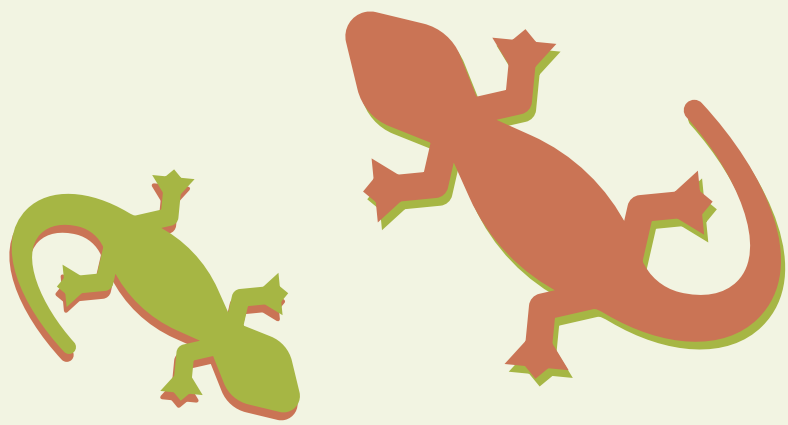


A review of tail anomalies in lizards (Reptilia: Sauria) in Poland with additional records

Zuzanna Purwin^{1,2}, Piotr Kazimirski³, Paweł Błęcki⁴ & Przemysław Zdunek^{5,6}

¹ Department of Comparative Anatomy, Institute of Zoology and Biomedical Research, Jagiellonian University, Gronostajowa 9, 30-387 Kraków, Poland;
² Student Naturalists' Association of the Jagiellonian University, Gronostajowa 7, 30-387 Kraków, Poland;
³ Regional Directorate for Environmental Protection, Kościuszki 57, 61-891 Poznań, Poland;
⁴ Independent researcher;
⁵ NATRIX Herpetological Association, Opolska 41/1, 52-010 Wrocław, Poland;
⁶ Pôle Sup Nature, 205 Rue de l'Acropole, 34000 Montpellier, France



Contact mail: zuzanna.purwin@gmail.com

Key words: autotomy, caudal anomaly, reptiles, tail deformations, central Europe

INTRODUCTION

Autotomy (tail loss, usually as a defensive mechanism) occurs in many lizards [1, 2]. After breakage, the tail stump heals quickly and regeneration begins [4]. During the regeneration process, vertebrae do not regrow and are replaced by cartilaginous tissue [5, 6]. Lizards with **double**, **bifurcated**, or even **triple tails** are not uncommon [7, 8, 9, 10; **Figure 1**]. Cases of **multiple tail furcations** have also been recorded [11, 12]. These phenomena usually occur when the tail is only partially broken and does not detach completely, but is damaged enough to stimulate the growth of a new tail [5]. In Poland, such phenomena have been documented very rarely [2,13]; below, we present a review of such **anomalies in Poland** along with an additional record.

MATERIALS & METHODS

To search for documented observations, standard search engines such as Google Scholar, ResearchGate, Academia.edu, and google.com were used. The following **keywords were applied**: “viviparous lizard”, “zootoca vivipara”, “sand lizard”, “lacerta agilis”, “common slow worm”, “anguis fragilis”, “eastern slow worm”, “anguis colchica”, “common wall lizard”, “podarcis muralis“, “tail”, “bifid”, “double”, “deformation”, “anomalies”, “tail furcations”, “autotomy”. Searches were conducted in 3 languages (English, French, Polish). As a result of the above steps, we obtained **the following records see Table 1**. The search ended on 1st August 2024.

RESULTS

Tab. 1. Summarized data on tail anomalies in Polish lizard species based on the literature and our results.

