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Dispersal and other inter-group movements in badgers, *Meles meles*

By S. F. Christian

School of Biological Sciences, University of Sussex, Brighton, UK

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Abstract

Investigated dispersal and other movements of badgers between social groups in a high density badger population in Sussex, southern England, during the period November 1988 to October 1993. Fourteen badgers (10 female, 4 male) were radio-collared, tracked and observed during nocturnal ranging. Daily sleeping locations of collared badgers were also recorded for a 2-year period. In addition bait-marking was carried out twice annually to determine territory boundaries. Twenty-eight movements between groups were recorded, including 7 permanent group changes, one temporary group change and 20 visits of shorter duration. All of the adult badgers that permanently changed groups were mature females. An adult male changed groups temporarily and another was killed 3.5 km from where he was trapped. No aggression from territorial residents towards immigrants was observed and 3 females bred successfully following their group change.

Introduction

Badgers are unusual among the mustelids in that they typically live in mixed-sex social groups, sharing a communal range and one or more setts (Kruuk 1978; Powell 1979; Christian 1993). The social groups scent-mark and actively defend territories that are usually contiguous, mutually-exclusive and remarkably stable over time (Kruuk 1978; Kruuk and Parish 1982). Kruuk (1978, 1989) reportet that badgers are highly aggressive towards their neighbours and Neal (1986 p. 151) stated that 'a resident boar will fight any intruder which hasn't the correct communal scent of his social group'. Serious territorial fights have been reported (Kruuk 1978; Neal 1986; Christian 1993) and intraspecific aggression is thought to be a significant cause of badger mortality (Gallagher and Nelson 1977; Anderson and Trewhella 1985). Thus, there is a high cost to leaving the group territory and, in populations where the social structure is stable, evidence from live-trapping suggests that dispersal of juveniles from their natal group is rare (Kruuk and Parish 1982; Cheeseman et al. 1987, 1988; Evans et al. 1989). However, little has been reported about the movements of individual badgers between social groups.

The aim of this study is to report observations of social group changes and other intergroup movements by radio-collared individuals in a high-density rural population of badgers with a stable territorial structure.

Material and methods

The observations were made as part of a long-term, intensive radio-tracking study of badger behaviour and ecology in Sussex, southern England over the period November 1988–October 1993. The estimated population density was 16.7 adults per km^2 (for further details see Christian 1993). A total of 14 badgers (4 males, 10 females) from six adjacent social groups were radio-collared, tracked and observed during the night for an average of 6 hrs per badger per night during the period 1988 to 1992. Over the period October 1989 to October 1991 the setts used by radio-collared badgers as underground sleeping locations were also recorded daily. In addition, bait-marking (Kruuk 1978) was

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carried out twice each year in April and November, and the results were used to determine the boundaries of the 16 group territories in the study area.

Four categories of movement between social groups were distinguished:

1. Nocturnal visits. These included brief visits to the main setts of other social groups during nocturnal ranging. They lasted from a few minutes to one hour, during which the visitor might investigate the sett from the outside, or enter it and remain underground for some time.
2. Diurnal visits. These were visits in which individuals slept for a day or two in another social group's main sett but subsequently returned to their own territory.
3. Temporary group changes. These were longer-term movements in which badgers moved from their original social group to a new one, but returned to their original group after a period of several months.
4. Permanent group changes. These were movements in which the badgers moved from their original social group to a new social group, where they remained for the rest of the study period.

Results

Permanent and temporary group changes

Twenty-eight movements between social groups were observed during the study period: eight were classed as Permanent and Temporary group changes and 20 as other movements. Seven individuals made Permanent group changes and one individual made a Temporary group change (Fig. 1). All of the six adult badgers that changed groups permanently were mature females in their second year or older and two of them were known to have bred successfully prior to moving. The seventh badger to change social groups permanently was a young cub which accompanied its mother to her new territory. The badger which made a temporary group change was an adult male that moved to a neighbouring territory for a 3-month period.

All of these badgers were in good general body condition, showed no signs of injury or ill health and were not observed to be socially peripheral or subject to persecution in their original groups. In each case of Permanent group change the social group that was joined was well-established and contained several adults of either sex, occupying a stable, well-defined territory. Two of the groups to which females moved contained at least two resident females which were known to have bred successfully in the year preceding the movement and went on to raise cubs in the year following the movement. Three of the six females that moved permanently bred successfully in their new social group within a year of moving.

