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An assessment of the herpetofauna of the Oriental Sweetgum forests in southwestern Anatolia, Turkey

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Abstract

An assessment of the herpetofauna of the Oriental Sweetgum forests in southwestern Anatolia, Turkey. Oriental Sweetgum (*Liquidambar orientalis*) is a threatened tree species restricted to Rhodes Island (Greece) and southern Anatolia (Turkey), best known for its rare riparian forests. These small patches of forests are severely fragmented and scattered, and are rarely found in southwestern Turkey. Based on field sampling and data compilation, we performed an assessment of the herpetofauna in these forests in southwestern Turkey during the spring of 2019 and 2021. Sampling was carried out using a line-transect method in 13 forests with various habitats, resulting in data at the community and population levels. Sixteen families, including 26 amphibian and reptile species (four anurans, four turtles, nine lizards, and nine snakes), were recorded from these unique forests, based on 1440 individuals. Twenty-two species were recorded for the first time from these forests; in addition, *Emys orbicularis* and *Elaphe sauromates* were recorded for the first time from the region. Richness in the forest patches, habitat use by the recorded species, and interspecific interactions are discussed to explain the conspicuous patterns observed in the species distributions. The unique distribution pattern of *Phoenicolacerta laevis* among the existing forest patches represents the most prominent finding, with implications for a recent introduction. The fossorial species *Xerotyphlops vermicularis, Blanus strauchi,* and *Eryx jaculus* are unlikely to occur in the Oriental Sweetgum forest due to annual flooding. The data obtained during this study will be transferred to the Oriental Sweetgum forest conservation action plan (2019–2024) as part of the biodiversity monitoring tools for use in the long-term conservation of these forests.

Keywords: Amphibians, *Liquidambar orientalis*, Reptiles, Riparian forests.

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Resumo

Uma avaliação da herpetofauna das florestas orientais de "Sweetgum" no sudoeste da Anatólia, Turquia. O "Oriental Sweetgum" (*Liquidambar orientalis*) é uma espécie de árvore ameaçada, restrita à Ilha de Rodes (Grécia) e ao sul da Anatólia (Turquia), mais conhecida por suas raras florestas ripárias. Essas pequenas manchas de floresta são severamente fragmentadas e dispersas e raramente são encontradas no sudoeste da Turquia. Com base em amostragem de campo e compilação de dados, fizemos uma avaliação da herpetofauna nessas florestas no sudoeste da Turquia durante a primavera de 2019 e 2021. A amostragem foi realizada pelo método de transecto de linha em 13 florestas com vários habitats, resultando em dados nos níveis de comunidade e população. Dezesseis famílias, incluindo 26 espécies de anfíbios e répteis (quatro anuros, quatro tartarugas, nove lagartos e nove serpentes), foram registradas nessas florestas únicas, com base em 1440 indivíduos. Vinte e duas espécies foram registradas pela primeira vez nessas florestas; além disso, *Emys orbicularis* e *Elaphe sauromates* foram registradas pela primeira vez na região. A riqueza nas manchas florestais, o uso do habitat pelas espécies registradas e as interações interespecíficas são discutidas para explicar os padrões conspícuos observados nas distribuições das espécies. O padrão único de distribuição da *Phoenicolacerta laevis* entre os fragmentos florestais existentes representa a descoberta mais proeminente, com implicações para uma introdução recente. É improvável que as espécies fossórias *Xerotyphlops vermicularis, Blanus strauchi* e *Eryx jaculus* ocorram nesse tipo florestal devido à inundação anual. Os dados obtidos durante este estudo serão usados no plano de ação de conservação da floresta "Oriental Sweetgum" (2019-2024) como parte das ferramentas de monitoramento da biodiversidade para uso na conservação dessas florestas a longo prazo.

Palavras-chave: Anfíbios, Florestas ripárias, *Liquidambar orientalis*, Répteis.

Introduction

The tertiary relict Oriental Sweetgum (*Liquidambar orientalis* Mill.) is an endangered endemic tree species of southwestern Anatolia (Turkey) and Rhodes Island (Greece) (Akman *et al.* 1992, Kurt 2008, Kavak and Wilson 2018). It occurs in groups in small groves or on riverbanks throughout its distribution (Ürker and Çobanoğlu 2017). These gallery forests form a unique flooded riparian forest, included in the EUNIS Habitat Classification System under "G1.39 - *Liquidambar orientalis* woods" in "G1.3 - Mediterranean riparian woodland."

