

Species Conservation Action Plan for *Varanus griseus* (Daudin, 1803) Distributed in Southeastern Anatolia

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ABSTRACT

Desert Monitor, *Varanus griseus* (Daudin, 1803), has limited distribution in Turkey and is poorly studied. In this study, the current status of the species and potential threats were documented and required conservation measures were defined. In this project, 24 days of field study was conducted in 2019 (between May and July) to collect information about the distribution, habitat preference, behavior, life cycle, and population status of the species. In addition, potential threats to the species were investigated by interviewing the local people. As a result of the field studies and the current literature data, the species was found in 16 new localities among 348–888 altitudes in Turkey. As a result of studies conducted to date and of our findings, it has been determined that the main threats to the species are habitat loss, habitat degradation and fragmentation, death by road accidents, and other human activities.

Keywords: Behavior, conservation, Desert Monitor, distribution

Introduction

The members of the Varanidae family are the largest lizards living on earth. Some species have been known to exceed 2 m in length. They are widespread in Africa, Australia, and Asia. The typical feature of this family is elongated nose structure and position of nostrils which are closer to the eye rather than the tip of the nose. It is found in arid desert regions (Carranza et al., 2018; Cogălniceanu et al., 2014; Martin et al., 2017; Showler, 2018). *Varanus griseus* (Daudin, 1803) is the only member of the family distributed in Turkey (Anderson, 1999; Ilgaz et al., 2008; Mertens, 1954).

Varanus griseus is widely distributed in North Africa, India, South-West Asia, and Central Asia. It is the most widely distributed one among the monitor lizards and its distribution corresponds to the northernmost part of the genus (Aengals et al., 2018; Alshammari & Ibrahim, 2015; Al-Quran, 2009; Anderson, 1999; Fathnia et al., 2009; Nilson & Andren 1981; Padial, 2006). There are three subspecies [*V. g. griseus* (Daudin 1803), *V. g. caspius* (Eichwald 1831), and *V. g. koniecznyi* Mertens 1954] of the Desert Monitor and its zoogeographical origin is Sahar o-Turano-Sindian region (Anderson, 1999; Baig et al., 2008; Bauer et al., 2017; Bayless, 2002; Damadi et al., 2017; Escoriza et al., 2011; Jablonski et al., 2021; Khan, 2004; Mertens, 1954; Malakhov & Chirikova, 2018; Sindaco et al., 2000). According to the studies carried out to date, the Turkey population of the Desert Monitor belongs to the nominal subspecies *V. g. griseus* (Ilgaz et al., 2008; Mertens, 1954; Šmíd et al., 2014). Desert Monitor is listed as “LC” in the IUCN, listed in Appendix I of the CITES, and in Appendix III of the Bern Convention.

The research on the Desert Monitor is limited and insufficient on the Southeastern Anatolia population. It was recorded only in seven localities (Ceylanpınar, Birecik, Harran, and Viranşehir districts of Şanlıurfa province, Devegeçidi village of Diyarbakır, and Silopi district, Şırnak province) (Ilgaz et al., 2008; Sindaco et al., 2000). Although the general characteristics of the species are known, there is a lack of knowledge of its biology and ecology in Turkey.

This article aims to assist species conservation action plan prepared and implemented by the General Directorate of Nature Conservation and National Parks (GDNCNP) by presenting the evaluations of the current

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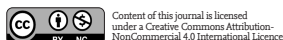
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status of the species, the threats to it, and the necessary conservation measures that should be taken for the species in Turkey.

Methods

The field study was conducted at 85 different localities (including Şanlıurfa, Adiyaman, and Şırnak provinces) with altitudes ranging from 348 to 888 m to collect information about the distribution, habitat preference, behavior, life cycle, and population status of the species for 24 days in 2019 (between May and July). During the field studies, the altitudes and coordinates of the observation areas were taken with Garmin brand GPS (Montana 650). The coordinates of the localities are preserved in the Zoology Museum of Adiyaman University (ZMADYU). For the ecological evaluations, necessary notes such as temperature, habitat structure, etc., of the species' habitats were taken during the field studies. Nikon D300s and Nikon D80 digital cameras were used to take photos of the habitats and the specimens during the field studies. The distribution area of the species was calculated with habitat modeling using geographical information systems.

