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## Spatial distribution-patterns on the Northern Dobrogean mainland (Romania) of the species belonging to "green lizards" group of the *Lacerta* genus

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**A**BSTRACT. Based on the results of field investigations carried out in 1994 – 2008 period, the author established the general distributional patterns in the northern part of the Dobrogean mainland of three lizard species. The Sand Lizards (*Lacerta agilis*) populates habitats with linear shape, the species being present along river valleys and some roads. The Balkan Green Lizards (*L. trilineata*) and the Green Lizards (*L. viridis*) were recorded mostly nearby or inside the forests (or plantations). In case of *L. trilineata* and *L. viridis* there is quite obvious the spatial segregation: in areas where the two species were present, the Balkan Green Lizard (*L. trilineata*) occurs mostly at lower altitudes, meanwhile the Green Lizard (*L. viridis*) was more frequently present at higher altitudes.

**Key words:** lizards, *Lacerta agilis*, *L. viridis*, *L. trilineata*, distribution, spatial segregation, Dobrogea, Romania

### INTRODUCTION

In the XIXth century there is only one publication (a note signed by Franz Steindacher) which indicates the presence in the northern Dobrogean mainland of the Green Lizard (*Lacerta viridis*) and the Balkan Green Lizard (*L. trilineata*) (this later on being nominated by the respective author as the *quinquelineata* variety of the species *L. viridis*) [20]. At the beginning of the XXth century, Kirîtescu added to the regional faunistical list the Sand Lizard (*L. agilis*) (based on some specimens captured at Atmagea and nearby lake Sinoe) [8]. In the same work Kirîtescu confirmed the presence of *L. viridis* și *L. trilineata* (both species at Atmagea and at Tulcea) [8]. Practically all the other scientific works published in the first half of the XXth century are faunistical papers, mentioning various localities (from Northern Dobrogea) nearby which one or more of these three species were recorded [1; 13; 14].

In the second half of the XXth century, the most important contributions related to the group of "green lizards" belonging to *Lacerta* genus are those from the papers focused on the intra-specific taxonomy of these reptiles, as follows: occurrence in Dobrogea of the subspecies *Lacerta viridis viridis* și *Lacerta viridis meridionalis* [5], respectively two subspecies described for the first time - *Lacerta trilineata dobrogica* [4] and *Lacerta agilis euxinica* [7].

The monographical volume on reptiles, of the series "Fauna Republicii Populare România", included practically all of the previous faunistical data on the occurrence of lizards in northern Dobrogea [6]. Most of the herpetological works dealing with Dobrogea and published after the above mentioned monography were also faunistical ones, including those written in recent years [2; 3; 9; 10; 11; 12; 15; 16; 17; 18; 19; 21; 23].

### MATERIALS AND METHODS

The fieldworks were carried out in 1994 – 2008 period.

In open habitats with uniform structure (plain areas covered with steppic vegetation) observations were made on plots of 250 m<sup>2</sup>, distributed at each 100 m along the investigated transect of 1 km or more (up to 3 km) total length. The detailed description of the method was provided in a previous work [22].

In habitats with linear structure (e.g. forest edges, valley of rivulets etc.) there were recorded the specimens occurring along the transects parallel to the longitudinal axe of the respective habitat.

During the field investigations there were recorded the presence or absence of the lizards of *Lacerta* genus, the number or specimens, type of habitat, vegetation cover (%), notable plant species occurring in the study plots or along the transects, occurrence of potential predators for lizards etc.

## RESULTS AND DISCUSSIONS

### Habitat selection in *Lacerta* species from the North-Dobrogean mainland

The Sand Lizard (*Lacerta agilis*) was recorded in the valley of Taița river (sector nearby Nalbant locality, south-eastward of the settlement), Telița river (sector between Cataloi village and Mihail Kogălniceanu locality – Tulcea county), Hagilarul rivulet (sector located westward of Lăstuni village and a sector located southward of Mihail Kogălniceanu locality - Tulcea county) (Fig. 2), Săruri rivulet (nearby Mihai Viteazu locality – Constanța county), respectively along the valley of a temporary watercourse which is tributary of the Istria rivulet (nearby and eastward of Fântânele locality – Constanța county). Also, we have identified Sand Lizards (*Lacerta agilis*) at the limit eastern of the Dobrogean mainland, nearby Sinoe village (Constanța county) and nearby Baia locality (Tulcea county). An isolated population of *Lacerta agilis* was recorded at the northern limit of the Dobrogean mainland, on the shore of the Danube river, between Tulcea and Nufăru localities [24].

