

Distribution and conservation status of *Emys orbicularis* in Morocco

GUILLERMO VELO-ANTÓN^{1,*}, BAHIJA EL MARNISI², UWE FRITZ³ & SOUMIA FAHD²

¹ CIBIO-InBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos da Universidade do Porto, Campus Agrário de Vairão, R. Padre Armando Quintas, 4485-661 Vairão, Portugal — ² Département de Biologie, Faculté des Sciences de Tétouan, Université Abdelmalek Essaâdi, Tétouan, Morocco — ³ Museum of Zoology, Senckenberg Dresden, A. B. Meyer Building, 01109 Dresden, Germany — * Corresponding author; guillermo.velo(at)cibio.up.pt

Accepted 20.iii.2015.

Published online at www.senckenberg.de/vertebrate-zoology on 4.v.2015.

Abstract

The distribution and conservation status of *Emys orbicularis occidentalis* is reviewed for Morocco. Populations are highly fragmented and vulnerable. The species is largely restricted to mountainous areas in the western Rif and Middle Atlas, with scattered observations of isolated individuals in the Gharb plain and the eastern Rif. Our literature survey and fieldwork indicate an accelerated regression of *Emys* populations along the Moroccan Atlantic coast due to habitat loss. At the same time, we found European pond turtles having a wider distribution in the Rif Mountains than previously known. However, in the central and western Rif, the species is increasingly threatened by expanding cannabis plantations. Other country-wide menaces include water pollution, catching of turtles for pets, desertification, and possibly competition with another terrapin species (*Mauremys leprosa*).

Key words

Emydidae; *Emys orbicularis occidentalis*; Morocco; North Africa; Testudines.

Introduction

The European pond turtle (*Emys orbicularis*) is a widespread species, distributed from the Maghreb region in North Africa through many parts of Europe, Turkey and the Caucasus region to the former Aral Sea (FRITZ 2003). Throughout its highly fragmented distribution range, the species is clearly in regression (*cf.* FRITZ & CHIARI 2013).

Comprehensive, nearly rangewide phylogeographic studies have identified nine genetic lineages of *E. orbicularis* and elucidated its evolutionary history (e.g. LENK *et al.* 1999; FRITZ *et al.* 2007; 2009; VELO-ANTÓN *et al.* 2008, 2011; PEDALL *et al.* 2011; STUCKAS *et al.* 2014; VAMBERGER *et al.* 2015). One of the genetic lineages, lineage VI, is distributed in Morocco and across most of the Iberian Peninsula (FRITZ *et al.* 2007; VELO-ANTÓN *et al.* 2011; STUCKAS *et al.* 2014), with a contact zone with two other lineages in northeastern Iberia (FRITZ *et al.* 2007;

PEDALL *et al.* 2011). Based on phylogenetic and population genetic data, all populations of lineage VI are now identified with the subspecies *E. o. occidentalis* (STUCKAS *et al.* 2014), which originated in North Africa and later colonized the Iberian Peninsula, with a subsequent northward range expansion across Spain and Portugal (VELO-ANTÓN *et al.* 2008).

The distribution of *E. o. occidentalis* is well known for Spain and Portugal (PLEGUEZUELOS 2002; LOUREIRO *et al.* 2010), and it has been a target species of numerous conservation projects throughout the Iberian Peninsula (AYRES *et al.* 2013; TEIXEIRA *et al.* 2013). In contrast, the present distribution and conservation status of Moroccan populations are still poorly known.

