

Comparison of the eggs size between two subspecies of the Kotschy's Gecko *Mediodactylus kotschyi* (Steindachner, 1870) (Reptilia: Gekkonidae) in Bulgaria

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Abstract. The current study compares the egg size (length, width, egg volume and clutch size) between two subspecies of the Kotschy's Gecko – *Mediodactylus kotschyi rumelicus* and *Mediodactylus kotschyi daniliewskii* from Bulgaria. Our results showed that *M. k. rumelicus* from Plovdiv has bigger eggs, compared to *M. k. daniliewskii* from Sozopol, The South Black Sea Coast and Ukraine, regarding length, width and egg volume. The clutch size between the two subspecies both from Bulgaria and Ukraine is very similar and contains average of 2 eggs.

Key words: *Mediodactylus kotschyi*, eggs size, reproduction, Bulgaria, Ukraine.

Introduction. The Kotschy's Gecko - *Mediodactylus kotschyi* (Steindachner, 1870) is the only representative from the Gekkonidae family, occurring in Bulgaria, which is considered to be a synanthrope (Beshkov & Nanev 2002). Because of the fact that it is mainly nocturnally active animal and inhabits predominantly human settlements some aspects of its biology and ecology are still poorly studied. One such aspect is reproduction. The Kotschy's Gecko is the only lizard occurring in Bulgaria, which lays eggs with calcareous shell (Undjian, 2000). So far data about the eggs size is quite scarce in the herpetological literature. Partial data about the eggs size, incubation period, growth rates etc. can be found in the works of Shterbak (1960, 1961, 1965), Shterbak & Golubev (1986), Valakos & Vlachopoulos (1989), Undjian (2000), Beshkov & Nanev (2002) and others. Currently there is only one study giving data about the eggs size of *Mediodactylus kotschyi daniliewskii*, conducted in Bulgaria (Undjian 2000).

The aim of the current study is to supplement the knowledge about the eggs sizes and breeding ecology of the Kotschy's Gecko (*Mediodactylus kotschyi*) in Bulgaria.

Material and Methods. We examined 9 gecko eggs from four clutches – two from Danov halm Hill and two from Mladezhki halm Hill in Plovdiv, Bulgaria. The material was collected in 25.VIII.2008 from Mladezhki halm Hill and 23.IV.2008 and 05.VIII.2008 from Danov halm Hill. Both hills are located in the center of the city and are declared as "nature monuments" by the Bulgarian legislation (Mollov 2005).

Egg data (length and width) were measured by means of digital caliper with 0,01 mm accuracy. Egg volume was calculated as an ellipsoid: $V = 4/3\pi a^2b$, with a and b being half of the width and length of the egg, respectively (Arribas & Galán 2005). Total clutch volume is the sum of all egg volumes. Data from the available literary sources was statistically processed and used to compare with the results from the current study.

Literary data about the Kotschy's gecko egg sizes of *M. k. daniliewskii* from Bulgaria are given by Unjian (2000) based on 11 eggs from the South Black Sea Coast. We were able to take more precise measurements of another 15 *M. k. daniliewskii*'s eggs from a photograph with a size marker, from the same author (Undjian 2000, fig. 40) from Sozopol (Bulgaria). For the analysis we also used data given by Shterbak (1961, 1965) for the same subspecies from Sevastopol (Ukraine) and by Shterbak & Golubev (1986) from Hersones, Sevastopol (Ukraine) and for *M. kotschyi* (unknown subspecies) from Naxos Island, Greece (Valakos & Vlahopanos 1986).

Statistical calculations were performed with the software package "Statistica 7.0" (StatSoft Inc. 2004). The results were statistically processed using descriptive statistics and all values are presented as means \pm standard error of means (S.E.) for each egg characteristic (length, width and volume). A cluster analysis (Bray-Curtis index, Group average link) using the minimum and maximum value of the egg volume was used based on literary data to group the available data from different localities and find similarities between the egg sizes of the subspecies. The cluster analysis was calculated using "Biodiversity Professional" software package (McAleece et al. 1997)

