



The Amphibian and Reptilian Fauna of Değirmenboğazı Nature Park, Balıkesir Province, Turkey

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Abstract.—We surveyed the herpetofauna of Değirmenboğazı Nature Park and its surroundings, in Balıkesir Province, Turkey, and encountered a total of 3,229 individuals of four amphibian (three anurans, one salamander) and 21 reptilian species (three turtles, 12 snakes, six lizards), plus an additional invasive species of turtle. Most observations were recorded during the spring, while the fewest were observed in August and September. The most frequently observed species were *Pelophylax cf. bedriagae* (Anatolian Waterfrog), *Laudakia stellio* (Roughtailed Rock Agama), *Lacerta diplochondrodes* (Rhodos Green Lizard), *Eirenis modestus* (Asia Minor Dwarf Racer), and *Montivipera xanthina* (Ottoman Viper). The least observed species were *Platyceps collaris* (Red-headed Sand Racer) and *Malpolon insignitus* (Eastern Montpellier Snake). Our results indicate that the study area supports 17.4% of the country’s and 62.5% of the province’s herpetofauna. Species richness was primarily concentrated in the scrub and rocky areas in the northern part of the study area, in contrast to the coniferous forests in the southern part. We anticipate that these data will inform the development of improved regional conservation strategies.

Since the early 1980s, sharp declines in amphibian and reptilian populations, particularly in protected areas, have led researchers to focus more on the conservation, distribution, and ecology of these groups (Gibbons et al. 2000; Church et al. 2007). Although amphibians and reptiles are among the most species-rich taxa of terrestrial vertebrates and despite a recent surge of academic interest in their conservation, a paucity of comprehensive scientific understanding of their risks of extinction nonetheless remains (Tingley et al. 2016; Olson and Pilliod 2022). Consequently, biodiversity surveys in protected areas are particularly important. However, designating a piece of nature as a community asset with recreational connotations can have detrimental side effects that include increased tourist activity, which can impose additional pressure on populations (Behrooz et al. 2015) — ultimately undermining the conservation capabilities of these areas (Amo et al. 2006).

Located at the crossroads of Europe and Asia in the Western Palearctic Realm, Turkey is home to three of the world’s 36 biodiversity hotspots, the Caucasus, Irano-Anatolian, and Mediterranean Hotspots (Mittermeier et al. 2004). The nation, characterized by an exceptionally high level of terrestrial biodiversity, encompasses four distinct biomes and thirteen ecoregions (Şekercioğlu et al. 2011; Dinerstein et al. 2017) that collectively support 12,141 vascular plant

species, 403 freshwater fish species, 35 amphibian species, 142 reptilian species, 500 bird species, and 175 mammalian species (T.C. Tarım ve Orman Bakanlığı Bilgi Teknolojileri Genel Müdürlüğü 2025). However, those figures do not reflect the diversity within species. When considering subspecies, Turkish herpetofaunal diversity totals 51 amphibian and 198 reptilian taxa, plus the invasive Red-eared Slider (*Trachemys scripta elegans*) (Yaşar et al. 2021; AmphibiaWeb 2025; Uetz et al. 2025). When taxa with uncertain distributions or validity are included, the total number of taxa reaches 62 for amphibians and 228 for reptiles.

Turkey has 13 different categories of protected areas, covering a total area of 3.7 million hectares, approximately 4.7% of the country’s terrestrial area (GDNCNP 2023). One category, “Nature Park,” of which 266 occur in the country, is defined by the GDNCNP (2024) as “natural areas with vegetation and wildlife characteristics suitable for the recreation and enjoyment of the public within the integrity of the landscape.” Değirmenboğazı Nature Park was designated as a Nature Park on 11 June 2011. We herein record the amphibian and reptilian species inhabiting Değirmenboğazı Nature Park in an effort to address the lack of regional herpetofaunal knowledge and to serve as a basis for future conservation studies in the area.

