New records for the reptile fauna of the Tichka plateau (western High Atlas, Morocco)

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Resumen: El páramo de Tichka es un altiplano remoto localizado en el Alto Atlas occidental de Marruecos. En esta nota comunicamos la presencia de 12 especies de reptiles detectadas en la planicie en mayo de 2019. Proporcionamos la primera presencia de *Quedenfeldtia trachyblepharus* y *Chalcides montanus* en el Alto Atlas occidental, y *Atlantolacerta andreanskyi* y *Coronella girondica* en el páramo de Tichka. Además, aportamos un nuevo límite altitudinal (2.700 m) para *Psammodromus algirus* en Marruecos, así como dos nuevas localidades para *Vipera monticola* dentro del páramo de Tichka.

Morocco is one of the countries with the richest herpetofauna of the Mediterranean Basin, with at least 12 species of amphibians and 95 species of reptiles recognized so far, about 25% of which are endemic (Cox *et al.*, 2006; Bons & Geniez, 1996; Pleguezelos *et al.*, 2010; Martínez del Mármol *et al.*, 2019). Covering an area of more than 400,000 km^2 (Schlüter, 2006), this country includes a wide variety of climates, habitats and topographic features. Such heterogeneity is one of the main factors supporting Moroccan herpetological diversity (see Blondel *et al.*, 2010; Martínez del Mármol *et al.*, 2019).

Morocco is one of the best sampled areas of the Maghreb, and the distribution of many of its amphibians and reptiles is relatively well known (see Bons & Geniez, 1996; Martínez del Mármol *et al.*, 2019). However, some regions of the country have been, so far, poorly surveyed, and range extensions for certain species have been reported in recent times as a result of increased fieldwork in this area during the last few years (e.g., Barata *et al.*, 2011; Koleska *et al.*, 2018; Kane *et al.*, 2019).

The Tichka Plateau (30°54'00"N / 8°37'48"W) is a 2,700 m high tableland located at approximately 170 km south-west of Marrakech, in the Western High Atlas Mountains' range (Figure 1a, b). Consisted of relatively flat terrain dominated by granitic substrates, it is characterized by sub-humid and humid Mediterranean climates (700 ml of mean annual precipitation; Hijmans *et al.*, 2005) as well as very cold winters (6.6 º C of mean annual temperature; Hijmans *et al.*, 2005) coupled with snow cover lasting between 4 to 5 months of the year (Haroni *et al.*, 2009). The plateau's vegetation is composed of thorny bushes and grasslands, with small streams converging in the "oued Nfis" (Figure 1c). Human activities in the area almost exclusively revolve around traditional farming (Haroni *et al.*, 2009), evidently shown by the presence of ovines and abundant cattle manure seen in the plateau.

In this note, we report distributional and altitudinal records for all the reptile species encountered in the Tichka Plateau and access path from the locality of Tigouga (30°50'49.85"N /

