



An Invaded Natural Monument: Two Species of Alien Terrapins, *Trachemys scripta* (Thunberg in Schoepff, 1792) and *Pseudemys floridana* (Le Conte, 1830) (Testudines: Emydidae), in Lake Mavrobara, Greece

Aleksandar Urošević

Institute for Biological Research “Siniša Stanković” – National Institute of the Republic of Serbia, University of Belgrade, 142 Bulevar Despota Stefana, 11000 Belgrade, Serbia; E-mail: aurosevic@ibiss.bg.ac.rs

Abstract: Two allochthonous species of terrapins, *Trachemys scripta* (Thunberg in Schoepff, 1792), represented by individuals of the subspecies *T. s. scripta* and *T. s. elegans* (Wied-Neuwied, 1839), and the potentially invasive *Pseudemys floridana* (Le Conte, 1830), are recorded in the natural habitat Lake Mavrobara on the Kassandra Peninsula (Chalkidiki, Central Macedonia, Greece). The subspecies of *Trachemys scripta* have already been documented in various localities in Greece, with cases of possible but unconfirmed reproduction. *Pseudemys floridana* has not been previously recorded in Greece and this paper presents the first documented record for the country.

Key words: Invasive species, *Trachemys scripta*, *Pseudemys floridana*, Chalkidiki

Introduction

The introduction of non-native flora and fauna is considered a global problem, with the invasive species being defined as “an exotic species whose introduction does or is likely to cause economic or environmental harm or harm to human health” (NATIONAL INVASIVE SPECIES COUNCIL 2008). A good example for an invasive species is the red-eared slider *Trachemys scripta elegans* (Wied-Neuwied, 1839) (SCALERA 2006, BRINGSØE 2006, UROŠEVIĆ et al. 2016, 2019). This freshwater terrapin is documented in almost every European country (SCALERA 2006), with many published localities for Greece (BRUEKERS 1993, BRUEKERS et al. 2006, BALEJ & JABLONSKI 2006–2016, ZENETOS et al. 2009, UROŠEVIĆ 2014, 2021, ADAMOPUOLOU & LEGAKIS 2016, GRANO

2020). Since the EU-imposed ban on trade and import of these terrapins, a few “substitute” species (and subspecies) have emerged in the European pet trade and, consequently, have begun to find their way to local freshwater ecosystems. Among them, the other two subspecies of *Trachemys scripta* (Thunberg in Schoepff, 1792) are frequently recorded in natural ecosystems (BRINGSØE 2006). Yellow-bellied slider *Trachemys scripta scripta* (Thunberg in Schoepff, 1792) has been documented in Europe (BRINGSØE 2006, MARTÍNEZ SILVESTRE et al. 2006, VALDEÓN et al. 2010, KLEWEIN 2014), including Greece (BALEJ & JABLONSKI 2006–2016, UROŠEVIĆ 2014). The Florida cooter *Pseudemys floridana* (Le Conte, 1830) was also noted as one of the “substitute” species whose import into Europe has been increased (ADRADOS et al. 2002, BRINGSØE 2006). It is

recognised as a potentially invasive species (MASIN et al. 2014).

In this article, new data on the occurrence of two alien terrapin taxa, *Pseudemys floridana* and *Trachemys scripta*, in a natural ecosystem on the Chalkidiki Peninsula, Greece, are presented.

Materials and Methods

The small lake Mavrobara (240 m a.s.l., 40°00'05.59" N 23°30'24.49" E) is situated near the Polichrono Town in the Kassandra Peninsula (Chalkidiki, Central Macedonia, Greece). It is the only natural lake in the peninsula. It is protected by the Bonn Convention No. 2719 and the European Union Directive on the conservation of wild flora and fauna. Native terrapins inhabiting the Balkan Peninsula and this lake are *Emys orbicularis* (Linnaeus, 1758) and *Mauremys rivulata* (Valenciennes, 1833) (SILLERO et al. 2014). The presence of *Trachemys scripta* has also been detected (BALEJ & JABLONSKI 2006–2016, AD-

AMOPULOLOU & LEGAKIS 2016). The terrapins were observed and photographed *in situ*, avoiding intentional disturbance. Species were identified according to the literature sources and by an expert (SEIDEL 1994, ARNOLD & OVENDEN 2002, BRINGSØE 2006, GREENE 2022, FRITZ, personal communication).

