and five females), belonging to four adjacent social groups, were caught, sexed, aged and equipped with radio-transmitters (see Brøseth, Knutsen & Bevanger 1997). Three males and one female were classified as young, i.e. they were ≤2 years old. Badgers were located both during their nocturnal foraging period and in setts during the day in order to identify territories. Territory size was estimated by calculating 100% minimum convex polygons from fixes on animals belonging to the same social group.

Data on the utilisation of different setts as diurnal resting sites were collected during April-September by locating radio-tagged badgers during the day (0800-1700 GMT), on average for 39 days (range: 16-62) for each animal. In December we located the setts used for overwintering. One adult female provided insufficient data on sett use, and was excluded from the sett utilisation analysis. The sett use of a group consisting of three females in spring (April-June) was treated separately, because the presence of cubs prevented two adult females from choosing freely between resting sites on a daily basis.

The area was surveyed during March-April, and setts were located by tracks in the snow. Other setts were found through information from local people or by tracking radio-tagged badgers. The vegetation and soil characteristics in the vicinity of setts were used to assign natural setts to one of six biotope categories (deciduous forest, pasture, arable land, rich coniferous forest, poor coniferous forest and fen; see Brøseth et al. 1997). The direction in which each sett faced was measured using a compass and compared with the facing direction at stratified randomised

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points on a map (1:5,000) of the study area (one random location per 250 m²). The number of sett entrances was used as a measure of sett size.

Deviations from the random distribution of N setts within a territory was tested by a simulation test. The distance (d_i) to the nearest neighbouring sett was calculated for each sett in the territory, and the mean of these distances, $t = \sum_i d_i / N$, was used as the test statistic. The t* was calculated for the setts observed in the territory. The distribution of t under H_0 was then simulated by calculating t_j for each of j = 1, 2,.. .,10,000 simulated samples, each sample consisting of N setts randomly distributed within the territory. A random distribution of setts was rejected if the observed value of the test statistic t* was sufficiently different from the simulated value. The P-value of the test is the proportion of simulations for which $t_j > t^*$. The simulation program was written in Pascal.

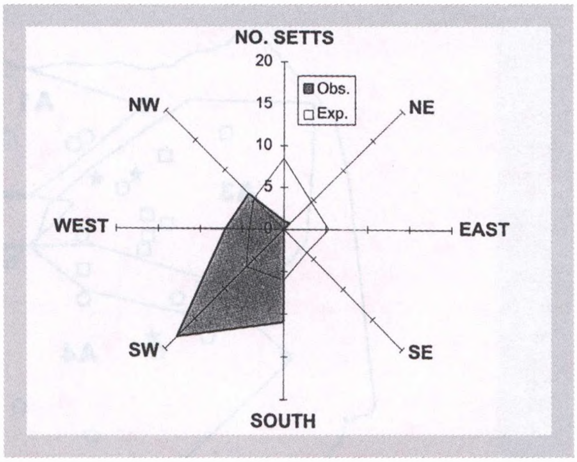

Figure 1. Facing direction of 44 natural badger setts in a boreal forest area of central Norway, with most setts facing south-southwest (shaded), compared with the facing direction at stratified randomised points in the same area. Grouped on the basis of 45° sectors.

Results

General description and distribution of setts

The study area contained a total of 53 setts showing signs of recent badger activity (0.88 sett/km²). Nine setts were built in man-made structures (e.g. barns, cottages and rock enbankments) and 44 were natural setts. Natural setts were small, with few entrances (1.8 ± 1.1 SD, range: 1-6), often dug in connection with large stones, boulders or rocky slopes. Latrines were found close to an entrance at 88% of setts, averaging 4.1 m ± 3.7 SD. No natural setts were found on flat ground (sloping less than 5°). Most were situated on medium slopes (mean: 27°, range: 8-42°), and more in the upper third than in the lower two-thirds of slopes (26, 12 and 6, respectively, $\chi^2 = 14.4$, df = 2, $P < 0.001$). Natural setts had a facing direction which differed from that found at random points in the area (G = 28.2, df = 7, $P < 0.001$), with most setts facing southwest (Fig. 1). More setts than expected were found in rich coniferous forest and less than expected in open biotopes ($\chi^2 = 35.9$, df = 3, $P < 0.001$, Table 1).

