

SHORT COMMUNICATION

First observation of partial neoteny in *Salamandrina perspicillata* (Savi, 1821)Ernesto Filippi^{1*}, Valeria Gargini², Maura Brancaleoni³, Piero Felici²

Abstract - Different forms of neoteny were recorded in some Italian amphibian species: full (absolute or temporary) and partial. However, this physiological phenomenon was never observed in the Italian endemic *Salamandrina perspicillata*. The authors report the first record of partial neoteny in an individual of this species, a leucistic larva observed in a drinking trough in the Valle del Treja Regional Park (Latium - Central Italy).

Key words: amphibians, leucism, neoteny, reproduction, *Salamandrina perspicillata*.

Riassunto - Prima osservazione di neotenia parziale in *Salamandrina perspicillata* (Savi, 1821).

Differenti forme di neotenia sono presenti in alcune specie di anfibi italiani: totale (assoluta o temporanea) e parziale. Questo fenomeno non è mai stato osservato in *Salamandrina perspicillata*, endemita italiano. Gli Autori riportano il primo dato di neotenia parziale in un individuo di questa specie, una larva leucistica osservata in un abbeveratoio nel Parco Regionale Valle del Treja (Lazio - Italia centrale).

Parole chiave: anfibi, leucismo, neotenia, riproduzione, *Salamandrina perspicillata*.

According to Lanza *et al.* (2007) there are different forms of neoteny (the delaying or slowing of larval state) in amphibians: i) full (larvae never undergo metamorphosis); ii) full but temporary (larvae remain more or less as such for a long time and then undergo metamorphosis, often after having reached a rather large size, and can bre-

ed); iii) partial (some characters undergo metamorphosis while others do not, usually after the individuals have reached a rather large size). In Italy, this process is exhibited by the following species: *Pelophylax* kl. *esculentus* and *Triturus carnifex* (partial neoteny); *Mesotriton alpestris*, *Lissotriton italicus*, *L. vulgaris*, *T. carnifex* (neoteny full temporary); *Proteus anguinus* (full neoteny) (Lanza *et al.*, 2007). Albinism or leucism (lack of integumentary pigment with normal eyes; Dyrkacz, 1981), has been reported in the following species: *Salamandra salamandra*, *Salamandrina perspicillata*, *L. vulgaris*, *T. carnifex*, *Ichthyosaura alpestris*, *Hydromantes sarrabusensis*, *H. flavus*, *H. supramontis*, *Bufo viridis* (Modesti *et al.*, 2011; Lunghi *et al.*, 2017). In amphibians, colour anomalies are due to genetic factors, but depigmentation and paling may also be due to temperature, disease, or chemicals (see the review by Henle & Dubois, 2017).

S. perspicillata (Savi, 1821) is a tiny salamander (70-100 mm total length), endemic to Central and Northern Italy (Romano *et al.*, 2009; Liuzzi *et al.*, 2011) characterized by a prolonged phase of terrestrial activity (Della Rocca *et al.*, 2008) and a reduced phase of aquatic activity, generally confined to the larval stage and to females during oviposition (Angelini *et al.* 2007). Breeding sites are mostly found in pools near slow-running streams, drinking troughs, springs (Barbieri & Pellegrini, 2006). Females of *S. perspicillata* generally spawn 30-60 eggs, which take 20-22 days at 14 °C to develop; at hatching, larvae are 7-13 mm long (Vanni, 1981). Metamorphosis can require 2-5 months, depending on time of oviposition (spring or autumn), water temperature, availability of food and other ecological factors (Corsetti, 1999; Della Rocca *et al.* 2005; Angelini *et al.*, 2008).

Larvae display a continuous vertebral crest throughout their back up to the tail. Young individuals have crests starting right at the back of the neck. During the development, the crest disappears on the back but remains on the tail up to the metamorphosis. The gills of the larvae are quite well developed (Lanza, 1983). At the time of metamorphosis, larvae range 20-35 mm (Angelini *et al.*, 2007).

In *S. perspicillata* both albinism and leucism are reported by Crucitti *et al.* (2016) while neoteny was unknown so far. Usually, *S. perspicillata* larvae display a dark colouration with more or less extensive yellow or

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Received: 21 April 2020

Accepted for publication: 10 July 2020

Online publication: 18 November 2020

orange spots. However, they may show different colour shades as a result of age, temperature and site-specific photic conditions (Lanza *et al.*, 2007; Angelini *et al.*, 2008).

In this paper, we report the first record of partial neoteny in *S. perspicillata*. The observations were made in Valle del Treja Regional Park (VTRP) during a scientific study carried out from February 2011 to April 2012 in preparation to a monitoring survey of amphibians and reptiles by the Protected Area managing authority.

VTRP is a protected area covering 628 ha, located in Latium, 30 km north of Rome. The park preserves part of the River Treja, a 30 km long tributary of the Tiber, which flows through an inaccessible area characterized by deep gorges and shady, cool and damp valleys, with slow-running brooks bordered by thick vegetation. Riparian forests (*Populus nigra*, *Alnus glutinosa*) and mixed woods (*Quercus cerris*, *Q. ilex*, *Carpinus betulus*, *Ostrya carpinifolia*, *Acer campestre*) are present in the area.

