

Age, survival and growth in *Triturus dobrogicus* (Amphibia, Urodela) from the lower Danube floodplain

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Summary: Age structure assessed by skeletochronology is reported for the first time for the Danube Crested Newt, *Triturus dobrogicus*, from a population in the lower Danube floodplain. The animals matured rapidly, with a mean age of 3.2 years in males and 3.5 years in females. Observed longevity was low suggesting that the disturbance caused by the periodic floods of the Danube has a negative impact on survival.

Key words: skeletochronology, age, *Triturus dobrogicus*, survival, growth, floodplain.

Introduction

The Danube Crested Newt, *Triturus dobrogicus*, belongs to the *Triturus cristatus* superspecies. Its range is restricted to the floodplain of the Danube and its tributaries, and consists of two distinct parts, the Pannonian plain and the southern plain of Romania including northern Dobrogea and the Danube Delta (ARNTZEN et al., 1997, LITVINCHUK and BORKIN, 2000, THIESMEIER and KUPFER, 2000). It is under severe threat both from habitat destruction and pollution. Due to its restricted range, relative rarity and the rapid loss of habitat, its conservation status was assessed as vulnerable. *Triturus dobrogicus* is protected under the Berne Convention (strictly protected, under Annex II) and is included in the IUCN Red List of Threatened Animals under the category "data deficient" (OLIVEIRA et al., 1997). Urgent measures of protection are needed to insure its survival. Relatively little is known about its life history, most of the information available coming from the western part of its range, near Vienna (JEHLE et al. 1995, ELLINGER and JEHL, 1997).

It is very difficult to study the demography of amphibian population on floodplain islands of a large river such as the Danube, so that estimates of age structure can provide good surrogates. Skeletochronology allows to estimate age structure of amphibian populations by recording the periods of arrested growth in long bones (CASTANET and SMIRINA, 1990, CASTANET, 2002). The method is especially useful for newts where phalanges and even limbs can be cut without permanent damage since they can regenerate. We used skeletochronology to estimate age, survival and growth in a Danube Crested Newt population from the lower Danube floodplain, and compared our results with a similar study involving capture-mark-recapture.

Materials and Methods

Newts were sampled in the lower Danube floodplain on the Insula Mică a Brăilei (Romania). With an area of 17.58 km² it is one of the largest wetlands left upstream the Danube Delta, still under a natural inundation regime, and was established as a Ramsar site in 2001 in recognition to its importance. It is a disturbance-dominated landscape where floods are major regulators of both aquatic and nearby terrestrial communities. The level of the Danube can oscillate with up to 10,000 m³/s between high and low water level.

Newts were captured by dip-netting or on land by actively searching under logs. Adults were sexed based on external secondary sexual characters. Snout-vent length (SVL) was measured with dial-callipers with a precision of 0.5 mm. The longest toe from the left hind limb was sectioned and stored in 80% alcohol until analysis. The skeletochronological analysis was done according to MIAUD et al. (1993). Bones from a total of 51 individuals (both adults and juveniles) were used, of which 47 allowed estimation of age. Normality of age and body size distributions in both males and females were verified with Kolmogorov-Smirnov D-test (SIEGEL and CASTELLAN, 1988) and since they were normally distributed ($p < 0.05$) the parametric t-test was used for comparison. Adult life expectancy was calculated according to SEBER's formula (1973) and represents a calculated expected average, different from the "longevity" value which is simply the highest recorded age. Age and body size distributions were compared between sexes with Kolmogorov-Smirnov D-test.

Growth was estimated according to the VON BERTALANFFY's equation previously used in several other studies in amphibians (e.g. ARNTZEN 2000, MIAUD et al. 2001). The starting point of the growth curve was at

metamorphosis (SVL=35 mm), since the growth during the aquatic larval stage was not considered. The growth coefficient K , the rate at which SVL_{max} is approached, defines the shape of the curve. The parameters SVL_{max} and K and their asymptotic confidence intervals (CI) were estimated by non-linear least-square regression. All tests were performed with the Statistica 5.0/W software package (Statsoft Inc., USA).

