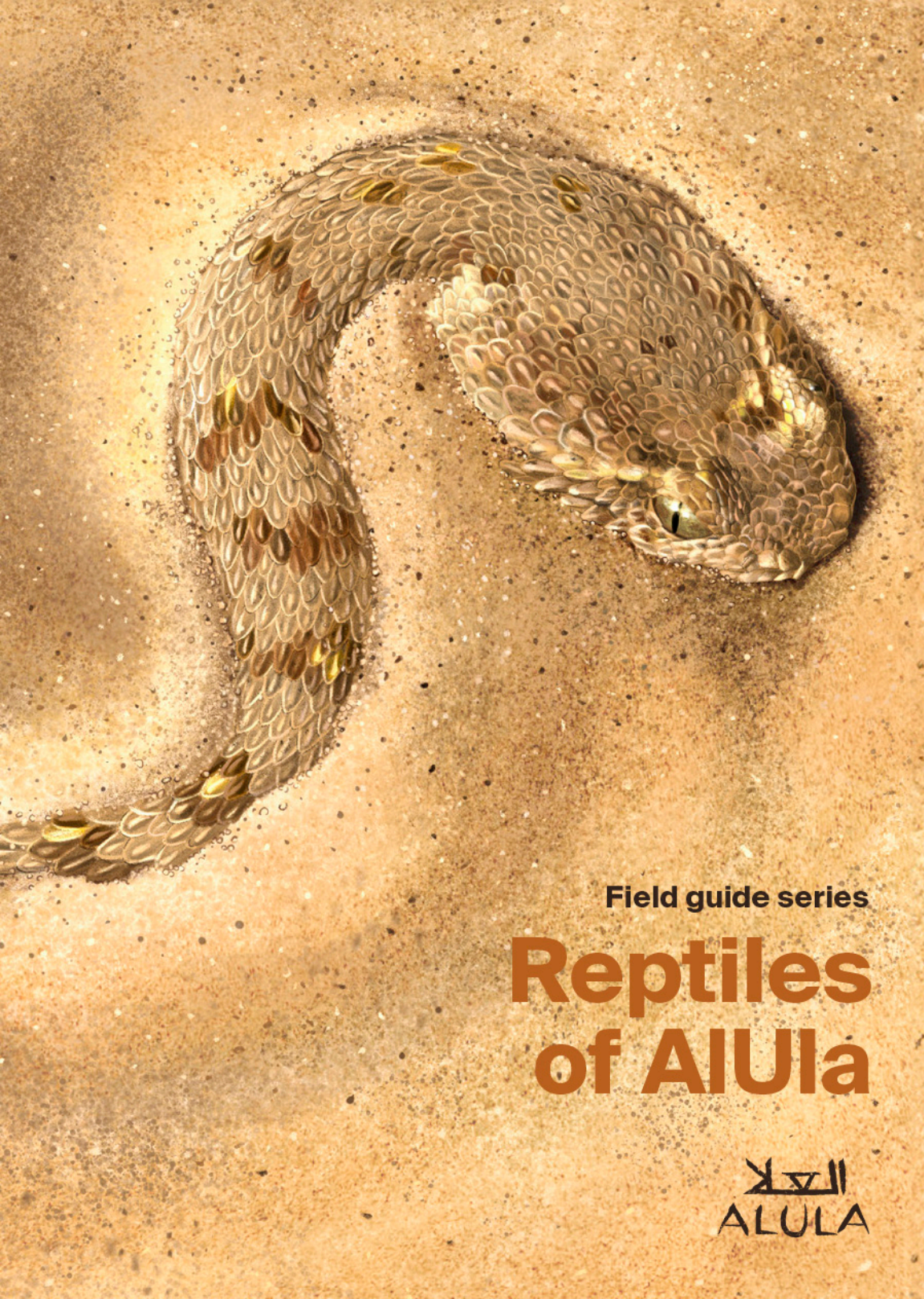

Field guide series

Reptiles of AlUla

العلا
ALULA

Field guide series

Reptiles of AlUla

Field guide series: Reptiles of AlUla

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This book is a product of the collaborative efforts within the framework of the 'Inventory of AlUla Flora & Fauna' project. We extend our gratitude to every colleague from The Royal Commission for AlUla who contributed to the series. They include members of the Tourism Department for their support and the rangers who assisted in data collection.

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ALULA

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Field guide series

Reptiles of AlUla

Fulvio Licata, André Vicente Liz, Bárbara Santos,
Margareta Lakušić, Pedro Tarroso, Ahmed Taheri,
Duarte Vasconcelos Gonçalves and José Carlos Brito

Royal Commission for AlUla
BIOPOLIS/CIBIO-InBIO/BIODESERTS

ARTE E CIÊNCIA

Contents

Foreword

As the Director of Research in the Wildlife & Natural Heritage department of the Royal Commission for AlUla (RCU), it gives me great pleasure to introduce the Field Guide to the Reptiles of AlUla. This book and its sister volumes are the culmination of 24-months of collaborative efforts by RCU and BIOPOLIS/CIBIO-InBIO, BIODESERTS research group. The guides are the result of the ambitious Inventory of AlUla Fauna project, which aimed to create a meticulous record of the biodiversity treasures of this extraordinary region.

This expertly curated book is a testament to the passion and curiosity, displayed by the team, towards the natural world, and the deep-rooted desire to understand the underlying workings of nature. It is often the unexpected, the puzzling or the surprising that fire our imagination, inspire us to persevere every day in the field, and lead to new ideas and new discoveries. As such, there are few places left in the world for discovery – where there are empty pages in the book of biodiversity.

AlUla, Saudi Arabia, is one of those places.

The AlUla region, in the Kingdom of Saudi Arabia, stands as a testament to the rich tapestry of human history and natural wonders. Its landscape, framed by majestic sandstone mountains and remnants of extensive volcanic activity, has been a cradle for civilizations dating back millennia. The region has witnessed the rise and fall of ancient cultures such as the Dadanites, Lihyanites and Nabataeans, leaving behind a legacy of architectural marvels and inscriptions that adorn its rugged cliffs.

As extensive as the cultural history is of AlUla, so was the biodiversity of the region underdescribed, until the 'Inventory of AlUla Fauna' project embarked on a journey to explore the biodiversity of this unique area. The dedicated team conducted surveys across 541 sites, employing various methodologies, resulting in an astounding assembly of over 31,000 observations, illuminating the fauna diversity of AlUla in unprecedented detail.

The findings of this endeavor are as remarkable as they are revelatory. A total of 385 species and an additional 19 genera inhabiting the AlUla region were recorded. Out of the total species recorded, 37% of

the taxa were never before reported, whether for the AlUla region, for the Kingdom, or for science.

Consequently, a wide-ranging series of field identification guides on the region's mammals, birds, reptiles and invertebrates were compiled to share our discoveries with the world. The series of field guides will join already existing guides on the geology of AlUla and the historical uses of plants in the AlUla area. The intention in the publication of the various field guides is that they serve as invaluable resources for researchers, conservationists and nature enthusiasts alike.

RCU is committed to the conservation and sustainable management of the natural resources of AlUla county, in synergy with the preservation of the cultural and historical treasures, for generations to come.

We encourage you to visit AlUla and experience its natural beauty firsthand. During your adventure, may these field guides serve as your companions, enriching your understanding of the biodiversity that surrounds you.