The riparian forests formed by the Oriental Sweetgum occur naturally in southwestern Anatolia and partly in the nearby Rhodes Island (Greece). Often seen at low altitudes favoring rich, deep, moist soils, such as banks or marshlands (Kurt 2008, Küçükala *et al.* 2010, Caudullo *et al.* 2017), these forests are typically densely vegetated and located in coastal areas with little relief (Kaya and Alan 2003, Ürker and Yalçın 2011, Kavak and Wilson 2018). The forests are severely fragmented because of anthropogenic impacts, mainly urbanization and transformation to farmlands. Historical records indicate a land cover of 6312 ha in 1949, whereas today, approximately 2000 ha of forests remain, represented by isolated, small patches (Caudullo *et al.* 2017, Özkil *et al.* 2017). Oriental Sweetgum has been classified as Endangered (EN-A2c) on the IUCN Red List (Kavak and Wilson 2018), and EUFORGEN has listed it as protected on the European Continent (Kaya and Alan 2003).

The uniqueness and threatened situation of these forests necessitate immediate conservation actions; however, the biodiversity within these forests has been neglected until recently. The herpetofauna has been no exception; no faunistic report of amphibians or reptiles in these forests exists in the literature, although some records of the herpetofauna in the general vicinity are available Kasparek (1990) compiled records of

three amphibian and 21 reptile species from the Köyceğiz basin, particularly in the Dalyan region. Baran *et al.* (1994) and Kumlutaş *et al.* (2015) published inventories based on field surveys for the specially protected areas (SPAs) of Köyceğiz-Dalyan and Fethiye-Göcek. They reported five amphibians and 24 reptiles, and six amphibians and 20 reptiles, respectively. Ilgaz *et al.* (2016) found *Bufotes sitibundus* (Pallas, 1771), *Phoenicolacerta laevis* (Gray, 1838), and *Ophisops elegans* Ménétries, 1832 in a sweetgum forest patch in Dalaman. To our knowledge, no other publications refer to these forests or to the region.

Herein, we summarize our findings based on field studies and data compilation, focusing on the herpetofauna of Oriental Sweetgum forests and associated habitats at the community and population levels.

Materials and Methods

Oriental Sweetgum forests show remarkably variable habitat diversity based on the areal size, isolation, fragmentation, and nature of origin (Ürker and İlemin 2019, Ürker and Benzeyen 2020) as summarized in Appendix I. This study has been carried out by collecting or compiling data from 13 major Oriental Sweetgum forest patches in Muğla Province on the southwestern Anatolian coast of Turkey (Appendix I, Figures 1 and 2).

Data collection was carried out by a line-transect method using hypothetical straight lines that ran through the core or peripheral regions of each forest patch. In large and intact patches, transects were selected to sample the core regions at least 50 m away from the forest border at the closest point, whereas in small and fragmented patches, we did not implement this rule. In addition, ecotones between forests and the associated biotopes were sampled by peripheral transects, selected 10 to 20 m from the border, outside the forests. Associated biotopes were citrus and pomegranate orchards or grassland, all characterized by a more open

Figure 1. Some views of the Oriental Sweetgum forests. (**A**) Karabatak, (**B**) Hisarönü, and (**C**) Kızılyaka.

Figure 2. Map of the study area: (**A**) Turkey in the world map (©Worldmap 2022); (**B**) Native and isolated populations of the Oriental Sweetgum forests (Caudullo *et al.* 2017); (**C**) Study locations denoted with red pins (Google Earth 2022).

canopy or a lower vegetation height than the Oriental Sweetgum forests. Two separate techniques were used across the transects: pitfall trap surveys were conducted, or one observer proceeded by walking and recording observed specimens.

Sampling with pitfall traps was conducted in the five larger forest patches (>100 ha in surface area), namely Dalaman, Kavakarası, Karabatak, Toparlar, and Kızılyaka. Twelve to 15 cylindrical plastic container (dived 15 cm under surface), 9 × 12 cm^2, were deployed per transect at 10 m intervals. As a result, 255 pitfall traps were used in five forest patches between 22 April 2019 and 14 June 2019. Fifteen transects were used to sample the core, and six transects were used to sample the peripheral parts of these forests. Specimens collected were identified in the field, recorded, and set free immediately if thriving otherwise transferred to the laboratory and stored as museum specimens in the zoological collection of the Department of Biology at Erzincan Binali Yıldırım University.

Transect walks were used to sample the areas during the day (McDiarmid *et al.* 2012). All forest patches except those in Fethiye were sampled with at least one transect walk per patch on 20–26 May 2021. The identity and abundance of every herptile species observed was recorded. During transect walks, individuals fleeing or foraging were recorded by direct observation; rocks, logs, or other organic material were turned for the fossorial species as well. Transect walks were dedicated mainly to the core parts of the forests; nevertheless, forest edges were also sampled, particularly in fragmented patches. Catching, handling, or collecting for identification was not necessary and was avoided.

Another source of data input was gathering observation records from professional field personnel, mainly by photos captured in the field or records collected during routine fieldwork in these forests from various projects since 2018. All data from the Fethiye forest comes from such records.

