SHORT NOTE

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PRELIMINARY DATA ON REPRODUCTIVE ECOLOGY OF *LACERTA LEPIDA* AT A MOUNTAIN SITE IN CENTRAL SPAIN

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The home ranges of radio-collared eyed lizards (*Lacerta lepida*) were studied in the mountains of central Spain. The home range of females and males varied from 2800-5844 m^2 and 1424-22106 m^2 respectively. Two measures of core area and home range covaried significantly with mass. Home range and 75% core area were significantly larger in males than in females, while 50% core area did not differ between sexes. Age has no significant effect on home-range size. Each male's home range overlapped with the home ranges of 2-6 males and 2-6 females. Males used 11-17 different rocks 0.5-5 m diameter as shelters during 17-25 nights. The extensive home range areas of large males may be related to maximizing access to the few reproductive females available, but costs may be high, as indicated by the mortality data.

Key words: abundance, home range, *Lacerta lepida*, mortality, skeletochronology

The eyed lizard (*Lacerta lepida*) is a large lacertid that occurs in Mediterranean areas of south-western Europe. The natural history of this species is largely unknown (Bischoff *et al*., 1984; Pérez-Mellado, 1998). We present here the results of a field study on home-range size carried out in the mountains of central Spain.

The study site was a deciduous oak forest (*Quercus pyrenaica*) near Navacerrada (40° 44' N, 4° 00' W), Sierra de Guadarrama, at an altitude of 1250 m. Shrubs, grasses, and rocks were also predominant at the site. For a more detailed description of cover see Salvador *et al*. (1995). We established a 1 ha plot (100 × 100m), with markers on a grid every 10 m. During 2000 and 2001 we visited the plot, five days a week, from 20 February until 15 July. We captured lizards by noosing, with a 7 m fishing pole. Capture efficiency was high and allowed us to catch all lizards on the first day they were sighted. It is likely that we captured most of the adults present in the plot because no unmarked individuals were observed once all individuals had emerged. In the 1 ha plot, we captured seven males and six females in 2000 and four males and one female in 2001. Additional data were gathered on five males and one female captured in a nearby 3 ha plot, with markers on a grid every 20 m. This plot was less intensively sampled than the 1 ha plot.

The lizards were transported to El Ventorrillo Field Station (5 km distant by air) where they were weighed to the nearest 0.01 g on an electronic balance, and their snout-vent length (SVL) measured with a ruler to the nearest 0.5 mm. Lizards were toe-clipped for a skeletochronological study (see below). We fitted lizards with 2.5 g radio-transmitter collars (Biotrack Ltd.) and released them at the site of capture within 4 hrs of capture. Final recapture of radio-collared lizards occurred during 1-15 July, and we released them after transmitter removal.

We used a RX-8910HE (Televilt) radio receptor to locate radio-collared individuals and noted their position on a map to the nearest 1 m. Between one and three locations points were taken at each of the following time periods: 7-8 hr, 11-12 hr and 14-15 hr GMT. Home range area was measured using the convex polygon method. We used the statistical package Ranges V (Natural Environment Research Council, UK) to compute home-range areas corresponding to 50%, 75% and 100% of sightings. We define 50% and 75% values as core areas which exclude fixes furthest from arithmetic mean. The minimum number of cumulative sightings (mean±SE) that accurately estimated 50%, 75% and 100% of home-range size, using the method of Rose (1982), were, respectively, 11.3±4.4, 24.3±5.6 and 41.3±7.3 observation points. To examine the number and characteristics of night shelters used by a subset of males, we located them before daily emergence. The maximum diameter of the rocks utilized as shelter was also recorded. To analyze reproductive condition, we recaptured females several times and noted mating scars visually and the presence of eggs by palpation.

