ÖGH Herpetozoa
Austrian Herpetological Society

Herpetozoa 36: 249–257 (2023)
DOI 10.3897/herpetozoa.36.e106864

Occurrence and status of the European Pond Turtle, *Emys orbicularis hellenica* (Valenciennes, 1833), on Aegean and Ionian Islands (Greece, Turkey)

Mario F. Broggi[1]

1 *Kirchstrasse 11, LI-9490 Vaduz, Liechtenstein*

https://zoobank.org/6380721C-8527-483C-A2F9-75E4E394635A

Corresponding author: Mario F. Broggi (mario.broggi@adon.li)

Academic editor: Günter Gollmann ♦ **Received** 23 May 2023 ♦ **Accepted** 4 August 2023 ♦ **Published** 23 August 2023

Abstract

A study on the occurrence of *Emys orbicularis* in the Aegean, published in 2012, is here extended to the Ionian Islands. For the first time, a status analysis has also been carried out for the individual islands. *Emys orbicularis* is found on 11 Greek islands and one Turkish. Its presence on the big islands of Rhodes and Chios has not been ascertained so far, while for four previously mentioned islands there is no confirmation. On Corfu and Lesbos there are still viable larger *Emys* populations. Most other island occurrences are characterized by small populations. On Kefalonia, Zakynthos, Thassos and Samos, *E. orbicularis* is in danger of extinction because the wetland biotopes are threatened. In the meantime, many wetlands have been placed under protection. The enforcement of these nature conservation regulations needs to be monitored, and *E. orbicularis* can be a lead species for such monitoring.

Key Words

conservation, Emydidae, Insular Greece, Reptilia, Testudines, threats

Short portrait of the species

Emys orbicularis occurs in freshwater habitats, with a range extending from the Maghreb over the Iberian Peninsula, southern France and central Europe to the Baltic States, and in the south over Italy, the Balkan peninsula and Turkey to the Caspian Sea (Fritz 2001). In this large distribution area, a number of different subspecies are described. In Greece, the Eastern Mediterranean *Emys orbicularis hellenica* (Valenciennes, in Bibron and Bory de Saint-Vincent 1833) is described (Fritz 1998). This subspecies is small to medium-sized and its carapace is relatively high and narrow, with a usual maximum length of 25 cm. Its plastron is yellowish (Fritz 2001). The only similar species in Greece is the Balkan Terrapin *Mauremys rivulata* (Valenciennes, 1833), from which *E. orbicularis* differs in neck colouration pattern – striped in *M. rivulata*, spotted in *E. orbicularis*. *Emys orbicularis* lives in still or slow-flowing water in the shore area of lakes, ponds and ditches. Also, along the Mediterranean coasts, it is found in slightly brackish water in the backwaters of estuaries. Dense vegetation with a muddy substrate is preferred. It feeds mostly carnivorously, on snails, crustaceans – in fact, virtually anything it can catch – but will also eat aquatic plants (Fritz 2001).

Suitable habitats on the islands are similar to those on the mainland except that I never saw *E. orbicularis* in streams at higher altitudes. However after observations, it is noticeable that it only occurs on the peripheral larger islands along the continental shelf. There, *M. rivulata* and *E. orbicularis* usually live in the same habitat, thus sharing it sympatrically (Fritz 2001). *Mauremys* then shows itself to be in the majority, perhaps with the exception of Corfu. *Emys* also demands in my estimation less polluted waters than *Mauremys* and is less tolerant of salinity. It is striking that *Emys* on the Greek islands – contrary to

Copyright *Mario F. Broggi*. This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

PENSOFT

the mainland – has not been observed by me in flowing streams and seems not to use them as a refugial habitat, unlike *Mauremys*. Their occurrences are concentrated in the lowlands, especially on the estuaries of water flowing into the sea with their network of hydrological structures.

Exploration on Greek islands

Herpetological research on Greek islands goes back almost 200 years. This begins with the Excursion de Morée in 1828–1833, which was a French military action in the Peloponnese as part of efforts for Greek independence. This military action was accompanied by a natural science commission under Bory de Saint-Vincent with 17 experts, including Gabriel Bibron, who was active in herpetology (Pafilis 2010). Werner (1938) and Wettstein (1953) made significant progress in herpetological research on Greek islands in the 20th century. The history of such research in Greece is described by Pafilis (2010). Valakos et al. (2008) present the amphibians and reptiles of Greece with distribution maps, which give us a good overview, as do Lymberakis et al. (2018) in a shorter contribution.

How does this present itself for *E. orbicularis* in particular? In the course of herpetological research in Greece, the Ionian Islands were initially the focus of attention. They were perhaps easier to reach for central European herpetologists, and they already belonged to the Greek state, in contrast to the islands of Asia Minor. The Cyclades then became the focus of herpetological research in the 20th century. However, no *Emys orbicularis* have been recorded there. In the Aegean, records are restricted to the larger peripheral islands on the Anatolian side, which were not the focus of the Austrian studies by Werner (1938) and Wettstein (1953). Another reason for late records is that *E. orbicularis* associates with *M. rivulata* and is less conspicuous, with its smaller populations, among Balkan Terrapin. This was at least the case for the observations by the author during the field research on Lesbos and Samothrace. It could also be true that for many field herpetologists the snake and lizard species are more in the foreground of consideration, and therefore the habitats of pond turtles were less well searched.

Occurrences on Greek islands and on Gökçeada (Turkey)

In the following, an overview of *Emys* occurrences on Aegean and Ionion islands (Fig. 1) is given in alphabetical order. A question mark appears against islands where a past occurrence is questionable. In each case the first description is mentioned, and further later observations from the literature are evaluated. Likewise, my own observations recorded in the field books of the excursions were included. As far as possible, the *Emys orbicularis* status on each individual islands is also described. This present contribution is the continuation of studies published in 2012, which referred only to the Aegean Sea (Broggi and Grillitsch 2012). Also in 2012, the species *M. rivulata*, which is sympatric with *E. orbicularis*, was dealt with for the Aegean (Broggi 2012). This study has now been updated (Broggi 2023).