No.	Lizard taxon	Lizard life stage	Type of tail abnormality	Location	Source
1	<i>Lacerta agilis</i>	Unknown	duplications, trifurcations, pentafurcations	Unknown	Juszczuk 1987
2	<i>Lacerta agilis</i>	Adult	Double tail	Warmian–Masurian Voivodeship	Kolaneck, 2008; personal archive
3	<i>Lacerta agilis</i>	Adult	Double tail	Greater Poland Voivodeship	Dudek & Ekner-Grzyb 2014
4	<i>Lacerta agilis</i>	Adult	Double tail	Warmian–Masurian Voivodeship	Kolaneck, 2016; personal archive
5	<i>Lacerta agilis</i>	Juvenile	Bifid tail	Lubusz Voivodeship	Kolenda et al. 2017
6	<i>Lacerta agilis</i>	Adult	Double tail	Lubusz Voivodeship	Kolenda et al. 2017
7	<i>Zootoca vivipara</i>	Sub-adult	Bifid tail	Greater Poland Voivodeship	Dudek & Ekner-Grzyb 2014
8	<i>Zootoca vivipara</i>	Adult	Double tail	Lubusz Voivodeship	Kolenda et al. 2017
9	<i>Zootoca vivipara</i>	Adult	Bifid tail	Pomeranian Voivodeship	Błęcki et al. 2025

The most common anomaly in Poland was a double tail (**Figure 2**). All of anomalies have been repeatedly confirmed in majority of studied species outside the borders of Poland [14, 15, 16]. In the case of the Slow worm (*Anguis fragilis*) and the Eastern slow worm (*A. colchica*), such observations have not yet been documented in Poland; the only

such record in the literature is a double tail in *A. fragilis* from Spain [17]. A similar situation applies to the Common wall lizard (*Podarcis muralis*), a cryptogenic species in Poland, for which numerous anomalies have been documented abroad [18, 19, 20].

OBSERVATION

The Viviparous lizard (*Zootoca vivipara*) is the smallest Polish lizard species and occurs throughout the country, preferring cool and humid environments [13]. On 7 August 2023 at 15:20, an **adult Viviparous lizard** (approx. 15 cm in total length) **was observed** foraging near a woodpile in the village of Lisówko (**Photo 1**). Attention was drawn to a tail anomaly in

the form of **bifurcation** (bifid tail). The observation site was an anthropogenically modified environment. This individual was not observed again despite numerous subsequent visits to the site. **Potential predators** in the observation area include Feral cats (*Felis catus*), Red foxes (*Vulpes vulpes*), and corvids (*Corvidae*).