Lourens van Essen
The Royal Commission for AlUla
Wildlife & Natural Heritage Department
Research & Advisory Director

1. Introduction

This field guide is the first detailed reptile assessment for AlUla county and neighbouring areas. It provides original information on the diversity, distribution and richness of reptiles in the AlUla region. In total, 54 species of reptiles are depicted and described in the field guide, including one introduced species. However, this number is likely to change and maybe increase still further in the future, with taxonomic reassessment, undescribed cryptic diversity, and new occurrence records. Data for the field guide were obtained from a thorough bibliographical revision and more than a year of intensive field and laboratory work by the authors. Its primary purpose is to provide the tools for the identification of the reptiles of the AlUla region, and it may be used by both novice and experienced herpetologists.

Located in the north-western sector of the Arabian Peninsula, in the Kingdom of Saudi Arabia (KSA), the AlUla region is fully included in the Palaearctic Realm. Most of it comprises the Biome Deserts & Xeric Shrublands and has an exceptional biogeographical position in the transition zone between five Ecoregions and two global Biodiversity Hotspots. Because of this geographic position, a high diversity of flora and fauna is expected to occur, particularly in arid-adapted species. Of the 172 reptile species recognised in the Arabian Peninsula, 89 (52%) are endemic, and the northern area has a high reptile diversity. Still, the available knowledge regarding reptile diversity and distribution in the AlUla region is limited. For these reasons, the Royal Commission for AlUla (RCU) supported the development of an inventory of reptiles.

AlUla is an extraordinary example of the coexistence of human and natural heritage. It is fast becoming a top world destination for tourists seeking unique experiences and exceptional arid landscapes. It is a flagship for global initiatives promoting sustainable development, integrating the natural and cultural heritage as one living environment. Within the framework of Vision 2030, the development programme set by RCU encompasses a broad range of initiatives across archaeology, tourism, culture, education and arts. The major components of the project include the conservation of cultural heritage, natural assets and

tourism, as well as the social and economic development of AlUla. Within this context, the objective of this field guide is to provide a work tool for species monitoring, research programmes and touristic activities.

In preparing this field guide, the authors have received help from a great number of people, all of whom have given their advice and encouragement. We would particularly like to thank the following individuals for their contributions: Ana Coelho, Diogo Ferreira, Francisco Álvares, G. Hosein Yusefi, Hugo Rebelo, Jaime Sousa, László Patkó, Leili Khalatbari, Martina Panisi, Mohammad Darwish, Nuno Ferrand, Sophia Rosa, Vidak Lakušić, Yuri Simone, Zbyszek Boratyński and the rangers of the conservation areas for collecting reptile observations; Davina Falcão for supplying the superb illustrations that accompany this field guide; Nina Serén, Ana Ramos, Sofia Mourão, Patrícia Ribeiro, Diana Castro, Sara João and Susana Lopes for their assistance in the laboratory work; Neil Rowntree and Udo Schutte for granting reference pictures of reptiles in their habitats for illustrations; and Alaaeldin I Soultan, Ayman A. Abdulkareem, Ingrid Stirnemann, László Patkó and the Royal Commission for AlUla in general, for their support in developing fieldwork in the AlUla region. We would also like to thank the people of AlUla county for their support and hospitality. Last, but not least, the authors would like to thank the Royal Commission for AlUla for commissioning and overseeing its production.

2. How To Use This Guide

The field guide is structured to provide general information about the AlUla region and reptiles, followed by a brief description and illustration of all of the species recorded so far.

Chapters 3 and 4 provide a synoptic overview of the geographical and ecological context of AlUla, describing the topography, its diverse biomes and habitats, climate and weather conditions, and designated conservation areas.

It is followed by a glossary and list of abbreviations that will help navigate the guide (Chapter 5), an overview of reptiles' biology and diversity (Ch. 6), with a focus on the families and species inhabiting the AlUla region, and an illustrated section (Ch. 7) that will guide the readers in the first steps in the identification of reptiles at the family and genus levels through the use of relevant diagnostic morphological traits.

Chapter 8 contains detailed information accompanied by line-art illustrations for the 54 reptile species present in the AlUla region. Species are listed according to the phylogenetic order provided in Chapter 6. For each species, it provides:

- the common and scientific names;
- the global distribution;
- the distribution in AlUla, including the elevation range and the conservation areas where the species was observed. For the species not observed within the conservation areas, it provides an approximate indication of the locality of the observation;
- a map with a prediction of the occurrence probability of the species in the AlUla region. Occurrence probabilities for each species were mapped based on the definition of the climatic envelope (i.e. the set of climatic conditions within which the species is predicted to occur where the environmental requirements are suitable for the species to live and survive). In the current case, the climatic envelope was defined based on the Normalised Difference Vegetation Index and Land-Surface Temperature derived by remote sensing where the species currently occurs in the AlUla region. Averages for both variables were estimated based on the observational data for each

species and mapped as occurrence probabilities at 1 km spatial resolution;
- the body measurements of the animal (total body length and tail length);
- the most relevant identification traits, such as the number of scales and the colouration, including eventual differences between sexes and age groups;
- the frequented habitat and habits, including activity type (diurnal, crepuscular or nocturnal), and most peculiar life and natural history aspects;
- an evaluation of abundance indicating the likelihood of encountering each species in the wild, based on the number of sites at which the species was observed. The categories used are abundant (observed in more than 25 sites), common (11 to 25 sites), scarce (2 to 10 sites), rare (1 single site), and not evaluated (when it was not possible to determine the abundance); and
- the conservation status following the International Union for Conservation of Nature (IUCN) criteria, evaluated at the global and regional levels. The latter was based on the last available assessment for reptiles of the Arabian Peninsula (Cox et al. 2012).

In snakes, the toxicity is reported as venomous and non-venomous. The World Health Organization (WHO) categories are used for venomous species: highest medical importance (species responsible for the highest morbidity and mortality) and secondary medical importance (less venomous and/or less frequently encountered species). The category 'not listed as medically important' is applied to species not listed by WHO.

Chapter 9 identifies the important areas for reptile conservation in the AlUla region based on the distribution of reptile species richness at 1 km spatial resolution. The estimated species richness was calculated from the sum of the individual distribution maps for each species displayed in Chapter 9.

Chapter 10 provides information about the toxicity of venoms of snakes, measures to prevent snakebites, and recommendations in case of envenomation.

Chapter 11 provides a synthetic checklist of the reptiles of AlUla, including species names and conservation status.

Lastly, the book concludes with bibliographical references suggested for further reading (Ch. 12) and an Index (Ch. 13).

Data for the production of this field guide were based on fieldwork performed by the BIODESERTS research group and available literature. The fieldwork comprised four sampling missions in November/December 2022, January/March 2023, May/June 2023 and October/November 2023, to collect species distribution data in 120 sampling sites. The missions aimed to cover the distinct climatic conditions experienced in the AlUla region throughout the year, thus representing the variability in the activity patterns of reptiles across the different seasons. The field sampling scheme encompassed the environmental variability of the AlUla region. Visual encounter surveys were performed in the morning, late afternoon, and at night, when reptiles are most active, either thermoregulating or foraging. During the warmest hours of the day and at night, rocks were flipped to find individuals hiding underneath. Other signs of reptile presence, such as shed skins and faeces, were also collected to identify the species. Captured specimens were sexed and aged (juvenile or adult) whenever possible; body measurements were collected, and reference photographs were taken to be used for scale counts and meristic measurements. In addition, distribution data were collected from available literature, online databases (e.g., Global Biodiversity Information Facility data portal) and local collaborators.

3. Map of AlUla

The region of AlUla is located in north-western KSA, encompassing distinct, important habitats and containing relevant floral and faunal diversity (**Figure 1**). To safeguard the protection of natural heritage in the region, 12 conservation areas have been gazetted: the Nature Reserves of Harrat Uwayrid, Wadi Nakhlah, AlGharameel, Harrat AlZabin and Sharaan, the mountains of Jabal Nahar, Jabal Al Ward and Jabal Shayhoub, the National Geopark of Harrat Khaybar, and the Oases of AlUla, Old Khaybar and Tayma (**Table 1**).