Andros? (380 km²)

Bedriaga (1882) referred to Erhard's "Fauna of the Cyclades" (Erhard 1858) in his overview of the amphibians and reptiles of Greece with the following statement: "Erhard has seen *Emys* on Naxos, Amorgos, Andros and Mykonos. I suspect that Erhard rather confused *Clemmys caspica* ssp. *orientalis* with *Emys orbicularis*.". Werner (1938), therefore, does not take Erhard's statement into account. *Mauremys* occurs today on the above islands, except Amorgos. After my visit to Amorgos in 2006, an earlier record of *M. rivulata* on that island is assumed to be rather unlikely (Broggi 2007). According to Fritz (1992), a colonization axis of Andros-Tinos-Mykonos would be possible in principle. Corresponding habitats would also be available. However, apart from the reference for Mykonos, which is to be confirmed, there are no indications of past or present *Emys* occurrences on these islands. Our intensive search on Andros in 1995 was also fruitless (Broggi 1996). I do not believe in the Andros-Tinos-Mykonos colonization axis for *Emys orbicularis*.

Chios? (843 km²)

While there are *Emys* records for Lesbos and Samos, this is not yet the case for Chios. The herpetological contributions by Tsunis and Dimitropoulos (1995), Kasapidis et al. (1996) and Cattaneo (2003) do not provide any information in this regard. In Kasapidis et al. (1996), a distribution overview of *Emys* on the North-Eastern Aegean islands is published but without reference to Chios. I visited the island in 1991, without any *Emys* record, but with some *Mauremys* observations. Is it just that a record for Chios is still missing, or does *Emys* really not occur here? A possible occurrence is to be expected.

Corfu (Kerkyra) (585 km²)

Werner (1894) mentions the occurrence of *Emys* on Corfu, which is probably the best herpetologically researched Greek island, including turtles (see Stille and Stille 2017). Wütschert (1984) reported that in the central part of the island *Emys orbicularis* is 9–10 times more common than *Mauremys*. He calls it widespread – in a pond near Tebloni in central Corfu he saw 150 specimens. Mertens (1960, 1961), on the other hand, described it as less common than *Mauremys*. In any case, the ratio between the two species is nowhere else on the Greek islands as balanced as on Corfu. Kattinger (1972) mentions *E. orbicularis* several times, for example on 3.8.1965 in a stream on the coastal plain, flowing from a walled well to Lake Korission; on 5.8.1965 several specimens there; and on

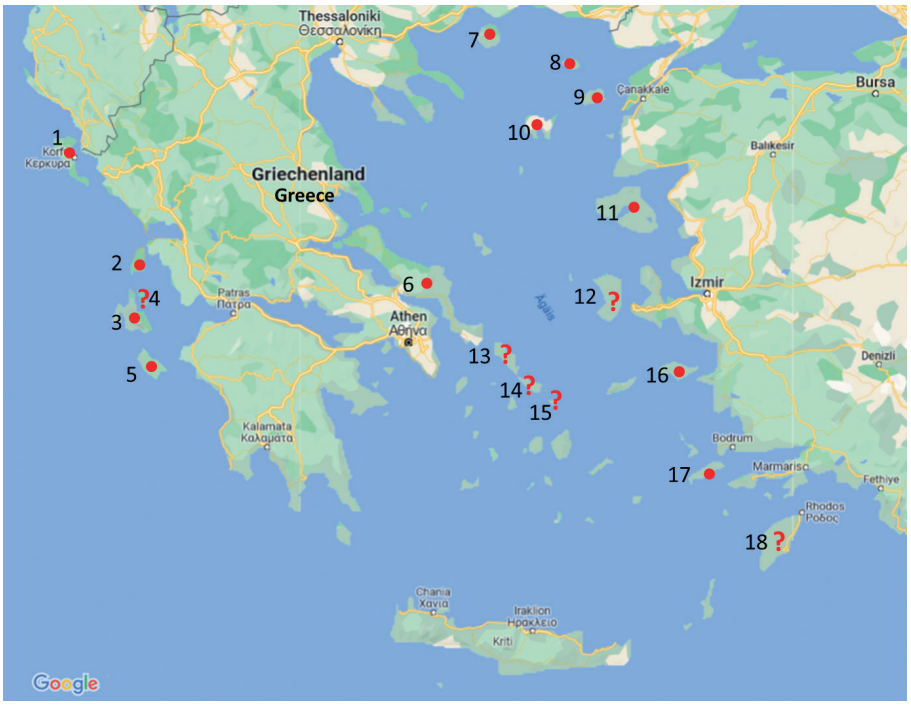

Figure 1. Occurrence of *Emys orbicularis* on Aegean and Ionian Islands in categories present and question mark absent/status unknown. 1. Corfu; 2. Lefkas; 3. Kefalonia; 4. Ithaca; 5. Zakynthos; 6. Euboea; 7. Thassos; 8. Samothrace; 9. Gökçeada; 10. Lemnos; 11. Lesbos; 12. Chios; 13. Andros; 14. Tinos; 15. Mykonos; 16. Samos; 17. Kos; 18. Rhodos.

21.8.1965 several *Emys orbicularis* were seen among *Mauremys rivulata* in a stream in the lower reaches of the Sutoria. Toth et al. (2002) give an overview of *Emys* occurrences on the island. They also refer to other sightings: at Linia, Lake Korission (Kattinger 1972), Temblisi (Gundke 1988), Paleokastritsa (Werner 1894; Wütschert 1984), the Sidari region (Mertens 1960; Gundke 1988; Fritz 2001). Larger occurrences are mentioned several times for the Antinioti Lagoon and Lake Korission. Wilson (2014) mentioned *Emys* in his Corfu report for 2014.