Results and Discussion

As observed in numerous newt species, lines of arrested growth (LAGs) were stained in the periostic bone. These LAGs refer to periods of inactivity and allow for precise age estimation. A cross-section in the phalange of a female *T. dobrogicus* is shown in Figure 1. Body size, age and growth parameters are presented in Table 1. Mean body length was slightly higher in females but did not differ significantly between sexes (t-test, $t = 1.52$, d.f. = 35, $p = 0.15$). Mean age and distribution did not differ significantly between males and

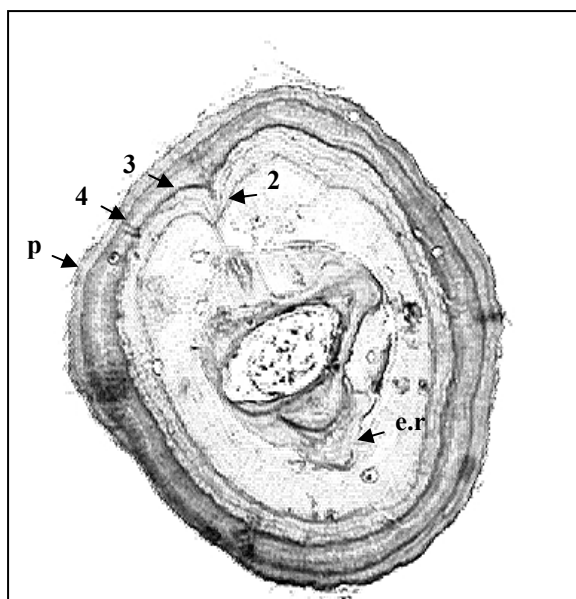


Figure 1. Cross section in the phalanges of a female *T. dobrogicus*. Lines of arrested growth (LAGs) (arrows with number 2 to 4) and the periphery (p) correspond to past winters. The periphery (p) corresponds to the last winter before capture. Note that the first inner LAG was eroded by endosteal resorption (e.r). This individual was thus 5 years old.

Table 1 - Body size, age, growth and survival parameters for *Triturus dobrogicus*, where SVL_{max} is the maximum body length, and K the growth coefficient.

| Parameter | Males | Females |
|---|-----------------|-----------------|
| | N = 16 | N = 21 |
| Body length (mm); mean \pm standard deviation | 65.0 \pm 8.80 | 68.9 \pm 6.60 |
| Range of body length (mm); min - max | 41.2 - 78.1 | 62.0 - 84.8 |
| Mean age (years); mean \pm standard deviation | 3.2 \pm 0.75 | 3.5 \pm 0.68 |
| Longevity (years) | 4 | 5 |
| SVL_{max} \pm confidence interval | 94 \pm 2.7 | 107 \pm 3.3 |
| K \pm confidence interval | 0.27 \pm 0.02 | 0.20 \pm 0.01 |

