

Variation of moulting activity in *Lacerta agilis* and *Zootoca vivipara* (Reptilia: Sauria: Lacertidae)

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Abstract. Specimens of *Lacerta agilis* and *Zootoca vivipara* were investigated at the vicinity of Tomsk, Russia, with respect to their moulting activity. There are species-specific, age-specific, sex-specific, seasonal and annual differences in the process of moulting. Seasonal dynamics of moulting had one or two peaks per season and depended on the habitat. Because of intensive growth, immature individuals had 2 or 3 moults per season. Adult females may shed their skin after pregnancy. According to changing abiotic factors the frequency of moulting increased or decreased. Individuals usually moult non-simultaneously. Differences in moulting frequency seem to be species-specific.

Introduction

It is known that hormone influence is the trigger mechanism for moulting in reptiles. When the pituitary gland affects the thyroid gland then thyroindin defines the beginning of moulting. This process is not autonomous, but triggered by the environment and abiotic factors. Quantitative data on the moulting dynamics of Lacertilia are fragmentary. In the Asian part of Eurasia this process was mainly studied in *Eremias* and *Phrynocephalus* lizards (e.g., Semenov and Shenbrot, 1986; Kotenko, 1985). Few aspects of the moulting in *Lacerta agilis* and *Zootoca vivipara* in the Asian part of their huge natural range were studied by Garanin (1983). The purpose of the present study is the identification of species-specific, age-specific, sex-specific, seasonal and annual differences in moulting activity in the two sympatric species *L. agilis* and *Z. vivipara*.

Materials and methods

Research was carried out from May to September in the years 2002-2004 on two stationary experimental grounds in the vicinity of Tomsk, Russia. The size of the first experimental ground (investigated in 2002) is 800 m². It is located in the ecotone of overgrown cutting and a plot of mixed forest in the drainage trench. The size of the second experimental ground (investigated 2003-2004) is 2100 m². It was located within pine forest, approximately 500 m distance from the forest edge. The northern border was pine forest, whereas the southern border was a mixed forest with the prevalence of small-leaved plants. In the south, the ground is covered by dense brushwood.

Capturing of lizards was done by hands. Individual marking was done using paint from moult to moult and by phalangeal amputation (Kuranova et al., 1981). Counting of lizards was carried out on transects and by the route method. The first experimental ground was split into 464 squares, the second one into 319 squares (2 x 2 m

each), respectively. For each square the number of individuals of *L. agilis* and *Z. vivipara* was calculated. In total, 119 record excursions were conducted; 82 individuals of *L. agilis* and 151 individuals of *Z. vivipara* of both sexes and different ages were marked; 48% and 36%, respectively, of the repeatedly moulted individuals were registered. Statistical data processing was done according to traditional methods (Rokitsky, 1967; Lakin, 1980) and the use of application programs (Microsoft Excel 7.0).

Results and discussion

Specific dynamics of seasonal moulting

Lacerta agilis: Adult females and males showed the same tendency of moulting during one season. At the time of emergence from hibernation (April–May) lizards shed the skin. Due to the duration of the certain period of emergence from hibernation this process was prolonged (June–July). For this reason, most of the moulting individuals were registered in June. In July the recordings of moulting lizards was significantly lower. In August lizards moult repeatedly prior to their disappearance into hibernation. This fact explains the second seasonal peak in moulting activity (Fig. 1).

In contrast to adults, immature males and females of *L. agilis* shed their skin asynchronously. In June, moulting immature males were registered more often than immature females. This is quite different in the fall (Figs. 1-2).

Zootoca vivipara: Clear differences in the nature of moulting among individuals of different sexes were noticed: males (adults and subadults) moult relatively smoothly and synchronously from June to July, whereas intensity of moulting of females of the same groups is different in various periods of the season (Figs. 1-2). Climatic conditions have a significant influence on the seasonal nature of moulting. Under conditions of the lingering cold spring in 2003 the largest value of

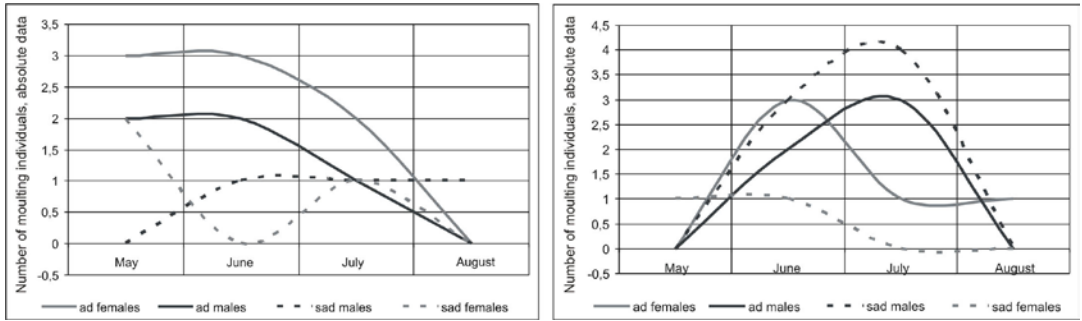


Figure 1. Seasonal dynamics of moulting of lizards in the vicinity of Tomsk in 2002. Left, *Lacerta agilis*; Right, *Zootoca vivipara*.