There are also numerous photographic descriptions of trips, for example by Balej and Jablonski (2006, 2021) with sites at Acharavi 10.5.2007 and 2.8.2009; Agios Georgios 6.8.2011 and 8.5.2014; Ormos Ermones (38 m above sea) 13.8.2011 and 8.5.2011; as well as Stroggili 10.8.2011 and 8.5.2011. Kalter (2013) mentions for his trip in July 2010 five different sites with *Emys orbicularis*, three of them in small rivers and two in marshes and standing water. Some travel reports, among others by Vandenbroeck (2014), can also be found on the webpage of fieldherping.eu, where *Emys* is mentioned in a river near Agios Georgios, as well as in a pond near Sidari, which has as many as three species of water turtle, namely *Emys*, *Mauremys* and the invasive Red-eared Slider Turtle *Trachemys scripta*. The most recent report is by Speybroek (2022) covering an excursion from 10–17.4.2022. *Emys* cannot normally be seen in flowing water on Greek islands, so the above are exceptions, but probably the water was very slow flowing. Lake Antinioti, with about 40 hectares in the north of the island, is called "heaven for turtles". It is located between the beaches of Almyros and Agios Spyridonas. *Emys* is, therefore, widespread on Corfu and has suitable habitats here to ensure its survival. It probably has a larger population here than on any other Greek island. Nevertheless, Stille and Stille (2017) consider *E. orbicularis* to be highly endangered on Corfu.

Euboea (Evia) (3,660 km²)

In Boettger's (1891) overview of the reptiles of Euboea, *E. orbicularis* is not yet listed. Cyren (1935) mentioned the species on the island for the first time. He saw some *M. rivulata* and an *E. orbicularis* in brackish water on the beach in the north of the island, the latter having a necrosis on its dorsal shield. He wondered if this was caused by the brackish water. Cyren (1941) mentioned again that he had captured, in brackish water, an *E. orbicularis* that had a dorsal carapace badly affected by algae. Werner (1938) refers to Cyren (1935) for his cited occurrence on Euboea. There are no later herpetological contributions with further *Emys* references, but there are individual references such as in Fritz (2001), and in Moysiadis and Efthimiou (2012), on a Natura 2000 object sheet GR 2420004, at Megalo Livari in the north of Euboea. *Emys* photos are also known from the island, for example by Davranoglou (2020) on a beach near Profitis Ilias. The status of this species on the island is thus not clarified; we can only state here that it does occur.

Gökçeada (Imbros) (279 km²)

The first record was from the estuary of a stream near Aydmerk on 29.4.1998 (Fig. 2), then on 5.5.1998 and in a residual pond two kilometres away on 6.5.1998 on the east

Figure 2. First record of *Emys orbicularis* on Gökçeada (Imbros) (May 1998) (Photo: M.F. Broggi).

coast see location map in Broggi (1999). Bayrakey et al. (2016) also confirm this evidence. As frequently observed in the Aegean, European Pond Turtles were only found sporadically among *Mauremys rivulata*. Suitable habitats are present on Gökçeada, although only small *Emys* populations can be expected, based on the observations.

Ithaca? (118 km²)

Keymar (1986) refers to Cyren (1935) in his herpetological survey of the Ionian Islands. Cyren sighted water turtles in a well on Ithaca but was unable to identify the species. Keymar said this was all the more remarkable because Ithaca had no permanent open water. Cisterns are probably the last refugial habitats of amphibians and hydrophilic reptiles on the island. Broggi (2009) can confirm that there are no suitable habitats for aquatic turtles on Ithaca today. If Cyren's (1935) observation is correct, *M. rivulata*, which has fewer habitat requirements than *Emys*, would probably be more likely. Strachinis and Artavanis (2017) found a new record of *Bufo bufo*, but equally no terrapins.

Kefalonia (773 km²)

Werner (1894) mentions *Emys* for Kefalonia, but little is known about its occurrence on the island since then. Wilson (2006a) does not mention *E. orbicularis* at all. One occurrence known to me is in the Livadi marshes, where I was able to observe about a dozen *Emys*, some of them mating, during a visit to the island on 16.4.1992. The observation was repeated in April 2017. An observation was also made in a stream near the artificial Karovomilos Lake at Sami. The Livadi marshes are described in Archipelagos (2016) in a natural history article titled "Wetlands in Kefalonia". On the webpage of the Kefalonia-Ithaca Geopark, *Emys* is described as "rarely seen in Kefalonia" (kefaloniapark.gr/en/node/293, later unavailable). In any case, it seems that the status of *Emys* on Kefalonia is endangered.

Kos (287 km²)

The first recorder of the species for Kos is probably Fritz (1989) with a collected specimen between Kos Town and Psalidi. Kos is otherwise not mentioned for *Emys* in the herpetological literature (see e.g. Cattaneo 2005). In Cattaneo et al. (2020), a paper on the herpetofauna of the Dodecanese, a photo with *Emys* on Kos is included without further comment. Further data on finds, in taxonomic contributions by Fritz (1989) and Fritz et al. (1998), prove that the species occurs on Kos, while Bader et al. (2009) point out in their contribution on Rhodes, that on 13.4.1984 a specimen was collected between Kos Town and Psalidi (Naturhist. Museum Wien, NHMW 28291). There is also photographic evidence of *Emys* on Kos on the internet, for example in a field report from 8.-22.6.2006 by Wilson (2006b), who saw two *Emys*. Troidl (2022) presented a photo of *E. orbicularis* from Kos in iNaturalist. These are single data, indicating sparse populations.

Lefkas (325 km²)

De Betta (1868) is named as the first describer by Werner (1894). Another early mention of the species is by Lehrs (1912), where he refers to several occurrences on the island. During my visit to Lefkas I saw three specimens, on 19.5.1985 in Nidri Bay, and on 20.5.1985 and 23.5.1985 in Vasili Bay. For further *Emys* data, see Sindaco and Rossi (2020). They found 15 specimens along Lake Maranthodi and two in a small channel near Vasiliki. The species is, therefore, present on Lefkas but probably only in small populations.