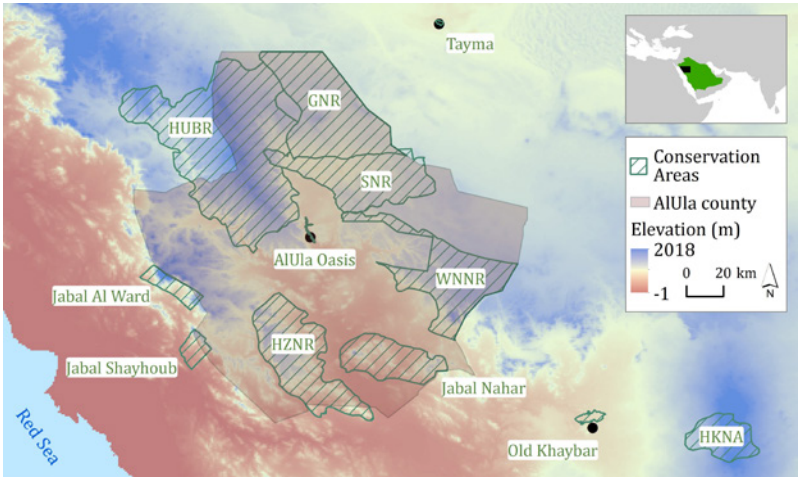
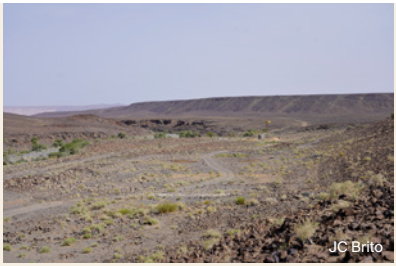


Figure 1 Location of AlUla, major urban areas, and conservation areas for the protection of natural values and ecological heritage in the county.

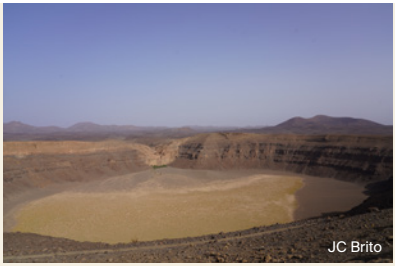
Table 1 Conservation areas within the AlUla region.

Acronym	Name	Category	Area (km²)
HUBR	Harrat Uwayrid	Biosphere Reserve	4680
WNNR	Wadi Nakhlah	Nature Reserve	1602
GNR	AlGharameel	Nature Reserve	2115
HZNR	Harrat AlZabin	Nature Reserve	1677
SNR	Sharaan	Nature Reserve	1550
HKNA	Harrat Khaybar	National Geopark	600
JNAH	Jabal Nahar	Special Conservation Area	883
JWAR	Jabal Al Ward	Special Conservation Area	251
JSHA	Jabal Shayhoub	Special Conservation Area	174
OKHA	Old Khaybar	Special Conservation Area	56
ALUO	AlUla Oasis	Special Conservation Area	10
TAYM	Tayma	Special Conservation Area	6

Figure 2 Shows photographs representing the landscapes found in the conservation areas of the AlUla region.



Harrat Uwayrid: *wadi* in rocky basalt plateau – Site 001



Harrat Uwayrid: sandy volcano crater – Site 023

Wadi Nakhlah: sandy *wadi* and rock outcrops – Site 075

Wadi Nakhlah: sandy *wadi* and rocky hills – Site 080

AlGharameel: rock outcrops in sandy desert – Site 044

AlGharameel: sandy desert and sandstone outcrops – Site 057

Harrat AlZabin: rocky plateau and outcrops – Site 095

Harrat AlZabin: rocky *wadi* and outcrops – Site 097

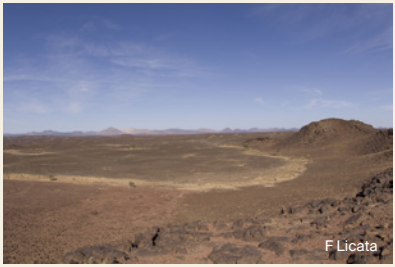
Sharaan: sandy valley and sandstone outcrops – Site 059

Sharaan: sandy valley and sandstone outcrops – Site 070

Jabal Nahar: basalt outcrops – Site 128

Jabal Nahar: sandy valley – Site AH060

Harrat Khaybar: rocky *wadi* in basalt plateau – Site 143



Harrat Khaybar: basalt plateau – Site 144

Jabal Al Ward: rocky *wadi* in basalt mountain – Site 118

Jabal Al Ward: basalt plateau – Site 198

Jabal Shayhoub: rocky *wadi* in basalt mountain – Site 119

Jabal Shayhoub: rocky *wadi* in basalt mountain – Site 122

Old Khaybar: oasis – Site 140

Old Khaybar: irrigation channels in oasis – Site 140

AlUla Oasis: oasis – Site 150

AlUla Oasis: oasis – Site 153

Tayma: oasis – Site 136

Tayma: *sabkha* – Site 136

Harrat Uwayrid	S001:	*A. boskianus*, *A. engaddensis*, *B. tuberculatus*, *E. coloratus*, *L. vulgaris*, *M. bahaeldini*, *O. elbaensis*, *P. guweirensis*, *P. sinaitus*, *P. guttatus*, *P. hasselquistii*;
	S023:	*B. tuberculatus*, *C. chamaeleon*, *L. vulgaris*, *M. bahaeldini*, *P. guweirensis*, *P. guttatus*.
Wadi Nakhlah	S075:	*A. boskianus*, *A. opheodurus*, *A. schmidti*, *B. tuberculatus*, *C. gasperettii*, *E. coloratus*, *L. vulgaris*, *M. bahaeldini*, *O. elbaensis*, *P. guweirensis*, *P. aqabensis*, *P. hasselquistii*, *S. doriae*, *S. conirostris*, *T. yomtovi*;
	S080:	*A, boskianus*, *A. opheodurus*, *A. schmidti*, *B. tuberculatus*, *C. gasperettii*, *L. vulgaris*, *P. guweirensis*, *P. sinaitus*, *P. hasselquistii*, *R. hejazicus*, *S. doriae*, *T. agnetae*, *V. griseus*.
AlGharameel	S044:	*A. boskianus*, *A. opheodurus*, *A. schmidti*, *C. gasperettii*, *L. vulgaris*, *P. guweirensis*, *P. ananjevae*, *P. hasselquistii*, *S. conirostris*, *S. diadema*, *S. doriae*, *T. dhara*, *T. yomtovi*, *U. aegyptia*, *V. griseus*;
	S057:	*A. schmidti*, *L. vulgaris*, *P. hasselquistii*, *R. hejazicus*.

