

## Ecology of a Swedish population of the sand lizard (*Lacerta agilis*) – a preliminary report

MATS OLSSON

With 1 figure

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### Introduction

During 1984 and 1987 an individually marked lizard population was studied in various respects such as spatial distribution and mating systems, demography, sexual dimorphism and sex ratio and habitatspecific abundances. Most of the data in this report were collected during the mating season in 1984 and should be regarded as preliminary until further results are presented.

### Material and methods

The study area is situated 50 km south of Göteborg on the Swedish west coast. The coastline along which the lizards live is a mosaic habitat with *Juniperus*, *Populus*, *Betula*, *Calluna*, *Prunus* and *Angelica* interspersed between rocky areas. Lizards are caught by noosing or by hand, marked dorsally, toeclipped and measured before being released at the place of capture. The catching-marking routine was normally over in 5–10 minutes. The toes that were cut off during the marking procedure were preserved in formalin after which they were sectioned and stained for skeleto-chronological age determination (for detailed information on skeletochronology see HEMELAR 1981). Coordinates of the observation points were taken by measuring distances and angles from a fixed point. The coordinates were then used for plotting individual home ranges.

### Results and discussion

#### Sexual dimorphism, Demography and Sex Ratio

Since the sand lizard has been described as a territorial animal in the literature (BISCHOFF 1984), one would suspect it to follow the same trends in morphology and dimorphism as other territorial lizards, i. e. with the male as the larger of the two sexes. However, table 1 shows that in the sand lizard females are the largest sex.

Sex/Geschlecht	June-values Juni-Maße	total-values Gesamtmaße
Males/Männchen	7,47 ( $\pm$ 0,13) (n = 17)	7,00 ( $\pm$ 0,09) (n = 44)
Females/Weibchen	7,89 ( $\pm$ 0,48) (n = 25)	7,82 ( $\pm$ 0,07) (n = 45)

Tab. 1. Sexual size dimorphism (SVL in cm) in a population of Swedish sand lizards during the 1984 mating season. Standard errors are given within parantheses. Größenunterschiede der Geschlechter (Kopf-Rumpflänge in cm) in einer Population schwedischer Zauneidechsen während der Paarungszeit 1984. Standardabweichungen jeweils in Klammern.

Neglecting the underlying evolutionary explanations for a reversed sexual dimorphism, the causal explanation of the dimorphism can be either of the following: a) females grow at a faster rate than males and remain larger throughout life, or b) females live longer than males and because of the continual growth in lizards, will on average be larger than males or c) both phenomena occur simultaneously. Clarifying this calls for agedetermination of the animals. In figure 1 an age pyramid obtained through skeletochronology of a sample of the adult population indicates that females are more numerous in higher age classes than males.

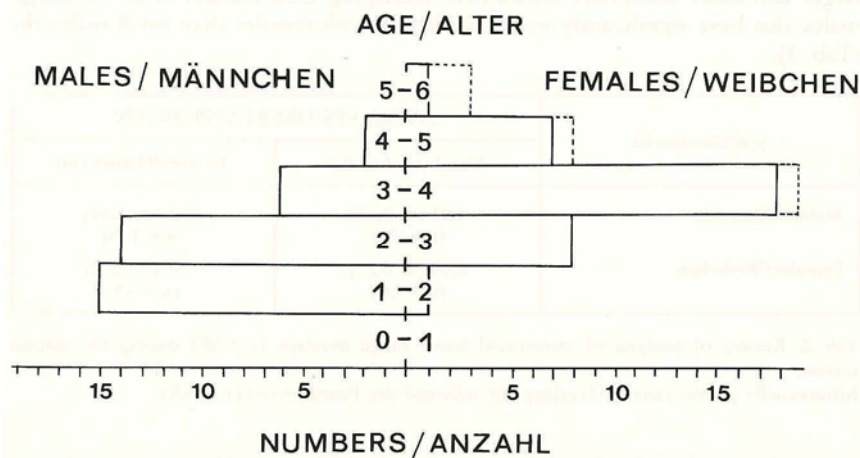


Fig. 1. Observed age distribution in a population of sand lizards during the 1984 mating season.

