diversity

MDPI

Article

Distribution and Conservation Status of European Pond Turtles *Emys orbicularis* (L., 1758) in Algeria

Nourhane Gherbi [1], Manel Tiar-Saadi [1], Abdennour Boucheker [2,3], Pavel Široký [4,5,*], Chahinez Mezghiche [1], Khalil Draidi [2,6], Zihad Bouslama [7] and Ghoulem Tiar [1,6]

[1] Functional and Evolutionary Ecology Laboratory, Faculty of Natural and Life Sciences, University Chadli Bendjedid-El Tarf, 76, El Tarf 36000, Algeria; hakimagherbi36@gmail.com (N.G.); manels84@yahoo.fr (M.T.-S.); chahinez23mezghiche@gmail.com (C.M.); tiarghoulem@yahoo.fr (G.T.)
[2] Department of Biology, Faculty of Sciences, University Badji Mokhtar-Annaba, BP 12, El Hadjar, Annaba 23000, Algeria; babdennour2007@yahoo.fr (A.B.); khalildraidi@yahoo.fr (K.D.)
[3] Wetland Conservation Laboratory, 8 Mai 1945 University, Guelma 24000, Algeria
[4] Department of Biology and Wildlife Diseases, Faculty of Veterinary Hygiene and Ecology, University of Veterinary Sciences Brno, Palackého 1946/1, 612 42 Brno, Czech Republic
[5] CEITEC—Central European Institute of Technology, University of Veterinary Sciences Brno, Palackého 1946/1, 612 42 Brno, Czech Republic
[6] Environment and Biodiversity Research Division, Environmental Research Center, Alzon Castle, Boughazi Said Street, PB 2024, Annaba 23000, Algeria
[7] Environmental Research Center, Alzon Castle, Boughazi Said Street, PB 2024, Annaba 23000, Algeria; zihadb@yahoo.fr
* Correspondence: sirokyp@vfu.cz; Tel.: +420-541-562-637

Abstract: The Maghreb population of *Emys orbicularis* extends over a narrow strip of northern Morocco, Algeria, and Tunisia. Our understanding of the presence of this turtle in Algeria, in contrast to Morocco and Tunisia, is quite limited and frequently rests on a few small-scale studies or even reports from a century ago. The present study provides the first complete data on the distribution and level of threat of this species in Algeria. A field survey was carried out based on the data obtained from scattered local reports and available studies that suggested the presence of the species in Algerian wetlands. Data on climatic and habitat preferences, the geographic elevation of inhabited localities, and their conservation status were collected. A total of 45 wetlands were inhabited by *E. orbicularis*, of which 40 were part of a well-interconnected eastern metapopulation, joined by an extensive hydrographic network. In some places, the species has persisted for over 130 years in the same wetland complex. However, the five remaining populations living in central North Algeria are fragmented, highly isolated, and therefore more threatened. With a few exceptions, turtles inhabit lowlands below 100 m above sea level. Detected sub-populations inhabit mostly stagnant waters (60%), sometimes dams and lakes (24%), and sporadically also slow-moving water bodies (16%). Altogether, the Algerian distribution of *E. orbicularis* extends to a total area of 2900 km^2, a 40 km wide strip with a length of 490 km west of the Tunisian border. Although restricted to this narrow strip, the persistence of numerous populations in Algeria, especially in Numidia, testifies to their relatively better conservation status. In order to ensure the sustainability of these efforts, follow-up and monitoring activities should be suggested, with special attention paid to highly isolated populations to maintain their long-term viability.

Keywords: *Emys orbicularis*; turtle; wetlands; spatial distribution; status of conservation; Numidia; Kabylia; Algeria

Citation: Gherbi, N.; Tiar-Saadi, M.; Boucheker, A.; Široký, P.; Mezghiche, C.; Draidi, K.; Bouslama, Z.; Tiar, G. Distribution and Conservation Status of European Pond Turtles *Emys orbicularis* (L., 1758) in Algeria. *Diversity* **2023**, *15*, 993. https://doi.org/10.3390/d15090993

Academic Editors: Geraldo Jorge Barbosa De Moura, Leonardo Pessoa Cabus Oitaven and Adán Pérez-García

Received: 8 August 2023
Revised: 23 August 2023
Accepted: 31 August 2023
Published: 5 September 2023

1. Introduction

The European pond turtle, *Emys orbicularis* (Linnaeus, 1758) (Emydidae Rafineque, 1815), is one of three native chelonians to Algeria, the second being the Mediterranean stripe-necked turtle *Mauremys leprosa* (Schweigger, 1812), and the third being the terrestrial

spur-thighed tortoise *Testudo graeca* Linnaeus, 1758 [1–4]. Morocco, Tunisia, and Algeria are the southernmost areas where *E. orbicularis* occurs [5]. Its range is more widespread northwards, extending from the Iberian Peninsula over much of Europe into western and central Asia, to the border of the Aral Sea [5–9]. The species has been listed as Near Threatened (NT) by the IUCN since 1996 due to significant long-term population declines [10]. The species is also protected in Europe by the Bern Convention (Annex II, 1979) and by Council Directive 92/43/EEC, Annexes II and IV, 1992. In Algeria, it appears in the official journal determining indigenous wild protected animal species (Decree No. 12-235, 10 June 2012). Modification, alteration, and pollution, as well as the introduction of competitors into its habitat, have been the main factors determining its global conservation status [11–15]. However, because no comprehensive studies on the distribution and occurrence of the European pond turtle in Algeria have been undertaken, we are unable to identify which of these causes was responsible for the drop, let alone state that there has been a decline.

According to current knowledge, *Emys orbicularis* is a seriously imperilled species in North Africa. Fragmented and highly isolated populations were documented over a wide area of Morocco, from the Gharb to the eastern plains and from the Rif Mountains in the north to the Middle Atlas in the south [16,17]. The Tunisian population of *E. orbicularis* is currently concentrated in a small area in the northwestern periphery [18], while it has completely disappeared from most of the relict habitats it once occupied throughout the northern part of the country [19–22]. The distribution of the Algerian population in a vast area between Morocco and Tunisia remains unclear due to the absence of complete studies.

Historical documents indicate that this species was locally distributed in Algeria. The oldest available documents on Algerian reptiles, dating from 1840 to 1891, indicated the presence of *E. orbicularis* in El-Kala and Annaba, as well as around Algiers, in El Harrach, and along the Sebaou River in Kabylia at Tizi Ouzou [23–26]. While the presence of the species in the extreme northeast of the country had been confirmed and unanimously accepted by the herpetologists of that time [24,26,27], the affirmation that it occupies the central region had raised a debate. The statement of Guichenot [28], who is considered the pioneer who mentioned the presence of the European pond Turtle in Algeria, that "it was present in all the rivers of the Algiers region with prodigious quantity", was considered to be too exaggerated, and maybe caused by confusion of *E. orbicularis* with *M. leprosa* [24,26]. Old documents produced after 1891 reproduce the earlier reports without any revision or update of the species distribution [27,29–31]. The enigmatic distribution of the species remains relevant even today, as there has been little improvement in our knowledge over more than a century since the last compilation. Scattered recent studies confirm *E. orbicularis* presence in four northeastern sites of Algeria, namely El-Kala, Annaba, Skikda, and Jijel, without providing further information on its overall distribution in Algeria [1,32–34]. Hence, the numerous questions remain. Is their Algerian range fragmented or interconnected? Are there other additional populations of the species? What types of habitats does it prefer? Is it restricted to particular climate ranges and elevations? Only a field study covering the entire northern part of the country could answer these questions. A recent study of the modelled distribution of *E. orbicularis* in Algeria, based on five groups of niche descriptors (climate, topography, soil, land cover, and drainage system), has suggested that it could theoretically occur throughout the northern coastal strip, with a higher probability in the central and eastern parts [35].

