

## Habitat dimension and activity pattern differences in allopatric populations of *Lacerta agilis*

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With 8 figures

Key words: Sauria; Lacertidae; *Lacerta agilis*; allopatric populations; habitat choice; daily activity pattern.

### Introduction

About six years ago, intensive ecological investigations on lizards were carried out at two different places in Hungary. Both study areas, separated from each other by ca. 105 km, are inhabited by the sand lizard (*Lacerta agilis*), but it was not the exclusive object of the original researches. In one of the areas, namely around Babat near Gödöllő, northern Hungary the investigations focused on the niche segregation of the sympatric *Lacerta agilis* and *Lacerta viridis* populations (KORSÓS 1984); while in the other study area, in Bugac, *Podarcis taurica* was viewed as the most important one of the three present lizard populations in abundance as well as in biomass (GYOVAI 1984). It was possible to compare the data collected over two years in the two different areas as far as the sand lizard populations and their ecological relations to their habitat are concerned. Partly because of the different methods applied, but rather because of the divergent study purposes mentioned above, the following aspects seemed to be suitable for elaborating: temperature relations, which have fundamental importance with regards to these poikilotherm animals; relative air humidity; cover and structure of the vegetation and the daily activity pattern, which might also have basic thermal ecological background. Unfortunately we have not been able to compare other possibly relevant factors such as food, etc., for technical and conservation reasons.

### Material and methods, study areas

In both cases investigations were carried out by using capture-recapture experiments. At the sighting spots of the lizards soil and air temperatures, light exposure (Babat), air temperature and relative air humidity (Bugac) were measured in addition to the body measurements of the lizards. Vegetation cover (Bugac) and



Fig. 1. Babat study area. — Photo Z. Korsós.  
Das Untersuchungsgebiet in Babat.

woody plant density (Babat) were also estimated. Niche overlap values were calculated by SCHOENER's formula (SCHOENER 1968).

The study area in Babat (Fig. 1) is a young, ca. 8-9 year old hillside plantation of Scotch pine (*Pinus silvestris*), with a southern exposure and a slope of 15%. The field site is inhabited by other trees such as oak (*Quercus petraea*), maple (*Acer campestre*), black-locust tree (*Robinia pseudacacia*) and spiny oleaster (*Eleagnus angustifolia*) as well as completely closed and usually high herbaceous vegetation. Sand lizards (*Lacerta agilis*) and green lizards (*Lacerta viridis*) occurred in the area, the abundance of the former being twice as much as the latter (KORSÓS 1984).

The Bugac study area (Fig. 2) is situated in the Kiskunság National Park, at the edge of the famous "puszta" landscape, where on the sandy soil three different kinds of plant associations meet (*Festucetum vaginatae*, *Potentillo-Festucetum pseudovinae*, *Molinio-Salicetum rosmarinifoliae*) (KÖRMÖCZI et al. 1981). The presence of the green lizard here is supported by the nearby poplar black-locust tree plantation, and they are confined mainly to the wind furrows having denser vegetation. The area is obviously dominated by the meadow lizard (*Podarcis taurica*, density ca. 350 individual/ha), followed by the other two populations with far less numbers in the ratio *agilis*:*viridis* = 2:1 (GYÓVAI 1984).

Comparing the study sites, Bugac in general is drier and more homogeneous, with open or hardly closed vegetation, structured only by the presence of wind furrows and sandhills. The vegetation at Babat is richer in species as well as in



Fig. 2. Bugac study area. — Photo F. Gyovai.  
Das Untersuchungsgebiet in Bugac.

structure, more heterogeneous, thus giving more shadows and hiding places for the lizards. It should be mentioned, however, that the Babat area gives an impression of a secondary habitat, with lots of antropogenous effects, and — unfortunately — had to be considered as a temporary lizard habitat, which becomes more and more obvious as the growing Scotch pine trees slowly form a closed canopy.