Festgestellte Altersstruktur einer Zauneidechsenpopulation während der Paarungszeit 1984.

This gives rise to a number of new questions. The lack of females in lower age classes could be caused by poor sampling during a stage in life when females are secretive in their behaviour. The age pyramid could also indicate that the observed 1 : 1 sex ratio need not necessarily be the correct one. In populations from Holland the sex ratio is approximately 0.7 (STRIJBOSCH pers. comm.) in favour of females. Should there exist females in lower age classes equal in numbers to males but undetected, the sex ratio would be close to 0.7. Since the 1984 study was carried out in the core area of a population, males with their centres of activity outside the actual study site but moving into the study area during mate search, would also be recorded. Because males are more mobile they may also be overrepresented in the sample compared to females which are more stationary (see "Spacing patterns and Mating strategies").

By using the same method of age determination, the age at first reproduction for females and the likely age at first reproduction for males could be determined for the 4th and 3rd year respectively.

#### Spacing pattern and Mating strategies

In southern Sweden sand lizards appear after hibernation in mid-April. For the first week or so they bask under sparse heath or grass from last year. Gradually the home ranges of males will expand due to mate search. Males are aggressive at this time of the year and about 30 % of the males show scars from interactions, mainly on head and jaws. The spacing pattern, though, is not of a territorial kind in the sense that males defend a geographically defined area. Rather, they seem to defend an umbrellalike territory around themselves and possibly the female of immediate interest. The home range overlapping is extensive and males have both significantly larger and more numerous intrasexual overlapping than females (Tab. 2). Large males also have significantly more overlapping with females than small males do (Tab. 3).

Sex/Geschlecht	OVERLAPS/ÜBERLAPPUNGEN	
	Numbers/Anzahl	% Area/Gebiet (m)
Males/Männchen	4,83 ( $\pm$ 0,43) (n = 29)	18,1 ( $\pm$ 2,00) (n = 139)
Females/Weibchen	1,00 ( $\pm$ 0,22) (n = 16)	9,81 ( $\pm$ 4,00) (n = 19)

Tab. 2. Results of analysis of intrasexual home range overlaps ( $x \pm SE$ ) during the mating season.

Intrasexuelle „home range“-Überlappung während der Paarungszeit ( $x \pm SA$ ).

Females, on the other hand, have small and widely spaced home ranges. Interactions between females, or signs thereof, I have never observed in the field. Still, in terraria fights between females have been observed by KITZLER (1941) and



	Males/Männchen > 7,5 cm (n = 8)	Males/Männchen < 7,5 cm (n = 18)
No. of overlaps with females Anzahl der Überlappungen mit Weibchen	3,00 (± 0,50)	2,16 (± 0,38)

Tab. 3. Intersexual home range overlaps between two different size classes of males with females ( $x \pm SE$ ).  
Intersexuelle „home range“-Überlappung zweier verschiedener Größenklassen von Männchen mit Weibchen ( $x \pm SA$ ).

others. In conclusion, males seem to be hierarchical, polygynous and mobile during the mating season. Large males are more succesful than small males in staying in the proximity of females. I regard this as an indication of higher mating success in large males. Females are stationary, have small home ranges and if there is pronounced territoriality in the sand lizard at all, it is among the females. That is, providing one judges by intrasexual home range overlaps alone.

#### Abundances and Management of Critical Habitat

During May and June of 1984 90 adults were marked within the study area. The abundances, measured in stationary animals (individuals with 5 or more sightings) and total number of observations varies considerably between different habitats within the study area, as given by table 4.

CHARACTERISTICS OF HABITAT Habitatcharakter	NO OF OBS. Anzahl der Beobachtungen	NO OF STAT.ANIM. Anzahl stationärer Tiere
Rocky, low elevation, <i>Prunus</i> , sparse <i>Betula</i> felsig, flach, <i>Prunus</i> , wenig Birken	252	30,1
<i>Calluna</i>	223	54,6
Rocky, high elevation, <i>Calluna</i> , <i>Betula</i> felsig, hügelig	21	9,9
Rocky, seaside, <i>Angelica</i> felsig, Küste	63	7,6

Tab. 4. Characteristics of areas with different habitats, numbers of stationary animals and total number of sightings made inside these areas. Numbers of stationary animals are given per hectare.