Several studies over a large part of the *E. orbicularis* range are available outside the Maghreb, e.g., Portugal: [36], Spain: [37,38], France: [39,40], Italy: [41], Slovenia: [42], Serbia: [43], Albania: [44], Hungary: [45], Slovakia: [46], Poland: [47], Lithuania and Latvia: [48], Ukraine: [49], Romania: [50], Bulgaria: [12], Russia: [51,52], Turkey: [15], and overall [5,7]. Comparatively, recent distribution and conservation data for the Maghreb are only available for Tunisia and Morocco from six decades of retrospectives, e.g., [5,16–18,21,22,35,53–56]. However, no studies have been conducted in Algeria that address these issues. Undetected populations present on Algerian territory cannot receive proper protection.

The North African populations were previously identified as *E. o. occidentalis* [57]. However, analysis of mitochondrial and microsatellite markers demonstrated that only the Moroccan populations belong to this subspecies [58]. Populations from eastern Algeria and Tunisia are characterized as distinct evolutionary lineage IX representing an endemic distinct subspecies undescribed so far [58]. This study aimed to provide detailed information on the current distribution and conservation status of *E. orbicularis* in Algeria, and to complete our knowledge on the overall distribution of the endemic Algerian-Tunisian lineage. It also will provide a better understanding of the conservation status of the species throughout the Maghreb region.

2. Materials and Methods

2.1. Study Area and Climate

Algeria is the largest country in the Mediterranean region and in the African continent. It borders the sea to the north, Tunisia and Libya to the east, Morocco and Western Sahara to the west, Niger, Mali and Mauritania to the south. Structurally, it consists of four major geographical units, ordered from north to south: the Tell Atlas, the Plateaus, the Saharan Atlas and the Sahara. The Tellian strip, formed by a succession of mountain, coastal and sublittoral massifs and plains, is the only area where the presence of *E. orbicularis* is probable [35]. It stretches linearly along the Algerian coast for about 1200 km and widens to 190 km. The focus of the study area was the northern region, from the Tunisian border in the east to the vicinity of the capital Algiers in the center. The study area is administratively attached to the provinces of El-Tarf, Annaba, Skikda, Jijel, Bejaia, Boumerdes and Algiers from east to west, respectively.

Algeria has many different climatic zones, from humid on the Mediterranean fringe of the northern coast, to semi-arid and arid in the central highlands, between the two parallel mountain barriers of the Tell and the Saharan Atlas, and until the Sahara further south, which dominates over a large part of the country. Humid to sub-humid Mediterranean climates prevail in the northern study region, which include hot, dry summers and rainy winters [1,32,59,60]. The highest monthly mean temperatures are observed between June and September, ranging from 20 to 26 °C. The mean annual total rainfalls, according to the closest meteorological stations, were 641 mm in Annaba, 668 mm in El-Kala, 722 mm in Guerbes-Sanhadja, Skikda, 1000 mm in Beni-Belaid, Jijel and 1057 mm Akfadou, Bejaia [1,32,60,61].

2.2. Data Collection

Field observations were carried out between the beginning of April and the end of July, coinciding with the months of peak turtle activity, for four consecutive years (2020–2023). The seasonal and daily weather influence the pond turtle's activity. Males have a shorter overwintering phase with an earlier spring outing, exhibit higher levels of activity, and move for purposes of mate searching from the end of April to the end of May, whereas females dominate and become more active during the nesting period from early May until the end of July [1,34,39,40]. Both sexes engage in a diurnal activity spent mainly on basking (several hours in the morning, but during twilight in the hottest days), comparable to feeding or mate-searching sessions [1,34]. It may be seen warming up on a rock, in the middle of a stream, on submerged trunks, or on the bank. During the summer, the activity of the species decreases, movements are reduced, and sunbathing is limited to cool days. The shaded shores serve to protect it from excessive heat [1,34]. Based on our knowledge of biology, preferred weather patterns, and turtle behavior, we have chosen the days and times for field observations.

The selection of water bodies and sites to be surveyed was based on historical records, studies carried during the last 25 years, and unpublished reports from the Algerian Forest Conservations, or National Parks, which evoked the presence of the species in Algerian wetlands. Considering three essential elements, using this traditional approach was the most appropriate. First, the presence of the species has been reported at various locations

throughout around 700 km, resulting in several habitats that need to be monitored. The majority of these notes were produced by foresters who were not necessarily skilled in herpetology and who might not have been able to differentiate *E. orbicularis* from the other syntopic species, *M. leprosa*. Second, the sampling effort was substantial, occurring once every fortnight over four months in four consecutive years. Third, because Algeria covers a huge area, applying more thorough spatial coverage approaches is difficult, labor-intensive, and would take years of monitoring.

In the field, we interviewed traditional fishermen, nearby farmers, and residents about turtle aggregation sites. All wetland types (large, small, artificial or natural) were considered in the data collection effort. Suspected sites were visited at a frequency of once every two weeks until the end of the sampling period, limited to the end of July, and stopped at a site only when the presence of terrapins was confirmed.

Turtle detection was performed using a Konuspot (Konuspot-60 C: 7125) ornithological telescope (20–60 × 60). The identification of *E. orbicularis* was based on distinctive external morphological characters (size, shape and color of the head, carapace, plastron, limbs and tail) [9], photographed from a close distance, with a Tamron SP, 150–600 mm, F/5-6.3, Di VC USD G2, paired with a professional Canon wildlife camera (EOS 7D Mark II).

2.3. Geographical Analysis

For spatial representation we aggregated the distribution records to the Universal Transverse Mercator (UTM) grid system at a spatial resolution of 100 km^2 (10 × 10 km). We performed all spatial analyses in Q-GIS (3.28.4 Firenze). Recent bibliographic data collected in the Maghreb region were integrated with our new Algerian data for an overall assessment of distribution.

3. Results

3.1. Distribution of Emys orbicularis in Algeria

Based on historical documents, studies carried out during the last 25 years, and reports from the Algerian Forest Conservations, or National Parks, the presence of the species mentioned in the bibliography has been indicated exclusively in the wetland complexes of north-eastern and central Algeria, from the Tunisian border to the surroundings of Algiers. A total of 23,600 km^2 was surveyed over a horizontal strip near the coast with a maximum length of 590 km and a maximum width of 40 km (Figure 1). After checking all the sites indicated, the area occupied by the species was 2900 km^2, representing 12.3% of the surveyed area and barely 0.12% of the total area of Algeria.

