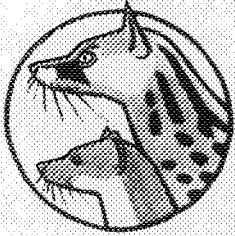


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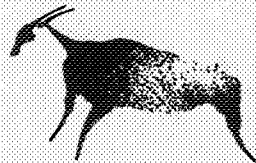


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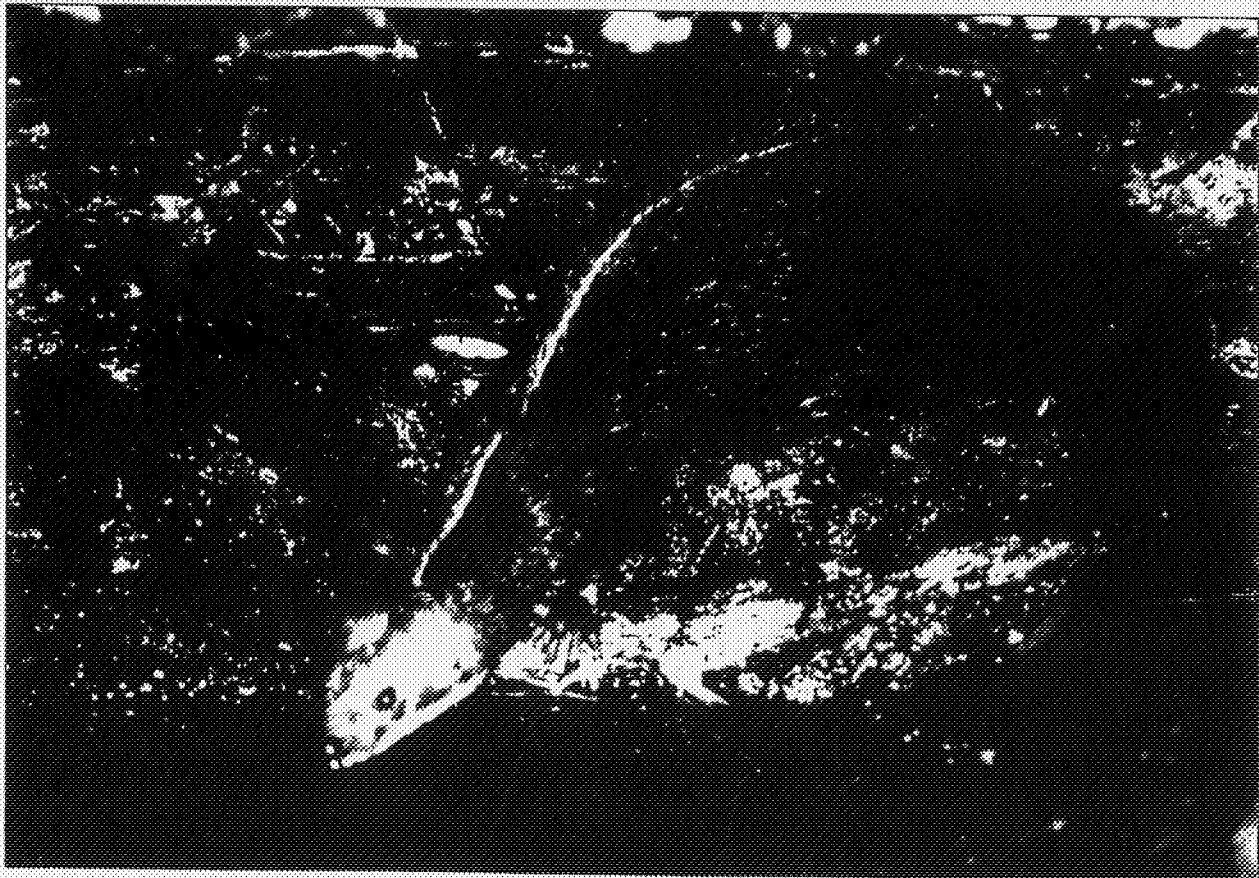
