Northern coastal populations of *Pelobates varaldii* Pasteur & Bons, 1959: new breeding ponds and proposal for their conservation

The Moroccan Spadefoot Toad, *Pelobates varaldii* Pasteur & Bons, 1959, is the only species of the family Pelobatidae present in Africa. It is endemic to the coastal plains of northern Morocco between Tanger and Oualidia (Bons & Geniez 1996; de Pous et al. 2012; Frost 2015). This species is classified as endangered according to the IUCN Red List categories (Salvador et al. 2012) due to habitat loss and degradation, and introduction of exotic fishes and crayfish (García et al. 2010; de Pous et al. 2012). *Pelobates varaldii* is considered the most stenoecious Moroccan amphibian species (Beukema et al. 2013), occupying the surroundings of Mediterranean temporary ponds situated at low altitudes on sandy soils with significant tree cover (de Pous et al. 2012; Beukema et al. 2013). Nevertheless, this species can be found punctually in regions with other types of substrate and minor tree cover, as in the surroundings of

Fig. 1: Locality #1, breeding pond of *Pelobates varaldii* PASTEUR & BONS, 1959, in the north of the Province of Larache, Morocco (between the cities of Larache and Asilah at 35°16'42.7"N, 6°04'05.2"W). Photo: Alicia Talavera Júdez.

Oualidia on rocky soils (DE POUS et al. 2012) or in the recently discovered population of Ben Slimane, in a treeless area surrounded by agricultural fields and a sandstone/schistous substrate (ESCORIZA & BEN HASSINE 2013).

The northernmost populations of *P. varaldii* live in the Tingitan Peninsula, Prefecture of Tanger-Asilah and the Province of Larache. Within the prefecture, only two aquatic localities are known, one in Houara consisting of three ponds less than 100 m apart from each other, surrounded by a mixed forest of *Eucalyptus* trees, oaks and pine trees (LAPEÑA et al. 2011; pers. obs.) and a second one, a single pond in a pine, *Eucalyptus* and oak forest fragment (DE POUS et al. 2012; pers. obs). Both places are located at less than 700 m of the Atlantic Sea and separated by a distance of 6.32 km from each other. The province of Larache holds a higher number of registered populations, mainly between Larache and Ksar El Kebir (BEUKEMA et al. 2013).

In this note, the authors report on unknown breeding ponds (localities #1 and #2) for *P. varaldii*, discovered during January 2015 through the observation of larvae and clutches. The larvae were identified by their oral disc features and pigmentation following SCHLEICH et al. (1996) and BEUKEMA et al. (2013). The locations described below lie in two types of habitat: a clay soil area with abundant tree cover, and an area of loose sandy soil devoid of trees, both in the Tanger-Tetouan region.

Locality #1, located between the cities Larache and Asilah (35°16'42.7"N, 6°04' 05.2"W) is a muddy livestock pond surrounded by *Quercus suber* forest with clay soil and close to National Road N1 (Fig. 1). Two egg clutches of *P. varaldii* found in this pond comprised recently hatched embryos. The pond was scarce in macrophytes, and it contained larvae of *Hyla meridionalis* BOETTGER, 1874, and *Discoglossus scovazzi* CAMERANO, 1878, plus a high density of the crustacean *Streptocephalus torvicornis*.

Fig. 2: Locality #2: Coastal shallow pond at Houara in the Prefecture of Tanger-Asilah, Morocco, at 35°38'9.43"N, 5°58'28.76". Breeding site of *Pelobates varaldii* Pasteur & Bons, 1959. Photo: Alberto Sánchez-Vialas.

Locality #2, a coastal stretch of 1.6 km, is located between the previously reported breeding ponds (Lapeña et al. 2011; de Pous et al. 2012) within the Prefecture of Tanger-Asilah (35°38'9.43"N, 5°58'28.76" W). It contains a chain of seasonal ponds of different sizes and hydroperiods, arranged in parallel to the shoreline along an inshore depression of 4 m below sea level (Fig. 2). The soil is loose and sandy; there are cultivated fields and scattered shrubs (*Chamaerops humilis* and *Pistacia*) in the otherwise treeless area.

