Note on the discovery of a new relict population of *Salamandra salamandra* (Amphibia: Salamandridae) from the Minervois in Southern France

Axel Hernandez[1] & Jean Raffaëlli[2]

[1] Department of Environmental Sciences, Faculty of Sciences and Technics. University Pasquale Paoli of Corsica. 20250 Corte. France. C.e: hernandez.axel.1989@gmail.com

[2] Penclen 56420. Plumelec. France.

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Resumen: Se aportan los datos obtenidos de una nueva población críptica de *Salamandra salamandra* (Amphibia: Salamandridae) descubierta en la región del Minervois, Languedoc, en el sur de Francia, con especial énfasis en su distribución, su ecología y su estatus. Esta población aparece en un bosque mediterráneo de *Quercus ilex* a baja altitud (70 mnsm) y se caracteriza por su gran talla y por un patrón de coloración más similar a la subespecie nominal *Salamandra salamandra salamandra* que a la *S. s. terrestris* que aparece en La Montagne Noire, un macizo montañoso situado en la extremidad suroeste del Macizo Central, en Francia y que establece la separación geográfica natural entre los departamentos franceses de Tarn, Hérault y Aude.

The Fire Salamander *Salamandra salamandra terrestris* Bonnaterre, 1789 is widely distributed in Western Europe from Northwestern France (Bretagne) to Central and Northern Germany, Switzerland up to North-eastern Spain and Northern Italy. This subspecies is bordered by *Salamandra salamandra fastuosa* Schreiber, 1912 in Spain and by the nominal subspecies *Salamandra salamandra salamandra* Linnaeus, 1758 to the East of its distribution (Dubois & Raffaëlli, 2009; Raffaëlli, 2013). In southern France and especially in the Languedoc-Roussillon region, most of the populations are known from the southwestern part up to Les Corbières and La Montagne Noire in the northern part of the region. Furthermore, no records were previously reported from the Aude department with the Hérault's border and no populations of the genus *Salamandra* are known to occur in coastal areas in this region (Lescure & Massary, 2012; Geniez & Cheylan, 2012).

The first author on February 2003 found 32 specimens of *Salamandra salamandra* Linnaeus, 1758 in the Minervois area (43°18'59 N, 2°52'16" E; elevation: 70 masl), between Aude and Hérault departments, near to the mountain ranges of La Montagne Noire and Les Corbières, Southern France, which were very different from the populations of La Montagne Noire located immediately to the North, known to host topotypic *Salamandra s. terrestris* Bonnaterre, 1789 (Hernandez, 2016; Figure 1). The habitat is located on a karstic massif with forests mainly composed of evergreen oaks such as *Quercus ilex* and shrubs containing a small shallow stream surrounded by vineyards (Figure 2). Caves are also present in this location and could favour salamanders to survive during warm periods of summer when temperatures grow up to 38°C. Seventeen larvae have been observed on January 2004 in patches of a stream with no flowing water after rains. Some other larvae have been observed in other months, and larvae laying

