

First evidence of an egg-laying attempt of feral *Trachemys scripta* (Schoepff, 1792) in Sicily (Lake Pergusa, Italy)

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The pond slider *Trachemys scripta* (Schoepff, 1792) is currently the world's most widespread freshwater turtle (Ernst and Lovich, 2009). The natural distribution of *T. scripta* ranges from southern Virginia south to northern Florida and west to Kansas, Oklahoma, New Mexico and north-eastern Mexico (Bringsøe, 2006; Ernst and Lovich, 2009). To date, as a result of their massive import as pets (Arvey and Servan, 1998; Bonin, 2004), this turtle has been introduced outside its natural range throughout all continents except Antarctica and on some oceanic island (Ernst and Lovich, 2009). Recently, an increase in the incautious releases of American pond sliders in the water bodies of Europe drove the European Union (EU) to adopt restrictive measures on the trade and breeding of *T. scripta* thus prohibiting its transportation, purchase, sale, exchange, release and breeding (Commission Implementing Regulation 2016/1141 of 13 July 2016).

In Europe, the pond sliders are known to compete for food and basking places with the European pond turtle *Emys orbicularis* (Linnaeus, 1758) (Cady and Joly 2003, 2004; Ficetola et al., 2009) and for nesting sites with the Spanish pond turtle *Mauremys leprosa* Schweigger, 1812 (Perez-Santigosa et al., 2008). However, not all pond sliders occurring in Europe are reproductively active (Cadi et al., 2004; Ficetola et al., 2009), and there

is a lack of data regarding the reproductive biology of this invader under natural conditions.

In Sicily the first record of the alien red-eared slider *Trachemys scripta elegans* (Wied-Neuwied, 1839) dates back to 1993 (Lo Valvo, 1998). Despite this species is frequently reported in the Sicilian lacustrine environments (i.e. in the outskirts of Catania, the Catania plain, the Pergusina basin and the mouth of the river Irminio) (Bella and Turrisi, 2005) very limited data are available. To date, no evidence of the presence of reproducing populations of the locally abundant pond slider, *T. scripta*, are confirmed in Sicily (Marrone and Naselli-Flores, 2015; Naselli-Flores and Marrone, 2019), although the subspecies *T. scripta elegans* is known to successfully breed on the Italian peninsula and might find in Sicily suitable bioclimatic conditions for its breeding (Ficetola et al., 2009). In this study we report on an egg-laying attempt of a feral turtle specimen belonging to this subspecies in a protected area of Sicily where *Trachemys scripta* and the endemic Sicilian pond turtle *Emys trinacris* Fritz et al., 2005 coexist.

On 28 July 2017, at 19:30 h, a large *Trachemys scripta scripta* (Schoepff, 1792) female was observed while attempting to excavate a nest with her hind limbs along the north-western shore of the lake "Lago di Pergusa" (WGS84 Geographical coordinates: 37.5197°N, 14.3061°E) (Fig. 1, 2). The climatic parameters, based on the 2002-2015 data of the meteorological station of the Pergusa Lake (owned by the Libero Consorzio Comunale di Enna, managing authority of Nature Reserve), showed that the mean annual precipitation for the area is 744 mm, and mean annual temperature is 14.8 °C (Termine, 2018). At the same station (data recorded from 2003 to 2015) the mean maximum temperature of the warmest month (July) is 34.0 °C, while the mean minimum temperature of the coldest month (February) is 0.1 °C (Termine, 2018).

The specimen was collected, measured using a calliper, and weighed with a precision balance. The