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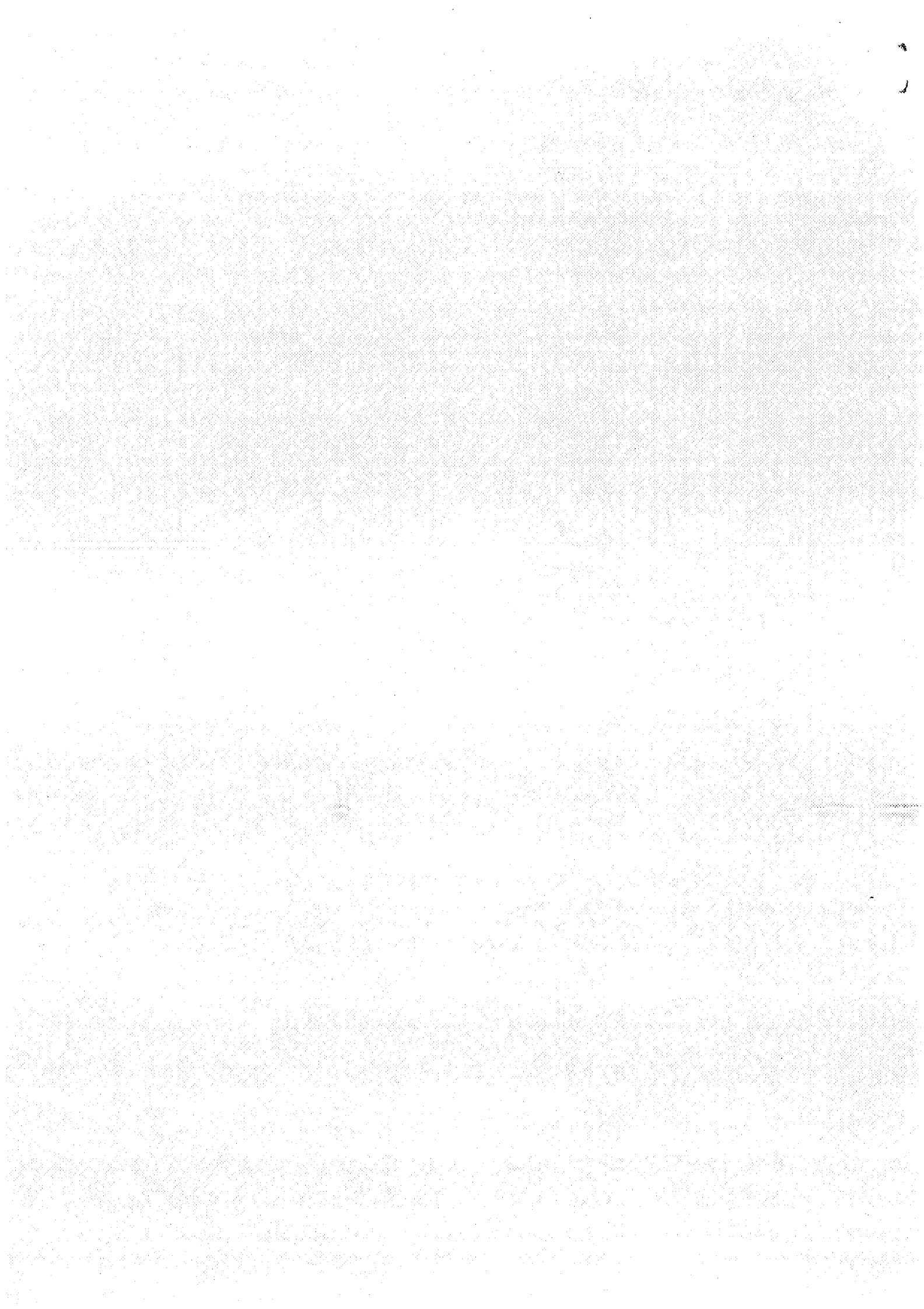
Back-striped weasel (*Mustela strigidorsa*) in Phu Khieo Wildlife Sanctuary, Thailand - Photo: N. Suannarong