The literature data, field survey observations, and interviews with the locals were used to identify the threats to the species, its habitats, and its distribution range.

Conservation Action Plan

We obtained knowledge and opinions of local people and officers about the species during the field studies and tried to confirm their validity during fieldwork. Fieldwork, interview with the local people, and literature data on species were used to form a draft of the conservation action plan (CAP). We followed the Open Standards methodology (2013, www.cmp-openstandards.org) and used threats classification (ver. 3.2) for threats and actions classification (ver. 2.0) keys. The 5-year action plan was discussed with the participation of the GDNCNP, regional administration, and non-governmental organizations.

Results

Reptile populations are particularly damaged by human-induced habitat loss, habitat fragmentation, agricultural activities, and climate change (Araújo et al., 2006; Gibbons et al., 2000; Tok et al., 2021). Some species and species groups are used as an indicator of healthy ecosystems. For example, some bird and amphibian species can be used for wetland habitat indicators, some mammal species for woodlands, and reptile species for the pastures and steppe (Carignan & Villard, 2002). Desert Monitor strictly depends on the arid climates and semi-desert habitats and can be considered as an indicator species for arid steppes/semi-desert habitats. It is stated in different studies that reptile populations are particularly damaged by human-induced habitat loss, habitat fragmentation, agricultural activities, and climate change, the growth rate of populations and the effect of human-induced threats on the population are inversely proportional (Araújo et al., 2006; Gibbons et al., 2000; Graeter et al., 2013; Maritz et al., 2016; Tok et al., 2021). People fear Desert Monitor due to its large size; therefore, it needs special conservation measures and actions for the sustainability of its population.

Morphology

Varanus griseus, the largest lizard species in Turkey, is easily distinguished by its size and its total length can exceed 1 m. It has medium-sized eyes (Figure 1). The neck is quite long in comparison to the body. The mouth has strong teeth and tongues are long and forked (Figure 1B and C). The nostrils are closer to the eye than rostrum (Figure 1C). Coloration may differ according to the habitat. The dorsum is yellowish-orange e-grey (Figure 1A). There are dark transverse stripes on the back and tail which are usually bifurcated laterally. The pattern is much more pronounced especially in juveniles and semi-adults. Patterns become indistinct in adults. The ventral part is light-colored and usually unspotted (Figure 1D). They can use their tail, which is longer than the rest of the body, like a whip and the tail is round in a cross-section. *V. g. griseus* has 6–9 crossed stripes on the back, a rounded tail in cross-section,