Chorotypic classification of the species using the Oriental Sweetgum forests was used to assess the uniqueness of the fauna, based on global chorotypes defined by Vigna-Taglianti *et al.* (1999). The conservation status of herpetofaunal species is also reported based on IUCN Red List (Ver.2021.3), Annexes of CITES (UNEP-WCMC 2013), and Annexes of Bern Convention (2021; Council of Europe).

Results

Twenty-six species belonging to four orders and 16 families were recorded in the Oriental Sweetgum forests and the associated habitats, based on 1440 individuals (Table 1). The number of individuals observed in these forest patches varied (Appendix I). The species list is composed of Anura [Bufonidae (2 spp.), Ranidae (1), Hylidae (1)], Testudines [Geoemydidae (1), Emydidae (1), Testudinata (1), Trionychidae (1)], Sauria [Gekkonidae (1), Agamidae (1), Chamaeleonidae (1), Lacertidae (4), Anguidae (1), Scincidae (1)], and Serpentes [Colubridae (6), Natricidae (2), Viperidae (1)] (Figure 3). Taxonomic status, conservation categories (IUCN, Bern, and CITES), and global chorotypes are given in Table 1. The dominant anuran species observed in the Oriental Sweetgum forests was the Water frog, *Pelophylax bedriagae* (Camerano, 1882). The Common toad, [*Bufo bufo* (Linnaeus, 1758)], the Green toad (*Bufotes sitibundus*), and the Oriental tree frog (*Hyla orientalis* Bedriaga, 1890) are three other amphibian species frequently recorded from the Oriental Sweetgum forests and associated habitats. For turtles, *Mauremys rivulata* (Valenciennes, 1833) was the most frequently and abundantly observed species, while *Trionyx triunguis* (Forskål, 1775) was represented as a singleton found dead in Kersele. *Phoenicolacerta laevis* and *Lacerta diplochondrodes* Wettstein, 1952 were two dominant, mutually exclusive lizard species with conspicuous and distinct distribution patterns in these forests. *Phoenicolacerta laevis* was represented by well-established populations in the four southeastern forests