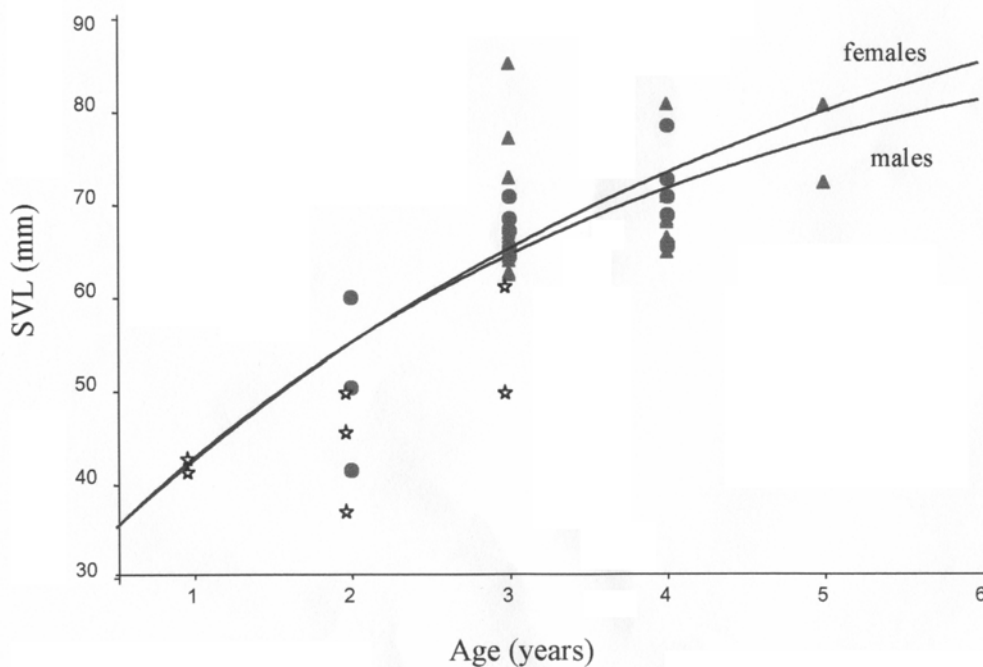


Figure 2 - Growth curve fitted to von Bertalanffy's model for both sexes of the Danube Crested newt *Triturus dobrogicus* (males - filled circles; females - filled triangles; juveniles - open stars).

females (t-test, $t=1.22$, $d.f.=35$, $p=0.23$ and D-test, $D_{max}=0.18$, $p>0.10$, $N_1=16$, $N_2=21$), but the parameters of the growth curve (i.e. both SVL_{max} and K) were significantly different (Table 1 and Figure 2). Since age distribution did not differ between sexes, both survival and adult life expectancy were estimated for males and females together: annual adult survival was 0.59 (i.e. 59% of the population survives from one year to the next) and adult life expectancy was 2.9 years.

ELLINGER and JEHLE (1997) conducted on *T. dobrogicus* a nine years capture-mark-recapture study on an island near Vienna, and estimated the mean age of males and females at 2.9 and 3.1 years respectively, close to that observed in the lower Danube floodplain. Their estimated longevity of nine years is much higher than the one observed in the lower Danube. The relatively small sample used in our study can lead to an underestimation of longevity, but the differences are nevertheless significantly higher. This suggests that the disturbance caused by the periodic floods induces a higher mortality, not observed in the Upper Danube where most of the river is not free-flowing anymore (SCHIEMER et al., 1999). Historically, during high floods, up to five km³ of water was retained in the lower floodplain, but since the massive dyking and draining that has reduced by more than 80% its surface, this buffering capacity was severely diminished making floods more devastating. The restoration of former wetlands associated to large rivers can help to reduce the amplitude of the disturbance caused by floods and improve the survival of floodplain populations. Other closely related newt species of the *Triturus cristatus* superspecies inhabiting permanent ponds or lakes exhibited a similar higher longevity to the Vienna population, between 8-18 years old (e.g. CVETKOVIC et al., 1996; HAGSTRÖM, 1977; MIAUD et al., 1993). NOBILI and ACCORDI (1997) compared age at maturity in another newt species, *Triturus vulgaris*, from permanent and temporary ponds. They observed that age at maturity was earlier and longevity tended to decrease in the most unpredictable environment, i.e. temporary ponds. A negative impact of the prolonged periods of inundation on the body condition and fecundity of water frog and newt populations was already observed in the studied site (COGĂLNICEANU, 1997, 1999). If the present trend of damming, draining and dyking will continue, the range of water level fluctuations will increase in the remaining naturally flooded areas of the lower Danube floodplain. We suggest that the effects of floods on the species inhabiting the floodplain might change from an intermediate-level disturbance allowing for non-equilibrium coexistence, i.e. early successional species that coexist with late successional species (PALMER, 1994), to a high-level disturbance. Thus, the remaining parts of the floodplain can become unsuitable for many of their inhabiting species.

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