Lesbos (1,633 km²)

I succeeded in making the first record for the island in April 1978, when I found a dead *E. orbicularis* on the country road at the northern end of Geras Bay (Broggi 1978). In the following days, every fifth turtle observed turned out to be *Emys*. More juveniles were found in a swamp south of the main town of Mytilene. Buttle (1995) did not succeed in confirming *Emys*, nor did Kasapidis et al. (1996). Only Perez Mellado et al. (1999) confirm this species for Lesbos with an observation of a specimen at Kopster-Myrtiotissas-Filia. Hofstra (2003) found an *Emys* with a carapace length of 13 cm in a polluted river near Kalloni Lake. He describes it as extremely shy, much shyer than *Mauremys*. In the wetlands of Kalloni Bay, the two species share the habitat. Some nature photographers have posted examples on their websites, for instance of some *Emys* sites, on iNaturalist (2022). Christopoulos and Zevgotis (2022) report from a 12-year study. They surveyed 119 wetlands on the island. They found them within stable populations of *Emys* and *Mauremys*. They present a distribution map with six *Emys* sites, compared to 83 for *Mauremys*. All these *Emys* sites were found in Kalloni Bay. The populations do not seem large but are stable according to Christopoulos and Zevgotis (2022). These authors also found three sites where Red-eared Slider Turtles (*T. scripta*) co-occurred with the native terrapins.

Limnos (476 km²)

Werner (1938) does not mention *Emys* on Limnos. The first record was made by Schneider (1986), who found a site with two specimens behind the beach of Evgatis. Strachinis and Roussos (2016) studied the herpetofauna of the island for many years, and Strachinis found a dead specimen near Plaka on 30.7.2007, which had been killed by heavy machinery during reed harvesting. This was followed in April 2015 by his further observation of three specimens in a narrow ditch near the airfield. The authors describe *E. orbicularis* as threatened with extinction and refer in particular to attempts to drain back-dammed water towards the sea near Aliki. I was able to detect 11 *Emys* sites on the island, each with low numbers, during intensive surveys (Broggi 2017). *Emys* and *Mauremys* shared the habitat, with *Mauremys* being more common (Fig. 4). The assessment of the threat to the species remains valid despite these new findings.

Mykonos? (105 km²)

Bringsøe (1985) writes that a Swedish tourist brought him a live European Pond Turtle on Mykonos. This was the first, and so far the only, find in the Cyclades. We know about the endangered status of *Mauremys rivulata* on the island (Broggi 2012; Broggi in press), and *E. orbicularis* has not been seen again since this single record. It is difficult to assess this 1985 find. Is it a release, is it a relict? Fritz (1992) writes about Tinos, "due to the recent finding of an *Emys orbicularis* on the neighbouring island (meaning Mykonos),

Figure 3. Estuary of the Fonias-Brook on Samothrace with first record of *Emys orbicularis* in May 1988 (Photo: M.F. Broggi).

Figure 4. Shared habitat of *Emys orbicularis* and *Mauremys rivulata* on Lemnos (22.04.2016) (Photo: M.F. Broggi).

however, the old record for Tinos deserves re-examination.". The wetland situation on Mykonos has deteriorated dramatically in the meantime, whereas a suitable habitat would be available on Tinos. From today's point of view, without further evidence, we must consider the 1985 finding as an introduction, as is now often the case for land tortoises.

Rhodes? (1,401 km²)

Surprisingly, there is still no confirmed evidence for Rhodes. Helmdag (1993) visited the island and states: "It is possible that *Emys orbicularis*, the European Pond Turtle, also lives there. In any case, it seemed to me that an animal I saw belonged to this species but could only be seen once for a few seconds while taking a breath." Bader et al. (2009) cannot confirm the species in their herpetological article on Rhodes. Although several animal photographers have visited the island in recent years, there has been no confirmation from this side either. Thus, the species` presence on the island remains unconfirmed.

Samos (477 km²)

Calabresi (1923) and Ioannides et al. (1994) do not mention *Emys* for Samos in their herpetological contributions.

In 1975, I also failed to find any. In a popular article on the herpetofauna of some Greek islands, Buttle (1995) mentions *E. orbicularis* in a list for Samos, without commenting on this or identifying it as a first record. Meyer and Fritz (1996) succeeded in establishing a reliable record of *Emys* on Samos on 12.4.1996. A specimen was photographed on the reedy shore of an irrigation pond near the mouth of the Tourkomyla River between the villages of Mesokambos and Mykalis in Eastern Samos. The site was about 200 metres from the seashore. Clark (2000) also mentions one observation of *Emys*. Speybroeck et al. (2014), in turn, report seven observations in four grids on the south-east coast. They describe *Emys* as "extremely rare on Samos" and thus threatened with extinction.

Samothrace (178 km²)

Neither Werner (1938), nor Wettstein (1953) mentions the species for Samothrace, nor later do Clark (1991), Buttle (1995), Cattaneo (2001) and Ochsenhofer (2012). The first record of the species was made on the north coast, east of the Fonias stream, on 26.5.1987, when two *Emys orbicularis* were found in a group of *Mauremys* (Broggi 1988, 1994). Again, on 3.6.1987, I found *Emys* among *Mauremys* in a residual pond on the same road. The island of Samothrace is rich in water, and there are several watercourses with syphons, as well as standing water on the island (Fig. 3). The numbers of *Emys* are clearly low if so many herpetologists have overlooked the species, and it has not been confirmed since. On the other hand, the existence of *Emys* has been cited several times since then, for example in the nomination application for a UNESCO biosphere reserve in September 2013.

Thassos (380 km²)

Emys was also discovered late on Thassos. During my visit to the island in 1996 I did not see any *E. orbicularis* individuals. Clark (1999) also does not refer to *Emys*, though Fritz (2001) collected a specimen. In Fowles (2012) we read: "*Emys* was related as recorded from the island by Yann Horstink in July 2007 near Prinos. A single individual along with circa 20 *Mauremys* (was seen) in a small area of open water in a reed-filled ditch, and Lance Chilton photographed two *Emys* in May 2012." Berthomieu and Vermeer (2021) mention the presence of *E. orbicularis* on Thassos but without citing a source. So far, these are the only references to an occurrence on the island. Information on population sizes is also missing.

Tinos? (194.5 km²)

Werner (1938) refers to the Morée expedition in 1832 for Tinos and adds a question mark to the statement. Beutler and Frör (1980) write: "St. Hilaire (after Bedriaga 1882) lists the European Pond Turtle, *Emys orbicularis*, for the River Eurotes on Tinos. However, a watercourse of that name does not exist on the island; the record probably refers to the Evrotes in Laconia, where the species was found by Cyren (1941)."Fritz (1992) notes the following on the history of Tinos: "1833 *Emys antiquorum* Valenciennes in Bory de Saint-Vincent (Eurotes estuary Peloponnese and Tinos) ". The river is recorded here for the Peloponnese, and Tinos is given independently. Fritz (1992) considers an earlier occurrence on Tinos (and also Mykonos) as possible. Regarding suitable habitats, the lagoons of Kolimpithra and Panormos on Tinos would be quite possible for *E. orbicularis*, according to my own visit in 2018, but did not find it there (Broggi 2019). Likewise, for both Andros and Mykonos, a confirmation is missing.