Larvae of *P. varaldii* were found in the three largest ponds, which were separated by 200 m and 500 m from each other. It is noteworthy the presence of larvae in a relatively shallow pond of 9,647 m², with maximum depth of 40 cm in the rainy season. The other ponds were deeper with surfaces of 18,200 m² and 19,100 m², respectively.

Moreover, these ponds contained larvae of *H. meridionalis*, *D. scovazzi* and *Pleurodeles waltl* Michahelles, 1830, which (unlike *P. varaldii*) were also present in most of the other smaller sized ponds of the area, being the last species the most common one. The crustaceans *Triops mauritanicus*, *Cyzicus bucheti* and *Streptocephalus torvicornis* were among the most abundant arthropods found. Diving beetle (Dytiscidae) larvae (water tigers) were common and seen to prey on *P. varaldii* larvae. The ponds were covered by *Ranunculus* sp. (90-98 % of the water surface). Examination of droppings of *P. varaldii* larvae demonstrated that this macrophyte is part of their diet, given the presence of non digested remains in the feces.

The population size was considerable based on larvae abundances estimated through catch per unit effort (CPUE) (authors' unpublished data). The big developmental and size differences (total lengths 2 - 8 cm, with leg buds absent or present) among some of the larvae indicated the existence of different cohorts. The close vicinity of the ponds (22 m – locality #1;

219 m - locality #2) to National Road N1 may adversely affect the population by overrunning of migrating individuals and by street runoff (CARR & FAHRING 2001). Also, the possible use of agrochemicals in locality #2 in the nearby cultivated fields, could influence amphibian survival (ROHR et al. 2008). Another potential threat to locality #2 (besides nearby expanding urban development) is climate change. It is expected that these freshwater ponds will disappear in the long run when the sea level rises (RAHMSTORF 2007), given their closeness to the sea and location in a depression (-4 m).

The importance of locality #2 relies on the fact that the implementation of simple purposeful conservation actions such as habitat protection through microreserves, vegetation restoration in some parts of the coastline and creation of new ponds that act as a corridor among populations would connect the endangered airport population (DE POUS et al. 2012) with the one in Houara (LAPEÑA et al. 2011) by a strip of coastal habitat promoting gene flow and increasing the chance of survival.

Future conservation efforts should take into account that, although the species is known to use forestal habitats and deep ponds for reproduction, it might, in some parts of its range, also thrive in places that lack these features. This note also highlights the importance of unfragmented coastal habitats as migratory corridors between the northern populations of the species and of further field studies that should be carried out in the north of the Province of Larache (locality #1) to estimate the state of this *P. varaldii* population.

AKNOWLEDGMENTS: This work received the support of the Hassan II Academy of Sciences and Technics (ICGVSA project: Impact of Global Change on the Semi-aquatic Vertebrates along a Mediterranean to Pre-Saharan gradient). It was authorized by the High Commissariat for Water and Forest (Morocco), Scientific Permits 234/12 HCEFLCD/DLCDPN/DPRN/CFF and 05/2013 HCEFLCD/DLCDPN/DPRN/CFF. The authors would like to thank Daniel ESCORIZA, Wouter BEUKEMA and Mario GARCÍA PARÍS for advice and helpful information.