Methods

Değirmenboğazı Nature Park (39.70584, 27.96244) lies northwest of the capital city center in Balıkesir Province (Fig. 1) and is part of the Anatolian conifer and deciduous mixed forest (Eco ID: 786) ecoregion (Olson et al. 2001; Atalay and Efe 2010; Dinerstein et al. 2017; One Earth 2025). Ortaca Creek runs through the park, resulting in a substantial portion of area located in a river valley. River valleys are geomorphological features that offer climatic refuges and natural corridors for plant and animal species, often resulting in biodiversity that is much higher than that of surrounding areas (Didukh et al. 2015; Holešťová and Douda 2022; Yang et al. 2022). The study area of 3.56 km² also encompasses the Balıkesir urban forest (Uzun et al. 2019). The area is largely dominated by coniferous trees (*Pinus brutia*, *Cupressus* sp.), whereas White Poplar (*Populus alba*) and Oriental Plane Trees (*Platanus orientalis*) are abundant along streambanks (Derinöz 2022). In the north, rocky outcrops and oak

(*Quercus* spp.) dominate the landscape (Fig. 2). No previous research had been conducted on the herpetofauna of the area at the time of this study.

The study site was divided into 44 250 x 350-m UTM grids (Fig. 3). Field surveys were conducted over 78 days by a team of two people between early February and late November at various intervals from 2015 to 2018. We established three walkable transects (400 x 3 m) in the dominant macrohabitat in which amphibians and reptiles were most abundant in each grid. Transects were surveyed once daily from 1200–1600 h in February and November and twice daily from 0800–1200 h and 1500–1900 h during the other eight months by a two-person team, with each member spending 20 minutes using the visual-encounter survey method while also searching under rocks and logs, all of which were returned to their original state. We photographed all amphibians and reptiles encountered and recorded locations using a handheld GPS device (Garmin GPSMAP 62).