In no case was aggression from residents towards immigrants or from immigrants towards residents observed. No injuries caused by intra-specific fighting were re-

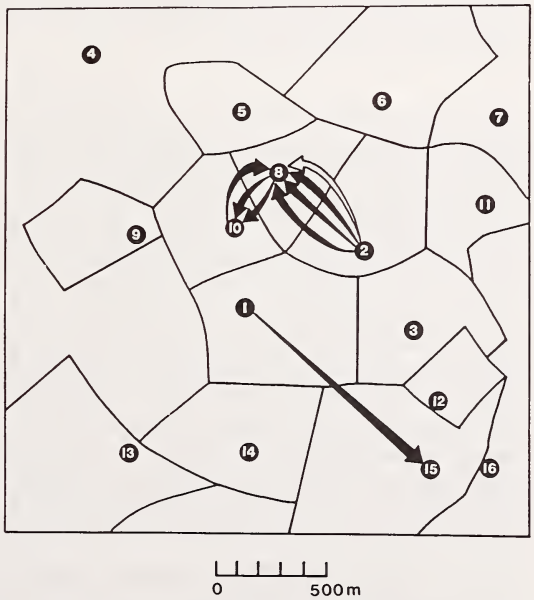

Fig. 1. Permanent (black arrows) and Temporary group changes (white arrows) by badgers, 1988–1993. Bold lines denote territory boundaries and dots numbered 1–16 denote main setts

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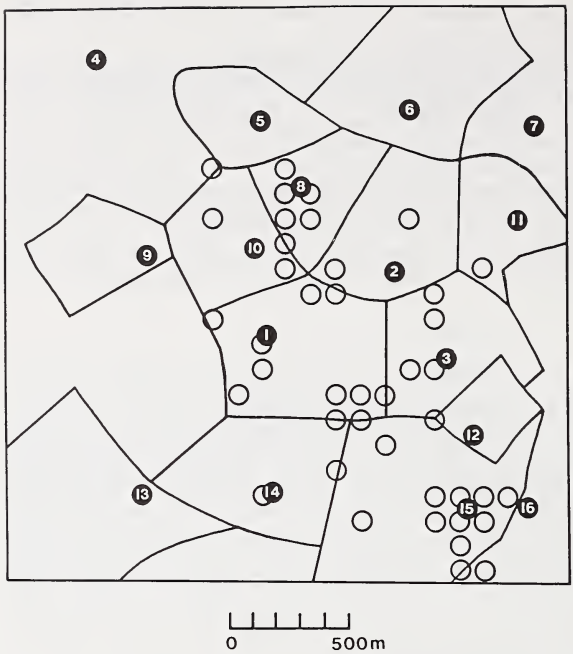

Fig. 2. Home range of female 15F1, during November 1988–October 1990. The study area was divided into 1-ha grid squares (not shown), and open circles denote squares in which 15F1 foraged. Bold lines denote territory boundaries and dots numbered 1–16 denote main setts

corded during tracking or recapture on any of the individuals that changed groups and there was no evidence of the immigrants avoiding the residents at the new sett or during nocturnal ranging.

The movement of the Group 2 badgers to Group 8 was immediate and unexpected: the badgers concerned (two females, one accompanied by a cub, and an adult male) began foraging near to a neighbouring main sett one night and by the following day had taken up residence there. In all other cases the movement from one territory to another was a more gradual process, the badgers concerned moving into outlying setts in their own territories, from these into outlying setts in the new territory and only then into the new main sett.