During the study, we recorded the use of 48 setts by tracking radio-tagged individuals. Natural setts and setts built in man-made structures were used according to their availability (40 and 8, respectively, G-test with correction, G < 0.01, df = 1, P = 0.97). No sett was used by more than one social group, and on average 12 setts were used in each territory (range: 10-16). There was no deviation from a random distribution of setts within territories (Table 2 and Fig. 2), except in one territory (A2: P = 0.01, two-tailed) where the observed distance to the nearest neighbouring sett was larger than the simulated distance.

Utilisation of setts and possible correlates

Individual badgers used an average of nine different setts during the active season (range: 5-12), and we found no differences in the number of setts used by adults and young (Mann-Whitney U-test with correc-

Table 1. Distribution of natural badger setts in a 60 km² boreal forest area of central Norway in various biotope categories. (For estimation of 90% family confidence coefficient, see Neu, Byers & Peek 1974.)

Biotope	Proportion of study area[1]	Setts (N = 44)	Proportion of setts	Confidence interval on observed proportion of setts[2]		
				Low	High	
Deciduous forest	0.014	4	0.091	0	0.199	
Poor coniferous forest	0.651	22	0.500	0.312	0.688	
Rich coniferous forest	0.181	17	0.386	0.203	0.569	preference
Arable land, pasture and fen	0.154	1	0.023	0	0.079	avoidance

[1] water not included
[2] compared with the corresponding proportion of the study area to test for deviations from proportional distributions

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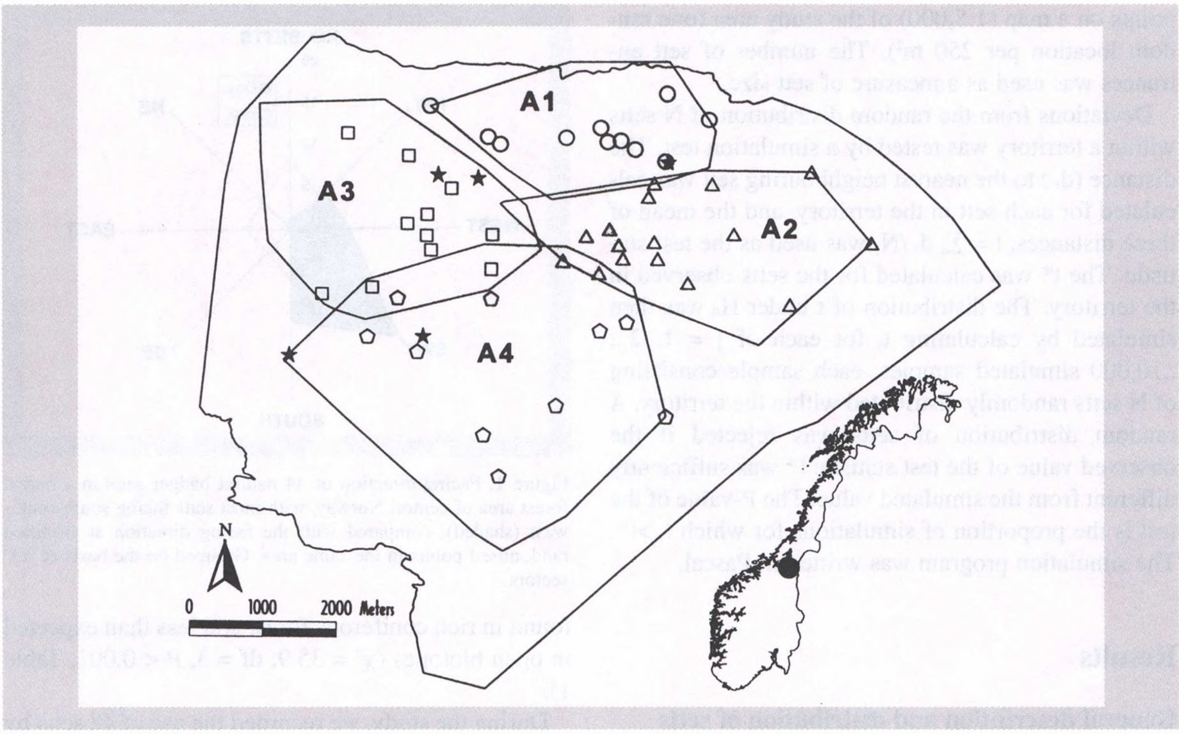