The areas populated by Sand Lizards (*L. agilis*) have linear shape, this characteristic being very obvious in case of the areas located nearby Mihail Kogălniceanu locality (Tulcea county) (Fig. 2).

The Green Lizard (*Lacerta viridis*) was recorded mostly along the edge of forests (in Măcin Mountains and Culmea Pricopan Ridge, northern slope of Beștepe Hills, Căprioara stop – nearby Horia locality, Babadag forest, Somova forest, Gura Dobrogei and Cheia protected areas etc.) and in forestry plantations (at Mihai Viteazu, southern slope of Beștepe Hills) and in bushy areas (General Praporgescu village – Cerna locality, Culmea Pricopan Ridge, Cape Doloșman, Văcărie hill nearby Camena village – Fig. 13; Bacșișului valley nearby Ciucurova locality – Fig. 12 – , etc.), inclusively in various quarries scattered with bushes (Zebil quarry, southern slopes of Denistepe Hill etc.).

The Balkan Green Lizard (*Lacerta trilineata*) we have recorded at the edge of forested area (including plantations) from Beștepe Hills, Culmea Pricopan Ridge, forestry plantations from Dunavăț area, Tulcea and valleys nearby forested areas (e.g. at the base of Priopcea Hill – Fig. 14). In those cases where there were no compact forests, Balkan Green Lizards were present in rocky areas (e.g. Piatra Roșie hill nearby Cerna – Fig. 15 – , the gorge with the railway in Tulcea city, Sitorman quarry), along the valley of some rivulets (e.g. Megina valley, northward of Cerna locality) or in bushy areas along various dry valleys (e.g. at Cape Doloșman and southward of Tulcea city).

Also, we have recorded some Balkan Green Lizards (*Lacerta trilineata*) at quite big distance from natural forests and plantations, but in areas with widely scattered bushes, as it is the case of the populations present at Horan hill (between Mihai Viteazu and Fântânele localities, Constanța county).

A peculiar case is represented by the populations from Murighiol-Dunavăț area, where Balkan Green Lizards (*Lacerta trilineata*) were recorded only at the edge or inside of the small forestry plantations (mostly *Fraxinus* sp, *Populus* sp. *Robinia pseudacacia*), separated by each other by agricultural fields (Fig. 9).

### Altitudinal segregation in *Lacerta* species from the North-Dobrogean mainland

At Culmea Pricopan Ridge and at Beștepe Hills we have observed the spatial segregation of *Lacerta viridis* and *Lacerta trilineata*. In areas where both species are present, the Balkan Green Lizard (*L. trilineata*) occurs mostly at lower altitudes, meanwhile the Green Lizard (*L. viridis*) was more frequently present at higher altitudes (although *L. viridis* is also present at the base of the respective hills).

In case of Culmea Pricopan Ridge and its neighbouring areas, the spatial segregation of the above mentioned two species could be more easily detected both in horizontal and in vertical plan. In lower areas (e.g. Vițelariu hill and the hill of a former caoline quarry - Fig. 16, 17 and 18 – and along some channels from agricultural fields) there were recorded only *L. trilineata*. This species was also observed at the base of Cheia Hill (the northern limit of Culmea Pricopan Ridge), being sporadically present also at higher

altitudes, generally till the half of the respective slopes. Most of the specimens observed at higher altitudes in Culmea Pricopan Ridge were juveniles (Fig. 19).

The results of the comparative analysis of the *L. trilineata* and *L. viridis* distribution shows that if in a site there was present only one of the two species, there could be observed the following situation:

- if there was present only the Balkan Green Lizard (*L. trilineata*), this species occurred constantly not only at the base of the hill, but also on its top;
- if there was present only the Green Lizard (*L. viridis*), the specimens belonging to this species generally had generally the same density on each level of the hill or other geomorphological element (Fig. 1).

In the same areas there is present the Balkan Wall Lizard (*Podarcis taurica*), a small sized species – if compared with the *Lacerta* sp.). There seemed to be no differences in the populations density of *P. taurica* in areas where there was only *L. viridis* or only *L. trilineata* or in areas where there were both of the two *Lacerta*-species (Fig. 17).