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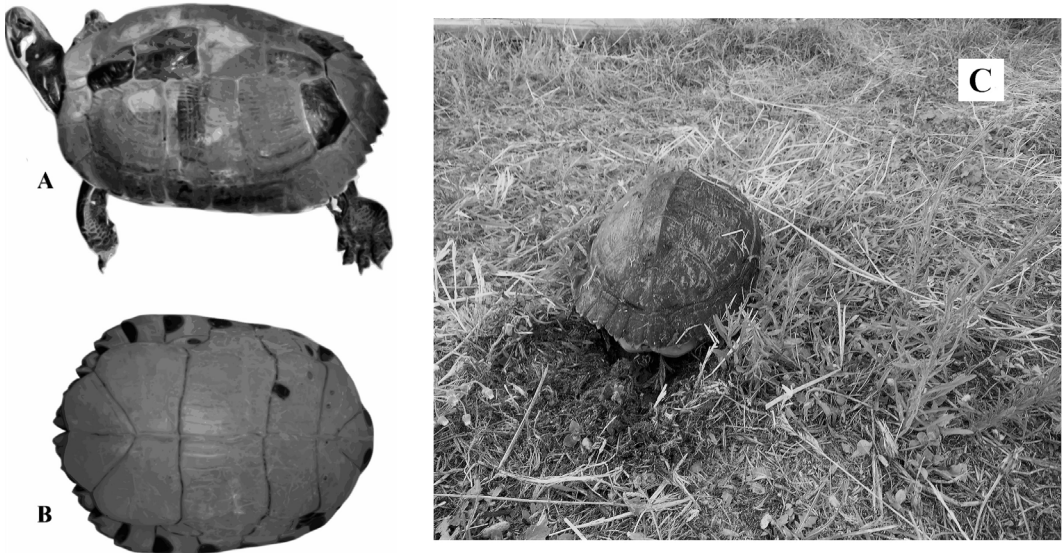


Figure 1. Dorso-lateral view of *Trachemys scripta scripta* collected in the R.N.S. “Lago di Pergusa” (A); ventral view of the same individual; (B) the same specimen while excavating the nest (C).

carapace length (SCL, 235 ± 0.1 mm), carapace width (CW, 180 ± 0.1 mm), plastron length (PL, 227 ± 0.1 mm) and body mass (BM, 2164 ± 1 g) were recorded. The pond turtle female was inspected by inguinal

palpation to detect the presence of oviductal eggs. Oviposition was induced in the laboratory (University of Palermo, Italy) by injection of oxytocin (Ewert and Legler, 1978) because the human presence possibly had

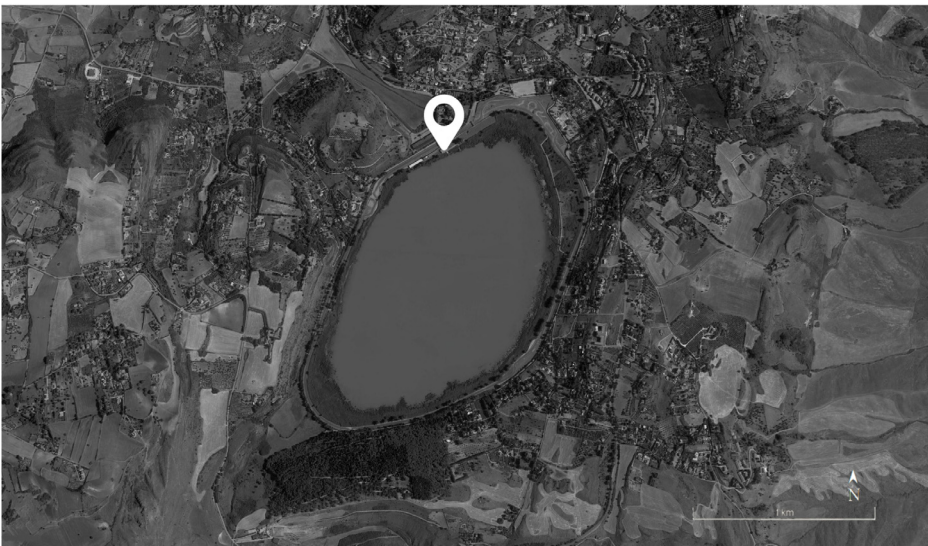


Figure 2. Location of the egg-laying attempt. The symbol represents the Sicily locality where *Trachemys* specimen was collected.