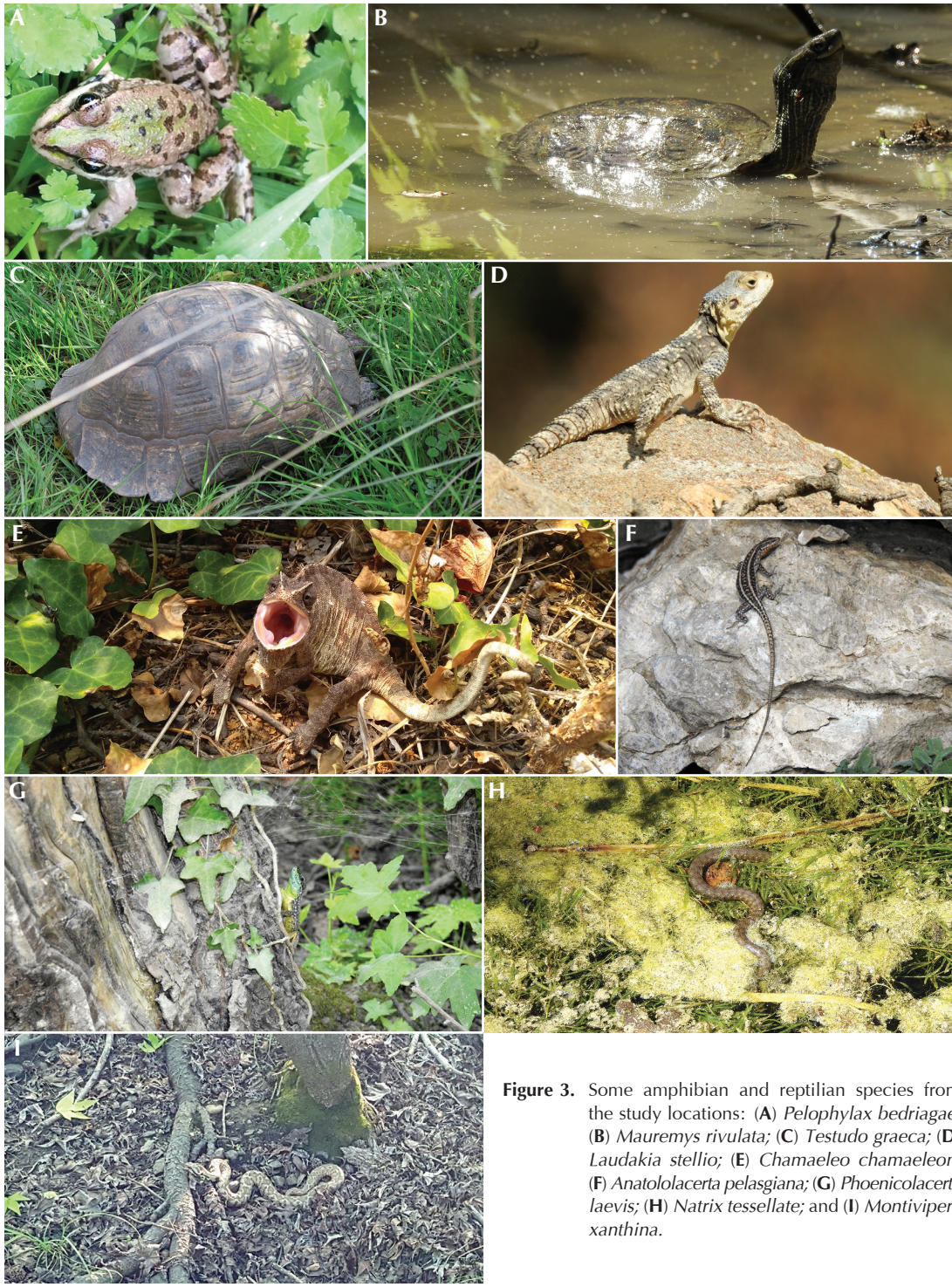

Figure 3. Some amphibian and reptilian species from the study locations: (**A**) *Pelophylax bedriagae;* (**B**) *Mauremys rivulata;* (**C**) *Testudo graeca;* (**D**) *Laudakia stellio;* (**E**) *Chamaeleo chamaeleon;* (**F**) *Anatololacerta pelasgiana;* (**G**) *Phoenicolacerta laevis;* (**H**) *Natrix tessellate;* and (**I**) *Montivipera xanthina.*

(namely the Dalaman, Kavakarası, Eskiköyceğiz, and Zeytinalanı), whereas *Lacerta diplochondrodes* showed a higher frequency with records from nine forest patches, establishing higher abundances in the northeast (in Karabatak and Toparlar). Among snakes, *Platyceps najadum* (Eichwald, 1831), *Dolichophis jugularis* (Linnaeus, 1758), *Natrix natrix* (Linnaeus, 1758), and *Natrix tessellata* (Laurenti, 1768) were the most abundant and frequently observed species, whereas the rest of the species were rarely recorded.

The abundance and species richness varied between 3–239 and 1–14, respectively. In the larger patches Dalaman, Kavakarası, Karabatak, Toparlar, and Kızılyaka, where the sampling effort was greatest, richness varied between 8–14 species (Appendix I). No endemic herptile species were found in these forests. *Emys orbicularis* (Linnaeus, 1758) was identified as "Near Threatened" while *Testudo graeca* Linnaeus, 1758 and *T. triunguis* (Forskål, 1775) were classified as "Vulnerable" in the IUCN red list. *Bufotes sitibundus, Hyla orientalis, Mauremys rivulata, Anatololacerta pelasgiana* (Mertens, 1959), and *Lacerta diplochondrodes* have not been listed yet, whereas the remaining 18 species are listed as "Least Concern." According to Bern criteria, 14 species were listed in Bern's Appendix II (as strictly protected species), and 12 species were classified in Bern's Appendix III (as protected species). *Chamaeleo chamaeleon* (Linnaeus, 1758), *T. graeca,* and *T. triunguis* were listed in CITES' Appendix II, whereas the rest of the species were not listed.

The herpetofauna from the Oriental Sweetgum forests belong to nine global chorotypes (Table 1). The dominant global chorotypes are Turano-Mediterranean (eight species, 31%) and East Mediterranean (seven species, 26%). Turano-Europeo-Mediterranean is represented by three species (11%); both Southwest Asiatic and Mediterranean were represented by two species (8%). Single (4%) species global chorotypes for the study area were listed as European, Europeo-Mediterranean, Centralasiatic-European, and Centralasiatic-Europeo-Mediterranean.

Discussion

Prior to our work, no comprehensive study had focused on the Oriental Sweetgum forests. The pioneering authors Kasparek (1990) and Baran *et al.* (1994) studied Köyceğiz and Dalyan, and Kumlutaş *et al.* (2015) focused on the Fethiye region. Given that Köyceğiz, Dalyan, and Fethiye include the majority of the remaining sweetgum forest patches in Anatolia, previous studies included these forests as a significant component. These authors apparently did not visit or recognize Oriental Sweetgum forests as a unique habitat, except that Baran *et al.* (1994) provided a single record of the water frog *Pelophylax bedriagae* from a forest patch near Toparlar. The contribution of Ilgaz *et al.* (2016) is the second and last record referring to this unique ecosystem, noting the lizard *P. laevis* as the most significant finding. *Pelophylax bedriagae* and *Phoenicolacerta laevis* were the two most abundant species in our inventory, so it is not surprising that they were the first recorded species from these forests.