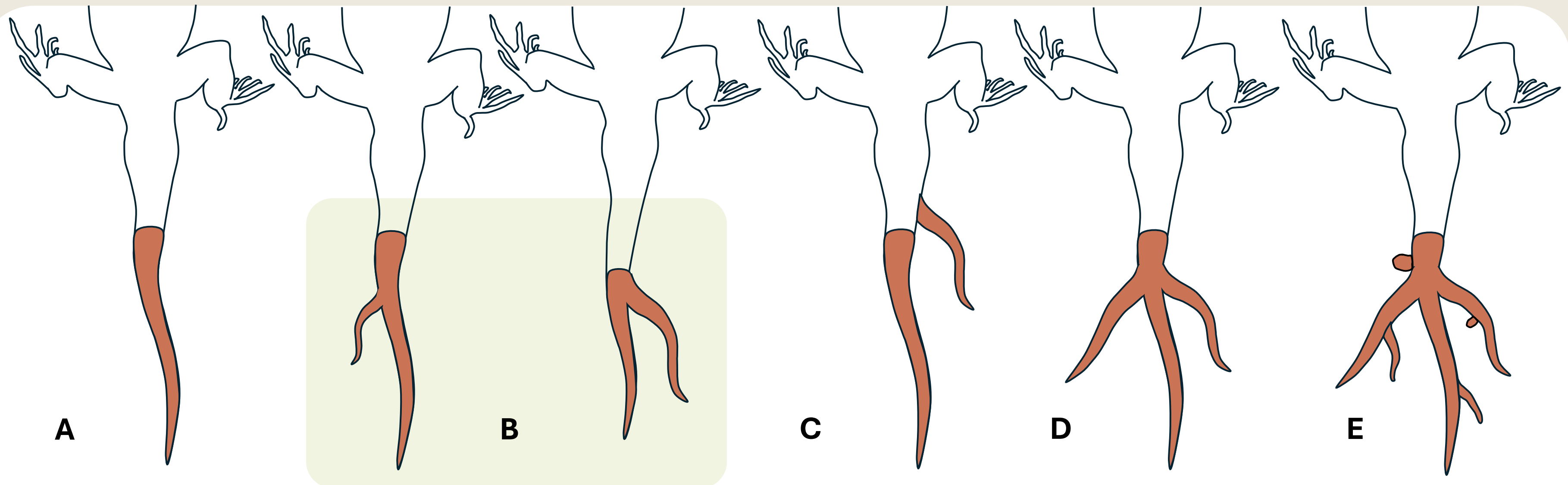


Figure 1. Examples of regeneration types of tail autotomy in lizards: typical (A), bifid (B), double-tailed (C), trifid (D), multifid (E). Figures by Z. Purwin.



Photo 1. An adult specimen of the Viviparous lizard (*Zootoca vivipara*) with a bifid tail. Photo by P. Błęcki.