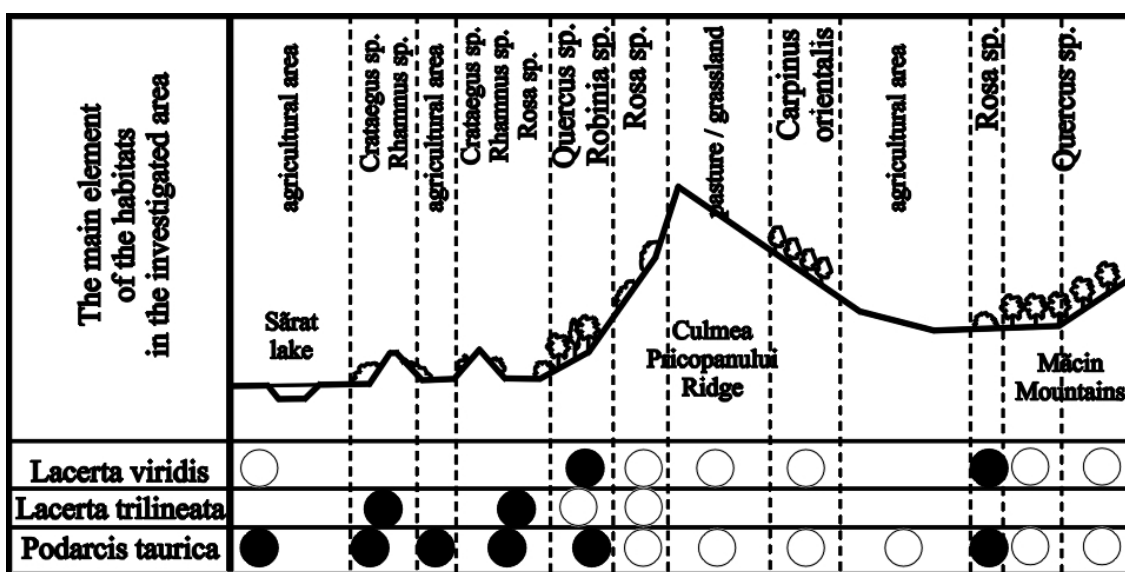


Fig. 1. Spatial ecological niches of the lizard species from Culmea Pricopan Ridge.

Note. black circle – high population-density; white circles – low population-density.

Based on the results of the field-investigations we could establish a preliminary map with the local distribution of *L. viridis* and *L. trilineata* in the northern part of Măcin Mountains s.l. (Fig. 3). The map from Fig. 3. shows that the Balkan Green Lizard (*L. trilineata*) populates the lower areas of the western slope of Culmea Pricopan Ridge and some areas from its close neighbourhood (westward of the respective slope), meanwhile the Green Lizard (*L. viridis*) populates the higher altitudes of the western slope of Culmea Pricopan Ridge, respectively the whole eastern slope of the ridge and, also the neighbouring areas (namely the main chain of Măcin Mountains, called Culmea Moroianu Ridge) located eastward of Culmea Pricopan Ridge (Fig. 1).

After establishing the limits of the areas inhabited by local populations of *L. trilineata* and *L. viridis*, we noted the existence of spatial segregation of the two species in other regions, too. For example, nearby Cerna locality we recorded the Balkan Green Lizard (*L. trilineata*) only at the base of the small hills where there were also present the Green Lizard (*L. viridis*) in habitats located at higher altitudes (Fig. 4). The same phenomenon exists at Priopcea Hill (B in Fig. 4) and în Megina Valley (C in Fig. 4) where Balkan Green Lizards (*L. trilineata*) occur in lower areas (Fig. 14), meanwhile Green Lizards (*L. viridis*) populates the places with higher altitudes. At Piatra Roşie Hill (A in Fig. 4) we have found only Balkan Green Lizards (*L. trilineata*) both at the base and nearby the top of the respective hill (Fig. 15). At Arheuziu Hill (D in Fig. 4) we have found only Green Lizards (*L. viridis*). In the absence of *L. trilineata* the Green Lizard (*L. viridis*) was present also at the base of the hill, not only at higher altitudes (Fig. 4).

Similar results were obtained in case of the areas located nearby Iaila (General Praporgescu) village and Horia locality (Fig. 5). The Balkan Green Lizard (*L. trilineata*) was recorded only along one valley, westward of Iaila village (area indicated by the red line in Fig. 5). The Green Lizard (*L. viridis*) populates larger areas (indicated by the polygons with blue limits in Fig. 5) in the upper sections of the valley located south-westward of Iaila village, respectively on the hill (the so-called Căprioara stop) between Iaila and Horia localities, both at the base and nearby the top of the hill.