With this note we aim (i) to summarize all available distribution records for *E. o. occidentalis* in Morocco,

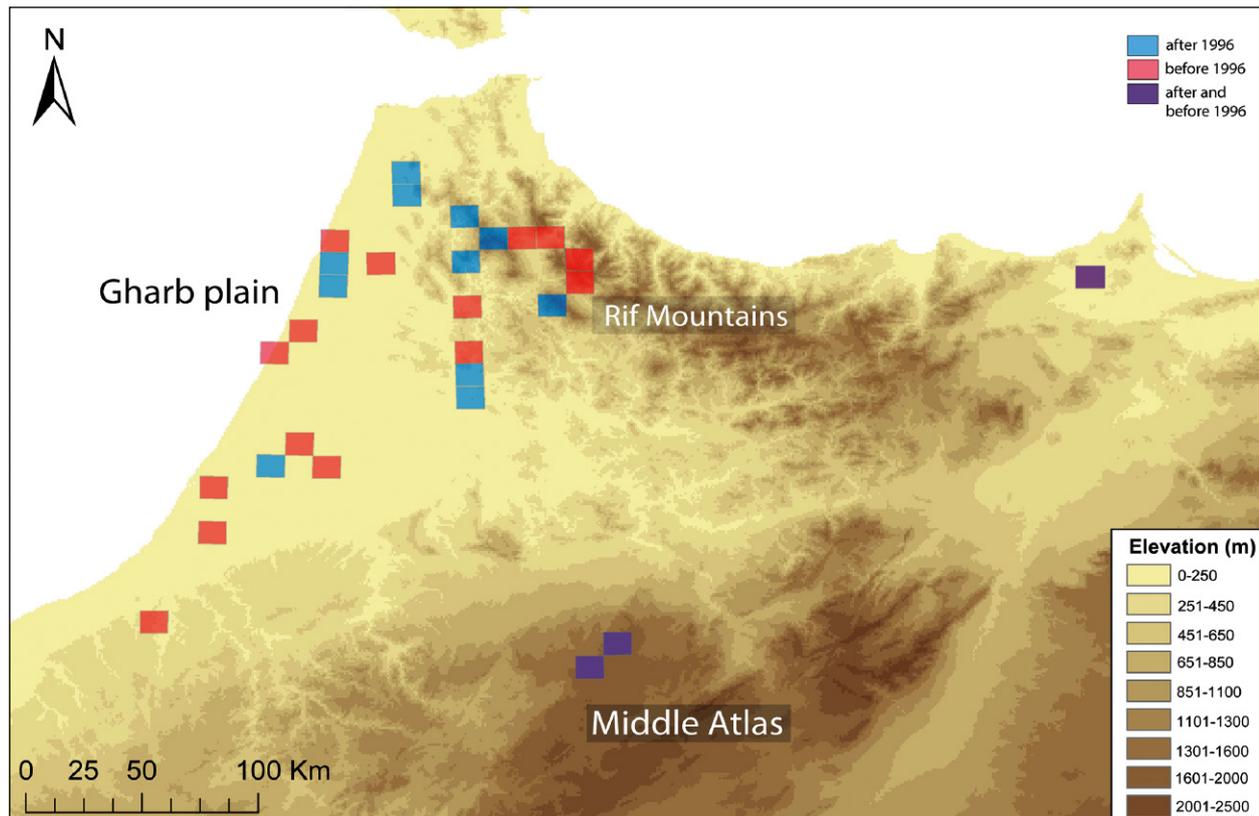


Fig 1. Records of *Emys orbicularis occidentalis* in Morocco. Coloured cells represent UTM squares (10 km). The three main regions (Gharb plain, Rif and Middle Atlas Mountains) where the species occurs are highlighted.

and (ii) to identify the major threats for Moroccan populations based on a literature review and own recent observations.

Materials and Methods

Here we review and summarize all previously published records of *Emys orbicularis occidentalis* for Morocco and combine these with our observations. We present all distribution data using an UTM grid (10 × 10 km) and distinguish between records after 1996 and before 1996, the year of publication of the distribution atlas by BONS & GENIEZ (1996). In Morocco, *E. o. occidentalis* is generally considered rare and as having a patchy distribution (FAHD & PLEGUEZUELOS 1996; FAHD *et al.* 2009; MATEO *et al.* 2003). The species occurs mostly within humid and sub-humid bioclimatic regions in small ponds and streams with abundant vegetation (BONS & GENIEZ 1996). For Morocco, its presence was reported for 21 localities corresponding to 13 UTM squares (BONS & GENIEZ 1996; Fig. 1), including the Middle Atlas Mountains (near Ifrane), the north-western Atlantic coast (Gharb plain), the Rif Mountains (Tingitana Peninsula), and isolated individuals in the eastern Rif (Oued Kert; FAHD & PLEGUEZUELOS 1992). Additional recent records were