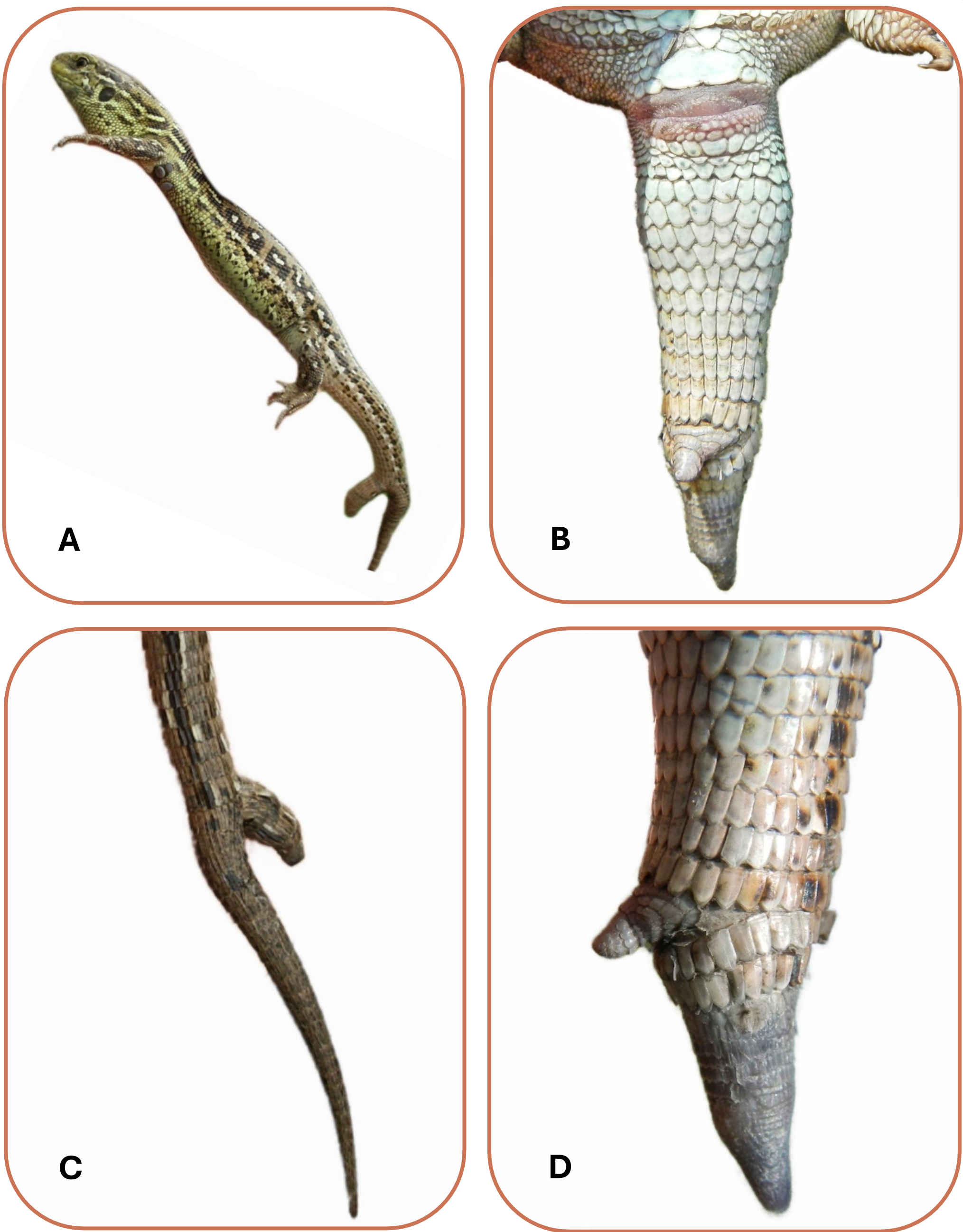


Figure 2. Adult double-tailed Sand lizards (*Lacerta agilis*) from 2008 (AB) and from 2016 (CD). Photos by A. Kolaneck.