In case of Tulcea area (Fig. 6) we have observed the same phenomenon as in the above mentioned examples. The Green Lizard (*L. viridis*) populates larger areas than the Balkan Green Lizard (*L. trilineata*). Actually the Green Lizard (*L. viridis*) is present at all altitudes on the hills around Tulcea city, excepting the following sites where there were Balkan Green Lizards (*L. trilineata*), too: in the gorge with the railway (in the north-western part of Tulcea city), in valleys located southward and south-eastward of Tulcea, respectively at the base of Bididia Hill (located eastward of Tulcea city).

At Tulcea there was also observed the meso-spatial segregation in the *Lacerta* species. For example, in the gorge with the railway occur both species: the Balkan Green Lizards (*L. trilineata*) were at the base of the loess-walls, meanwhile the Green Lizards (*L. viridis*) were present at the top of the respective (at about 10 – 15 m high) walls. In the dry valley located southward of Tulcea city, the Balkan Green Lizards (*L. trilineata*) were recorded in the respective valley, meanwhile the Green Lizards (*L. viridis*) were observed only on the slopes of the hills from the close vicinity of the respective valley (Fig. 20). In the upper section of the valley, the local areas of distribution of the two species were overlapping, but the Balkan Green Lizards (*L. trilineata*) were present only inside the valley, and the Green Lizards (*L. viridis*) were present only outside of the valley, till its edge (Fig. 21). Generally, the distance between the surfaces populated by these species was bigger in the lower section of the valley than in the upper section of the same valley.

At Beștepe Hills the Green Lizards were also present in habitats located at different altitudes (Fig. 7). The Green Lizards (*L. viridis*) were present on both (northern and southern) slopes of the Beștepe Hills: from the base to the top on the northern slopes (on this side of the hills there were no Balkan Green Lizards – *L. trilineata*) and only in the upper half of the southern slopes of the respective hills (on this side of the hills, at their base, there were present Balkan Green Lizards – *L. trilineata* – Fig. 22). Actually, the Balkan Green Lizards (*L. trilineata*) were recorded in the lower half of the first two hills from the eastern part of Beștepe Hills, where there are some forestry plantations dominated by *Fraxinus* sp. (mixed in some plots with *Robinia pseudacacia*, *Rhus* sp. etc.), but these lizards also occurred in areas between the forestry plantations where there were various bushes (*Crataegus* sp., *Rosa* sp.).

South-eastward of Beștepe Hills there were no Green Lizards (*L. viridis*) recorded, but the Balkan Green Lizard (*L. trilineata*) was present nearby Murighiol locality, in a small forestry plantation (and its close vicinity) located on the top of a hill placed between Sărăturile-Murighiol lake and Popu-Beibugeac lake (Fig. 23).

The area located between Murighiol, Dunavățu de Jos and Popu localities represents the north-eastern border of the Dobrogean mainland (Fig. 8). In this area the Balkan Green Lizards (*L. trilineata*) were recorded in only three small sites, exclusively in or along the limit of some forestry plantations with *Fraxinus* sp., *Populus* sp., *Robinia* sp. etc. The sites populated by Balkan Green Lizards (*L. trilineata*) are separated by agricultural areas (Fig. 9).

At Enisala village (Tulcea county), the Balkan Green Lizards (*L. trilineata*) was recorded in only one site: south-westward of Heraclea Hill, in the lower section of a dry valley at the base of the respective hill. The Green Lizards (*L. viridis*) populates the pastures and forests from the slopes of the hills (practically it is the eastern limit of Babadag Plateau) located southward of Heraclea Hill.

Up to now, the only one area where all the three *Lacerta* species were recorded in sites located quite close (at only few km distance) to each other is placed between Mihai Viteazu and Fântânele localities (Constanța county) (Fig. 10). The Sand Lizards (*L. agilis*) were present on the slope of the upper section of Săruri rivulet, respectively in the valley of a tributary of Istria rivulet. The Balkan Green Lizards (*L. trilineata*) were in the same habitat with the Sand Lizards (*L. agilis*) from the slope of the upper section of Săruri rivulet. The Green Lizards (*L. viridis*) were recorded only in the forestry plantation (dominated by *Fraxinus* sp., mixed in some plots with *Pinus* sp. and other tree species), placed on the top of the hill which represents the sites with the highest altitude from the respective region. In this forestry plantation there were no Sand Lizards (*L. agilis*) or Balkan Green Lizards (*L. trilineata*).