Results

On September 13th 2016, numerous specimens (at least five large adults and one juvenile) of the red-eared slider (*T. s. elegans*) and one specimen of yellow-bellied slider (*T. s. scripta*) were observed in Lake Mavrobara (Fig. 1 a, b, c), together with only one *Mauremys rivulata*. No *Emys orbicularis* was seen on this day. Red-eared sliders could be unmistakably identified by the presence of the red stripe behind the eye. Yellow-bellied slider could also be identified based on the conspicuous yellow bars on the pleural scutes and the yellow blotch behind the eye. On September 18th 2016, one male specimen of

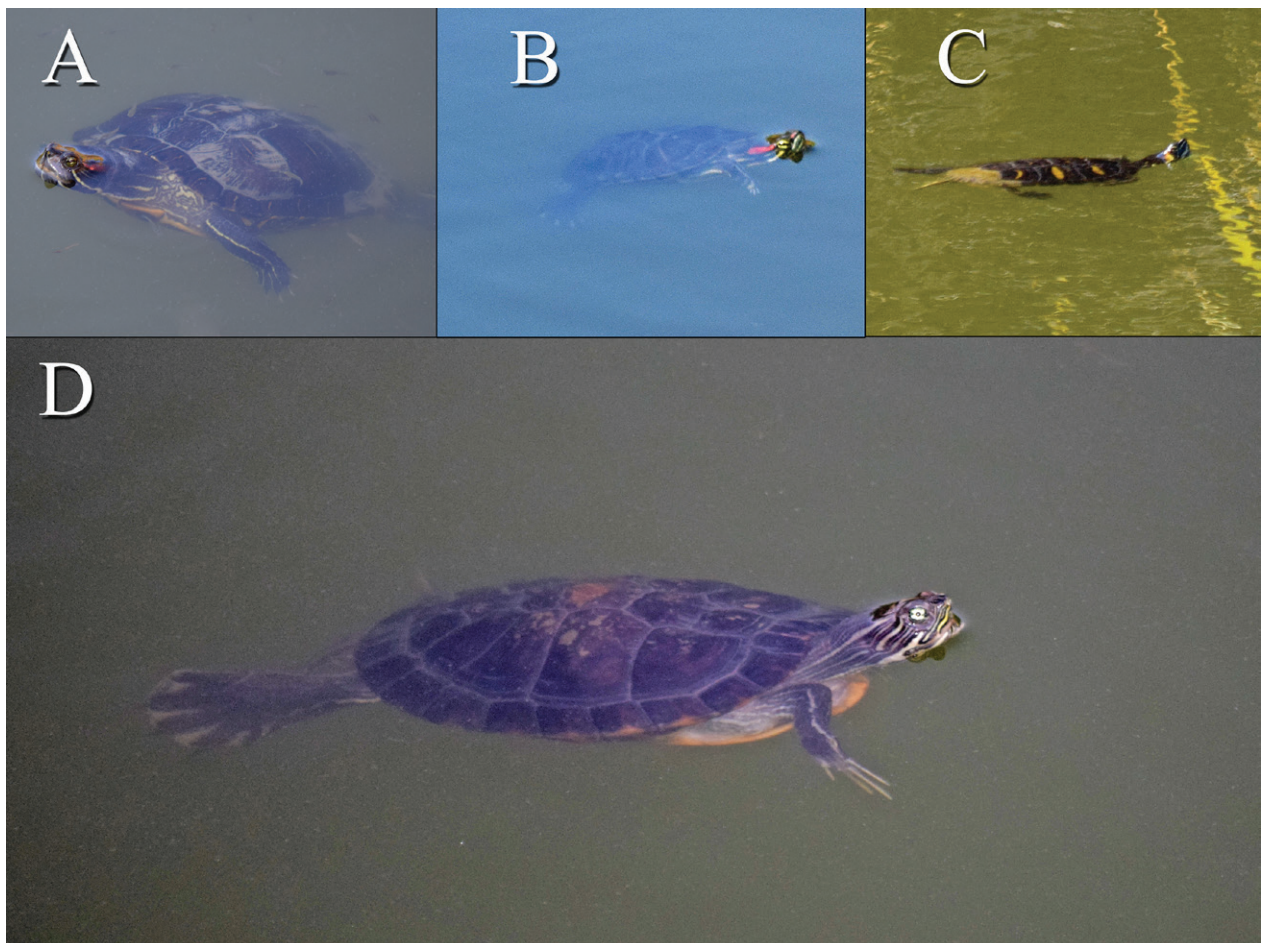


Fig. 1. Specimens of alien turtles photographed *in situ* at the Mavrobara Pond. A. Adult specimen of *Trachemys scripta elegans*. B. Juvenile specimen of *Trachemys scripta elegans*. C. Specimen of *Trachemys scripta scripta*. D. Adult specimen of *Pseudemys floridana*.