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Use of Eurasian badger (*Meles meles*) setts and latrines in an area of the Italian Prealps (Lombardy, Italy)

Monica MARASSI and Carlo M. BIANCARDI

Abstract

Twelve badger setts were detected and duly checked for two years, in an area of 58 km², in the Lombardy Prealps (Lecco County). Sett density (1.6 setts/10 km²) is low, but similar to values recorded in other submountain and mountain areas. All the setts were located under coverage by high trees; the great part of them in the submountain belt, between 400 and 800 m a.s.l. The setts were homogeneously distributed on the limestone and morainic subsoils that characterise the study area. Sett use has been detected recording (during every inspection) the ratio between the number of entrances that had been used and the number of entrances that had not. The results, as expected, show greater activity in spring and summer. Latrine use, versus other defecation sites (ODS), shows a statistically significant trend towards larger latrine use (which means greater marking activity) during the months immediately after births when there is a peak in mating activity. Territorial behaviour accords with the Anti-Kleptogamy Hypothesis (AKH).

Key-words: badger, sett use, marking activity, Anti-Kleptogamy Hypothesis, Italy

Introduction

The Eurasian badger, *Meles meles* (L., 1758), is a widely distributed mustelid which lives in social groups. Badgers dig underground setts which are used as daily resting sites; the sett represents a profitable investment for badgers, so much so that they rarely abandon one: some badger setts have been known for centuries and still occupied (Neal & Cheeseman, 1996). Badger setts are commonly classified into four categories (Main, Annexe, Subsidiary and Outliers) depending on their size and their use (Thornton, 1988; Neal & Cheeseman, 1996). If such a classification is useful in situations of high density populations, such as in the British Isles and other areas of north and central Europe, in low density areas it may be difficult to realise the differences between the sett types (e.g. Virgós & Casanovas, 1999; Revilla *et al.*, 2001).

Badgers live in groups (clans) and share a territory, which is marked with latrines - one or more open pits dug by the animal and filled with their faeces and, sometimes, a secretion from the anal glands. Latrines may also be scent-marked with a whitish fatty secretion from the subcaudal gland (Kruuk, 1978; Kruuk *et al.*,

Table 1: Setts in the study area

N.	SETT	MUNICIPALITY	ALTITUDE (asl)	INCLINATION	TREE COVERAGE	CATEGORY	N ENTRANCES	ORIENTATION	GEOLOGY	VEGETATION
1	GISAZIO	PERLEDO	690	20°	4	MAIN	9	W	MORAINIC	MIXED BROADLEAF WOOD
2	GISAZIO 2	PERLEDO	720	30°	4	ANNEXE	1	NW	MORAINIC	MIXED BROADLEAF WOOD
3	ALBIGA	PERLEDO	860	30°	4	MAIN	8	W	LIMESTONE	BEECH WOOD
4	ALBIGA 2	PERLEDO	880	10°	4	ANNEXE	1	W	LIMESTONE	BEECH WOOD
5	AGUEGLIO	PERLEDO	1100	20°	5	MAIN	4	W	LIMESTONE	BEECH WOOD
6	SAIOLI	LIERNA	370	10°	4	SEASONAL	1	SW	MORAINIC	MIXED BROADLEAF WOOD
7	CAMPELLI	ABBADIA LARIANA	700	10°	5	MAIN	3	SW	LIMESTONE	MIXED BROADLEAF WOOD
8	ZUCCO ROCCA	ABBADIA LARIANA	530	5°	4	SEASONAL	1	S	LIMESTONE	EX-CULTIVATED LAND
9	LINZANICO	ABBADIA LARIANA	360	5°	4	SEASONAL	5	W	MORAINIC	EX-CULTIVATED LAND
10	VIGGIO	MANDELLO DEL LARIO	570	20°	4	SEASONAL	2	SW	LIMESTONE	EX-CULTIVATED LAND
11	CA' BIANCA 1	MANDELLO DEL LARIO	520	20°	4	SEASONAL	1	NW	LIMESTONE	MIXED BROADLEAF WOOD
12	CA' BIANCA 2	MANDELLO DEL LARIO	480	15°	4	SEASONAL	1	NW	LIMESTONE	MIXED BROADLEAF WOOD

	Min (cm)	Max (cm)	Mean (cm)	95% CI of mean (cm)
Height	15	50	27	24 to 30
Width	19	65	30	27 to 33

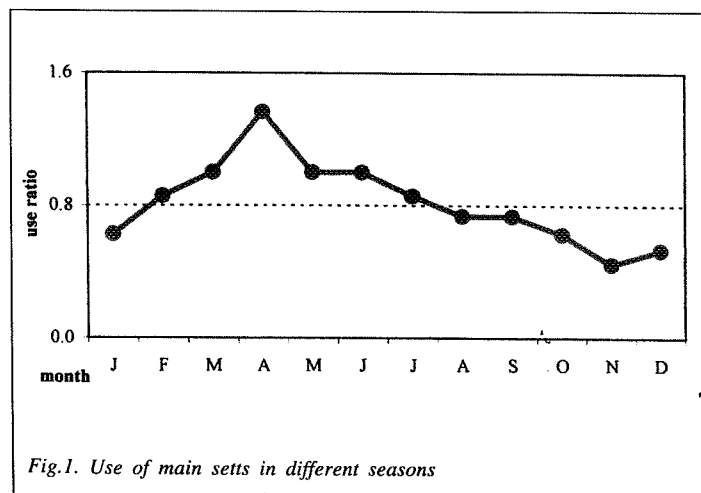
1984). Latrines are located at strategic places, often near paths or at the perimeter of the territory (Neal & Cheeseman, 1996). Badger clans are defined as "spatial groups" (Macdonald, 1983), but the benefits for group living are not easy to find: individuals do not cooperate in food searching, and females do not cooperate in rearing the young (Woodroffe & Macdonald, 1993). Sharing a sett within a territory seems to be the only reason for living together. The Resource Dispersion Hypothesis (RDH: Macdonald, 1983) and the Constant Territory Size Hypothesis (CTSH: Lindström, 1986) explain territorial and group-living behaviour as a strategy to defend food resources. On the other hand, for the Anti-Kleptogamy Hypothesis (AKH: Roper *et al.*, 1986) badger territorial behaviour is based on the defence of the breeding females. One of the AKH's predictions is that scent marking activity increases during the breeding period.