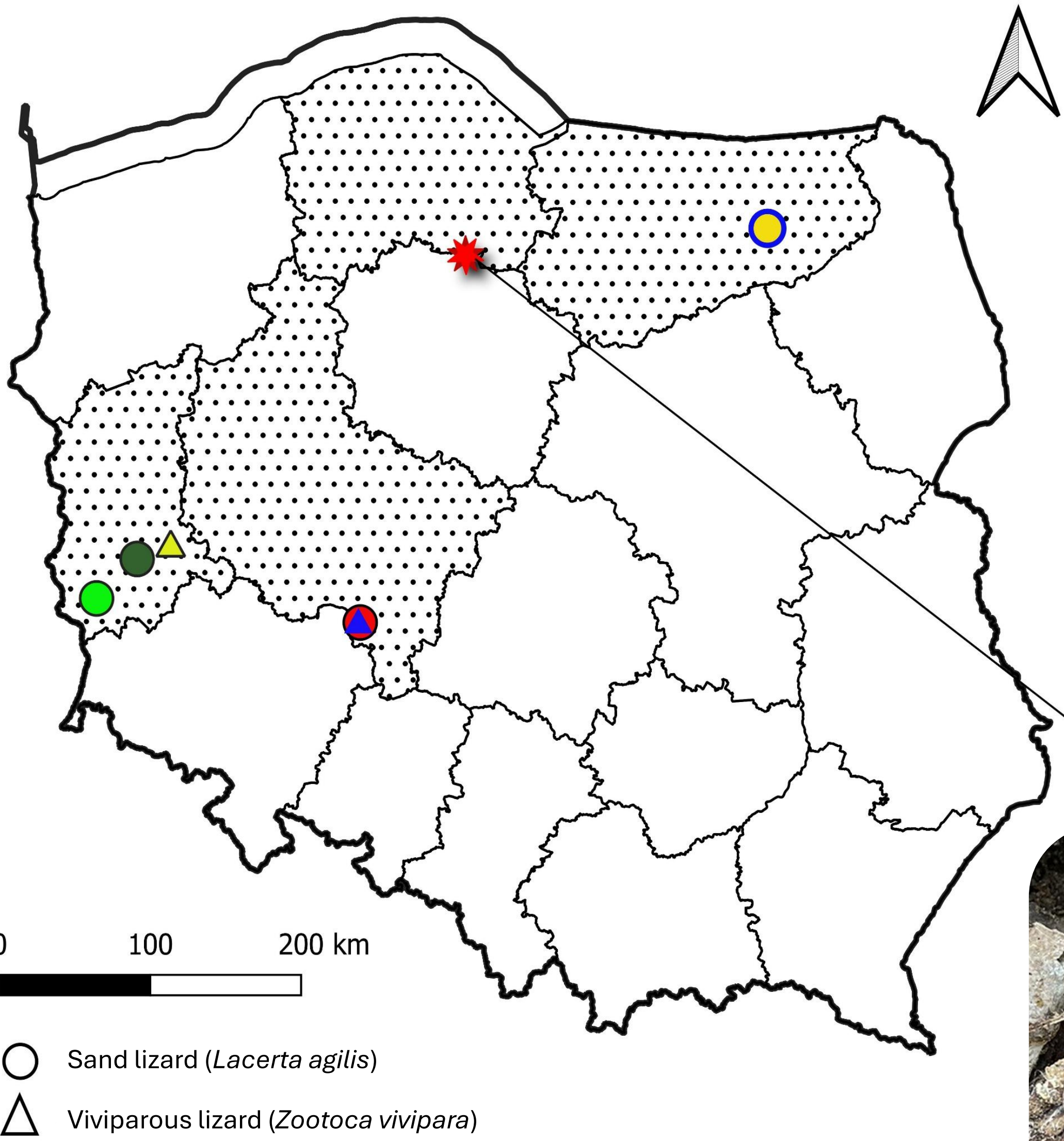


Figure 3. Map showing the current documented reports of tail anomalies in lizards in Poland. Created by P. Kazimirski.

LEGEND:
Błęcki et al. (2025)
★ 2023
Dudek & Ekner-Grzyb (2014)
● 2010
▲ 2010
Kolenda et al. (2017)
● 2012
● 2016
▲ 2017
Kolaneck (2008, 2016)
● 2008 & 2016
... voivodeships with observations

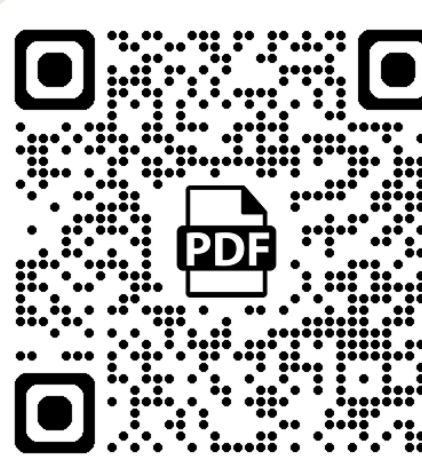


DISCUSSION

As unanimously noted by all previous authors, the percentage of individuals with anomalies in a given population from Poland was negligible [13, 21, 22]. Although the **cost of tail loss** has been extensively studied, understanding the **possible impact** of abnormal tail regeneration on individual survival requires more research. Future studies on selected populations in different parts of Poland would help to better understand this rare phenomenon and its hypothetical relationship to habitat, predator pressure, or a specific region in Poland. **By summarizing literature records together (Figure 2)**, we hope to facilitate future research in this subject.



Literature



**A review of tail anomalies in lizards (Reptilia: Sauria) in Poland
with additional records**

Zuzanna Purwin, Piotr Kazimirski, Paweł Błęcki & Przemysław Zdunek

REFERENCES

1. ARNOLD E.N. 1988. Caudal autotomy as a defense. In: GANS C., HUEY R. (Eds.). *Biology of the Reptilia*. Volume 16. Ecology B: Defense and Life History. Alan R. Liss, New York: 235–273.
2. BŁĘCKI P., KAZIMIRSKI P, ZDUNEK P. 2025. Obserwacja rozdwojenia ogona u jaszczurki żyworodnej, *Zootoca vivipara* (Lichtenstein, 1823), z północnej polski, z nakreśleniem tego typu anomalii u polskich jaszczurek (Reptilia: Sauria). *Przegląd Przyrodniczy* XXXVI(2), 93–97.
3. QUAH E.S.H., GRISMER L.L. 2024. Tail bifurcation in *Gehyra mutilata* (Wiegmann, 1834) and an updated compilation of tail abnormality records in Gekkota. *Herpetology Notes* 17, 359–365.
4. 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.
5. ALIBARDI L. 2009. *Morphological and Cellular Aspects of Tail and Limb Regeneration in Lizards: A Model System with Implications for Tissue Regeneration in Mammals*. Springer-Verlag, Berlin, Germany.
6. JACYNINAK K., MCDONALD, R.P., VICKARYOUS M.K. 2017. Tail regeneration and other phenomena of wound healing and tissue restoration in lizards. *Journal Experimental Biology* 220, 2858–2869.
7. RENET J. 2013. Deux cas d'anomalie caudale chez le lézard ocellé *Timon lepidus lepidus* (Daudin, 1802) dans le sud-est de la France (Bouches-du-Rhône). *Nature de Provence, Revue du CEN PACA* 2, 99–101.
8. BADIANE A. 2017. Trifurcation caudale chez le lézard des murailles *Podarcis muralis* (Laurenti, 1768) (Squamata: Lacertidae). *Bulletin de la Société Herpétologique de France* 163, 106–107.
9. BARR J.I., SOMAWEERA R., GODFREY S.S., GARDNER M.G., BATEMAN P.W. 2020. When one tail isn't enough: abnormal caudal regeneration in lepidosaurs and its potential ecological impacts. *Biological Reviews* 95, 1479–1496.
10. BAUM T.J., KAISER H. 2024. Tail furcations in lizards: a revised summary and the second report of tail duplication in the Western Fence Lizard, *Sceloporus occidentalis* Baird & Girard, 1852. *Herpetology Notes* 17, 459–475.