On January 31st, 2012 we noticed a solitary leucistic larva of *S. perspicillata*, in an advanced stage of development (all four legs, length about 3-4 cm) in one of the four drinking troughs present in the study area and located in a wood dominated by Turkey oak (*Q. cerris*). This drinking trough was characterized by cool running

water and abundant aquatic vegetation. No other larvae were simultaneously present. During the following check, on February 27th, 2012, the leucistic individual was captured and measured using an electronic Vernier calliper.

The snout-vent length of this individual was 23.75 mm and its total length was 54.73 mm. Although it completely lacked dark pigments on the body and tail, the eyes were dark. The gills were pink (Fig. 1). The vertebral crest was present and clearly visible along the tail. The individual was also assayed for the presence of the pathogenic fungus *Batrachochytrium dendrobatidis* (BD) using a swab and the obtained sample was tested following the protocol of Federici *et al.* (2008). The individual resulted negative, as the other checked amphibians in VTRP.

As to its particular colouration, it is worth to mention that chromatic anomalies, such as albinism or leucism, are quite common in amphibians (see for example, Bechtel, 1995) and cases of albinism and leucism in adults of seven species of Italian amphibians have recently been reported (Modesti *et al.*, 2011; Lunghi *et al.*, 2017). Moreover, Crucitti *et al.* (2016) have recently reported eight adult depigmented individuals of *S. perspicillata* in the Natural Reserve “Macchia di Gattaceca and Macchia del Barco” (Campagna Romana, Latium), a protected area near the