Pelophylax bedriagae is common in swamps with vegetation throughout western Anatolia (Dufresnes 2019). The occurrence of *Phoenicolacerta laevis* is interesting because it is not common in southwestern Anatolia; this species shows a rather continuous distribution between Hatay, western Syria, and north of Israel (Bischoff and Schmidtler 1999). Other records from Anatolia are scattered throughout the Mediterranean coast, corresponding to 11 isolated populations, including this study (Karış and Göçmen 2014, Ilgaz *et al.* 2016). These populations may be remnants of recent introductions (Bischoff and Schmidtler 1999, Karış and Göçmen 2014), but there is no supporting evidence for this. Tamar *et al.* (2015) showed that the Anatolian populations of *P. laevis* are genetically indistinct, including one of the isolated populations from Turkey (Anamur). Tarkhnishvili *et al.* (2017) discovered an isolated population from Georgia at the Black Sea coast, revealing its origin as an introduction possibly

Table 1. General information on the amphibian and reptilian species found in the Oriental Sweetgum forests. Total abundance: number of recorded individuals of a species. Name of Forest: F, Fethiye; D, Dalaman; O, Okçular; KA, Kavakarası; EK, Eski Köyceğiz; Z, Zeytinalanı; KB, Karabatak; T, Toparlar; HA, Hamitköy; KE, Kersele; KI, Kızılkaya; C, Çetibeli; HI, Hisarönü.

Order/Family	Species	IUCN (Ver.2021.3)	Bern	CITES	Global Chorotype	Total Abundance	Name of Forest Patches
Anura							
Bufonidae	*Bufo bufo* (Linnaeus, 1758)	LC	III	-	European	184	F, Z, KB, T, KI
	Bufotes sitibundus (Pallas, 1771)	Not Listed	III	-	Turano-Europeo-Mediterranean	9	F, T
Ranidae	*Pelophylax bedriagae* (Camerano, 1882)	LC	III	-	Turano-Europeo-Mediterranean	586	D, KA, EK, Z, KB, T, KE, KI, C, HI
Hylidae	*Hyla orientalis* Bedriaga, 1890	Not Listed	III	-	Europeo-Mediterranean	12	Z, KB, KE, KI, HI
Testudines							
Geoemydidae	*Mauremys rivulata* (Valenciennes, 1833)	Not Listed	III	-	Turano-Mediterranean	70	KA, KB, T, KE, KI, C, HI
Emydidae	*Emys orbicularis* (Linnaeus, 1758)	NT	II	-	Turano-Europeo-Mediterranean	5	D, KB
Testudinidae	*Testudo graeca* Linnaeus, 1758	VU	II	II	Turano-Mediterranean	43	D, KA, KB, T, KE, KI, C, HI
Trionychidae	*Trionyx triunguis* (Forskål, 1775)	VU	II	II	Southwest Asiatic	1	KE
Squamata							
Agamidae	*Laudakia stellio* (Linnaeus, 1758)	LC	II	-	East Mediterranean	53	D, EK, T, C
Anguidae	*Pseudopus apodus* (Pallas, 1775)	LC	II	-	Turano-Mediterranean	2	T, HA
Chamaeleonidae	*Chamaeleo chamaeleon* (Linnaeus, 1758)	LC	II	II	Mediterranean	2	F, EK

Table 1. *Continued.*

Order/Family	Species	IUCN (Ver.2021.3)	Bern	CITES	Global Chorotype	Total Abundance	Name of Forest Patches
Gekkonidae	*Hemidactylus turcicus* (Linnaeus, 1758)	LC	III	-	Mediterranean	2	D, Z
Lacertidae	*Anatololacerta pelasgiana* (Mertens, 1959)	Not Listed	III	-	East Mediterranean	8	T, KE
	Ophisops elegans Ménétries, 1832	LC	II	-	East Mediterranean	12	KE, KI
	Phoenicolacerta laevis (Gray, 1838)	LC	III	-	East Mediterranean	302	D, KA, EK, Z
	Lacerta diplochondrodes Wettstein, 1952	Not Listed	III	-	East Mediterranean	103	D, O, KA, KB, T, HA, KI, C, HI
Scincidae	*Ablepharus kitaibelii* Bibron and Bory St.-Vincent, 1833	LC	II	-	East Mediterranean	2	KA, T
Colubridae	*Dolichophis caspius* (Gmelin, 1789)	LC	III	-	Turano-Mediterranean	2	KB, T
	Dolichophis jugularis (Linnaeus, 1758)	LC	II	-	Southwest Asiatic	6	KB, T, KE
	Platyceps najadum (Eichwald, 1831)	LC	II	-	Turano-Mediterranean	5	D, KA, EK, KE, KI
	Elaphe sauromates (Pallas, 1811)	LC	II	-	Turano-Mediterranean	1	KA
	Hemorrhois nummifer (Reuss, 1834)	LC	III	-	Turano-Mediterranean	1	KI
	Telescopus fallax Fleischmann, 1831	LC	II	-	Turano-Mediterranean	1	KA
Natricidae	*Natrix natrix* (Linnaeus, 1758)	LC	III	-	Centralasiatic-Europeo-Mediterranean	14	EK, KB, KE, C, HI
	Natrix tessellata (Laurenti, 1768)	LC	II	-	Centralasiatic-European	10	F, KA, KB, T, KE, KI
Viperidae	*Montivipera xanthina* (Gray, 1949)	LC	II	-	East Mediterranean	1	HI

from Mersin, Turkey. The current literature does not explain the scattered distribution pattern on the Mediterranean coast of Turkey. Introductions due to transport by historical trading activities may explain the pattern, but more data are needed.