In case of the Green Lizard (*L. viridis*) and the Sand Lizard (*L. agilis*), the spatial segregation could also be observed in sites located nearby Mihail Kogălniceanu locality (Tulcea county) (Fig. 11). In thi area, the Sand Lizards (*L. agilis*) was recorded only in the valleys of the rivers (Telița, Taița and Hagilar), respectively in the vegetation-stripes parallel to the Tulcea – Constanța national road. In the same area, the Green Lizards (*L. viridis*) populate the sites with higher altitude as Denistepe Hill (blue polygon nearby the left, lower corner of the image from Fig. 11), Zebil quarry (blue polygon at the lower limit of the image from Fig. 11) and the forest from the top of the hill between Mihail Kogălniceanu and Agighiol localities (blue polygon in the right, upper corner of the image from Fig. 11), respectively in in some sites along the Tulcea – Medgidia railway. In the areas populated by Green Lizards (*L. viridis*) there were not present Sand Lizards (*L. agilis*). In the linear areas populated by Sand Lizards (*L. agilis*) there were not present Green Lizards (*L. viridis*). Along the national road we have recorded Green Lizards (*L. viridis*), but only in areas that were outside of the range of the Sand Lizard (*L. agilis*): northward of Mihail Kogălniceanu, between the intersection from Cataloi village of the two national roads (Tulcea-Constanța and Tulcea-Hârșova) and Tulcea (this area practically belong to the Tulcea hills), respectively southward of Mihail Kogălniceanu (from about Zebil quarry to Babadag city).

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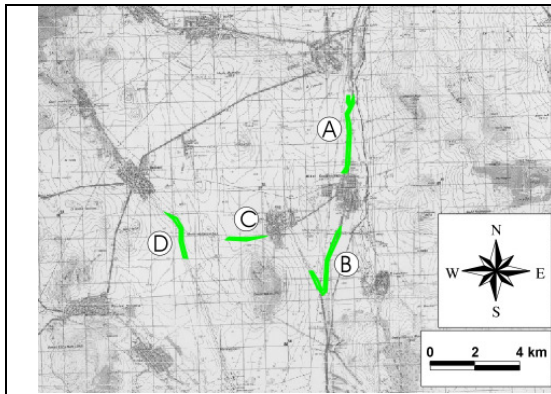
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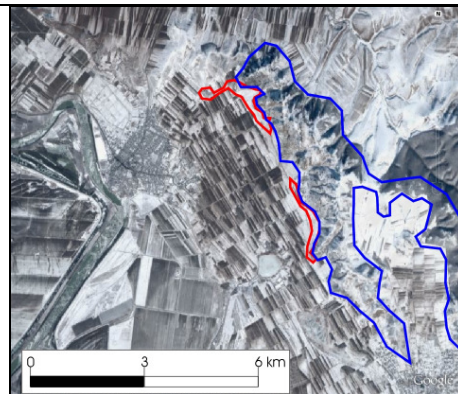
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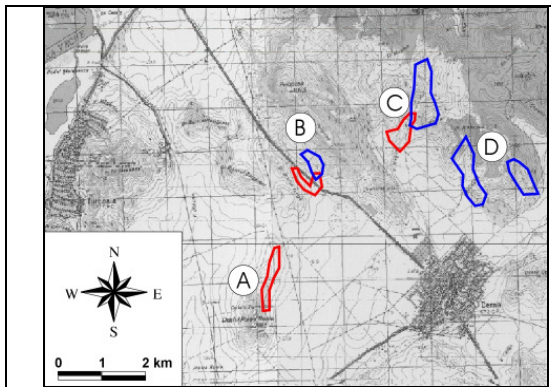
**Fig. 2.** Distribution of *Lacerta agilis* in Nalbant basin (Tulcea county)

**Note.** A – subpopulation in Telița river valley; B – subpopulation from the confluence of Telița river and Hagilarul rivulet; C – subpopulation nearby Lăstuni village; D – subpopulation in the valley of Taița river.