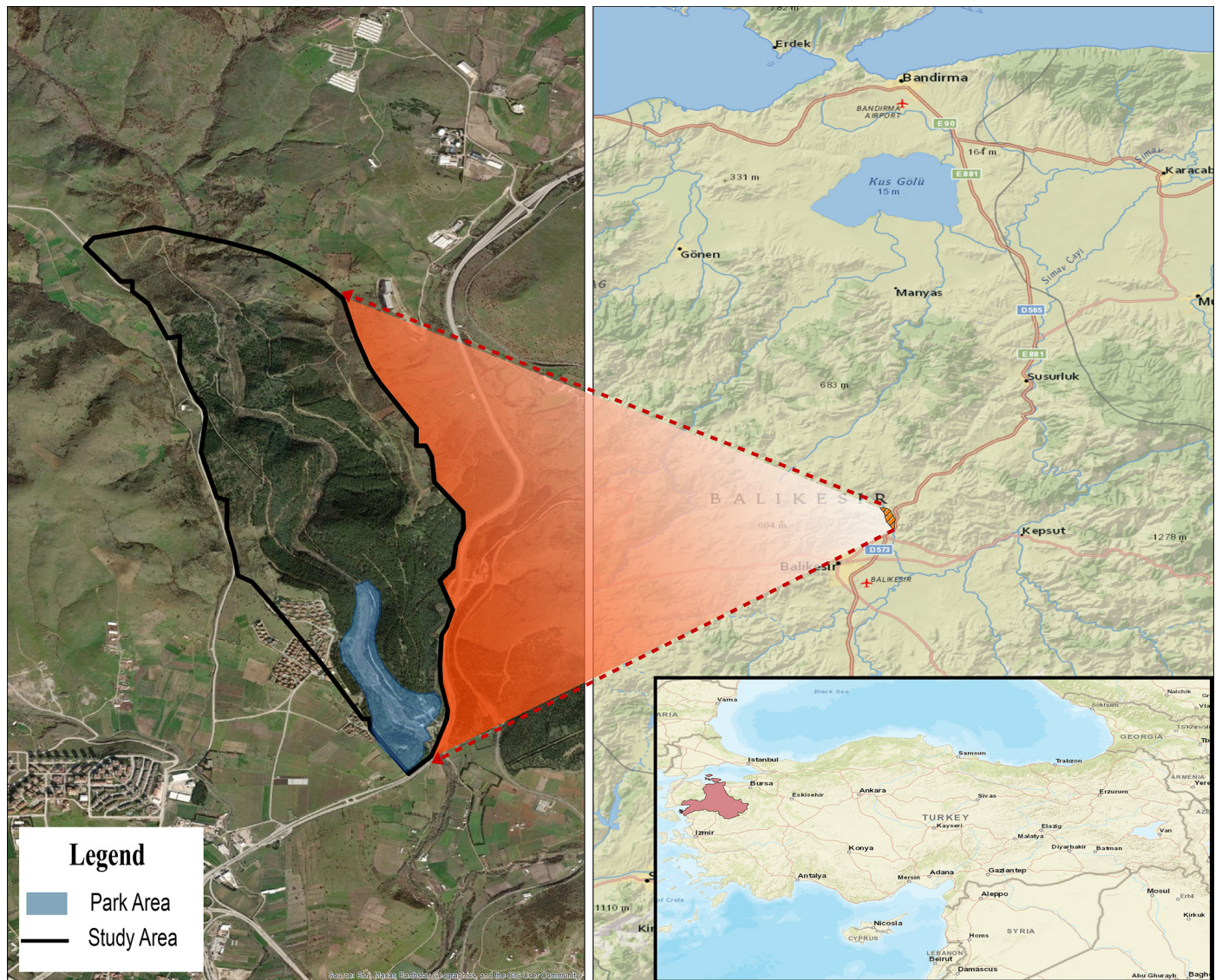


Figure 1. Location of the study area in and around Değirmenboğazı Nature Park, Balıkesir Province, Turkey.



Figure 2. Representative habitats within the study area in and around Değirmenboğazı Nature Park, Balıkesir Province, Turkey: Streambanks with an abundance of poplars and sycamores (A), slopes dominated by rocky outcrops and oaks (B & D), and coniferous forest throughout much of the area (C). Photographs by Burak Akdağ.

GPS records for each species were entered into Excel and moved to ArcGIS vers. 10.0 (ESRI ver. 10.8 trial vers.). All data sets were georeferenced to the WGS-84 coordinate system. We used the Kernel Density Analysis tool of ArcGIS to create a species richness map (Fig. 3). For each species, we recorded the conservation status according to the IUCN Red List (IUCN 2025), the Bern Convention (Council of Europe 2025), and the CITES Appendices (CITES 2025).

Results

We recorded 3,229 individuals of 24 native species of amphibians and reptiles and one non-native turtle (Table 1; Fig. 4). According to current literature and citizen-science data (Baran et al. 2013; iNaturalist 2025; TürkHerptil 2025), excluding three species of sea turtles, 40 native and the one non-native herpetofaunal species had been recorded in Balıkesir Province. The results of this study indicate that Değirmenboğazı Nature Park and its surroundings host 62.5% of the herpetofauna previously recorded in the province and 17.4% of those known to occur in the country.

The most frequently encountered species were *Pelophylax* cf. *bedriagae* (Anatolian Waterfrog; 539 individuals), *Laudakia stellio* (Roughtailed Rock Agama; 180 individuals), *Lacerta diplochondroides* (Rhodos Green Lizard; 181 individuals), *Eirenis modestus* (Asia Minor Dwarf Racer; 172 individuals), and *Montivipera xanthina* (Ottoman Viper; 225 individuals). The least frequently observed species were *Platyceps collaris* (Red-headed Sand Racer; 10 individuals) and *Malpolon insigninitus* (Eastern Montpellier Snake; 6 individuals). Frequencies of observations varied by season. As expected, the most observations were in the spring (February–May), whereas the fewest were in August and September (Table 2). The number of observations declined for many species during the third year of our survey (Table 3). The northwestern regions of the study area (notably stations 31, 36, and 42), characterized by maquis vegetation and rocky terrain, exhibited the highest diversity of amphibians and reptiles (Fig. 3). Fewer species were found in the coniferous forest to the south.