Harrat AlZabin	S095:	*B. tuberculatus*, *E. schneiderii*, *M. bahaeldini*, *P. guttatus*, *T. yomtovi*, *U. ornata*;
	S097:	*E. schneiderii*, *P. guweirensis*, *P. sinaitus*, *P. guttatus*, *W. aegyptia*.
Sharaan	S059:	*A. boskianus*, *A. schmidti*, *L. diadema*, *P. saharicus*, *P. schokari*, *P. sinaitus*, *P. ananjevae*, *P. hasselquistii*, *S. doriae*, *S. slevini*, *U. aegyptia*;
	S070:	*A. boskianus*, *A. opheodurus*, *C. gasperettii*, *L. vulgaris*, *M. bahaeldini*, *P. schokari*, *P. ananjevae*, *P. hasselquistii*, *R. hejazicus*, *S. conirostris*, *T. yomtovi*.
Jabal Nahar	S128:	*M. bahaeldini*, *P. aqabensis*, *P. sinaitus*, *P. hasselquistii*, *U. ornata*;
	AH060:	*A. opheodurus*, *B. tuberculatus*.
Harrat Khaybar	S143:	*E. coloratus*, *H. granosus*, *L. vulgaris*, *M. bahaeldini*, *P. guweirensis*, *P. aqabensis*, *P. hasselquistii*, *T. yomtovi*, *U. aegyptia*;
	S144:	*B. tuberculatus*, *M. bahaeldini*, *P. hasselquistii*, *S. slevini*.
Jabal Al Ward	S118:	*Eirenis cf. coronella, H. granosus, P. hasselquistii;*
	S198:	*A. engaddensis, B. tuberculatus, L. vulgaris, M. bahaeldini, P. guweirensis, P. guttatus, T. dhara, T. yomtovi.*
Jabal Shayhoub	S119:	*L. vulgaris*, *M. bahaeldini*;
	S122:	*E. coloratus*, *L. vulgaris*, *M. bahaeldini*, *O. cf. elbaensis*, *P. hasselquistii*, *T. yomtovi*.
Old Khaybar	S140:	*A. boskianus*, *C. ocellatus*, *E. coloratus*, *E. taeniolata*, *H. granosus*, *P. rhodorachis*, *P. guweirensis*, *P. hasselquistii*, *P. schokari*, *T. agnetae*, *E. coloratus*.
AlUla Oasis	S150 and S153:	*A. pannonicus*, *B. tuberculatus*, *C. ocellatus*, *E. coloratus*, *H. granosus*, *L. vulgaris*, *P. saharicus*, *P. guweirensis*, *P. schokari*, *P. hasselquistii*, *S. diadema*, *U. ornata*.
Tayma	S136:	*A. schmidti*, *D. zarudnyi*, *P. sinaitus*, *P. ananjevae*, *P. hasselquistii*, *S. diadema*, *U. aegyptia*.

Figure 2 Photographs of the main landscapes found in the conservation areas of the AlUla region, and list of reptiles that can be found at each site.

4. Geography, Climate and Habitats

The AlUla region is located in the northern sector of the Hijaz Mountain range of the Arabian Peninsula, between latitudes 25°30' and 27°40' and longitudes 37°00' and 40°50'. It covers an area of about 22,500 km^2, of which about 20% is included in conservation areas. The AlUla region is fully encompassed in the Palaearctic Realm, and most of it comprises the Biome Deserts & Xeric Shrublands and has an exceptional biogeographical position in the transition zone between four Ecoregions: the Arabian desert, North Arabian desert, Red Sea-Arabian Desert shrublands, and Deserts & Xeric Shrublands. In addition, parts of the Jabal Al Ward are included in the Biome Mediterranean Forests, Woodlands & Scrub and are part of a fifth Ecoregion: Eastern Mediterranean conifer-broadleaf forests. The AlUla region is located halfway between two global biodiversity hotspots: the Mediterranean Basin and the Horn of Africa (which includes a section in the south-western Arabian Peninsula).

Topography

The Hijaz Mountain range dominates the landscapes of the AlUla region, with the altitude of the summits reaching 1,958 m on Harrat Khaybar, 1,940 m on Jabal Al Ward, and 1,711 m on Harrat Uwayrid (**Figure 3**). The conservation areas located in the Hijaz Mountains are topographically heterogeneous, and elevation in the Harrat Uwayrid, Harrat AlZabin, Jabal Al Ward, Jabal Shayhoub and Jabal Nahar spans over 1000 m between the lowland areas and the mountainous summits. By way of contrast, the oases of AlUla, Tayma and Old Khaybar are located between 600 m and 800 m in elevation and are generally flat, following the courses of river beds. The conservation areas of AlGharameel, Sharaan and Wadi Nakhlah are located on the north-western extreme of the Great Nafud sands, where the altitude ranges from 650 m up to 1,500 m.

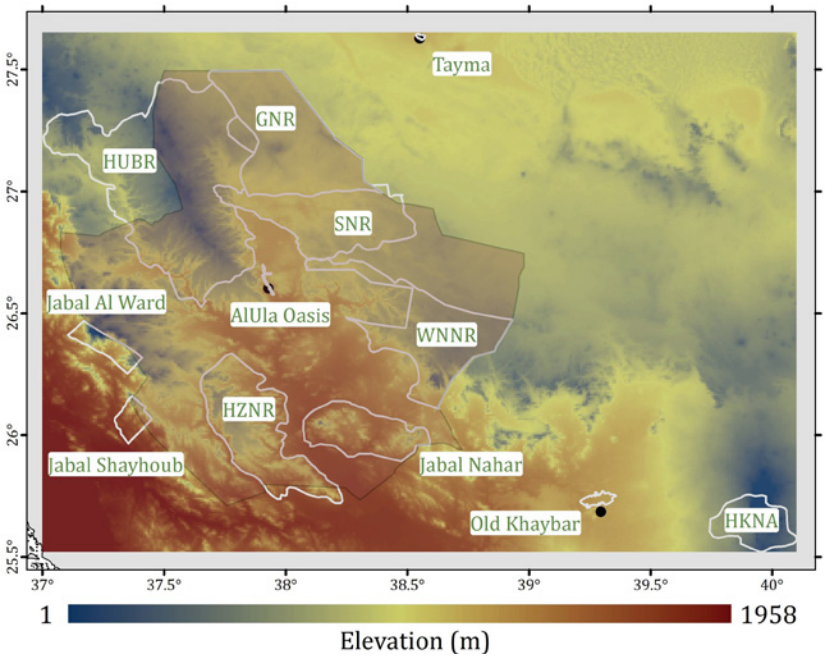


Figure 3 Elevation in the AlUla region. AlUla county (grey polygon), major urban areas (black dot), and conservation areas (white polygons) are identified.

Climate

The AlUla region comprises one of the most arid parts of the Arabian Peninsula. In the city of AlUla, the summers are long, sweltering, arid and clear, and the winters are short, cool, dry and mostly clear. The average temperature typically varies from a minimum of 3 °C up to a maximum of 38 °C, and is rarely below 0 °C or above 40 °C. The hot season lasts four months, from June to September, with an average daily high temperature above 35 °C. The hottest months are August and September, with an average high of 38 °C and a low of 20-22 °C. The cool season lasts three months, from December to February, with an average daily high temperature below 24 °C. The coldest months of the year are January and February, with an average low of 4-5 °C and a high of 21-22 °C. There is no significant seasonal variation in the frequency of wet days (i.e., days with precipitation above 1 mm). Thus, the quantity of rainfall does not vary significantly over the year. The highest rainfall is recorded in January, with an average total rainfall of 2.9 mm, followed

by December, February and March, with average total rainfall of 1.7 mm. The average total rainfall from June to August is 0 mm.

Annual average temperature within the AlUla region follows a latitudinal gradient, where southern regions are warmer, and the temperature may reach up to 26.8 °C. In comparison, northern regions are cooler, and the temperature may drop to 17 °C. Within the conservation areas, Jabal Nahar and Old Khaybar exhibit the highest annual average temperatures (around 25 °C). In contrast, Harrat Uwayrid, AlGharameel, Sharaan and Jabal Al Ward exhibit the coldest annual average temperatures (around 20-21 °C). The highest amplitude in annual average temperature within the conservation areas is recorded in Harrat Uwayrid (5.3 °C) and Jabal Al Ward (6.3 °C).