Figure 2. Spatial distribution of badger setts within territories in a boreal forest area of central Norway. Asterisks indicate setts with no recorded use by radio-tagged badgers during the study. For a description of territories A1-A4 see Table 2.

tion for ties, $N_1 = 5$, $N_2 = 4$, $U = 4.5$, $P = 0.17$). Individual utilisation of different setts within the territory was not significantly different from a Poisson distribution for any animal (Fig. 3), except for two adult females reproducing in spring (Kolmogorov-Smirnov, both $z > 1.9$, both $P < 0.001$) and a young female in summer-autumn ($z = 1.8$, $P < 0.005$). When excluding the two reproducing females in spring, badgers frequently changed setts. Individual badgers spent only one day in a sett before changing to another sett on an average of 71% (± 22 SD) of the occasions.

In spring we found differences in the stability of sett use between females in the reproducing group (G-test with correction, $G = 27.9$, $df = 2$, $P < 0.001$). The two adult reproducing females were found not to have changed setts on 86% and 91% of days, respectively, while the young female was found in the same sett on only 18% of days. Also for the rest of the season we found differences in stability between adults and young ($N_1 = 5$, $N_2 = 4$, $U = 1.5$, $P < 0.05$), but during this period adult badgers changed setts more often than young badgers, being found at the same sett on 23% and 37% of days, respectively.

In the three social groups holding more than one marked badger, we found no differences between marked animals in the number of the available setts within the territory used during the season (all groups; $G < 0.99$, $P > 0.62$). On average, 42% of setts were used by all group members (range: 27-60), and

Table 2. Distribution of badger setts within four adjacent territories (A1-A4) in part of the boreal forest of central Norway. Mean observed nearest neighbour distance between setts in territories is compared with 10,000 simulated mean nearest neighbour distances of randomly placed setts within territories. P-values given are the proportion of simulations with a mean nearest neighbour distance that is larger than the observed distance.

Group	No of badgers	No of setts	Territory size (ha)	Nearest neighbour distance (m)		P
				Observed	Simulated	
A1	3	11	510	400	396	0.470
A2	3	16	740	529	385	0.005
A3	1	11	831	493	496	0.513
A4	2	10	1410	777	681	0.229

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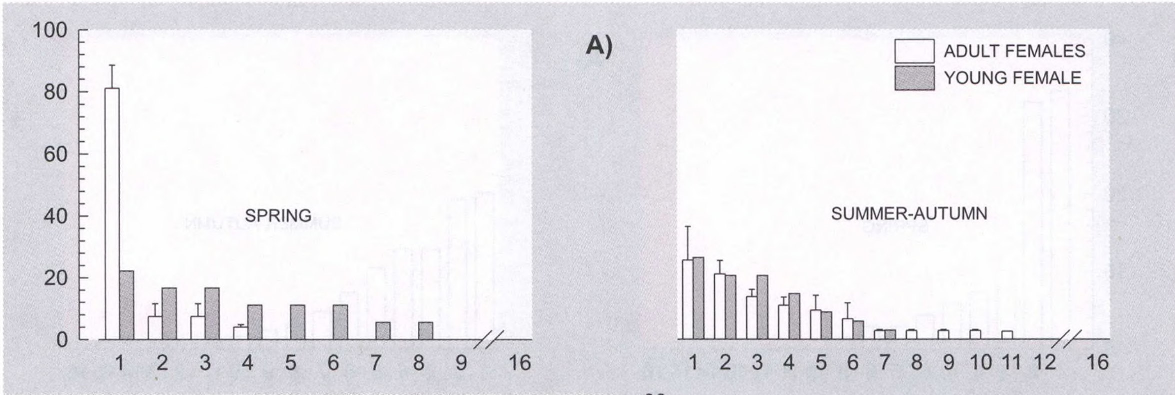