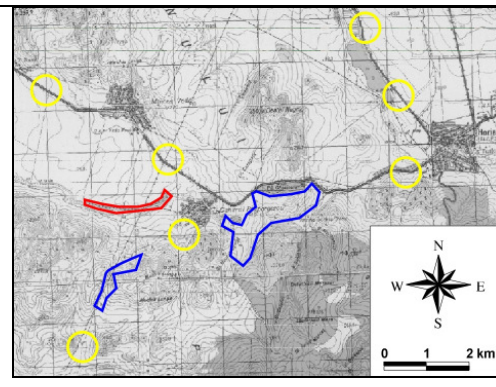
**Fig. 3.** Spatial segregation of *Lacerta* species in the northern part of Măcin Mountains

(source of background image: GoogleEarth)  
**Note.** red line – limit of the area populated by *Lacerta trilineata*; blue line – limit of the area populated by *Lacerta viridis*.

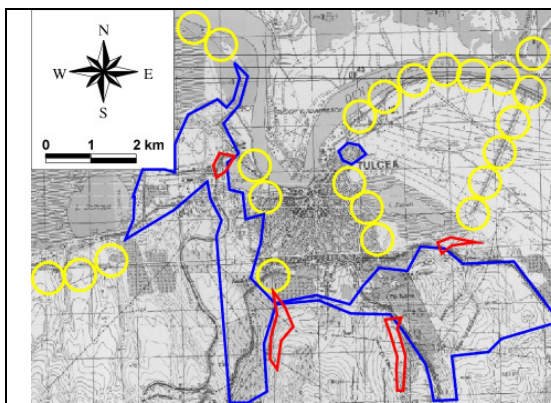


**Fig. 4.** Distribution of *Lacerta* species nearby Cerna locality

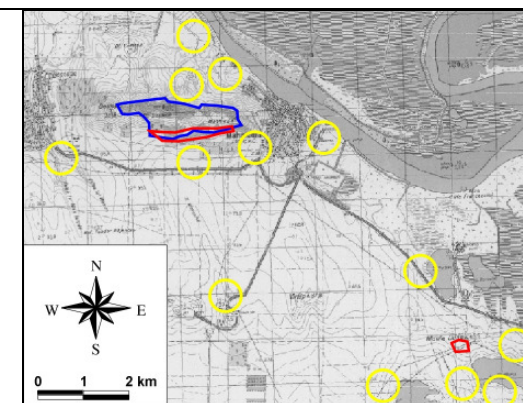
**Note.** A – Piatra Roșie Hill; B – Priopcea Hill; C – Megina Valley; D – Arheziu Hill; red line – limit of the perimeter where *Lacerta trilineata* specimens were recorded; blue line – limit of the areas where *Lacerta viridis* specimens were recorded; yellow circles – other investigated sites where there were not recorded specimens belonging to *Lacerta* genus.



**Fig. 5.** Distribution of *Lacerta* species nearby Iaila (General Praporgescu) village and Horia locality

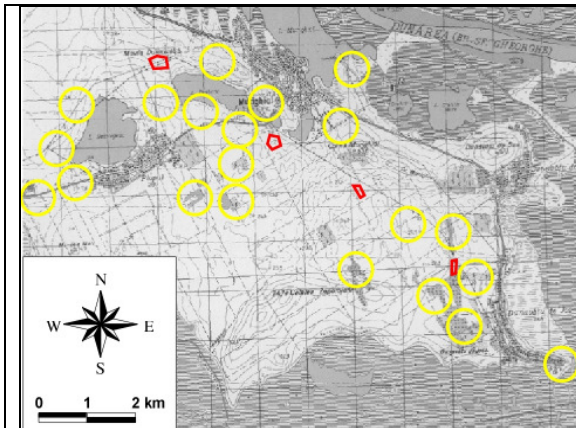


**Fig. 6.** Distribution of *Lacerta* species at Tulcea city



**Fig. 7.** Distribution of *Lacerta* species at Beștepe Hills

**Note.** red line – limit of the perimeter where *Lacerta trilineata* specimens were recorded; blue line – limit of the areas where *Lacerta viridis* specimens were recorded; yellow circles – other investigated sites where there were not recorded specimens belonging to *Lacerta* genus.