Average total precipitation within the AlUla region follows a longitudinal gradient, where eastern regions are wetter and precipitation may reach up to 154 mm/year. In comparison, western regions are drier, and precipitation may drop to 32 mm/year. Within the conservation areas, Wadi Nakhlah and Harrat Khaybar exhibit the highest average total precipitation (84 and 125 mm/year, respectively). In contrast, Jabal Shayhoub and the AlUla Oasis exhibit the lowest average total precipitation (52 and 60 mm/year, respectively). The highest amplitude in average total precipitation within the conservation areas is recorded in Jabal Al Ward (67 mm/year) and Harrat Khaybar (53 mm/year).

Land cover

The AlUla region comprises eight main land cover categories (**Figure 4**): 1) Rocky mountain (32.8%) covering most of Jabal Al Ward, Jabal Nahar, Jabal Shayhoub, Harrat AlZabin, Harrat Uwayrid, southern Harrat Khaybar, and southern Wadi Nakhlah; 2) Sand and stony flatlands (30.4%) covering most of Sharaan, southern AlGharameel, and northern Wadi Nakhlah; 3) Stony flatland (13.4%) covering lowland areas surrounding the mountain areas; 4) Sandy flatland (12.3%) covering AlGharameel and Sharaan; 5) Sandstone (9.3%) covering most of AlGharameel, Sharaan, western Harrat Uwayrid, and northern Wadi Nakhlah; 6) Volcanic rock (1.3%) covering most of Harrat Khaybar; 7) Salt pan (0.3%) covering parts of Tayma; and 8) Oasis (0.2%) covering the oases of AlUla, Tayma and Old Khaybar.

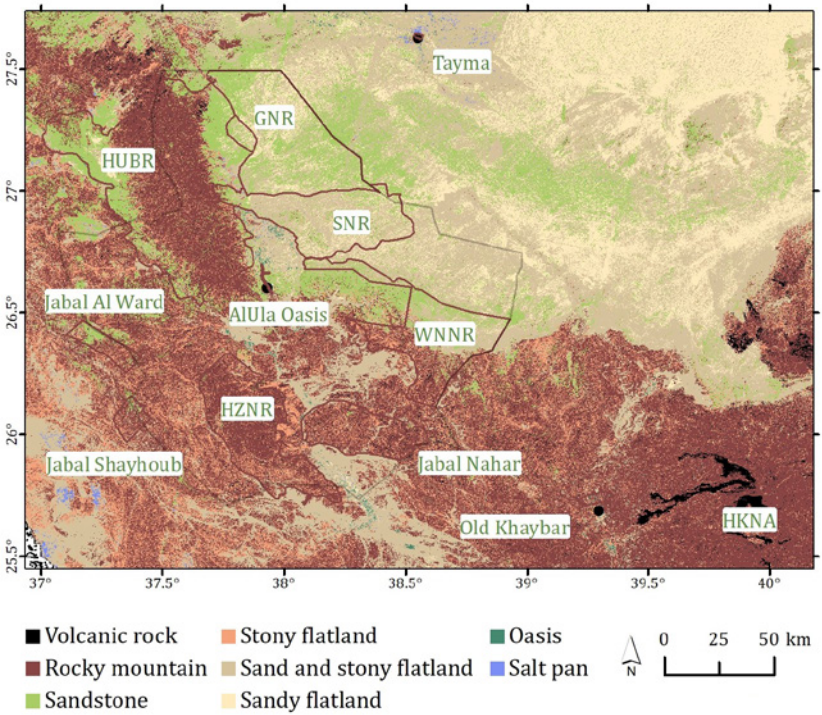


Figure 4 Main land-cover categories found in the AlUla region. AlUla county (grey polygon), major urban areas (black dots) and conservation areas (brown polygons) are identified.

Environmental variation

The environmental variation within the AlUla region is mostly related to the availability of water and types of land cover (**Figure 5**). Five broad environmental units can be identified within the conservation areas of the AlUla region: 1) the north-eastern barren or sandy plains (blue colouration) dominating AlGharameel, Sharaan and the northern and eastern sectors of Wadi Nakhlah; 2) the vegetated areas along the oases of AlUla, Old Khaybar and Tayma, and the plateaux of Harrat AlZabin (pink colouration); 3) the south-western mountain areas of Jabal Al Ward and Jabal Shayhoub, and parts of Jabal Nahar (yellow-green colouration); 4) the rocky mountains of Harrat AlZabin, Harrat Uwayrid, and the southern sector of Wadi Nakhlah (brown-green colouration); and 5) the volcanic lava fields of Harrat Khaybar (light blue colouration).

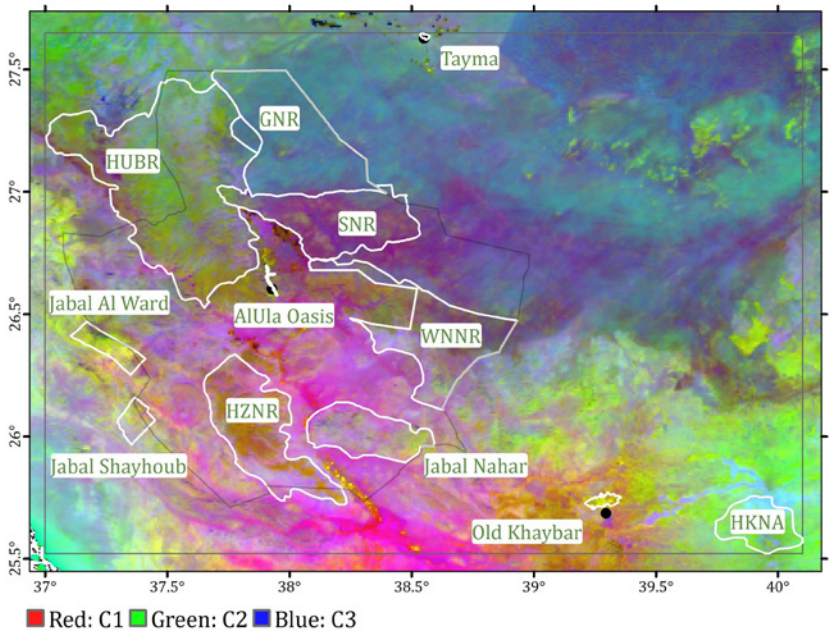


Figure 5 Environmental variability in AlUla county depicted by Harmonic Regression. Scaled coefficients (depicted in RGB colour palette) represent variation in the Normalised Difference Vegetation Index (NDVI; 250m resolution; MODIS satellite) along 2011-2020. AlUla county (grey polygon), major urban areas (black dot) and conservation areas (white polygons) are identified.

5. Glossary, Abbreviations and Map Symbology

Technical words, abbreviations and map symbols used in the Field Guide.

Glossary

Aglyph: Snake dentition with no specialised venom-injecting teeth (fangs).

Anal plate: Scale located in front of and covering the cloacal opening in snakes.

Anterior: Near the front of the body.

Arboreal: Living in trees.

Autotomy: Voluntary separation of body parts (e.g., tail).

Canthus rostralis: Angular ridge from the eye to the nostril.

Cloaca: Posterior orifice in reptiles that serves as the only opening for the digestive, reproductive and urinary functions.

Congeneric species: Species belonging to the same genus.

Conspecific: Belonging to the same species.

Crepuscular: Active at twilight.

Cryptic: Camouflaged, difficult to detect.

Cryptic species: Species morphologically identical that can only be differentiated by genetic analyses.

Cytotoxic: Affecting cells, often leading to swelling, blistering and tissue necrosis around the bite site.

Diurnal: Active during the day.

Dorsum: Back, upper side of the body.

Endemic: Native or confined to a particular region.

Fangs: Snakes' specialised teeth for delivering venom.

Femoral pores: Secretory pores on the inside of the thighs of certain lizards.

