Studies in Herpetology, Roček Z. (ed.)	pp. 331 - 336	Prague 1986

Growth, Age and Longevity of *Lacerta lepida* Assessed by Skeletochronology

M. A. CASTILLA[1] and J. CASTANET[2]

[1]Unitad de Zoologia Aplicada, Dpt. de Ecologia,
Instituto Nacional de Investigaciones Agrarias, Madrid, Spain

[2]E. R. "Formations squelettiques" and UA 04 11 37 CNRS, Univ. Paris 7,
2, pl. Jussieu, 75251 Paris Cédex 05, France

Lacerta lepida /Daudin 1802/ is a typical Mediterranean lizard common in Spain. With the genus Gallotia in the Canary Islands and L. pater /Bischoff, 1982/ in North Africa, it is one of the largest lacertids. Many aspects of its biology and ecology are still unknown, although data have been collected in natural conditions /Seva, 1982/ and in captivity /Peters, 1962/.

Histological marks expressing periodic bone growth /skeletochronology/ have contributed to interesting eco-demographic results in many lacertid populations /Castanet, 1982/. For instance, an earlier study /Castanet and Baez, 1983/ provided new data on individual age, sexual maturity and ecological longevity of Gallotia galloti. Preliminary studies suggest that this histological method would be also valid in L. lepida /Castanet, 1982; Cheylan, pers. comm./.

Hence, in this paper, we have used skeletochronology to study L. lepida, within the context of more extensive researches on the ecology of some Spanish populations of this species.

MATERIALS AND METHODS

80 specimens /43 males and 37 females/ of different size from different localities in central Spain /Caceres, Toledo, Ciudad Real and Madrid provinces/ were studied. All specimens were preserved in 70% alcohol. Body length was measured from snout tip to cloaca /SVL/. The left femur was removed from every specimen and the humerus and phalanges were removed from 7 specimens for comparison. Small bones were demineralized 15 hrs, in 3% HNO_3 and large bones in 5% HNO_3. 20 µm thick transverse diaphyseal sections were made with a freezing microtome and stained for 30 min. with Ehrlich's hematoxylin. Preparations were examined using a light microscope and all photographed at the same magnification. The circumference of the rest lines was measured on photographs with a curvimeter. Mean rest line circumferences within age groups were compared and results were extrapolated to obtain the range of removed rest lines. The average daily bone growth was obtained by dividing the average thickness of each

growth cycle by 240 days, the number of days in the growing season /Mar. - Oct./ /Castanet and Cheylan, 1979/.

RESULTS

The histological bone structure of L. lepida is similar to that of other lacertids. Blood vessels in the diaphysis of the femur, humerus and phalanges are rare or lacking.

Varying tissue types are found from the medulla to the external bone surface, namely: near the endosteal limits, a woven fibered bone with round, randomly distributed cells; next, a progression towards more and more regularly oriented parallel-fibered bone, and finally, in the oldest specimens, true lamellar bone. These different types of bone suggest variations in growth rate /Amprino, 1947; Ricqlès, 1975; Castanet, 1982/.

The hematoxylinophilic "rest lines", corresponding to hibernation, were obvious in L. lepida; they separate the less chromophilic layers of bone deposited during the growing seasons.

In our sample, we recognized various histological growth stages according to the rest lines /Figs 1-7/. Bones of juveniles under 1 year had 1 or 2 rest lines, depending on whether they had hibernated; if not, the first rest line from the medulla corresponds to the birth line described in other lizards /Smirina, 1974; Pilorge and Castanet, 1981; Castanet, 1982; Nouira et al., 1982/.

The bone between the medulla and birth line is poorly hematoxylinophilic, in comparison with other layers, and corresponds to embryonic bone /op. cit./. The rest line of the first hibernation is generally close to the birth line. The thickness of the layer between the last rest line and bone surface depends on season of death. In most young lizards, part or all of the birth line has already been resorbed.