The distribution of *Phoenicolacerta laevis* is non-continuous within the Oriental Sweetgum forests. The forest fragment at Zeytinalanı represents the northernmost limit of this species, and the populations attain high densities in the three larger southern patches: Dalaman, Kavakarası, and Eskiköyceğiz, whereas they are absent in the northern forests. The region where this species occurs is located between two ancient trading ports, which correspond to the primary seaway connections with Egypt (Africa). The ancient port of Kaunos City, located a few kilometers west of the modern town of Dalyan, dates back to the 10th century B.C. and was one of the most important sea connections between Anatolia (and from here to Europe), Africa, the Indian Peninsula, and the Arabic Peninsula (Öğün 1971, Marek and Beck 2006, Türe 2011) (Figure 2). The relatively recent port in Sarsala is located west of the Dalaman River and was built in 1905 for grain shipment from the Dalaman and Ortaca plains to Egypt (Mikhail 1992) (Figure 2). The fact that the southern forest patches harboring *P. laevis* are located between two historically significant trading nodes might be used to confirm a historical introduction event.

Phoenicolacerta laevis is absent in the Karabatak forest, a large patch physically connected with Zeytinalanı, where the species occurs. *P. laevis* can establish high densities in these forests, possibly because it is well adapted to the riparian forest habitat. The small number of individuals recorded in Zeytinalanı might indicate that this species is barely thriving in this small, narrow, fragmented patch. A lower affinity of this lizard to peripheral habitats around the sweetgum forests is evident in the extensively sampled Kavakarası forest as well. This forest is one of the largest and most fragmented patches due to transformation to orchards, mainly citrus or pomegranate. In comparison, *P. laevis* was represented by 30 and six individuals in core and peripheral parts, respectively (Figure 4). This observation indicates a clear preference for intact forest habitat by this lizard species, partly explaining why the Zeytinalanı forest is unsuitable for dispersion and the species could not colonize the Karabatak forest.

The Green lizard *Lacerta diplochondrodes* is the most abundant lizard species in the Oriental Sweetgum forests. It is common in western Anatolia, where it is associated with dense vegetation, explaining its occurrence in these forests. However, even though it was recorded in nine of the 13 forest patches and five of the six large forests throughout the Oriental Sweetgum forests, it attained the highest abundances in the forests around the Köyceğiz city center, namely in Karabatak and Toparlar. In contrast, it is rare or absent in southern patches dominated by *P. laevis,* suggesting that these two species are mutually exclusive (Figure 5). Large populations of *L. diplochondrodes* might be another factor limiting the distribution of *P. laevis* because of competitive exclusion or predation, in addition to its strict habitat preference.

Laudakia stellio (Linnaeus, 1758) is another abundant species but was mainly recorded from peripheral habitats such as large openings in the forest. Likewise, *Anatololacerta pelasgiana*, *Ophisops elegans,* and *Ablepharus kitaibelii* Bibron and Bory St.-Vincent, 1833 were recorded from the peripheral or small, fragmented habitats with edge effects. Evidently, these species rely on habitat structure different from the core sweetgum forests. The amphibian species *Bufo bufo* and *Hyla orientalis* were frequently recorded from both core and peripheral habitats, but their low abundances make it challenging to interpret their reliance on the Oriental Sweetgum forest. The infrequently recorded species *Bufotes sitibundus, Hemidactylus turcicus* (Linneaus, 1758), *Chamaeleo chamaeleon,* and *Pseudopus apodus* (Pallas, 1775) were represented mainly as singletons or doubletons in our inventory,

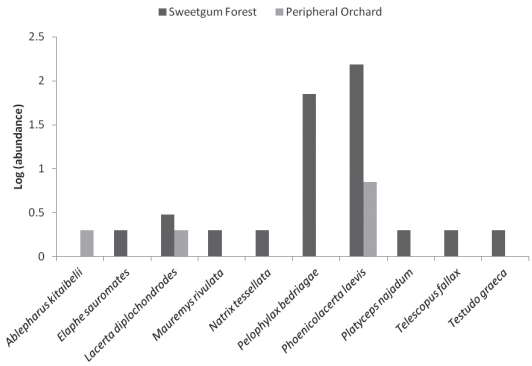

Figure 4. Log transformed abundances measured in the Oriental Sweetgum forest patch and the peripheral habitats from Kavakarası.

