

Tail bifurcation recorded in *Sauromalus ater*

Daniel Koleska^{1*}, Veronika Svobodová¹, Tomáš Husák¹, Martin Kulma¹ and Daniel Jablonski²

Sauromalus ater Duméril, 1856 is a desert member of the family Iguanidae distributed in the Sonoran and Mojave deserts in southwestern United States and northwestern Mexico, where it inhabits rocky flats and hillsides. It reaches a total length of approximately 50 cm, while the tail may reach half of this length. Herein, we report a case of tail bifurcation in an imported individual of *S. ater* held in captivity in Zoopark Zájezd, Zájezd, Czech Republic, recorded in this species for the first time.

On 24 October 2015 staff of Zoopark Zájezd received a shipment of two imported individuals of *S. ater*. One of the individuals (an adult female) had a bifurcated tail (Fig. 1A). According to the importer, the individual was already caught with this anomaly. The bifurcation was located 89 mm posterior to the cloaca. The supernumerary tails were of different length (Fig. 1B). The longer tail measured 18 mm while the shorter tail was 7 mm long. Snout-to-vent length (SVL) of the individual was 123 mm, vent-to-tail length (VTL) was 107 mm. Although the individual was in poor nutritional condition, it had no other visible malformations or injuries.

Tail bifurcation is considered to be a frequent malformation among lizards and is recorded in families Agamidae (Ananjeva and Danov, 1991), Anguinae (Conzendej et al., 2013), Gekkonidae (Kumbar et al., 2011), Gymnothalamidae (Pheasey et al., 2014), Iguanidae (Mata-Silva et al., 2013), Lacertidae (Dudek and Ekner-Grzyb, 2014; Tamar et al., 2013), Mabuyidae (Vrcibradic and Niemeyer, 2013), Scincidae (Mitchel et al., 2012), Teiidae (Pelegrin and Leão, 2016; Cordes

and Walker, 2013), Tropiduridae (Passos et al., 2014; Martins et al., 2013). Supernumerary tails are considered to be a result of a previous injury rather than congenital malformation (Lynn, 1950). Although e.g., Bateman and Fleming (2009) mention that caudal autotomy appears



Figure 1. Individual of *Sauromalus ater* with a bifurcated tail.

¹ Department of Zoology and Fisheries, Faculty of Agrobiolgy, Food and Natural Resources, Czech University of Life Sciences Prague, Kamýcká 129, 165 00, Praha, Czech Republic

² Department of Zoology, Comenius University in Bratislava, Mlynská dolina, Ilkovičova 6, 842 15, Bratislava, Slovakia

* Corresponding author e-mail: koleska@af.czu.cz

to be absent in the Iguanidae, there are several recent records of supernumerary tail malformations of lizards belonging to this family; e.g., *Cophosaurus texanus* (Mata-Silva *et al.*, 2010), *Cyclura carinata*, *C. cychlura*, *C. rileyi* (Hayes *et al.*, 2012) or *Urosaurus bicarinatus* (Mata-Silva *et al.*, 2013). Etheridge (1967) noted that juveniles of *Iguana iguana* have skeletal adaptations allowing tail autotomy, which disappear as they grow older and reach maturity. Therefore we presume that our specimen suffered a tail injury during an early stage of its life and the tail bifurcation developed as a result. Tail breaks in Iguanidae are considered as outcomes of intraspecific aggression (Pérez-Buitrago *et al.*, 2010), sexual aggression during mating (Iverson *et al.*, 2004) or failed attempts of predation (Hayes *et al.*, 2012). Nevertheless, as far as we know, this is the first record of tail bifurcation for this species and one of the few recorded in the Iguanidae. Tail regeneration is of recent interest as a comparative model for regenerative medicine (Alibardi, 2010; Delorme *et al.*, 2012). Therefore we believe that our observation on this anatomical anomaly could have certain value for future research.

Acknowledgements. We thank Jiří Marek from Zoopark Zájezd (Czech Republic) for providing access to the specimen. This work was supported by the Internal Grant Agency of the Czech University of Life Sciences Prague (CIGA) through Project No. 20172002.

