# Life-history traits in *Pelophylax saharicus* from Tiaret semiarid lands (northwestern Algeria)

Neus Oromi[1], Pau Brunet[1], Khaled Taibi[2], Mohamed Aït Hammou[3] & Delfi Sanuy[1]

[1]*Escola Tècnica Superior d'Enginyeria Agrària, Departament de Producció Animal, University of Lleida, Spain*

[2]*Faculty of Sciences, Department of Biology, Es-Senia University, Oran, Algeria*

[3]*Faculty of Agricultural Sciences and Veterinary Department of Agricultural Sciences, Ibn Khaldoun University, Tiaret, Algeria*

Demographic life-history traits of *Pelophylax saharicus* from the Tiaret region (Algeria) were analysed using skeletochronological methods. Lines of arrested growth (LAGs) were characterized by a weak expression of bone growth marks, similar to other North African populations of the same species and probably due to a short inactivity period in pre-Saharan areas. The age attained (1–8 years) and snout–vent length (21.2–106.8 mm) were different from other North African populations of *P. saharicus*, suggesting that climatic conditions have a large impact on life-history traits in this species.

*Key words:* demographic traits, lines of arrested growth, semiarid environment

Life-history theory predicts that demographic traits such as age at maturity, longevity and reproductive lifespan can vary depending on habitat quality or climate (Stearns, 1992). The skeletochronological method has been used intensively to assess the age of temperate (e.g. Guarino et al., 2003), subtropical (e.g. Morrison et al., 2004) and tropical anurans (e.g. Pancharatna & Deshpande, 2003). Lines of arrested growth (LAGs) are produced in bones during hibernation, and counting the number of LAGs provides an age estimate with a low margin of error (e.g. Tejedo et al., 1997; Morrison et al., 2004). In semiarid areas, the histological expression of bone growth and line marks could also be influenced by local climate (Sinsch et al. 2007). The pattern of bone growth marks depends on local conditions, and is largely influenced by external factors (Esteban et al., 1996). In *Pelophylax saharicus* (Esteban et al., 1999), the prolonged breeding period allows metamorphosis to take place at different seasons, a strategy which could be important in areas where climatic conditions are subject to large fluctuations.

In this study, we determined the age structure of *Pelophylax saharicus* from three breeding sites near the city of Tiaret, Algeria (35.21ºN, 1.19ºE, 990 m a.s.l.). The climate is influenced by abrupt changes in temperatures, with an average temperature of 7 ºC in winter and 28 ºC in summer. The area is semiarid and characterized by cereal fields and pastures, with an annual average precipitation of 350 mm, mainly concentrated in January (P.A.W., 2007). Sample collection was carried out at three breeding sites during the reproductive period of *P. saharicus*. The breeding sites are separated from one another by a maximum of 4.2 km, and are permanent ponds created as water reservoirs for agriculture. A total of 51 females and 12 males were captured and released *in situ* after sex determination, measurement of snout–vent length (SVL in mm) and toe-clipping (third toe of the right hind limb, preserved in 70% ethanol until skeletochronological analysis). Skeletochronological analysis was performed following the standard protocols of Smirina (1972) and Tejedo et al. (1997). Clipped toes were decalcified for 20 min in 3% nitric acid, and bone cross-sections (12–14 μm) obtained with a cryostat-microtome were stained with cresylviolet (Sinsch et al., 2001). Age was determined by counting LAGs in the diaphysis of the periosteal bone where the size of the medullar cavity was at its minimum, using a light microscope at 200–400× magnification. We distinguished between the line of metamorphosis (LM) and annual growth marks (LAGs *sensu stricto*) using the approach described in Sinsch et al. (2007). The three breeding sites were considered as a single population to represent local demographic characteristics. We measured the following life-history variables: age at maturity (the minimum number of LAGs found in reproductive animals), size at maturity (the average SVL of these individuals), longevity (maximum number of LAGs), potential reproductive lifespan (longevity subtracted by age at maturity), and median lifespan (median of age distribution). All distributions were tested for normality, and all calculations were conducted using the program STATGRAPHICS Plus for Windows, version 5.0.