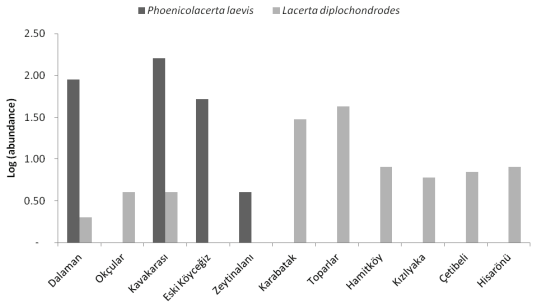

Figure 5. Log transformed abundances measured in the Oriental Sweetgum forest patches for *Phoenicolacerta laevis* and *Lacerta diplochondrodes;* forests sorted in the south to north direction.

implying that their occurrences are coincidental in the sweetgum forests.

Snakes are the most secretive group among herptiles, making it much more challenging to interpret their ecology or the number of species during our study. Our inventory is biased toward diurnal and conspicuous species, whereas nocturnal species such as geckos or cryptic species such as snakes are likely not well represented. *Platyceps najadum, Dolichophis jugularis* (Linnaesu, 1758), *Dolichophis caspius* (Gmelin, 1789), *Natrix tessellata,* and *N. natrix* are well represented in our inventory, indicating their preference for the Oriental Sweetgum forests and possibly explained by the high abundances of prey and availability of suitable habitat. The occurrence of *P. najadum* and *D. jugularis* in a densely vegetated riparian forest habitat is unusual, considering the preference of these species for dry, rocky habitats with low vegetation (Geniez 2018). The availability of lizard prey in high abundances, including *P. laevis* and *L. diplochondrodes,* might explain this phenomenon. The rest of the species were rarely represented in the inventory, indicating the necessity of further sampling.

Among turtles, *Mauremys rivulata* and *Testudo graeca* were the most common species inhabiting aquatic and terrestrial microhabitats in the forests, respectively. *E. orbicularis* appeared as a rare species in our inventory, with records from two of the larger forest patches in Dalaman and Karabatak. Our record of *Trionyx triunguis* is based on an individual found dead in the Kersele forest patch, located at the shore of the lake Köyceğiz. Some of the coastal forest patches, namely Kersele and Karabatak, are flooded annually by the lake during the rainy seasons. The soft-shelled turtle *T. triunguis* is a common species in the lake, but it is unknown whether or how it uses the Oriental Sweetgum forest during the submerged or terrestrial periods.

The dataset we produced enabled comparisons with historical records from the study area. Ilgaz *et al.* (2016) recorded *Bufotes sitibundus* and *Ophisops elegans* as sympatric species with *P. laevis,* referencing the Oriental Sweetgum forest. The abundance of these two species throughout the Mediterranean coast confirms this record. Our data suggest that those records must be either coincidental or due to sampling in peripheral habitats. Our data from the Dalaman forests contained neither of the species in natural forest or in land recently converted into forest, and even if they occurred elsewhere, they were not associated with the Oriental Sweetgum forest, as explained above. We disagree with the emphasis on sympatry in Ilgaz *et al.* (2016). Some other herptile species previously recorded from the region were not found in our inventory.

The fossorial species *Xerotyphlops vermicularis* (Merrem, 1820), *Blanus strauchi* (Bedriaga, 1884), and *Eryx jaculus* (Linnaeus, 1758) are unlikely to occur in the Oriental Sweetgum forest biotope because of annual flooding. *Lyciasalamandra fazilae* (Başoğlu and Atatür, 1974) is another species recorded in the vicinity of dense forests, but our efforts to observe this species in the sweetgum forests were fruitless. These forests do not resemble the typical *Lyciasalamandra* habitat structure because they lack rocky limestone outcrops. Similarly, *Pelobates syriacus* Boettger, 1889, a species that depends on sandy or muddy clay soils with little vegetation, was not recorded from the densely vegetated Oriental Sweetgum forest biotope. The dense vegetation structure of these forests probably acts as a filter for basking reptile species such as *Heremites auratus* (Linnaeus, 1758) and other lizard species that seem to prefer peripheral habitats. For snakes, it is impossible to presume that the species list is complete with so few records; we strongly encourage new projects that sample snakes in this habitat. Finally, we recorded *Emys orbicularis* and *Elaphe sauromates* (Pallas, 1811) for the first time from the region.

We also compared the five large patches sampled by pitfall traps and transect walks. The highest richness (14) was observed in Toparlar, probably because of a considerable amount of non-forested biotopes, which yielded records of species that prefer peripheral habitats. Kavakarası forest had similar habitat but had fewer species (10); this area lacked two toad and two lizard species found in Toparlar. Large intact patches from Dalaman, Karabatak, and Kızılyaka had similar richness with similar composition regardless of whether they consisted of plantations or natural forest. They differed from the fragmented patches mentioned above mainly due to the exclusion of species that prefer peripheral habitats.

