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Tail loss and escape behaviour in the Common Wall Lizard *Podarcis muralis* LAURENTI, 1768. A preliminary analysis
(Squamata: Sauria: Lacertidae)

Schwanzautotomie und Fluchtverhalten
bei der Mauereidechse *Podarcis muralis* LAURENTI, 1768. Eine vorläufige Analyse
(Squamata: Sauria: Lacertidae)

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KURZFASSUNG

Bei einigen Eidechsenarten kann der Verlust des Schwanzes zu einer Veränderung der Verteidigungsstrategie führen, wobei die Fluchtdistanz abnimmt. In der vorliegenden Arbeit untersuchte ich den Einfluß des Schwanzverlustes auf das Fluchtverhalten der Mauereidechse *Podarcis muralis* LAURENTI, 1768. Die Untersuchung erfolgte an einer Population in einem Waldgebiet etwa 17 km östlich von Rom (Latium, Mittelitalien). Insgesamt standen 77 Beobachtungen zur Auswertung zur Verfügung. Die Ergebnisse sprechen dafür, daß Schwanzverlust die Fluchtdistanz bei *P. muralis* nicht beeinflußt, da die diesbezüglichen Daten von Tieren mit unversehrtem und fehlendem Schwanz ähnlich waren. Die Fluchtdistanz erwies sich weiter als nicht abhängig von Geschlecht und Körpergröße, sehr wohl aber vom Deckungsgrad des Sitzplatzes der Eidechse.

ABSTRACT

In some lizard species tail loss can involve a shift in defensive strategy, resulting in decrease of the escape distance. In this study I examined whether tail loss influences escape behaviour of the Common Wall Lizard, *Podarcis muralis* LAURENTI, 1768. Data were obtained from a population inhabiting a forested area situated about 17 km east of Rome (Latium, Central Italy). A total of 77 observations was collected. Results of this study seem to show that tail loss does not influence escape distance in *P. muralis* since defensive behaviour of specimens with intact tail was similar to that of specimens which had lost their tail. Escape distance was not affected by sex and body size, but was by vegetation coverage level.

KEY WORDS

Sauria, Lacertidae, *Podarcis muralis*; behaviour, tail loss, defensive strategy shift; Central Italy

INTRODUCTION

The action of escape represents one of the principal defense mechanisms in lizards, which are preyed by a wide variety of vertebrates (e. g. HENLE 1988; CAPIZZI & al. 1995) and consitute an important link of the food chain in many ecosystems. Escape behaviour can be influenced by numerous factors, e.g. body temperature (RAND 1964; HERTZ & al. 1982; CROWLEY & PIETRUSZKA 1983; MAUTZ & al. 1992), distance to be covered (BULOVA 1994), reproductive status (BAUWENS & THOEN 1981; SCHWARZKOPF & SHINE 1992; BRANA 1993; BULOVA 1994), and habitat type (SNELL & al. 1988; BULOVA 1994; MARTIN & LOPEZ 1995). Among the factors influencing the escape behaviour, tail loss is very important. When a lizard is taken at its tail by a predator, it can free itself by means of autotomy of the tail. Some studies have shown that in some lizard species this phenomenon can involve a shift in defense strategy, resulting in a decrease of the escape distance. This is the case, e.g. in *Scincella lateralis* (SAY, 1823) (FORMANOWICZ & al. 1990) and *Sceloporus virgatus* SMITH, 1938 (SMITH 1996).

In this preliminary study I examined whether tail loss influences the escape behaviour of the Common Wall Lizard, *Podarcis muralis* LAURENTI, 1768.

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STUDY AREA AND METHODS

Data were obtained during summer 1996 from a population of *P. muralis* inhabiting a forested area of about 40 ha situated near the village of Tor Lupara, about 17 km east of Rome (42° N / 12°40' E; about 70 - 100 m a.s.l.) where other herpetological studies were made (RUGIERO & LUISELLI 1995, 1996). The habitat was characterized by a forest (*Quercus cerris, Ulmus minor, Carpinus betulus*) bordered by herbaceous pastures and cultivated fields. The study area is situated in the temperate Mediterranean bioclimate (hypomesaxeric subregion of type B; sensu TOMASELLI & al. 1973).

Approach distance was estimated by walking toward the lizards at a constant speed and measuring the distance as soon as they began to move. Lizards should be undisturbed, and with their heads pointing in a direction which guaranteed immediate recognition of my presence. In total 77 observations were organized into three groups corresponding to the level of vegetation coverage at the spot where the specimens started their flight [levels: (1) - no coverage; (2) - medium coverage (e.g., some blades of grass or twigs around or near the lizard); (3) - high coverage (specimens were covered by dense vegetation, e. g., inside bushes)].

After the approach test the lizard was noosed or caught by hand, measured for snout-vent lenght (SVL) and tail lenght (to the nearest 0.1 cm) with the tail condition (intact; broken or regenerated) recorded, marked by toe-clipping (BAUBAULT & MOU 1986) and released on the capture site. Females > 5.1 cm SVL and males > 5.9 cm SVL were considered adult; females according to EDSMAN (1986), males on the basis of the dimensions of the smallest specimen which I observed to exhibit sexual behaviour in the study area (RUGIERO, unpublished). Sex of adults was determined by their femoral pores (see e.g., BRUNO & MAUGERI 1977; ARNOLD & BURTON 1978).