During the three-year field study, we interviewed 42 visitors along hiking trails in the study area. Thirteen of these visi-

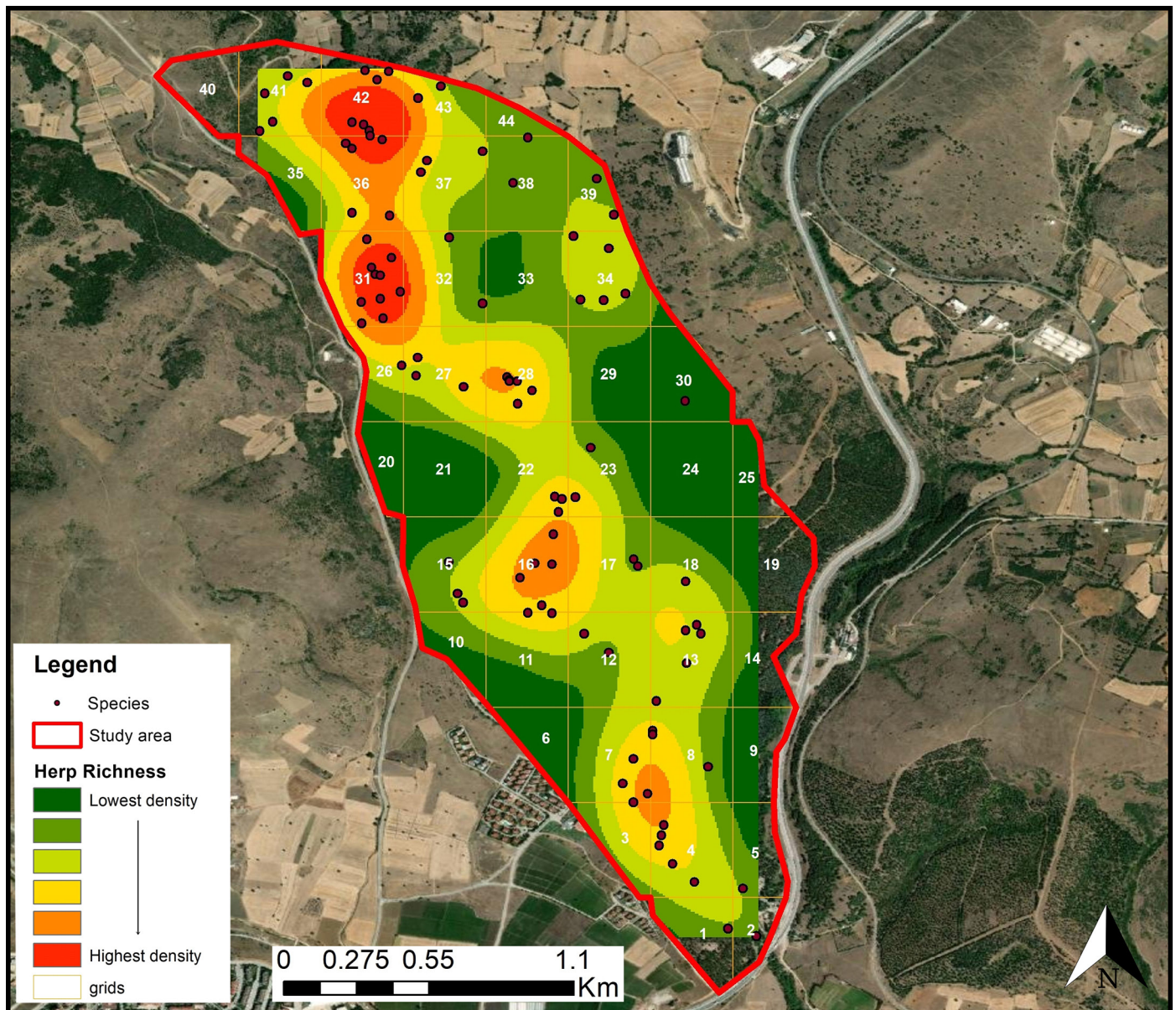


Figure 3. Amphibian and reptilian species richness in and around Değirmenboğazi Nature Park, Balıkesir Province, Turkey.

tors had either killed or attempted to kill snakes when encountered. Furthermore, eight of these individuals identified the legless European Glass Lizard (*Pseudopus apodus*) as a snake.