Zakynthos (406 km²)

Werner (1938) first mentions *E. orbicularis* for the island with reference to W. Kühnelt without citing the source. Keymar (1988) mentioned *Emys* for Lake Keri, where he saw some juveniles. Podlouky and Fritz (1994) observed two specimens at Lake Keri and believed the site was threatened by desiccation. Extinction is feared. Wilson (2006a) mentions a marsh and watercourse at Limni Keri in the south-west of the island, where he observed six individuals and also noted drainage in the area. Wilson (2009) wrote from two excursions in May 2005 and June 2006 that there was only one occurrence on Zakynthos, at Lake Keri. He observed around 20 animals there in 2005 and 30 in 2006. Urosevic (2014) recorded an adult *Trachemys scripta scripta* in a canal near Lake Keri and later saw a juvenile *T. s. elegans* there. The other turtles observed there have been *Emys orbicularis* in larger numbers and some *Mauremys rivulata* (Urosevic 2014). Pafilis et al. (2015) points to a monitoring program as a case study for Zakynthos that also includes *E. orbicularis*. These references are all clearly about the same endangered site on Zakynthos, and thus this species must be assessed as threatened with extinction from the island.

Discussion

Emys orbicularis lives mainly in stagnant waters along the Greek mainland and on the larger Ionian Islands except Ithaca. It is absent from Kythera, Crete and the Cyclades. Its occurrences in the Ionian area and in the Aegean are restricted to the larger islands close to the mainland that have wetlands in their coastal areas. Viable populations exist on Lesbos and Corfu, but on other islands only small populations were found. The situation seems to be particularly critical on Kefalonia, Zakynthos, Thassos and Samos.

While the sympatric species *M. rivulata* occurs on 29 Greek and two Turkish islands (Broggi in press), *E. orbicularis* has so far been found on only 11 Greek islands and one Turkish. It has rather more specific habitat requirements than *Mauremys* (Fritz 2001). Occurrences on Rhodes and Chios have not yet been clarified, while for four other islands early reports have never been confirmed and are therefore questionable. Samothrace, with

a land area of 178 km^2, is the smallest island with *Emys* sightings. It is obvious that only the larger islands allow large hydrological catchment areas, which can then form corresponding watercourses with estuaries.

Threats and protection

Most of the Greek islands have an arid climate and, therefore, have few wetlands due to a lack of annual precipitation (WWF-Greece 2014). According to my observations the habitats of swamp turtles in the estuaries of watercourses are often located in sandy areas and are characterized by the formation of beach walls. Sea currents can close the estuary to flowing waters, with falling water pressure then causing backwater in the form of lagoons or other smaller areas of standing water. These habitats are naturally rare in the Greek island world and tend to be small. Human influence is all the more detrimental to these hydrophilic species. A gene exchange between populations is hardly possible via land routes but only via drifting into the open sea after heavy rainfall. It is known that *Emys* from the Neretwa estuary in Croatia have drifted to the island of Korcula, 5km away (Jelič et al. 2012). However, the surviving animals did not find suitable habitats there. This observation supports the inter-island drift theory for the distribution of the species during the last millennia (Lymberakis and Poulakakis 2010). It is obvious that *Mauremys* is better adapted to this as it is more salt-resistant than *Emys*.

In its preferred habitat in the backwaters of sandy beaches, numerous conflicts of use arise. Tourism claims these sandy beaches and impairs or destroys habitats with its infrastructure. This affects not only the aquatic habitats but also the nesting sites needed. Intensified agriculture is also exploiting flat areas in the estuaries of watercourses. Agriculture is also involved in water loss by diverting water for field irrigation over many kilometers and thus drying out suitable habitats. It also extracts groundwater by pumping, causing watercourses to dry up more quickly. I have the impression that *Emys* proves to be a more sensitive species to pollution than *Mauremys*, which can still thrive in heavily eutrophic waters (Wischuf and Busack 2001). Similarly, refugial habitats in streams are used by *Mauremys*, which has not been observed for *Emys*, at least on the islands. All *Emys* occurrences on islands are in low-lying areas, on islands they hardly penetrate the streams at higher elevations. A new threat is the introduction of invasive turtles. Cady and Joly (2004) find weight loss and high mortality of *E. orbicularis* in mixed groups, and their study calls for a halt to slider turtle introduction in all European wetlands. Likewise, ongoing climate change with drying tendencies may be another threat.

Emys orbicularis is a species in Greece protected by national legislation (Presidential Decree 67/1981). It is also protected and listed in Annex II of the EU Habitats Directive, as well as by the Bern Convention. It is believed that many wetlands on the islands have been destroyed in the past century (WWF-Greece 2014). WWF-Greece mapped 824 wetland structures on 76 islands in 2004–2013. Of these, 100 are in the Ionian Islands, 526 in the Aegean and 192 in Crete. The data is available at oikoskopio.gr/ygrotopio (WWF-Greece 2014). In a presidential Act in 2012, 350 properties on 58 islands were placed under protection. According to Paragamian et al. (2014), this is said to have been extended from 350 to 562, which corresponds to around 70% of all those in the inventory. Enforcement of protection will now have to be monitored; some of our own observations suggest these decrees are being disregarded.

The present study is a second report on the occurrence and status of *E. orbicularis* on the Greek islands. It is based on literature studies, although there are certainly gaps in our knowledge. In addition, the author and his colleagues were able to visit about 60 Greek islands, with local inspections, to get a picture of the prevailing habitat conditions. The assessment of threats to *Emys orbicularis* on the individual islands is not based on monitoring, as such data are lacking. It is my subjective expert assessment. This is mostly based on a systematic search of suitable habitats on the islands. However, such findings may date back many years and thus be outdated. The occurrences of *Emys orbicularis* on the islands are usually very isolated, their populations small and therefore vulnerable. Accordingly, the occurrences of *Emys orbicularis* are endangered and must be ensured through conservation measures. The report explicitly refers to open questions that need to be closed by further field herpetological work. The most obvious is the clarification of the occurrence of *E. orbicularis* on Chios and Rhodes.

