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Population characteristics of the European Pond Turtle *Emys orbicularis* (Linnaeus, 1758) in an urban environment

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Abstract. The European Pond turtle (*Emys orbicularis*) has a wide distribution in Bulgaria, yet most of its populations are not dense, and its ecology and relationship with humans remain understudied. This study aimed to evaluate and compare population characteristics of the species across three zones along the Maritsa River in the city of Plovdiv, Bulgaria, representing a hypothetical urban gradient: urban, suburban, and rural. A total of 42 individuals were captured, and 10 of them were recaptured. Population size estimates and survival probability calculations indicated that the two urban zones do not provide optimal conditions for the species' development. The sex ratio was skewed in favour of males, and the age-structure analysis showed a predominance of subadult individuals, followed by adults and juveniles. Some morphometric measurements were assessed, and the shell volume and the Sexual Dimorphism Index were calculated. Analysis of this data confirmed the general perception that females of this species are larger and heavier than males. Finally, some conservation threats were identified, including habitat destruction, pollution, disturbance, human-caused mortality, and the presence of an invasive turtle species.

Keywords: Reptilia, Emydidae, capture-mark-recapture, morphometrics, Balkan Peninsula, Bulgaria, Plovdiv, sexual dimorphism.

Introduction

Fragmentation, excessive water use, land-use changes, and the introduction of invasive species pose significant threats to riparian biodiversity. The European wetlands have been modified over the centuries due to the development of agriculture, navigation, and the need to protect settlements from flooding. Today, approximately half of Europe's entire population lives in areas that were once such environments. As a result, around 50% of the wetlands' original extent and 95% of the floodplains have been lost (Tockner et al. 2022).

Wetlands are situated at the interface between aquatic and terrestrial ecosystems and can therefore support exceptionally rich biodiversity due to the ecotone rule. They also play an important role by providing various ecosystem services, including: water, nutrient, or pollutant retention; carbon fixation; facilitation of the nitrogen, sulfur, and phosphorus cycles; provision of breeding grounds for species across all classes of vertebrates, including endangered species; contribution to the maintenance of the gene pool of native populations; fostering ecotourism (de Groot et al. 2002).

The stereotypical image of urban rivers consists of straightened channels with buildings and roads along the banks, and a lack of floodplains. This structure limits biodiversity and the development of a well-functioning ecosystem. Moreover, it can act as a barrier, obstructing the ecological flow between the upper and lower sections of the river. Proper development and maintenance of urban riverbeds are therefore crucial for the health of the ecosystems (Lerner & Holt 2012).

As a rapidly growing city, the second-largest in Bulgaria, and with the major river Maritsa flowing through it, Plovdiv offers a significant area for studying the effects of urbanisation on local wetland and riparian ecosystems.

Reptiles are among the most vulnerable animals to anthropogenic impact. They are adapted to conditions with unevenly distributed food resources and play an important role in regulating insect and rodent populations (Biserkov et al. 2007). Due to their close association with specific habitats and the longer lifespans of some species, they can serve as bioindicator organisms for detecting pollution and habitat loss (Crain & Guillette 1998, Hopkins 2000). As noted by Mollov & Georgiev (2015), herpetological diversity in Plovdiv has declined significantly over the last century. They observed a nearly 50% decrease in previously reported species, which they link directly to urbanisation and habitat destruction. With the city's ongoing expansion, these processes are likely to continue. For this reason, further studies on the impact of human activity on these organisms, along with the implementation of conservation measures, are critical to their survival.

A particularly interesting representative of the herpetofauna in the urban environments is the European Pond turtle *Emys orbicularis* (Linnaeus, 1758). Because it is a predominantly aquatic species, suitable habitats, such as wetlands and floodplains, are essential for its presence. These requirements are not easily met in human-dominated environments and, given the turtle's various life stages, forested areas in proximity to the wetlands are also essential, as they can provide places for basking, nesting, and hibernation away from predators (Ficetola et al. 2004, Liuzzo et al. 2024). Although the species has a wide distribution, its populations in Europe are now highly fragmented (van Dijk & Sindaco 2004).

Mollov (2019a) reports that *E. orbicularis* has expanded its range within the urban area of Plovdiv, compared to studies conducted over the past 100 years, mainly due to the development of a network of irrigation canals. Despite this expansion, the populations remain at low densities, with adults and juveniles the most abundant age groups, indicating population instability. The author identifies habitat destruction and direct killing of animals as the main threats to the species' survival in the urban area.