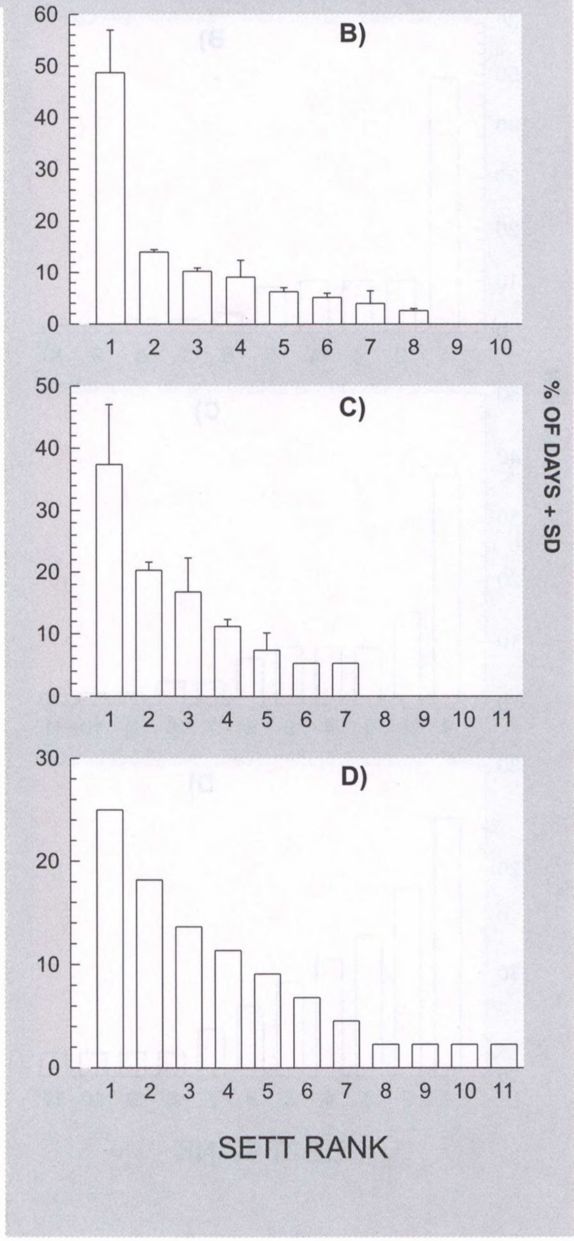

Figure 3. Individual utilisation of available setts in badger territories in a boreal forest area of central Norway. A) group A2 holding three females in spring (N = 18, 22 and 29 days, respectively) and summer-autumn (N = 34, 39 and 33 days, respectively), B) group A4 holding two males (N = 35 and 44 days, respectively), C) group A1 holding two males and one female (N = 19, 16 and 19 days, respectively), and D) group A3 holding one male (N = 43 days).