Acknowledgments

I would like to thank my faithful companions Dr. Peter Goop, Vaduz, and Mag. Günter Stadler, Frastanz (Vorarlberg) for their help on the excursions. We remember our deceased colleagues Edith Waldburger, Buchs SG, Wilfried Kaufmann, Balzers FL, and Dr. Christian Burri, Untervaz GR. A thank you also to the three evaluators and the editors for their valuable advice.

References

Archipelagos (2016) Wetlands in Kefalonia, 26.9.2016. https://archipelagos-org.eu/en/wetlands/ [last accessed 19.5.2023]

Bader T, Riegler C, Grillitsch H (2009) The herpetofauna of the island of Rhodes (Dodecanese, Greece). Herpetozoa 21(3/4): 147–169.

Balej P, Jablonski D [Eds] (2006, 2021) Amphibians and Reptiles of the Balkans. Balcanica.info – Amphibians and Reptiles of the Balkans. Keyword Corfu. https://en.balcanica.info [last accessed 19.5.2023]

Bayrekey Y, Dinger Y, Yakun B, Çiçek K, Tok CV (2016) Abundance of western Caspian Turtle *Mauremys rivulata* (Valenciennes, 1833) on Gökçeada (Imbros), Turkey. Russian Journal of Herpetology 23(4): 254–269.

Bedriaga J (1882) Die Amphibien und Reptilien von Griechenland. Bulletin de la Société impériale des Naturalistes de Moscou 56: 43–103. [278–344.]

Berthomieu L, Vermeer J (2021) EAZA Best Practical Guideline, European Pond Turtle *Emys orbicularis*. European Association of Zoos and Aquariums, Amsterdam, Netherlands, 101 pp.

Beutler A, Frör E (1980) Die Amphibien und Reptilien der Nordkykladen (Griechenland). Mitteilungen Zoologische Gesellschaft Braunau 3(10/12): 255–290.

Boettger O (1891) Reptilien von Euböa. Zoologischer Anzeiger 14: 1–418.

Bringsøe H (1985) A checklist of Peloponnesian amphibians and reptiles, including new records from Greece. Annales Musei Goulandris, Kephesia 7: 271–318.

Broggi MF (1978) Herpetologische Beobachtungen auf der Insel Lesbos (Griechenland). Salamandra 14(4): 161–171.

Broggi MF (1988) Herpetologische Beobachtungen auf Samothrake (Griechenland). Berichte Botanisch-Zoologische Gesellschaft Liechtenstein-Sargans-Werdenberg 17: 93–99.

Broggi MF (1994) Feldherpetologische Beobachtungen und Bemerkungen zu schützenswerten Biotopen. Herpetozoa 7(1/2): 29–34.

Broggi MF (1996) Die Feuchtgebiete der Insel Andros mit ihren Amphibien und hydrophilen Reptilien. Herpetozoa 8(3/4): 135–144.

Broggi MF (1999) Notizen zur Herpetofauna der Ägäisinsel Gökçeada. Herpetozoa 12(1/2): 73–78.

Broggi MF (2007) Herpetological notes on the island of Amorgos (Cyclades, Greece). Herpetozoa 20(1/2): 93–96.

Broggi MF (2012) The Balkan Terrapin *Mauremys rivulata* (Valenciennes, 1833), on the Aegean islands. Threats, conservation aspects and the situation on the island of Kea (Cyclades) as a case study. Herpetozoa 24(3/4): 149–164.

Broggi MF (2017) The "wetland" island of Lemnos (Greece): herpetofauna and nature conservation. Herpetozoa 30(3/4): 169–178.

Broggi MF (2019) Herpetological notes on *Mauremys*, *Pelophylax* and *Stellagama* for the Cycladic island of Tinos (Greece). Herpetozoa 31(3/4): 225–229.

Broggi MF (2023) Occurrence and tentative population status of the Balkan Terrapin *Mauremys rivulata* (Valenciennes, 1833) on Greek islands. Herpetozoa 36: 233–247. https://doi.org/10.3897/herpetozoa.36.e100533

Broggi MF, Grillitsch H (2012) The European Pond Terrapin (*Emys orbicularis* L.) in the Aegean: Distribution and Threats. Herpetozoa 25(1/2): 47–58.

Buttle D (1995) An introduction to the reptiles and amphibians of the Greek islands. International Reptilian 3(7): 15–25.

Cady 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. https://doi.org/10.1023/B:BIOC.0000048451.07820.9c

Calabresi E (1923) Anfibi e Rettili dell Isola di Samos. Monitore Zoologico Italiano. Firenze 34(5): 75–80.

Cattaneo A (2001) L`Erpetofauna delle isole greche di Thassos, Samothraki e Lemnos. Bolletino del Museo Civico di Storia naturale di Venezia 52: 155–181.

Cattaneo A (2003) Note herpetologiche sulle isole egee di Lesvos, Chios e Samos. Bolletino del Museo Civico di Storia Naturale di Venezia 54: 95–116.

Cattaneo A (2005) Osservazioni sull`erpetofauna dell`isola greca di Kos (Sporadi meridionali). Museo di Storia Naturale della Maremma 21: 79–91.

Cattaneo A, Cattaneo C, Grano M (2020) Update on the herpetofauna of the Dodecanese Archipelago (Greece). Biodiversity Journal 11(1): 69–84. https://doi.org/10.31396/Biodiv.Jour.2020.11.1.69.84

Christopoulos A, Zevgolis Y (2022) A new invasion of the Common Slider on a Mediterranean Island (Lesvos, Greece). A potential threat to native terrapin populations. Diversity 14(12): e1018. https://doi.org/10.3390/d14121018

Clark R (1991) A report on herpetological investigations on the island of Samothrace, North Aegean-Greece. British Herpetological Society Bulletin 38: 3–7.