The data obtained in this study will be transferred to the Oriental Sweetgum forests conservation action plan (2019–2024) and will be used as practical biodiversity monitoring tools for the long-term conservation of these forests. Due to the annual flooding of the Oriental Sweetgum forests, conservation of this habitat is crucial for hydrophilic reptiles and amphibians such as *Emys orbicularis, Mauremys rivulata, Natrix natrix, N. tessellata, Bufo bufo* and *Bufotes sitibundus.* Finally, the origin of *Phoenicolacerta laevis* in the Oriental Sweetgum forests should be investigated to determine whether it is a relict of a historical retraction or an invader originating from a recent introduction.

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Appendix I. *Study locations and their habitats.*

Locations	Habitat isolation	Habitat fragmentation (fragmentation rate)	Size (ha) and origin	UTM 35 S		Species Richness	Total Abundance
				East	North		
1. Fethiye	Semi-isolated; connection with the sea; moderate interruption with the settlements, agricultural areas, roads, etc	Low fragmented (10–40%)	Riparian forest patch (100–200 ha); converge with a large water body such as a sea; with many permanent water supplies.	684915	4061839	4	4
2. Dalaman	Isolated; no connection with the sea, lake or forest; high interruption with the settlements, agricultural areas, roads, etc.	Non-fragmented (0–10%)	Plantation (100–200 ha); semi-natural, semi-artificial habitat reclaimed by means of intensive planting of sweetgum saplings, following significant degradation.	660955	4073572	8	150
3. Okçular	Isolated; no connection with the sea, lake or forest; high interruption with the settlements, agricultural areas, roads, etc.	Low fragmented (10–40%)	Small grove areas (10–30 ha); located in a rural area with a permanent water supply.	648802	4078017	1	3
4. Kavakarası	Semi-isolated; connection with the lake and forest; moderate interruption with the settlements, agricultural areas, roads, etc.	Highly fragmented (40–100%)	Riparian forest patches (> 200 ha); converge with a large water body such as a lake; with many permanent water supplies.	652364	4085155	10	239
5. Eski Köyceğiz	Semi-isolated; connection with the lake; moderate interruption with the settlements, agricultural areas, roads, etc.	Non-fragmented (0–10%)	Small grove area (10–30 ha); located in a bay and a rural area; with or without a permanent water supply.	654084	4088965	6	92
6. Zeytinalanı	Semi-isolated; connection with the lake; moderate interruption with the settlements, agricultural areas, roads, etc.	Non-fragmented (0–10%)	Small grove area (10–30 ha); located in a bay and a rural area; with or without a permanent water supply.	654045	4090386	6	6
7. Karabatak (Köyceğiz)	Semi-isolated; connection with the lake; moderate interruption with the settlements, agricultural areas etc.	Low fragmented (10–40%)	Riparian forest patches (> 200 ha); converge with a large water body such as a lake; with many permanent water supplies.	651301	4091238	11	203
8. Toparlar	Semi-isolated; connection with the lake and the forest; moderate interruption with the settlements, agricultural areas, roads, etc.	Highly fragmented (40–100%)	Riparian forest patches (> 200 ha); converge with a large water body such as a lake; with many permanent water supplies.	648141	4093443	14	177

Appendix I. *Continued.*

Locations	Habitat isolation	Habitat fragmentation (fragmentation rate)	Size (ha) and origin	UTM 35 S		Species Richness	Total Abundance
				East	North		
9. Hamitköy	Isolated; no connection with the sea, lake or forest; high interruption with the settlements, agricultural areas, roads, etc.	Non-fragmented (0–10%)	Small grove (10–30 ha); inside a rural area	643427	4090668	2	8
10. Kersele	Non-isolated; connection with the lake and the forest; no interruption with the settlements, agricultural areas, roads, etc.	Non-fragmented (0–10%)	Small grove areas (10–30 ha); located in a bay; with a permanent water supply.	642422	4085661	11	140
11. Kızılyaka	Semi-isolated; connection with the forest; moderate interruption with the agricultural areas, roads, etc.	Low fragmented (10–40%)	Plantation area (> 200 ha); semi-natural, semi-artificial habitat reclaimed by means of intensive planting of sweetgum saplings	629704	4096772	10	208
12. Çetibeli	Semi-isolated; connection with the sea and forest; moderate interruption with the settlements, agricultural areas, roads, etc.	Low fragmented (10–40%)	Small grove area (10–30 ha); located in a rural area with a permanent water supply.	614241	4092415	6	37
13. Hisarönü	Semi-isolated; connection with the sea and forest; moderate interruption with the agricultural areas, roads, etc.	Low fragmented (10–40%)	Small grove area (10–30 ha); located in a rural area with a permanent water supply.	602184	4077347	7	173