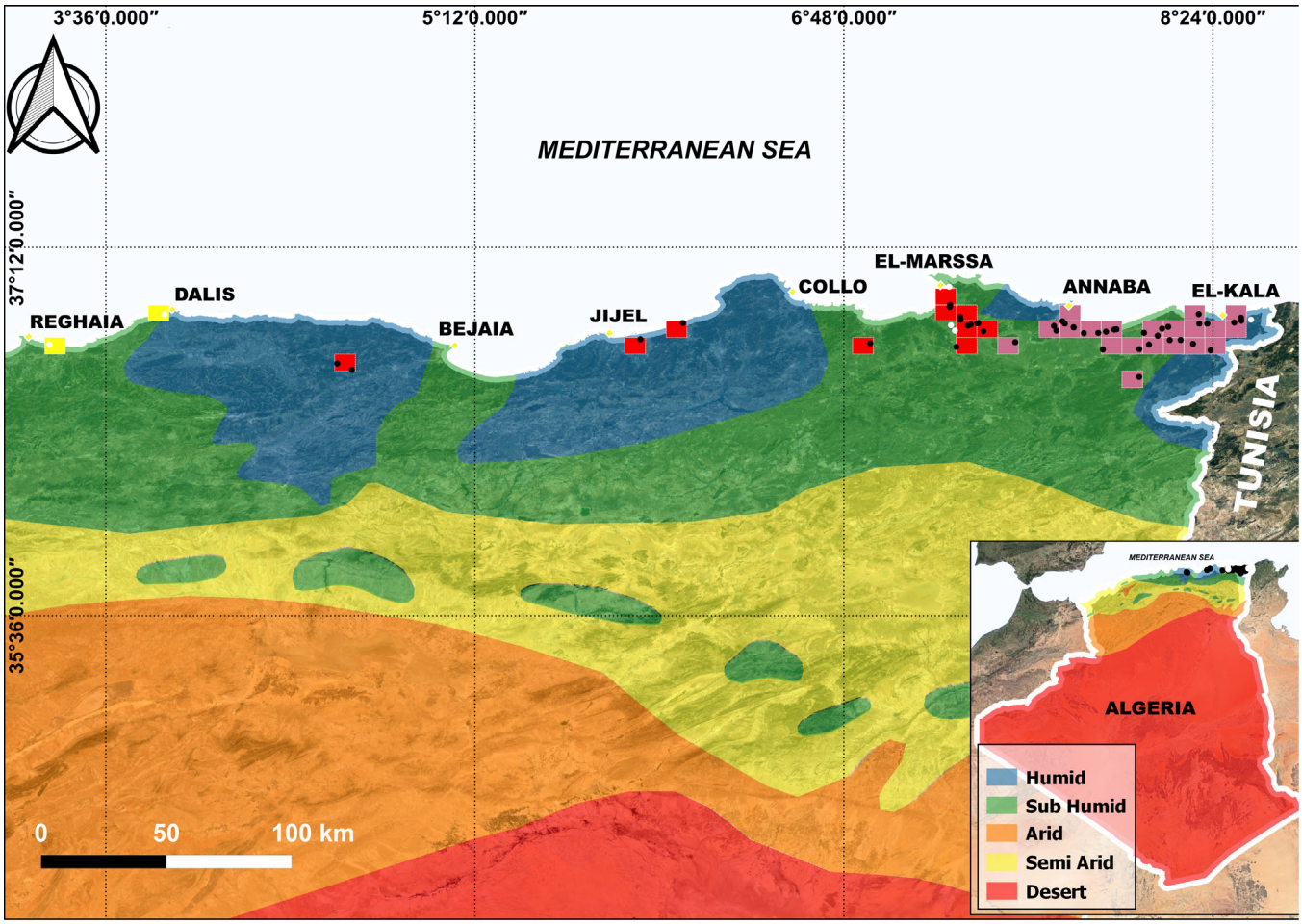

Figure 1. Distribution map of *E. orbicularis* in Algeria. Grid size was 10 km × 10 km UTM; light yellow squares—occurrence of the species suspected before 1891, but not confirmed during the present study; bright red squares—new areas of occurrence confirmed during the present study; pinkish purple squares—presence confirmed before 1891 and during the present study; white points—surveyed habitat without presence of *E. orbicularis*; black points—confirmed presence of *E. orbicularis*; The historical data before 1891 are taken from the following studies: [23–26].

Altogether, 54 wetlands were surveyed during the study period (Table 1), of which 45 (83%) were positive for the presence of *E. orbicularis*. Forty out of 45 positive sites (89%) were concentrated in the wetland complex of Numidia (ranging from Lake Tonga in El-Kala to the Guerbes-Sanhadja wetland complex in El Marsa), three (7%) in the Little Kabylia (at Collo and Jijel), and two (4%) in the Great Kabylia (at Bejaia). The detected distribution area in Numidia is uninterrupted, with 40 aligned populations interconnected by an extensive hydrographic network. However, the other five populations recorded in central and eastern Kabylia were fragmented and highly isolated.

Table 1. An overview of the efforts made for the detection of *E. orbicularis* in the monitored sites. In 2020, due to travel restrictions related to health issues associated with COVID19, we carried out only four observations in the field.

Period, Year Field Monitoring Effort	1 April–31 July 2020	1 April–31 July 2021	1 April–31 July 2022	1 April–31 July 2023
Positive to one up to four field observations	2–4,11,20,22,26,29–31,34–35	2,11,22,26,29–31,34–35,37–44,46–47,49,52	2,10–11,14,17–18,20–22,26,29–31,34–35,37–44,46–47,49,52	2,11,14,17–18,21,26,29–31,34–35,37–44,46–47,49–52
Positive to five up to eight field observations	-	3,8,10,12,14,16–23,27–28,32–33,48,50–51	3–4,8,12,16,19,23,27–28,32–33,48,50–51	7–8,10,12,16,19–20,22–25,27–28,32,36
Negative at eight field observations		1,5,6,9,13,15,45,53–54	1,5–7,9,13,15,36,45,53–54	1,5–6,9,13,15,33,45,48,53–54

The monitored sites are organized according to their longitudinal position from east to west as follows: 1, Oued Draidra; 2, Lake Tonga North East; 3, Messida Marsh; 4, Lake Tonga-Central North; 5, Oued El Frine; 6, Oued Bouhchicha; 7, Mexa Dam; 8, Lake Oubeira; 9, Oued El-Kbir Dam; 10, El Mallah Lagoon Swamp; 11, Blue lake; 12, Ain Khiar Alder grove; 13, Oued Gargour; 14, Bourdime Marsh; 15, Wlad Anane Pond; 16, Oum Laagareb swamp; 17, Black Lake Peat-bog; 18, Garaet Khoubzi; 19, Righia Swamp; 20, Garaet El-Touyour; 21, Sebaa Pond; 22, Mekhada Marsh-South; 23, Dike of the Chafia dam; 24, Dakhla Pond; 25, Stah Pond; 26, Mekhada Marsh-North; 27, Bounamousa Dam; 28, El-Chat Marsh; 29, Oued Boukhmira; 30, Sidi Salem Ponds; 31, Bousedra Marsh; 32, Zouzina Pond; 33, Tabacob Pond; 34, Cheaiba Pond; 35, Oued Bidari; 36, Fetzara Dewatering channel; 37, Lake Guirech; 38, Barket El Khwaled; 39, Garaet Zawiya; 40, Gareat Khmisa; 41, Garaet Tabga; 42, Garaet Sidi Makhlouf; 43, Garaet Lihlaymia; 44, Oued Berka Zarga; 45, Lake Hadj Tahar; 46, Gareat Mamri; 47, Garaet Khellalba; 48, Mazaat Hmidani Pond; 49, Lake Beni Belaid; 50, Rajla Marsh; 51, Alsus Pond; 52, Akfadou Black Lake; 53, Oued Sebaou; 54, Lake Reghaia.

3.2. Climate and Elevation of Habitats

The wetlands inhabited by the turtles belonged to the sub-subhumid climate (64%), and to the humid climate (36%) (Figure 1). Most of these habitats (43 patches) were located between 1 and 170 m in altitude, with all but one of them below 100 m a.s.l. (Figure 2). As an outlier we consider two populations recorded at 618 m a.s.l. and 1246 m a.s.l. in the Akfadou Mountains (Alsus and Black-Lake marshes).

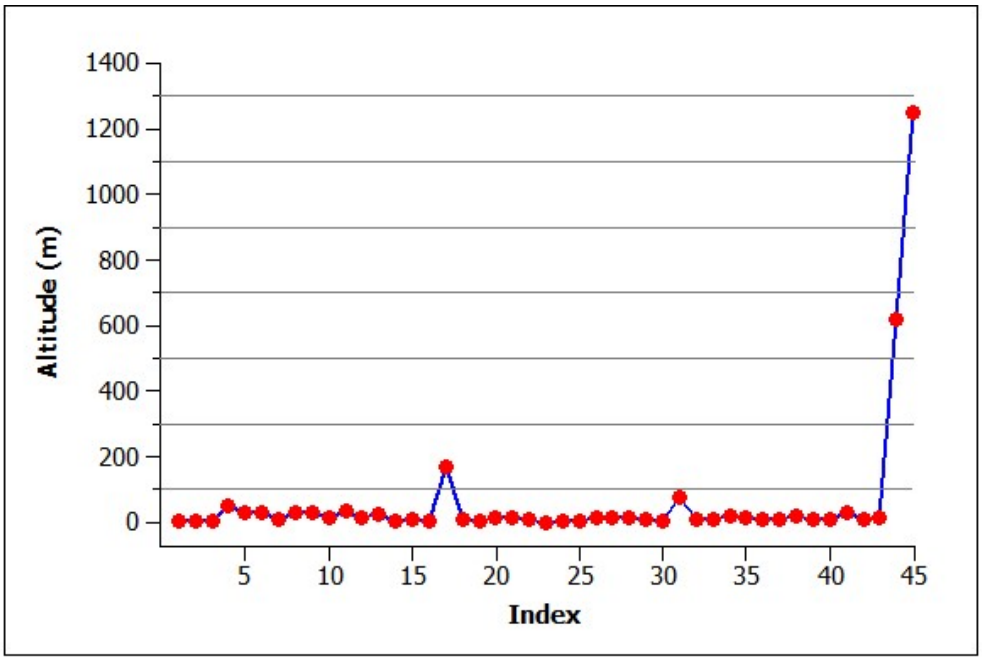

Figure 2. Altitude of *E. orbicularis* habitats in Algeria. The habitats are aligned according to their longitudinal position.

