

An apparent case of bilateral gynandromorphy in the femoral pores of the Caucasian rock lizard *Darevskia raddei*

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In Squamates, skin glands (on the ventral thigh) produce secretions involved in intraspecific chemical communication, these secretions may have different functions, such as revealing individual identity and reproductive condition, but can also be related to territoriality, male dominance status and sexual selection (Mason, 1992; Houck, 2009). The same is true for the femoral pores which appear on internal side of the thighs of lacertid lizards in both sexes (Cooper and Pérez-Mellado 2002; López and Martín 2004; Martín, Moreira and López, 2007). Femoral pores of male and female lacertids usually differ not only in the number (Kaliontzopoulou, et al., 2006) but also in size, shape and colour (Blasco, 1975). Males tend to carry more pores, which are bigger and more open than those of females. In fact, the size and shape of femoral pores constitutes a practical tool for sexing of individuals within species and populations (Arnold and Ovenden, 2002).

While asymmetry in the number of femoral pores is frequent within lacertid populations (about 50% of individuals, Carretero, 2003), their distribution pattern

can be used as a measure of fluctuating asymmetry (Lima, Kaliontzopoulou and Carretero, 2007) to estimate the effects of inbreeding and/or environmental stress (Braña and Ji, 2000; Crnobrnja-Isailović, Aleksić and Bejaković, 2005). Less frequently, other abnormalities may occur, such as supernumerary rows (Kaliontzopoulou and Carretero 2006; Lazić and Crnobrnja-Isailović, 2011), or total absence of femoral pores (Barata, Harris and Perera, 2011). Here we report a case of a bilateral gynandromorphy (simultaneous presence of male and female characteristics) in the morphology of the sexual secondary characters, namely, the femoral pores, in a lacertid species.

Radde's Lizard, *Darevskia raddei*, (Boettger, 1892) belongs to a genus of predominantly Caucasian lizards in which parthenogenesis was first reported in terrestrial vertebrates (Darevsky, 1967). *Darevskia raddei* is widely distributed throughout Armenia, southern Georgia, the whole Nagorno-Karabach (Arakelyan et al., 2011), the state of Azerbaijan, the Iranian provinces adjacent of East and West Azerbaijan (Anderson, 1999) and North Western Turkey (Tuniyev et al., 2009). It is listed in the IUCN database as a species of Least Concern (LC) due to its wide distribution and large population size (Tuniyev et al., 2009). Although it occurs in pristine, well-conserved areas, it displays considerable tolerance to habitat disturbance. This species is bisexual with populations composed of both males and females (Darevsky, 1967). It has been involved in the processes of hybridisation responsible for the origins of some parthenogenetic lineages. These lineages are comprised solely of females, that are able to reproduce without male contribution and whose progeny is female only (Darevsky, 1967; Murphy et al., 2000).

During fieldwork in Armenia on 7 June 2011, an individual of *D. raddei* with apparent bilateral gynandromorphy in the femoral pores was captured in Jermuk, South-West of Armenia (39.83804N; 45.66061E). This locality is situated in the upper part of

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Figure 1. View of the individual's femoral pores, note the differences between right and left legs

river Arpa, 173 km from Yerevan (capital of Armenia) at an altitude of approximately 2000 meters above sea level. The individual reported here had 18 pores on the right leg and 19 pores on the left. Furthermore, left side and right side pores differed considerably in size, shape, and also in the quantity and colour of the secretion they produce (Figure 1). Left side pores were larger and covered much greater area of the scale than right side pores. Furthermore, left side pores produced a dark yellow secretion whereas right side pores produced a grey secretion. These differences correspond to the differences between femoral pores of males and females observed in this population (Figure 2) and in this species in general (Darevsky, 1967). The number of femoral pores in this individual was similar to other individuals from of the same population (females, right leg mean

= 17.43 ± 0.61 (14-19), left leg mean = 18.29 ± 0.61 (16-21), $n = 7$; males, right leg mean = 19.3 ± 0.56 (18-24), left leg mean = 19.1 ± 0.48 (17-22), $n = 10$). These values fall within the range (13-23) reported for this species by Darevsky (1967) who, unfortunately, did not report separate pore counts for sexes. In our sample, males had more right (but not left) femoral pores than females (Mann-Whitney U tests, right $Z_{10} = 2.24$ $p = 0.02$; left $Z_{10} = 0.92$ $p = 0.34$) while no bilateral differences were detected (Wilcoxon test $Z_{10} = 0.46$, $p = 0.64$). No other abnormalities were observed among approximately 300 individuals from 15 different localities examined during two years of fieldwork in Armenia and Southern Georgia.

Despite these sexually ambiguous traits, the individual displayed other usual sexual secondary characters

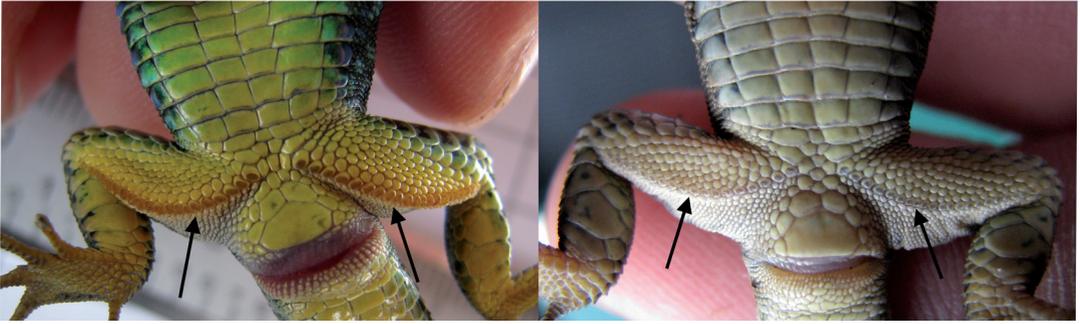


Figure 2. View of two individuals' femoral pores, male (left) and female (right).

(Figure 1) (i.e. blue ocelli, Arakelyan et al., 2011) and everted apparently normal hemipenises (clearly different for female “pockets”) when gentle pressing at the postcloacal area following the typical procedure for sexing lacertids. After examination, the individual was photographed, a tissue sample (tail tip) was taken and the lizard was released at the site of capture. No other sympatric *Darevskia* species were observed in that locality during four hours of sampling.

This case is particularly interesting given the peculiarities of this lizard genus in terms of reproduction and reticulate evolution. In addition to recurrent hybridisation between different bisexual species (Tarkhishvilli, 2012) and backcrossing of the parthenogenetic lineages with males of parental species (Danielyan, Arakelyan and Stepanyan, 2008), rare cases of intersexual individuals and male or female hybrids has been described in other *Darevskia* species. Darevsky, Kupriyanova and Bakradze (1978) found an intersex individual with hermaphroditic features (presence of hemipenises and testes together with well-developed oviducts and oocytes) among specimens collected from the south slope of Smenovsky Pass in Northern Armenia. These authors suggested “relictual sexuality” [sic] as the most likely explanation for these anomalies.

Without evidence on internal anatomy or genetic makers, we cannot be certain that hermaphroditism or hybridisation caused the morphological anomalies we observed. In fact, environmental stress resulting in early development (Chen et al., 2005) can also be responsible. Namely, incubation stress has been experimentally shown to cause asymmetry of quantitative traits such as femoral pores (Zhdanova and Zakharov, 2006).

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