published for the northern Rif (FAHD & PLEGUEZUELOS 1996; MATEO *et al.* 2003; DONAIRE *et al.* 2011), the Middle Atlas (FAHD *et al.* 2009), and the Jebala region (Tingitana Peninsula), with an isolated population at Jebel Haouch Ben Kre'aa (MEDIANI *et al.* 2009).

Distribution Records

Rif Mountains: The European pond turtle was observed until the end of the last century in different sites along the western part of the Rif (UTM 30S: TD67, TE80, TE90, UD09, UD09; BONS & GENIEZ 1996), and an isolated population was reported from the Oued Kert in the easternmost Rif (VD88; FAHD & PLEGUEZUELOS 1992). In this century, numerous fieldwork campaigns led to an increase of the known range in the western part of Rif (UTM 30S: TD63, TD64, TD97, TD69, TE61, TE70, TE42, TE43; MATEO *et al.* 2003; MEDIANI *et al.* 2009; DONAIRE *et al.* 2011; present study; Fig. 1). The species is frequently found in ponds and streams near Bouhachem and south of Bab Taza, even though recent efforts failed to record it in the mountains north of Bab Taza (Talassemiane National Park). In a small pond near Bouhachem, we have noticed declining individual numbers, from some dozens of European pond turtles found in 2009 to less

than 10 individuals in 2012, coinciding with the arrival of the Mediterranean stripe-necked terrapin *Mauremys leprosa*. A small and isolated *Emys* population occurs in the northwestern Rif (Jebel Haouch Ben Kre'aa) and a few isolated individuals were recently observed in several localities near Ouezzane. A major threat for the species in this area comes from cannabis plantations (FAHD *et al.* 2005), which are rapidly growing along the central and western Rif (LABROUSSE & ROMERO 2001) and increasingly threaten habitats (CHARCO 1999) by desiccating water bodies (e.g. Bab Taza surroundings, pers. observ.). These habitat alterations are also threatening species such as vipers (BRITO *et al.* 2011).

Emys orbicularis occidentalis is probably more widespread along the central Rif Mountains. However, the central Rif Mountains are a dangerous region with many cannabis dealers hampering surveys in this area. On the other hand, we could not confirm the presence of *E. o. occidentalis* in the Oued Kert (eastern Rif) during our field surveys. However, we could sample a captive individual from there during a trip in 2007, which was said to have been recently caught. The record in this isolated area (FAHD & PLEGUEZUELOS 1992) may result from migrating turtles from the eastern Rif Mountains, a region that has been also under-studied.

Using microsatellite and mitochondrial data, the Rif turtles are genetically differentiated from the populations of the Middle Atlas and Gharb plain (STUCKAS *et al.* 2014).

Gharb plain: During the last century, *Emys orbicularis occidentalis* was widespread in the Gharb plain (UTM 29S: QT03, QT27, QT29, QU51, QU60, QU45, QU56, QV60; UTM 30S: TD39; FAHD *et al.* 2009), but our recent fieldwork in this coastal region indicates massive habitat loss due to recent and intense human development (transformation of natural humid areas into crop, vegetable and cane fields, urbanization; CHARCO 1999; RAMDANI *et al.* 2001; CUTTELOD *et al.* 2008; FAHD *et al.* 2009). For the same reasons, local extinction of *Vipera latastei* has also been suggested (BRITO *et al.* 2011). Only a few isolated pond turtles have been observed in the southern Gharb plain (near Dar Gueddari; UTM 29S: QU40) and near Larache (UTM 29S: QU68-QU69; F. JIMÉNEZ CAZALLA pers. comm.). Two individuals from the southern Gharb plain (Kenitra province) grouped in population genetic analyses with the Middle Atlas populations (STUCKAS *et al.* 2014), but further work is needed for a better understanding of the genetic differentiation of possibly surviving remnant populations in the Gharb plain.