In mountain areas, where the density of badgers is low, the study of badger setts and latrine use may allow us to better understand differences in social and territorial behaviour between high and low density populations, and to formulate hypothesis for further investigations.

Study area

Badger setts had been found in an area of 58 km² in the Lombard Prealps, in the territory of Lecco County. The study area lies between the eastern coast of Lake Lario (Lake Como) and the massif of the Grigne. Altitude ranges between 200 - 1300 m ASL. The territory is included in the municipalities of Perledo (46°01'N, 9°30'E), Lierna (45°96'N, 9°30'E), Mandello del Lario (45°92'N, 9°32'E) and Abbadia Lariana (45°90'N, 9°33'E).

Large woods grow in the lowest vegetation belt, where chestnut trees (*Castanea sativa*) have replaced most of the original species: downy oak (*Quercus pubescens*) and hop hornbeam (*Ostrya carpinifolia*). Woods are mixed, with cultivated or ex-cultivated land and also fields with fruit-trees that are now growing wild. The higher vegetation belt is characterised by beech (*Fagus sylvatica*) woods.



The massif of Grigne consists of very hard Triassic limestone, dolomite and crumbly marl. The slopes are covered by Quaternary morainic alluvium (Amm. Prov. Como, 1995).

Methods

Setts were located through local gamekeepers and earlier interviews with local inhabitants. During our survey we found only 12 setts because of dense undergrowth and steep slopes. We considered a "main" sett to be one at which we were able to find activity signs over the whole year, however, in one case we classified an "annexe" sett because it was found <150 m from a main sett and several badger paths joined them. All the other setts were classified as "seasonal". Data were collected on vegetation and on the the various soil types.

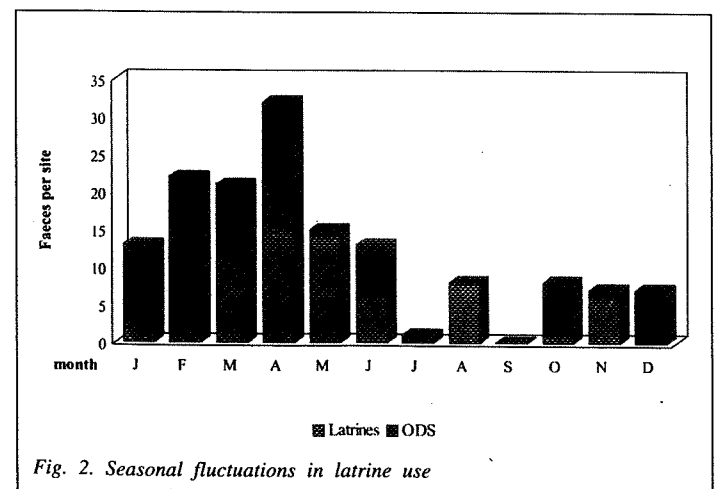
To estimate activity each sett was visited at monthly intervals during a two-year survey period, during which all the entrances were checked. During each visit the entrances were baited with one or two short twigs. The removal of the twigs, together with other signs of badger passage, allowed us to count the entrance being "used".

Defecation sites were located by walking all over the study area and, during each survey, we recorded the number of pits and the number of dung samples in each pit. We considered as "Latrines" all samples collected from dung pits used more than once throughout the year, and we noted samples collected in single pits or outside pits as "Other Defecation Sites". Badger scats were analysed to study feeding behaviour (Marassi & Biancardi, in preparation).

