

DEMOGRAPHIC LIFE HISTORY TRAITS OF *BUFO CALAMITA* IN A SEMIARID ZONE OF “EL PINÓS” (ALACANT)

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INTRODUCTION

Variation in demographic life history traits between populations are often explained by differences in habitat quality such as altitude, latitude and climate (review in Morrison and Hero, 2003). Age structure can vary between sexes as reproductive investment differs also between males and females (Charlesworth, 1980). Histological expression of annual bone growth marks used for age determination is influenced by climate conditions (Castanet *et al.*, 1993). A recent study of Sinsch *et al.* (2007) shows multiple growth marks formation per year that represent informative histological correlates of local environmental impacts on life history in semiarid zones.

In this study, skeletochronology was used to estimate demographic life history traits and histological expression in bone marks of *Bufo calamita* population in a semiarid zone of “El Pinós” (Alacant).

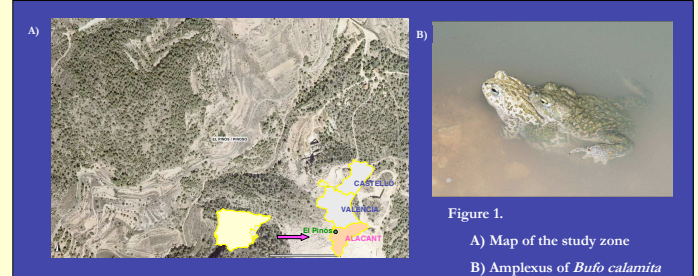


Figure 1.

A) Map of the study zone
B) Amplexus of *Bufo calamita*

MATERIAL AND METHODS

Population of *Bufo calamita* was studied in Serra del Reclot (fig. 1: El Pinós town, province of Alacant, eastern Iberian Peninsula). The climate is mediterranean, characterized by low precipitations (<300 mm), cold winter and dry summer. Toads reproduce in several permanent or temporal ponds in the study area where a programme for amphibian habitat conservation exists.

A total of 38 adults (14 males and 14 females) were collected during the reproduction period at breeding pond in 2007. They were released again in situ after sex determination, measuring of snout-vent length (SVL) and toe-clipping. Laboratory protocols followed the standards methods of skeletochronology (Smirina, 1972) modified by Sinsch *et al.* (2007). Phalanges were decalcified in 3% nitric acid for 6 hours. Cross sections (14 µm) were obtained with a criostat and stained with cresylviolet. Age was determined by counting lines of arrested growth (LAGs) in the diaphysis of the periosteal bone using a light microscope at magnifications of 200–400 x. The population of natterjack toads was characterized by local age structure and 6 sex-specific life history traits: 1) age at maturity: minimum estimated age of breeding toads; 2) size at maturity: minimum SVL of sexually active toads; 3) longevity: maximum age of breeding individuals; 4) potential reproductive lifespan: differences between longevity and age at maturity; 5) median lifespan: median of age distribution; 6) age-size relationship: average SVL per age class.

RESULTS

Histological bone marks show a multiple LAGs formation in one year. We used the method proposed by Sinsch *et al.* (2007) for age determination based in comparing the size of successive growth areas (= two dimensional estimate) instead of distances between LAGs (fig. 2). Multiple lines per year were found in 75% of the toads captured.

Demographic life history traits of natterjack toads were calculated for each sex. The sex-specific shape of age distributions varied significantly between sexes due to the old females (Kolmogorov-Smirnov test, $p < 0.0001$). The age at maturity can be attained at 3 years and the median of lifespan was 5 in both sexes (fig. 3). Maximum lifespan recorded was 6 years in males and 9 years in females; consequently the potential reproductive lifespan varied between sexes (3 in males and 6 in females). The effects of age (2-factor ANOVA, $F=0.44$, $P=0.51$) and sex (2-factor ANOVA, $F=1.03$, $P=0.43$) did not affect significantly the SVL (fig. 4).

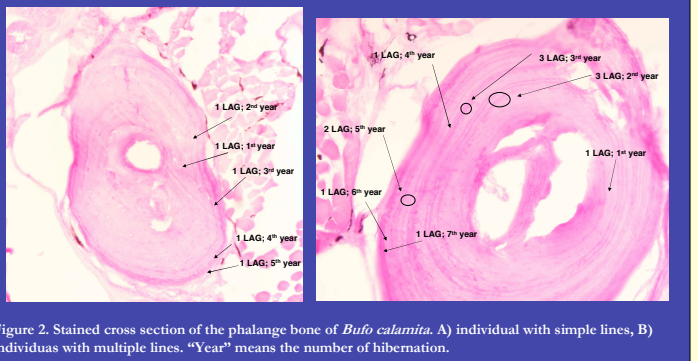


Figure 2. Stained cross section of the phalange bone of *Bufo calamita*. A) individual with simple lines, B) individuals with multiple lines. “Year” means the number of hibernation.

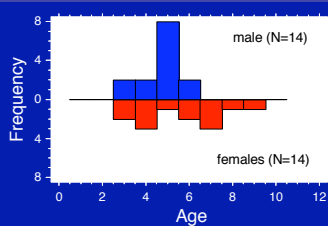


Figure 3. Sex-specific variation of age structure between males and females of reproductive *Bufo calamita*.

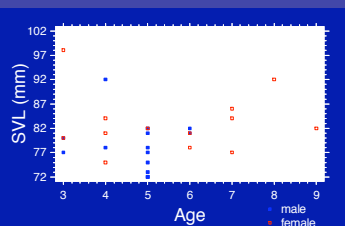


Figure 4. Age-size relationship of reproductive *Bufo calamita*.

DISCUSSION

Growth pattern of the population are similar to populations of other semiarid zones in the Iberian Peninsula. This pattern is characterized by a multiple line formation by year or hibernation due to specific climate features. The formation of multiple growth marks in one year offers valuable insights into local modifications of the life history strategies of ecologically plastic amphibians such as the natterjack toad (Leskovar *et al.*, 2006).

A comparison with a review of demographic life history traits of *B. calamita* in Europe shows a decrease size and increase longevity and potential lifespan from southern and northern latitudes and altitudes in females. These results suggest that lifetime numbers of offspring seem to be optimized by locally different trade-off: big female size at the cost of longevity in southern populations and increased longevity at the cost of size in northern ones (Leskovar *et al.*, 2006). Overall fitness achieved by this trade-off is probably similar in northern and southern populations.

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