The fact that *E. orbicularis* is among the herpetofauna still found within the Plovdiv territory is of great interest to urban ecology. There is a clear need for more information on its ecology, population characteristics, reproductive biology, and ethology in Bulgaria. The lack of up-to-date data on *E. orbicularis* at both local and regional levels, combined with ongoing anthropogenic habitat changes, underscores the relevance of this study. The aim is to provide new ecological data on its populations and contribute to its conservation in urban environments.

Material and methods

Study area

The study was conducted from May to September in 2023 and from March to June in 2024. Three sites along the Maritsa River in Plovdiv City were selected based on their distance from the city centre to create a hypothetical urban gradient extending from the centre to the periphery (McDonnell 1997). This approach aimed to track changes in the population characteristics of *E. orbicularis* across the city's three zones: central urban, suburban, and rural. The central urban zone experiences the most significant anthropogenic impact and is characterised by riverbanks lined with residential and administrative buildings. The suburban zone encompasses the area around the forested Adata Island, where riverbank development is lower and consists mainly of industrial buildings. The rural zone is located west of Plovdiv, close to the village of Orizari, and features swamps with some preserved natural shrub and tree vegetation (Fig. 1).

Figure 1. Indicative map of the study area – Maritsa River in the city of Plovdiv (A – central urban zone; B – suburban zone; C – rural zone).

Field surveys

Population size was assessed using the capture-mark-recapture (CMR) method (Sutherland 2000), and data on the sex and age structure of the populations were collected. A series of visits was conducted in the study zones, with a minimum one-kilometer or one-hour transect completed each time, according to the National System for Monitoring of the Biodiversity (Tzankov et al. 2016). Turtles were captured manually or with a fishing net. Morphometric measurements were recorded, sex and age were determined, and the turtles were photographed and marked before being released at the same location. Marking was done using non-toxic, plant-based paint, which was used to write a unique combination of letters and numbers on the carapace. This method proved to be non-damaging and effective for short-term studies such as the current one. In some instances, traces of the marking were visible for up to 11 months after the initial marking and the winter hibernation period. In cases of recapture, where the paint was only partially preserved and/or the unique text was unreadable, photos of the initial marking, along with the unique coloration and shape of each individual's carapace and plastron, were used to identify it.

The population size (N) was calculated using the Jolly-Seber method (Jolly 1965, Seber 1965). The data were analysed using the program "MARK" v. 10.1 (White & Burnham 1999).

The average survival probabilities (ϕ) and recapture probabilities (p) for the populations were calculated using the Cormack-Jolly-Seber method (Cormack 1964, Jolly 1965, Seber 1965). The data were also analysed with the program "MARK" v. 10.1. The survival probability reflects the likelihood of marked individuals surviving to each subsequent recapture, whereas the recapture probability represents the likelihood of these individuals being recaptured.

The results with the lowest Akaike's Information Criterion (AIC) were selected. AIC evaluates the relative quality of a statistical model for a given data set, with lower AIC values indicating a better fit to the data (White & Burnham 1999). For population size, the time-independent variant N(.) was chosen, while for the survival and recapture probabilities, time-dependent variants (ϕ(t)p(t)) were selected (Cooch & White 2014). Due to software requirements, the capture sessions were consolidated and standardised into four overall sessions.

For the captured individuals, some general and specific data were collected.

General data:

- Date, time, and location of capture (recorded using a handheld GPS device).
- Sex (whenever possible to determine), based on the following characteristics of males: presence of a concavity on the plastron; longer and thicker tail at the base, with the cloacal opening positioned closer to the tip; significantly more curved and longer claws on the front limbs; darker iris colouration (Auer & Taskavak 2004, Najbar & Szuszkiewicz 2006, Biserkov et al. 2007, Tzankov et al. 2014, Alarcos et al. 2019, Escoriza et al. 2024).
- Age group – individuals with a carapace length of less than 11 cm were considered as juveniles (according to Çiçek & Ayaz (2011)); those with a length of 11 to 14 cm – as subadults (according to Kotenko 2000), and those over 14 cm – as adults.

Specific data:

- Body weight (BW) in grams (g), measured with a digital scale accurate to 5 g.

- Morphometric parameters (Fig. 2), measured in millimeters (mm) with calipers (accurate to 0.1 mm), including: SCL – straight-line carapace length, MPL – maximum plastron length, CH – carapace height, MCW – maximum carapace width (measured at the widest point) (according to Mazzotti 1995 and Alcayde 2007). Based on these measurements, the carapace shape index (SCL/MCW), the ratio between carapace length and body weight (SCL/BW), and the shell volume (SV) were calculated.

