Status of the green toad (*Bufotes viridis*) and marsh frog (*Pelophylax kurtmuelleri*) on Ios (Cyclades, Greece)

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Initial situation

Graham *et al*. (2021) report a new finding of the green toad (*Bufotes viridis*) on Ios. It was observed in a seasonally flooded area near the coast at Mylopotas (36.7147 N, 25.2955 E). For the marsh frog (*Pelophylax kurtmuellleri*), two sites are reported, a garden pond near Mylopotas Reservoir (36.4252 N, 25.182 E) and a seasonally flooded area in Ios Port (36.7258 N 25.2740 E). In view of this paucity of sites, the authors suggest further clarification, particularly regarding the status of the species and conservation aspects. This is the subject of the following article.

Introduction

The Cycladic island of Ios is located 12 km south of Naxos; it is arid, mountainous and has an area of 108 km2. At 713 m a.s.l., Pyrgos is the highest point on the island. In addition to the amphibian species mentioned above, the documented herpetofauna of the island (cf. Cattaneo 1999) comprises the two gecko species *Cyrtodactylus kotschyi* and *Hemidactylus turcicus*, Erhard's wall lizard (*Podarcis ehrhardii*), the Balkan green lizard (*Lacerta trilineata*) and the three snake species sand boa (*Eryx jaculus*), four-lined snake (*Elaphe quatuorlineata*) and horned-nose viper (*Vipera ammodytes*). With the exception of the Balkan green lizard, these species were observed during our visit to the island from 8-17 April 2022. Our follow-up search focused on potential sites of hydrophilic herpetofauna. The Western Caspian turtle (*Mauremys rivulata*) was also a species of interest. The search concentrated on the water bodies still bearing water and the seasonally flooded mouths of the streams. The site data provided by Graham *et al*. (2021) were checked. The 1:25,000 SKA map of Ios (no. 315) was used for the field work, and GARMIN eTrex 20 was used to determine the coordinates.

Status of the green toad (*Bufotes viridis*)

The mouth of the Stroubouli stream in Mylopotas is enclosed by hotel and other high-rise buildings

(see figure 2) . This is where Graham *et al*. (2021) made their only find of the green toad on the island (36.7147 N, 25.2955 E). The backwater area of the stream is located behind the coastal road and north of the access road to the Deep Blue Restaurant behind the hotel of the same name. The owner reported nightly choruses and the presence of toads in the car park and garden area. The area that was still flooded on 9 April 2022 also included a vehicle track filled with water. There the tadpoles were very numerous and already well developed, although still without their hind legs. At other locations in the area of flooding, dense swarms of even younger tadpoles were found. The water-filled track was kept under observation in the following days. On 9 and 10 April 2022 over a hundred tadpoles were to be seen. However, a little egret (*Egretta garzetta*) and two species of wader, the common sandpiper (*Actitis hypoleucos*) and the wood sandpiper (*Tringa glareola*) were also permanent visitors to the site. On 12 April, no tadpoles were observed in the reduced volume of water in the vehicle track, which was found to be dry on 15 April. The tadpoles in this unprotected habitat obviously served as a concentrated source of food for the waterfowl. This area is listed in the WWF wetland inventory for the Greek islands and is supposed to be protected by a presidential decree. The remaining land, which dries up during the spring, is threatened by a variety of potential measures related to the development of tourism there. After a wet spring, the green toad is able to metamorphose at this site.

On 9 April 2022, tadpoles of the green toad were found in two concrete intakes on the Mylopotas Reservoir (figures 3 & 4). The intake streams themselves had dried up. Residual water remained in the concrete channels, which was impounded by a small cross member. On both spawning sites there is a chance that enough water will remain for metamorphosis to take place. The reservoir itself, which was built in 1995, is fenced off, covered with a sterile synthetic membrane and has steep embankments, so that no vegetation can grow there. This makes it useless as a spawning ground for amphibians.

Apart from the resort of Mylopotas, other sites of relevance in the search for green toads were concentrated in the southeast of the island. In Maganari, in the western sandy bay, five wet bodies were found in backwater areas of the Fylladhakia stream on 9 April 2022 (figures 5 & 6). All these pools were populated with thousands of tadpoles. Two of the five could possibly remain wetted until the tadpoles metamorphose. The wetted areas were found over a distance of 200 metres between the end of the bay in the west, where there is a residential

building and a car park, to Antoni's restaurant in the east.