3.3. Diversity of Inhabited Biotopes

The European pond turtles have only been observed in freshwater habitats. They were mainly found in stagnant water in 84% of occupied habitats, mostly in shallow water (pools, marshes, ponds, and swamps), and sometimes on the banks of deep water (dams and lakes). They also sporadically inhabited slow-moving water bodies, both wide (slow rivers, river banks), especially their deltas, and even narrow (brooks, streams, drainage canals, uncleaned ditches), at a rate of 8% each (Figure 3).

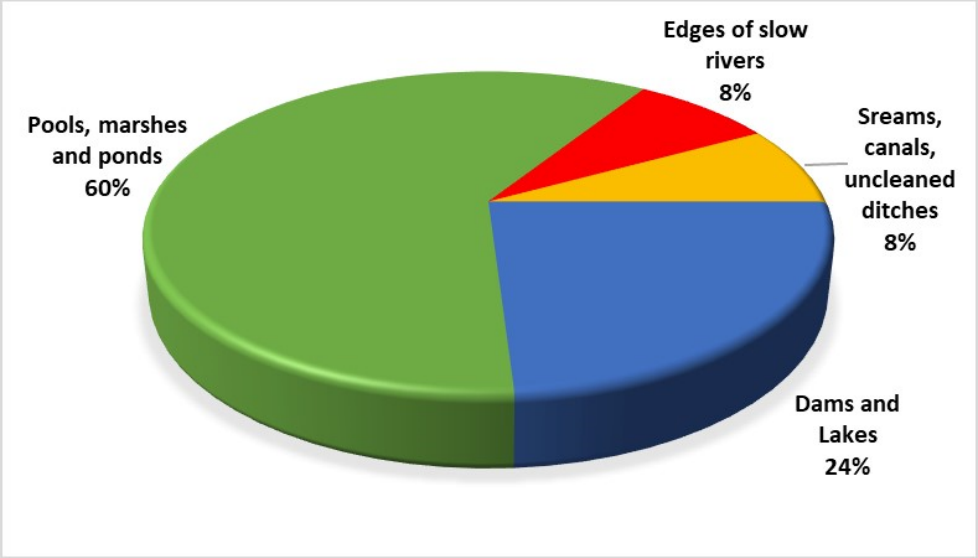

Figure 3. Habitat types inhabited by *E. orbicularis* in Algeria.

3.4. Conservation Status of Algerian Habitats of Emys orbicularis

Of the 45 wetlands inhabited by the European pond turtle, 23 (51%) sub-populations were found in 12 Ramsar sites, three sub-populations (7%) were found in three dams, and the remaining 19 (42%) were located in unprotected areas. Without exception, all of the Ramsar coastal wetlands, from El Kala to Jijel, have hosted European pond turtles. The 12 Ramsar wetlands that were inhabited are Lake Tonga, Lake Oubeira, Blue Lake, El-Melah swamp, Ain-Khiar Alder grove, Bourdim marsh, Oum-Laagareb swamp, Black Lake Peat-bog, Garaet El-Touyour, Mekhada marsh, Lake Fetzara, the wetland complex of Guerbes Sanhadja, and Lake Beni-Belaid.

4. Discussion

4.1. Distribution of E. orbicularis in Algeria

The distribution range of *E. orbicularis* in Algeria remained rather understudied, with limited reports published recently [1,32–34]. The data presented here help to fill these gaps in knowledge on the Algerian populations and to complete the view on distribution of the species in the Maghreb, since in comparison, the distribution in Morocco and Tunisia is well-documented, e.g., [5,16–18,21,35,53]. Lake Tonga in El-Kala National Park and the Boukhmira estuary in Annaba, located 10 km and 60 km from the Algerian-Tunisian border, respectively, were the only confirmed Algerian populations [1,34]. The presence of the species was also noted in the faunal checklists of the Guerbes-Sanhadja wetland complex and Lake Beni-Belaid [32,33]. Currently, forty-five populations are known to occur in Algeria. These range from Lake Tonga, which would be the easternmost, to the Black Lake of Akfadou in the center of coastal plain, covering a coastal strip 490 km long and 40 km wide. The current distribution reveals that the species has persisted for more than 130 years in the extreme northeast of the country, particularly in Annaba, El Kala, and their surroundings [23–26]. There, the species occupies patches densely interconnected by a rich and ramified hydrographic network. Even if presently, this study also resolves the existence

of the species in Kabylia, which was a subject of debate in historical documents [24,26]. We cannot conclude that the populations are perpetuated in this area, given that their presumed historical presence in the Sebao River, the largest in Great Kabylia, has been rejected by the herpetologists of that time. We did not observe *E. orbicularis* at the mouth of the Oued Sebaou (Figure 1), but the closest two water bodies in the Akfadou Mountains (Bejaia), which are part of the hydrographic network that feeds it during rainy periods [62] were inhabited by this turtle species. Moreover, the first and only mention of the species' presence was suggested in Little Kabylia at the lake of Beni-Belaid (Jijel) in 2000 [33]. The authors commented that it was unexpected in this region, far from its known range in the extreme northeast. We confirm the persistence of this population in the form of a peripheral patch and the existence of another one nearby, a few kilometers away. Overall, there is evidence for the stability of the Numidian metapopulation and even for its expansion further west and as far as Kabylia. None of the recent reports and studies that we are aware of have mentioned pond turtles further west, not even in adjacent Algiers. We did not find any *E. orbicularis* at the Reghaia wetland, the only Ramsar site around Algiers. Nevertheless, this can in no way refute Guichenot's historical document [28], which claims to have observed the species in large numbers in almost all Algiers waters during the years 1840–1842, nor does it support the hypothesis of his successors [24,26], who believe that he confused it with *M. leprosa*, as they did not observe it during their field trips.

The clustering of 40 populations over the Numidian wet complex, in the northeasternmost region between El Kala and the east of Skikda, allows us to deduce the central core of the Algerian populations. The spatial proximity, density, and good hydrographic connection of the areas identified mainly in Numidia, led us to believe that there is a permanent genetic exchange between the adjacent populations so that they function according to a metapopulation model [63]. Moreover, the absence of the species from the three previously occupied sites in Numidia (see Figure 1) does not necessarily imply definitive extinction. It is well-known that local disappearance and re-colonization of previously occupied habitats are attributes of *E. orbicularis* spreading dynamics, and these localities can be re-colonized from adjacent habitats [64]. Suitable water, food, and mate, as well as insolation, overwintering, egg-laying, and estivation sites, are the key life cycle elements that pond turtles constantly seek. If not satisfied in a single habitat with low competition, they will adopt partial or permanent movements between different patches, providing all or part of their needs [39,63–65]. The congregation of the species in the coastal strip of the Numidian wetland complex, which is rich in water bodies, suggests that this area provides all its needs in the adjacent patches. However, when the connectivity between colonized habitats is weakened or lost due to distance, individuals lost through dispersal or migration cannot be compensated [63,64,66]. Highly isolated populations end up being surrounded by barriers of unfavorable habitats and are less able to react effectively to significant degradation of their environment, and even less when they live on small surfaces, increasing the risk of local extinction [67,68]. The five highly isolated peripheral populations recorded in eastern and central Kabylia are therefore at risk of local extinction, especially in the case of small areas, such as Lac Noir and the Assous Pond, which occupy small areas of less than 3 ha.