Figure 3. The eggs after the incubation, showing dents and affected by mould.

inhibited the nesting attempt in the wild (Moore and Seigel, 2006). Veterinary grade oxytocin (20 IU/mL) was administered intramuscularly as recommended by Ewert and Legler (1978). After the injection, the turtle was placed in a tank on a wire mesh platform, which allowed us to collect the eggs undamaged. Eggs are usually laid within 3 - 4 hours, but in present case it was necessary to administer three doses of oxytocin. 48 hours were elapsed between the first and second dose while the third oxytocin treatment was performed 5 days after the second, increasing the dose to 4 IU/50g due to the inefficiency of the second treatment. The clutch was incubated in moistened vermiculite at a constant temperature of 28.5 °C for about 100 days (Mcarthur et al., 2004). Overall, 13 eggs were laid. The eggs were 24.0 – 30.5 mm (mean: 26.5 mm) long and 15.7 – 19.2 mm (mean: 17.1 mm) wide. After 100 days of incubation no egg was hatched, some showed dents and were affected by mould (Fig. 3).

This is the first evidence of an egg-laying attempt of a feral *Trachemys scripta* in Sicily. A dedicated monitoring programme of this allochthonous species is thus desirable in order to verify whether it was an isolated breeding attempt, and if the eggs laid are fertilized and able to develop and hatch in the wild. In its native distribution area, *T. scripta* occurs in a wide variety of different climate zones, ranging from humid subtropical to semi-arid climate (Ernst and Lovich,

2009). It is thus not unlikely that *T. scripta* is able to reproduce in the Mediterranean climate of southern Europe, as shown by our data.

At present, this species is considered to be among the 100 most invasive species in the world (Lowe et al., 2000). In optimal environments, invasive *T. scripta* could reach larger population sizes compared with native aquatic turtles, and it is also favoured in the interspecific agonistic interactions for resources because of its larger body size. Indeed, studies on trophic competition between *Emys orbicularis* and *Trachemys s. elegans* have shown that there is potential for trophic competition between representatives of these two emydid genera (Balzani et al., 2016). Also, the activity patterns and aquatic home range areas are different among exotic *Trachemys s. elegans* and native turtles *Mauremys leprosa* and *Emys orbicularis*, and the differences in these activity patterns may provide advantages for exotic individuals (Perez-Santigosa et al., 2013). In Sicily, this may have important consequences for the management and conservation of the endemic Sicilian pond turtle (*Emys trinacris*). Moreover, analogously to what stressed by Iglesias et al. (2015) and Arizza et al. (2016), the possible presence of pathogen spillover from non-native taxa on native turtles is not to be overlooked.

Verifying the actual presence of successful breeding events of *T. s. scripta* in Lake Pergusa is essential for the proper management of the study area and for planning effective eradication programs.

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References

- Arizza, V., Sacco, F., Russo, D., Scardino, R., Arculeo, M., Vamberger, M., Marrone, F. (2016): The good, the bad and the ugly: *Emys trinacris*, *Placobdella costata* and *Haemogregarina stepanovi* in Sicily (Testudines, Annelida and Apicomplexa). *Folia parasitologica* **63**: 029. DOI: 10.14411/fp.2016.029
- Arvey, C., Servan, J. (1998): Imminent competition between *Trachemys scripta* and *Emys orbicularis* in France. Proceedings of the *Emys* symposium Dresden 96, Mertensiella. Rheinbach **10**: 33–40.
- Balzani, P., Vizzini, S., Santini, G., Masoni, A., Ciofi, C., Ricevuto, E., Chelazzi, G. (2016): Stable isotope analysis of trophic niche in two co-occurring native and invasive terrapins, *Emys orbicularis* and *Trachemys scripta elegans*. *Biological Invasions* **18**: 3611–3621. DOI: 10.1007/s10530-016-1251-x.
- Bella, S., Turrisi, G.F. (2005): Status e conservazione dei Testudinati in Sicilia. WWF Sicilia, 50pp.