Spawning sites can also be expected in road construction excavation sites as long as they retain their water. An isolated site of this type was found by the roadside on 10 April 2022 near Kalamos Bay on the eastern side of the island. On 12 April 2022, a wetted depression containing tadpoles was found by the side of the newly upgraded road to Maganari near Vigla Kalamou. There was also water crowfoot growing in the pool, indicating the prolonged presence of water. This was also the case, albeit without tadpoles, with a waterhole excavated out of the rock near the houses of Maganari. Finally, three kilometres north of the bay, two more waterholes with tadpoles were found along the above mentioned new road to Maganari on 16 April 2022 (figures 7 & 8). A total of 12 reproduction sites of the green toad were thus identified on the island of Ios. They are all located in the southwest of the island.

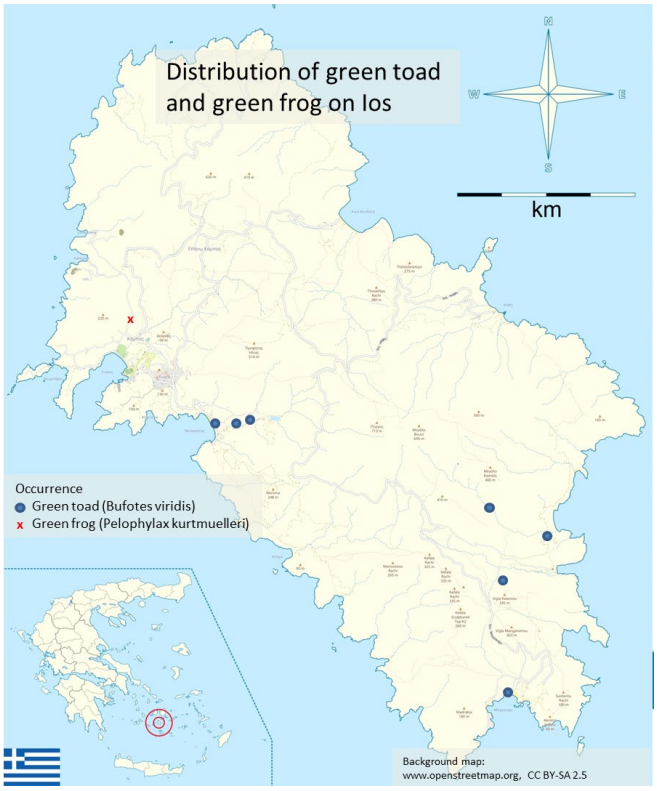

Figure 1. Distribution of green toad and green frog on Ios.

Status of the marsh frog (*Pelophylax kurtmuelleri*)

The two sites with marsh frogs reported in Graham *et al*. (2021) could no longer be confirmed two years after their find. In the private garden pond south of the Mylopotas Reservoir, repeated searches failed to produce evidence of the marsh frog. The seasonal backwater in Ios Port still comprised two water bodies, but there were no signs of the marsh frog. Moreover, it was apparent that the residual puddles were unlikely to remain wetted much longer and the area would soon dry out.

In the grey literature there are two further references to marsh frogs for Ios, but no location details are provided. Whether they correspond to the above sites is uncertain. Carl Corbridge wrote in Yorkshire Field Herping and Wildlife Photography in 2014 about finding "a very nice spring with green frogs", and in his herpetological blog, Matt Wilson mentions a "moderate amount of waterfrogs in ponds" in 2019. During our visit to the island, the mouths of many streams were checked for backwater

areas as well as many upper and middle reaches of mountain streams for flowing or still surface water. Only a few pools were found on bedrock, for example in the Mylopotas stream above the reservoir, but without any evidence of amphibians. It was therefore all the more surprising to come across sections of stream that still held water while hiking on waymarked path no. 1 leading from the Skarkos archaeological site near Ios northwards in the direction of Eparios Kambos. This was the case on 15 April 2022 on the Perivolia stream, where a marsh frog was heard calling near a bridge (figures 9 & 10). Two individuals were eventually seen in a backwater area and one was photographed. Despite the intensive search conducted, this remained the only sighting of the marsh frog on Ios.