We filled the Algerian gap in our knowledge of the distribution of *E. orbicularis* in the Maghreb. Currently, two distinct aggregates occur in the Maghreb, separated by over 700 km of mountains, plains, and highlands. One is in Morocco, covering a large area between the Gharb plains and the Rif mountains, and the second is on both sides of the Algerian-Tunisian border (Figure 4). The two population aggregates were determined to belong to two different evolutionary lineages, *E. o. occidentalis* and a yet undescribed taxon, respectively [58]. Although restricted to a wide strip along the coast area, the census of many populations in Algeria testifies to a relatively better conservation status of the undescribed taxon, especially in Numidia. Comparing Tunisia, of the 48 wetlands surveyed across the north in 2017–2018, there were only two sites in Kroumiria in the northwest where *E. orbicularis* were found [18]. The species had disappeared over two decades from

11 relict habitats it had previously occupied [21,22]. It should be noted that the landscapes and environmental conditions on both sides of the border are identical in Numidia, which stretches from El-Marsa in Algeria to Kroumiria in Tunisia [69]. The isolation of the eastern population of the species in the geographical area of Kabylia-Numidia-Kroumiria once again reinforces the qualification of this entity as a biodiversity hotspot and as a center of endemism in the whole Mediterranean [69,70]. The western North African taxon, endemic to Morocco, is in a more critical situation because it is highly fragmented over a relatively large geographic area [17].

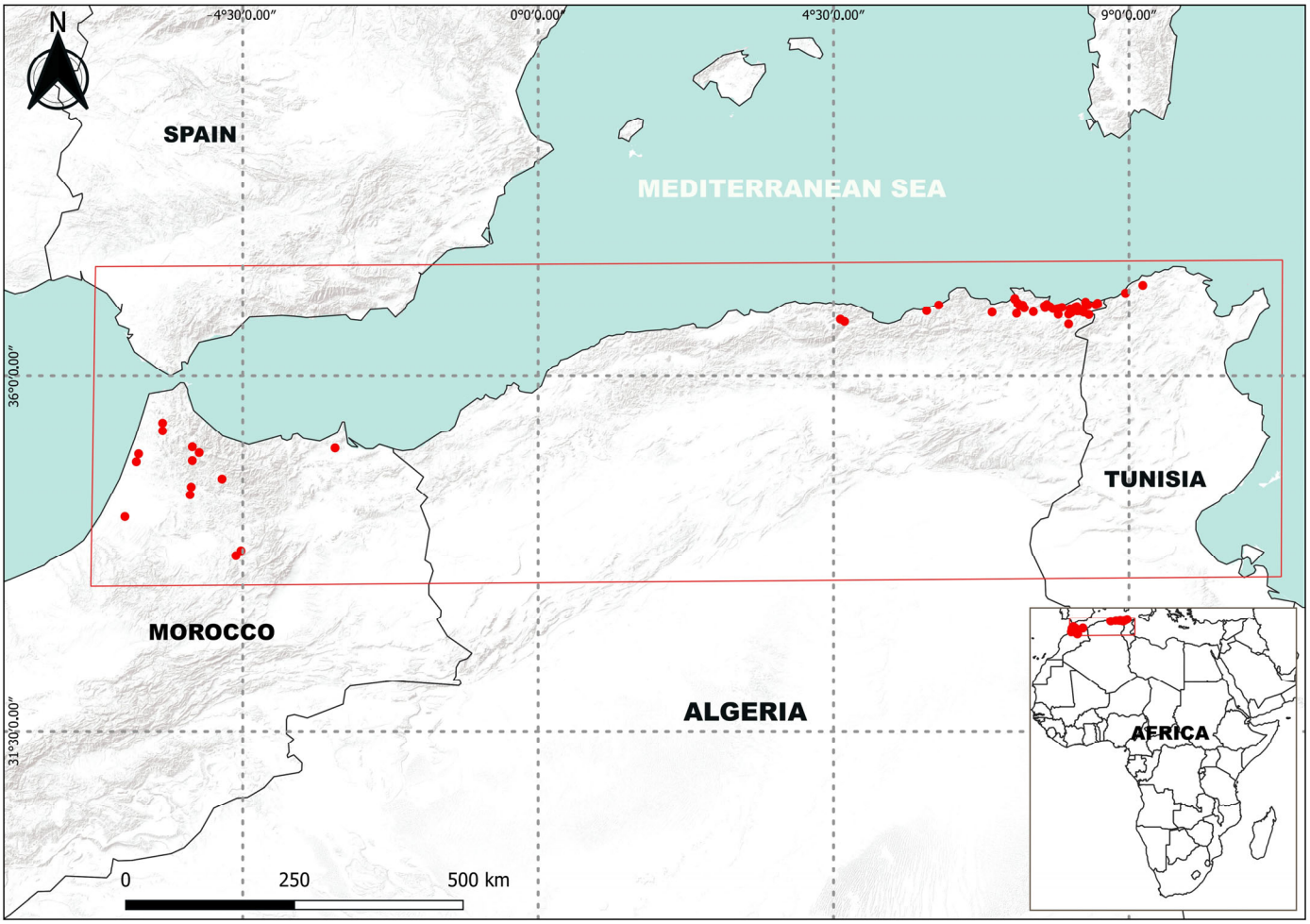

Figure 4. Distribution of *E. orbicularis* in Maghreb. The Moroccan data were taken from the study conducted by Velo-Antó et al. [17], and of the Tunisian from El Hili et al. [18].

4.2. Climate and Elevation of Occupied Habitats

Between the two wetland complexes, from El-Kala, close to the Tunisian border, to the black lake of Akfadou in Bejaia, the Algerian populations were found exclusively in the sub-humid and humid zones. It is precisely under the same bioclimatic floor where we have always detected the Maghreb populations, including those that had become locally extinct, e.g., [5,16–18,21,22,35,53,55,56]. The peculiarity of the Algerian regions belonging to the humid and sub-humid climates is that they are endowed with a greater density and heterogeneity of habitats favorable to the European pond turtle [35]. It is estimated that nearly 1.2 million hectares of wetlands are located in the northeastern region. This is almost one-third of the total wetlands in Algeria, spread over the humid and sub-humid climates (calculated based on the General Directorate of Forests report [71]). However, the whole European and Asian range of the species covers wider variety of climate zones from humid to arid, e.g., [35,43,46].

All Maghrebian pond turtle populations studied to date, including this study, occur in lowlands below 250 m a.s.l., e.g., [5,16,17,21,33]. As exceptional we consider two Algerian isolated populations recorded at 618 m a.s.l. and 1246 m a.s.l. in the Akfadou mountains (the present study) and two other Moroccan populations recorded at 1300 m a.s.l. and 1680 m in the Middle Atlas [17,35]. This finding is consistent with studies conducted throughout the northern Mediterranean, where the species is known to prefer lowlands [36,41,45,46,46,50]. Altitudinal distribution has reached 1500 m a.s.l. in Serbia and Italy [72,73].

4.3. Diversity of Occupied Habitats

European pond turtles mainly inhabit stagnant or slow-moving waters at shallow depths, ranging from 10 cm to a few meters [36,45,52,74], corresponding to the depth range observed in this study. It prefers muddy wetlands with abundant aquatic and riparian vegetation [11,52]. The diversity of lentic and lotic waters occupied by the species in Algeria, including pools, marshes, swamps, ponds, canals, and the edges of slow rivers and streams, reflects the wide range of its habitat preferences [35,36,41,44,46,52].

4.4. Conservation Status of Occupied Habitats

Habitat fragmentation, modification, and alteration are the primary threats endangering the European pond turtle [11–15]. In addition, there are the consequences of various interactions with human presence that have a direct impact on the turtles. These include mortality from nearby roads, freshwater maintenance, accidental fishing, and agricultural activities, which can also destroy eggs [75,76]. While these activities have not been measured to determine how they affect turtle distribution, it is known that they are less pronounced in protected areas. Altogether, 58% of Algerian populations of *E. orbicularis* have been recorded at protected Ramsar sites or dams, of which 98% are in the Numidia region. It seems to be the only vertebrate to be found in all 12 Ramsar coastal sites, from Tonga in El Kala to Beni-Belaid in Jijel, making it an excellent bioindicator of the high habitat quality. This is reassuring since it is in protected areas that programs to protect, restore, or rehabilitate terrapin populations have been more successful, e.g., [38,39,46–48,72,76]. The requirements of this threatened species should be effectively supported by implementing specific conservation measures inside and outside protected areas. To manage the wetlands for the needs of the European pond turtle, it is necessary to manage the floating vegetation, the flooded rushes and reeds, and the surrounding area and nesting sites on the nearby dry perimeter [75]. This should be performed while reducing the risk of mortality associated with freshwater maintenance and weeding activities on the dry periphery.