- Bonin, F. (2004): Concordia Turtle Farm - Die größte rotwan - gen-Schmuckschildkröten-Farm der Usa, *Radiata*, Rheinbach **13**: 18–24.
- Bringsoe, H. (2006): Invasive alien species fact sheet – *Trachemys scripta*, online database of the north European and Baltic network on invasive alien species. Digital resource available at <https://www.nobanis.org/>. Accessed on 26 April 2019.
- Cadi, A., Joly, P. (2003): Competition for basking places between the endangered European pond turtle (*Emys orbicularis galloitalica*) and the introduced red-eared slider (*Trachemys scripta elegans*). *Canadian Journal of Zoology* **81**: 1392–1398. DOI: 10.1139/z03-108
- Cadi, A., Joly, P. (2004): Impact of the introduction of the red-eared slider (*Trachemys scripta elegans*) on survival rates of the European pond turtle (*Emys orbicularis*). *Biodiversity and Conservation* **13**: 2511–2518. DOI: 10.1023/B: BIOC.0000048451.07820.9c
- Cadi, A., Delmas, V., Prevot-julliard, A.C., Joly, P., Pieau, C., Girondot, M. (2004): Successful reproduction of the introduced slider turtle (*Trachemys scripta elegans*) in the South of France. *Aquatic Conservation* **14**: 237–246. DOI: 10.1002/aqc.607
- Ernst, C.H., Lovich, J.E. (2009): *Turtles of the United States and Canada*, 2nd Edition, Johns Hopkins University Press, Baltimore.
- Ewert, M.A., Legler J.M. (1978): Hormonal induction of oviposition in turtles. *Journal of Herpetology* **34**: 314–318.
- Ficetola, G.F., Thuiller, W., Padoa-schioppa, E. (2009): From introduction to the establishment of alien species: bioclimatic differences between presence and reproduction localities in the slider turtle. *Diversity and Distributions* **15**: 108–116. DOI: 10.1111/j.1472-4642.2008.00516.x
- Iglesias, R., García-Estévez, J.M., Ayres, C., Acuña, A., Cordero-Rivera, A. (2015): First reported outbreak of severe *spirorchidiasis* in *Emys orbicularis*, probably resulting from a parasite spillover event. *Diseases of Aquatic Organisms* **113**: 75–80. DOI: 10.3354/dao02812
- Lo Valvo, F. (1998): Status e conservazione dell'erpeto fauna siciliana. *Naturalista siciliano* **22**: 53–71.
- Lowe, S., Browne, M., Boudjelas, S., De Poorter, M. (2000): 100 of the World's worst invasive alien species. A selection from the Global Invasive Species Database. IUCN 1–12.
- Marrone, F., Naselli-flores, L. (2015): A review on the animal xenodiversity in Sicilian inland waters (Italy). *Advances in Limnology and Oceanography* **6**: 2–12. DOI: 10.4081/aiol.2015.5451
- Mcarthur, S., Wilkinson, R., Meyer, J. (2004): *Medicine and surgery of tortoises and turtles*, Blackwell Publishing Ltd, Oxford.
- Moore, M.J.C., Seigel, R.A. (2006): No place to nest or bask: Effects of human disturbance on the nesting and basking habits of yellow-blotched map turtles (*Graptemys flavimaculata*). *Biological Conservation* **130**: 386–393. DOI: 10.1016/j.biocon.2006.01.001
- Naselli-Flores, L., Marrone, F. (2019): Different invasibility of permanent and temporary waterbodies in a semiarid Mediterranean Island, *Inland Waters* **9**: 411–421. DOI: 10.1080/20442041.2019.1653110
- Perez-Santigosa, N., Diaz-Paniagua, C., Hidalgo-Vila, J. (2008): The reproductive ecology of exotic *Trachemys scripta elegans* in an invaded area of southern Europe. *Aquatic Conservation* **18**: 1302–1310. DOI: 10.1002/aqc.974
- Pérez-Santigosa, N., Hidalgo-Vila, J., Díaz-Paniagua, C. (2013): Comparing Activity Patterns and Aquatic Home Range Areas Among Exotic and Native Turtles in Southern Spain. *Chelonian Conservation and Biology* **12**: 313–319. DOI: 10.2744/CCB-1028.1
- Termine, R. (2018): *Monitoraggio aeropalino logico presso la Riserva Naturale Speciale del Lago di Pergusa (Enna)*. Unpublished thesis, Università di Catania, Catania, Italia.