11. 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.
12. BEIJDRORFF F., ZDUNEK P. 2024. Multiple tail furcations in a common house gecko *Hemidactylus frenatus* from Thailand. *Herpetological Bulletin* 170, 48.
13. JUSZCZYK W. 1987. Płazy i gady krajowe. Część 3. Gady – Reptilia, wydanie drugie. Państwowe Wydawnictwo Naukowe, Warszawa.
14. MOSER J. 2000. Beobachtung eines doppelschwänzigen Zauneidechsen-Weibchens. *ÖKO.L, Zeitschrift für Ökologie, Natur- und Umweltschutz* 22, 36.
15. BLANKE I. 2010. Die Zauneidechse zwischen Licht und Schatten. *Zeitschrift für Feldherpetologie* 7 (Supplement), 1–176.
16. GRAMENTZ D. 2013. Die Farbvarianten der Zauneidechse in Berlin und dem stadtnahen Umland. *Die Eidechse* 24, 35–42.
17. ESPASANDIN I. 2017. Cola bífida en *Anguis fragilis* (Linnaeus, 1758). *Boletín de la Asociación Herpetológica Española* 28(2), 11–12.
18. FUNKE O. 2001. Auffälliges Vorkommen von Gabelschwanzregeneraten in einer Population von *Podarcis muralis merremia* (Risso, 1826) in Südfrankreich. *Die Eidechse* 12; 84–85.
19. FERNANDEZ-FERNANDEZ D. 2020. Cola bífida en *Podarcis muralis* (Laurenti, 1768). *Boletín de la Asociación Herpetología Española* 31(1), 26–28.
20. HEAD A., AMER A., FOSTER E.G., FRAIRE L., LIVINGSTON E.H., MOORE M.M., GANGLOFF E.J. 2024. Caudal regeneration in the invasive Common Wall Lizard, *Podarcis muralis* (Laurenti, 1768), in Ohio, USA, with a report of a rare tail trifurcation. *Herpetology Notes* 17, 367–369.
21. 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.
22. KOLENDA K., WIECZOREK M., NAJBAR A., NAJBAR B., SKAWIŃSKI T. 2017. Limb malformation and tail bifurcation in sand lizards (*Lacerta agilis*) and common lizards (*Zootoca vivipara*) from Poland. *Herpetology Notes* 10, 713–716.

ACKNOWLEDGEMENTS

The authors would like to thank Aleksandra Kolanek for providing observations from her private archive.