Middle Atlas Mountains: In these mountains, some populations have been studied during several surveys since 2008, which match with the UTM localities of BONS & GENIEZ (1996). These populations occur in several ponds near Sidi Mimoune (UTM 30S: UC12) and Ifrane (UTM 30S: UC01). Further surveys are needed to identify the current range of the species in this wide mountain region.

Discussion

It is obvious that populations of *Emys orbicularis occidentalis* are at present highly fragmented and vulnerable in Morocco. European pond turtles are now largely restricted to mountainous areas in the western Rif and in the Middle Atlas, with few additional observations of isolated individuals in the Gharb plain and the eastern Rif. The turtles from the Gharb plain might represent the last survivors of formerly abundant populations in this region (Fig. 1), which has been massively modified since the 1950s (FAHD *et al.* 2009). Accordingly, our literature and fieldwork surveys indicate an accelerated regression of *Emys* populations due to habitat loss in this area. At the same time, we found pond turtles having a wider distribution in the Rif Mountains than previously thought. However, in the central and western Rif, the species is increasingly threatened by expanding cannabis plantations. Other menaces include water pollution, catching of turtles for pets and desertification. Furthermore, in one population in the Rif, we observed a declining individual number, which could be associated with the recent arrival of the Mediterranean stripe-necked terrapin *Mauremys leprosa*, which could outcompete and displace European pond turtles. Finally, we wish to highlight the importance of further surveys for assessing the current situation of *E. o. occidentalis* in Morocco, which is the rarest turtle species in this country and much more endangered than *Testudo graeca*. For getting an accurate picture of the distribution range of *E. o. occidentalis*, any misidentifications and confusions with the abundant *M. leprosa* have to be excluded.

Acknowledgments

We thank M. Casal, F. Martínez-Freiría, J. C. Brito, P. Sierra, Z. Boratynski, J. Campos, S. Ferreira, C. García-Cardenete, F. Jiménez Cazalla, J. M. Pleguezuelos and U. Joger for assistance and companionship during fieldwork. GVA was supported by a post-doctoral fellowship from the Fundação para a Ciência e Tecnologia (FCT, Portugal: SFRH/BPD/74834/2010) and his work was funded by the Instituto de Estudios Ceutíes in 2012. Soumia Fahd's fieldwork for the present study was partially funded by two Heinz Schiemenz grants of DGHT.

References

- AYRES, C., ÁLVAREZ, A., AYLLÓN, E., BERTOLERO, A., BUENETXEA, X., CORDERO-RIVERA, A., CURCO-MASIP, A., DUARTE, J., FARFAN, M.A., FERRÁNDEZ, M., FRANCH, M., FORTUÑO, L., GUERRERO, J., HERNÁNDEZ-SASTRE, P.L., LACOMBA, I., LORENTE, L., MIGUELEZ-CARBAJO, D., PINYA, S., RADA, V., ROMERO, D., SÁNCHEZ, J., SAN-

