

## Influence of the environmental temperature regime on the body temperature of *Lacerta agilis* Linnaeus, 1758 (Lacertidae, Reptilia) in local populations of the Khoher river floodplain in spring

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**Abstract.** An analysis was made of the influence of the biotope temperature regime on the body temperature of *Lacerta agilis* in local populations of the floodplain of the middle reaches of the Khoher river (Saratov region). The rectal body temperature in active *L. agilis* out-side their shelters was shown to be 18.3–35.1°C and 18.2–34.8°C for males and females, respectively. The rectal temperature of *L. agilis* males and females in the spring period does not differ significantly. The optimal body temperature of *L. agilis*, which the activity of individuals is observed at, should be considered as 24.2–33.0°C.

**Keywords:** Reptilia, *Lacerta agilis*, body temperature, Saratov region

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The swift lizard (*Lacerta agilis* Linnaeus, 1758) is the most widespread species of the family Lacertidae inhabiting the northern part of the Lower Volga region (Zavialov et al., 2003). Comprehensive studies of the autecology of this species in the Khoher river valley (Saratov region) made it possible to reveal features of its biotopic distribution, some aspects of feeding ecology and morphology in local populations (Zavialov et al., 2000; Tabachishin, Zavialov, 2001; Shlyakhtin et al., 2006, 2019). However, many aspects of the ecology of *L. agilis* still remain insufficiently studied. In particular, no features of the microclimate characteristic of the habitats of these lizards, as well as no temperature reactions of these animals to environmental factors, have been determined. Conducting thermobiological studies is becoming especially relevant against the backdrop of the steady trend towards climate warming in the habitat of this species, including the Saratov region (Yermokhin et al., 2016; Yermokhin, Tabachishin, 2022a, b). That is why an analysis of the thermobiology of reptiles, as well as their distribution within a particular territory, makes it possible to reveal these animals' requirements for their habitat and factors limiting their abundance (Ruzanova, Tabachishin, 2000; Litvinchuk, Gan-

schuk, 2003; Chetanov et al., 2009; Tabachishin, Yermokhin, 2013). This information can be used during the implementation of complex measures for the conservation and reproduction of reptile populations.

The purpose of this work was to analyze the influence of the temperature regime of biotopes on the body temperature of *Lacerta agilis* in local populations of the floodplain of the middle reaches of the river Khoher (Saratov region).

The activity of *L. agilis* at different temperatures of the air and substrate surface was studied in its main habitats in the floodplain of the Khoher river (vicinities of the Letyazhevka village, Saratov region) from the third decade of April to the third decade of May, 1998 and 2008. For each *L. agilis* individual encountered, its sex, habitat type, air temperature (at a height of 1 m), soil temperature (on the surface and at a depth of 5 cm), and body temperature were determined. Air and soil temperatures were measured with an inertial thermometer with thermal insulation. *L. agilis* rectal temperature was measured in the cloaca for 20 s after the capture of this animal using a TPМ-1 electrothermometer (Medfizpribor, Russian Federation). During the study period, the body temperature of 52 lizard individuals was measured in total (26 specimens of each sex).

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Statistical data processing was used to estimate the mean values of the parameters, their standard deviation and range of variation (*min–max*). Means were compared using Fisher’s *F*-test (variances were homogeneous according to Levene’s test for homogeneity of variance). The consistency of variation in reptile body temperature and ambient temperature was assessed by calculating the Spearman rank correlation coefficient ( $r_s$ ). A one-dimensional regression analysis of the dependence of the lizard body temperature on the ambient temperature was then carried out. The similarity of the obtained models between the sexes in local lizard populations was assessed by analysis of covariance (ANCOVA). Statistical processing of the material was carried out using the Statistica 6.0 and PAST 2.06 software packages (Hammer et al., 2001).

It has been established that the main settlement sites of *L. agilis* in the spring period are confined to areas with sparse trees and shrubs, the slopes and bottoms of ravines in the floodplain of the Koper river. The maximum population density of *L. agilis* was noted on gentle slopes with well-developed shrub vegetation of the southern exposure of the ravine-gully system of the river’s floodplain (up to 153 individuals/ha) (Tabachishina, 2004). Somewhat lower values of the *L. agilis* abundance are typical for coastal slopes (149.1 ind./ha), forest edges (127.5 ind./ha), and roadsides (93.6 ind./ha). The floodplain meadows and adjacent areas are characterized by the minimum abundance values (from 6.7 to 21.8 ind./ha).