Clark R (1999) Herpetofauna of Thassos, Northern Aegean Sea, Greece. British Herpetological Society Bulletin 66: 14–18.

Clark R (2000) The herpetology of Samos island (Eastern Aegean Sea, Greece). The Herptile 25(4): 172–175.

Cyren O (1935) Herpetologisches vom Balkan. Blätter Aquarien-Terrarienkunde 46: 125–135.

Cyren O (1941) Beiträge zur Herpetologie der Balkanhalbinsel. Mitteilungen Naturwissenschaftliches Institut Sofia 14: 36–152.

Davranoglou L (2020) Checkliste von Euböa. https://www.inaturalist.org/observations/72176227 [last accessed 6.3.2023]

De Betta E (1868) I rettili ed anfibi della Grecia, con alcune notizie della distribuzione geografica delle specie. Atti regio Istituto veneto Scienze Letterare Arti Venezia 3(13): 1–892.

Erhard D (1858) Fauna der Cykladen – Die Wirbeltiere der Cykladen, Leipzig, Voigt & Günther, 117 pp.

Fowles AP (2012) An introduction to the wildlife and wild places of Thasos, Greece: vertebrates, reptiles and amphibians. https://yrefail.net/Thasos/herptiles.htm [last accessed on 18.5.2023]

Fritz U (1989) On the intraspecific variability of *Emys orbicularis* (Linnaeus, 1758) 1. A new subspecies of the European Pond Turtle from Asia Minor, *Emys orbicularis luteofusca*. Salamandra 25: 143–168.

Fritz U (1992) Zur innerartlichen Variabilität von *Emys orbicularis* (Linnaeus, 1758), 2. Variabilität in Osteuropa und Redefinition von *Emys orbicularis orbicularis* (Linnaeus, 1758) und *E.o. hellenica* (Valenciennes, 1832). Zoologische Abhandlungen, Staatliches Museum für Tierkunde Dresden 47(5): 37–77.

Fritz U (1998) Introduction to zoogeography and subspecies differentiation in *Emys orbicularis*. Mertensiella 10: 1–27.

Fritz U (2001) *Emys orbicularis* (Linnaeus, 1758) – Europäische Sumpfschildkröte. In: Fritz U (Ed.) Handbuch der Reptilien und Amphibien Europas, Schildkröten (Testudines) I. Aula Verlag, Wiebelsheim, 343–516.

Fritz U, Baran I, Budak A (1998) Some notes on the morphology of *Emys orbicularis* in Anatolia on *Emys orbicularis luteofusca* and *E. o. colchica* with the description of a new subspecies from southeastern Turkey. Mertensiella 10: 103–121.

Grundke FD (1988) Die Amphibien und Reptilien der Insel Korfu. Die Aquarien- und Terrarien-Zeitschrift (DATZ) 41: 426–428.

Helmdag A (1993) Faunistic observations on the island of Rhodes. The Lizard 10: 25–26.

Hofstra J (2003) Herpetological observations on the Greek island of Lesbos. POD@RCIS 4(3): 101–111.

iNaturalist (2022) Checklist Lesvos, *Emys orbicularis* 24.9.2022. https://www.inaturalist.org/check_lists/33600-Lesvos-Check-List [last access: 19.5.2023]

Ioannides Y, Dimaki M, Dimitropoulos A (1994) The herpetofauna of Samos (Eastern Aegean, Greece). Annales Musei Goulandris 9: 445–456.

Jelič D, Budinski I, Laus B (2012) Distribution and conservation status of the batracho- and herpetofauna of the Croatian island of Mljet. Herpetozoa 24(3/4): 165–178.

Kalter G (2013) Die Reptilien Kretas – Europäische Sumpfschildkröte (*Emys orbicularis hellenica*). https://www.schildkroetenteiche.de/korfu.html [last accessed 19.5.2023]

Kasapidis P, Provatidou S, Maragou P, Valakos ED (1996) New data on the herpetofauna of Lesbos (Aegean Islands, Greece) and some biogeographical remarks on the islands of the northern Aegean archipelago. Salamandra 32(3): 171–180.

Kattinger E (1972) Beitrag zur Reptilienkunde der südwestlichen Balkanhalbinsel. Berichte Naturforschende Gesellschaft Bamberg 47: 42–75.

Keymar P (1988) Vorläufige Ergebnisse herpetologischer Aufsammlungen auf den Ionischen Inseln: II. Zakynthos und Marathonisi. Annalen des Naturhistorischen Museums Wien, Serie B 90: 17–25.

Lehrs P (1912) Reptilien Leben in Lefkas. Verhandlungen der Gesellschaft Deutscher Naturforscher und Ärzte 83(2): 28–29.

Lymberakis P, Poulakakis N (2010) Three continents claiming an archipelago: The evolution of the Aegean`s herpetofaunal diversity. Diversity 2010(2): 233–255. https://doi.org/10.3390/d2020233

Lymberakis P, Pafilis P, Poulakakis N, Sotiropoulos K, Valakos E (2018) Amphibians and Reptiles of the Aegean Sea. In: Sfenthourakis S, Pafilis P, Parmakelis A, Poulakakis N, Triantis KA (Eds) Biogeography and Biodiversity of the Aegean. In honour of Prof. Moysis Mylonas. Broken Hill Publishers Ltd, Nicosia, Cyprus, 169–189.

Mertens R (1960) Zoologische Wandertage auf Kreta, der Insel der Phäaken. Natur und Volk, Frankfurt a.M. 423(1/2): 356–366.

Mertens R (1961) Die Amphibien und Reptilien der Insel Korfu. Senckenbergiana Biologica 42(1/2): 1–29. https://doi.org/10.2307/1440026

Meyer A, Fritz U (1996) Die Europäische Sumpfschildkröte *Emys orbicularis hellenica* auf Samos. Herpetofauna 18 (103): 27.

Moysiadis A, Efthimiou G (2012) Temporal Landcover Analysis of a Natura 2000 wetland – the case study of Megalo Livari (GR 2420004) in Northern Evia, Greece. Advances in Geosciences, Conference: 32nd EARSd Symposium 36th General Assembly 2012, Vol. 1

Ochsenhofer G (2012) Botanisch-Zoologische Exkursion nach Samothraki. Österreichische Gesellschaft für Herpetologie, ÖGH-Aktuell 28: 20–25.