One case of a permanent group change is worth reporting in more detail because the badger concerned was exceptional in the extent to which it ranged within other groups' territory. The badger in question (an adult female) was trapped and collared at the main sett of Territory 1 in November 1988, and continued to inhabit that sett until February 1989, when she began to spend her days in outlying setts near the territory boundary. In early March 1989 she was found during the day at the main sett in Territory 15, and thereafter she continued to sleep at that sett (over 1.5 km from her original sett). On the night following her move, during a 5-h period, she made an extensive tour of the study area, moving through 10 different territories, passing close to the residents of several of them, and entering four main setts (Setts 1, 3, 8, and 10). Similar excursions were seen on subsequent nights and until October 1990 she was frequently located (often accompanied by a cub) foraging in other territories: particularly Territory 1 (her original territory) whose outliers she sometimes entered during the night and with whose residents she frequently associated; Territory 3 where she was recaptured in March 1990 during a nocturnal visit; and Territory 10 where she foraged with members of Groups 1 and 10 (Fig. 2). Despite this extensive extra-territorial ranging she was never observed in aggressive interactions with members of other social groups.

Other movements between social groups

Two individuals (a male and a female) made Diurnal visits to other main setts on four occasions, in January, July, August and September respectively, on each occasion spending the day underground with the residents. Fifteen Nocturnal visits (10 by females, 5 by males) were also recorded (Fig. 3). These usually lasted 5–20 minutes, during which time

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the visitor sniffed around the sett entrances and sometimes entered the sett. On one occasion a female spent an hour underground at a neighbouring sett with several of its residents, having previously spent more than two hours peacefully feeding with them in a nearby maize-patch. On two occasions a male visiting a neighbouring sett was fought by an occupant and chased away, and on two occasions a male visiting a neighbouring sett was observed to copulate with a resident female.

Finally one other badger was known to have moved a long way outside of its original territory. An adult male badger was captured whilst at Sett 6 in April 1993 but was never recorded in the study area again. In October 1993 he was found dead at the side of a road 3.5 km from Sett 6.

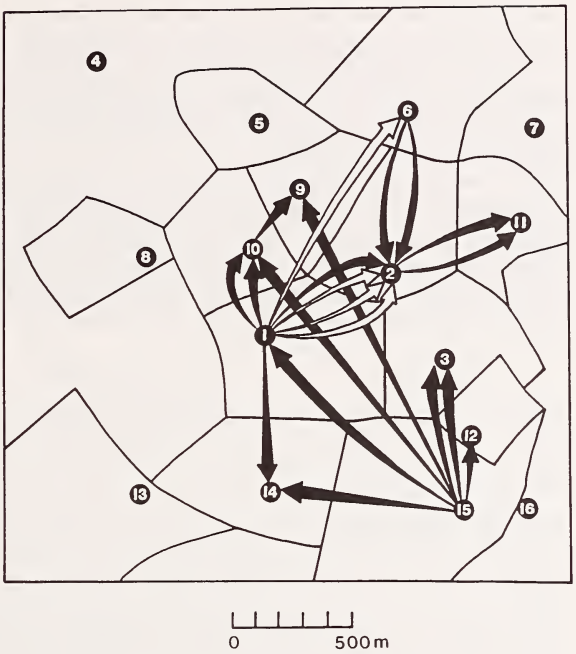

Fig. 3. Nocturnal (black arrows) and Diurnal visits (white arrows) by badgers, 1988–1993. Bold lines denote territory boundaries and dots numbered 1–16 denote main setts

Discussion

Several studies suggest that the movement of adult badgers between groups is rare. Kruuk (1978) reported that movements between territories in Wytham Woods were infrequent and in Speyside (Kruuk 1989) he found that of 60 badgers caught in consecutive years (37 females, 23 males) only six (all male, all adult) emigrated from their original territories. He concluded that male badgers remain in their natal territories for as long as it takes to move to a vacancy in a neighbouring territory, or until evicted by a relative or a usurper, whereas females remain permanently in their natal territories.

In other populations, however, both sexes may change social groups. Cheeseman et al. (1988) reported dispersal and movement patterns in badger populations in rural Gloucestershire and suburban Bristol. In the lower-density Bristol population the social structure appeared to be fluid and inter-group movements were relatively common. Movements were less frequent in the high-density Gloucestershire population, although their incidence increased as a result of disturbance, involving the complete removal of 11 social groups for reasons of disease control. In both populations, more males than females changed groups. Most of these movements involved sexually mature individuals and constituted movements to neighbouring territories. In a low-density rural Irish population subject to frequent human persecution, Sleeman (1992) reported that long-distance movements between social groups by individuals of both sexes may be relatively common. Similarly, Roper and Lüps (1993) have reported an increase in extra-territorial ranging and nocturnal visits to a main sett following the sudden death of all of its male occupants. Thus, overall the evidence points to the idea that in undisturbed high-density rural populations, where all

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the available habitat is divided up in a well-defined and stable territorial system, movements from one social group to another are uncommon and largely involve the occasional movement of individuals, usually males, to neighbouring social groups. In areas where the removal of social groups, persecution or some other factor causes territorial disruption, or severely depresses the population, extra-territorial movements and group changes are probably much more frequent.

