

Salamandra algira splendens and *Pleurodeles waltl* in Moroccan caves; new distributional records

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The Mediterranean Basin is a global hotspot of biodiversity, exhibiting high levels of endemism and is considered an important centre of diversification for Amphibians (Bons & Geniez, 1996; Schleich et al., 1996). Two urodeles species are distributed throughout Morocco: *Pleurodeles waltl* and *Salamandra algira* (Escoriza & Ben Hassine, 2015). They both are threatened by loss of their habitat and pollution (Hernandez, 2017). *Pleurodeles waltl* occurs also in Spain and Portugal. In Morocco, the species is mainly found within the Atlantic lowlands ranging from Tangier southwards to Essaouira, where it generally occupies temporary ponds and flooded fields (Bons & Geniez, 1996; Schleich et al., 1996; Beukema et al., 2013). Several fragmented populations are also found in the western Rif at Chefchaouen, and in eutrophic lakes of the Middle-Atlas Mountains such as Daït Ifrah and Daït Aoua near Ifrane (Hernandez, 2017). *Salamandra algira* is the only species of the genus *Salamandra* present in North Africa (Bons & Geniez, 1996; Schleich et al., 1996). Its distribution comprises northern Morocco up to north-eastern Algeria (Escoriza & Ben Hassine, 2015). Its presence in Tunisia is questionable (Ben Hassine & Nouira, 2012; Bogaerts et al., 2013). Several subspecies and genotypes are known to occur in isolated populations confined to humid to sub-humid mountainous areas containing forests; *S. algira tingitana* in the Tingitana Peninsula (northern Morocco) including Ceuta (Spain), *S. algira splendens* in the north-eastern Middle Atlas and Rif mountains (northern Morocco), and *S. algira spelaea* in the Beni Snassen mountains (north-eastern Morocco), being restricted the nominotypical form to northern Algeria (Raffaëlli, 2013; Ben Hassine et al., 2016). Recently, new localities were reported for *S. algira splendens* that improve our understanding of its biogeography through Morocco; the easternmost population in central Rif Mountains was recently found in the Bokkoyas massif at Al Hocéima around caves (Hernandez & Escoriza, 2017; See Fig. 1. A, B, C); and the southernmost record was discovered in Jbel Sidi Ali, central Middle Atlas, at 190 km south of the current distribution range (Hernandez, 2018).

Some authors discussed the presence of these urodeles in Moroccan caves where habitats are poorly vegetated and where the species live under xeric and hard arid conditions (Escoriza & Comas, 2007; Beukema et al., 2013; Hernandez & Escoriza, 2017; Hernandez, 2017, 2018). In this short communication new localities for *S.*



Figure 1. **A.** Adult female of *S. algira splendens* found under rocks near to the Mediterranean sea at 214 m a.s.l in Al Hocéima, Rif Mts, Morocco. **B.** Cave used as a refuge for this population. **C.** Young juvenile measuring 18 mm found near the cave. This population is suspected to be viviparous and occurs under xeric conditions.

algira splendens and *Pleurodeles waltl* found in Moroccan caves are described. During field work (12 February to 15 April 2017), six adult *S. algira splendens* were found at Tabehirte, Grotte de Chaâra, Taza region, north-eastern Middle Atlas ($33^{\circ}57'24.336''$ N, $4^{\circ}14'44.957''$ O) which is located 1213 m above sea level. The adults were found in a large chamber of the cave that included a permanent stream (See Fig. 2. B; two individuals are shown on Fig. 2. A, C). On the Atlantic coast, one adult female of *P. waltl* was found at Cap Beddouza, grotte de Ghar-Goran, north of Safi ($32^{\circ}33'22.278''$ N, $9^{\circ}15'5.774''$ O) located 34 m a.s.l (Fig. 3. B, C). The specimen was observed on the ground characterised by clay soil (Fig. 3. A).

These observations indicate use of caves for urodeles as already reported for Morocco in *S. algira* (Escoriza & Comas, 2007; Beukema et al., 2013; Hernandez & Escoriza, 2017); but also for *P. waltl* in Portugal (Herrero & Hinckley, 2014). Moreover, Chaâra cave is near Ikfou Ouan cave where specimens were already observed during speleological expeditions (Camus & Lamouroux, 1981; Ayoub pers. obs.). This habitat use seems to be a widespread phenomenon that may be linked to specific biogeographical factors of regions characterised by Mediterranean climates