Discussion

Değirmenboğazi Nature Park is under intense local tourist pressure because it is regarded as a recreational area by the local population (Derinöz 2022). We are concerned that this pressure could intensify due to the Ministry's plans to expand visitor capacity. Certain groups of reptiles, such as viperids, are known to be highly dependent on suitable habitats and show great site fidelity (Nordberg et al. 2021). However, at sites with low prey availability, especially when competition and human pressure are also high, many herpetofaunal species migrate to surrounding areas using ecological corridors

(Ettling et al. 2013; Sahlean et al. 2020). In addition to serving as an ecological corridor, the presence of the small river valley makes this a regional hotspot for herpetofaunal diversity (Almasieh et al. 2019) by providing optimal conditions for foraging and thermoregulation with comparatively high prey and refuge availability. Nilsson and Grelsson (1995) suggested that small areas can evolve into fragile ecosystems requiring enhanced and more comprehensive protection. In addition, the direct killing of snakes and lizards by humans in the study area is a significant concern, and the areas where deliberate killings occur overlap with those where observations were highest. The higher number of reptilian species observed in the area likely can be attributed to the suitability of oak-dominated areas, in contrast to dense coniferous forests, to support rodent populations (Villalobos et al. 2023).

Table 1. Amphibian and reptilian taxa encountered within and around Değirmenboğazi Nature Park, Balıkesir Province, Turkey, along with their conservation status according to the IUCN Red List (IUCN 2025), the Bern Convention (Council of Europe 2025), and the CITES Appendices (CITES 2025). The taxon column is presented at the subspecies level, whereas the other columns are organized at the species level.

Taxon	Observed Stations	IUCN	BERN	CITES
Amphibia: Caudata: Salamandridae				
<i>Lissotriton schmidtleri</i> (Raxworthy 1988) (Turkish Smooth Newt)	16, 22	LC	III	Not Listed
Amphibia: Anura: Bufonidae				
<i>Bufo bufo</i> (Linnaeus 1758) (Common Toad)	1, 4, 7, 17	LC	III	Not Listed
<i>Bufo viridis sitibundus</i> Pallas 1971 (Variable Green Toad)	7, 11	LC	II	Not Listed
Amphibia: Anura: Ranidae				
<i>Pelophylax cf. bedriagae</i> (Camerano 1882) (Anatolian Waterfrog)	4, 7, 8, 12, 16, 27, 28, 41	LC	III	Not Listed
Reptilia: Testudines: Emydidae				
<i>Trachemys scripta elegans</i> Wied 1838 (Red-eared Slider)	4	LC	III	Not Listed
Reptilia: Testudines: Geoemydidae				
<i>Mauremys rivulata</i> (Valenciennes 1833) (Western Caspian Turtle)	4, 8, 16, 22, 23	LC	II	Not Listed
Reptilia: Testudines: Testudinidae				
<i>Testudo graeca ibera</i> Pallas 1811 (Iberian Greek Tortoise)	31, 36, 41	VU	II	II
Reptilia: Squamata (lizards): Agamidae				
<i>Laudakia stellio daani</i> (Beutler and Frör 1980) (Daan's Starred Agama)	27, 28	LC	II	Not Listed
Reptilia: Squamata (lizards): Anguillidae				
<i>Pseudopus apodus thracicus</i> (Pallas 1775) (Thracian Glass Lizard)	31, 36, 38, 42	LC	II	Not Listed
Reptilia: Squamata (lizards): Scincidae				
<i>Ablepharus kitaibellii</i> ssp. (Bibron and Bory St.-Vincent 1833) (European Snake-eyed Skink)	26, 36, 42	LC	II	Not Listed
<i>Heremites auratus</i> (Linnaeus 1758) (Golden Grass Mabuya)	31, 36, 37, 38, 42, 43	LC	III	Not Listed
Reptilia: Squamata (lizards): Lacertidae				
<i>Lacerta diplochondroides cf. cariensis</i> Peters 1964 (Carian Giant Emerald Lizard)	4, 7, 8, 13, 16, 23, 28, 29, 34, 41, 42	LC	III	Not Listed
<i>Ophisops elegans macrodactylus</i> Berthold 1840 (Elegant-eyed Skink)	15, 34, 39	LC	II	Not Listed
Reptilia: Squamata (snakes): Boidae				
<i>Eryx jaculus turcicus</i> (Olivier 1801) (Turkish Sand Boa)	27, 28, 42	LC	III	II