Results and Discussion. Egg characteristics are presented in Table 1. Apparently *M. k. rumelicus* lays eggs that are longer and wider than *M. k. daniliewskii* from Bulgaria and Ukraine. In terms of egg volume, *rumelicus* also exhibits the biggest eggs (Table 1). The two subspecies have a relatively similar egg sizes, but the differences in the egg volume are more clearly visible. The mean clutch size for *M. k. rumelicus*, recorded in this study is 2,3 eggs, for *M. k. daniliewskii* from Sevastopol (Ukraine) – 2 eggs (Shterbak 1961), 1,67 eggs (Shterbak 1965) and for the same subspecies from Hersones, Sevastopol (Ukraine) – 1-2 eggs (Shterbak & Golubev 1986). Valakos & Vlahopanos (1986) give a mean clutch size of 2,25 eggs for *M. kotschyi* from Naxos Island (Greece).

Table 1. Egg and clutch characteristics of the two subspecies of *M. kotschyi* from the current study and comparison with literary data.

Egg characteristics	<i>M. k. rumelicus</i> Plovdiv, Bulgaria (current study)	<i>M. k. daniliewskii</i> Sozopol, Bulgaria (Undjian, 2000)	<i>M. k. daniliewskii</i> South Black Sea Coast, Bulgaria (Undjian, 2000)	<i>M. k. daniliewskii</i> Sevastopol, Ukraine (Shterbak 1961, 1965)	<i>M. k. daniliewskii</i> Hersones, Sevastopol, Ukraine (Shterbak & Golubev 1986)	<i>M. kotschyi</i> Naxos Island, Greece Valakos & Vlahopanos (1986)
Egg length (mm)						
Mean \pm SE	9,87 \pm 0,25	7,55 \pm 0,09	9,55	8,75 \pm 0,24	8,60	7,05
SD	0,74	0,37	—	0,80	—	—
Range (min-max)	9,30-11,50	7,00-8,10	9,30-9,80	7,50-9,70	7,50-9,70	7,00-7,10
Egg width (mm)						
Mean \pm SE	8,35 \pm 0,11	6,11 \pm 0,09	7,55	7,60 \pm 0,17	6,95	4,49
SD	0,34	0,34	—	0,57	—	—
Range (min-max)	7,90-8,80	5,20-6,90	7,30-7,80	6,60-8,20	5,80-8,10	4,48-4,50
Egg volume (mm³)						
Mean \pm SE	361,80 \pm 15,02	147,53 \pm 3,60	361,41	268,20 \pm 16,85	284,94	116,85
SD	45,08	13,93	—	55,88	—	—
Range (min-max)	307,17-424,87	113,26-174,50	330,58-392,23	171,06-334,46	170,82-399,05	115,45-118,25
Total clutch volume (mm³)						
Mean \pm SE	814,05 \pm 100,05	—	—	491,71 \pm 49,41	—	—
SD	200,12	—	—	121,02	—	—
Range (min-max)	646,11-1099,68	—	—	334,46-604,85	—	—
Number of eggs studied	9	15	11	11	—	—
Number of clutches	4	—	—	6	—	—
Mean clutch size	2,25	—	—	1,67-2,00	1,00-2,00	2,25

The cluster analysis of the egg volume size showed that *M. k. rumelicus* from Plovdiv shows closer values to the volume size of *M. k. daniliewskii* from the Black Sea Coast (Bulgaria) at about 80% similarity. The egg volume size of *M. k. daniliewskii* from Sevastopol

(Ukraine) clusters with the one of *M. k. daniliewskii* from Herones, Sevastopol (Ukraine) at about 90% similarity. *M. k. daniliewskii* from Sozopol (Bulgaria) shows closest similarity (about 80%) to *M. kotschy* from Greece (Fig. 1).