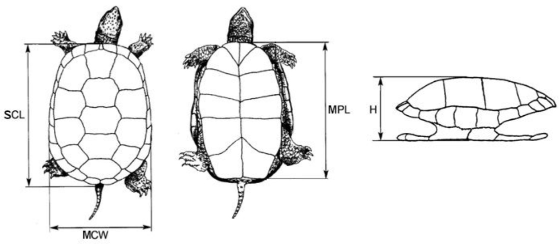

Figure 2. Measured morphometric parameters (abbreviations according to Zuffi & Gariboldi (1995), with modifications): SCL – carapace length, MCW – maximum carapace width, MPL – maximum plastron length, H – carapace height (based on Alcayde, 2007).

Mathematical and statistical processing of the data

The shell volume (SV) was calculated as an ellipsoid using the carapace dimensions with the following formula (Loehr et al. 2004):

$$SV = \pi \times SCL \times H \times MCW / 6000.$$

The size dimorphism index (SDI) was calculated using the following formula (Lovich & Gibbons 1992):

$$SDI = \left(\frac{SCLf}{SCLm} - 1\right).100$$

where: SCLf – average carapace length in females, mm; SCLm – average carapace length in males, mm.

To calculate the index with respect to weight and shell volume, the corresponding mean values were used. Positive index values indicate that females are larger than males, and vice versa.

Shell volume (SV) was calculated using electronic spreadsheets. Statistical processing of the data was performed using the statistical software package PAST v. 5.2.2 (Hammer et al. 2001). The data was analysed using descriptive statistics. The normality of data distribution was assessed with the Shapiro-Wilk test (Shapiro & Wilk 1965). To compare or identify differences between certain variables that did not follow a normal distribution, non-parametric tests were applied (χ^2-test, Mann-Whitney U-test for independent pairs) (Fowler et al. 1998). In the cases of χ^2-tests where the degrees of freedom equaled 1, the Yates' correction was applied. Differences with $p < 0.05$ [$\alpha = 5\%$] were considered statistically significant.

Results and discussion

Population size and survival probability

During the entire study period, a total of 42 individuals were captured, 9 of whom were recaptured once, and one was recaptured twice. The data on the number of individuals captured by study zone, age group, and sex are presented in Table 1.

In various natural (anthropogenically unaffected) habitats within the species' range, including protected areas, different authors report population sizes ranging from 60 to 1009.4 individuals (Mitrus & Zemanek 2004, Mosimann & Cadi 2004, Šebela 2017, Escoriza et al. 2020, Liuzzo et al. 2021). Our population size estimates, calculated using the Jolly-Seber method, are as follows: central urban area – 9.00 individuals; suburban area – 4.00 individuals; rural area – 58.64 individuals. The combined population estimate for the three zones in our study is 96.26 individuals. This data suggests that the urban environment does not provide optimal living conditions for *E. orbicularis*, which explains the significant difference in population size between the rural and the two urban zones. It should be noted that the suburban zone lacks swamp microhabitats, which are preferred habitats for the species in the other two zones. Where swamps occurred, individuals were observed in much more concentrated groups, whereas in open, flowing river waters, their distribution was more sporadic. This is likely the reason for the small number of individuals captured and the greater number of observations (a total of 11 for *E. orbicularis* and 7 for invasive turtles) around the Adata Island, where individuals were most often seen basking in inaccessible locations, such as small islands or fallen trees in the middle of the river. Given this, we can assert that the population in the suburban zone is almost certainly larger than the calculated estimate, albeit not too dense.

Using the Cormack-Jolly-Seber model, we calculated the survival probability and the recapture probability as follows (mean ± standard deviation): central urban area (ϕ=0.32 ± 0.23; p=0.48 ± 0.40), suburban area (ϕ=0.17 ± 0.24; p=0.33 ± 0.58), rural area (ϕ=0.87 ± 0.22; p=0.28 ± 0.29). The high standard deviation values are likely due to the small number of recaptured individuals and the small overall sample sizes in the suburban and central urban zones. The mean survival and recapture probabilities for the rural zone are similar to data reported by other authors: ϕ=0.94 ± 0.02, p=0.17 (Bayrakci & Ayaz 2014); ϕ=0.87, p=0.39 (males) and ϕ=0.90, p=0.45 (females) (Escoriza et al. 2020).