## Results

### 1. Habitat dimensions

Comparing the air temperature data of both areas, we can see a high degree of similarity between the extremes:

Babat 17.6-37.6 °C

Bugac 17.3-36.0 °C

The relative abundance at different air temperatures is also very similar, but in Babat there is a slight declining tendency between 21 and 37 °C, having the maximum at about 21-23 °C, whereas in Bugac the sand lizard frequency is almost uniformly high in the section of 21-31 °C (Fig. 3). Although this difference is not properly supported by a statistical test ( $\chi^2 = 11.88$ ,  $p < 20\%$ ) and niche overlapping in athis dimension is also very high (79.4%), we can accept the assumption that the

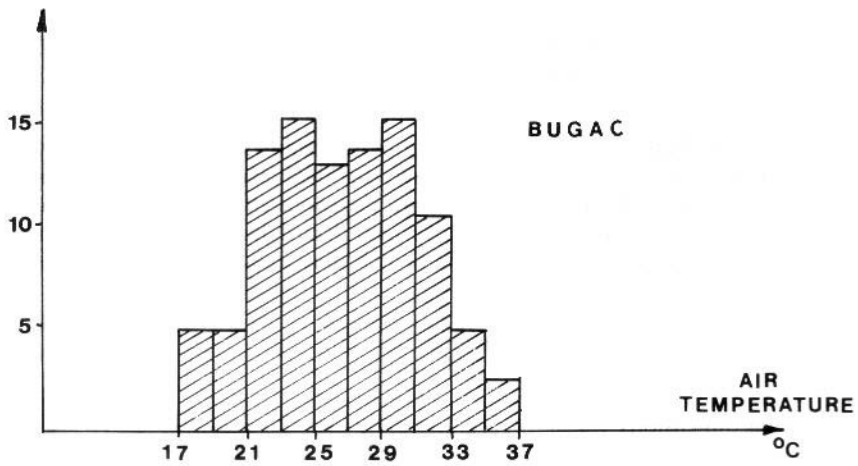
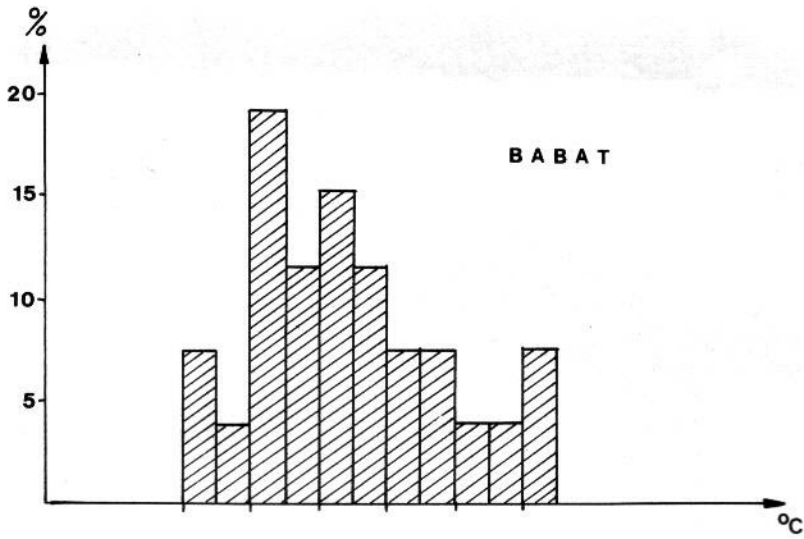


Fig. 3. Relative frequency distributions of *L. agilis* with respect to the air temperature.  
Relative Häufigkeitsverteilung der Zauneidechse nach der Lufttemperatur.