individual badgers used on average 67% of the setts within territories (range: 46-80). In spring, the two adult reproducing females were found in the same sett as the young female on 3.3% and 7.4% of days, respectively, but never together with each other. Excluding the sett use by this group in spring, group members were found together with other group members on 28% of days (range: 22-39), with no difference between adults and young ($N_1 = 4$, $N_2 = 4$, $U = 7.5$, $P = 0.89$). Group members correlated positively in the frequency of days they rested in different setts (all $r > 0.50$, all $P < 0.05$), except for a male cub and an old female in group A1, which showed only a positive trend ($r = 0.43$, $N = 11$, $P = 0.19$). There was a significant difference in the utilisation of setts with different numbers of entrances (Kruskall Wallis, $H = 13.0$, $df = 5$, $P < 0.05$), and we found a positive correlation between the number of entrances and the frequency with which setts were used ($r_s = 0.44$, $N = 48$, $P = 0.002$), indicating higher use of larger setts. Group utilisation of different setts in the territory indicates that in some groups one sett was considerably more used as a diurnal resting site than other setts in the territory, but this was not the case in all the groups (Fig. 4).

Discussion

Frequent changes and random utilisation of setts in Malvik suggest that badgers may use multiple setts to

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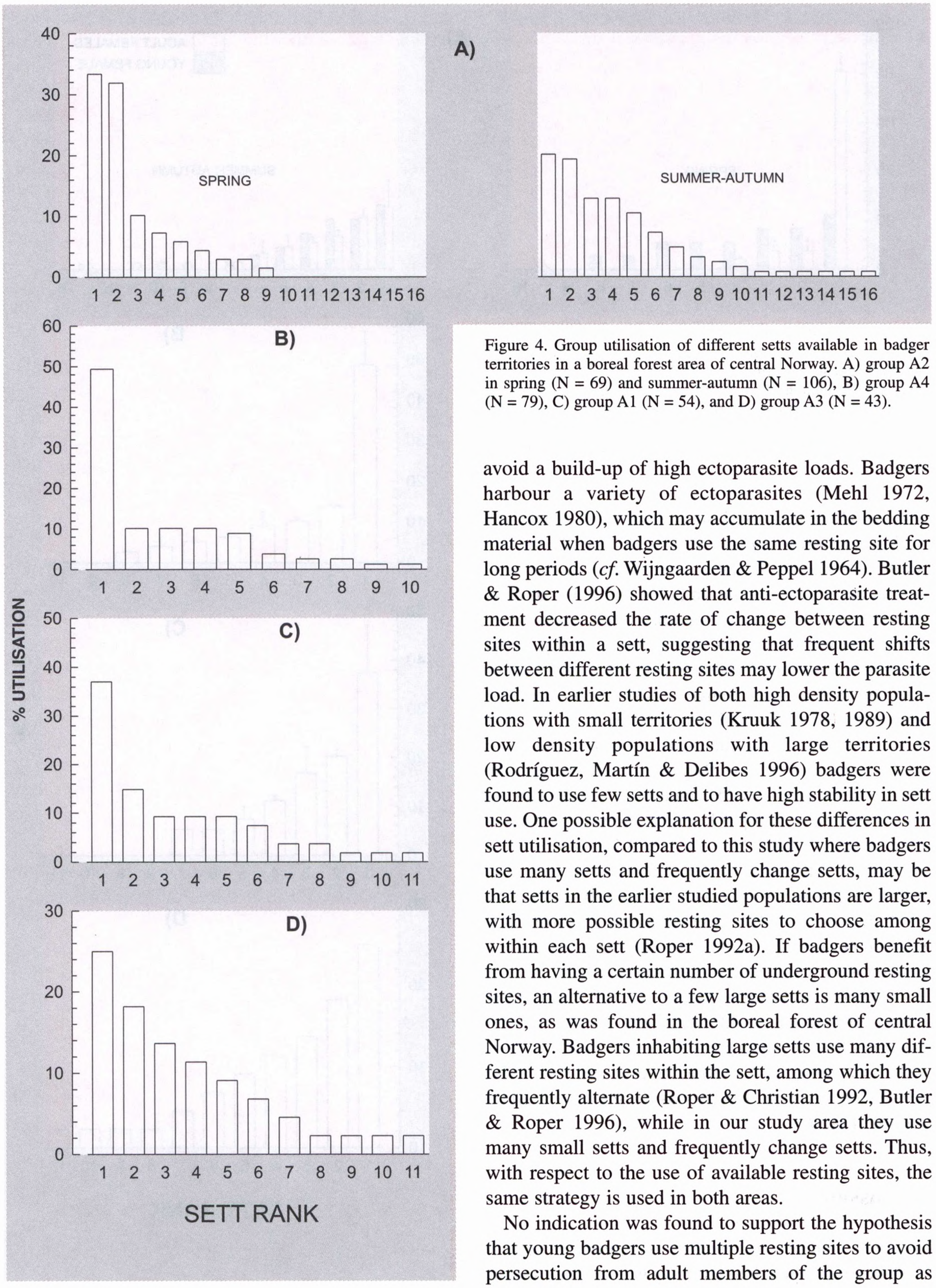