REFERENCES: BONS, J. & GENIEZ, P. (1996): Amphibiens et reptiles du Maroc (Sahara Occidental compris) : atlas biogéographique = Anfibios y reptiles de Marruecos (incluido Sahara Occidental) : atlas biogeografico = Amphibians & reptiles of Morocco (including Western Sahara) : biogeographical atlas. Barcelona (Asociación Herpetológica Española), pp. 319. CARR, L. W. & FAHRIG, L. (2001): Effect of road traffic on two amphibian species of differing vagility.- Conservation Biology, Malden; 15 (4), 1071-1078. DE POUS, P. & BEUKEMA, W. & DINGEMANS, D. & DONAIRE, D. & GENIEZ, P. & EL MOUDEN, E.H. (2012): Distributional review, habitat suitability and conservation of the endangered and endemic Moroccan spadefoot toad (*Pelobates varaldii*).- Basic and Applied Herpetology, Salamanca, Madrid; 26: 57-71. ESCORIZA, D. & BEN HASSINE, J. (2013): New record of *Pelobates varaldii* in the region of Ben Slimane (northern Morocco).- Herpetological Bulletin, London; 124: 26-27. FROST, D. R. (2015): Amphibian species of the world: an online reference. Version 6.0. WWW database accessible at < http://research.amnh.org/herpetology/ amphibia/index.html >. American Museum of Natural History, New York, USA [last accessed: 31 October, 2015]. GARCÍA, N. & CUTTELOD, A. & ABDUL MALAK, D. (2010): The status and distribution of freshwater biodiversity in northern Africa. Gland, Cambridge, Malaga (IUCN), pp. 141. LAPEÑA, M. & BARBADILLO, L. J. & MARTÍNEZ-SOLANO, I. (2011): Geographic distribution. *Pelobates varaldii*.- Herpetological Review, New York; 42: 108. RAHMSTORF, S. (2007): A semi-empirical approach to projecting future sea-level rise.- Science, Washington; 315 (5810): 368-370. ROHR, J. R. & SCHOTTHOEFER, A. M. & RAFFEL, T. R. & CARRICK, H. J. & HALSTEAD, N. & HOVERMAN, J. T. & JOHNSON, C. M. & JOHNSON, L. B. & LIESKE, C. & PIWONI, M. D. & SCHOFF, P. K. & BEASLEY, V. R. (2008): Agrochemicals increase trematode infection in a declining amphibian species.- Nature, London; 455: 1235–1239. SALVADOR, A. & DONAIRE-BARROSO, D. & SLIMANI, T. & EL MOUDEN, E. H. & GENIEZ, P. (2004): *Pelobates varaldii*. The IUCN Red List of Threatened Species 2004: e.T58054A11723994. WWW document available at < http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T58054A11723994.en >. [last accessed: 1 November, 2015]. SCHLEICH, H. H. & KÄSTLE, W. & KABISCH, K. (1996): Amphibians and reptiles of North Africa. Koenigstein (Koeltz Scientific Books), pp. 627.

KEY WORDS: Amphibia: Anura: Pelobatidae, *Pelobates varaldii*; endangered species, new breeding ponds, threat, conservation, habitat, ecology, temporary ponds, Morocco

SUBMITTED: December 14, 2015

AUTHORS: Alberto SÁNCHEZ-VIALAS (Corresponding author < albertosv@mncn.csic.es >) [1], Arlo HINCKLEY [2], Alicia TALAVERA [3] & Tahar SLIMANI [4]

[1] Departamento de Biodiversidad y Biolología Evolutiva. Museo Nacional de Ciencias Naturales (MNCN-CSIC), c/ José Gutiérrez Abascal, 2, 28006, Madrid, Spain.

[2] Estación Biológica de Doñana (EBD-CSIC), Conservation and Evolutionary Genetics Group, Avda. Americo Vespucio s/n, Sevilla 41092, Spain.

[3] Instituto de Hortofruticultura Subtropical y Mediterránea 'La Mayora' (IHSM-UMA-CSIC), 29750 Algarrobo-Costa, Málaga, Spain.

[4] Cadi Ayyad University, Faculty of Sciences Semlalia. Laboratory Biodiversity and Ecosystem Dynamics. PO Box 2390. Marrakech 40000. Morocco.