

## Towards better management of European pond turtles (*Emys orbicularis*) in conservation programs

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The European pond turtle (*Emys orbicularis*) is considered a threatened species across its wide distribution from the northern Africa Maghreb region to Eastern Europe and adjacent Asia. Multiple threats push this species to local extinctions and population declines, some of which are commonly identified across its distribution: habitat fragmentation and/or destruction, invasive species, and pathogens.

For the last decade numerous initiatives lead by conservationists and herpetologists have engaged public and private administrators to protect this species at local and regional scales across most of the European countries. Recently, an important and necessary initiative has summarized these conservations actions aiming to increase public awareness regarding the risks faced by *Emys orbicularis*, and to share conservations practices developed at local and regional levels across the species distribution (Fritz and Chiari, 2013). Among the several conservation actions applied to reinforce *Emys* populations, captive breeding and/or translocations (including abandoned or confiscated individuals of unknown origin in zoos and recovery centers), are growing practices in conservation programs that have already been applied in some of the local conservation projects across the species distribution (France, Germany, Hungary, Italy, Portugal, Spain, Serbia, Switzerland and Turkey). While these actions could benefit *E. orbicularis* in specific circumstances (e.g. very low population sizes), we must be very cautious before applying these methods to avoid bad practices in species conservation. A crucial step that urges to include in these actions protocols is the knowledge of the genetic background of the turtles used in captive breeding and translocation programs. Phylogeographic studies in *E. orbicularis* have detected several mitochondrial lineages, which are likely explained by the isolation of populations in

southern refuges across its distribution during climatic oscillations (Lenk et al., 1999; Fritz et al., 2007, 2009; Sommer et al., 2007), and recent genetic studies unveiled cryptic lineages (the sister species, *E. trinacris*; Fritz et al., 2005) and new haplotypes (Fritz et al., 2009; Velo-Antón et al., 2011). These studies unveiled the evolutionary history of the species as a whole, but also the distinct lineages already identified. Conservation programs of *E. orbicularis* across European countries were recently summarized in a series of publications in Herpetology Notes (SPECIAL SERIES: *A summary of conservation actions for European pond turtles*). Some of these local projects included captive breeding and/or translocation actions in their goals, having mostly overlooked the genetic research on *E. orbicularis*, which aims to construct a feasible genetic procedure that serves to analyze genetically individuals of unknown origin with the ultimate purpose of release them and to reinforce wild populations. In this note I aim to highlight the need of genetic analyses in conservation programs of *E. orbicularis*, using the Iberian populations as a case study in which genetic assignment approaches have been already applied.

Molecular methods are being increasingly used to help enforce wildlife conservation laws. Multilocus genotyping (e.g. microsatellite markers) constitute a valuable and useful genetic tool to infer genetic structuring and to detect illegal translocations within and among species. The Iberian populations of the Ibero-Maghrebian lineage, distributed from northern Morocco tonortheasternSpain, have been genetically characterized. A genetic protocol has also been established in order to detect potential introduced specimens and to geographically allocate individuals of unknown origin (Velo-Antón et al., 2007; 2008). Moreover, although the levels of translocated allochthonous lineages (likely due to pet trade and illegal translocations) into the Iberian Peninsula do not appear to be as dramatic as it is in central Europe (Austria, Denmark, Germany, Switzerland), allochthonous lineages have been detected in southwestern and northeastern Iberian populations (Velo-Antón et al., 2011). The release of allochthonous lineages or individuals from distinct genetic demes

into wild populations may have an important negative effect on the intraspecific genetic structure and genetic variability within populations by increasing the risks of outbreeding and hybridization (Templeton, 1986; Gong et al., 2009; Fong and Chen, 2010; Fritz et al., 2010).