We followed histological procedures for skeletochronological estimation of age after Castanet (1978, 1987). Toes were washed for three hours in water and then decalcified in 3% nitric acid for one-two hours, according to the size of the bone. They were then rinsed with running tap water overnight. Frozen sections of 16 µm from the mid diaphysis were obtained on a cryostat freezing microtome, stained in Ehrlich's haematoxylin for 5 min and rinsed for 1 hr in tap water. The smallest transverse sections with the smallest medullar cavity and the thickest cortical bone, were selected and mounted in aqueous synthetic resin (Aquamount, Gurr) on a glass microscope slide. The age of specimens was determined by counting the number of lines of arrested growth (LAGs). Phalanges of two females captured in 2000 and recaptured in 2001 showed one additional LAG in the second year. These data show that LAGs are annually deposited in this population. Bone remodelling

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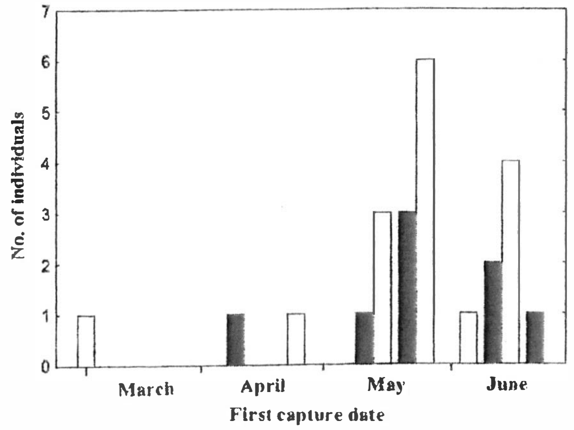

FIG. 1. First capture date of males (white bars) and females (black bars) of *Lacerta lepida*. Years 2000 and 2001 combined.

was obvious at the inner border of the periosteal bone. First – and even second – LAGs were partially eroded in older individuals. However, there was no evidence of LAGs totally removed by the process of endosteal resorption.

Over the two years, the first individual of the year was captured on 1 March 2000 and 26 April 2001. However, in both years, most individuals were captured for the first time during May (Fig. 1). There were no significant differences in the date of first capture between males and females (Mann-Whitney *U*-Test, P=0.50).

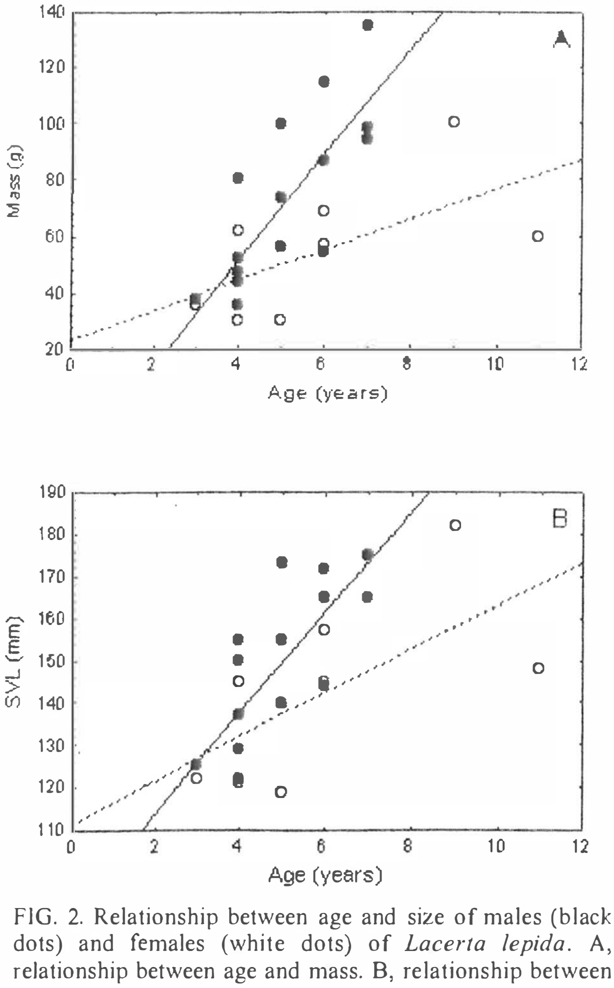

FIG. 2. Relationship between age and size of males (black dots) and females (white dots) of *Lacerta lepida*. A, relationship between age and mass. B, relationship between age and snout-vent length.