Results

As shown in Table 1, setts are actually small: half of them had only one entrance and the biggest had nine. These 37 entrances were measured (Table 2). In order to calculate the density of setts we considered the two annexe setts as being part of the main sett, also considered as a single sett were the two seasonal but quite near setts of "Cà Bianca 1" and "Cà Bianca 2". Thus we calculated a density of 1.6 setts/10 km².

The major part of the setts were located in the submountain belt, between 350 - 800 m, in mixed-broadleaf woods or in formerly cultivated land, now abandoned and reconquered by the wood. The three setts above 800 m were found in beech woods. Tree coverage is always very high and, in every habitat, badgers can find



many food resources related to human activities: fruit-trees, market gardens and vineyards.

The predominant type of soil in the study area is limestone and almost 70% of setts were located on this kind of substratum. The remaining setts were in morainic terraces. Geological factors influence the shape of sett entrances. Limestone is very hard to dig but gives good drainage, so badgers make use of natural fissures and local patches of softer material, giving sett entrances an irregular shape. Morainic or marl strata are easy to excavate and the entrances are oval-shaped.

Badgers prefer sloping land because this is well-drained and facilitates the removal of excavated soil; 65% of setts were on steep slopes with an angle of inclination of 10-20 degrees. The aspect of the setts does not differ from the pattern of the study area, where the great part of the mountain slopes are west orientated.

We tried to understand the use of main setts in different seasons, so we calculated the ratio between used and disused entrances in every month. The pattern (Fig. 1) shows a maximum in spring, which is connected with the mating period and the first appearance of cubs. We recorded the minimum in the use ratio during the cold season, however, the differences in the number of entrances used are not statistically significant ($G = 6.77$; d.f. = 11; $p > 0.1$).

Seasonal fluctuations in latrine use were evaluated by comparing the number of faeces in latrines and the number of scats in ODS each month (Fig. 2). The hypothesis that latrines are used more frequently than ODS in some seasons is confirmed ($G = 15.44$; d.f. = 1; $p < 0.01$).

Discussion

The calculated density of setts in our study was rather lower than that in Great Britain and Ireland, as reported by many authors (e.g. Cheeseman *et al.*, 1981; Kruuk & Parish, 1982; Feore & Montgomery, 1999), but similar to the lower densities generally reported from the continent (e.g. appendix 1 in Kowalczyk *et al.*, 2000). Data from the Alpine region were collected by Monnier (1993) for Switzerland (Canton of Neuchâtel: 0-2.2 setts/10 km²) and by Biancardi & Rinetti (1998) in another prealpine area (Valli del Luinese, Varese: 1.1 setts/10 km²).

Small setts, their distribution and density suggest a low badger population density and small family groups, but we need more evidence to confirm this hypotheses; it is possible that other badger setts remain hidden in dense undergrowth or other inaccessible places.

Soil type seems not to affect the distribution of badger setts in these prealpine environments, where the food availability may instead be most important (Biancardi & Rinetti, 1998).

Latrine use, which suggests a low marking activity as expected in low-density populations, increases in spring, just after the births of the cubs. This peak in territorial marking behaviour can be correlated to mating activity, rather than to feeding resource, as suggested by the Anti-Kleptogamy Hypothesis.

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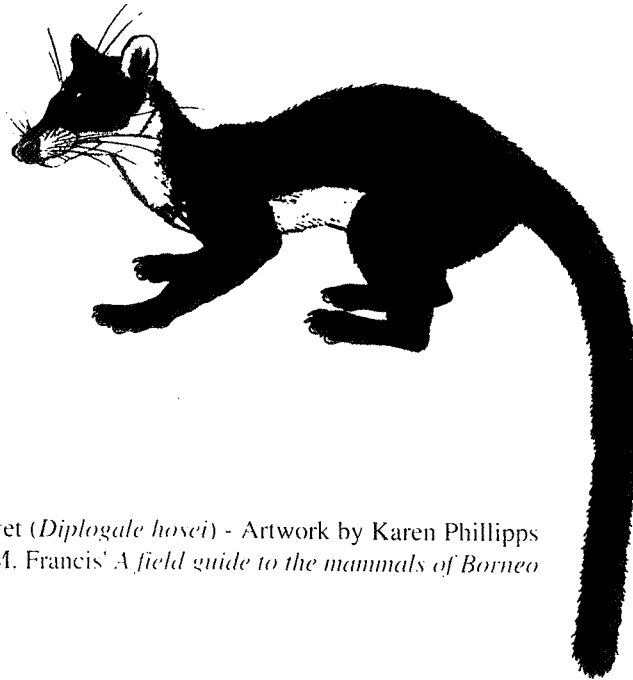
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