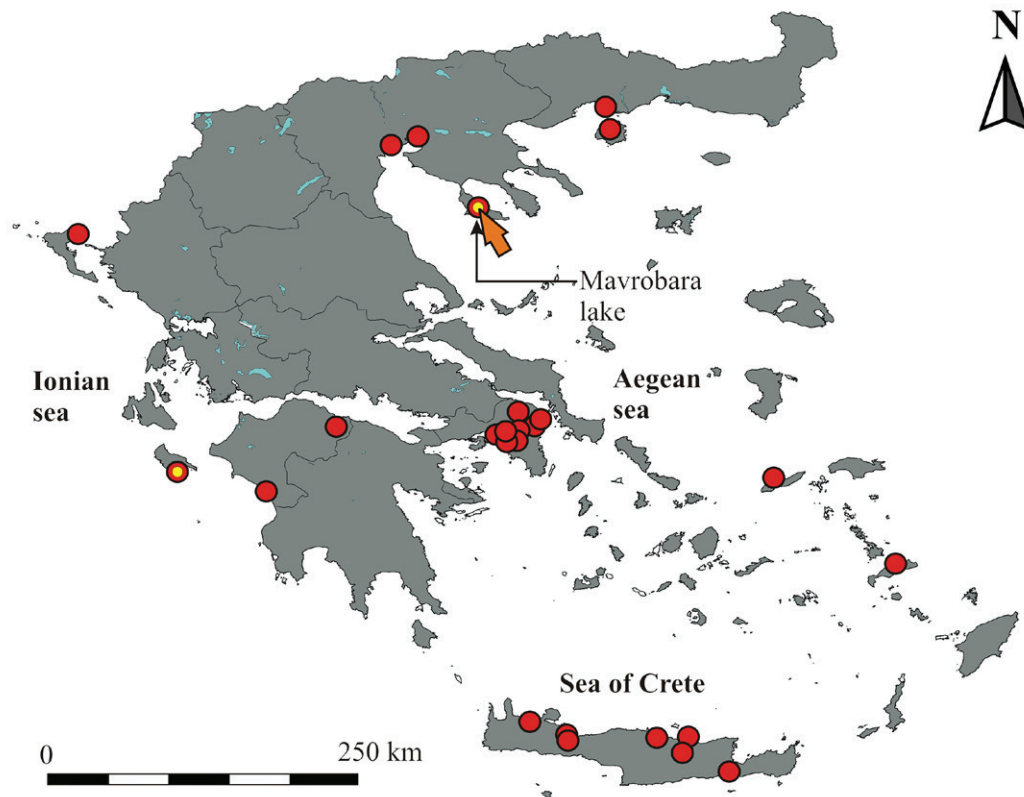


Fig. 2. Records of the red-eared slider *Trachemys scripta elegans* in Greece. The locality examined in the present study is arrowed.

Florida cooter (*Pseudemys floridana*) was observed (Fig. 1d). The Florida cooter could be identified by the following diagnostic characters (SEIDEL 1994, GREENE 2022): carapace flatter in appearance than the similar sized slider turtle; colour of carapace dark, with very faint yellow or orange pattern; head and neck with thin parallel yellowish stripes. Visible part of plastron yellow/orange. The findings were mapped (Fig. 2) together with the published records of the red-eared slider in Greece (BRUEKERS et al. 2006, UROŠEVIĆ 2014, 2021, ADAMOPUOLOU & LEGAKIS 2016, GRANO 2020).