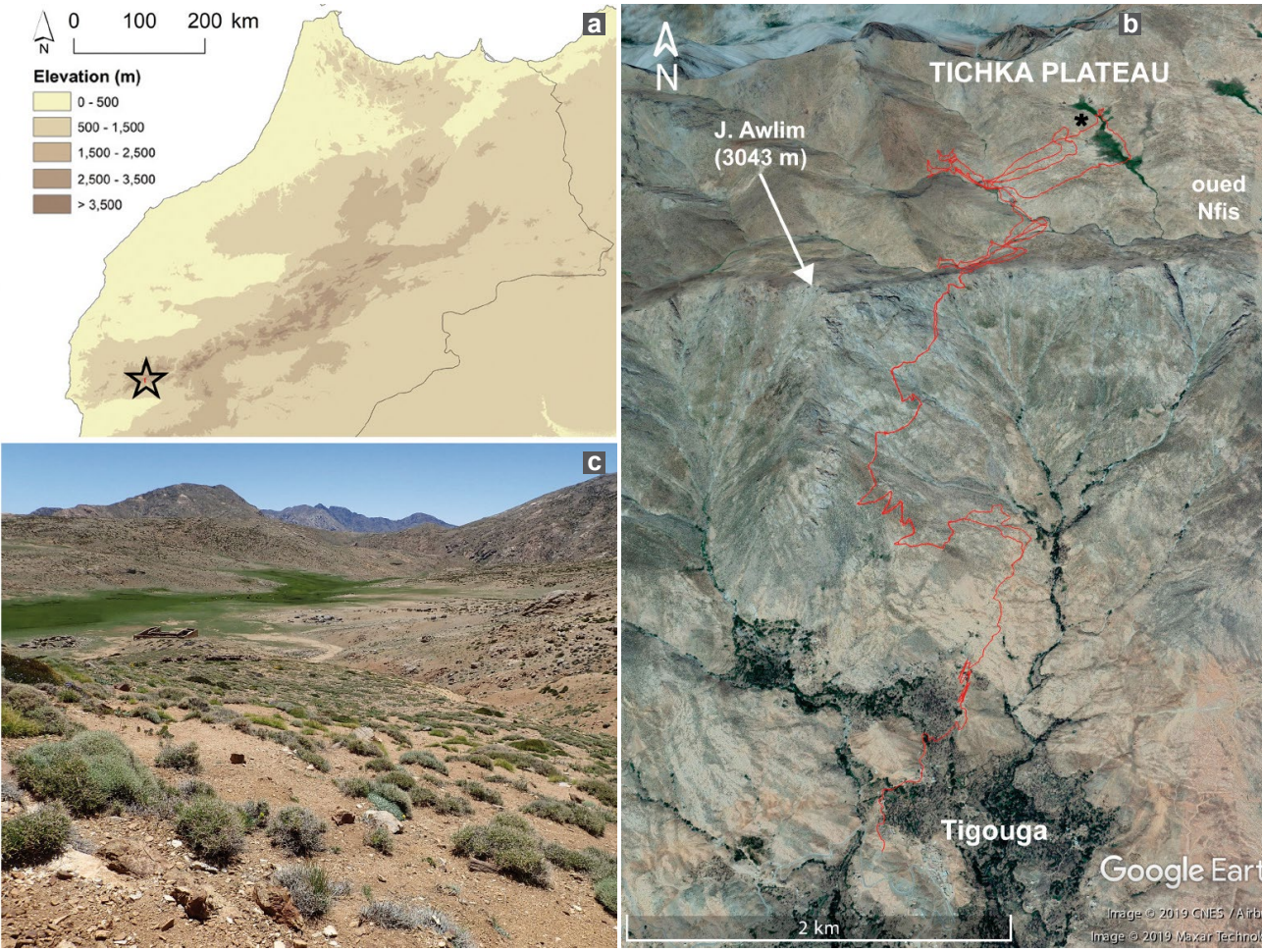

Figure 1: a) Location (star) of the Tichka Plateau in Morocco. b) Zoom into the Tichka plateau region and adjacent area of access, depicting the route of access and sampling (in red). c) View of the landscape taken from one of the higher areas sampled in the Tichka Plateau (signalled with an * in b).

Figura 1: a) Localización (estrella) del páramo de Tichka en Marruecos. b) Aproximación a la región del páramo del Tichka y el área adyacente de acceso, mostrando la ruta de acceso y muestreo (en rojo). c) Vista del paisaje tomada desde una de las áreas más altas muestreadas en el páramo de Tichka (señalada con un * en b).

8°36'58.70"W; 1,800 masl) during herpetological sampling sessions performed from the 8th to the 10th of May 2019. The main objective of the fieldwork performed in the Tichka Plateau was to sample the Atlas Dwarf Viper *Vipera monticola* (*V. latastei-monticola* complex; see Freitas *et al.*, 2018), to assess evolutionary and conservation units within this species. The five authors were the only people involved in the fieldwork sessions, performing visual encounter surveys and turning stones along defined transects. Records were gathered with a GPS and are expressed in 1x1 km UTM squares (WGS 1984 datum).