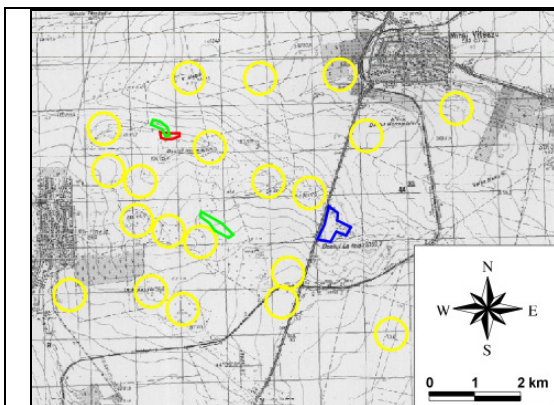


**Fig. 8.** Distribution of *Lacerta trilineata* in Murighiol-Dunavăț area.

**Note.** red line – limit of the perimeter where *Lacerta trilineata* specimens were recorded; yellow circles – other investigates sites where there were not recorded specimens belonging to *Lacerta* genus.

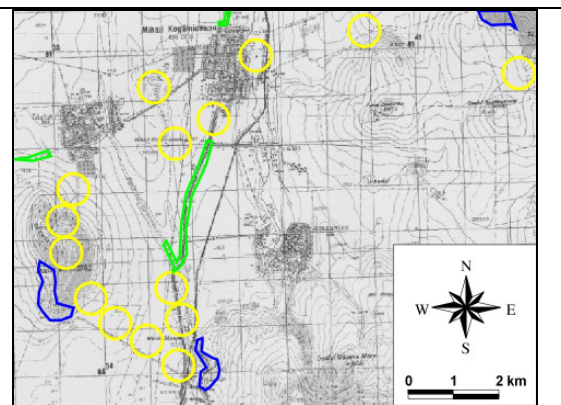


**Fig. 9.** Plantation in Dunavăț area populated by *Lacerta trilineata* (June 19<sup>th</sup>, 2008)

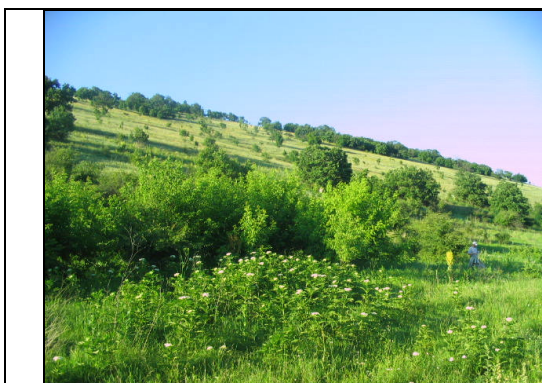


**Fig. 10.** Distribution of *Lacerta* species in Fântânele – Mihai viteazu area (Constanța county)

**Note.** red line – limit of the perimeter where *Lacerta trilineata* specimens were recorded; blue line – limit of the areas where *Lacerta viridis* specimens were recorded; green line - limit of the areas where *Lacerta agilis* specimens were recorded; yellow circles – other investigates sites where there were not recorded specimens belonging to *Lacerta* genus.



**Fig. 11.** Distribution of *Lacerta* species in Mihail Kogălniceanu – Denistep Hill area



**Fig. 12.** Habitat populated by *Lacerta viridis* at Bacșifului Valley (nearby Ciucurova, Tulcea county; June 22<sup>nd</sup>, 2005)



**Fig. 13.** Habitat populated by *Lacerta viridis* at Văcărie Hill (Camena village, Tulcea county; June 22<sup>nd</sup>, 2005)