Discussion

Disposal of unwanted pet terrapins into water bodies was considered the only effective pathway of spreading alien terrapins (ARVY & SERVAN 1998, BRINGSØE 2006). Since this is the only natural freshwater body on the Kasandra Peninsula, it could be the preferred spot for disposal of unwanted pet terrapins by the local irresponsible owners. There are evidence that red-eared sliders can successfully reproduce in Southern Europe and establish naturalised populations (CADI et al. 2004, BRUEKERS et

al. 2006, PEREZ-SANTIGOSA et al. 2008, Đorđević & ANĐELKOVIĆ 2015, JELIĆ et al. 2016, STANDFUSS et al. 2016, UROŠEVIĆ et al. 2019). In Greece, red-eared sliders are considered widespread, especially in the urbanised areas or tourist centres: most reports are from Attiki Prefecture (the city of Athens and its surroundings) and Crete (ADAMOPUOLOU & LEGAKIS 2016). Other findings are scattered throughout mainland Greece (ADAMOPUOLOU & LEGAKIS 2016) and the islands of Kos (BRUEKERS et al. 2006), Corfu (ADAMOPUOLOU & LEGAKIS 2016), Zakynthos (UROŠEVIĆ 2014, ADAMOPUOLOU & LEGAKIS 2016), Icaria (GRANO 2020) and Thassos (UROŠEVIĆ 2021) (Fig. 2). Its presence is likely underestimated (ADAMOPUOLOU & LEGAKIS 2016). Although juvenile specimens have been observed in Zakynthos (UROŠEVIĆ 2014), Athens (ADAMOPUOLOU & LEGAKIS 2016) and Mavrobara (this study), ADAMOPUOLOU & LEGAKIS (2016) have suggested that it is difficult to assert whether the red-eared sliders breed locally and that the release by the pet owners is still the main path of introduction. However, it is considered as established in the study by ZENETOS et al. (2009). Introduced or established, red-eared sliders can have large negative impact on native

terrapin populations, mainly through a competition for food, basking places and breeding sites (ARVY & SERVAN 1998, CADI & JOLY 2004). There are also documented cases of introduced terrapins behaving aggressively towards native terrapins (POLO-CAVIA et al. 2011). The substantial number of aggressive and large introduced terrapins could lead to competitive displacement of native terrapins from a relatively small lake. This could explain the small number of native terrapins observed. The yellow-bellied slider is ecologically similar to the red-eared slider (ERNST & LOVICH 2009) and there is a possibility of hybridisation (SEIDEL et al. 1999). Florida cooter is a large (22–33 cm) opportunistic omnivore, with females being largely herbivorous and males preying on aquatic invertebrates. It is social, often basking in groups (SEIDEL 1994, GREENE 2022). The coastal areas of Europe show high climatic suitability for the species and it is recognised as one of the potentially invasive species requiring regulation (MASIN et al. 2014). Since there are no published records of this species in Greece, this study provides the first documented case of introduction of the Florida cooter for the country. Any further release of alien terrapins into Lake Mavrobara should be strongly discouraged. It is possible that removal of introduced terrapins, an expensive and time-consuming procedure with uncertain outcome (VALDEÓN et al. 2010), should be conducted in order to prevent eradication of native terrapin population from this unique and ecologically important habitat.

Acknowledgements: I would like to thank two anonymous reviewers for the critical comments that greatly improved this manuscript, Uwe Fritz for the correct identification of *Pseudemys floridana* and Jelena Pavlović for help in the field. The realisation of this short communication was partly funded by the Serbian Ministry of Education, Science and Technological Development, Grant no. 451-03-9/2021-14/ 200007.