(continued)

(Table 1 continued)

Reptilia: Squamata (snakes): Colubridae					
<i>Dolichophis caspius</i> (Gmelin 1789) (Caspian Whipsnake)	31, 34, 41	LC	III	Not Listed	
<i>Eirenis modestus semimaculatus</i> (Böttger 1876) (Modest Sand Racer)	15, 28, 31, 36, 34, 38, 42	LC	III	Not Listed	
<i>Elaphe sauromates</i> (Pallas 1811) (Eastern Four-lined Ratsnake)	36, 41, 42	LC	III	Not Listed	
<i>Platyiceps collaris rubriceps</i> Venzmer 1919 (Red-headed Sand Racer)	42	LC	III	Not Listed	
<i>Platyiceps najadum dahlui</i> (Fitzinger 1826) (Dahl's Sand Racer)	28, 31	LC	II	Not Listed	
<i>Telescopus fallax fallax</i> (Fleischmann 1831) (Mediterranean Catsnake)	13, 42	LC	II	Not Listed	
Reptilia: Squamata (snakes): Natricidae					
<i>Natrix natrix moreotica</i> (Bedriaga 1882) (Morea Watersnake)	4, 16, 17	LC	III	Not Listed	
<i>Natrix tessellata</i> (Laurenti 1768) (Dice Snake)	2, 4, 5, 12, 22	LC	II	Not Listed	
Reptilia: Squamata (snakes): Psammophiidae					
<i>Malpolon insignitus fuscus</i> (Fleischmann 1831) (Eastern Montpellier Snake)	37	LC	III	Not Listed	
Reptilia: Squamata (snakes): Typhlopidae					
<i>Xerotyphlops vermicularis</i> (Merrem 1820) (Eurasian Blindsnake)	38, 41, 43	LC	III	Not Listed	
Reptilia: Squamata (snakes): Viperidae					
<i>Montivipera xanthina xanthina</i> (Gray 1849) (Ottoman Viper)	13, 28, 31, 34, 37, 38, 42	LC	II	Not Listed	

Table 2. Monthly observations of each species encountered within and around Değirmenboğazı Nature Park, Balıkesir Province, Turkey.

Species	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	TOTAL
<i>Lissotriton schmidtleri</i>	18	8	4	0	0	0	0	0	0	4	34
<i>Bufo bufo</i>	20	28	16	4	0	0	0	0	0	4	72
<i>Bufo viridis</i>	24	32	22	4	0	0	0	0	0	4	86
<i>Pelophylax cf. bedriagae</i>	32	158	121	60	40	32	24	16	24	32	539
<i>Trachemys scripta</i>	2	6	8	8	6	4	4	3	2	0	43
<i>Mauremys rivulata</i>	8	32	85	84	60	38	28	29	45	24	433
<i>Testudo graeca</i>	12	28	32	28	14	0	0	0	12	12	138
<i>Laudakia stellio</i>	6	12	28	32	34	31	11	10	8	8	180
<i>Pseudopus apodus</i>	12	48	42	15	2	0	0	0	0	4	123
<i>Ablepharus kitaibelii</i>	9	18	33	35	18	15	7	5	9	7	156
<i>Heremites auratus</i>	10	22	31	33	16	14	5	7	12	12	162
<i>Lacerta diplochondrodes</i>	10	24	33	45	19	14	5	7	12	12	181

(continued)

(Table 2 continued)

