

Low altitudinal distribution of *Salamandra salamandra* from the Balkan Peninsula

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The fire salamander, *Salamandra salamandra* (Linnaeus, 1758) is a common European amphibian species of the Caudata order, Salamandridae family, which is characterized by a black body and several yellow spots or stripes (Arnold and Ovenden, 2002). The fire salamander is distributed through large parts of western, central, and southern Europe, including the main three Mediterranean peninsulas: the Iberian, Apennine, and Balkan. Its distribution in western and central Europe is relatively continuous (except for the British Isles). However, the distribution is rather discontinuous in the southern parts (Gasc et al., 1997), although this is probably a result of the lack of data. Fire salamanders usually inhabit thick and broadleaved mixed forests, especially beech and oak forests, but they can also occur in treeless regions (Juszczyk, 1987; Opatrný, 1992). They occur near water bodies, especially in stony streams and springs, where their larvae develop. In addition, adults can be partly aquatic at higher altitudes (Arnold and Ovenden 2002). The upper limit of its altitudinal distribution may be higher than 2,000 m (e.g., Vences et al., 2003; Stojanov et al., 2011). The lowest altitude in which this species occur is in central and southeastern Europe, with recorded altitude between 140 – 250 m a.s.l. (Juszczyk, 1987; Opatrný, 1992; Covaciu-Marcov et al., 2007a; Vörös et al., 2010; Stojanov et al., 2011; Balogová et al., 2012; Covaciu-Marcov et al., 2012). However, all records under 200 m a.s.l. are very rare and interesting.

In this paper, we report three cases in which *S. salamandra* was recorded in extremely low altitudes in the Balkan Peninsula.

The first record is of a newly metamorphosed specimen in the canyon of the Cetina River, southern Croatia (Fig. 1. A, B). The specimen was found near a river pool, ca. 5 km away from its mouth (43.440572° N; 16.743231° E) on 17 May 2006, 8:30 h. The altitude there is 4 m a.s.l. The weather was sunny after a few fine rainy days at the time of the finding. The canyon's weather is not completely Mediterranean, but relatively humid with abundant vegetation.

The second record is from southwestern Slovenia, where we found seven late-developing larvae (Fig. 1 C, D, E). The larvae were found in waters of almost dried stream, under the dam of the Vogrsko Lake, close to the Sempas village (45.906620° N; 13.723349° E) on 31 July 2009, 11:45 h. The altitude is 100 m a.s.l. The weather was hot and sunny at the time of the finding. The surroundings of the stream were covered by vegetation and broadleaved wood, which created shade for the whole day.

The third record is of a juvenile in eastern Bulgaria (Fig. 1. F, G). The specimen was found on 9 August 2013 at 8:40 h in a dry, rocky riverbed near Elenite village, near the forest reserve of Ortoto (42.714458° N; 27.810390° E), at an altitude of 40 m a.s.l. The weather was sunny and the temperature was around 15° C with relatively high humidity in the valley. The sunlight reached this point only by noon. The stream had come standing water in some places, but higher amounts of water were found about 500 m further up. Other tributaries were dry as well. The watered part was about 1.5 km long with the depth no more than 0.5 m. The water was still running in other places. The riverbed was ca. 5 m wide. The whole valley stretches about 10 km from the coast into the mainland and the stream spring is at 400 m a.s.l. The valley slopes are covered with old oak trees, underbrush and sometimes only with fallen leaves.

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Fig. 1. A - *Salamandra salamandra* juvenile from the canyon of the Cetina River. B - Habitat from the canyon of the Cetina River. C, D - Larvae of *S. salamandra* close to the Sempas village. E - Locality of the species near the Sempas village. F – Juvenile specimen close to the Elenite village. G – Locality near the Elenite village.

Basic data about altitudinal distribution of *S. salamandra* are missing from many parts of its range. The occurrence of *S. salamandra* is known in this region in Slovenia and Bulgaria (Gasc et al., 1997; Stojanov et al., 2011), although the altitudinal range is poorly known. The fire salamander is known to occur between 250–2,350 m a.s.l. in Bulgaria (Stojanov et al., 2011). This species was previously known to occur in the studied area, but only in higher altitudes. This locality is the easternmost known place of occurrence of the fire salamander in Bulgaria, following the continuous occurrence in the Stara Planina Mts. (Stojanov et al., 2011). The Slovenian record belongs to the known continuous species distribution and it is probably one of the lowest altitudes recorded for this species in this country. Even though the species is also described from the coastal areas of Slovenia (Poboljšaj, 2007), specific localities and altitudes are not described.

Published data about recent occurrence of this species in Croatian Dalmatia is missing (Gasc et al., 1997) and so is data concerning its presence with regard to altitude. Henle (1985) reports two findings without describing the altitude from the region in middle and southern Dalmatia. His findings were potentially recorded from altitudes up to 150 m a.s.l.

In case of our described Croatian and Bulgarian findings, we suppose that the specimens could be flooded out from higher altitudes into lower altitudes during heavy rains from places with higher species density. However, exact data about the density are missing in this region. It is possible that specimens can be flooded out to the valley of the Cetina River, because the slopes of the mountains are very steep there. Similar studies also suggested the same (Blahák, 1989; Zavadil, 1993).

Nevertheless, the species is likely to occur in such low altitude, due to microclimatic conditions of the Cetina River canyon. This corresponds with Henle's (1985) and our own observations from lower parts of the Velika Paklenica River canyon on 17 June 2005. We observed the occurrence and reproduction of this species in about 180 m a.s.l. in this canyon. In Albania, where hillsides almost stretch to coastal areas as in Croatia, Haxhiu (1994) reported the species occurrence at altitudes from the sea level up to 2,000 m a.s.l. However, Haxhiu (1994) does not give exact localities. This is similar to our finding from Bulgaria, where the occurrence of fire salamanders in such low altitudes can be related to positive configuration of the land. The riverbed is carved 150–200 m into the mountain ridges, it is shaded

and provides suitable microclimate. Despite the gentle decline of the riverbed, the possibility of specimens being flooded out from the higher altitude cannot be ruled out.

Finally, we assume that the geomorphological and microclimatic characteristics of the locality have an influence on the species occurrence in lower altitudes. The presence of *S. salamandra* is not significantly connected with convenient altitudes or average temperatures of the region, but the limiting factor is probably humidity. A similar case can be found in other species from high altitude that also have populations at lower altitudes, given the appropriate conditions, such as: *Ichthyosaura alpestris* (Covaciu-Marcov et al., 2010), *Lissotriton montandoni* (Covaciu-Marcov et al., 2007b), *Zootoca vivipara* (Kluch et al., 1965; Covaciu-Marcov et al., 2008), and *Vipera berus* (Tóth and Farkas, 2004; Cafuta, 2010). Thus, Fire salamanders can occur in extremely low altitudes, given the suitable environmental conditions (deep, cool, and humid valleys with abundant vegetation and breeding sites). Extensive mapping of its recorded occurrences in the whole range is necessary in order to have more precise description of the altitudinal distribution of this species.

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