Figure 4. Group utilisation of different setts available in badger territories in a boreal forest area of central Norway. A) group A2 in spring (N = 69) and summer-autumn (N = 106), B) group A4 (N = 79), C) group A1 (N = 54), and D) group A3 (N = 43).

avoid a build-up of high ectoparasite loads. Badgers harbour a variety of ectoparasites (Mehl 1972, Hancox 1980), which may accumulate in the bedding material when badgers use the same resting site for long periods (*cf.* Wijngaarden & Peppel 1964). Butler & Roper (1996) showed that anti-ectoparasite treatment decreased the rate of change between resting sites within a sett, suggesting that frequent shifts between different resting sites may lower the parasite load. In earlier studies of both high density populations with small territories (Kruuk 1978, 1989) and low density populations with large territories (Rodríguez, Martín & Delibes 1996) badgers were found to use few setts and to have high stability in sett use. One possible explanation for these differences in sett utilisation, compared to this study where badgers use many setts and frequently change setts, may be that setts in the earlier studied populations are larger, with more possible resting sites to choose among within each sett (Roper 1992a). If badgers benefit from having a certain number of underground resting sites, an alternative to a few large setts is many small ones, as was found in the boreal forest of central Norway. Badgers inhabiting large setts use many different resting sites within the sett, among which they frequently alternate (Roper & Christian 1992, Butler & Roper 1996), while in our study area they use many small setts and frequently change setts. Thus, with respect to the use of available resting sites, the same strategy is used in both areas.

No indication was found to support the hypothesis that young badgers use multiple resting sites to avoid persecution from adult members of the group as

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young badgers were found in the same sett as adults and showed the same pattern of sett utilisation. We were not able to evaluate if badgers selected the nearest sett when they ended their nocturnal foraging trips, because we used discontinuous radio-tracking in our study (Brøseth et al. 1997). Badgers may roam over much of their territory during a given night, and the only way to test the hypothesis is to continuously record where a radio-tagged badger feeds during a given night and then see whether it goes to the nearest sett when leaving the last used foraging patch.

Two adult reproducing females deviated from the general pattern of sett utilisation in spring, showing preference for one sett and a high stability in sett use. When cubs are small they are restricted to the setts in which they were born and they do not accompany their mother on nightly foraging trips until they are 12-18 weeks old (Long & Killingley 1983), which usually is around June at these latitudes (Bevanger, Brøseth, Johansen, Knutsen, Olsen & Aarvak 1996). From July, the two reproducing females showed the same pattern of sett use as the other individuals, i.e., they visited many setts and changed frequently between them. This indicates that reproducing females do not 'prefer' to use only one sett in spring, but rather that they are forced to do so because of the restricted mobility of their cubs.