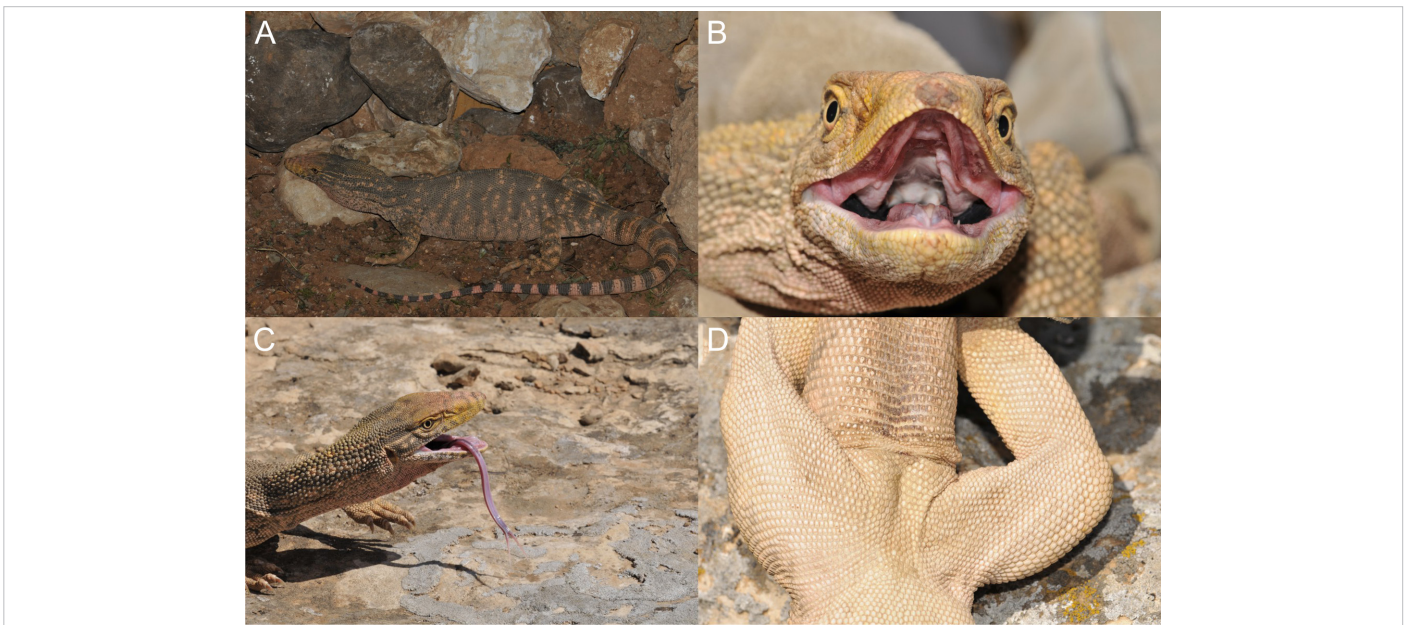


Figure 1. General Views (A), Head (B), Forked Tongue (C), and Anal Region (D) of *Varanus griseus* (Desert Monitor) (Akçakale/Şanlıurfa) *Varanus griseus* (Desert Monitor) (Akçakale/Şanlıurfa)

and 22–25 transverse stripes extending almost to the tip of the tail (Figure 1A) (Al-Sadoon et al., 2016; Anderson, 1999; Fathnia et al., 2009; Ilgaz et al., 2008; Mertens, 1954; Mohammed et al., 2015).

Habitat Characteristics

Varanus griseus was reported in seven different localities in Turkey so far (Ilgaz et al., 2008; Sindaco et al., 2000). In this study, Desert Monitor was observed in 16 new localities including semi-desert and desert habitats and the distribution area of *V. griseus* in Turkey was calculated as approximately 8267 km² (Figure 2). Two specimens were found on an average of 5 km² per locality. In addition, experts (Nedret YAKALI and Mehmet Kürşad ŞAHİN) who carried out biodiversity projects in Mardin and Diyarbakır provinces were contacted and they stated that they did not observe the Desert Monitor during their biodiversity project between 2017 and 2019.

Desert Monitor can be found in many different habitat types including desert and semi-desert habitats, stony and rocky areas, sand dunes including stony and gravel areas, near human settlements, and almost all available microhabitats such as salt marshes and salt waters

(Alshammari & Ibrahim, 2015; Anderson, 1999; Ibrahim, 2002; Ilgaz et al., 2008; Jablonski et al., 2021; Malakhov & Chirikova, 2018; Martin et al., 2017; Šmíd et al., 2014). They prefer desert and semi-desert habitats in Turkey (Figure 3A and B). They can also hide in crevices, cavities, and fissures of rocks (Figure 3C). Two specimens were observed inside cisterns in the Viranşehir district. The Desert Monitor burrows into the ground by carving a flat-domed cavity large enough to penetrate by using its very powerful claws. The entrance of the cavity can vary between 65 mm and 225 mm in males and 50 mm and 180 mm in females (Figure 3D) (Ibrahim, 2002).