Specimens with two rest lines beyond the birth line are interpreted as having experienced two winters. Usually the birth line is completely resorbed and the first winter line partially resorbed /Figs 5-7/. In some specimens, a thin layer of endosteal lamellar bone is deposited /Figs 4, 5, 7/.

Endosteal resorption increases with age: 62 % of 2 year-old lizards or older have lost the first rest line and 78 % of the 3 year or older specimens have done so. 5 % of the lizards over 3 year have lost the first 2 rest lines. Nonetheless, a 10 year-old specimen still shows every rest line, or portions of them. To solve the problems raised by lost rest lines for correct age estimation, we used a back-calculation technique previously used in herptiles /e.g. Castanet and Cheylan, 1979/. According to this calculation, our oldest specimen had 11 rest lines. At death /20.V.85/, it was 10 year 9 month-old /birth in August or September/. That corresponds to 11 possible age groups in our sample. However 9 rest line lizards were lacking /Fig. 9/.

The first 4-5 rest lines are generally well separated. Beyond these, the lines are closer, a phenomenon described in other reptiles /Castanet, 1982/ and which seems to be related to the decline in body growth after sexual maturity; consequently maturity would be reached at 2.5 - 3.5 years for L. lepida studied here. At this time, the mean SVL is 140 mm.

The present data provide seemingly a realistic idea of wild L. lepida growth curve /Fig. 8/, similar to those previously recorded for the species /Castanet, 1982; Cheylan, pers. comm./. After sexual maturity, growth slows slightly more in females than in males, the latter eventually attaining larger size. Comparing body growth to femoral

cortex growth, we obtained similar curves. In the 1st year, the growth rate in cortex thickness is 0.99 µm/day and 0.40 µm/day in the 4th year. After this growth falls off.

DISCUSSION

In this study, no lizards of known age or experimental data were available to corroborate the annual periodicity of the rest lines. However, in view of the results obtained in other reptiles including some captive L. lepida /see Castanet, 1982/, we assume the rest lines to be annual. The number and pattern of rest lines was the same in femur, humerus and phalanx; therefore, the analysis could be made with phalanges.

In L. lepida the rest lines are well marked except for the first one, which does not take stain well and is sometimes diffuse. This could be explained by the absence of a complete growth stop, osteogenesis continuing at a very slow pace during the first winter of the young lizards.

In our sample only about 18 % of lizards have one - rarely more - split rest line. Then, for these animals, the accuracy of age determination would be one year. The calculated age of the other specimens does not seem to suffer such inconsistencies, with some exceptions for older individuals.

The main problem in aging L. lepida by skeletochronology is the resorption of the birth line and 1st or 1st and 2nd rest lines, a phenomenon that also occurs in many other herptiles /Castanet and Cheylan, 1979; Gibbons and McCarthy, 1983; Francillon et al., 1984/. Small, short-lived lizards generally do not undergo this resorption, nor does Gallotia galloti /see Castanet and Baez, 1983/, in contrast to L. lepida. This difference between two close species of similar size and longevity is noteworthy and poses the question of whether this histological pattern has a mainly genotypical and/or environmental determinism. In any case, even though rest lines are lost, when the remaining lines are clearly distinguishable, as in L. lepida, the back-calculation technique provides a reliable age estimate.

As regards the biology and eco-demography of L. lepida in central Spain, our study reveals an ecological longevity of at least 11 years, concurring with data from other Mediterranean populations /Cheylan, pers. comm./. However, the maximum recorded ages in captivity are 17 years /Decaux, 1897/ and 14 years /Flower, 1925/. There may be older specimens in the population at large that were not represented in our sample, or we failed to recognize them as such if growth of bones in diameter effectively reaches a plateau in old age, as observed in Sphenodon /Castanet et al., submitted/. In any case, in a wild population, very old specimens are likely to be rare.

The larger size and greater longevity of the males after sexual maturity has been noted by Cheylan /pers. comm./ in a northern Mediterranean population. This situation is not widespread /e.g. Barbault, 1974/, but has been recorded in many species /Castanet, 1982; Nouira et al., 1982/ including G. galloti /see Castanet and Baez, 1983/.