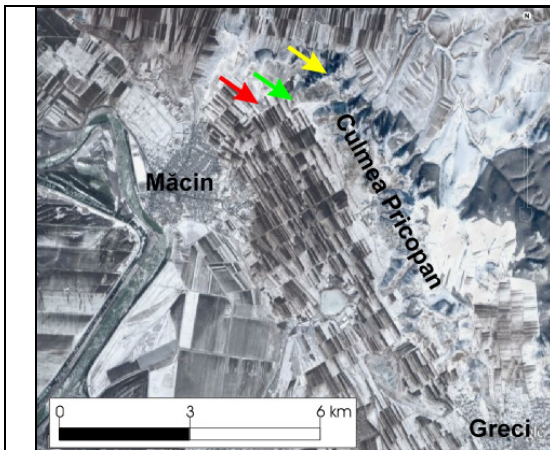




**Fig. 14.** Habitat of *Lacerta trilineata* at the base of Priopcea Hill (June 23<sup>rd</sup>, 2006)

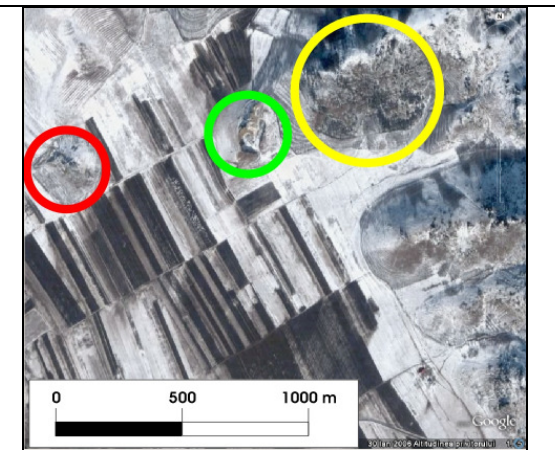


**Fig. 15.** Habitat of *Lacerta trilineata* at Piatra Roșie Hill (June 23<sup>rd</sup>, 2006)



**Fig. 16.** Spatial segregation of *Lacerta* species in the northern part of Culmea Pricopan Ridge (source of background image: GoogleEarth)

**Note.** red arrow – Vițelariu hill; yellow arrow – hill with the former caoline quarry; blue arrow – Cheia Hill.



**Fig. 17.** The northern limit of Culmea Pricopan Ridge.

(source of background image: GoogleEarth)  
**Note.** red circle – Vițelariu hill; yellow circle – hill with the former caoline quarry; blue circle – Cheia Hill.



**Fig. 18.** Small hills located westward of Cheia Hill (northern limit of Culmea Pricopan Ridge)

**Note.** In the back (at right) – Vițelariu hill; the hill with the white patch is the one with the former caoline quarry; in the front is the plantation from the western slope of Cheia hill, where *L. trilineata* occurs in the lower part of the hill and *L. viridis* is present at higher altitudes.

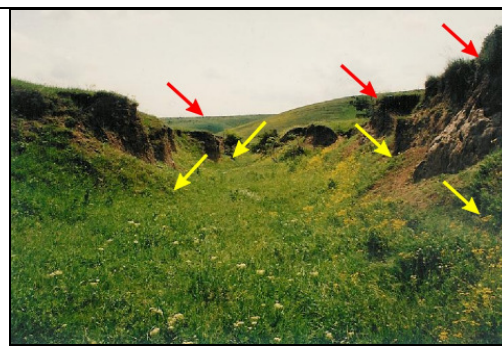


**Fig. 19.** Juvenile of *Lacerta trilineata* present at about the half distance between the base and the top of Cheia Hill (May 17<sup>th</sup>, 2005)



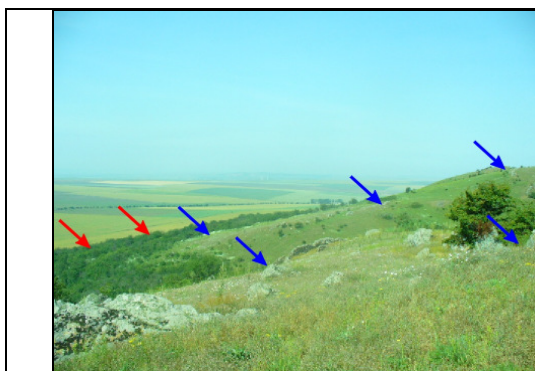
**Fig. 20.** Spatial segregation in *Lacerta* species in the lower section of the valley located southward of Tulcea city

**Note.** yellow arrows indicate the places where Balkan Green Lizards (*Lacerta trilineata*) were recorded; red arrows indicate the places where Green Lizards (*Lacerta viridis*) were recorded.



**Fig. 21.** Spatial segregation in *Lacerta* species in the upper section of the valley located southward of Tulcea city

**Notă:** yellow arrows indicate the places where Balkan Green Lizards (*Lacerta trilineata*) were recorded; red arrows indicate the places where Green Lizards (*Lacerta viridis*) were recorded.



**Fig. 22.** Spatial segregation in *Lacerta* species on the southern slope of Beștepe Hills (June 7<sup>th</sup>, 2008).

**Note.** red arrows indicate the places where Balkan Green Lizards (*Lacerta trilineata*) were recorded; blue arrows indicate the places where Green Lizards (*Lacerta viridis*) were recorded.



**Fig. 23.** The site with *Lacerta trilineata* nearby Sărăturile-Murighiol lake (June 19<sup>th</sup>, 2004)

**Note.** red arrow indicates the place where Balkan Green Lizards (*Lacerta trilineata*) were recorded.