Activity, Phenology, and Feeding

The activity of *V. griseus* is highly dependent on ambient temperature, sunlight, and prey availability. Desert Monitors can keep their body temperature above the surrounding temperature by means of their metabolism and this ability provides them protection against cold temperatures during winter (Malakhov & Chirikova, 2018). They are more active in May and June before the summer heat reaches its peak in Southeast Anatolia. Some studies state that the species is more active between 09:00 am and 10:00 a.m. and less active between the hours

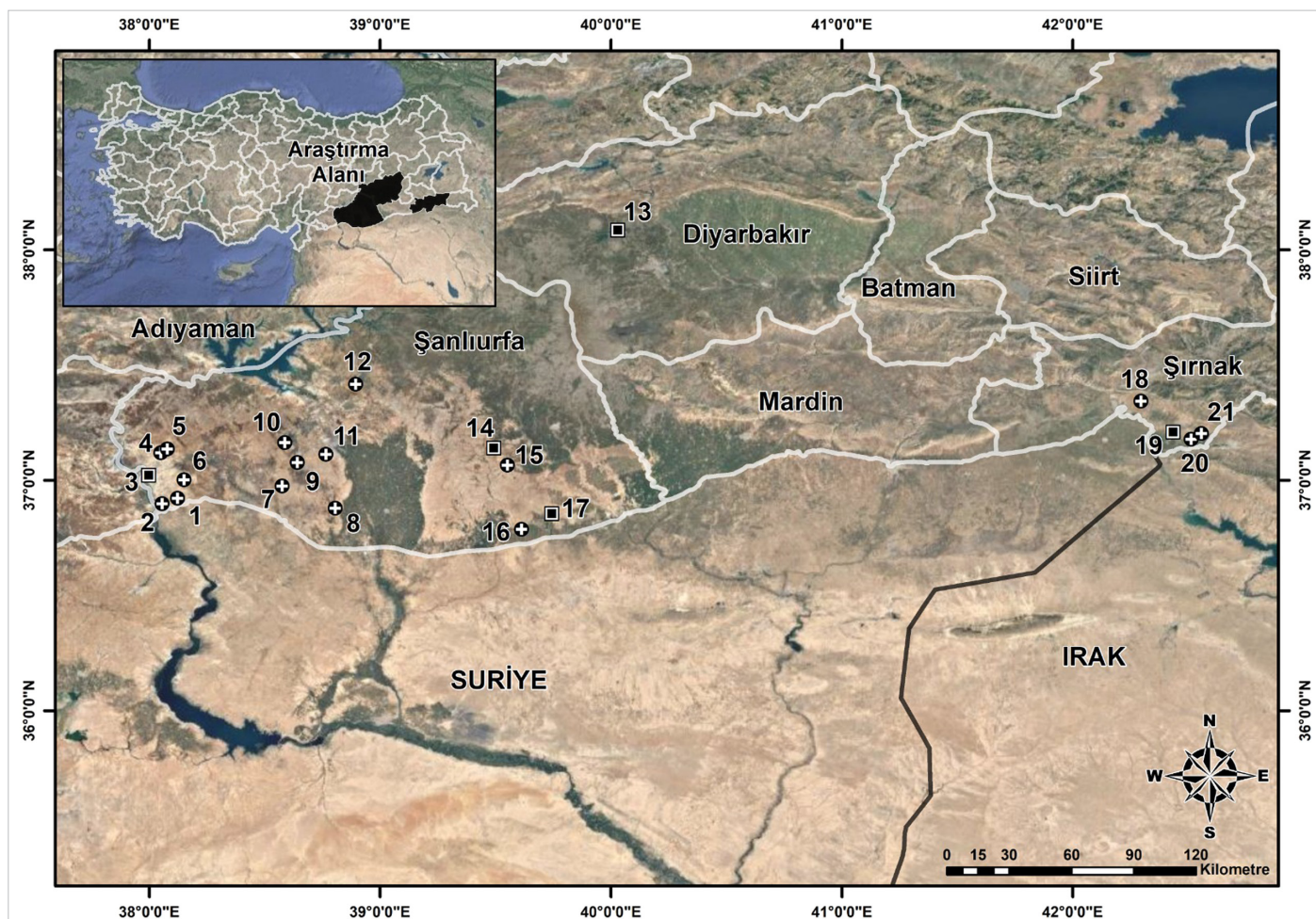


Figure 2.