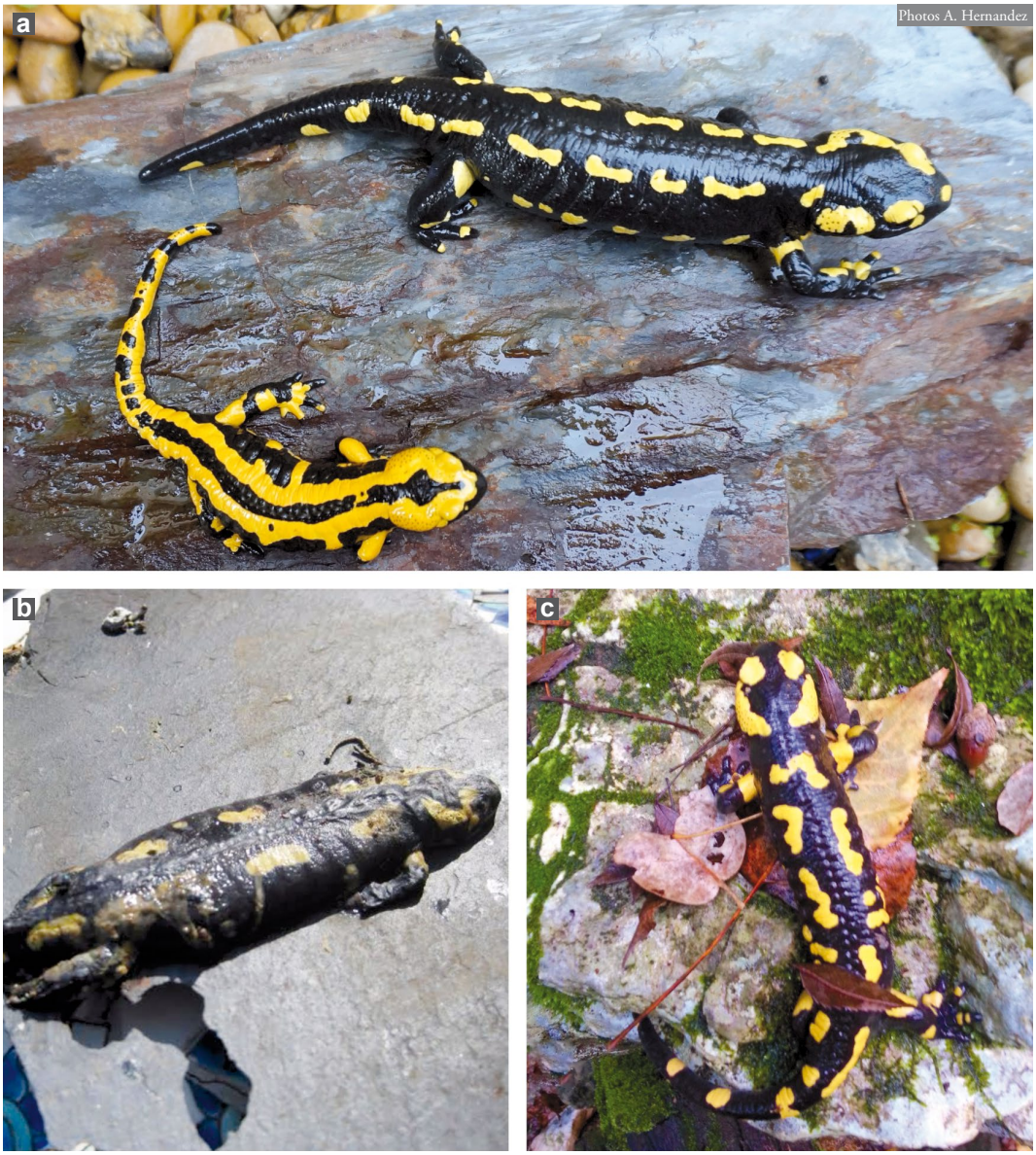

Figure 1: a) *S. s. terrestris* (*S. s. quadrivirgata*) from Solling-Vogler Massif (bottom) compared to one adult female from the Minervois Giant Salamander (top). b) Large individual of the new population found dead in a swimming pool. c) Adult male in its habitat.

Figura 1: a) *S. s. terrestris* (*S. s. quadrivirgata*) de Solling-Vogler Massif (abajo) comparada con una hembra adulta de Salamandra Gigante de Minervois (arriba). b) Gran individuo de la nueva población encontrado muerto en una piscina. c) Hembra adulta en su hábitat.

seems to depend of precipitations all over the year because many larvae were also found in August after hard rains.

The species possibly has a limited occurrence, restricted to this location because severe aridity doesn't allow amphibians

Figure 2: a) Habitat of the new population surrounded by vineyards. b) Breeding pond from the new locality in the Minervois area, Languedoc.
Figura 2: a) Hábitat de la nueva población rodeada de viñedos. b) Estanque de reproducción de la nueva localidad en la zona de Minervois, Languedoc.

life underground. For instance, the nearest known population of salamanders lives as far as around 50 km from this new location in the Minervois in La Montagne Noire (Hernandez, 2016). A large adult female of 280 mm in total length has been found dead in a swimming pool during summer 2013 at about 10 km from the spot where we found the main population (Figure 1b). This finding shows maybe a larger distribution in the southern territory of Languedoc including the Aude department where local people have recorded some individuals in the past thirty years in Ouveillan and Rabette (Baillat personal communication).

Thus, in 32 adult individuals of the new population some preliminary morphological differences were observed: Adults of both sexes are much bigger (SVL of about + 20% than the nearest population known from La Montagne Noire), with a reduction of yellow pigment, short tail and a pointed snout. According to Raffaëlli (2013) the maximum length in females in the nominative form usually is no more than 230 mm. (Figure 1), when average length of subspecies *S. s. terrestris* is between 160 and 180 mm, with a maximum TL size known of 220 mm. The larvae too are much larger than the ones recorded from La Montagne Noire. The dorsal and lateral yellow spots of the adults of the new population are mostly arranged in interrupted lines and spots corresponding to the classical pattern of *Salamandra. s. salamandra* subspecies, known to occur in Southeastern France. The yellow spots on the dorsolateral parts of adults individuals observed are relatively scarce and irregular, leaving a large proportion of black pigment, recalling the dorsal pattern of the nominal subspecies (Figure 1c). The tail is remarkably short especially in females and the head has a rather

triangular shape, compared with many specimens of *S. s. terrestris*. This last subspecies is known to be very variable in morphology as previously reported (Raffaëlli, 2013; Hernandez, 2016; Figure 1a). Several isolated populations, especially in Northern Germany, have been found, presenting particular dorsal pattern and morphological variations. One lives in Harburger Berge (North of lower Sax) not far from Hamburg, characterized by a large size, broad head and intensive irregular yellow spots (Giesenberg, 1991). Another population has been registered in Solling-Vogler mountains (South of lower Sax, North of Germany) which might be an ecotype or a local form known by a particular dorsal pattern and shape (from broad yellow to red lines leaving a reduced jet black pigment on the center of the head and the back), for which the name *Salamandra. s. quadrivirgata* Dürigen, 1897 was given then recognized by Mertens (1984) and then synonymized with *S. s. terrestris* by Eiselt, 1958. *Salamandra salamandra hispanica* Wolterstorff, 1937, described from the Montseny Massif, Barcelona area, in Catalunya, is characterised by a short tail, triangular head and frequently the absence of well delimited dorsal yellow bands recalling partially the new population. According to Rivera *et al.* (2014) and Donaire-Barroso *et al.* (2014) who compared dorsal patterns of numerous specimens from Spain with specimens from Central Europe, this subspecies could be valid or close to the nominal subspecies of Southeastern France even if no genetic studies confirm it to this date. We suggest that the Minervois giant population of *Salamandra salamandra* looks similar to the nominal subspecies in size and global pattern and to *Salamandra s. hispanica* not recognized anymore. Pending molecular works, Minervois giant salamander represents actually a relict population leaving in hard and xeric conditions, which is a special ecotype endemic to the Languedoc. Further studies, especially molecular, should be undertaken to confirm the taxonomical status of this population.

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