Pafilis P (2010) A brief history of Greek herpetology. Bonn Zoologisches Bulletin 57(2): 329–345.

Pafilis P, Panayiotis K, Lymberakis P, Poirazidis K, Karris G, Dimitriadis C (2015) Herpetofauna surveys in protected areas: a case study from Zakynthos. Int. Congress on Zoogeography and Ecology in Greece, 7–11 October 2015, Irakleo, Crete.

Paragamian K, Giannakakis T, Georgiadis N, Poursanidis D, Kardamaki A, Catsadorakis G, Vrettou F, Chasiotos G, Liarikos C, Nantsou T, Christopoulou I (2014) Greek island wetlands on the WWF Greece initiative. 8th European Ramsar Meeting. Kufstein Austria, 20–24.10.2014.

Perez Mellado V, Valakos ED, Gil MJ, Guerrero F, Luch J, Navarro P, Maragou P (1999) Herpetological notes from mainland and insular Greece. British Herpetological Society Bulletin 67: 33–38.

Podloucky R, Fritz U (1994) On the occurrence of *Emys orbicularis hellenica* on Zakynthos (Ionian Islands, Greece). Herpetozoa 16: 28–30.

Schneider B (1986) Die Herpetofauna auf Limnos (Hellespontische Insel, Nördliche Ägäis, Griechenland). Salamandra 22(4): 276–280.

Sindaco R, Rossi R (2020) Annotated checklist of the herpetofauna (Amphibia, Reptilia) of Lefkada island (Ionian Islands, Greece). Natural History Sciences 7(2): 57–68. https://doi.org/10.4081/nhs.2020.480

Speybroeck J (2022) Corfu 2022. https://www.hylawerkgroep.be/jeroen/index.php?id=111 [last accessed 19.5.2023]

Speybroeck J, Bohl D, Razzetti E, Dimaki M, Kirchner MK, Beukema W (2014) The distribution of amphibians and reptiles on Samos island (Greece). Herpetozoa 27(1/2): 39–63.

Stille B, Stille M (2017) The Herpetofauna of Corfu and Adjacent Islands. Edition Chimaira, Frankfurt a.M., 354 pp.

Strachinis I, Artavanis D (2017) Additions to the known herpetofauna of the Island of Ithaki, Ionion Sea, Greece. Herpetozoa 30(172): 64–66.

Strachinis I, Roussos S (2016) Terrestrial herpetofauna of Limnos and Agios Efstratios. Herpetology Notes 9: 237–248.

Tóth T, Krecsák L, Madsen T, Újvári B (2002) Herpetological locality records on the Greek island of Corfu. Herpetozoa 15(3/4): 149–169.

Troidl WS (2022) European Pond Turtle (*Emys orbicularis*). iNaturalist. https://www.inaturalist.org/observations/118901589 [last accessed 4.3.2023]

Tsunis G, Dimitropoulos A (1995) The Amphibians and Reptiles of Lesvos and Chios (Aegean Islands Greece). Biologia Gallo-Hellenica 22: 37–548.

Urosevic A (2014) Report of two subspecies of an alien turtle, *Trachemys scripta scripta* and *T. scr. elegans* (Testudines: Emydidae), sharing the same habitat on the island of Zakynthos, Greece. Ecologia Montenegrina 1(4): 268–270. https://doi.org/10.37828/em.2014.1.35

Valakos E, Pafilis P, Sotiropoulos K, Lymberakis P, Maragou P, Foufopoulos J (2008) The Amphibians and Reptiles of Greece. Edition Chimaira, Frankfurt am Main, 463 pp.

Vandenbroeck B (2014) Yet another Corfu trip 2014. https://fieldherping.eu/Forum/viewtopic.php?f=13&t=1924&p=18588&hilit=Yet+another+Corfu+trip+2014#p18588 [last accessed 19.5.2023]

Werner F (1894) Die Reptilien und Batrachierfauna der Ionischen Inseln. Sitzungsberichte Zoologisch-Botanische Gesellschaft in Österreich 44: 225–237.

Werner F (1938) Die Amphibien und Reptilien von Griechenland. Zoologica – Original-Abhandlungen aus dem Gesamtgebiet der Zoologie. Schweizerbart`sche Verlagsbuchhandlung, Stuttgart 35(1): 94–114.

Wettstein O (1953) Herpetologia aegea. Sitzungsberichte der österreichischen Akademie der Wissenschaften, Wien 162: 651–833. https://doi.org/10.1007/978-3-662-25591-9_1

Wilson M (2006a) Herpetological observations on the Greek islands of Kefallinia and Zakynthos. Herpetological Bulletin 97: 19–28.

Wilson M (2006b) Field report Kos Greece 8–22.6.2006. http://www.mwilsonherps.com/Field/Kos1.phb [last accessed 5.5.2012]

Wilson M (2009) Zakynthos. https://mwilsonherps.com/Greece-trips/Zakynthos/ [last accessed 19.5.2023]

Wilson M (2014) Corfu 2014 (26th May-1st June). https://mwilsonherps.com/Greece-trips/corfu-2014/ [last accessed 19.5.2023]

Wischuf T, Busack S (2001) *Mauremys rivulata* (Valenciennes in Bory de Saint-Vincent et al.,1833) – Ostmediterrane Bachschildkröte. In: Fritz U (Ed.) Handbuch der Reptilien und Amphibien Europas, Schildkröten (Testudines) I. Aula-Verlag, Wiebelsheim, 89–110.

Wütschert R (1984) Neuigkeiten zur Reptilienfauna der Insel Korfu. Salamandra 20(4): 221–228.

WWF-Greece (2014) Conservation of the island wetlands of Greece 2004–2013. Athens,78 pp.

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: Herpetozoa

Jahr/Year: 2023

Band/Volume: 36

Autor(en)/Author(s): Broggi Mario F.

Artikel/Article: Occurrence and status of the European Pond Turtle, Emys orbicularis hellenica (Valenciennes, 1833), on Aegean and Ionian Islands (Greece, Turkey) 249-257