5. Conclusions

The present study provides the first complete data on the distribution and conservation status of the European pond turtle *E. orbicularis* in Algeria. Even though it is an isolated metapopulation in a restrained geographical area, it is the most stable Maghrebian distribution observed in recent years. Presumably, the studied localities provide the species with a habitat quality appropriate to its environmental requirements. The favorable climatic conditions, low elevation, population connectivity, habitat diversity, and limited anthropogenic impact, when some localities also enjoy the benefit of legal protection, allow us to formulate a positive finding on the stability of the Algerian populations. This positive outlook does not apply to the populations of Kabylia that are at high risk of local extinction. Populations of the Akfadou Mountains, which occur in small areas, are even more at risk. Nevertheless, it would be inappropriate not to consider the entire Maghreb scale, which remains a region highly vulnerable to the extinction of the species. Tunisian populations are currently on the brink of local extinction, and Moroccan populations are also threatened due to their isolation and high fragmentation. This is why follow-up and monitoring programs should be suggested following this work, with special attention to highly isolated populations. The measures to be implemented urgently should reduce the speed of the first phase of the local extinction that we are experiencing. This concerns the disappear-

ance of the relay sites forming biocorridors, which disconnect distant populations. It is imperative to prevent degradation from progressing to the final stage, where fragmented and highly isolated populations lose their resilience and local extinctions can no longer be compensated for by re-colonization or sufficient regeneration rates. Once started, erosion is progressive. Therefore, conservation efforts must take into account all three levels of habitat. The first level relates to large-surface-area sites that support healthy turtle populations and for which it would be reassuring to maintain their integrity. The second level focuses on smaller connected sites that are distinguished by their ecological significance (relay habitats, source populations, sink populations, secondary habitats), for which it is vital to maintain and repair their ecological networks. The third level concerns small, fragmented, and highly isolated populations, whose persistence depends on successful long-term action to improve their connectivity and dynamics. We see this paper as a call to action for all local and national environmental and biodiversity stakeholders to raise awareness about saving this species throughout the Maghreb.

Furthermore, to accurately assess the biogeography of European pond turtles in Algeria and thus improve our understanding of the species evolution in this region, a comprehensive genetic analysis using a robust genetic data set of populations' mitochondrial and microsatellite DNA is required.

Author Contributions: Conceptualization, G.T.; methodology, G.T., M.T.-S. and N.G.; software, G.T. and A.B.; validation, G.T., Z.B. and P.Š.; formal analysis, G.T.; investigation, N.G., K.D., C.M. and G.T.; resources, G.T., Z.B. and P.Š.; data curation, N.G. and G.T.; writing—original draft preparation, G.T. and M.T.-S.; writing—review and editing, G.T., N.G., M.T.-S., Z.B. and P.Š.; visualization, G.T.; supervision, G.T.; project administration, G.T.; funding acquisition, G.T., Z.B. and P.Š. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the University of Veterinary Sciences Brno, grant number 2023ITA22.

Institutional Review Board Statement: The ethical approvals regarding animal handling were obtained through University Research and Training Projects (Project code: D00L02UN360120190001), by the Ethical Committee of the Directorate General for Scientific Research and Technological Development, which is under the direction of the Algerian Ministry of Higher Education and Scientific Research. The realization of the sampling protocol was approved by the direction of fisheries and aquaculture of Annaba province (976/2021—Certificate of authorization issued on 1 May 2021), as well as the direction of the El Kala National Park (248/PNEK/2022—Certificate of authorization issued on 20 April 2021), which manage the sampled habitats.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available because the authors will use them in future research.

Acknowledgments: We would like to thank the local Forest Conservations and National Parks, who helped us to establish contacts with the concerned services, gave us unpublished reports on the fauna counted in their sectors, guided us, and assisted us on the field: We thank NP of El Kala; Grira Abdesselam (N.P. El-Kala); Allem Mohcen (F.C. Annaba); Abed Labiod (N.P. Taza-Jijel); Circonscription of Adekar-Bejaia; Djardini Houari (G.F.C.); Saadane Bourourou (Cironscription of Ansar-Jijel).