ACKNOWLEDGEMENTS

This study was supported by a CNRS grant,"ATP Evolution: aspects biologiques et paléontologiques" and the Unidad de Zoologia Applicada, I.N.I.A.. Thank you Drs. A. de Ricqlès and F. Palacios for reviewing the manuscript.

REFERENCES

AMPRINO, R. /1947/: La structure du tissu osseux envisagée comme expression de différences dans la vitesse de l'accroissement. - Arch. Biol. 58 : 315-330.

BARBAULT, R. /1974/: Structure et dynamique des populations naturelles du lézard Mabuya buettneri dans la savane de Lamto /Cote d'Ivoire/. - Bull. Ecol., 5 : 105-121.

CASTANET, J. /1982/: Recherche sur la croissance du tissu osseux des Reptiles. Application: la méthode squelettochronologique. - Thèse Dr. d'Etat, Paris, 152 pp.

CASTANET, J., BAEZ, M. /1983/: Data on age structure in Gallotia galloti /Reptilia, Lacertidae/. - S.E.H. Abstracts of the II ordinary general Meeting. p. 32.

CASTANET, J., CHEYLAN, M. /1979/: Les marques de croissance des os et des écailles comme indicateur de l'âge chez Testudo hermanni et Testudo graeca /Reptilia, Chelonia, Testudinidae/. - Can. J. Zool., 57 : 1649-1665.

DECAUX, C. /1897/:Un lézard ocellé conservé en captivité depuis 14 ans. - La Nature, Paris 49, 1255 : 43-44.

FLOWER, S. S. /1925/: Contribution to our knowledge of the duration of life in vertebrate animals. III-Reptiles. - Proc. Zool. Soc. London, 95 : 911-981.

FRANCILLON, H., BARBAULT, R., CASTANET, J., RICQLÈS, A. de /1984/: Etude complémentaire sur la biologie de l'Amphibien déserticole Bufo pentoni: données de squelettochronologie et d'écodémographie. - Rev. Ecol. /Terre Vie/, 39 : 209-224.

GIBBONS, M. M., McCARTHY, T. K. /1983/: Age determination of frogs and toads /Amphibia, Anura/ from north-western Europe. - Zool. Scripta, 12 : 145-151.

NOUIRA, S., MAURY, M. E., CASTANET, J., BARBAULT, R. /1982/: Détermination squelettochronologique de l'âge dans une population de Cophosaurus texanus /Sauria, Iguanidae/. - Amphibia-Reptilia, 3 : 213-219.