Localities where the species was determined (Square: Literature, Round: Fieldwork) (1: Göktepe/Birecik, Şanlıurfa 2: Çiçekalan/Birecik, Şanlıurfa 3: Birecik, Şanlıurfa (Sindaco et al. 2000) 4–5: Akpınar/Birecik, Şanlıurfa 6: Mengelli/Birecik, Şanlıurfa 7: Yolbilir/Şanlıurfa, 8: Yedi yol/Akçakale, Şanlıurfa 9: Koçören/Şanlıurfa, 10: Kızılburç/Şanlıurfa, 11: Şahinler/Şanlıurfa, 12: Ağzhan/Şanlıurfa, 13: Devegeçidi/Diyarbakır (Sindaco et al. 2000), 14: Başaran/Viranşehir (Ilgaz et al. 2008), Şanlıurfa 15: Binekli/Viranşehir, Şanlıurfa 16–17: Ceylanpınar, Şanlıurfa (Ilgaz et al. 2008) 18: Bozalan/Cizre, Şırnak 19: Kavallı/Silopi, Şırnak (Ilgaz et al. 2008) 20: Aktepe/Silopi, Şırnak; 21: Başverimli/Silopi, Şırnak).

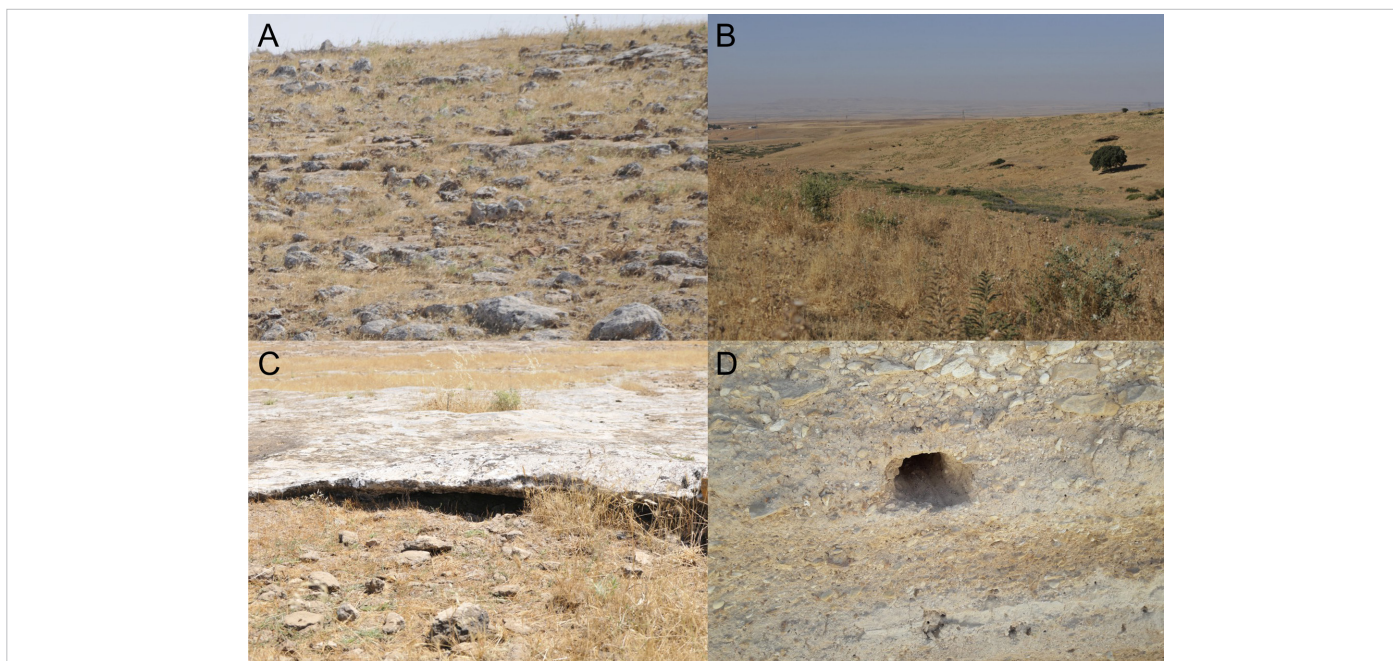


Figure 3. Views From Different Habitats Where the Species Was Observed (A) Viranşehir, Şanlıurfa; (B) Bozalan, Şırnak; (C) Viranşehir, Şanlıurfa; (D) Birecik, Şanlıurfa.