Table 1. Data on the number of *E. orbicularis* individuals captured in the three zones along the Maritsa River in Plovdiv; *Legend:* M – males, F – females, J – juveniles/unsexed subadults.

Zone	Central urban			Suburban			Rural			Total		
Sex	M	F	J	M	F	J	M	F	J	M	F	J
Number of captured individuals	4	3	2	2	2	0	14	5	10	20	10	12
Number of recaptured individuals	1	1	0	1	0	0	3	2	2	5	3	2

Sex structure

The sex structure of the population in the central urban zone demonstrated a male-to-female ratio of 1.33:1 (n = 7). In the suburban area, the observed sex ratio was exactly 1:1 (n = 4). In the rural zone, the male-to-female ratio was skewed in favour of males at 2.8:1 (n = 19) and revealed a statistically significant difference from the expected 1:1 distribution (χ^2 = 4.26; df = 1; p = 0.039). A two-year study by Bayrakci & Ayaz (2014) reported the following sex ratio for a population in Central Anatolia: M: F = 1:1.11 (n = 207; χ^2 = 0.585; df = 1; p = 0.445), indicating a slight predominance of females but without a statistically significant difference. Rivera & Fernandez (2004) studied a population of the species in Northwestern Spain during the period 1996–2002 and found a sex ratio of M:F = 1.56:1 (n = 100; χ^2 = 6.55; df = 1; p = 0.011), indicating a statistically significant deviation from the expected 1:1 ratio. According to Servan et al. (1989), data from Central France revealed a sex ratio of M:F = 1:2.13 (n = 290; χ^2 = 12.592; df = 6; p < 0.05), showing a statistically significant difference in favour of females. During the period 2013–2015, Fediras et al. (2017) collected data on the species from a population in Lake Tonga, Algeria. The observed sex ratio was M:F = 1.14:1 (n = 100; χ^2 = 25.06; p < 0.0001), indicating a statistically significant deviation from the equal distribution of 1:1, favouring males. As evident, the sex ratio in this species varies widely across different populations. Tiar-Saadi et al. (2017) discuss possible causes for this variation, highlighting ambient temperature as a determinant of the sex of hatchlings. Additionally, the authors suggest that the sex which reaches sexual maturity more quickly in a given population and habitat may become more numerous, as older individuals tend to experience lower mortality rates.

Age structure

The age structures of *E. orbicularis* populations from the three areas along the Maritsa River in Plovdiv are characterised by a predominance of subadult individuals, followed by adults and juveniles. In the central urban area, subadults accounted for the largest proportion (n = 4), followed by adults (n = 3) and juveniles (n = 2). In the suburban zone, no juvenile individuals were recorded; adults and subadults were equally represented (n = 2 each). In the rural zone, a statistically significant deviation from the 1:1:1 distribution was observed ($\chi^2 = 24.07$; df = 2; $p < 0.00001$), with subadults (n = 22) being the most numerous, followed by juveniles (n = 5) and adults (n = 2). At first glance, our data suggests that the populations are declining. It should be noted, however, that the low proportion of juveniles across all three populations does not necessarily indicate a decline in their numbers. Among all age groups, juveniles are the most challenging to observe and capture due to their small size, highly secretive behaviour, and rare emergence from the water (Luiselli 2017). During the period 2007–2010, Mollov (2019b) observed an age ratio of 1:0.75:0.5, with adults comprising the largest share (44.44%), followed by subadults (33.33%) and juveniles (22.22%). The author notes no statistically significant deviation from the equal 1:1:1 distribution ($\chi^2 = 0.67$; df = 2; p = 0.72). Several other studies also indicate a prevalence of adult individuals compared to subadults and juveniles: 83.15% adults, 7.88% subadults, and 8.97% juveniles (Mosimann & Cadi 2004), 94.5% adults and 5.5% juveniles (Saçdanaku & Haxhiu 2015), 92.72% adults and 7.28% subadults and juveniles (Šebela 2017).

Morphometric analysis

The measured morphometric parameters of the *E. orbicularis* populations are presented in Table 2.

The body length of male individuals measured along the Maritsa River in Plovdiv ranged from 116.3 to 144.2 mm, while that of females ranged from 112.6 to 162.5 mm. The weight of males ranged from 275 g to 475 g, whereas that of females ranged from 355 g to 840 g. The carapace volume for males ranged from 262.2 to 648.7 mm³, while for females, it ranged from 322.2 to 774.6 mm³. The mean values, standard deviations, and size dimorphism indices are presented in Table 3.