Fossorial: Burrowing, living partially underground.

Fringes: Elongated scales located around lizard toes.

Genus: Taxonomic rank in the biological classification between the Family and the Species levels. The genus forms the first part of the binomial species name.

Gular sac: Area that joins the lower mandible to the neck.

Hammada: Rocky plateau.

Harrat: Volcanic lava field.

Hemotoxic: Affecting the coagulation and integrity of blood vessels, often resulting in excessive bleeding.

Hemipenial pouch: Cloacal sac containing the hemipenis, one of the pair of copulatory organs of male Squamates.

Imbricate scales: Overlapping scales, like roof tiles.

Insectivorous: Animals that feed mainly on insects.

Keeled scales: Scales with a central ridge.

Lamella (plural: 'lamellae'): Thin layer of tissue, membrane.

Medically relevant venomous snake: Venomous snakes that can threaten human life if a person is bitten.

Neurotoxic: Affecting the nerves, typically resulting in respiratory complications.

Nocturnal: Active during the night.

Nuchal crest: Crest of spines in the dorsal-posterior region of the head.

Ocellus (plural: 'ocelli'): Eye-like marking in animals.

Opisthoglyph: Snake dentition with grooved fangs located at the back of the upper jaw.

Oviparous: Any organism producing eggs that develop and hatch outside the maternal body.

Ovoviviparous: Any organism producing eggs that develop and hatch inside the maternal body.

Parthenogenetic: Animals whose females produce offspring from unfertilised eggs.

Preanal pores: Similar to femoral pores, but confined to the area anterior to the vent.

Proteroglyph: Snake dentition with relatively short fangs located at the front of the maxillae, pointing downwards.

Psammophilous (or Psammophilic): Inhabiting sandy habitats.

Rupicolous: Inhabiting rocks.

Sabkha: Salt-encrusted mudflat or sandflat located in internal, closed drainage basins, but also often found near seacoasts and usually in hot, dry regions.

Sibling (or sister) species: Two related species that are morphologically nearly identical and can only be identified by genetic, biochemical, behavioural or ecological factors, and are thought to have become divergent very recently.

Solenoglyph: Snake dentition typical of Viperids, with large fangs at the front of the maxillae, folded against the roof of the mouth and pointing posteriorly.

Suture: An immovable junction between two scales, such as those of the skull.

Syntopic: Populations of two or more species sharing the same habitats within the same geographic range.

SVL: Snout-vent length: Measurement taken from the tip of the snout to the most posterior opening of the cloacal slit (vent).

Terrestrial: Living on the ground.

Viviparous: Any organism producing living young that, as embryos, develop within and derive nourishment from the maternal body.

Wadi: River valley or ephemeral riverbed.

Whorl: Scale ring surrounding and wrapping another in an expanding circular pattern.

Xeric: Very dry.

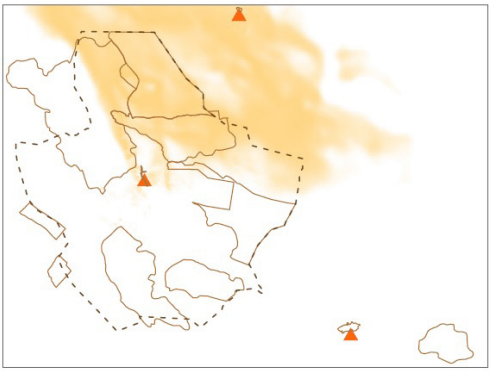
Abbreviations

a.s.l.	above sea level
c.	circa
cf.	compare with
cm	centimetres
e.g.	for example
et al.	and others
i.e.	that is
IUCN	International Union for Conservation of Nature
km	kilometres
m	metres
mm	millimetres
Mya	millions of years ago
SVL	snout-vent length
TBL	total body length
vs	versus
WHO	World Health Organization
DD	Data Deficient (IUCN Red list criteria)
NE	Not Evaluated (IUCN Red list criteria)
LC	Least Concern (IUCN Red list criteria)
VU	Vulnerable (IUCN Red list criteria)

Map symbology

In the distribution maps for each species:

- dashed polygon: AlUla county
- brown polygons: conservation areas
- orange triangles: cities
- yellow shading: areas of probability of species occurrence, where darker tones indicate a higher occurrence probability



6. Reptile Taxonomy

Taxonomic names are given through a process dependent on phylogeny – the history of the evolution and relationships of living beings. Increasing scientific knowledge based on new molecular or morphological evidence may imply updates in phylogeny, which in turn may cause the names of species to change over time. This guide follows the most updated taxonomy and nomenclature of reptiles, taken from 'The Reptile Database', a dedicated reptile taxonomy database maintained by Peter Uetz and colleagues. For consistency, the common names were selected from the same source or adopted when unavailable according to their etymology. To avoid controversial taxonomic entities, the guide does not include subspecies of reptiles (a category in biological classification that ranks immediately below a species).

The Reptile Class

Reptiles include lizards, snakes, turtles, crocodiles and tuataras, and with 12,020 species (as of July 2023), represent the most diverse group of terrestrial vertebrates (The Reptile Database). Reptiles are a paraphyletic group, i.e. animals with a common ancestor but not all its descendants. This controversial systematic classification is because crocodiles are more closely related to birds (Class Aves) than other reptiles.

Reptiles successfully colonised and diversified worldwide except Antarctica, partially thanks to the evolution of shelled eggs that can be laid on land (the amniotic egg). However, a wide array of reproductive strategies exist, and while crocodiles, turtles and tuataras are oviparous, lizards and snakes may lay eggs or give birth to live young.

Another emerging feature of reptiles is their skin, characterised by keratinised epidermal structures called scales, forming a barrier against injuries, reducing water loss, and facilitating dispersal in different habitats.

Growth in reptiles depends on temperature, slowing or ceasing at critical temperatures, and is influenced by the availability and quality of food. This condition allows reptiles to persist in extreme environments like deserts, where they cope with seasonal shortages of resources or critical temperatures, by entering a state of inactivity and reduced metabolism (aestivation).

Four orders of reptiles exist:

- Turtles or Chelonians (Order Testudines) are characterised by a shell consisting of a plastron (ventral) and carapace (dorsal), with defensive functions. Some 361 species exist, divided into 11 families, inhabiting terrestrial (tortoises) and aquatic ecosystems (freshwater and marine turtles). No turtles occur in the AlUla region.
- Crocodilians (Order Crocodilia) include crocodiles, alligators and gharials, and are large-sized (>5 m) semi-aquatic predators, inhabiting both marine and freshwater habitats in tropical, subtropical and temperate regions. No crocodilians are found in Saudi Arabia.
- Rhynchocephalia (Order Rhynchocephalia) includes only one living representative of the Sphenodontidans, once a rich and diverse group globally distributed during the early Mesozoic. The Tuatara (*Sphenodon punctatus*) is a stout lizard-like reptile with a beak-like snout and dorsal spines, endemic to New Zealand, and unlike other reptiles, it is not covered with scales.
- Squamates (Order Squamata) include lizards and snakes, and is the most diverse and species-rich group of reptiles, with 11,631 species (July 2023) divided into 75 families across six major groups: Gekkota, Iguania, Lacertoidea, Anguimorpha, Scincoidea and Serpentes. This group embeds all Reptiles that occur in the AlUla region, which are also all of Palaearctic origin.