07:00 and 08:00 a.m. in the daytime (Ibrahim, 2002; Ilgaz et al., 2008; Mertens, 1954; Mohammed et al., 2015; Stanner, 2004). As a result of interviews with locals, they are rarely seen before 07:00 am and after 07:30 pm in the summer. The results are compatible with the literature. The hibernation period of Desert Monitor is thought to be between October and March in Turkey.

Desert Monitor is a carnivore. They usually eat their prey by tearing it apart. Adults can feed on all kinds of carrion. Small mammals, birds, frogs, lizards, snakes, and their eggs are their main food. Young individuals are fed with grasshoppers and spiders. It is seen that they frequently eat individuals of their own kind so they are cannibals. It is known that male Desert Monitors generally have a larger home range than females while females generally do not leave much of the nest area. For this reason, it is seen that male individuals use a larger area for feeding (Ibrahim,



Figure 4. Feeding Behavior of *Varanus griseus* from Ortaköy Village (Silopi, Şırnak) (Photo: M. Yılmaz).

Table 1. The Major Threats for the Desert Monitor

Major Threats	Reasons	Threat Level
Agriculture and Aquaculture		
Livestock Farming and Ranching	Intense grazing activities cause both the removal of Desert Monitor from the area and the destruction of habitats that they need to feed, nest, breed, hibernate, etc	High
Energy Production and Mining		
Mining and Quarrying	The activity of mining and quarrying threatens the habitat of the species	High
Biological Resource Use		
Hunting and Collecting Terrestrial Animals	Deliberate or accidental killing by locals, illegal collection, scientific collection	High
Natural System Modifications		
Fire and Fire Suppression	Stubble burning, a method of local people obtaining fresh grass for domestic livestock	High
Other Ecosystem Modifications	The habitat of the species is narrowing day by day	High
Pollution		
Agricultural and Forestry Effluents	The habitat of the species is polluted due to the pesticides used in agriculture	High
Climate Change		
Changes in Temperature Regimes	Potentially affecting the phenology and distribution of species	Unknown
Changes in Precipitation and Hydrological Regimes	Potentially affecting the phenology and distribution of species	Unknown

2002; Ilgaz et al., 2008; Malakhov & Chirikova, 2018; Stanner, 2004; Tsellarius et al., 1997). Desert Monitors are rarely observed in nature due to their ability to move fast (Al-Quran, 2009; Ibrahim, 2002). In this study, not much information could be obtained about their feeding but a photo obtained from the locals shows that Desert Monitor preyed on a snake, *Malpolon insignitus* (Figure 4).

When the Desert Monitor was scared, hissing, tilting its head, and using the tail like a whip as a defensive behavior were observed. They do not bite unless they are captured. They can cause deep wounds with their long and sharp teeth.

The breeding period can last from April to the beginning of June. They lay the eggs in pits they dig in the soil during the breeding period. A female can lay between 10 and 25 eggs. The soil temperature during spawning ranges from 25.5°C to 32.5°C. The hatching ends up in September (Earley et al., 2002; Stanner 2004).

Some researchers (Ibrahim, 2000; Mendyk et al., 2014) reported that the body temperature of the Desert Monitor ranges from 5°C to 42°C, and exceeding this range often causes death. The average body temperature of an active individual ranges from 36°C to 38°C and it is one of the most important regulatory factors for *V. griseus*. The average ambient hibernation temperature is $15.8 \pm 1.2^\circ\text{C}$. Below 20°C, Desert Monitor becomes inactive and body temperature in the hibernation period is between 16°C and 18°C (Ibrahim, 2000; Mendyk et al., 2014).

Conclusions and Recommendation

As a result of the field surveys, anthropogenic factors are the main threats to the species like habitat loss, habitat degradation and fragmentation, death by road accidents, and killing by humans (Table 1).