References

- Alibardi, L. (2010): Morphological and Cellular Aspects of Tail and Limb Regeneration in Lizards: A Model System with Implications for Tissue Regeneration in Mammals. *Advances in Anatomy, Embryology and Cell Biology* **207**: 1-109.
- Ananjeva, N.B., Danov, R.A. (1991): A rare case of bifurcated caudal regeneration in the Caucasian agama, *Stellio caucasicus*. *Amphibia-Reptilia* **12**: 343-349.
- Bateman, P.W., Fleming, P.A. (2009): To cut a long tail short: a review of lizard caudal autotomy studies carried out over the last 20 years. *Journal of Zoology* **277**:1-14.
- Conzendey, P., Campos, S.P.S., Lanna, F.M., De Amorim, J.D.C.G., De Sousa, B.M. (2013): *Ophiodes striatus* (Striped Worm Lizard). Bifurcated tail. *Herpetological Review* **44**: 145-146.
- Cordes, J.E., Walker, J.M. (2013): *Aspidoscelis velox* (Plateau Striped Whiptail). Bifurcation. *Herpetological Review* **44**: 319.
- Delorme, S.L., Lungu, I.M., Vickaryous, M.K. (2012): Scar-Free Wound Healing and Regeneration Following Tail Loss in the Leopard Gecko, *Eublepharis macularius*. *The Anatomical Record* **295**: 1575-1595.
- Dudek, K., Ekner-Grzyb, A. (2014): Field observation of two-tailed sand lizard *Lacerta agilis* Linnaeus, 1758 and a common lizard *Zootoca vivipara* (Jacquin, 1787) in Poland. *Natura Sloveniae* **16**: 65–66.
- Etheridge, R. (1967): Lizard caudal vertebrae. *Copeia* **4**: 699-721.
- Hayes, W.K., Iverson, J.B., Knapp, C.R., Carter, R.L. (2012): Do invasive rodents impact endangered insular iguana populations? *Biodiversity and Conservation* **21**: 1893-1899.
- Iverson, J.B., Smith, G.R., Pieper, L. (2004): Factors affecting long-term growth of the Allen Cays rock iguana in the Bahamas. In: *Iguanas: biology and conservation*, p. 176–192. Alberts, A. C., Carter R. L., Hayes W. K., Martins E. P., Eds., Berkeley, USA, University of California Press.
- Kumbar, S.M., Ghadage, A.B., Shndage V.M. (2011): *Hemidactylus flaviviridis* (House Gecko). Bifurcation. *Herpetological Review* **42**: 94.
- Lynn, W.G. (1950): A case of duplication of the tail in *Plethodon*. *Herpetologica* **6**: 81-84.
- Martins, R.L., Peixoto, P.G., Fonseca, P.H.M., Martinelli, A.G., Silva, W.R., Pelli, A. (2013): Abnormality in the tail of the collated lizard *Tropidurus gr. torquatus* (Iguania, Tropiduridae) from Uberaba city, Minas Gerais State, Brazil. *Herpetology Notes* **6**: 369-371.
- Mata-Silva, V., Rocha, A., Gandara, A., Johnson, J.D. (2010): *Cophosaurus texanus* (Greater Earless Lizard). Multiple tails. *Herpetological Review* **41**: 352-353.
- Mata-Silva, V., Rocha, A., Johnson, J.D., Wilson, L.D. (2013): *Urosaurus bicarinatus* (Tropical Tree Lizard). Bifurcation. *Herpetological Review* **44**: 686-687.
- Mitchell, J.C., McDaniel, W., McDaniel, J. (2012): *Plestiodon inexpectatus* (Southeastern Five-lined Skink). Bifurcation. *Herpetological Review* **43**: 650.
- Passos, D.C., Pinheiro, L.T., Galdino, C.A.B., Rocha, C.F.D. (2014): *Tropidurus semitaeniatus* (Calango de Lagedo). Tail Bifurcation. *Herpetological Review* **45**: 138.
- Pelegrin, N., Leão, S.M. (2016): Injured *Salvator merianae* (Teiidae) regenerates six tails in central Argentina. *Cuadernos de Herpetología* **30**: 21-23.
- Pérez-Buitrago, N., Sabat, A.M., McMillan, W.O. (2010): Spatial Ecology of the Endangered Mona Island Iguana *Cyclura cornutastejnegeri*: Does Territorial Behavior Regulate Density? *Herpetological Monographs* **24**: 86-110.
- Pheasey, H., Smith, P., Brouard, J.-P., Atkinson, K. (2014): *Vanzosaura rubricauda* (Red-tailed Vanzosaur). Bifurcation and Trifurcation. *Herpetological Review* **45**: 138-139.
- Tamar, K., Maza, E., Meiri, S. (2013): *Ophisops elegans* (Snake-Eyed Lizard). Bifurcation. *Herpetological Review* **44**: 146.
- Vrcibradic, D., Niemeyer, J. (2013): *Mabuya frenata*, *M. macrorhyncha*. Tail bifurcation. *Herpetological Review* **44**: 510-511.