Due to their low number, data from recaptures remained unconsidered in this study. As data were normally distributed, only parametric analyses were used. All tests were two-tailed, with $\alpha = 0.05$.

RESULTS AND DISCUSSION

Table 1 presents data on escape distances in the three different vegetation coverage categories. Comparison of specimens with intact and broken or regenerated tails, did not reveal significant differences in escape distance for any considered vegetation category (ANOVA: category (1), $F_{1,31}$ = 1.83; category (2), $F_{1,31}$ = 1.86; category (3), $F_{1,9}$ = 0.21). Considering the escape distances of the specimens having intact tail, there was no significant difference in comparing categories (1) and (2) (ANOVA, $F_{1,28}$ = 2.68), and categories (2) and (3) ($F_{1,19}$ = 3.77), but there were in comparing categories (1) and (3) ($F_{1,17}$ = 8.24, p <0.05). In the case of the specimens with broken or regenerated tail, differences were not significant when comparing categories (1) and (2) ($F_{1,34}$ = 1.17), and (1) and (3) ($F_{1,23}$ = 3.49), but there were significant differences between categories (2) and (3) ($F_{1,21}$ = 6.43, p < 0.05). Escape distance was not significantly correlated with SVL in either specimens with intact tail (r = 0.14, $F_{1,33}$ = 0.71, p = 0.4) or in the other specimens (r = 0.20, $F_{1,40}$ = 1.63, p = 0.21).

Table 2 shows the escape distances of males, females and juveniles. Tail loss was found in 62.7 % of males, 46.7 % of females and 27.3 % of juveniles. Comparisons between (i) lizards with intact tail and (ii) other lizards did not show significant differences in escape distance in either males (ANOVA, $F_{1,49}$ = 0.03) or females ($F_{1,13}$ = 0.10). Due to small sample size in juveniles with broken or regenerated tail (n = 3), it was not possible to execute this analysis; however, the means obtained were quite similar (see table 2).

Tail loss could constitute a significant disadvantage for a lizard, as it decreases its sprint performance (BALLINGER & al. 1979; PUNZO 1982; DIAL & FITZPATRICK 1984), thus increasing the risk of predation. Some authors suggested that decreased escape

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Table 1: Escape distances (m) of *Podarcis muralis* specimens with intact and regenerated or freshly broken tail. Vegetation coverage level (V.L.) considered (see text). n - number of specimens; r - range; S.D. - standard deviation; x̄ - mean.

Tab. 1: Fluchtdistanzen (m) von *Podarcis muralis* mit intaktem und regeneriertem oder frisch abgeworfenem Schwanz, unter Berücksichtigung der Deckungsverhältnisse (V.L.) am Sitzplatz der Eidechse [(1)- deckungsarm, (2) - mäßige Deckung, (3) - starke Deckung]. n - Anzahl Exemplare; r - Spannweite; S.D. - Standardabweichung; x̄ - Mittelwert.

V.L.	Intact Tail / Unversehrter Schwanz				Broken Tail / Regenerierter Schwanz			
	x̄	S.D.	r	n	x̄	S.D.	r	n
(1)	2.66	0.94	1.21-4.97	14	2.23	0.88	0.79-4.57	19
(2)	2.14	0.81	1.25-4.44	16	2.56	0.96	1.40-4.94	17
(3)	1.41	0.29	1.19-1.90	5	1.52	0.46	0.89-2.20	6

Table 2: Escape distances (m) observed in various sex and age categories of *Podarcis muralis* specimens with intact and regenerated or freshly broken tail. F - females; J - juveniles; M - males; n - number of specimens; r - range; S.D. - standard deviation; x̄ - mean.

Tab. 2: Fluchtdistanzen (m) bei *Podarcis muralis* verschiedenen Alters und Geschlechts. Vergleich von Tieren mit intaktem bzw. regeneriertem oder frisch abgeworfenem Schwanz; F - Weibchen; J - Jungtiere, M - Männchen; n - Anzahl Exemplare; r - Spannweite; S.D. - Standardabweichung; x̄ - Mittelwert.

Sex	Intact Tail / Unversehrter Schwanz				Broken Tail / Regenerierter Schwanz			
	x̄	S.D.	r	n	x̄	S.D.	r	n
M	2.25	0.91	1.19-4.44	19	2.30	1.01	0.79-4.94	32
F	2.38	1.24	1.25-4.97	8	2.22	0.56	1.39-3.03	7
J	2.11	0.50	1.36-2.87	8	2.00	0.53	1.40-2.42	3

distance after tail loss - as observed in some terrestrial lizards - might be combined with a shift in predator avoidance strategy (FORMANOWICZ & al. 1990; SMITH 1996). According to the above authors, these specimens should change their defensive strategy in that they remain motionless and rely on the camouflage of their cryptic dorsal colorations.

Data presented in this study, however, seem to show that this is not the case in *P. muralis*. According to the results of the univariate statistics applied, defensive behaviour of specimens with intact tail was similar to that of specimens which had lost their tail. Moreover, escape distance was not influenced by sex or body size. It seems that vegetation coverage level could influence the escape behaviour, as specimens which rested in very well-covered places permitted a closer approach distance than those which were in more open sites.

Some preliminary results presented in this paper deserve a more detailed analysis and further studies are required before firm conclusions should be drawn.

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