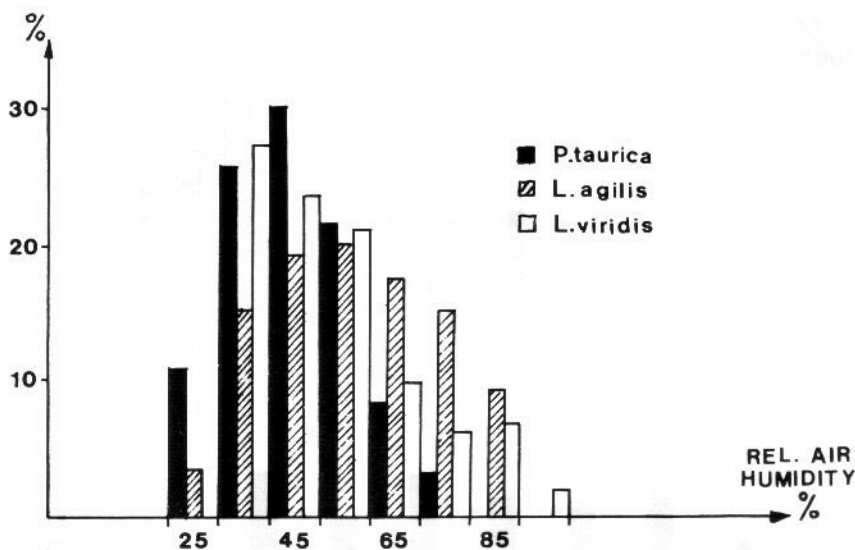


Fig. 4. Relative frequency distributions of the three lizard species with respect to the air humidity in Bugac.

Relative Häufigkeitsverteilung der drei Eidechsenarten von Bugac bezogen auf die Luftfeuchtigkeit.

sand lizards in Bugac have to adapt to a certain degree to the warmer climatic conditions. They do not, however, like dry air, as it is shown by the relative frequency distributions with respect to relative air humidity (Fig. 4). Niche overlapping between *L. agilis* and *P. taurica* is 69.4%. Regrettably enough, we had no possibility to measure air humidity at Babat.

Both air temperature and relative air humidity are effected by vegetation, and it is obvious that every lizard population may have its own relation to the plants as to one of the most important substrates for its life history (PIANKA 1986). In Bugac, vegetation cover is far from being uniformly 100%; comparing the three sympatric lizard populations along this niche axis, *P. taurica* is strikingly separate from the other two (Fig. 5). It has its niche position at around 65% of vegetation cover, whereas the niche overlappings of *agilis* and *viridis* are 27.8% and 37.4%, respectively. These two latter species occur almost exclusively in places with 90-100% (i. e. closed) vegetation cover. How can they further subdivide their habitat? There is a possible example from Babat: regarding the woody plant density, niche overlapping is 74.1% between the sand and green lizard. Although this is rather high, there is a traceable tendency of *L. viridis* preferring the denser and loftier woods and shrubs (Fig. 6).

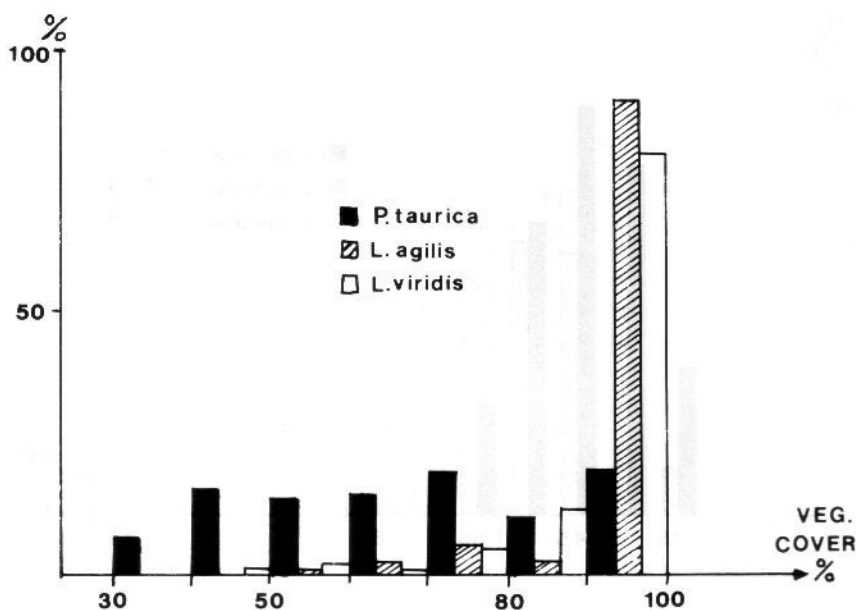


Fig. 5. Relative frequency distributions of the three species in relation to the vegetation cover in Bugac.

Relative Häufigkeitsverteilung der drei Arten von Bugac bezogen auf die Vegetationsbedeckung.