<i>Ophisops elegans</i>	8	24	33	28	15	16	6	8	12	10	160
<i>Eryx jaculus</i>	0	0	2	11	7	0	0	0	0	0	20
<i>Dolichophis caspius</i>	4	12	17	38	14	4	3	7	11	10	120
<i>Eirenis modestus</i>	12	50	61	38	7	0	0	0	0	4	172
<i>Elaphe sauromates</i>	0	8	12	15	11	2	0	0	4	2	54
<i>Platyceps collaris</i>	0	0	4	4	2	0	0	0	0	0	10
<i>Platyceps najadum</i>	0	4	6	16	12	3	0	0	2	2	45
<i>Telescopus fallax</i>	4	5	11	13	12	4	0	0	2	1	52
<i>Natrix natrix</i>	12	14	13	18	12	2	0	0	4	1	76
<i>Natrix tessellata</i>	13	16	15	18	10	4	0	0	4	3	83
<i>Malpolon insignitus</i>	0	0	4	2	0	0	0	0	0	0	6
<i>Xerotyphlops vermicularis</i>	0	0	12	24	19	4	0	0	0	0	59
<i>Montivipera xanthina</i>	8	29	35	62	41	14	0	4	17	15	225
TOTAL	224	578	680	635	371	201	93	96	180	171	3229

Table 3. Annual observations of each species encountered within and around Değirmenboğazı Nature Park, Balıkesir Province, Turkey.

Species	2015	2016	2017	Total
<i>Lissotriton schmidtleri</i>	16	14	4	34
<i>Bufo bufo</i>	26	28	18	72
<i>Bufo viridis</i>	34	26	26	86
<i>Pelodytes cf. bedriagae</i>	154	225	160	539
<i>Trachemys scripta</i>	5	18	20	43
<i>Mauremys rivulata</i>	178	99	156	433
<i>Testudo graeca</i>	41	28	69	138
<i>Laudakia stellio</i>	51	69	60	180
<i>Pseudopus apodus</i>	72	41	10	123
<i>Ablepharus kitaibelii</i>	41	62	53	156
<i>Heremites auratus</i>	48	62	52	162
<i>Lacerta diplochondrodes</i>	61	50	70	181
<i>Ophisops elegans</i>	58	64	38	160
<i>Eryx jaculus</i>	2	11	7	20
<i>Dolichophis caspius</i>	21	47	52	120
<i>Eirenis modestus</i>	71	61	40	172
<i>Elaphe sauromates</i>	28	17	9	54
<i>Platyceps collaris</i>	4	5	1	10
<i>Platyceps najadum</i>	24	18	3	45
<i>Telescopus fallax</i>	22	18	12	52
<i>Natrix natrix</i>	40	22	14	76
<i>Natrix tessellata</i>	51	27	5	83
<i>Malpolon insignitus</i>	0	4	2	6
<i>Xerotyphlops vermicularis</i>	19	21	19	59
<i>Montivipera xanthina</i>	58	75	92	225
TOTAL	1125	1112	992	3229

Additionally, the oak-dominated areas in the region feature more forest openings than the coniferous forests, providing greater sunlight exposure, which likely enhances their capacity to support a higher abundance of orthopterans. Since orthopterans and rodents are highly preferred food sources of many reptilian species, these habitat characteristics almost certainly contribute to the high reptilian diversity (Agrjmi and Luiselli 2021; Akdağ et al. 2024).

One non-native reptilian taxon, *Trachemys scripta elegans* (Red-eared Slider), was abundant in the study area. Introduced across much of the globe due to the exotic pet trade, this species is widely reported to not only outcompete native turtles for food and basking areas but also to transmit alien pathogens (Perez-Santigosa et al. 2008; Perez-Santigosa et al. 2011; Standfuss et al. 2016). This species is particularly abundant in natural areas with permanent bodies of water used also for human recreation. We recommend monitoring the pressure exerted by *T. scripta* on local species, particularly regarding the risk of pathogen transmission.