In total, we recorded 12 species of reptiles in the Tichka Plateau and along the path taken to access the Plateau, representing a sampling area of 11 1x1 km UTM squares (Table 1). Altitudinal range covered during fieldwork went from

Table 1: List of reptile species detected in the Tichka Plateau and access path from the locality of Tigouga. Approximate number of specimens detected, and 1x1 km UTM square (29R NQ) and elevation range for their location are reported.
Tabla 1: Lista de las especies de reptiles detectadas en el páramo de Tichka y camino de acceso desde la localidad de Tigouga. Se muestra el número aproximado de especímenes detectados, la celda UTM 1x1 km (29R NQ) de la localización y la elevación o rango de la ocurrencia de los especímenes.

Family, species	n	1x1 km UTM square	Elevation (m)
Family Sphaerodactylidae			
Quedenfeldtia moerens	> 10	3614-17, 3515–16	2250 – 2600
Q. trachyblepharus	> 100	3517–18, 3617–18, 3718	2600 – 2750
Family Phyllodactylidae			
Tarentola mauritanica	1	3613	1900
Family Scincidae			
Chalcides montanus	> 20	3518, 3617–18, 3718	2600 – 2750
Family Lacertidae			
Acanthodactylus erythrurus	1	3614	2250
Atlantolacerta andreanskyi	> 100	3517–18, 3617–18, 3718	2600 – 2750
Podarcis vaucheri	> 100	3515, 3516, 3518, 3616–18, 3718	2250 – 2750
Psammodromus algirus	4	3613-15, 3518	1900, 2100, 2200, 2701
Timon tangitanus	2	3617	2600
Family Agamidae			
Agama impalearis	2	3613, 3515	1800, 2250
Family Colubridae			
Coronella girondica	1	3618	2735
Family Viperidae			
Vipera monticola	10	3518, 3617–18	2600 – 2750

1,800 to 2,750 masl. Among the species detected, some deserve a particular mention: (1) the mountain endemics *Quedenfeldtia trachyblepharus* and *Chalcides montanus* (Figure 2a), which were not recorded in the mountain range, although some doubtful records were already reported for *Q. trachyblepharus* in the adjacent regions (Bons & Geniez, 1996; Martínez del Mármol *et al.*, 2019); (2) the mountain endemic *Atlantolacerta andreanskyi* and the Mediterranean *Coronella girondica* (Figure 2b), which were not recorded in the Tichka Plateau, although both species were found westwards (i.e. in adjacent squares in Bons & Geniez, 1996); (3) the Mediterranean *Podarcis vaucheri*, *Psammodromus algirus* (Figure 2c) and *Timon tangitanus*, which were reported in the adjacent lowland regions but not in the Tichka Plateau (Bons & Geniez, 1996; Martínez del Mármol *et al.*, 2019). Interestingly, one of our observations of *P. algirus* from the Tichka Plateau (Figure 2c) provides an increase (100 m) in the altitudinal range limit reported for this species in Morocco (2,600 m; Bons & Geniez, 1996; Martínez del Mármol *et al.*, 2019).

Vipera monticola (Figure 2d), previously reported for only one locality in the Tichka Plateau (Freitas *et al.*, 2018), was found in two additional areas within the plateau, corresponding to two new 1x1 km UTM squares (Table 1). The relatively high number of individuals recorded during fieldwork suggests a good conservation status for the *V. monticola* populations of the Tichka Plateau, particularly when compared to populations

Figure 2: Photos of selected species found in the Tichka Plateau. a) *Chalcides montanus,* b) *Coronella girondica*, c) *Psammodromus algirus*, d) *Vipera monticola*. Photos Fernando Martínez-Freiría (a, c), Ignazio Avella (b), and Nahla Lucchini (d).