Within Order Squamata, the six major groups are very distinct:

Iguania (15 families, 122 genera, 2,065 species) are widely distributed, medium- to large-sized reptiles presenting a fleshy tongue. Iguanids offer one of the best examples of visual communication among reptiles, expressed through colourful male rivalries and head displays. In the AlUla region, there are 2 families and 9 species of Iguanids:

Family Agamidae (63 genera, 575 species). Small to large lizards, widely distributed across Africa, Asia, Australia and Tasmania. Agamids are usually diurnal and predominantly terrestrial and semi-arboreal, but a few species are strictly arboreal. Agamids are mostly oviparous, with a few live-bearing species. In the AlUla region, 5 genera and 8 species can be observed.

Family Chamaeleonidae (12 genera, 228 species). Tiny- to large-bodied reptiles, distributed across Africa, the Middle East, Madagascar, Southern Europe, Sri Lanka and India, from tropical forests to deserts. Chameleons have prehensile tails and unique feet with opposable claws. Remarkably, chameleons have a projectile tongue to catch distant

prey, eyes that move independently, and can adjust their body colours to camouflage with the surrounding environment. Most species have arboreal habits, although terrestrial species exist. Chameleons may lay eggs or give birth to live young. One species (*Chamaeleo chamaeleon*) can be found in the AlUla region.

Gekkota (Geckos) (7 families, 130 genera, 2,305 species) are small- to medium-sized reptiles distributed across all warm areas of the world, from tropical forests to deserts and mountains. Nearly all geckos lack eyelids and have specialised adhesive toe pads that allow climbing even smoother vertical surfaces. Many geckos make squeaking calls with defensive or territorial functions. In Saudi Arabia, there are 3 families and 25 species, 11 of which can be found in the AlUla region:

Family Gekkonidae (60 genera, 1,553 species). Small- to medium-sized geckos, widely distributed across the tropics. Gekkonids can have toes with or without adhesive pads, and are primarily nocturnal, rupicolous, or arboreal, but a few terrestrial and diurnal species exist. All Gekkonids are oviparous, typically laying two eggs. In the AlUla region, 5 genera and 7 species can be observed.

Family Phyllodactylidae (10 genera, 163 species). Medium-sized geckos found in the Middle East, North Africa, the Mediterranean Region and Central-South America, occupying a wide range of habitats. They are primarily nocturnal and are all oviparous. Three species of the genus *Ptyodactylus* are present in the AlUla region.

Family Sphaerodactylidae (12 genera, 231 species). Dwarf geckos are tiny- to small-sized geckos found in Central-South America, eastern Asia, North Africa and the Middle East, from tropical forests to deserts. They have reduced adhesive pads, diurnal or nocturnal habits, and live on the ground or in trees. All species are oviparous and typically lay one egg. One species is present in the AlUla region.

Scincoidea (skinks) (4 families, 188 genera, 1,884 species) is a species-rich group widely distributed across all warm regions. It can be found in different habitats, from evergreen humid forests to extremely arid desert areas. Only the Family Scincidae occurs in the AlUla region.

Family Scincidae (168 genera, 1,740 species). Skinks are small to large lizards, distributed across all warm regions of the world and inhabiting a variety of habitats. Skinks can have well-developed limbs or be limbless, and may exhibit fossorial, terrestrial and semi-arboreal habits. Most skinks are diurnal, but some species are nocturnal or crepuscular, and may be oviparous or viviparous. In the AlUla region, 5 genera and 6 species occur.

Lacertoidea (Lacertid lizards) (9 families, 115 genera, 1,034 species) include small to large species widely distributed worldwide, including high latitude regions with low temperatures. Two families are found in the AlUla region:

Family Lacertidae (43 genera, 373 species). Small to large lizards, widely distributed across Africa, Europe and Asia. The body shape is typically elongated in most species, with a long tail. Lacertids are primarily diurnal and terrestrial, but a few species display arboreal habits. Most species lay eggs. In the AlUla region, 3 genera and 8 species can be found.

Family Trogonophidae (4 genera, 6 species). Small to medium-sized limbless lizards, distributed across North and East Africa and the Arabian Peninsula. They inhabit dry sandy soils and have fossorial habits. Nearly all trogonophids are oviparous. Only one species (*Diplometopon zarudnyi*) occurs in the AlUla region.

Anguimorpha (7 families, 27 genera, 249 species) are medium- to large-sized reptiles widely distributed across tropical regions. Anguimorph lizards are predators and occasional scavengers, and many species possess mandibular glands that produce toxins. Only one species of the Family Varanidae occurs in the AlUla region:

Family Varanidae (1 genus, 85 species). Medium- to large-sized reptiles, found across warm temperate and tropical sub-Saharan Africa, Asia and Australasia. Varanids have robust bodies with well-developed limbs and long muscular tails. They possess venomous glands and are active predators, but also scavengers. Most species are terrestrial to semi-arboreal, although a few are arboreal, and others show semi-aquatic habits. All varanids are oviparous.

Serpentes (snakes) (32 families, 542 genera, 4,060 species) are a species-rich group occurring on all continents except Antarctica. Snakes are limbless (or nearly so) and elongated, with flexible bodies. They present flexible jaw articulations that aid in capturing and ingesting prey. Snakes are predators with many feeding strategies, from ambushers to stalkers, including constrictors and venomous snakes. In the AlUla region, 7 families and 18 species occur.

Family Boidae (14 genera, 67 species). Small- to large-sized snakes distributed in America, Central Africa, South Asia, Madagascar and Southwest Pacific islands. They are found in a variety of habitats, from tropical forests to deserts, and include arboreal, terrestrial and fossorial species. They feed by constriction and are aglyphs. Most species give birth to live young, but can also be oviparous. The only species

found in AlUla (*Eryx jaculus*) is fossorial, predominantly nocturnal or crepuscular.

Family Colubridae (260 genera, 2,099 species). Colubrids are the most diverse group of snakes, widely distributed across almost all continents. They include aglyph, opisthoglyph, and proteroglyph species, which are mildly and non-venomous. Colubrids can be aquatic, fossorial, terrestrial, semi-arboreal or arboreal, and are primarily oviparous, but viviparous species exist. In the AlUla region, 6 genera and 9 species occur.

Family Atractaspididae (11 genera, 69 species). Small- to medium-sized snakes distributed in Sub-Saharan Africa, Jordan Valley region and parts of the Arabian Peninsula. This family of terrestrial or fossorial species includes harmless, rear-fanged snakes and highly venomous front-fanged species that can protrude the fangs laterally, biting with fast lateral movements. In the AlUla region, only one highly venomous species occurs (*Atractaspis engaddensis*).

Family Psammophiidae (8 genera, 55 species). Medium-sized, slender snakes distributed in Africa, southern Asia, Southern Europe and the Middle East. Psammophids are terrestrial or arboreal and are found from tropical forests to semi-arid deserts. The sand snakes (*Psammophis*) are fast, diurnal, opisthoglyph and mildly venomous. In the AlUla region, 2 genera and 2 species occur.

Family Elapidae (54 genera, 400 species). Small- to large-sized snakes distributed across all continents except Europe and Antarctica, inhabiting also part of the Pacific and the Indian Oceans. Elapids are proteroglyph and highly venomous. They are adapted to different environments, from arboreal to terrestrial, semi-fossorial and fully aquatic (marine snakes). Elapids are mostly oviparous, but a few species give birth to live young. One species (*Walterinnesia aegyptia*) can be found in the AlUla region.

Family Viperidae (37 genera, 383 species). Small- to large-sized snakes distributed worldwide and across a wide range of habitats, from the arboreal species inhabiting tropical forests to terrestrial ones found in deserts. Viperids are venomous snakes with stout bodies, distinctly triangular heads and a solenoglyph dentition. Both diurnal and nocturnal vipers exist. Viperids include eggs-laying and live-bearing species. Two genera and two species can be found in the AlUla region.