References

- ADAMOPOULOU C. & LEGAKIS A. 2016. First account on the occurrence of selected invasive alien vertebrates in Greece. *BioInvasions Records* 5 (4): 189–196.
- ADRADOS L. C., VEENVLIET P. & VEENVLIET J. K. 2002. Assessment of trade and ecological threat of species, potentially replacing *Rana catesbeiana* or *Trachemys scripta elegans* in the European Union. In: ADRADOS L.C. & BRIGGS L. (Eds.): Study of application of EU wildlife trade regulations in relation to species which form an ecological threat to EU fauna and flora, with case studies of American bullfrog (*Rana catesbeiana*) and red-eared slider (*Trachemys scripta elegans*). Unpublished study report to the European Commission. Ref. no. B4-3040/2001/326066/MAR/E.3. PP. III1-III27.
- ARNOLD E. & OVENDEN D. 2002. A field guide to the reptiles and amphibians of Britain and Europe. 2nd edition. London: Harper Collins Publishers. 288 p.
- ARVY C. & SERVAN J. 1998. Imminent competition between *Trachemys scripta* and *Emys orbicularis* in France. *Mertensiella* 10: 33–40.
- BALEJ P. & JABLONSKI D. (Eds.) (2006–2016): *Balcanica.info*. Available from: <http://www.balcanica.cz/> Accessed 04. October 2016.
- BRINGSØE H. 2006. NOBANIS–Invasive Alien Species Fact Sheet–*Trachemys scripta*. From: Online Database of the North European and Baltic Network on Invasive Alien Species–NOBANIS. Available from: <http://www.nobanis.org/> Accessed 16. September 2014.
- BRUEKERS J. 1993. Schildpadden op het Griekse eiland Kos. *De Schildpad* 19: 38–50.
- BRUEKERS J., UIJTTERSCHOUT G. & BROUWER A. 2006. Erstnachweis einer natürlichen Vermehrung der Rotwangenschmuckschildkröte (*Trachemys scripta elegans*) auf der griechischen Insel Kos. *Schildkröten im Fokus* 3 (3): 29–34.
- 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.
- CADI A., DELMAS V., PRIEEVOT- 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: Marine and Freshwater Ecosystems* 14: 237–246.
- Đorđević S. & ANDELKOVIĆ M. 2015. Possible reproduction of the red-eared slider, *Trachemys scripta elegans* (Reptilia: Testudines: Emydidae), in Serbia, under natural conditions. *Hyla* 2015 (1): 44–49.
- ERNST C. H. & LOVICH J. E. 2009. *Turtles of the United States and Canada*, 2nd edition. Baltimore: The John Hopkins University Press.
- GRANO M. 2020. Report of alien invasive turtle, the Red-eared slider *Trachemys scripta elegans* (Wied-Neuwied, 1839) (Testudines: Emydidae), in Ikaria island, Greece. *Parnassiana Archives* 8: 55–56.
- GREENE A. 2022. Florida Cooter (*Pseudemys floridana*). Savannah River Ecology Laboratory, University of Georgia. Available at: <https://srelherp.uga.edu/turtles/pseflo.htm> Accessed 16 August 2022.
- JELIĆ L., JANEV-HUTINEC B. & JELIĆ D. 2016. Reproductive biology of *Trachemys scripta* (Schoepff, 1792) in continental Croatia. 2nd Croatian Symposium on Invasive Species with International Participation. 21–22.11.2016. Book of Abstracts. Zagreb, Croatia.
- KLEWEIN A. 2014. Natural reproduction of *Trachemys scripta troostii* (Holbrook, 1836) x *Trachemys scripta scripta* (Schoepff, 1792) in Austria. *Herpetozoa* 26(3/4): 183–185.
- MARTÍNEZ SILVESTRE A., SOLER J., GORRIZ A., MUNNE P. & DE ROA E. 2006. *Trachemys scripta elegans* and other invasive species of chelonians in Catalonia (North-Eastern Iberian Peninsula). *Chelonii* 4: 53–54.
- MASIN S., BONARDI A., PADOA-SCHIOPPA E., BOTTONI L. & FICETOLA G. F. 2014. Risk of invasion by frequently traded freshwater turtles. *Biological Invasions* 16: 217–231.
- NATIONAL INVASIVE SPECIES COUNCIL 2008. 2008–2012 National invasive species management plan. Washington: Department