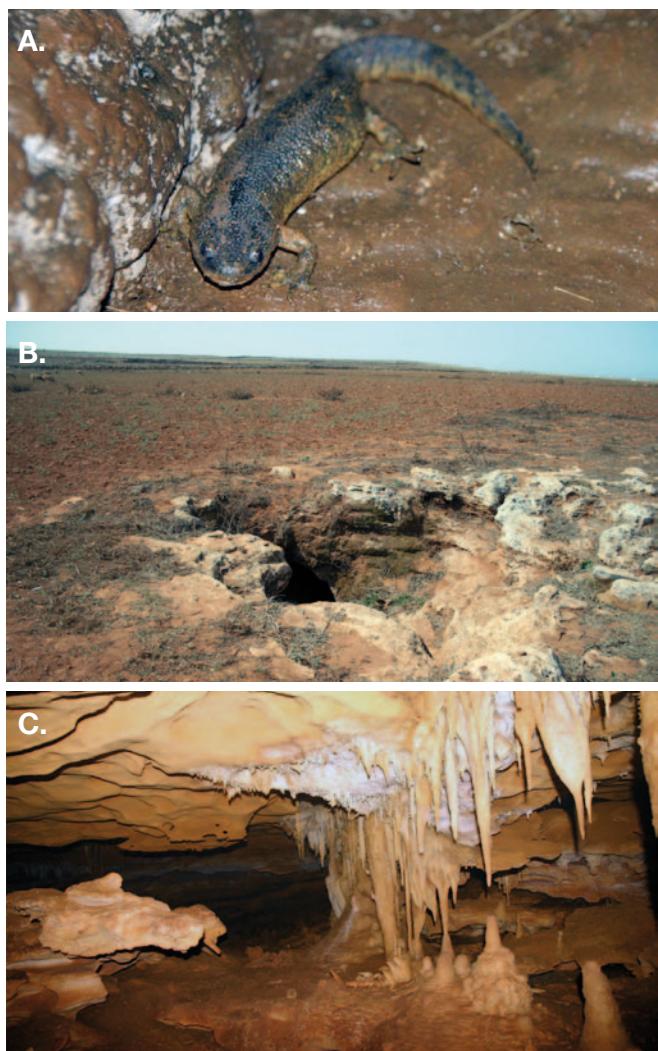


Figure 2. **A.** Adult female of *P. waltl* found at Cap Beddouza, grotte de Ghar-Goran, north of Safi. **B.** General view of the cave from the outside. **C.** The large chamber in the cave where the specimen was recorded. Pictures: Ayoub Nehili.

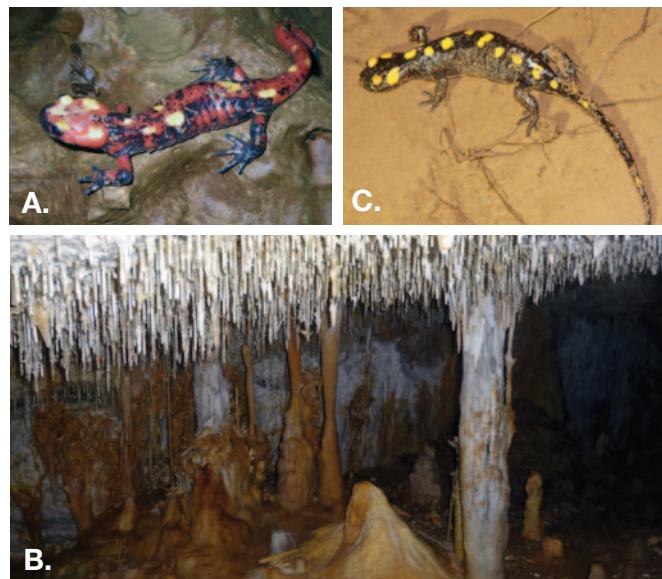


Figure 3. **A.** Adult male of *S. algira splendens* showing red discolouration marks on the dorsal part discovered at Grotte de Chaâra, Taza region, north-eastern Middle Atlas. **B.** Habitat view in the cave. **C.** Another adult female specimen found in the same habitat. Pictures: Ayoub Nehili.

with dry and warm summer periods (Manenti et al., 2017; Balogová et al., 2017; Hernandez, 2017). The environment of caves with groundwater and stable humidity play an essential role as refugia for urodeles (Hernandez, 2017). These habitats are also used as winter shelters, hiding places during the active season, feeding habitats and also as regular breeding sites in some cases (Herrero & Hinckley, 2014; Manenti et al., 2017; Balogová et al., 2017). However, the finding of just one specimen of *P. waltl* at Cap Beddouza, grotte de Ghar-Goran during the reproductive season of the species could be also explained by the fact that the specimen fall and become trapped in this cave. New studies are needed to understand the new cryptic and threatened populations within Morocco. Thus, the occurrence of salamanders in Moroccan caves can be an important refuge. This particular use need further assessments to improve our knowledge on their behaviour and distribution especially in poorly surveyed areas localised under xeric and hard arid conditions.

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