Therefore, a genetic protocol based on molecular analysis of mitochondrial DNA and multilocus genotyping would be advisable in conservation programs including captive breeding and/or translocations and reintroductions. For instance, genetic characterization of Iberian populations of *E. orbicularis* allowed the allocation of unknown turtles from recovery centers to the most likely region of origin (Velo-Antón et al., 2007) and this genetic database is being improved by sampling and analyzing new samples collected across Iberian and Moroccan populations of the Ibero-Maghrebian lineage (data not published). Ideally, the same genetic markers could be used to characterize *Emys* populations across its entire distribution. Although this has been implemented for mtDNA analyses (Lenk et al., 1999; Fritz et al., 2007; Velo-Antón et al., 2011), it has not been standardized for microsatellite markers, and four different sets of markers are now being used (Velo-Antón et al., 2007; Ciofi et al., 2009; Molnar et al., 2011; Pedall et al., 2011). Thus, although ambitious, a comprehensive genetic practice would be to work with all sets of markers used in *Emys*, genotyping populations across its entire range, as it has been done for mtDNA. A more realistic solution for those lineages studied at microsatellite level, as the Ibero-Maghrebian, will rely on the available genetic data to ensure that the specimens used for captive breeding and translocation activities are autochthonous, and thus helping to better manage *E. orbicularis* populations.

**Acknowledgements.** G. V.-A. is supported by a post-doctoral fellowships from Fundação para a Ciência e Tecnologia (FCT, Portugal: SFRH/BPD/74834/2010).

## References

- Ciofi, C., Tzika, A.C., Natali, C., Chelazzi, G., Naziridis, T., Milinkovitch, M.C. (2009): Characterization of microsatellite loci in the European pond turtle *Emys orbicularis*. *Molecular Ecology Resources* **9**: 189-191.
- Fong, J.J., Chen, T.H. (2010): DNA evidence for the hybridization of wild turtles in Taiwan: possible genetic pollution from trade animals. *Conservation Genetics* **11** (5): 2061-2066.
- 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., Fattizzo, T., Guicking, D., Tripepi, S., Pennisi, M.G., Lenk, P., Joger, U., Wink, M. (2005): A new cryptic species of pond turtle from southern Italy, the hottest spot in the range of the genus *Emys* (Reptilia, Testudines, Emydidae). *Zoologica Scripta* **43**: 351-371.
- Fritz, U., Guicking, D., Kami, D., 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., ValdeónVélez, 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., Hundsdörfer, A.K., Kottenko, T., Wink, M., Tok, C.V., 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.
- Fritz, U., Gong, S., Auer, M., Kuchling, G., Schneeweiß, N. (2010): The world's economically most important chelonians represent a diverse species complex (Testudines: Trionychidae: *Pelodiscus*). *Organisms Diversity & Evolution* **10**: 227-242.
- Gong, S.-P., Chow, A.T., Fong, J.J., Shi, H.-T. (2009): The chelonian trade in the largest pet market in China: scale, scope and impact on turtle conservation. *Oryx* **43**: 213-216.
- 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.
- Molnár, T., Lehoczky, I., Molnár, M., Benedek, I., Magyary, I., Jeney, Z. (2011): Genetic diversity of the European pond turtle (*Emys orbicularis*) in the South-West region of Hungary - first results *Amphibia-Reptilia* **32** (4): 519-526.
- 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.
- Sommer, R.S., Persson, A., Wieseke, N., Fritz U. (2007): Holocene recolonization and extinction of the pond turtle, *Emys orbicularis* (L., 1758), in Europe. *Quaternary Science Reviews* **26**: 3099-3107.
- Templeton, A. (1986): Coadaptation and outbreeding depression. In: Soule ME (ed) *Conservation biology: the science of scarcity and diversity*. Sinauer, Sunderland, MA, USA, pp 105-116
- Velo-Antón, G., Godinho, R., Ayres, C., Ferrand, N., Rivera, A.C. (2007): Assignment tests applied to relocate individuals of unknown origin in a threatened species, the European pond turtle (*Emys orbicularis*). *Amphibia-Reptilia* **28**: 475-484.
- Velo-Antón, G., García-Paris, 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.