Charakteristika der verschiedenen Mikrohabitate, Anzahl stationärer Individuen pro ha und Gesamtzahl der in den jeweiligen Gebieten gemachten Beobachtungen.

*Calluna* and *Prunus* habitat offers similar physical conditions in the way that lizards can thermoregulate in spots where sun filters through the vegetation. The importance of such habitat is clearly indicated by the reduction of lizards in number in the area during 1985 and 1986, when saplings of birch and aspen overshadowed a great deal of *Calluna* and *Prunus* vegetation. The landscape had been kept open for esthetical reasons by one of the landowners until 1984 when it was given up, with immediate consequences for habitat structure and sand lizard abundances.

During the winter of 1986/87 the area was cleared from overshadowing vegetation by simply chopping down birch and aspen. The result of this showed during 1987 when extensive fieldwork was carried out again in the area. In all, 160 individuals were marked, yet this was the total number for the whole season (April-August) why it is not directly comparable to the 1984-result (April-June). However, since most activity takes place during the reproductive season the result clearly indicates a recovery of the habitat and an increased attraction to sand lizards after the habitat management.

Another intention was to expose bare sandy areas in order to attract females for egg-laying. Since the management was performed during winter, an area was chosen in which lizards were rarely seen early in spring so that the risk of finding hibernating animals could be regarded as negligible. However, this proved to be incorrect. Immediately below the heath, roughly at a depth of 0.1 m a male sand lizard was found hibernating. The clearing of the area was of course stopped. This observation was made in February at a temperature of about minus 15-20 °C and a snowdepth of 0.3 m.

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### Zur Ökologie einer schwedischen Population der Zauneidechse (*Lacerta agilis*) — ein vorläufiger Bericht

In den Jahren 1984 und 1987 wurde eine individuell markierte Zauneidechsenpopulation, die sich an der schwedischen Westküste, circa 50 km südlich von Göteborg befindet, hinsichtlich räumlicher Verteilung, Paarungsverhalten, Demographie, Sexualdimorphismus, Geschlechterverhältnis und habitatspezifischer Abundanzen untersucht.

Diese Angaben sollten als vorläufig betrachtet werden, da die meisten Daten nur aus der Paarungszeit des Jahres 1984 stammen.

Das Untersuchungsgebiet ist eine felsige Küste, die durch *Juniperus*, *Populus*, *Betula*, *Calluna*, *Prunus* und *Angelica* aufgelockert wird.

Möglicherweise gibt es in der untersuchten Population mehr Weibchen als Männchen. Die jungen Weibchen scheinen aber unterrepräsentiert zu sein. Die Weibchen werden größer als die Männchen, was folgende Erklärungen haben kann: a) die Weibchen wachsen schneller, b) sie leben länger oder c) beide Komponenten spielen zusammen. Skelettchronologische Untersuchungen legen nahe, daß Weibchen in den höheren Altersklassen stärker vertreten sind als Männchen (Abb. 1).

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Südschwedische *L. agilis* verlassen Mitte April ihre Winterquartiere. Während der Paarungszeit sind die Männchen bedeutend mobiler als die Weibchen. Ältere und größere Männchen haben größere individuelle Aufenthaltsgebiete, daher häufiger Kontakt mit Weibchen und deshalb wahrscheinlich einen höheren Fortpflanzungserfolg.

1984 wurden zwischen April und Juni 90 und 1987 zwischen April und August insgesamt 160 adulte Zauneidechsen markiert. Die Tiere bevorzugten mit *Calluna* und *Prunus* bestandene Flächen. In den letzten Jahren zunehmende Birken- und Espenbestände wurden im Winter 1986/87 entkusselt. Es zeigte sich, daß die dadurch gewonnenen Sonnenflächen die Attraktivität des Gebietes für die Zauneidechsen deutlich steigerten.

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