Chicken Itza: USNM 46271, FMNH 27270, 36605, MCZ 46501 (formerly UMMZ 73088; paratype), UMMZ 73085 (paratype), 73089 (paratype), 73210 (paratype), 73087 (paratype), 81539-40.
Chicken Itza, Trail Thompson's Cenote: UMMZ 73083 (paratype).
Chicken Itza, 2mi S Hacienda: UMMZ 73084 (paratype).
Chicken Itza, XCan Cenote: UMMZ 73086 (paratype).
Chicken Itza, Imi S Hacienda (type locality): UMMZ 73090 (holotype).
Piste: KU 70923-27, 70929, 70931, UAZ 28839, 28843, 28846-47, 28849-50, CU 18222-23, 16128, JBI (7 specimens).
8mi W Vallodolid: CU 45949.
Tekom: BMNH 1973.2505 (not examined).

HERPETOLOGICAL JOURNAL, Vol. 1, pp. 291-293 (1988)

THE RELIABILITY OF THE TOE-CLIPPING METHOD WITH THE COMMON LIZARD (*LACERTA VIVIPARA*)

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(Accepted 3.12.87)

ABSTRACT

Out of a group of 954 individuals of *Lacerta vivipara* 8% showed naturally caused toe losses during a four year field study. Another 2% was naturally marked by nail losses or seriously damaged toes. The adult females had the greatest chance of natural toe loss, about three times as much as the adult males. For full reliability the toe-clipping method needs some additional data of the animals marked.

INTRODUCTION

When studying lizards it is mostly necessary to be able to recognise the animals individually. During the last few decades a number of marking techniques have been developed which are used separately or in combination (e.g. Vogt, 1944; Carlström and Edelstam, 1946; Woodbury, 1956; Tinkle, 1967; Honegger, 1979). The most widespread marking method for lizards is toe clipping in certain combinations (Ferner, 1979).

The occurrence of natural toe loss, however, may cause confusion when identifying. Only a few field studies mention this problem (e.g. Tinkle, 1967; Schoener and Schoener, 1980). A population study on the common lizard (*Lacerta vivipara*) in the nature reserve 'Overasseltse en Hatertse Vennen' near Nijmegen, in which a total of 954 animals were marked, offered the opportunity to test the reliability of the toe-clipping method.

METHODS

The study area is formed by river dunes with some moorland pools. It is alternately covered by woods (coniferous as well as oak and birch coppice) and by heathland and cultivated areas (Strijbosch, 1988). Within this study area four test sites were selected lying close to each other. They were visited each day and the lizards found were captured by hand, marked — if captured for the first time — and measured.

A maximum of one toe per foot was clipped. When reading the toes of each foot were numbered 1-5 from left to right as seen from dorsal. The combination of the toes clipped at the four feet — in the order left front, right front, left hind and right hind — gave the individual marking number. An unmutilated foot had the figure 0. So an animal whose second toe of the left front foot was clipped as well as the third of its left hind foot and the fourth of its right hind foot bore the number 2034. This system offers the possibility to give 1,295 animals individual numbers (viz. $6^4 = 1296$ minus one for the combination 0000).

Whenever we found an animal that had lost one or more toes through natural causes, this resulted in a 'natural' marking number or in an alteration of the number already given. Also when a nail was lost or when a toe was seriously damaged we gave the animal a new number in order to avoid confusion when reading. If an animal lacked more than one toe per foot we gave it a fraction number (e.g. number $2\frac{3}{4}14$ lacked an extra toe at the right front foot).

A correct identification of any animal was (sometimes considerably) supported by the data which we collected at each capture for the population study: date of capture, exact capture spot, age, sex, weight, snout-vent length, tail length, secondary tail growth if present, reproductive phase, sloughing phase, scars and other particulars if present.

RESULTS

The occurrence of natural numbers or the alteration of clipped numbers were caused by toe and/or nail loss. Tables 1 and 2 give the numbers of these phenomena. Adult males and females were defined as those that were mature (i.e. in their third year and onwards). Subadults were animals in their second year and juveniles those born in the year of study. The numbers of the adult animals in the total period 1977-1980 were corrected for doubles, e.g. when an adult male was captured both in 1977 and 1978 it was counted as one individual for the period 1977-1980.

TOE LOSS

From Table 1 it appears that most toe loss occurred in adult females (about 16% for the period 1977-1980); it was twice as much as for subadults (about 8%) and about three times as much as for adult males. So the adult females were the greatest risk-group. For the total group of animals identified (954 in the period 1977-1980) 8% of the number codes was caused by natural toe loss.