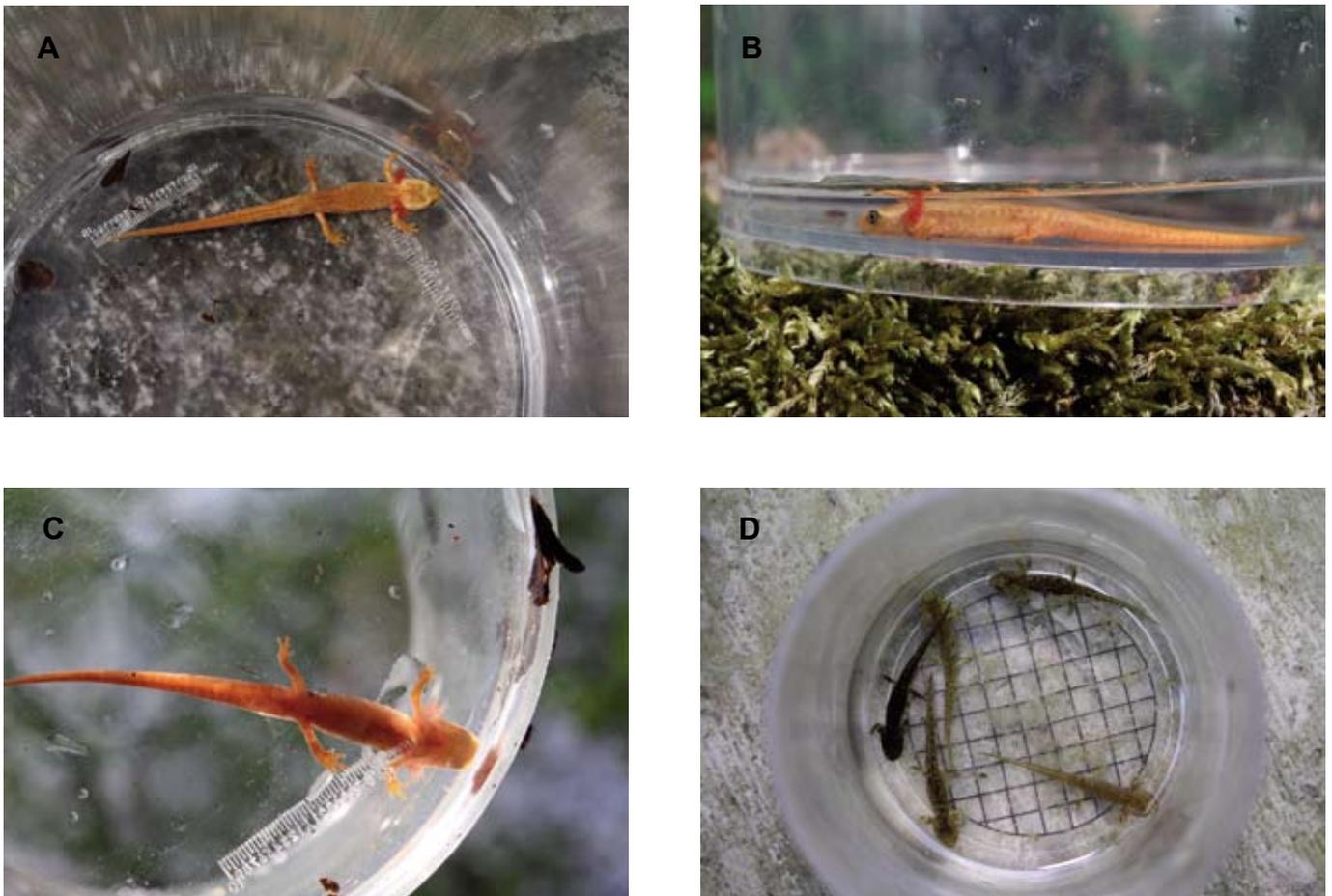


Fig. 1 - The leucistic larvae of *S. perspicillata* (A-C). Chromatic gradation of other larvae of *S. perspicillata*, in the same drinking trough (D). / La larva leucistica di *S. perspicillata* (A-C). La gradazione cromatica mostrata da altre larve di *S. perspicillata* presenti nello stesso abbeveratoio (D).

Tiber valley, 25 km away from VTRP. For a review on chromatic anomalies in adults of the genus *Salamandrina* see Romano *et al.*, 2017.

In comparison to the other aquatic habitats studied in VTRP, the larvae observed from February to October 2011 in this drinking trough were characterized by a remarkable chromatic gradation, from dark to light, also among individuals of the same larval cohort (Fig. 1).

The leucistic larva was observed and captured for the last time on April 4th, 2012. It is interesting to note that, in the 37 days period between the earlier check (February 27th) and the last (April 4th), the larva's measures and morphology had not changed.

The size of the studied individual exceeded that normally attained by the larvae of the same species at the metamorphosis (55 mm vs 20-35 mm), and was comparable to that of an adult; Vanni (1981) reports 35-40 mm for the first year of terrestrial life. The remarkable size and the long larval stage (from autumn 2011 to spring 2012) made us hypothesize that we were in the presence of a case of partial neoteny.

This hypothesis is corroborated by the concurrence of some environmental factors, which favour the appearance of partial neoteny in amphibians. According to Heiss (2017), permanently cool and oxygen-rich waters with abundant food (as in our drinking trough), as well as adverse conditions in the surrounding aerial environment (as the unusual air temperatures of autumn 2011,

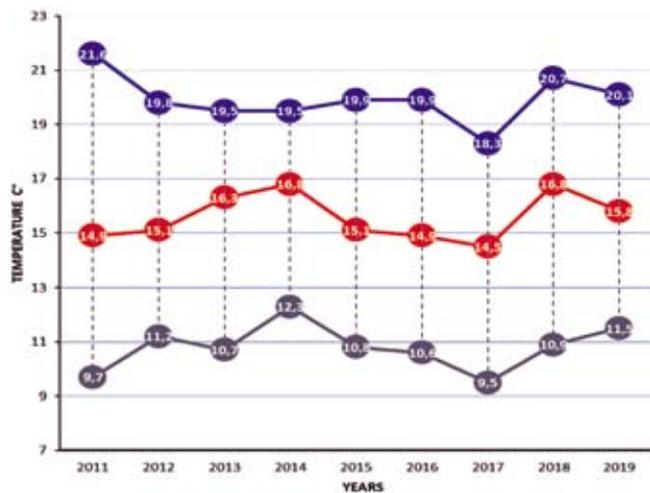


Fig. 2 - Average temperatures in September (top), October (middle), November (bottom) recorded from 2011 to 2019. The months of October and November 2011 were among the coldest ones, while the month of September 2011 was the hottest in the considered period. Please, note that the greatest difference in temperature was recorded between September and October 2011. The climatic data were obtained from the website of ARSIAL - the Regional Agrometeorological Service of Lazio (www.arsial.it) and refer to Corchiano station (Viterbo), around 10 km away from the study area. / Temperature medie nei mesi di Settembre (in alto), Ottobre (in mezzo) e Novembre (in basso) registrate dal 2011 al 2019. I mesi di Ottobre e Novembre 2011 sono stati i più freddi, mentre il mese di Settembre 2011 è stato il più caldo nel periodo considerato. Si noti che tra Settembre e Ottobre 2011 si è registrata la maggiore differenza di temperatura. I dati climatici sono stati tratti dal sito web di ARSIAL - Servizio Agrometeorologico della Regione Lazio (www.arsial.it) e si riferiscono alla stazione di Corchiano (Viterbo), a 10 km circa dall'area di studio.

when the larva presumably hatched (Fig. 2) might have triggered partial neoteny in the studied individual, incidentally a leucistic one, the first case ever recorded in *S. perspicillata*.

Acknowledgments

The research study was funded and supported by Valle del Treja Regional Park - Regione Lazio. The authors would like to thank Gian Lorenzo D'Alterio, Gianni Guaita and all the staff of Parco Regionale Valle del Treja for their precious support and assistance as well as Giorgio Chiozzi, Antonio Romano, Maria Luce Del Vecchio and an anonymous reviewer for their comments and suggestions.

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