'Main sett' is a term commonly used in badger sett studies on the British Isles, and has been defined as a sett that is in continuous use, constituting the primary sleeping, breeding and overwintering site for all group members, and is bigger than other setts in the territory (*cf.* Kruuk 1978, Thornton 1988, Roper 1992a). However, this concept seems less applicable to our study area situated in the boreal forest of central Norway. None of the setts found in our study area fulfil all of these criteria. In the groups studied, one sett in each territory was used for joint overwintering by all group members, but only in two of the groups was this sett also the one most used during the study period. None of the setts was in continuous use, and only in one group was the overwintering sett the largest available sett within the territory. However, we found that individual utilisation of different setts tended to increase with sett size. Breeding was documented in two different setts in the same territory.

Sett digging is a costly activity for badgers, and sett size is partly determined by the diggability of the soil (Neal & Roper 1991). In the boreal forest, where there is only a thin layer of soil above the bedrock and the soil consists of podzol with many boulders, it may be favourable to expand an already existing underground space, rather than start digging from scratch. This might explain why several of the badger setts were found in man-made structures and why 25% of the natural setts had a former history as red fox *Vulpes vulpes* breeding dens (based on information from local people).

As in several other badger populations, most of the natural setts were found at somewhat sloping sites with some cover (Clements, Neal & Yalden 1988, Thornton 1988, Skinner, Skinner & Harris 1991). The predominance of setts facing south to southwest may be related to increased radiation and earlier melting of snow at these localities, making the proximate areas readily available for food search. Sett entrance depressions would be filled with snow and ice until late spring on north-facing slopes at these latitudes where the snow cover lasts for 5-6 months, which in practice makes them unavailable. Earlier studies have indicated a similar pattern, with more setts found on south to west facing slopes (*cf.* Skinner et al. 1991). However, the present study is the first to document a preference for setts facing this direction, taking into account the availability of facing directions. Even though badgers show particular preferences when they select a sett site, setts tend to be randomly distributed within the territories in the boreal forest of central Norway. This might indicate that there is no lack of 'good', potential sett sites in the boreal forest area studied.

Acknowledgements - we are grateful for the financial support given by the NINA institute programme on landscape ecology, the County Governor's office for environmental affairs in Sør-Trøndelag and the University of Trondheim. We are indebted to Jarle Tufto for the simulation program, and Richard Binns for improving the English. John Atle Kålås, Tim Roper, Henrik Andrén and one anonymous referee made valuable comments on an earlier draft of this manuscript.

References

Begon, M., Harper, J.L. & Townsend, C.R. 1990: Ecology: individuals, populations and communities, 2nd Edition. - Blackwell Scientific Publications, Oxford, 945 pp.

Bevanger, K. & Lindström, E.R. 1995: Distributional history of the European badger Meles meles in Scandinavia during the 20th century. - Annales Zoologici Fennici 32: 5-9.

Bevanger, K., Brøseth, H., Johansen, B.S., Knutsen, B., Olsen, K.V. & Aarvak, T. 1996: Økologi og populasjonsbiologi hos europeisk grevling Meles meles L. i en

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urban-rural gradient i Sør-Trøndelag. (In Norwegian with English summary: Ecology and population biology of the European badger Meles meles L. in an urban-rural gradient in Sør-Trøndelag, Norway). - NINA Fagrapport 23: 1-48.

Brøseth, H., Knutsen, B. & Bevanger, K. 1997: Spatial organization and habitat utilization of badgers Meles meles: effects of food patch dispersion in the boreal forest of central Norway. - Zeitschrift für Säugetierkunde 62: 12-22.

Butler, J.M. & Roper, T.J. 1995: Escape tactics and alarm responses in badgers Meles meles: a field experiment. - Ethology 99: 313-322.

Butler, J.M. & Roper, T.J. 1996: Ectoparasites and sett use in European badgers. - Animal Behaviour 52: 621-629.

Clements, E.D., Neal, E.G. & Yalden, D.W. 1988: The national badger sett survey. - Mammal Review 18: 1-9.

Hancox, M. 1980: Parasites and infectious diseases of the Eurasian badger (Meles meles L.): a review. - Mammal Review 10: 151-162.