TOE AND NAIL LOSS

Beside natural toe loss also serious damage to a toe and/or nail lead to an alteration of the marking number: it was then completely clipped resulting in a new number code.

Table 2 also shows that in general adult females had most toe and nail losses, one and a half times as much as subadults and about three times as much as adult males. The subadults lost the greatest number of nails. Within the total group over the period 1977-1980 some 10% of the animals had a natural marking number or a number altered through toe and/or nail loss.

If a distinction is made between different habitats within the study area (Strijbosch, 1988), it was remarkable that far more toe and nail losses were found in dry open habitats than in the moist, more closed one. This can be illustrated by the following figures, for which we counted all individual cases of toe or nail loss in the two different habitat types. In the open dry habitat we found 154 cases of natural mutilation in a total of 568 individuals, in the closed moist one 51 in 384 individuals. This difference was highly significant (X^2-test, $P<0.001$).

It was also investigated as to which toes were most vulnerable. We found that the front feet toes, all being more or less equal in length, had an equal chance of damage. The hind feet, however, have toes different in length: the fourth toe counting from the body is clearly longer than the other toes and it appeared to run the greatest risk of damage. For some investigators (e.g. Honegger, 1979) this is reason enough never to clip this fourth toe when marking lizards.

DISCUSSION

Ferner (1979) mentions a number of criteria which must apply to an ideal mark or tag:

— it must not influence the survival chance or the behaviour of the animal.

— the animal must experience as little pain or stress as possible.

	ad. ♂♂		ad. ♀♀		subad.		juv.		Total	
year	A	B	A	B	A	B	A	B	A	B
1977	7	6.7	8	10.4	6	6.0	—		21	5.7
1978	3	4.2	14	16.3	9	8.8	—		26	6.7
1979	—		12	17.1	18	16.5	1	0.7	31	8.8
1980	1	4.0	2	9.5	1	2.1	3	3.6	7	3.9
'77-'80	11	5.8	31	16.5	30	8.4	4	0.9	76	8.0

TABLE 1: The number of individuals with natural toe loss (ad. = adult; subad. = subadults; juv. = juveniles; A = number; B = percentage of total number per age class).

	ad. ♂♂		ad. ♀♀		subad.		juv.		Total	
year	A	B	A	B	A	B	A	B	A	B
1977	7	6.7	9	11.7	8	8.0	—		24	6.4
1978	3	4.2	14	16.3	11	10.8	1	0.8	29	7.5
1979	1	2.9	14	20.0	26	23.8	2	1.5	43	12.2
1980	1	4.0	3	14.3	3	6.3	3	3.6	10	5.6
'77-'80	12	6.3	32	17.5	44	12.3	6	1.4	94	9.9

TABLE 2: The number of individuals with toe and nail loss (for legends see Table 1).

— the animal must be recognised later individually.
— the marking must be permanent.
— it must be easily read or seen.
— it must be applicable to animals of different sizes.
— it must be suitable both in the laboratory and in the field and the materials used must be cheap.

The toe-clipping method meets these demands more or less. Woodbury (1956) does mention the possibility that the clipping of toes might harm the lizards but Ferner (1979) did not find any indication or proof of that. The frequent capture of the animals in itself, however, may influence the survival chances or the behaviour of the animals (Bauwens, 1985). As for the permanent character of toe mutilation it may be said that regeneration of toes once lost has never been found (Bellairs, 1969).

An ideal mark should also meet the condition that it cannot be altered without knowledge of the investigator. The toe-clipping method does not always meet this demand. From this study it appeared that some 10% of the animals bore a marking number which was naturally caused or which was altered through natural toe and/or nail loss in the course of time. A six-year population study of *Uta stansburiana* showed 3% natural marking numbers (through toe loss), viz. 100 out of 3,500 numbers (Tinkle, 1967). In that species the adult males appeared to be most vulnerable, three times as much as the adult females. This lower probability of toe loss in *Uta stansburiana* will be particularly influenced by its relatively short life span (1-2 years) as compared to that of *Lacerta vivipara* (up to 7 or 8 years for females). According to Tinkle (1967) this toe loss has never led to serious problems with the identification of the animals.

Although 10% unreliability for *Lacerta vivipara* seems rather high, the field work proved that the chance of confusion is nevertheless slight. To avoid this confusion, however, the animals must be caught frequently and a great number of individual characteristics must be recorded. The more reference data of the animal are available the less one depends on the unreliability of the marking number. Certainly when a population study does not meet the above demands, natural toe loss, which unevitably occurs, prevents a complete reliability of the toe-clipping method.

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