LAGs were visible in all cross-sections, but the lines were not strongly marked. We did not observe any evidence for the resorption of LAGs, as evidenced by the presence of LMs in many individuals. When LMs were not visible, we considered periosteal bone before the deposition of the first visible LAG as an indicator for the first-year activity period, in which bone growth rate is at its maximum (Sinsch et al., 2007). The number of LAGs varied between one and eight. We did not observe double lines or aestivation lines. Age class distributions differed between males and females (Kolmogorov–Smirnov test, $P<0.01$), although the median lifespan was not discernibly different, being two years in both sexes (Mann Whitney test, $W=262.5$ $P=0.42$, Fig. 1). Two males and eight females reached sexual maturity during their first year of life, with an SVL of 30.41±2.31 mm. Longevity was higher for females (eight years) than for males (four years). Consequently, the maximum potential reproductive lifespan was seven years for females and three years for males. Age had a significant effect on SVL (two-factorial ANOVA, $F=34.54$; $P<0.01$). SVL ranged from 21.2 to 106.8 mm, and was not statistically different between sexes (2-factorial ANOVA; $F = 1.09$; $P = 0.33$).

*Correspondence:* Neus Oromi Farrus, Escola Tècnica Superior d'Enginyeria Agrària, Departament de Producció Animal, University of Lleida, Lleida, Catalonia, Spain. *E-mail:* noromi@prodan.udl.cat

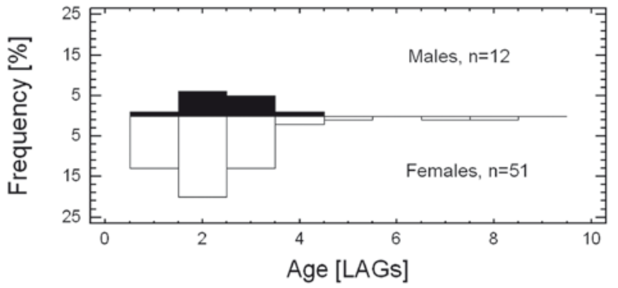


**Fig. 1.** Sex-specific variation in age structure of *Pelophylax saharicus*.

This study provides new data about life-history traits in *P. saharica*, for which comparable data are available from Morocco and Tunisia (Esteban et al., 1999; Meddeb et al., 2007). We observed a weak expression of growth marks as already described by Esteban et al. (1996) for *P. perezi*, and Esteban et al. (1999) for *P. saharicus* in Morocco. In sub-Saharan climates, *P. saharicus* only remains inactive during short periods of low temperature (Schleich et al., 1996), precluding the formation of multiple LAGs, which have been found in semiarid toad populations in north-eastern Spain (Sinsch et al., 2007). Growth marks can also correspond to an aestivation period during warm months (Tejedo et al., 1997); the bone marks of *P. saharicus* from Algeria, however, did not provide any evidence for arrested growth during summer, a similar result to those from Moroccan and Tunisian populations.

Although water frogs from temperate climates usually reach sexual maturity at the age of two years (*P. perezi*: Esteban et al., 1996; Patón et al., 1991), female *P. perezi* from northern Spain can mature during their first year (Docampo & Melagosa-Vega, 1991). In *P. saharicus* from Tiaret, some males and females were already sexually mature in their first year. Similar results were found in *P. saharicus* from Morocco, but at a larger size (about 40 mm; Esteban et al. 1999), whereas in Tunisia the species reaches maturity during the third year of life (Meddeb et al., 2007). The Tunisian population experienced a less extreme temperature range and higher precipitation (700 mm/year) compared to Morocco (70 mm/year) and Algeria (350 mm/year). Individuals living in extreme and unpredictable habitats can accelerate their development towards an earlier time of first reproduction (Atkinsons, 1996).

Contrary to Esteban et al. (1999) and Meddeb et al. (2007), we did not find any evidence for sexual size dimorphism. The differential longevity between the sexes could be attributable to the female-biased sample. The estimated median lifespan (two years) was comparable to populations from Morocco, but lower than in Tunisia (three years). In our study, individuals attained a higher SVL than in the Moroccan populations (Esteban et al., 1999), and were similar to those in the Tunisian populations (Meddeb et al., 2007). Differences in the demographic traits of *P. saharicus* in North African populations suggest that climatic conditions can have a large influence on important life-history traits in this species. More studies are needed to obtain a complete picture of the life-history traits of *P. saharicus* in the semiarid lands of Algeria.

*Acknowledgements.* We thank the Agencia Española de Cooperación Internacional para el Desarrollo (AECID) and Xarxa Vives d'Universitats for financed the studies. We also thank Mr Dellal of the Laboratory of Agro-Biotechnology and Nutrition in Semi-arid Zones for support, and student W. Dahmani from the University of Tiaret for his help during sample collection.

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*Accepted: 14 June 2011*