

ACTIVITY AND HOME RANGE OF THE LIZARD *LACERTA AGILIS* L.

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(Accepted 27.5.88)

ABSTRACT

During a three-year period of research on the lizard *Lacerta agilis*, observations on activity and home range area were obtained for two seasons. It was found that *L. agilis* had overlapping home ranges. The home range area of *L. agilis* was found to be smaller than would be predicted from studies on the relationship between the size of various lizard species and home range areas.

INTRODUCTION

The ecology of the lizard *Lacerta agilis* has been well researched, particularly its habitat requirements in England (House and Spellerberg, 1983a; Dent and Spellerberg, 1987). The habitats of this lizard species has also been studied in other countries including Russia (Tertyshnikov, 1970; Jablov, 1976), Germany (Glandt, 1979), Luxembourg (Parent, 1978), and Sweden (Andren and Nilson, 1979). A review of *Lacerta agilis* habitats is contained in House and Spellerberg (1983b) and some aspects of management are described in Corbett and Tamarind (1979). One aspect of the habitat requirements of this species that continues to be of interest to both conservationists and ecologists is area or space.

One way to investigate the space or area requirements of a species is to examine data on activity and home ranges. A home range is the entire area within which an individual moves (Rose, 1982) and data on the area of home ranges may be used as a basis for assessing how lizards use their resources. The aim of this paper is to present and assess such data which could later be used for the management, restoration and creation of habitats for the protected *L. agilis*.

METHODS

This research and other aspects of *L. agilis* ecology was undertaken over a period of three years at two study sites (A and B) in Dorset, England. Site A was approximately 0.5 ha on an area of open heathland near a National Nature reserve. Site B was heterogeneous in nature and included parts of a disused railway site, a bog and small lake and a mixed deciduous woodland. The vegetation of site B was composed of large areas of coarse grasses, bracken, brambles and typical early colonisers of disturbed ground.

Lizards were caught by hand and individual lizards were identified by clipping some claws to a predefined code. The characteristic dorsal markings and the various patterns on the lizards were also recorded in drawings. Adults were defined as those lizards that had experienced two winters, sub-adults were lizards that had experienced only one winter. Data on activity and home range area was accumulated during two years of

the field work in addition to other aspects of the ecology of this species being researched over the three years.

In order to assess levels of activity, lizards were caught by hand and also permission was obtained to trap *L. agilis* on site A with the use of pitfall traps (glass jars, 150mm deep and 70mm diameter at the base) set out in a grid. The pitfall traps were kept dry and were checked every day for lizards. During the first pitfall trapping programme, 66 traps were set in a grid of 5 metres. In the following year, 109 traps were positioned on a 7 metre grid over the central part of the study site and a 10 metre grid on the edge of the study site. Home range areas were calculated using the convex polygon method (Southwood, 1966). As it was known that the accuracy of home range area estimates are affected by the number of sightings used, a correction factor was used as part of the analysis.

RESULTS

SPRING EMERGENCE

During the research, the earliest date for emergence recorded for one season was 1st March (week 9) but most male *L. agilis* were first seen in the first two weeks of April (weeks 14, 15). Males were first sighted on average two weeks before females. Following emergence from overwintering sites (holes in banks or disused burrows of small rodents) the most predominant form of male behaviour was basking and this usually took place within a metre of the overwintering site. Only during warm spring days were the males seen to forage and feed. By mid-April, male lizards had left the vicinity of the overwintering sites but the same sites were used by other individuals as an overnight refuge. Shortly after this local dispersal of males, the first females were sighted (15th April).

ACTIVITY AND SOCIAL BEHAVIOUR

The total number of male lizards caught in pitfall traps was, for most months, greater than the number of female lizards caught (Fig. 1). This difference between sexes was clear in the second season but less clear in the first season when trapping commenced. If the sex ratio is near 1:1 (and there is no reason to believe otherwise) then it would appear that male lizards are usually more

active than female lizards. For the first few months of the pitfall trapping, sub-adults were caught in fewer numbers than were male or female lizards and it was only towards the end of the second season that comparatively high numbers of sub-adults were trapped.

Observations on behaviour of males during the spring suggested that there was a dominance hierarchy amongst the males (Nicholson, 1980). In all but one of nine male-male interactions observed, the smaller male

lizard withdrew and in all cases the interaction between conflicting males was terminated abruptly by withdrawal. Social interaction between females was not observed in the field. Although actual mating was not observed, identification of individuals involved in courtship suggested that males are polygynous (Nicholson, 1980).

HOME RANGE AREA

The uncorrected and corrected home range areas for individual *L. agilis* are shown in Table 1. Included in this Table are some individuals for which home range area was estimated more than once but on different occasions. These data indicate that the estimate of home range area is affected by sample size and a detailed analysis of this aspect is provided in Nicholson (1980).

Mean uncorrected (and corrected, Jennrich and Turner, 1969) home range areas for male and female lizards (excluding those based on only three sightings and also those observations made in the first year when the trap grid was small) are given in Table 2. The difference between the mean corrected home range areas of males and females was not significant at Site A ($t = 0.32, p = 0.8$) but was for Site B ($t = 2.97, P < 0.05$). The mean corrected home range area for female lizards was significantly smaller at Site B compared to Site A ($t = 2.61, P < 0.05$) but there was no significant difference between the male lizards from the two study sites ($t = 0.63, p = 0.5$).