Table 1. Amphibian sightings on the island of Ios (see also figure 1 Distribution of green toad and green frog on Ios)

Date	Location	Coordinates	Elevation (m a.s.l)
Marsh frog			
14 April 2022	Bridge on the Perivolia stream	36 44.200 N, 20 20.855 E	30
Green toad			
9 April 2022	Road construction excavation site near Kalamos Bay	36 41.481 N, 25 22 759 E	20
9 April 2022	Backwater area, western bay in Maganari	36 39.645 N, 25 21.970 E	2
10 April 2022	Stream mouth area, eastern coastal road, Mylopotas	36 71.47 N, 25 29.55 E	2
10 April 2022	1st intake, Mylopotas Reservoir	36 42.52 N, 25 18.37 E	60
10 April 2022	2nd intake, Mylopotas Reservoir	36 42.52 N, 25 18.37 E	60
13 April 2022	Road construction excavation site with water crowfoot (Ranunculus peltatus) after Maganari	36 40.659 N, 025 21.848 E	220
16 April 2022	Excavation site with Typha domingensis on a minor loop on the road to Maganari	36 41.943 N, 25 20.884 E	351
16 April 2022	Same excavation site with second water body	36 41.951 N, 25 20.833 E	350

Figure 2. Mouth of Stroubouli stream at Mylopotas enclosed by hotel and other buildings.

Figures 3 & 4. Tadpoles of the green toad remain in the concrete channels of the Myloptamus water reservoir

Conservation aspects

Together with Sikinos and Folegandros, Ios forms part of the Important Bird and Biodiversity Area IBA GR 157. The area around Profitis Ilias on Ios is also a designated Game Refuge with an area of 3,700 ha.

Figures 5 & 6. At Maganari several wet bodies were found in backwater areas of the Fylladhakia stream where populated with thousands of tadpoles of the green toad

Figures 7 & 8. Tadpoles of the green toad found in excavations sites of road construction

Figures 9 & 10. Periviolia stream north of Skarkos archaeological site where a marsh frog was photographed

The Inventory of the Wetlands of the Aegean Islands (Catsadorakis & Paragamian 2007) is a reliable source of information for locating them. It lists seven objects for Ios. All were visited. Apart from the above-mentioned reservoir, they are all stream mouth areas on the coast, where the outflowing water is retained for some time by barrier beach formation. The resulting standing water bodies serve as spawning grounds. On many islands they are also habitats for the Western Caspian turtle (*Mauremys rivulata*). Although protected by presidential decree, the object IOS0003 – arguably the most significant object on the island – no longer exists. It was the largest backwater of a stream in the sandy Pappa Aulaki Bay on the eastern coast. The area of the mouth has been of interest to a 5-star hotel for years and, according to information available at: https://save-ios-gr/en, has now been destroyed despite its protected status. Something similar happened in the Koumpara-Diakofti area north of Ios Port, where a luxury resort was built on a rocky island and a bridge constructed to connect it with the mainland. With a certain lack of sensitivity, old olive and palm trees were planted in the area in the form of an avenue on the access road and then presented as a conservation measure on the Internet. Only the wetland east of Aghia Theodoti covers a large area. The lax-flowered orchid Anacamptis laxiflora was found there. The wet meadows are no longer managed, and the farmhouse located near the slope seems to be abandoned. Domestic pigs have ploughed up much of the soil in the wetland. In these stream mouth areas with their beaches, tourism development is proving to be the biggest threat to the wetland habitats.

They are also threatened by agriculture. The stream mouths listed in the inventory had already dried up by mid-April and, this year at least, were no longer available to hygrophilic herpetofauna for reproduction. Water is also taken from the headwaters of the streams, with kilometre-long hoses used to irrigate fields. Climate change will increase the tendency to dry out early even more. The potential threats to wetlands on the Aegean islands are presented in detail in Broggi (2021).

What are the chances of survival for the two amphibian species on Ios? The green toad seems well adapted to arid conditions. It can survive dry years, taking advantage of favourable events. It can also migrate over long distances and make use of anthropogenic waterholes resulting from road construction or created for watering cattle. In this respect Ios still has some potential, as excavation sites were observed that contained water but did not as yet serve as spawning sites. With the use of such man-made spawning sites, the status of the green

toad for Ios therefore appears to be secure at present. Climate change, with increasingly dry conditions and loss of spawning grounds, is the greatest threat to the species.

The marsh frog needs more stable hydrological conditions than the green toad, as it does not leave its spawning site. Extinction of the marsh frog on Ios must be considered probable. In addition, the island populations of amphibians and hydrophilic reptiles such as the Western Caspian turtle (*Mauremys rivulata*) are often very small and therefore highly vulnerable without the necessary protection measures. Without targeted protection and conservation measures, their survival on the islands is not assured. This must be taken into account in the context of tourism development.

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