My results are consistent with these findings in two respects, in that all of the movements involved adults (with the exception of an accompanying cub) and all of the permanent group changes involved movement to an adjacent territory. However, the observed movements were relatively frequent (7 of 14 radio-collared badgers changed groups during a 3-year period and visits to other setts were relatively common) and permanent group changes exclusively involved mature females. Females also visited other main setts more frequently than males.

My observations of group changes are notable in several other respects. Firstly, dispersers were never observed suffering aggression from members of their own social group prior to changing social groups. This suggests that the individuals did not disperse because they were induced to do so by other group members. Secondly, dispersers were never observed fighting with members of their new social group. Female immigrants showed no signs of persecution but went on to breed simultaneously with resident females in the new social group. This suggests that badgers may be more free to move social groups than previously thought and suggests females may not be in direct competition with each other for opportunities to breed as has been reported in other populations (Kruuk 1989; Woodroffe and Macdonald 1993). Thirdly, the unchallenged movements through other territories suggest that under certain circumstances some individuals, or categories of individual, may be free to range and forage within other territories and to visit other setts. Finally, the movement of all of the known members of Group 2 to join Group 8 "en masse" (2 adult females, a dependent cub and an adult male) is the first reported group movement of its kind. It is important to note that the Group 2 badgers did not move to a previously unoccupied territory, nor did they take over a previously occupied territory and expel its occupants. Rather, the immigrants joined the existing group members in their main sett, associating frequently and harmoniously with them, and both immigrant and resident females went on to successfully rear cubs following the group change.

Visits to other setts by radio-collared badgers of both sexes were relatively common and were characterised by amicable association between visitors and residents. Visitors sometimes entered the new sett and even spent the next day underground there with residents. Visiting males twice achieved successful matings with resident females. On two other occasions, however, male visitors were attacked and chased away by a resident male.

These radio-tracking observations indicate that, even within a stable and undisturbed high-density rural population, interaction and movements between neighbouring social groups may be more common than has previously been estimated on the basis of recaptures at main setts. They also suggest that territoriality may be more flexible (seasonal or context-related), or more specific (only concerning specific individuals or categories of individual, e.g. adult males) than has been previously supposed.

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Zusammenfassung

Ausbreitung und andere Ortsbewegungen zwischen Gruppen von Dachsen, Meles meles

Untersucht wurden Ausbreitung und andere Ortsbewegungen zwischen sozialen Gruppen einer Dachs-Population mit hoher Dichte in Sussex, Südengland, von November 1988 bis Oktober 1993. Vierzehn Dachse (10 weiblich, 4 männlich) wurden mit Radio-Transmittern markiert und während ihrer nächtlichen Wanderungen verfolgt und beobachtet. Über einen Zeitraum von 2 Jahren wurden die Schlafplätze täglich registriert. Außerdem wurde zur Feststellung der Territoriengrenzen zweimal im Jahr das Futter mit farbigen Plastikquadern markiert. Es wurden 28 Bewegungen zwischen Gruppen beobachtet, darunter 7 dauerhafte Gruppenwechsel, ein vorübergehender Wechsel und 20 von kürzerer Dauer. Alle adulten Dachse, die dauerhaft die Gruppe wechselten, waren geschlechtsreife Weibchen. Ein adulter männlicher Dachs wechselte die Gruppe nur vorübergehend, ein anderer wurde 3,5 km von der Fangstelle entfernt getötet. Territorienbesitzer zeigten keine Aggression gegenüber Einwanderern. Drei weibliche Dachse zogen nach Gruppenwechsel erfolgreich Nachwuchs auf.

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Author's address: S. F. Christian, School of Biological Sciences, University of Sussex, Brighton BN1 9QG, UK

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