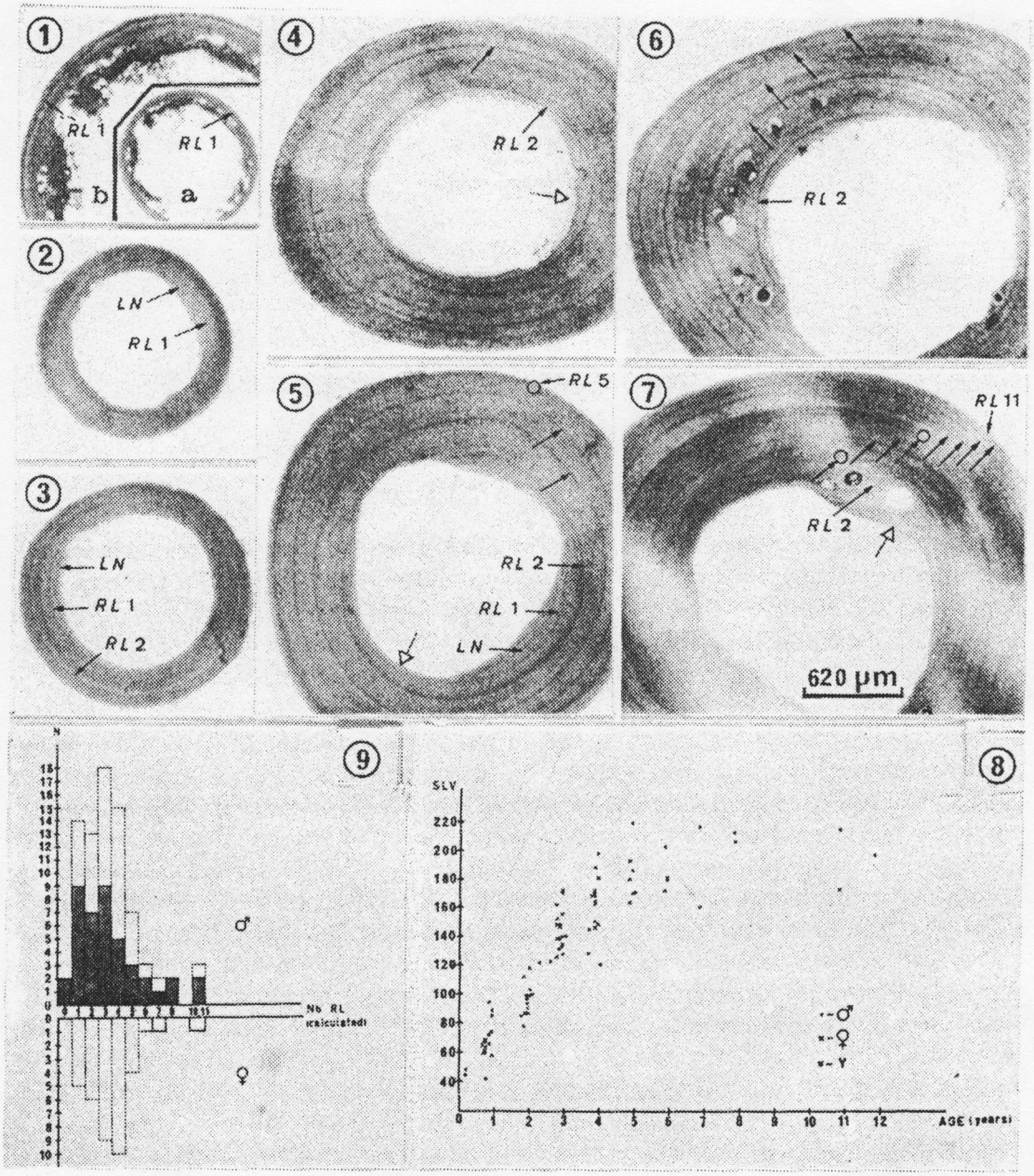
PETERS, G. /1962/: Die Perleidechse /L. lepida Daudin/ gehört zum subgenus Gallotia Boulenger. - Mitteil. Zool. Mus. Berlin, 37 : 271-285.

PILORGE, T., CASTANET, J. /1981/: Détermination de l'âge dans une population naturelle du lézard vivipare /Lacerta vivipara Jacquin 1798/. - Acta Oecologica; Oecol. Gener., 2 : 3-16.

RICQLÈS, A. de /1975/: Recherches paléohistologiques sur les os longs des tétrapodes. VII. Partie 1. - Ann. Paléont. /Vertébrés/, 61 : 51-129.

SEVA, E. /1982/: Taxocenosis de Lacertidos en un arenal costero alicantino. - Ed. Universidad de Alicante, Depto de Zoologia. 137 p.

SMIRINA, E. M. /1974/: Prospects of age determination by bone layers in Reptilia. - Zool. Zh., 53 : 111-117.



Figs 1 - 7 : Lacerta lepida of different ages : 1 yr /1-2/; 2 yrs /3/; 3 yrs /4/; 5 yrs /5/; 6 yrs /6/; 10-11 yrs /7/. Transversal sections at the femoral diaphysis; Ehrlich's hematoxyline. Same magnification except 1b. RL = Rest Line; LN = birth line; ⟶▷ = endosteal bone; o = double Rest Line. Fig. 8 : Lacerta lepida. Growth curve. Fig. 9 Lacerta lepida. Age distribution in our sample.