## 2. Diurnal activity rhythms

Daily activity patterns were recorded for the lizards in both study areas. Relative frequency distributions were pooled to plot a spring (March-May) and a summer (June-September) activity diagram. According to the results (Fig. 7), which are also detailed elsewhere (KORSÓS 1986), daily activity pattern of the sand lizard in Babat has a unimodal shape in both periods, while that of the sympatric green lizard, being in a subordinate position judged from its population size, shows a bimodal shape in order to decrease the intensity of competition. In Bugac the daily activity pattern of the sand lizard has only one peak in spring (there is little statistical difference from that of Babat,  $\chi^2=26.702$ ,  $p < 5\%$ ), but in summer there is a bimodal shape, which is very different from that at Babat ( $\chi^2=61.295$ ,  $p < 0.1\%$ ).

There can be two interpretations for this phenomenon. According to the first one, the peculiar climatic conditions at Bugac force the sand lizard to withdraw in the hot hours at noon (CRUCE 1970). In Babat there are enough shadows and hiding places in the vegetation to maintain temperature heterogeneity, and hence to allow the lizards to passively regulate of their body temperatures in the habitat.

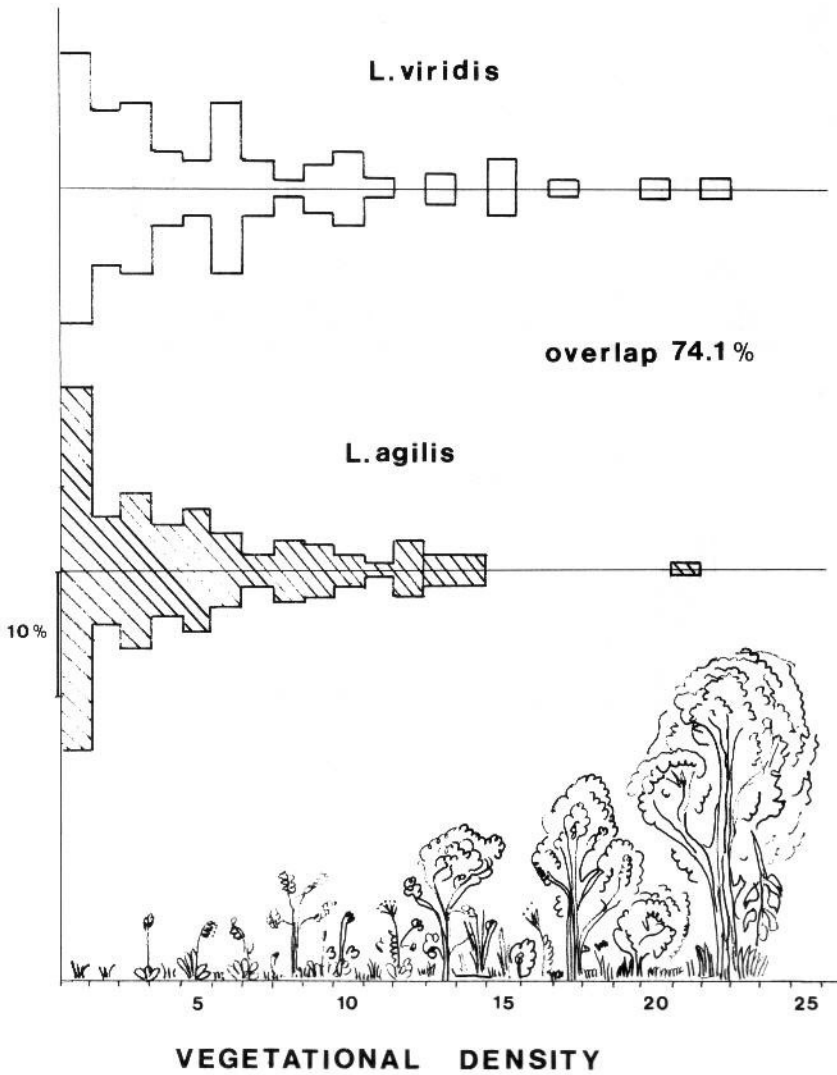


Fig. 6. Relative frequency distributions of the two species with respect to the woody plant density in Babat.

Relative Häufigkeitsverteilung der zwei Arten in Babat bezogen auf die dortige Baumdichte.