Females were found to be significantly heavier than males (Mann-Whitney U-test; U = 23, z = 3.36, p = 0.0008), with a longer carapace length than males (Mann-Whitney U-test; U = 50, z = 2.18, p = 0.029), and a larger carapace volume (Mann-Whitney U-test; U = 46, z = 2.35, p = 0.019).

Table 2. Descriptive statistics of the measured morphometric parameters of *E. orbicularis* – combined data from the three studied zones along the flow of Maritsa River in Plovdiv City. Legend: $\bar{x}$–mean value; SD – standard deviation; SE – standard error; CV – coefficient of variation. Abbreviations of the morphometric parameters are provided in the "Material and methods" section.

	Males (n = 20)				Females (n = 10)				Juveniles/Unsexed Subadults (n = 12)			
Parameter	$\bar{x}$	SD	SE	CV	$\bar{x}$	SD	SE	CV	$\bar{x}$	SD	SE	CV
Weight (BW), g	360.00	57.58	12.88	16.00	560.00	180.32	57.02	32.20	206.67	89.25	25.76	43.18
SCL, mm	129.11	7.23	1.62	5.60	140.18	15.05	4.76	10.74	103.92	16.09	4.65	15.49
MPL, mm	111.98	8.32	1.86	7.43	130.34	15.47	4.89	11.87	95.41	14.30	4.13	14.99
CH, mm	51.02	7.52	1.68	14.74	57.68	8.37	2.65	14.50	41.04	8.08	2.33	19.70
MCW, mm	105.64	8.88	1.99	8.41	113.14	10.92	3.45	9.65	83.35	12.04	3.48	14.45
SCL/MCW	1.23	0.06	0.01	5.17	1.24	0.08	0.03	6.47	1.25	0.04	0.01	3.16
SV, mm³	370.45	102.65	22.95	27.71	492.91	165.42	52.31	33.56	198.48	87.78	25.34	44.23

Table 3. Sexual Dimorphism Index (SDI) regarding body weight (BW, g), body length (SCL, mm), and shell volume (SV, mm^3) in *E. orbicularis* from the Maritsa River, Plovdiv (combined data from the three zones). Legend: $\bar{x}$ –mean value; SD – standard deviation.

	Males			Females			SDI, %		
	BW, g	SCL, mm	SV, mm^3	BW, g	SCL, g	SV, mm^3	BW	SCL	SV
$\bar{x}$	360	129.1	370.45	560	140.18	492.9	55.55	8.58	33
SD	57.58	7.23	102.65	180.32	15.04	165.41			

The analysis of the size sexual dimorphism index revealed a significantly higher percentage in weight and a significantly lower percentage in carapace length, both of which are in favour of females (Table 3).

Our results regarding size sexual dimorphism align with findings from several other studies conducted across the species' range. Luiselli (2017) provides data on the sexual dimorphism of the species in Azerbaijan. According to his results, females exhibit significantly greater carapace lengths than males (males: n = 40, $\bar{x}$ = 182.1 mm, SD = 20.1; females: n = 37, $\bar{x}$ = 193.1 mm, SD = 23.7; t = 2.353, df = 74, p < 0.05), and while the minimum values are nearly identical (123 mm for females and 121 mm for males), the maximum values differ significantly (220 mm for females and 200 mm for males). The data from Fediras et al. (2017) for Algeria also confirms the bigger carapace length of females (males: n = 51, $\bar{x}$ = 130.65 ± 10.57 mm; females: n = 68, $\bar{x}$ = 151.00 ± 18.96 mm; p < 0.0001 by t-test) and weight (males: $\bar{x}$ = 326.06 ± 110.13 g; $\bar{x}$ = 548.40 ± 200.28 g; p < 0.0001 by t-test). The results indicate statistically significant differences in the morphometry of the two sexes. According to Fattizzo (2004), a population from Southern Italy also shows this pattern of sex differences in *E. orbicularis*. For weight, the author reports the following data with statistically significant differences: males: n = 9, $\bar{x}$ = 151.2 ± 5.41 g; females: n = 16, $\bar{x}$ = 219.9 ± 6.57 g; p < 0.0001 by t-test. For carapace length, the results are as follows: males: $\bar{x}$ = 100.2 ± 16 mm; females: $\bar{x}$ = 112.4 ± 18 mm; p < 0.0001 by t-test. Other studies, as well as the current one, confirm the assertion that females of this species are larger and heavier. The body characteristics of females are likely due to their adaptation for carrying and laying eggs (Escoriza et al. 2024). Additionally, research shows that larger females lay more eggs, meaning that the presence of larger females in a population increases the likelihood of more hatchlings. This is particularly important given the species' high mortality rate in its early years (Joos et al. 2017). On the other hand, the smaller size of males, particularly of their plastron, likely contributes to greater mobility, which is crucial during the breeding season when the male attempts to attach to the female (Lebboroni & Chelazzi 1991).

