

## Tail regrowth in wall lizards *Podarcis muralis* from a population introduced into England

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A population of introduced wall lizards *Podarcis muralis* in a small (15 m x 8 m) undisturbed garden in the village of Newton Ferrers in Devon, England, has been studied intensively for 4 years. The lizards correspond in appearance to the subspecies *nigriventris* Boneparte, 1838, and so probably originated from central Italy. Individuals were identified by the pattern, shape and colouration of the scales around their eyes and cheeks, which, with one exception out of 18, were the same on both cheeks. In 2021, three adult males and six adult females were observed and photographed on 105 days, often three times a day, for periods from one minute to one hour, providing 4800 photographs. In 2022, one male and eight females were photographed on 161 days providing 6400 photographs. In 2021, a male lizard (M1) was seen to have suffered tail loss, as was a gravid female lizard (F2) in 2022. The subsequent progress of tail regeneration in these two cases was documented with photographs and tail measurements.

Measurements of total body length and tail length were made using a ruler which was laid horizontally beneath a paving slab that was often used as a basking place (Fig. 1). Regrowth was measured on the computer screen by enlarging the known part of the lizard's length to its actual size, enabling the new growth to be measured. The error in this measurement system was not determined but measurements over time gave progressive increases in the length of regenerated tails, indicating a reasonable degree of accuracy.

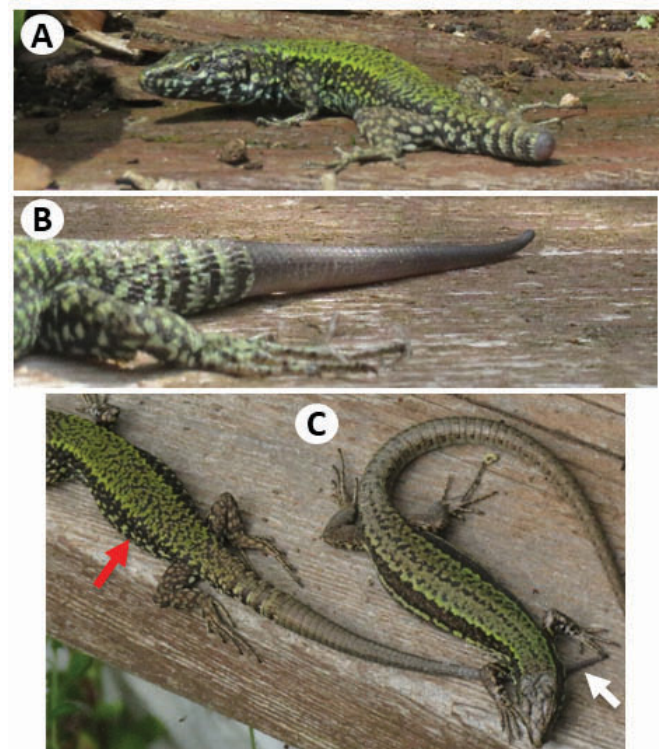
The male lizard (M1) was observed with a recently broken tail on 13 July 2021 and photographs and measurements were taken on five subsequent occasions until 16 August (Figs. 2 & 4). In this 34-day period the tail had regrown 83 mm. This occurred at a minimum rate of 0.7 mm/day and a maximum of 2.6 mm/day, as determined between the intervals that photographs were taken.

The gravid female lizard (F2) was observed with a recently shed tail on the 27 May 2022 (Figs. 3 & 4) and laid eggs 13 to 15 days later (9–11 June). At that time the regenerated tail (blastema) measured only about 1 mm in length, i.e. there was negligible regrowth before egg laying. Between 11 June and 18 July, the tail grew 53 mm, at an average rate of 1.6 mm/day.

The observations on male and female specimens were made in two different years, 2021 and 2022. In the period April to the end of July, these years showed marked differences



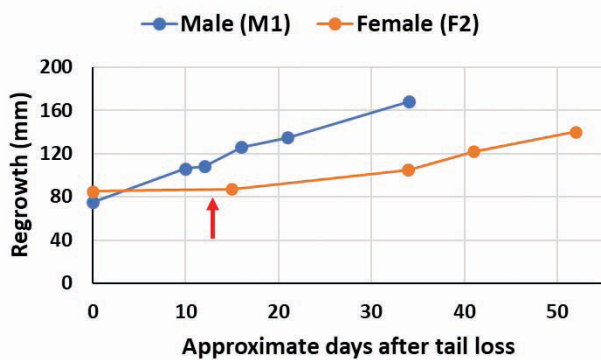
**Figure 1.** A female lizard on the paving slab with the ruler used to measure length



**Figure 2.** Tail regeneration in an adult male *Podarcis muralis* (M1) in 2021 - **A.** Soon after tail loss (13 July), **B.** After 12 days (25 July) with significant tail regeneration, and **C.** After 34 days (16 August) with further regeneration (the male indicated by red arrow, tail tip by white arrow)



**Figure 3.** Tail regeneration in an adult female *Podarcis muralis* (F2) in 2022 - **A.** Soon after tail loss on 27 May while still gravid, **B.** After 33 days (30 June) when eggs had been laid and with significant tail regeneration, and **C.** After 52 days (18 July) with further regeneration



**Figure 4.** Tail regrowth of a male and a female wall lizard *Podarcis muralis* that were photographed and measured several times after tail loss. The male was assessed from 13 July to 16 August 2021 and the female from 27 May to 18 July 2022 (red arrow indicates approximate time of egg laying)

from long-term average weather conditions; 2021 was relatively cool and moist while 2022 was exceptionally hot and dry. These differences would be expected to have impacted physiological processes in the lizards and also perhaps even food availability. Consequently, no direct comparisons can be made between male and female tail regrowth rates. There appear to be no data in the literature with which the current observations can be compared directly, although under laboratory conditions the tail of *P. muralis* is said to be able to regenerate in 20–30 days (Alibardi, 2010; 2018) which concurs with at least the male in this study. The lack of regeneration during the period that the female was gravid is particularly interesting, especially as it is known that the rate of tail regeneration in *Zootoca vivipara* is reduced in individuals that are heavily infected by blood parasites (Oppliger & Clobert, 1997). The extra physical stress involved

in reproduction may account for very slow regrowth rate until after egg laying although this could in part be attributed to the more extreme weather conditions of 2022, which may have been an important stress factor.

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