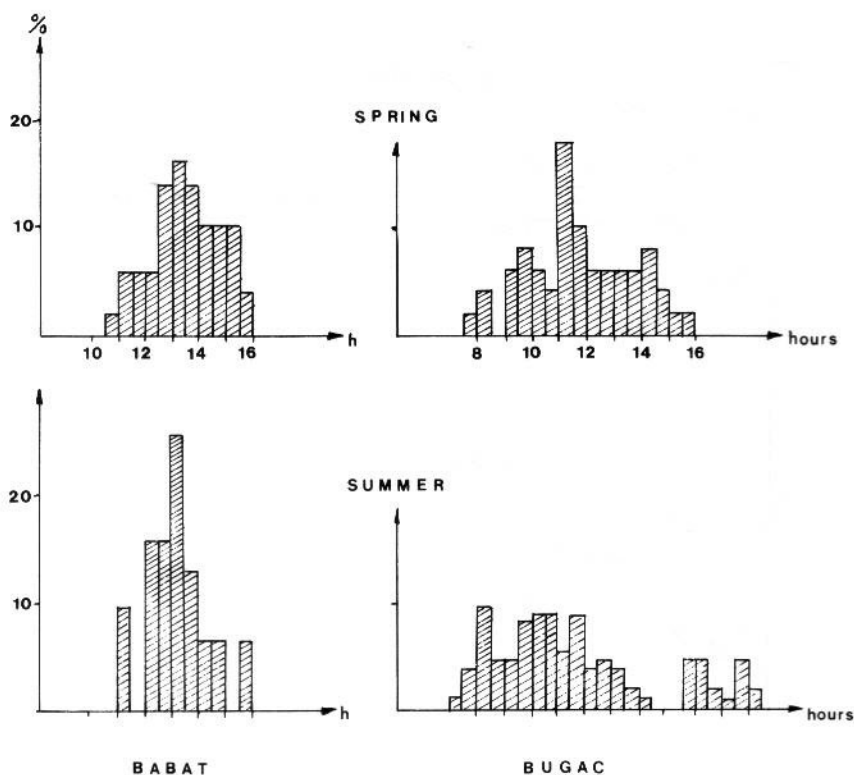


Fig. 7. Daily activity pattern of *Lacerta agilis* in the two study areas.  
Täglicher Aktivitätsrhythmus der Zauneidechse in den beiden Untersuchungsgebieten, oben im Frühjahr, unten im Sommer.

The other interpretation may rather emphasize the strategy of sympatric populations to avoid competition (SCHOENER 1974). According to this at Bugac *P. taurica* has a predominantly diurnal activity rhythm, and *L. agilis* tries to minimize competition and to decrease the overlapping between the realized niches by splitting its activity pattern to the periods when *P. taurica* is not so frequently foraging.

Nevertheless, looking at the summer activity diagram of both species on the same plot (Fig. 8), this latter hypothesis does not seem to be well supported. *P. taurica* essentially has similar relative frequencies in the appropriate section, thus the minimum in the activity curve of *L. agilis* around 15 h can unlikely be considered as a result of competition, all the more, as there is no activity maximum of *P. taurica* here, which could be avoided in this way. On the other hand, as one can remember the first section, there is little real need to decrease competition here as well, because there is a good segregation along the air humid-