**A review of tail anomalies in lizards (Reptilia: Sauria) in Poland
with additional records**

Zuzanna Purwin, Piotr Kazimirski, Paweł Błęcki & Przemysław Zdunek

REFERENCES

1. ARNOLD E.N. 1988. Caudal autotomy as a defense. In: GANS C., HUEY R. (Eds.). *Biology of the Reptilia*. Volume 16. Ecology B: Defense and Life History. Alan R. Liss, New York: 235–273.
2. BŁĘCKI P., KAZIMIRSKI P, ZDUNEK P. 2025. Obserwacja rozdwojenia ogona u jaszczurki żyworodnej *Zootoca vivipara* (Lichtenstein, 1823) z północnej polski na tle tego typu anomalii u polskich jaszczurek (Reptilia: Sauria). *Przegląd Przyrodniczy* XXXVI (3): 93–97.
3. QUAH E.S.H., GRISMER L.L. 2024. Tail bifurcation in *Gehyra mutilata* (Wiegmann, 1834) and an updated compilation of tail abnormality records in Gekkota. *Herpetology Notes* 17, 359–365.
4. 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.
5. ALIBARDI L. 2009. *Morphological and Cellular Aspects of Tail and Limb Regeneration in Lizards: A Model System with Implications for Tissue Regeneration in Mammals*. Springer-Verlag, Berlin, Germany.
6. JACYNINAK K., MCDONALD, R.P., VICKARYOUS M.K. 2017. Tail regeneration and other phenomena of wound healing and tissue restoration in lizards. *Journal Experimental Biology* 220, 2858–2869.
7. RENET J. 2013. Deux cas d'anomalie caudale chez le lézard ocellé *Timon lepidus lepidus* (Daudin, 1802) dans le sud-est de la France (Bouches-du-Rhône). *Nature de Provence, Revue du CEN PACA* 2, 99–101.
8. BADIANE A. 2017. Trifurcation caudale chez le lézard des murailles *Podarcis muralis* (Laurenti, 1768) (Squamata: Lacertidae). *Bulletin de la Société Herpétologique de France* 163, 106–107.
9. BARR J.I., SOMAWEERA R., GODFREY S.S., GARDNER M.G., BATEMAN P.W. 2020. When one tail isn't enough: abnormal caudal regeneration in lepidosaurs and its potential ecological impacts. *Biological Reviews* 95, 1479–1496.
10. BAUM T.J., KAISER H. 2024. Tail furcations in lizards: a revised summary and the second report of tail duplication in the Western Fence Lizard, *Sceloporus occidentalis* Baird & Girard, 1852. *Herpetology Notes* 17, 459–475.

11. 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.
12. BEIJDRORFF F., ZDUNEK P. 2024. Multiple tail furcations in a common house gecko *Hemidactylus frenatus* from Thailand. *Herpetological Bulletin* 170, 48.
13. JUSZCZYK W. 1987. Płazy i gady krajowe. Część 3. Gady – Reptilia, wydanie drugie. Państwowe Wydawnictwo Naukowe, Warszawa.
14. MOSER J. 2000. Beobachtung eines doppelschwänzigen Zauneidechsen-Weibchens. *ÖKO.L, Zeitschrift für Ökologie, Natur- und Umweltschutz* 22, 36.
15. BLANKE I. 2010. Die Zauneidechse zwischen Licht und Schatten. *Zeitschrift für Feldherpetologie* 7 (Supplement), 1–176.
16. GRAMENTZ D. 2013. Die Farbvarianten der Zauneidechse in Berlin und dem stadtnahen Umland. *Die Eidechse* 24, 35–42.
17. ESPASANDIN I. 2017. Cola bífida en *Anguis fragilis* (Linnaeus, 1758). *Boletín de la Asociación Herpetológica Española* 28(2), 11–12.
18. FUNKE O. 2001. Auffälliges Vorkommen von Gabelschwanzregeneraten in einer Population von *Podarcis muralis merremia* (Risso, 1826) in Südfrankreich. *Die Eidechse* 12; 84–85.
19. FERNANDEZ-FERNANDEZ D. 2020. Cola bífida en *Podarcis muralis* (Laurenti, 1768). *Boletín de la Asociación Herpetología Española* 31(1), 26–28.
20. HEAD A., AMER A., FOSTER E.G., FRAIRE L., LIVINGSTON E.H., MOORE M.M., GANGLOFF E.J. 2024. Caudal regeneration in the invasive Common Wall Lizard, *Podarcis muralis* (Laurenti, 1768), in Ohio, USA, with a report of a rare tail trifurcation. *Herpetology Notes* 17, 367–369.
21. 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.
22. KOLENDA K., WIECZOREK M., NAJBAR A., NAJBAR B., SKAWIŃSKI T. 2017. Limb malformation and tail bifurcation in sand lizards (*Lacerta agilis*) and common lizards (*Zootoca vivipara*) from Poland. *Herpetology Notes* 10, 713–716.

ACKNOWLEDGEMENTS

The authors would like to thank Aleksandra Kolanek for providing observations from her private archive.