The most important negative effect of agricultural activities is undoubtedly habitat loss, degradation, and fragmentation due to the conversion of natural habitats into cultivation areas. In this sense, the habitat

of the species is narrowing day by day and is polluted due to the pesticides used in agriculture (Figure 5A and B). Natural habitats that are not suitable for agriculture are exposed to heavy grazing activities. Stubble burning, a method of locals to obtain fresh grass for their domestic livestock or remove the weeds, is another factor causing habitat destruction (Figure 5C). Both intense grazing activities and stubble burning cause the removal of Desert Monitor from habitats that they need to feed, nest, breed, hibernate, etc.

Interviews with the local people living around the Desert Monitor habitats show that despite the fact that they know the Desert Monitors are harmless, they are still afraid and kill them because of their large size. Even though the species is endangered in Turkey, it has a bad reputation in the region and locals have called it "Monster" and "Crocodile." Therefore, training activities aiming to increase public awareness about the species should be organized in the region.

Some habitat destruction factors like thermal power plants, stone quarries, sand quarries, road construction works, and illegal settlements undoubtedly cause great damage to natural habitats (Figure 5D). Such activities have also restricted the habitat of the species and are likely to cause great damage to the individuals forming a population or weakening the present populations.

Climate change can affect Desert Monitor populations as it affects many living organisms. Rising temperatures may pose a threat to the continuation of their populations. The body temperature of the Desert Monitor ranges from 5°C to 42°C and above or below this range generally leads to death (Ibrahim, 2000).

In summary, the potential threats of the Desert Monitor are habitat loss, habitat degradation and fragmentation, death by road accidents, and anthropogenic effects. We recommend (1) conserving known habitats of the species, (2) supporting research and monitoring of the species, and (3) increasing awareness of the local people about the importance and conservation of the Desert Monitor (Table 2).

