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Spatial Distribution and Home Range Size in the Swedish Sand Lizard *(Lacerta agilis)* During the Mating Season

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INTRODUCTION

Generalizations about spacing patterns and mating systems operating in lacertids have been based on few studies, sometimes even with contradictory results. In the sand lizard for exmple, previous investigations have indicated a/ non-overlapping home ranges with occasional defence of boundaries and foraging routes i.e. territoriality, /Simms, 1970/ and b/ overlapping home ranges with no defence or defence only of particular sites /Smith, 1969; Tertyshnikov, 1970/. The aim of this study is to clarify the spacing pattern and mating system operating in a population of sand lizards. Fights between males are common and Bischoff /1984/ concludes that male sand lizards are territorial and in no way hierarchical. Female fights occur but seem to be rare events /Kitzler, 1942; Sjögren, 1976/.

MATERIALS AND METHODS

A population of sand lizards was studied during April to June 1984. The study area, a three ha large south east facing slope, is located on a peninsula 50 km south of Göteborg and consists mainly of bare rock alternating with shrub and bush vegetation. The lizards were caught by hand or noosing. Every animal was measured, weighed and marked by toe-clipping and dorsal painting before it was released at the place of capture. On the day of capture and/or marking of a lizard, only the first sighting was noted.

At the end of the mating season noted positions of the lizards were transformed into polar coordinates by measuring angles and distances from a fixed point. By connecting each lizard's most peripheral coordinates, 2-dimensional convex polygonal home ranges were formed.

An estimation of the average home range area for each sex was also made. A graph was constructed by non-linear regression for each sex and used to approximate the number of observations needed for an estimation of about 90% of the home range size /after Rose, 1982/. Individuals that were observed fewer times than predicted by the graph to describe 90% of the home range were excluded from the analysis. The distribution of

sightings inside a home range was investigated by segmenting home ranges and counting the observations made in the different segments /after Rose, 1982/.

RESULTS

570 lizard sightings were made of 45 individual females and 44 males. 29 males /66%/ and 19 females /42%/ were sighted three times or more in different places which enabled plotting of their home range areas. It is shown in Fig. 1 that females have a sighting frequency skewed towards the part of home range where their site for shelter and thermoregulation is situated. Males do not show a significant preference for any part of their home range /$p<0.02$, Chi-square/.

Table 1. Result of overlap analysis /$\bar{x} \pm SE$/.

	OVERLAPS		OBSERVATIONS	
SEX	INDIVIDUALS	% AREA	INSIDE H.R.	OUTSIDE H.R.
M	4.8 ($\pm$0.43) (N=29)	18.1 ($\pm$2.00) (N=139)	30	1
F	1.0 ($\pm$0.22) (N=16)	9.8 ($\pm$4.00) (N=19)	7	55

Male lizards have significantly more home range overlaps than females /Tab. 1, $p<0.0003$, Mann-Whitney U-test/. There is also a significantly larger area overlap in males than in females /Tab. 1, $p<0.0018$, Mann-Whitney U-test/.

Home range overlaps between females and two size classes of males were counted. This showed that large males have significantly more overlaps with females than small males have /$p<0.01$, Mann Whitney U-test/.

For animals observed less than three times I counted and separated the number of sightings made inside and outside home ranges of other individuals of the same sex /Tab. 1/. Significantly more males were seen trespassing on other male home ranges than females intruding on female home ranges /$p<0.0001$, Fishers exact prob./. The graphs constructed by non-linear regression to approximate average increase in area percentage for each sighting, showed that 90% of the home range area was covered by approximately 9 sightings in females and 11 sightings in males. Average male home ranges were calculated to be 1110 sq.m. /+-142, SE/ and female home ranges 156 sq.m. /+-76/.