During the study period, the rectal body temperature in active *L. agilis* outside their shelters was 18.3–35.1°C and 18.2–34.8°C for males and females, respectively (Table 1).

The rectal temperature of *L. agilis* males and females does not differ significantly ( $F=0.007, P=0.94$ ) under conditions of equal air temperatures in their biotopes, namely: the rectal temperature in males is, on average, 0.1°C higher than in females (Table 1). The temperature of the voluntary maximum in males

is slightly higher than in females. The interval between these temperatures in females is lower than in males, namely: 16.2°C versus 16.8°C. The optimal body temperature of *L. agilis* (25–75 percentiles) is probably in the range of 24.2–33.0°C.

Our correlation analysis of the dependence of the *L. agilis* body temperature on air temperature (Table 2) showed a high level of agreement between the variation of these two parameters (Spearman correlation coefficient  $r_s = 0.81–0.83, P < 0.0001$ ). However, no specificity in responses to external thermal effects between the sexes should be noted (ANCOVA covariance analysis, homogeneity (equality) of slopes:  $F=0.002, P=0.96$ ).

**Table 2.** Dependence of the *Lacerta agilis* body temperature on air temperature

Sex	$r_s \pm SE$ <i>P</i>	<i>F</i> <i>P</i>	Regression equation coefficients		<i>R</i> <sup>2</sup>
			$a \pm SE$ <i>P</i>	$b \pm SE$ <i>P</i>	
Males	<u>0.83±0.11</u> <0.0001	<u>52.64</u> <0.0001	<u>0.90±0.12</u> <0.0001	<u>8.52±3.07</u> 0.005	0.67
Females	<u>0.81±0.12</u> <0.0001	<u>45.59</u> <0.0001	<u>0.91±0.13</u> <0.0001	<u>8.21±3.01</u> 0.01	0.66

Thus, the results of our measurements of the body temperature of *L. agilis*, carried out in the Koper river floodplain, indicate that the body temperature is slightly higher (by 2.4°C) at low environmental temperatures. The optimal body temperature of *L. agilis* (24.2–33.0°C) in the spring period, which the activity of individuals is observed at, is obviously achieved at the soil temperature (at a depth of 5 cm) in the range of 19.5–26.1°C. The rectal temperature of *L. agilis* males and females in the spring period does not differ significantly. The presented results are obviously intermediate and can be the basis for further research using modern thermobiology and biotelemetry methods (Altobelli et al., 2022).

**Table 1.** Temperature characteristics of *Lacerta agilis* in spring

Sex	<i>N</i>	Temperature, °C			
		body	air	soil	$\Delta t_b$
Males	26	<u>28.2±5.2</u> 18.3–35.1			6.3±3.0 2.9–15.7
Females	26	<u>28.1±5.4</u> 18.2–34.8	<u>21.9±4.8</u> 14.9–32.2	<u>20.6±3.4</u> 15.2–26.1	6.2±3.2 2.4–15.3
<i>F</i>		<u>0.007</u>			<u>0.02</u>
<i>P</i>		0.94			0.89

*Note.* The mean value and its standard deviation in the numerator, the range of variation (*min–max*) in the denominator; *N* is the number of measurements;  $\Delta t_b$  the difference between the body temperature of the animals and the air temperature.

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**Влияние температурного режима среды на температуру тела  
*Lacerta agilis* Linnaeus, 1758 (Lacertidae, Reptilia)  
в весенний период в локальных популяциях поймы р. Хопёр**

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**Аннотация.** Проведен анализ влияния температурного режима биотопов на температуру тела *Lacerta agilis* в локальных популяциях поймы среднего течения р. Хопёр (Саратовская область). Показано, что ректальная температура тела у активных *L. agilis*, находящихся вне убежищ, составила 18.3 – 35.1°C и 18.2 – 34.8°C соответственно для самцов и самок. При этом ректальная температура самцов и самок *L. agilis* в весенний период достоверно не отличаются. Оптимальной температурой тела *L. agilis*, при которой реализуется активность особей, следует считать температуру 24.2 – 33.0°C.

**Ключевые слова:** Reptilia, *Lacerta agilis*, температура тела, Саратовская область

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