Conservation status and threats

The conservation status of *E. orbicularis* in Bulgaria is considered high according to both national and European legislation. Over the course of the current study, the following threats to the species in the surveyed area were identified:

Habitat destruction. In April 2024, the Plovdiv Municipality announced the start of a cleanup of the Maritsa riverbed within the city to remove self-grown and dead vegetation, aiming to prevent blockages and subsequent flooding. Although this action was coordinated with ecologists and conservation organisations to minimise environmental damage, the procedure included removing shrubs, small trees, and fallen trees. This has undoubtedly had a negative impact on *E. orbicularis*, for which these ecosystem elements are of vital importance (Ficetola et al. 2004, Tzankov et al. 2014).

Another threat related to habitat destruction, observed right next to the rural zone, was the extraction of inert materials (sand and gravel). Such activities not only result in habitat loss but also generate significant waste that eventually impacts adjacent habitats, even if they are outside the immediate exploitation zone.

Pollution. All surveyed areas showed significant amounts of pollution from household and construction waste along the banks and in the water. Personal observations indicate that this waste is primarily discarded by fishermen and strollers, but it also results from construction and industrial activities, especially near the city's industrial zones. In the rural part of the surveyed area, a dead subadult individual was found with a plastic object lodged in its throat. As Clause et al. (2021) discuss, the ingestion of plastics by freshwater turtles is an important, yet under-researched issue.

Disturbance and killing. Daily human presence, particularly by fishermen and bathers, was observed in parts of the surveyed areas. Given the species' cautious nature, this likely had a negative effect. Consequently, in these habitats, otherwise suited to the species' requirements, it was neither observed nor captured.

In the suburban part of the surveyed area, two decapitated adult individuals were found. Personal conversations with fishermen revealed that this is likely the result of turtles swallowing fishing hooks, which are then killed because removing the hook is deemed more difficult. Similar reports have been made by Beshkov (1993), Mollov (2019a), and Mollov et al. (2021).

Presence of an invasive turtle species. Numerous observations of the invasive turtle species *Trachemys scripta* (Thunberg & Schoepff, 1792) were recorded in suburban and central urban areas. All three subspecies were identified: the red-eared slider (*T. s. elegans* (Wied-Neuwied, 1839)) with five observations, the yellow-bellied slider (*T. s. scripta* (Schoepff, 1792)) with one observation, and the Cumberland slider (*T. s. troostii* (Holbrook, 1836)) also with one observation. Additionally, a newly hatched red-eared slider was observed and photographed on the Adata Island (suburban zone), indicating the species' successful reproduction in the study area.

Studies show that the presence of invasive turtle species negatively impacts native species by competing for food and basking sites (Cadi & Joly 2004, Pérez-Santigosa et al. 2011). Given that the primary route of establishment for this species in Bulgaria is through release by pet owners (Kuzmanova et al. 2018, Kornilev et al. 2020), raising public awareness about the harm such actions can cause to native ecosystems is of critical importance.

Conclusions

The populations of *Emys orbicularis* along the urban gradient of the Maritsa River in Plovdiv are characterised by low numbers compared to those in anthropogenically unaffected areas. The population in the rural zone is significantly bigger than that in the two urban zones and also shows the highest survival probability (ϕ). This suggests that the urban environment does not provide optimal conditions for the development of the European Pond turtle. The sex structure of the populations in the three zones shows a ratio close to balanced, with a slight predominance of males, most pronounced in the suburban zone. The age structure of populations in suburban and central urban areas shows a prevalence of subadult individuals, followed by adults and juveniles. While this indicates declining populations, it should be noted that juveniles of this species are significantly harder to detect/capture, which has likely influenced the results. Females are significantly heavier, with longer carapace lengths and larger shell volumes than males, displaying distinct sexual size dimorphism. The European Pond turtle is characterised by a high conservation status. Identified threats in the study area include habitat destruction, pollution, disturbance, and killing by humans, and the presence of the invasive turtle species *T. scripta*, identified with its three subspecies.

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