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

References

1. Tiar-Saadi, M. Bioécologie des Tortues D'eau en Algérie. Ph.D. Thesis, Département de Biologie, Université Badji Mokhtar, Annaba, Algérie, 2018.
2. Tiar, G.; Boudebza, R.; Souallem, I.; Tiar-Saadi, M. Enquête sur l'ampleur du ramassage illégal des tortues terrestres sauvages: Pratique non suffisamment contrôlée en Algérie (cas de la Wilaya d'El Tarf, nord-est algérien). *Rev. Algérienne Sci. A* **2019**, *2*, 71–75.
3. Gahmous, S.A.; Tiar, G.; Tiar-Saadi, M.; Bouslama, Z.; Širokỳ, P. Reproductive traits demonstrate how well the Mediterranean stripe-necked turtle *Mauremys leprosa* can flourish under highly degraded–polluted conditions. *Biology* **2022**, *11*, 1562. [CrossRef] [PubMed]
4. Tiar-Saadi, M.; Tiar, G.; Bouslama, Z.; Širokỳ, P. Mechanisms determining body size and shape difference in Algerian spur-thighed tortoises (*Testudo graeca*). *Animals* **2022**, *12*, 1330. [CrossRef] [PubMed]
5. Fritz, U. Die Europäische Sumpfschildkröte Laurenti Verlag. Suppl. *Z. Feldherpetol.* **2003**, *1*, 224.
6. Ernst, C.H.; Barbour, R.W.; Altenburg, R.G.M. *Turtles of the World*; Springer: Berlin/Heidelberg, Germany, 1989; Volume 272.
7. Fritz, U. *Emys orbicularis* (Linnaeus, 1758)—Europäische Sumpfschildkröte. Aula Verlag. *Handb. Reptil. Amphib. Eur.* **2001**, *3*, 343–515.
8. Sillero, N.; Campos, J.; Bonardi, A.; Corti, C.; Creemers, R.; Crochet, P.-A.; Isailović, J.C.; Denoël, M.; Ficetola, G.F.; Gonçalves, J. Updated distribution and biogeography of amphibians and reptiles of Europe. *Amphib. Reptil.* **2014**, *35*, 1–31. [CrossRef]
9. Seidel, M.; Ernst, C. A systematic review of the turtle family Emydidae. *Vertebr. Zool.* **2017**, *67*, 1–122. [CrossRef]
10. Tortoise and Freshwater Turtle Specialist Group Nature (IUCN), International Union for Conservation of Nature. *IUCN Red List of Threatened Species*; IUCN: Gland, Switzerland, 1996.
11. Ficetola, G.F.; Padoa-Schioppa, E.; Monti, A.; Massa, R.; Bernardi, F.D.; Bottoni, L. The importance of aquatic and terrestrial habitat for the European pond turtle (*Emys orbicularis*): Implications for conservation planning and management. *Can. J. Zool.* **2004**, *82*, 1704–1712. [CrossRef]
12. Mollov, I.A. Influence of urbanization on the populations of the European pond turtle *Emys orbicularis* (L., 1758) in the city of Plovdiv (Bulgaria). *Ecol. Balk.* **2019**, *11*, 269–278.
13. Stanford, C.B.; Iverson, J.B.; Rhodin, A.G.; Van Dijk, P.P.; Mittermeier, R.A.; Kuchling, G.; Berry, K.H.; Bertolero, A.; Bjorndal, K.A.; Blanck, T.E. Turtles and tortoises are in trouble. *Curr. Biol.* **2020**, *30*, R721–R735. [CrossRef]
14. Nekrasova, O.; Marushchak, O.; Pupins, M.; Skute, A.; Tytar, V.; Čeirāns, A. Distribution and potential limiting factors of the European pond turtle (*Emys orbicularis*) in eastern Europe. *Diversity* **2021**, *13*, 280. [CrossRef]
15. Ayaz, D.; Bayrakci, Y.; Çiçek, K.; Ihlow, F.; Tok, C.V.; Fritz, U. On the brink of extinction: Results of a 20-year quest for Eiselt's pond turtle (*Emys orbicularis eiselti*) in southeastern Turkey. *Chelonian Conserv. Biol.* **2021**, *20*, 222–230. [CrossRef]
16. Mediani, M.; Amezian, M.; Tattou, M.I.; Benhoussa, A.; Idrissi, H.R.; El Agbani, M.A.; Qninba, A. Nouvelles Citations de Deux Espèces Reliques Paléarctiques, *Emys orbicularis* Linnaeus, 1758 et *Vipera latastei* Boscá, 1878 Dans La Péninsule Tingitane (Rif Occidental, Maroc). *Bull. Inst. Sci. Rabat.* **2009**, *31*, 99–102.
17. Velo-Antón, G.; el Marnisi, B.; Fritz, U.; Fahd, S. Distribution and conservation status of *Emys orbicularis* in Morocco. *Vertebr. Zool.* **2015**, *65*, 131–134. [CrossRef]
18. El Hili, R.A.; Verneau, O.; Jrijer, J.; Achouri, M. Reassessment of distribution and conservation status of freshwater turtles (Testudines) in Tunisia. *Salamandra* **2020**, *56*, 362–372.
19. Chaignon, V.H. Contributions à L'histoire Naturelle de la Tunisie. *Bull. Soc. Hist. Nat. Autun* **1904**, *17*, 1–280.
20. Imprimerie et Librairie Dejussieu (Ed.) *Société d'Histoire Naturelle d'Autun Dix-Septième Bulletin*; La Société: Autun, France, 1905.
21. Blanc, C.P. Notes Sur Les Reptiles de Tunisie. III. Distribution et Perspectives de Protection Des Tortues Terrestres et Dulçaquicoles. *Arch. Inst. Pasteur Tunis* **1978**, *55*, 55–66.
22. Nouira, S. L'Herpétofaune. In *Biodiversité Des Écosystèmes Côtiers et Des Zones Humides Du Cap-Bon, Tunisie*; MedWetCoast, 2001; pp. 121–138. Available online: https://www.lacerta.de/AF/Bibliografie/BIB_13508.pdf (accessed on 3 August 2023).
23. Eichwald, E. Naturhistorische Bemerkungen Iiber Algiers Und Den Atlas IX (Kept, and Batr.). *Mem. Soc. Nat. Mosc.* **1851**, *2*, 414–444.
24. Strauch, A. *Essai D'une Erpétologie de l'Algérie*; Commissionnaires de l'Académie Impériale des Sciences: Bavaria, Germany, 1862.
25. Lallemant, C. *Erpétologie de l'Algérie ou Catalogue Synoptique et Analytique des Reptiles et Amphibies de la Colonie*; Savy: Paris, France, 1867.
26. Boulenger, G.A. Catalogue of the reptiles and batrachians of Barbary (Morocco, Algeria, Tunisia), based chiefly upon the notes and collections made in 1880-1884 by M. Fernand Lataste. *Trans. Zool. Soc. Lond.* **1891**, *13*, 93–164. [CrossRef]
27. Service Algérien de la Carte Géologique. *Bulletin: Stratigraphie de l'Algeria, Service de la Carte Géologique*; Imp. de l'Université; Y. Cadoret: Paris, France, 1935.
28. Guichenot, A. Histoire Naturelle Des Reptiles et Des Poissons de l'Algérie. [Section 2] Sciences Physiques. Zoologie. In *Exploration Scientifique de l'Algérie Pendant les Annees 1840, 1841, 1842) par Ordre du Gouvernement et avec le Concours D'une Commission Académique*; Arthus Bertrand, Imprimerie Nationale: Paris, France, 1850.
29. Doumergue, F. *Essai sur la Faune Erpétologique de l'Oranie: Avec des Tableaux Analytiques et des Notions Pour la Détermination de Tous Les Reptiles & Batraciens du Maroc, de l'Algérie et de la Tunisie. Extrait du Bulletin de la Société de Géographie et d'Archéologie d'Oran*; T. XIX à XXI; Imprimerie Typographique et Lithographique; L. Fouque: Oran, Algeria, 1901.

30. Société Centrale d'Aquiculture et de Pèche. *Bulletin de la Société Centrale d'Aquiculture et de Pèche*; La Société: Urbana, IL, USA, 1912; Volume 24—25.
31. Société d'Histoire Naturelle de l'Afrique du Nord. *Bulletin de la Société D'histoire Naturelle de L'Afrique du Nord*; La Société: Urbana, IL, USA, 1913.
32. Samraoui, B.; De Belair, G. The Guerbes-Senhadja wetlands (NE Algeria). Part I: An overview. *Ecologie* **1997**, *28*, 233–250.
33. De Belair, G.; Samraoui, B. L'écocomplexe Des Zones Humides de Beni-Belaid: Un Projet de Réserve Naturelle. *Sci. Technol. A Exactes Sci.* **2000**, *14*, 115–124.
34. Tiar-Saadi, M.; Tiar, G.; Bouslama, Z.; Širokỳ, P. First data on the population of the European pond turtle *Emys orbicularis* at Lake Tonga, El Kala National Park, Algeria. *Biologia* **2017**, *72*, 819–824. [CrossRef]
35. Escoriza, D.; Ben Hassine, J. Niche separation among North-West African semi-aquatic reptiles. *Hydrobiologia* **2017**, *797*, 47–56. [CrossRef]
36. Segurado, P.; Araújo, A.P.R. Coexistence of *Emys orbicularis* and *Mauremys leprosa* in Portugal at two spatial scales: Is there evidence of spatial segregation. *Biologia* **2004**, *59*, 61–72.
37. Mascort, R. Distribution and status of the European pond turtle, *Emys orbicularis*. *Catalonia. Mertensiella* **1998**, *10*, 177–186.
38. Andueza, I.L.; Alcayde, V.S. Advances in the action plan for *Emys orbicularis* in the Valencia region, Spain. *Biol. Bratisl.* **2004**, *59*, 173–176.
39. Cadi, A.; Nemoz, M.; Thienpont, S.; Joly, P. Home range, movements, and habitat use of the European pond turtle (*Emys orbicularis*) in the Rhône-Alpes region, France. *Biologia* **2004**, *59*, 89–94.
40. Cadi, A.; Nemoz, M.; Thienpont, S.; Joly, P. Annual home range and movement in freshwater turtles: Management of the endangered European pond turtle (*Emys orbicularis*). *Rev. Esp. Herp* **2008**, *22*, 71–86.
41. Zuffi, M.A.L. Conservation biology of the European pond turtle *Emys orbicularis* (L.) in Italy. *Stapfia* **2000**, *69*, 219–228.
42. Govedič, M.; Vogrin, M.; Bordjan, D.; Bombek, D.; Denac, D.; Gregorc, T.; Janžekovič, F.; Kirbiš, N.; Vamberger, M. New data on distribution of the European pond turtle *Emys orbicularis* (Linnaeus, 1758) in the Podravje region (NE Slovenia). *Nat. Slov.* **2016**, *18*, 77–82.
43. Krizmanić, I.; Urošević, A.; Simović, A.; Krstić, M.; Jović, D.; Ajtić, R.; Anđelković, M.; Slijepčević, M.; Đorđević, S.; Golubović, A. Updated distribution of the European pond turtle *Emys orbicularis* (Linnaeus, 1758) and its conservation issues in Serbia. *Arch. Biol. Sci.* **2015**, *67*, 1043–1053. [CrossRef]
44. Sacdanaku, E.; Haxhiu, I. Distribution, habitats and preliminary data on the population structure of the European pond turtle, *Emys orbicularis* (Linnaeus, 1758), in Vlora Bay, Albania. *Acta Zool. Bulg.* **2017**, *10*, 9–14.
45. Puky, M.; Gémesi, D.; Schád, P. Distribution of *Emys orbicularis* in Hungary with notes on related conservational and environmental education activities. *Biol. Bratisl.* **2004**, *59*, 55–60.
46. Horváth, E.; Martvoňová, M.; Danko, S.; Havaš, P.; Kaňuch, P.; Uhrin, M. Distribution range and population viability of *Emys orbicularis* in Slovakia: A review with conservation implications. *Nat. Conserv.* **2021**, *44*, 141. [CrossRef]
47. Rybacki, M.; Maciantowicz, M. Status, Distribution and protection of the European pond turtle (*Emys orbicularis*, L.) in western Poland. *Rev. Esp. Herp* **2008**, *22*, 131–137.
48. Meeske, A.C.M.; Pupins, M.; Rybczynski, K. Erste Ergebnisse zur Verbreitung und zum Status der Europäischen Sumpfschildkröte (*Emys orbicularis*) am nördlichen Rand ihrer Verbraitung in Litauen und Lettland. *Z. Feldenherpetologie* **2006**, *13*, 71–99.
49. Kotenko, T. Distribution, habitats, abundance and problems of conservation of the European pond turtle (*Emys orbicularis*) in the Crimea (Ukraine): First results. *Biol. Bratisl.* **2004**, *59*, 33–46.
50. Bîrsan, C.-C.; Iosif, R.; Székely, P.; Cogălniceanu, D. Spatio-temporal bias in the perceived distribution of the European pond turtle, *Emys orbicularis* (Linnaeus, 1758), in Romania. *Acta Zool. Bulg.* **2017**, *10*, 37–41.
51. Khabibullin, V. Distribution of *Emys orbicularis* in the South Urals, Russia. *Biol. Bratisl.* **2004**, *59*, 27–32.
52. Mazanaeva, L.; Orlova, V. Distribution and ecology of *Emys orbicularis* in Daghestan, Russia. *Biol. Bratisl.* **2004**, *59*, 47–53.
53. Loveridge, A.; Williams, E.E. Revision of the African tortoises and turtles of the suborder Cryptodira. *Bull. Mus. Comp. Zool.* **1957**, *115*, 163–557.
54. Bons, J.; Geniez, P. *Amphibiens et Reptiles du Maroc, Atlas Biogéographique*; AHE: Barcelona, Spain, 1996.
55. Real, R.; Pleguezuelos, J.M.; Fahd, S. The distribution patterns of reptiles in the Riff region, northern Morocco. *Afr. J. Ecol.* **1997**, *35*, 312–325. [CrossRef]
56. Fahd, S.; El Marnisi, B.; Mediani, M.; Fritz, U. Zur Verbreitung Und Zum Bedrohungsstatus Der Europäischen Sumpfschildkröte (*Emys orbicularis*) in Marokko. *Elaphe* **2009**, *17*, 30–33.
57. Fritz, U.; Guicking, D.; Kami, H.; Arakelyan, M.; Auer, M.; Ayaz, D.; Fernández, C.A.; Bakiev, A.; Celani, A.; Džukić, G.; et al. Mitochondrial phylogeography of European pond turtles (*Emys orbicularis*, *Emys irinacris*)—An update. *Amphib. Reptil.* **2007**, *28*, 418–426. [CrossRef]
58. Stuckas, H.; Velo-Antón, G.; Fahd, S.; Kalboussi, M.; Rouag, R.; Arculeo, M.; Marrone, F.; Sacco, F.; Vamberger, M.; Fritz, U. Where are you from, stranger? The enigmatic biogeography of North African pond turtles (*Emys orbicularis*). *Org. Divers. Evol.* **2014**, *14*, 295–306. [CrossRef]
59. Messaoudene, M.; Tessier, L. Relations Cerne-Climat Dans des Peuplements de Quercus Afares Willd et Quercus Canariensis Pomel en Algérie. *Ann. Sci. For.* **1997**, *54*, 347–358. [CrossRef]