- ment of the Interior Office of the Secretary (OS/SIO/NISC). 35 p.
- PEREZ-SANTIGOSA N., DÍAZ-PANIAGUA C. & HIDALGO-VILA J. 2008. The reproductive ecology of exotic *Trachemys scripta elegans* in an invaded area of southern Europe. *Aquatic Conservation: Marine and Freshwater Ecosystems* 18: 1302–1310.
- POLO-CAVIA N., LÓPEZ P. & MARTÍN J. 2011. Aggressive interactions during feeding between native and invasive freshwater turtles. *Biological Invasions* 13 (6): 1387–1396.
- SCALERA R. 2006. *Trachemys scripta*. DAISIE (Delivering Alien Invasive Species Inventories for Europe). Available at: <http://www.europe-aliens.org/> Accessed 23. August 2013.
- SILLERO N., CAMPOS J., BONARDI A., CORTI C., CREEMERS R., CROCHET P.-A., CRNOBRNJA-ISAILOVIĆ J., DENOËL M., FICETOLA G. F., GONÇALVES J., KUZMIN S., LYMBERAKIS P., DE POUS P., RODRÍGUEZ A., SINDACO R., SPEYBROECK J., TOXOPEUS B., VIEITES D.R. & VENCES M. 2014. Updated distribution and biogeography of amphibians and reptiles. *Amphibia-Reptilia* 35: 1–31.
- SEIDEL M. E. 1994. Morphometric analysis and taxonomy of cooter and red-bellied turtles in the North American genus *Pseudemys* (Emydidae). *Chelonian Conservation and Biology* 1 (2): 117–130.
- SEIDEL M. E., STUART J. N. & DEGENHARDT W. G. 1999. Variation and species status of slider turtles (Emydidae: *Trachemys*) in the southwestern United States and adjacent Mexico. *Herpetologica* 55 (4): 470–487.
- STANDFUSS B., LIPOVŠEK G., FRITZ U. & VAMBERGER M. 2016. Threat or fiction: is the pond slider (*Trachemys scripta*) really invasive in Central Europe? A case study from Slovenia. *Conservation Genetics* 17: 557–563.
- UROŠEVIĆ A. 2014. Report of two subspecies of an alien turtle, *Trachemys scripta scripta* and *Trachemys scripta elegans* (Testudines: Emydidae) sharing the same habitat on the island of Zakynthos, Greece. *Ecologica Montenegrina* 1 (4): 268–270.
- UROŠEVIĆ A. 2021. Herping in Thassos – September 2021. Hellenolacerta – Herping in Greece. Available at: <https://hellenolacerta.blogspot.com/2021/11/herping-in-thassos-septmber-2021.html>. Accessed 03. March 2022.
- UROŠEVIĆ A., TOMOVIĆ LJ., AJTIĆ R., SIMOVIĆ A. & DŽUKIĆ G. 2016. Alterations in the reptilian fauna of Serbia: Introduction of exotic and anthropogenic range expansion of native species. *Herpetozoa* 28 (3/4): 115–132.
- UROŠEVIĆ A., POPOVIĆ M., MARIČIĆ M., POMORIŠAC G., PETROVIĆ D., GRABOVAC D., SURLA A., MEDENICA I., AVRAMOVIĆ S., GOLUBOVIĆ A. 2019. New Data on the Spread of *Trachemys scripta* (Thunberg in Schoepff, 1792) (Testudines: Emydidae) and its Subspecies in Serbia. *Acta Zoologica Bulgarica* 71 (2): 247–251.
- VALDEÓN A., CRESPO-DÍAZ A., EGAÑA-CALLEJO A. & ALBERTO GOSÁ A. 2010. Update of the pond slider *Trachemys scripta* (Schoepff, 1792) records in Navarre (Northern Spain), and presentation of the Aranzadi Turtle Trap for its population control. *Aquatic Invasions* 5 (3): 297–302.
- ZENETOS A., PANCUCCI-PAPADOPOULOU M. A., ZOGARIS S., PAPAS-TERGIADOU E., VARDAKAS L., ALIGIZAKI K. & ECONOMOU A.N. 2009. Aquatic alien species in Greece: tracking sources, patterns and effects on the ecosystem. *Journal of Biological Research Thessaloniki* 12: 135–172.

Received: 16.07.2021

Accepted: 17.04.2022

Note added at the preprint stage: In an earlier version of this article announced online as a forthcoming publication in press, I have misidentified *Pseudemys floridana* as *Chrysemys picta*. Dr. Uwe Fritz kindly appointed my attention to this identification mistake and I have revised the text of the publication. The present version of the article is corrected and substantially differs from that initially published as a preprint.