Hoogland, J.L. 1994: The black-tailed prairie dog: social life of a burrowing mammal. - Chicago wildlife behaviour and ecology series, Chicago, 576 pp.

Kruuk, H. 1978: Spatial organization and territorial behaviour of the European badger Meles meles. - Journal of Zoology, London 184: 1-19.

Kruuk, H. 1989: The social badger: ecology and behaviour of a group-living carnivore (Meles meles). - Oxford University Press, Oxford, 155 pp.

Kruuk, H. & Parish, T. 1987: Changes in the size of groups and ranges of the European badger (Meles meles L.) in an area in Scotland. - Journal of Animal Ecology 56: 351-364.

Long, C.A. & Killingley, C.A. 1983: The badgers of the world. - Charles C. Thomas, Springfield, Illinois, 404 pp.

Mehl, R. 1972: Ektoparasitter på grevling i Norge. (In Norwegian with English summary: Ectoparasites from the badger, Meles meles, in Norway). - Fauna 25: 265-274.

Milinski, M. & Parker, G.A. 1991: Competition for resources. - In: Krebs, J.R. & Davies, N.B. (Eds.); Behavioural ecology: an evolutionary approach, 3rd Edition. Blackwell Scientific Publications, Oxford, pp. 137-168.

Neal, E.G. 1986: The natural history of badgers. - Croom Helm, London, 238 pp.

Neal, E.G. & Cheeseman, C. 1996: Badgers. - T. & A.D. Poyser Ltd, London, 271 pp.

Neal, E.G. & Roper, T.J. 1991: The environmental impact of badgers (Meles meles) and their setts. - In: Meadows, P.S. & Meadows, A. (Eds.); Symposia of the Zoological Society of London 63: 89-106.

Neu, C.W., Byers, C.R. & Peek, J.M. 1974: A technique for analysis of utilization-availability data. - Journal of Wildlife Management 38: 541-545.

Rodríguez, A., Martín, R. & Delibes, M. 1996: Space use and activity in a Mediterranean population of badgers Meles meles. - Acta Theriologica 41: 59-72.

Roper, T.J. 1992a: The structure and function of badger setts. - Journal of Zoology, London 227: 691-698.

Roper, T.J. 1992b: Badger Meles meles setts - architecture, internal environment and function. - Mammal Review 22: 43-53.

Roper, T.J. 1993: Badger setts as a limiting resource. - In: Hayden, T.J. (Ed.); The badger. Royal Irish Academy, Dublin, pp. 26-34.

Roper, T.J. & Christian, S.F. 1992: Sett use in badgers (Meles meles). - In: Priede, I.G. & Swift, S.M. (Eds.); Wildlife telemetry: remote monitoring and tracking of animals. Ellis Horwood, New York, pp. 661-669.

Roper, T.J., Christian, S.F., Fee, D. & Tait, A.I. 1992: Structure and contents of four badger (Meles meles L.) setts. - Mammalia 56: 65-70.

Roper, T.J., Tait, A.I., Fee, D. & Christian, S.F. 1991: Internal structure and contents of three badger (Meles meles) setts. - Journal of Zoology, London 225: 115-124.

Skinner, C., Skinner, P. & Harris, S. 1991: An analysis of some of the factors affecting the current distribution of badger Meles meles setts in Essex. - Mammal Review 21: 51-65.

Sleeman, D.P. & Mulcahy, M.F. 1993: Behaviour of Irish badgers in relation to bovine tuberculosis. - In: Hayden, T.J. (Ed.); The badger. Royal Irish Academy, Dublin, pp. 154-165.

Thompson, H.V. & King, C.M. 1994: The European rabbit: history and biology of a successful colonizer. - Oxford University Press, Oxford, 245 pp.

Thornton, P.S. 1988: Density and distribution of badgers in south-west England - a predictive model. - Mammal Review 18: 11-23.

Wijngaarden, A. van & Peppel, J. van de 1964: The badger, Meles meles (L.), in the Netherlands. - Lutra 6: 1-60.

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