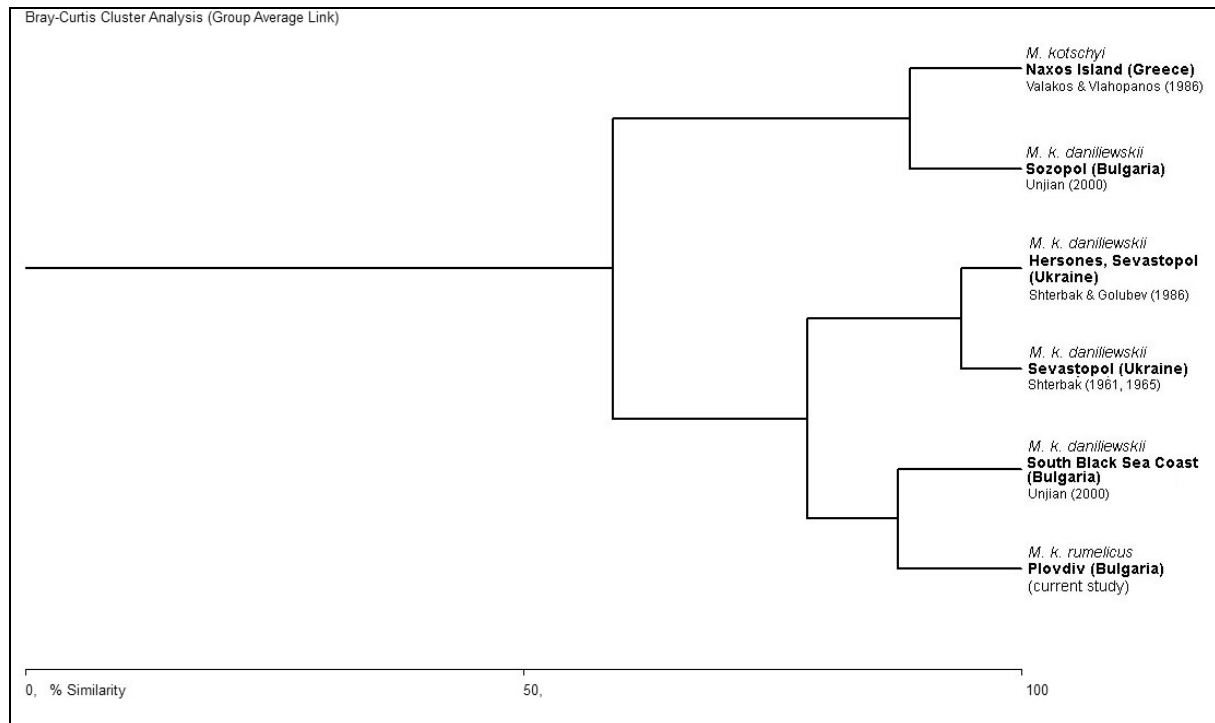


Fig. 1. Cluster analysis of the egg volume sizes of three subspecies of *M. kotschy* from the current study and comparison with literary data.

The Kotschy's Gecko is a small lizard species, which carries and lays only one or two (rarely three) eggs with hard calcareous shell during the reproduction period similar to other primitive geckos (Kratochvíl & Lukáskubická 2007). Clutch size in the two studied subspecies is very similar, but they differ concerning the eggs size and volume. Since the current study is just a short note, based on a small number of studied eggs and available literary data, generalized conclusions about the egg size differences between the two subspecies cannot be made. However, based on the data given by Muller (1939), who reports that *M. k. rumelicus* is slightly bigger than *M. k. daniliewskii* ($SVL_{rumelicus} = 48-52$ mm, $SVL_{daniliewskii} = 45-49$ mm) it is far to assume that the bigger egg size in that subspecies is due to the bigger size of the females. We also suppose that in some extent the larger size of the eggs in *M. k. rumelicus* can be partially explained with the urban heat island effect (Camilloni & Barros 1997). Perhaps the higher environmental temperatures in the centre of the big city (Plovdiv), where the studied sites are situated, influence the size of the hatched eggs.

In our opinion further studies on the egg sizes and reproduction of the Kotschy's gecko are needed. Interesting results could be obtained from comparison of the sizes between the three subspecies of *M. kotschy* that occur in Bulgaria, based on larger samples of eggs. As well as comparison of the egg sizes and the shell structure of populations from different climatic regions in Bulgaria in order to determine any differences based on the climatic conditions or the taxonomical affiliation.

Conclusions.

1. *M. k. rumelicus* from Plovdiv has bigger eggs, compared to *M. k. daniliewskii* from Bulgaria and Ukraine, regarding length, width and egg volume.
2. The clutch size between the two species both from Bulgaria and Ukraine is very similar and contains average of 2 eggs.

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