A test of homogeneity of slopes showed that the variation of mass with age differed significantly between sexes ($F_{1,20}$=7.78, P=0.01) (Fig. 2a). A similar result was obtained for the SVL, but in this case the difference between slopes was marginally significant ($F_{1,20}$=3.72, P=0.07) (Fig. 2b). These results show that males and females followed a different growth trajectory, males being increasingly longer and heavier at any given age above 3-4 years.

Home-range area of four females (SVL=145-157 mm) based on 28-67 location points (mean=46 points, SE=8.2) varied between 2800-5844 m^2 (mean=3750 m^2, SE=704). Home range area of eight males (SVL=122-175 mm), based on 31-86 location points (mean=45 points, SE=6.1), varied between 1424-22106 m^2 (mean=11087 m^2, SE=2673). Mass covaried significantly with all home-range estimates but the effect of sex was only significant for 75 and 100% home range areas (Table 1).

An ANCOVA on 100% home-range area with mass and age as covariates and sex as fixed factor showed a significant effect of mass ($F_{1,11}$=14.4, P=0.005), but no significant effects of age ($F_{1,11}$=0.003, P=0.96) or sex ($F_{1,11}$=1.4, P=0.27). In the 1 ha plot, each male's home range overlapped with the home ranges of 2-6 males (mean=3.7 males, SE=0.5) and 2-6 females (mean=3.3 females, SE=0.6).

Lizards spent the night under rocks 0.5-5 m in diameter. Four males (SVL=129-175 mm) used 11-17 different shelters (mean=13.5 shelters, SE=1.5) during 17-25 nights (mean=21.5 nights, SE=1.6 nights). Males used the same shelter during 2-4 consecutive nights. The same night shelter was used by the same individual and others at different times during the spring. We never observed two males together in a night shelter.

Two females (SVL=145 and 157 mm, 4 and 6 yrs old respectively) had mating scars, and later were observed to be gravid and laid eggs. Six females did not show any evidence of reproductive activity. Three of these females were small (SVL=119-122 mm), but the other three were large (SVL=145-180 mm; age= 6-10 years).

During the radiotracking period, three males were captured by predators. One of them (SVL= 173 mm) was found while being predated by a Montpellier snake (*Malpolon monspessulanus*) in 2000. Another male (SVL= 165 mm) disappeared from the study area in the same year and we were subsequently unable to detect it in the surrounding area. Thus, we supposed that it had

TABLE 1. ANCOVAs on home-range estimates with sex as factor and mass as covariate. Data for 8 males and 4 females.

	50% core area		75% core area		100% area	
	F	*P*	*F*	*P*	*F*	*P*
Mass	6.65	0.003	17.8	0.002	30.0	<0.001
Sex	2.34	0.16	6.0	0.03	7.0	0.027

been captured by an unidentified predator. The head of a third male (SVL=155 mm) was found near its transmitter on top of a 15 m boulder in 2001, suggesting that it had been killed by a bird of prey. None of the females were killed by predators.

At the study site, eyed lizards emerge from hibernation later than the smaller lizard *Psammodromus algirus*, which is active from February (Veiga & Salvador, 2001). It is possible that eyed lizards that emerge early risk predation exposure during long basking periods because of low temperatures. Late emergence from hibernation leads to a short annual period of activity of no more than six months. Thus, time available for growth is relatively short, which may account for the small size of adults in comparison to those from lower altitudes in central parts of the Iberian Peninsula (Castilla & Castanet, 1986; Mateo & Castanet, 1994). The low number of reproductive females also indicates that females do not reproduce every year. This result suggests that females are frequently unable to accumulate enough reserves for reproduction during the relatively short annual activity period.

The lack of differences in 50% core area between males and females seems to indicate that this area would mainly be related to fulfilling energetic requirements. In fact, 50% core area accounted only for 12.6±1.9 (mean±SE) percent of the total home range. The larger home ranges of eyed lizard males may be related to the need to maximize access to females, imposing costs of reproduction on males, but there are few field data sets available (Perry & Garland, 2002). Large male eyed lizard have extensive home-range areas and this may be related to maximizing access to the few reproductive females available, but costs may be high, as indicated by the mortality data.

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