DISCUSSION

Home range overlaps do not necessarily indicate non-territorial animals, as differences in individual activity will give potential trespassers opportunity to enter another

lizard's home range without being attacked. In a population of Sceloporus jarrovi, for example, individuals were shown to be active only 2.5 days/wk on average /Simon and Middendorf, 1976/. Absence of overlaps is not always evidence of territoriality. In the ground skink Lygosoma laterale females have small home ranges with few intrasexual overlaps /Brooks, 1967/ a spacing pattern similar to that in female sand lizards. As Brooks points out, though, female territoriality in Scincidae is without precendent and is also rare among lacertids /Stamps, 1983/.

In my study the difference between the sexes in size and frequency of overlap is conspicuous. As females occupy small areas, the overlap between individuals should consequently be rare and small. Because of this, it is important that overlap data are supported by further evidence that argues for or against territoriality. This is especially important as females in insectivorous species, independently of being territorial, seem to have few and small overlaps /Stamps, 1983/. In this study overlap data is supported by the fact that transient females, in contrast to males, are rare inside resident female home ranges /11 % of the sightings/. The likelihood of observing transient animals inside the home range of a resident one ought to decrease with decreasing area. My opinion, though somewhat speculative, is that the correlation between area and number of observations made is probably less pronounced than might be imagined. I have shown that female lizards are mostly seen in a core area of their home range, mainly around a site used for basking. I expect observations of transient females to be made in the proximity of these sites, especially as I regard sites used for basking as a critical resource in this habitat. However, I have found no such indication of transient females close to or in areas used by resident females for shelter and basking. My conclusion is that even though female interactions have not been observed by me, females avoid each other during the mating season.

The results presented here on sighting distribution inside male home ranges, shows that males do not prefer a particular part of their home range. They actively search for mates, hence the likelihood of encountering other males is high and fights are more numerous and observed more often in males than in females /no data shown/. The fact that males frequently overlap other males and that large males have significantly more overlaps with females than small males have, indicates a hierarchical system. This system is expressed in small males avoiding or being chased away by large males when they meet. Stamps /1983/ points out the possibility of using home range ratios as a quantification of polygyny in territorial lizards. This ought to be applicable to data of non-territorial animals as well, though it will not be possible to estimate a specific harem size. In the sand lizard the differences in home range size between males and females is considerable and indicates that males are polygynous.

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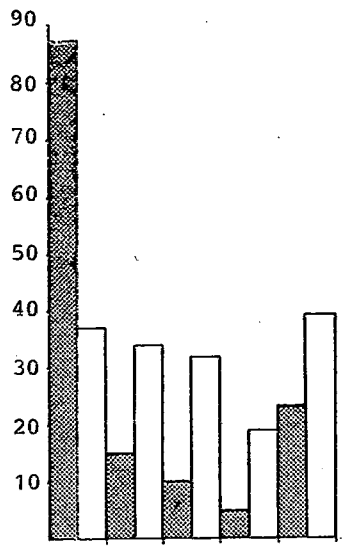

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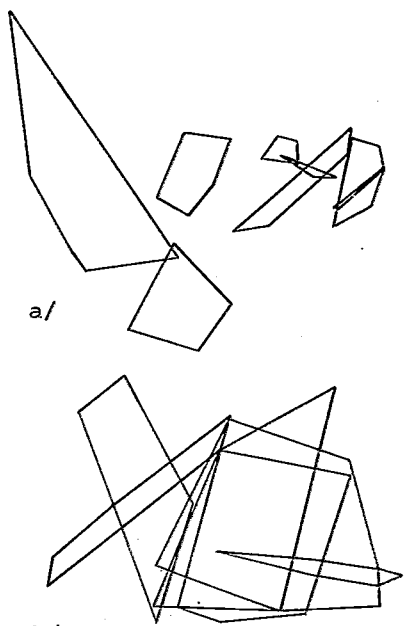

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Fig. 1: Sighting distribution inside home ranges of males ( ) and females (▒)
Fig. 2: Example of a/ female and b/ male home ranges used for the overlap analysis.