Figura 2: Fotos de especies seleccionadas encontradas en el páramo de Tichka. a) *Chalcides montanus,* b) *Coronella girondica*, c) *Psammodromus algirus*, d) *Vipera monticola*. Fotos Fernando Martínez-Freiría (a, c), Ignazio Avella (b) y Nahla Lucchini (d).

from other mountain ranges in Morocco, such as the Jebel Sirwa (see Martínez-Freiria *et al.*, 2017). High numbers of specimens were also found for other montane (*Q. trachyblepharus*, *C. montanus*) and Mediterranean (*P. vaucheri*) species (Table 1). The proximity of the plateau to the Atlantic Sea (less than 120 km in straight line to the coast) is likely providing enough precipitation to sustain the humid environments that these species require, hampering the negative effects of climate change predicted for the region (see Martínez-Freiría *et al.*, 2013, 2017).

The collection of new distribution records for such generally common reptile species in just three days of sampling in the Tichka Plateau, reflects the limited prospection carried out in this region in the past years. Further fieldwork campaigns are needed in the area in order to better investigate the diversity and distributional

patterns of the plateau's reptile community. Like other mountain ranges in Morocco, the Tichka Plateau offers the possibility to conduct monitoring campaigns to assess changes in the herpetofauna community in response to climate change along its altitudinal range (e.g., Shah *et al.*, 2015; Barrows *et al.*, 2016). With respect to this, the finding of *P. algirus* at high elevation in montane habitats (i.e., xeric scrublands) suggests the expansion of Mediterranean species to colder/humid areas (e.g. Ferreira *et al.*, 2018). On the other hand, the evolutionary distinctiveness of *V. monticola* populations from Tichka Plateau (see Freitas *et al.*, 2018) suggests that populations of other species inhabiting this region could be also important from an evolutionary point of view (e.g., *Q. trachyblepharus*, *A. andreanskyii*; Barata *et al.*, 2012a, b). Therefore, genetic and conservation assessments are also required in order to coherently preserve the herpetofauna of the Western High Atlas.

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Expansión hacia el norte de la lagartija colirroja (*Acanthodactylus erythrurus*)

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La lagartija colirroja (*Acanthodactylus erythrurus*) se distribuye por el norte de África y gran parte de la península ibérica (Belliure, 2015). Tiende a ocupar hábitats con suelos poco compactados (arenas, margas y limos), vegetación dispersa y escasa pendiente. Encuentra estos sustratos en dunas costeras y grandes depresiones del interior (Belliure, 2015). Entre mediados del siglo XX y 2005 se ha registrado una expansión hacia el norte en su área de distribución ibérica (Moreno-Rueda *et al.*, 2012). Esto coincide con los nuevos escenarios ecológicos para la especie previstos por el aumento de temperatura en la península ibérica a lo largo del siglo XXI, con incremento en su distribución potencial de entre un 81 y un 88% (Araújo *et al.*, 2011).

En la década de 1970, en la distribución ibérica conocida de esta especie no se incluían regiones como Aragón y Cataluña (Salvador, 1974). Sin embargo, a principios del siglo XXI la distribución más septentrional ya incluía el norte de Portugal y llegaba a las provincias de Huesca, Lleida y Tarragona (Loureiro *et al.*, 2008; Belliure, 2015). En la provincia de Huesca las citas más septentrionales en la base de datos de la AHE (SIARE, 2019) coinciden con la vertiente meridional de las sierras exteriores del Prepirineo. Hay citas en Barbastro (año 2014) y a unos 20 kilómetros al sur de esta localidad (años 2015-2017). El 24 de agosto de 2015 se observó (Ramón-Henares, comunicación personal) un ejemplar de lagartija colirroja (Figura 1) en el valle del Aragón (camino de Monte Pano, término municipal de Jaca; cuadrícula UTM: 30T YN01; 42°33'52.80"N / 0°34'9.66"O; Figura 2). Esta cita amplía su