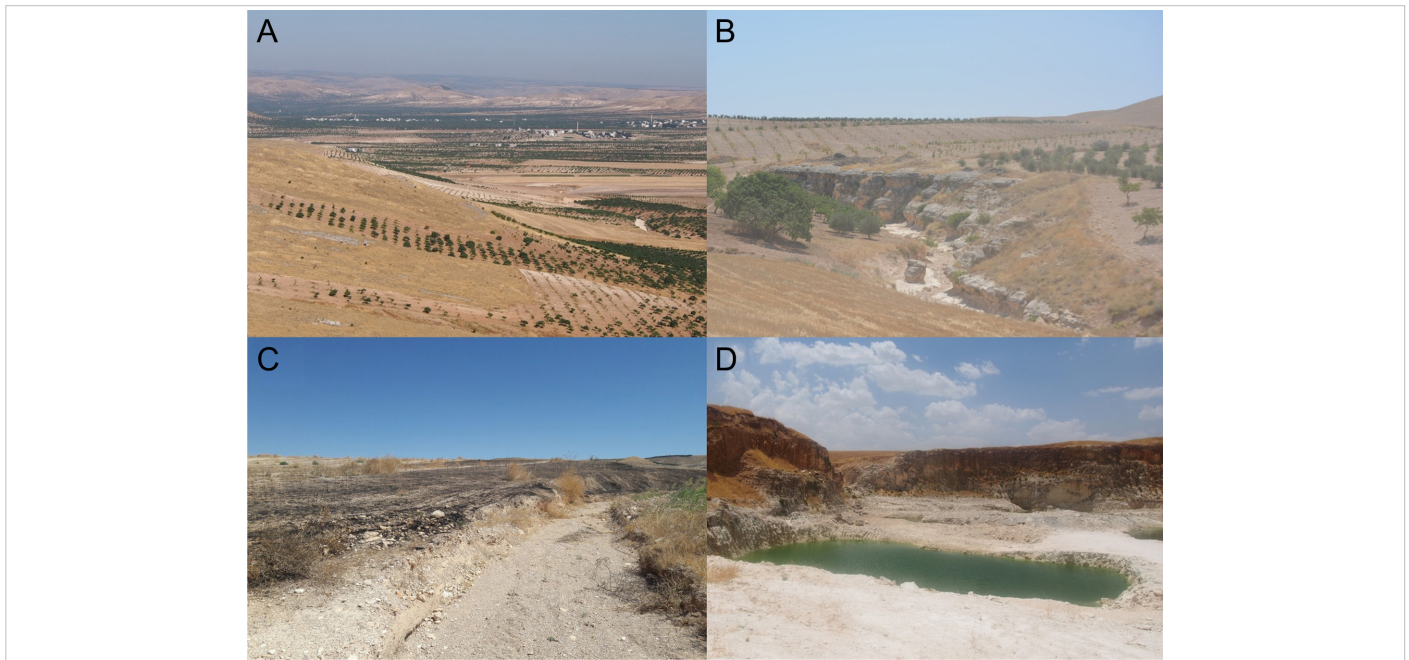


Figure 5. Views from Akpınar, Birecik, Şanlıurfa (A and C), Mengelli, Birecik, Şanlıurfa (B), and Hamurkesen, Karaköprü, Şanlıurfa (D)

Table 2.
The Implementation of the Conservation Action Plan for the Desert Monitor

Actions	Priority	Responsible Agencies, Organizations, and Individuals
A. Land/Water Management		
A.1 Site/Area Stewardship	High	GDNCNP, Municipalities, Ministry of Environment, Urbanization and Climate Change, Law enforcers, Mukhtars
Identifying projects and activities that have a negative impact on the species and its habitat and taking measures for possible negative impacts		
B. Species Management		
B.1 Species Stewardship	Critical	GDNCNP; Municipalities; Ministry of Environment, Urbanization and Climate Change; General Directorate of Highways; General Directorate of State Hydraulic Works; General Directorate of Forestry; Ministry of Culture and Turizm
Incorporating the distribution areas of the species into existing plans		
C. Awareness Raising		
C.1 Outreach and Communications	Low	GDNCNP; Governorship; Municipalities; Ministry of Culture and Turizm; Ministry of National Education; Public Education Centers; Universities; NGOs; Local Broadcasting and Press Organs
Include information about the species in Şanlıurfa, Diyarbakır, and Şırnak Governorship, District Governorship and Municipality websites, local press, and news		
Using Desert Monitor as a motif in training/works conducted by Public Education Centers		
Organizing competitions (painting, poetry, composition) on Desert Monitor		
D. Law Enforcement and Prosecution		
D.1. Detection and Arrest	High	GDNCNP, Municipalities, Ministry of Environment, Urbanization and Climate Change, Law enforcers; Mukhtars
To control and inspect once a month at different intervals between April and July in order to prevent all kinds of negative human activities within the distribution area of the species		
D.2. Non-Criminal Legal Action	High	GDNCNP; Universities
To support scientific research studies to fill the knowledge gap about the Desert Monitor		
E. Research and Monitoring		
E.1. Basic Research and Status Monitoring	High	GDNCNP; Universities
By processing the distribution area of the species in the GIS, to create monitoring parcels within these areas and monitor the population trend of the species at the determined stations		
Mapping potential habitats for the species and identifying habitat changes		
Preparation of a project for monitoring the area use and egg laying areas of the species by attaching a transmitter to three male and three female individuals		
E.2. Evaluation, Effectiveness Measures, and Learning	Low	GDNCNP; Public Education Centers; Ministry of National Education; Universities; Mukhtars
Measuring the current level of awareness for the Desert Monitor		
9. Education and Training		
F.1. Formal Education	Low	GDNCNP; Ministry of National Education; Universities
To carry out studies to raise awareness of the importance of the species to the teachers and students in the distribution area of the species and the surrounding schools		
F.2. Training and Individual Capacity Development	Low	GDNCNP; Municipalities; Governorship; Ministry of National Education; Universities
Preparing and distributing printed and visual materials (puzzles, stickers, coloring books, promotional videos, films, public service announcements, etc.) for the local people and especially students.		
Using Desert Monitor motifs in visible wall decorations, sidewalks, playgrounds, parks, bridges, local product packages, Nature Parks, overpasses, etc		
Determining the species as a flag species, preparing signs and posters for protecting and placing them on appropriate places and billboards		

Peer-review: Externally peer-reviewed.

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