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Growth of newts (*Triturus cristatus* and *Triturus vulgaris*) at various ages

(Amphibia: Caudata: Salamandridae)

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With 1 figure

Introduction

In a previous paper (Hagström 1977) the annual increase of body length in newts, *Triturus cristatus* (Laurenti) and *Triturus vulgaris* (Linnaeus), was investigated. It was found that there are considerable differences between individuals, between populations, and also between years. The material examined consisted of (1) free-living newts in two localities, recorded for up to five successive years when the individuals were identified by their belly pattern (Hagström 1973), and (2) preserved newts from three other localities, each specimen age-determined by counting skeletal growth marks on transverse sections of femur or humerus.

When the investigation of the newt populations in the first two localities was finished in 1974, a small sample was taken from each population for skeletal mark counting (Hagström 1979b). It was later realized that among those newts were specimens that had been recorded before (in the five year registration program). Accordingly, it became possible, for the first time in Scandinavia, to relate body length to age during several years for free-living adult individuals.

Material and methods

The localities investigated in the present paper are: the Gunnebo park pond (sixteen *T. cristatus*) and the Billdal rock pool (five *T. vulgaris*). They are both situated in the southern part of the Göteborg (Gothenburg) aera in southwestern Sweden. The actual newt populations are stable and established since long time. Further information about the localities and their newt populations can be found in Hagström (1979a).

A detailed description of the technique of photographing the belly pattern is given in Hagström (1973). Since the belly pattern remains sufficiently constant and every newt was photographed each time of capturing, a complete recording list (based on the photographs) could be written for each individual. On

the (natural size) photographs, body length was measured from snout to posterior end of cloaca. When the growth of an individual was estimated, only changes of 1,0 mm or more were considered. Measurements were however made with a much higher accuracy.

The ageing method means that cross-sections of alcohol-preserved femur or humerus, stained with EHRLICH's haematoxylin-eosin, are studied under a micro-

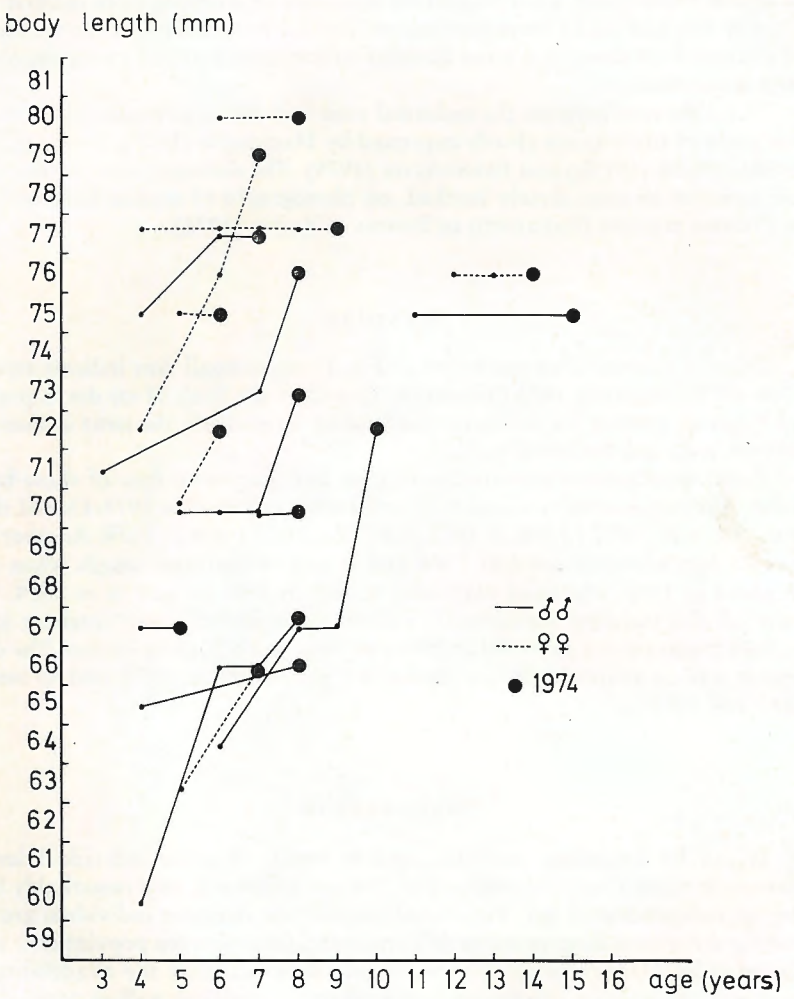

Fig. 1. Body lengths of sixteen individual *Triturus cristatus* at different ages. Each newt is presented by one line. Individuals were preserved for ageing in 1974. See text for further explanation.