Fifteen species of amphibians and reptiles native to Balıkesir Province were not observed in the present study. Of these, nocturnal geckos, *Hemidactylus turcicus* (Mediterranean House Gecko) and *Mediodactylus cf. danilewskii* (Mediterranean Thin-toed Gecko) are likely present in the study area. These species are often found sympatrically in suitable habitats in western Turkey but were likely overlooked in this study due to limited hours of fieldwork conducted after sunset. Two additional nocturnal species that eluded observation were *Hyla orientalis* (Eastern Treefrog) and *Pelobates syriacus* (Eastern Spadefoot Toad), both of which have stricter habitat requirements than the other anurans that were encountered (Gvoždík 2010; Stepanyan 2021). These two species generally need fishless ponds for reproduction,



Figure 4. Photographic documentation for amphibians and reptiles observed during fieldwork in and around Değirmenboğazi Nature Park, Balıkesir Province, Turkey: (A) *Lissotriton schmidleri* (Turkish Smooth Newt), (B) *Bufo bufo* (Common Toad), (C) *Bufo viridis sitibundus* (Variable Green Toad), (D) *Pelophylax cf. bedriagae* (Anatolian Waterfrog), (E) *Mauremys rivulata* (Western Caspian Turtle), (F) *Testudo graeca iberica* (Iberian Greek Tortoise), (G) *Laudakia stellio daani* (Daan's Starred Agama), (H) *Pseudopus apodus thracicus* (Thracian Glass Lizard), (I) *Ablepharus kitaibelii* (European Snake-eyed Skink), (J) *Heremites auratus* (Golden Grass Mabuya), (K) *Lacerta diplochondrodes cf. cariensis* (Carian Giant Emerald Lizard), (L) *Ophisops elegans macrodactylus* (Elegant-eyed Skink). Photographs by Burak Akdağ.

which are rare in the vicinity of Ortaca Creek. Moreover, damp meadows and areas with loose-soils, which are signature habitats of these species, were also scarce. These two anurans also have distinctive mating calls that easily reveal their presence, hence their populations are likely to be low even if they are present in the study area but avoided detection.

A second species of turtle native to Balıkesir Province, *Emys orbicularis* (European Pond Turtle), was not observed

in the study area. This species is often found sympatrically with *M. rivulata* in western Anatolia, but its populations are reported to be as much as seven times smaller than that of the latter species, primarily due to its lower tolerance to pollution (Bayrakçı et al. 2015). The invasive presence of *T. scripta* could have played a role in the extirpation of the local populations of *E. orbicularis* that would have already been threatened by anthropogenic pollution of Ortaca Creek.



Figure 4 (continued). Photographic documentation for amphibians and reptiles observed during fieldwork in and around Değirmenboğazi Nature Park, Balıkesir Province, Turkey: (M) *Eryx jaculus turcicus* (Turkish Sandboa), (N) *Dolichophis caspius* (Caspian Whipsnake), (O) *Eirenis modestus semimaculatus* (Modest Sand Racer), (P) *Elaphe sauromates* (Eastern Four-lined Ratsnake), (Q) *Platyceps collaris rubriceps* (Red-headed Sand Racer), (R) *Platyceps najadum dahlui* (Dahl's Sand Racer), (S) *Telescopus fallax fallax* (Mediterranean Catsnake), (T) *Natrix natrix moreotica* (Morea Watersnake), (U) *Natrix tessellata* (Dice Snake); (V) *Malpolon insignitus fuscus* (Eastern Montpellier Snake), (W) *Xerotyphlops vermicularis* (Eurasian Blindsnake); (X) *Montivipera xanthina xanthina* (Ottoman Viper). Photographs by Burak Akdağ and Balkan Mega.

Because our surveys included the entirety of Değirmenboğazi Nature Park as well as surrounding area where unbroken stretches of suitable habitats existed, we were astounded by the overwhelming abundance of herpetofauna outside the currently designated boundaries of the park. Furthermore, the park, a microcosm of the Anatolian Conifer and Deciduous Mixed Forests ecoregion, suffers from urban sprawl, anthropogenic pollution, and unsustainable agricultural

practices. Consequently, the area is an ideal candidate for local conservation work, given that such efforts likely would provide rapid and visible positive results that could serve as a model for the development and implementation of better conservation strategies on a regional level. Specifically for the conservation of the park's herpetofaunal diversity, aside from a boundary extension, the activity, ecology, and population dynamics of local amphibian and reptilian species should be further investigated.

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