HOME RANGE OVERLAP

During this research, it became evident that there was overlap between home range areas. The degrees of home range overlap (that percentage of an individual

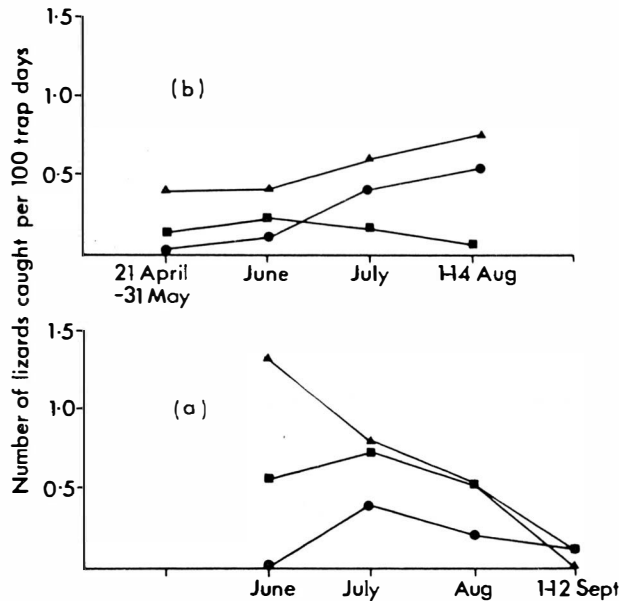


Fig. 1 Rates of capture of male (Δ), female (\blacksquare) and sub-adults (\bullet) *L. agilis* in pitfall traps at study site A. a = first season with 66 traps. b = second season with 109 traps.

Site	MALES				FEMALES			
	Time period over which observations made	Number of captures or sightings	Polygon home range (m ²)	Corrected home range (m ²)	Time period over which observations made	Number of captures or sightings	Polygon home range (m ²)	Corrected home range (m ²)
A	June-Oct	7	113	578	July-Aug	9	384	1492
	Aug-Sept	6	75	439	May-Aug	7	78	400
	June-July	3	63	1454	July-Aug	5	525	3890
	April-July	14	775	2135	*May-July	3	50	1163
	April-Aug	25	1155	2230	April-July	5	169	1250
	April-Aug	12	780	2400	April-July	8	431	1866
	June-July	3	161	3751	*June-July	7	641	3309
	May-July	6	75	438	June-July	17	654	1565
	*June-July	6	325	1901	One year	8	233	1007
	One year	17	950	2273	One year	4	63	679
B	One year	5	478	3538	One year	7	600	3060
	April-June	16	1396	3455	May-June	6	120	701
	May-June	6	150	879	May-July	12	59	182
	April-May	12	161	495	May-June	12	61	188
	April-May	10	904	3183	May-June	3	79	1843
	April-July	12	314	966	One year	5	105	776
	April-July	10	725	2553	April-May	5	81	599
	April-July	6	675	2921				
	April-May	5	183	1356				
	April-May	7	41	210				

TABLE 1: Home range area for *L. agilis*.

* Denotes a sub-adult individual.

Study Site	Sex	No. of Lizards	Home range areas (m ²)	
			Uncorrected	Corrected
A	0	7	648	2130
A	0	7	398	1819
B	0	9	505	1779
B	0	5	85	489

TABLE 2: Mean home range areas for *L. agilis*.

home range shared by lizards; Ferner 1974) should be estimated for each individual lizard but that can be done however only if the exact boundaries of the home range are known. However, an index of the extent of overlap within a population can be calculated if the population density and the mean home range size is known and if it is assumed that the lizards distribute their home ranges evenly over the study site. At Site A the population density was estimated as being one male lizard per 800m². On this basis and in the light of several assumptions, it was calculated that male *L. agilis* at Site A had a home range overlap of 75 per cent. This high degree of overlap was supported by observations of the use of overnight refuges. For example, during the course of one season as many as nine *L. agilis* used one particular overnight refuge.

DISCUSSION

The most notable and characteristic feature of the spring emergence behaviour was that males appeared before females (see also Nuland and Strijbosch, 1981) and basked for much of the time unless the weather was particularly warm. It would appear therefore that foraging could only be undertaken on warm days when insolation levels resulted in a lizard's body temperature reaching the preferred body temperature level or mean voluntary temperature (Spellerberg, 1980).

The costs of partitioning a lot of time to basking in the early spring when weather conditions are not always favourable are at least two-fold: one cost is the extra energy spent on raising body temperatures compared with the lesser amount of energy utilised by remaining inactive in a burrow; a second cost is exposure to predation. The benefits of this spring basking behaviour would therefore need to be high so as to balance such costs. In reptiles, many biochemical and physiological processes have been shown to be temperature related (Huey and Slatkin, 1976) and spermatogenesis is one such temperature dependent process (Licht, 1965).