60. Bouldjedri, M.; de Bélair, G.; Mayache, B.; Muller, S.D. Menaces et Conservation Des Zones Humides d'Afrique Du Nord: Le Cas Du Site Ramsar de Beni-Belaid (NE Algérien). *Comptes Rendus Biol.* **2011**, *334*, 757–772. [CrossRef]
61. Lemdani, S.; Ouaked, L. Etude D'une Zone Humide Montagneuse en Kabylie Cas Du: Lac Noir d'Akfadou. Master's Thesis, Université Mouloud Mammeri, Tizi Ouzou, Algeria, 2020.
62. Laribi, M.; Derridj, A.; Acherar, M. Phytosociologie de La Forêt Caducifoliée à Chêne Zéen (*Quercus Canariensis Willd*.) Dans Le Massif d'Ath Ghobri-Akfadou (Grande Kabylie, Algérie). *Fitosociologia* **2008**, *45*, 77–92.
63. Clarté, P.; Pinet, F.; D'amico, F. Importance Des Habitats Terrestres Dans La Dynamique d'occupation d'*Emys orbicularis* (Linnaeus, 1758) Sur Le Site Natura 2000 «Grande Brenne». *Naturae* **2020**, *4*, 71–84. [CrossRef]
64. Roe, J.H.; Brinton, A.C.; Georges, A. Temporal and spatial variation in landscape connectivity for a freshwater turtle in a temporally dynamic wetland system. *Ecol. Appl.* **2009**, *19*, 1288–1299. [CrossRef]
65. Roe, J.H.; Georges, A. Maintenance of variable responses for coping with wetland drying in freshwater turtles. *Ecology* **2008**, *89*, 485–494. [CrossRef] [PubMed]
66. Cushman, S.A. Effects of habitat loss and fragmentation on amphibians: A review and prospectus. *Biol. Conserv.* **2006**, *128*, 231–240. [CrossRef]
67. Gilpin, M.E.; Soulé, M.E. *Minimum Viable Populations: Processes of Species Extinction*; Soulé, M.E., Ed.; Conservation Biology: The Science of Scarcity and Diversity; Sinauer Associates: Sunderland, MA, USA, 1986; pp. 19–34.
68. Harrison, S. Local extinction in a metapopulation context: An empirical evaluation. *Biol. J. Linn. Soc.* **1991**, *42*, 73–88. [CrossRef]
69. Medail, F.; Quezel, P. Hot-spots analysis for conservation of plant biodiversity in the Mediterranean basin. *Ann. Mo. Bot. Gard.* **1997**, *84*, 112–127. [CrossRef]
70. Véla, E.; Benhouhou, S. Évaluation d'un nouveau point chaud de biodiversité végétale dans le Bassin méditerranéen (Afrique du Nord). *Comptes Rendus Biol.* **2007**, *330*, 589–605. [CrossRef]
71. General Directorate of Forests Stratégie Nationale de Gestion Écosystémique des Zones Humides d'Algérie. FAOLEX. Available online: https://www.fao.org/faolex/results/details/fr/c/LEX-FAOC210820/ (accessed on 3 August 2023).
72. Crnobrnja-Isailović, J.; Mesaroš, G. Conservation activities for the European pond turtle (*Emys orbicularis*) in Serbia. *Herpetol. Notes* **2013**, *6*, 119–123.
73. Ficetola, G.F.; Salvidio, S.; D'Angelo, S.; Bonardi, A.; Bottoni, L.; Canalis, L.; Crosetto, S.; Di Martino, S.; Ferri, V.; Filetto, P. Conservation activities for European and Sicilian pond turtles (*Emys orbicularis* and *Emys trinacris*, respectively) in Italy. *Herpetol. Notes* **2013**, *6*, 127–133.
74. Thienpont, S.; Cadi, A.; Quesada, R.; Cheylan, M. Overwintering habits of the European pond turtle (*Emys orbicularis*) in the Isère department (France). *Biol. Bratisl.* **2004**, *59*, 143–147.
75. Cadi, A.; Faverot, P. *La Cistude d'Europe–Gestion et Restauration des Populations et de Leur Habitat*; Guide Technique; Conservatoire Rhône-Alpes des Espaces Naturels: Vourles, France, 2004; 108p.
76. Gagno, S.; Jardé, N.; Marchis, N.; Ballouard, J.-M. Pressions Anthropiques Subies Par Les Chéloniens Dans Le Var-*Testudo hermanni* (Gmelin, 1789) et *Emys orbicularis* (Linnaeus, 1758): Premier Retour d'un Centre de Soins de La Faune Sauvage. *Bull. Soc. Herp. Fr.* **2013**, *145*, 157–168.