- CHO, V. & VALDEÓN, A. (2013): Conservation projects for *Emys orbicularis* in Spain. – *Herpetology Notes*, **6**: 157–164.
- BONS, J. & GENIEZ, P. (1996): Amphibiens et reptiles du Maroc (Sahara Occidental compris). Atlas Biogéographique. – Barcelona (AHE).
- BRITO, J.C., FAHD, S., MARTÍNEZ-FREIRÍA, F., TARROSO, P., LARRES, S., PLEGUEZUELOS, J.M. & SANTOS, X. (2011): Climate change and peripheral populations: predictions for a relict Mediterranean viper. – *Acta Herpetologica*, **6**: 105–118.
- CHARCO, J. (1999): El Bosque Mediterráneo en el Norte de África: biodiversidad y lucha contra la desertificación. – Madrid (Agencia Española de Cooperación Internacional).
- CUTTELOD, A., GARCÍA, N., ABDUL MALAK, D., TEMPLE, H. & KATARIRIYA, V. (2008): The Mediterranean: A Biodiversity Hotspot under Threat. – In: VIÉ, J.C., HILTON-TAYLOR, C. & STUART, S.N. (Eds), *The 2008 Review of the IUCN Red List of Threatened Species*. Gland (IUCN), pp. 89–104.
- DONAIRE, D., DEL CANTO-GONZÁLEZ, R., BOGAERTS, S., PASMANS, F. & EL MOUDEN, H. (2011): Nuevas localidades para *Emys orbicularis occidentalis* Fritz, 1993 (Testudines: Emydidae) en el Rif (Noroeste de Marruecos). – *Butlletí de la Societat Catalana d'Herpetologia*, **19**: 125–129.
- FAHD, S. & PLEGUEZUELOS, J.M. (1992): L'Atlas des reptiles du Rif (Maroc): Résultats préliminaires. – *Bulletin de la Société Herpétologique de France*, **63**: 15–29.
- FAHD, S. & PLEGUEZUELOS, J.M. (1996): Los reptiles del Rif, I: Quelonios y saurios. – *Revista Española de Herpetología*, **10**: 55–89.
- FAHD, S., BENÍTEZ, M., BRITO, J.C., CARO, J., CHIROSA, M., FERICHE, M., FERNÁNDEZ-CARDENETE, J.R., MARTÍNEZ-FREIRA, F., MÁRQUEZ-FERRANDO, R., NESBITT, D., PLEGUEZUELOS, J.M., REQUES, R., PAZ RODRÍGUEZ, M., SANTOS, X. & SICILIA, M. (2005): Distribución de *Vipera latastei* en el Rif y otras citas herpetológicas para el norte de Marruecos. – *Boletín de la Asociación Herpetológica Española*, **16**: 19–25.
- FAHD, S., EL MARNISI, B., MEDIANI, M. & FRITZ, U. (2009): Zur Verbreitung und zum Bedrohungsstatus der Europäischen Sumpfschildkröte (*Emys orbicularis*) in Marokko. – *Elaphe*, **17**: 30–33.
- FRITZ, U. (2003): Die Europäische Sumpfschildkröte. – Bielefeld (Laurenti).
- FRITZ, U. & CHIARI, Y. (2013): Conservation actions for European pond turtles – a summary of current efforts in distinct European countries. – *Herpetology Notes*, **6**: 105.
- FRITZ, U., GUICKING, D., KAMI, H., ARAKELYAN, M., AUER, M., AYAZ, D., AYRES FERNÁNDEZ, C., BAKIEV, A.G., CELANI, A., DŽUKIĆ, G., FAHD, S., HAVAŠ, P., JOGER, U., KHABIBULLIN, V.F., MAZANAeva, L.F., ŠIROKÝ, P., TRIPEPI, S., VALDEÓN VÉLEZ, A., VELO ANTÓN, G. & WINK, M. (2007): Mitochondrial phylogeography of European pond turtles (*Emys orbicularis*, *Emys trinacris*) – an update. – *Amphibia-Reptilia*, **28**: 418–426.
- FRITZ, U., AYAZ, D., HUNSDÖRFER, A.K., KOTENKO, T., GUICKING, D., WINK, M., TOK, C.V., ÇIÇEK, K. & BUSCHBOM, J. (2009): Mitochondrial diversity of European pond turtles (*Emys orbicularis*) in Anatolia and the Ponto-Caspian Region: Multiple old refuges, hotspot of extant diversification and critically endangered endemics. – *Organisms, Diversity & Evolution*, **9**: 100–114.