scope. A complete description of the technique is given in HAGSTRÖM (1977). On the bone sections, dark concentric zones, each indicating a hibernation period, can be seen. The youngest breeding newts collected have only one such well-developed zone; it is situated in the margin of the bone. Since the minimum age of breeding debute in southwestern Sweden is three years, the actual zone should indicate the winter inactive period of the third year of life. New bone tissue (including new hibernation zones) will be added successively in the outer margin.

Around the marrow cavity, the bone stains darker red. In this deeper coloured area is found (in its outer region) the bone tissue remaining from the first two years of life, and (in its innermost region) the endosteal zone. This zone consists of younger bone tissue of a more lamellar structure; it is added where the oldest bone is resorbed.

The difference between the endosteal zone and the bone remaining from the first years of life was not clearly expressed by HAGSTRÖM (1977), as pointed out by HAGSTRÖM (1979b) and FRANCILLON (1979). The different zones of the bone can however be seen, clearly marked, on photographs of similar bone sections of *Triturus alpestris* (LAURENTI) in SMIRNA & ROČEK (1976).

Results

Triturus cristatus data are shown in Fig. 1, where small dots indicate records 1969-1973, large dots 1974 (always at the end of the line). If no dot is present for a certain year on one of the lines indicating individuals, the newt in question was not recorded the actual year.

Triturus vulgaris is represented only by five specimens, four of those being males. Three of the males were six years old when collected in 1974. One of them was 39 mm in 1971, 42 mm in 1972 and 1973, and 44 mm in 1974. Another one was 43 mm when collected in 1974 and it was of the same length when first recorded in 1972. The third male was 42 mm in 1973 as well as in 1974. The material also included the oldest *T. vulgaris* male found in the Göteborg area: in 1974 it was twelve years old and 49 mm long, in 1972 it was 48 mm. The only female was six years old. It was 39 mm in 1971, 42 mm in 1972, and 45 mm in 1973 and 1974.

Discussion

It can be concluded from the present results that the individual length increase in adult *Triturus cristatus* and *Triturus vulgaris* is, to a remarkably high degree, independent of age. Possible reasons for the irregular individual growth and the differences in growth rate between years (and between populations) were discussed by HAGSTRÖM (1977), and it was supposed that the availability of food and the weather conditions (temperature, rainfall) as well as genetic and other factors difficult to reveal (e. g. disease) play an important role. The results of the present paper once again argue against the use of (body) length as an indication of age for adult newts.

Summary

Sixteen adult *Triturus cristatus* and five *Triturus vulgaris,* collected in 1974 in the Göteborg (Gothenburg) area, Sweden, and age-determined by counting skeletal marks on transverse sections of femur or humerus, were found to have been recorded before (during the period 1969-1973). Since the body length of the newts could be estimated each time, it became possible to relate size to age in several successive years for the same free-living individuals. Individual growth (and size) was found to be independent of age to a remarkably high degree and it is concluded that size should not be used as an indication of age for adult newts.

Zusammenfassung

Sechzehn adulte *Tristurus cristatus* und fünf *Triturus vulgaris,* die 1974 im Gebiet von Göteborg, Schweden, gesammelt wurden und deren Alter anhand von Merkmalen des Skeletts (gewonnen an Querschnitten des Femur und Humerus) bestimmt werden konnte, erwiesen sich als bereits früher (im Zeitraum von 1969 bis 1973) schon datenmäßig erfaßt. Da die Körperlänge der Molche jedesmal geschätzt und registriert worden war, konnte nun für diese freilebenden Exemplare das Verhältnis von Körpergröße zum Alter in einigen aufeinanderfolgenden Jahren ermittelt werden. Es zeigt sich, daß individuelles Wachstum (und Größe) vom Alter der Tiere weitestgehend unabhängig sind. Daraus ergibt sich auch, daß man aus der Größe adulter Molche keinen Hinweis auf deren Alter ableiten sollte.

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