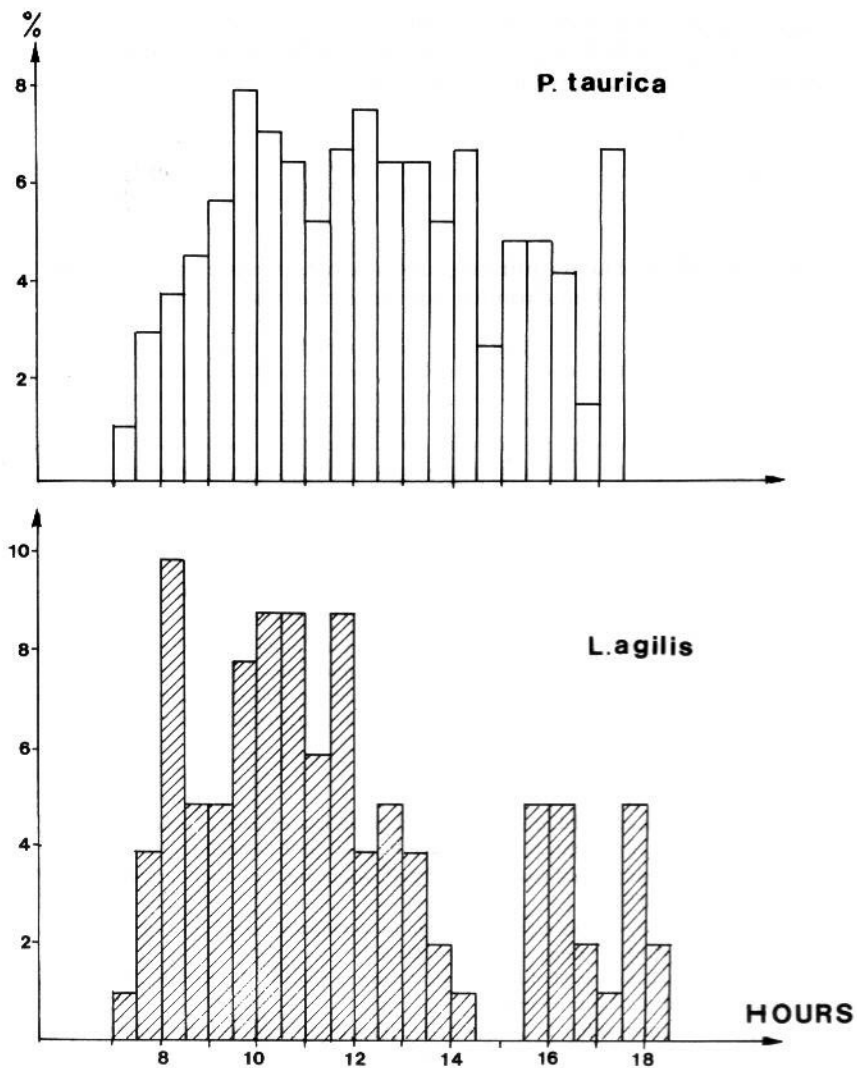


Fig. 8. Summer daily activity rhythms of the two species in Bugac.  
Sommerlicher Tagesrhythmus der zwei Arten in Bugac.

ity and vegetation niche dimensions. This is not the case with the sympatric *L. viridis* at Bugac, which segregates from the sand lizard mainly on the basis of their different prey types (see for details GYOVAI, 1984).

#### Acknowledgements

We would like to express our sincere thanks to Dr. D. GLANDT for the opportunity to participate in the Metelen symposium. We are indebted to Dr. L. FORRÓ for the German summary.

### Unterschiedliche Habitatnutzung und Aktivitätsmuster allopatrischer Populationen von *Lacerta agilis*

In zwei verschiedenen Untersuchungsgebieten in Ungarn (Babat und Bugac) wurden an der Zauneidechse (*Lacerta agilis*) mittels der Fang-Wiederfang-Methode ökologische Untersuchungen durchgeführt. Habitatwahl und tägliche Aktivitätsperioden beider Populationen wurden verglichen. Die Ergebnisse ermöglichen die Schlußfolgerung, daß die Zauneidechsen in den sonst recht verschiedenen Untersuchungsgebieten als Habitat ähnliche Bereiche auswählen. Dies wurde durch die Lufttemperatur- und Vegetationsbedeckungsdaten bestätigt, die eine ähnliche relative Häufigkeitsverteilung der beiden Populationen in diesen zwei Nischendimensionen ergaben. In Babat allerdings, vielleicht um die Konkurrenz mit der hier sympatrischen Smaragdeidechse (*L. viridis*) zu verringern, zeigt die Zauneidechse Unterschiede in der Wahl der Vegetationsdichte und im Tagesrhythmus. In Bugac läßt sie sich von der hier häufigeren Taurischen Eidechse (*Podarcis taurica*) in der Bevorzugung unterschiedlicher relativer Luftfeuchten und Vegetationsbedeckungen unterscheiden.

Auf einen interessanten Habitatunterschied zwischen Bugac und Babat weisen die Tagesaktivitätsmuster hin. In Bugac sind die Zauneidechsen im Sommer bimodal, wahrscheinlich aufgrund lokaler, homogener Klimafaktoren (Wärme und Trockenheit). Dagegen zeigen sie im viel heterogeneren Habitat von Babat im Sommer ein unimodales Aktivitätsmuster.

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