- LABROUSSE, A. & ROMERO, L. (2001): Rapport sur la situation du cannabis dans le Rif marocain. – Paris (Observatoire français des drogues et toxicomanies, OFDT).
- LENK, P., FRITZ, U., JOGER, U. & WINK, M. (1999): Mitochondrial phylogeography of the European pond turtle, *Emys orbicularis* (Linnaeus 1758). – *Molecular Ecology*, **8**: 1911–1922.
- LOUREIRO, A., FERRAND DE ALMEIDA, N., CARRETERO, M.A. & PAULO, O.S. (Eds.) (2010): Atlas dos Anfíbios e Répteis de Portugal, 2nd Edition. – Lisboa (Esfera do Caos).
- MATEO, J.A., PLEGUEZUELOS, J.M., FAHD, S., GENIEZ, P. & MARTÍNEZ-MEDINA, F.J. (2003): Los Anfíbios, los Reptiles y el Estrecho de Gibraltar. Un ensayo sobre la herpetofauna de Ceuta y su entorno. – Ceuta (Instituto de Estudios Ceutíes).
- MEDIANI, M., AMEZIAN, M., IBN TAITOU, M., BENHOUSA, A., RGUIBI IDRISSE, H., EL AGBANI, M.A. & QNINBA, A. (2009): Nouvelles citations de deux espèces reliques paléarctiques, *Emys orbicularis* Linnaeus, 1758 et *Vipera latastei* Boscá, 1878 dans la Péninsule Tingitane (Rif occidental, Maroc). – *Bulletin de l'Institut Scientifique, Section Sciences de la Vie (Rabat)*, **31**: 99–102.
- PEDALL, I., FRITZ, U., STUCKAS, H., VALDEÓN, A. & WINK, M. (2011): Gene flow across secondary contact zones of the *Emys orbicularis* complex in the Western Mediterranean and evidence for extinction and re-introduction of pond turtles on Corsica and Sardinia (Testudines: Emydidae). – *Journal of Zoological Systematics and Evolutionary Research*, **49**: 44–57.
- PLEGUEZUELOS, J.M. (2002): Atlas y libro rojo de los anfibios y reptiles de España. – Madrid (Dirección General de Conservación de la Naturaleza).
- RAMDANI, M., FLOWER, R.J., ELKHIATI, N., KRAIEM, M.M., FATHI, A.A., BIRKS, H.H. & PATRICK, S.T. (2001): North African wetland lakes: characterization of nine sites included in the CASSARINA project. – *Aquatic Ecology*, **35**: 281–302.
- STUCKAS, H., VELO-ANTÓN, G., FAHD, S., KALBOUSSI, M., ROUAG, R., ARCULEO, M., MARRONE, F., SACCO, F., VAMBERGER, M. & FRITZ, U. (2014): Where are you from, stranger? The enigmatic biogeography of North African pond turtles (*Emys orbicularis*). – *Organisms Diversity & Evolution*, **14**: 295–306.
- TEIXEIRA, J., MARTINS, B., PALHAS, J., ALVES, A. & AZEVEDO, F. (2013): Conservation activities for the European pond turtle (*Emys orbicularis*) in Portugal. – *Herpetology Notes*, **6**: 153–155.
- VAMBERGER, M., STUCKAS, H., SACCO, F., D'ANGELO, S., ARCULEO, M., CHEYLAN, M., CORTI, C., LO VALVO, M., MARRONE, F., WINK, M. & FRITZ, U. (2015): Differences in gene flow in a twofold secondary contact zone of pond turtles in southern Italy (Testudines: Emydidae: *Emys orbicularis galloitalica*, *E. o. hellenica*, *E. trinacris*). – *Zoologica Scripta*, **44**: 233–249.
- VELO-ANTÓN, G., GARCÍA-PARÍS, M. & CORDERO RIVERA, A. (2008): Patterns of nuclear and mitochondrial DNA variation in Iberian populations of *Emys orbicularis* (Emydidae): conservation implications. – *Conservation Genetics*, **9**: 1263–1274.
- VELO-ANTÓN, G., WINK, M., SCHNEEWEISS, N. & FRITZ, U. (2011): Native or not? Tracing the origin of wild-caught and captive freshwater turtles in a threatened and widely distributed species (*Emys orbicularis*). – *Conservation Genetics*, **12**: 583–588.