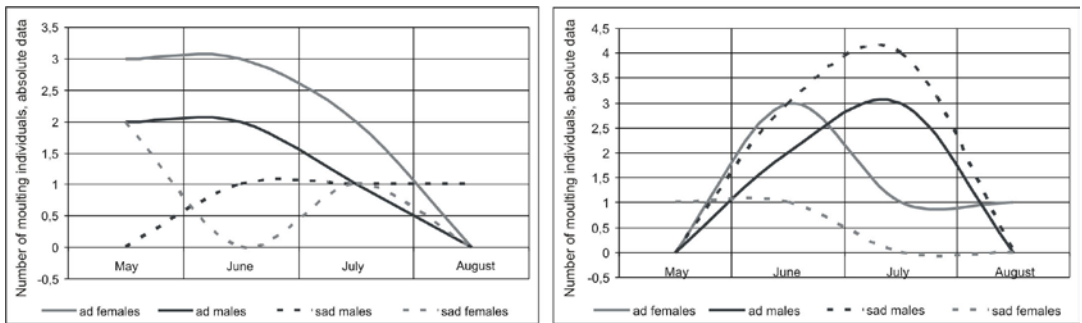


Figure 2. Seasonal dynamics of moulting of lizards in the vicinity of Tomsk in 2003. Left, *Lacerta agilis*; Right, *Zootoca vivipara*.

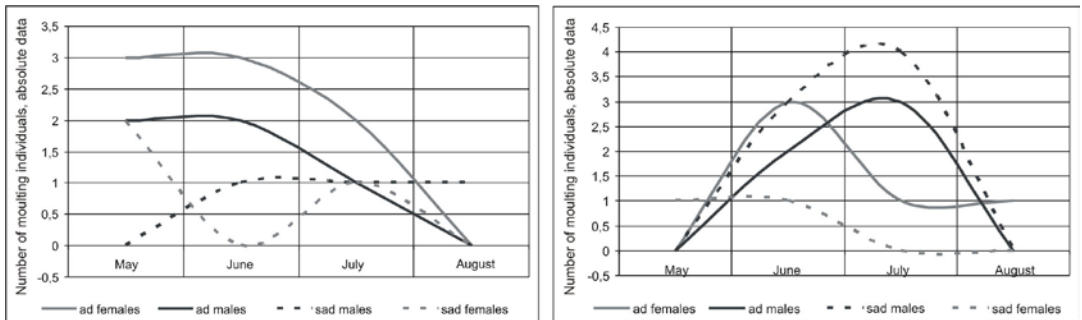


Figure 3. Seasonal dynamics of moulting of lizards in the vicinity of Tomsk in 2004. Left, *Lacerta agilis*; Right, *Zootoca vivipara*.

moulting females was noticed in July, whereas in 2002 this peak was obvious in June (Figs. 1-2).

Annual variability of moulting

Lacerta agilis: Phenology of the process changes according to climatic conditions of the specific year of observations. There is an annual variability in the duration and intensity of moulting (Figs. 1-3). In 2003, the spring began rather late. The process of moulting

was prolonged. Decrease of moulting frequency was smoother (Figs. 1-2). In 2004, the spring began quite late. The first half of the summer was cold and wet. The result was a delay of the emergence from hibernation and moulting was extended for the whole summer period. The peak of moulting was observed in August before the disappearance of the lizards into hibernation and at the same time the immature groups moulted synchronously in a considerable degree (Fig. 3). In 2003-2004, 25.5%

of 47 marked individuals were moulted, 19.1% of them repeatedly. This fact confirms the presence of annual variability in the frequency and intensity of moulting.

Zootoca vivipara: In 2003-2004, 37.5% of 104 marked individuals were moulting. Phenology of the process changes according to climatic descriptions of the specific year of observations. There is an annual variability in the duration and intensity of moulting (Figs. 1-3). Since phenology of the process changes according to climatic conditions of the specific year of observations, in 2004 the moulting of both species was characterized by considerable duration because of the late beginning of spring. Both species show the same tendency: moulting is prolonged from May to July (Fig. 3B).

Our results clearly show species-specific, age-specific and sex-specific differences in moulting activity, as well as seasonal and annual variation in the same process. The nature of the seasonal dynamics may have a single or two peaks of moulting activity, obviously related to habitat conditions. Because of intensive growth, immature individuals have 2 or 3 moults per season. Adult females usually shed their skin after pregnancy. According to the variation of abiotic factors moulting can be prolonged or short-termed.

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