The activity of *L. agilis* in a temperate climate is of course seasonal and one reproductive cycle occurs each year within a few months. It would seem therefore that male *L. agilis* direct some energy towards spermatogenesis in the early spring and although the total amount energy could be small (in relation to all other spring energy expenditure), the fact that the lizards need to complete the process of spermatogenesis as soon as possible during periods of unfavourable weather would seem to imply high costs which are not balanced by energy gains from feeding. Evidence for this latter point was obtained in the form of data on

weight loss amongst male lizards during the spring (Nicholson, 1980).

The seasonal level of activity (based on animals caught in pitfall traps) showed a predictable pattern with highest levels of adult activity occurring in June, July and August. In one year, male *L. agilis* seemed to be consistently more active than females but there is no evidence to suggest a reason for the apparent high level of male activity. The incidence of lizards caught in pitfall traps was highest on days when insolation was at its greatest (Nicholson, 1980) and this is explained by the activity of lizards being largely temperature dependent.

The uncorrected home range area of individual lizards as calculated by the convex polygon method was in all cases strongly related to the number of sightings. Although for this reason, a correction factor (Jennrich and Turner, 1969; Rose, 1982) was used, both uncorrected and corrected estimates have been given for comparative reasons. Mean corrected home range areas have been reported for *L. agilis* in Sweden (Olsson, 1986). Whereas the mean home range area for 29 male lizards was 1110m² the mean area was only 156m² for 19 females. Olsson's field work was undertaken in the spring and it is interesting to note that, in reference to the work reported here, small home ranges were found for female *L. agilis* (Table 1) during the spring (Nicholson, 1980). Small home range areas have been reported for both sexes of *L. agilis* in Russia (Tertyshnikov, 1970). In plantation compartments where trees had not reached the thicket stage, Dent (1986) found the mean uncorrected home range areas to be 1681m² for five males and 1100m² for 10 females (recalculated for comparative purposes from Dent's data and omitting data for lizards where there was less than six sightings for the calculation of the home range area).

In this study it was found that female home ranges were much smaller than those of males on study site B whereas on study site A there was little difference in home range size between the sexes. More recent studies (see above) describe statistically significant larger home ranges for males compared to female home ranges. Such differences are possibly related to social behaviour and in particular the reproductive behaviour of the females. In this study, the small home ranges of female lizards occurred throughout the breeding season and up to egg-laying, suggesting that these small home ranges are characteristic of gravid females.

Assuming that corrected results give a more accurate estimate of the actual home range area than uncorrected results, then the home range area of male *L. agilis* in some habitats could be near 2,000m². A home range area of near 2,000m² for a lizard of this size (9-10 g, 7-9cm snout-vent length) is not surprising and indeed this is smaller than would be predicted from the comparative data on lizard home range size and body weight provided by Turner *et al.* (1969). Furthermore, and in view of information on movement and the homing ability of this species, it is possible that all the above figures for home range size are underestimates. For example, in the present study, some individuals travelled hundreds of metres during the course of a season and one male lizard on one occasion took only

29 minutes to travel 43m. Arising out of some research on the homing behaviour of *L. agilis* and *L. vivipara* (Strijbosch *et al.*, 1983) it was found that 81.5 per cent of individual *L. agilis* displaced by 70m returned within a few days.

A small lizard species with a home range area of several hundred square metres could not effectively defend resources in a territorial manner in habitats where the structure and density of vegetation limits visibility to no more than a few metres. It is therefore not surprising that no evidence of territorial behaviour was found for male or female lizards. However, a high degree of home range overlap amongst the male lizards could be the basis for a dominance hierarchy amongst the males.

The home range or territory of any lizard must be large enough to contain all those resources necessary for survival throughout different times of the year. For *L. agilis*, these resources include certain prey types and abundance of prey (Nicholson, 1980), egg laying sites, overwintering sites used at night and during periods of unfavourable weather and conditions suitable for thermoregulation. Any one of these resources or a combination of these resources could be critical in determining the area (and indeed shape) of an individual lizard's home range and for *L. agilis* it is not known which resources affect home range size. However, it is interesting to note that inverse relationships between the one resource of food abundance and lizard territory size have been analysed and described by Rose (1982). Although Rose analysed territories of lizards, it would not be unreasonable to suggest that in some species of lizards, food abundance is a critical factor in determining home range size. Also, if such resources affect lizard population density, then we could expect small home ranges to occur where there was high population density.

There is little evidence to support this conclusion but House and Spellerberg (1983a) did find that population density of *L. agilis* was varied and that highest population densities occurred where vegetation structure was most diverse. Glandt (1979), working in Germany, has also drawn attention to the importance of vegetation structure in *L. agilis* habitats. Although home range size was not investigated by House and Spellerberg, it is possible that diverse vegetation structure could support high prey abundance resulting in both small home range size and high population density.

ACKNOWLEDGEMENTS

This study was part of a research programme supported by a grant from the Natural Environment Research Council. Staff at the Institute of Terrestrial Ecology, Furzebrook Research Station provided much help and support for the research. The Nature Conservancy Council gave their kind permission to work on the National Nature Reserve.

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