Family Leptotyphlopidae (14 genera, 142 species). Small-sized, slender and fossorial snakes distributed across the Americas, Asia and Africa, where they inhabit a wide variety of habitats, from tropical forests to sandy deserts. Due to their secretive habits, the life-history traits of many species are largely unknown; however, it is well-known that they

feed on ants and termites in their nests, producing a secretion that averts the attack of the soldier termites and ants. Leptotyphlopids are all eggs-laying species. One species can be found in the AlUla region.

One species introduced in AlUla was detected for the first time: the Brahminy blind snake (*Indotyphlops braminus*), which belongs to the Family Typhlopidae.

Notes on specific changes from the reference taxonomy 'The Reptile Database':

- *Acanthodactylus boskianus* – Differences in morphology (e.g. number of ventral scales) and genetics (e.g. lineage divergence >5 Mya) suggest that African and Arabian populations correspond to distinct species, which remain to be formally described (see Liz et al. 2021).
- *Bunopus tuberculatus species complex* – Populations in the AlUla region have been assigned to a new species, currently in the process of description (see Pola et al. 2024).
- *Hemidactylus granosus* species complex – This group of species includes two undescribed cryptic species from the AlUla region.
- *Phrynocephalus arabicus* – The *P. arabicus* complex was split into four species, and AlUla populations should correspond to the newly described *P. njedensis* (see Melnikov et al. 2014). However, there are persisting doubts about the systematics of the group. For this reason, here the systematics recognised by The Reptile Database were adopted.
- *Pseudotrapelus aqabensis* – The occurrence of further undescribed species in AlUla is possible following the recent findings of unclearly recognised specimens in central Saudi Arabia (see Tamar et al. 2019).
- *Ptyodactylus hasselquistii* species complex – Populations in the AlUla region have been assigned to a new species, currently in the process of description (see Šmíd et al. 2021).
- *Rhynchocalamus hejazicus* – Newly described species from the Hijaz region, not included in The Reptile Database at the time of production of this guide.
- *Trapelus agnatae* – Following The Reptile Database, previous observations for the local populations of *T. pallidus* correspond to *T. agnatae*.
- *Tropiocolotes yomtovi* species complex – Local populations of *T. yomtovi* were considered *T. nattereri*, yet genetic evidence confirms that they correspond to a newly described lineage. Furthermore, another cryptic species of *Tropiocolotes* was found in the AlUla region, closely related to *T. yomtovi*.

7. Reptile Topography

Reptiles can be identified by considering external morphological characteristics, some of which are particularly relevant for the identification process, as they are species- or group-specific.

For instance, the head scales can differentiate the main groups of lizards (Anguimorpha, Gekkota, Iguania, Lacertoidea and Scincoidea). Gekkota and Iguania have small scales on top of the head and snout, while Anguimorpha, Lacertoidea and Scincoidea have enlarged scales which form specific patterns (**Figure 6**).

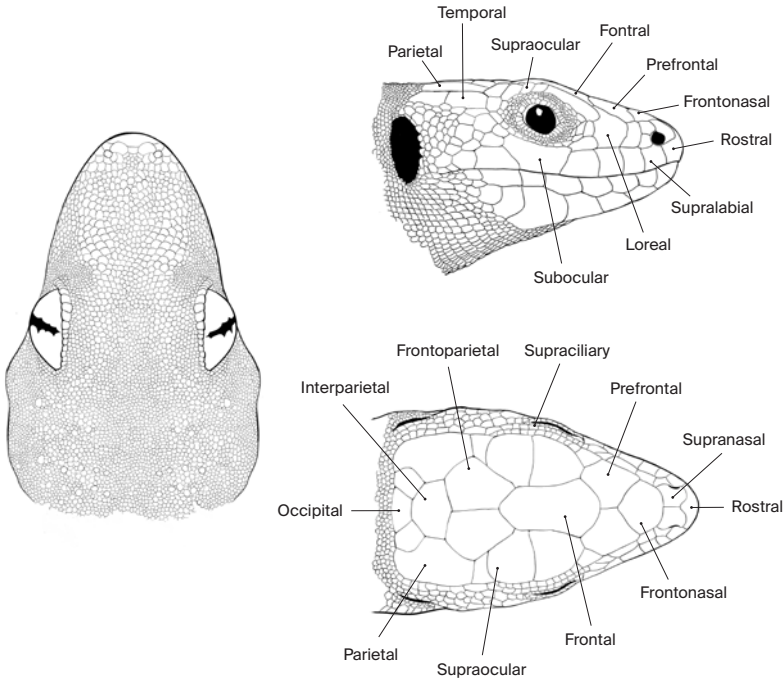


Figure 6 Dorsal view of the head of Gekkota with small scales (left), and lateral and dorsal view of the head of Lacertoidea with enlarged scales (right). Names of the main scales used for species identification are shown.

Other traits that help in the identification of lizards and snakes (**Figure 7**) include the scale shape (keeled or smooth), the pupil shape (vertical or round), the presence of adhesive toe pads and toe fringes.

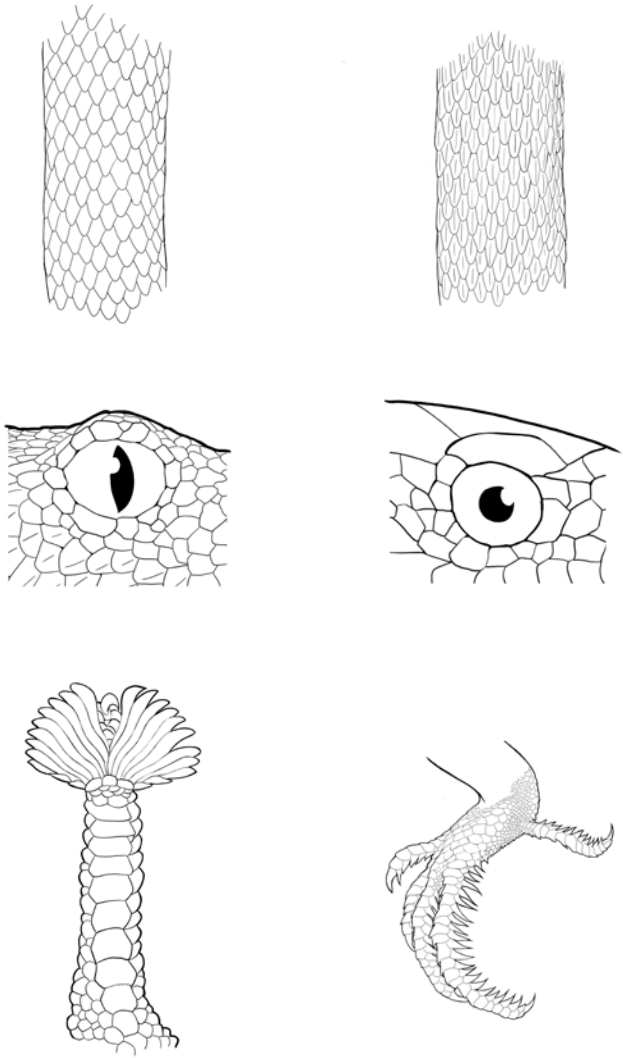


Figure 7 Relevant diagnostic traits for reptile identification. Smooth vs keeled scales (top left and right), vertical vs round pupils (mid left and right), adhesive toe pads typical (but not exclusive) of Gekkota (bottom left), and lateral fringes present around lizard toes, typically in species from sandy habitats (bottom right).

Anguimorpha

The only species of Anguimorpha occurring in AlUla, *Varanus griseus*, can be easily distinguished because it is the largest terrestrial lizard in the region (adults can be over 1 m in total length). Furthermore, it has a slender round body with an elongated head and neck, a pointed snout, round pupils, and a powerful tail and limbs.

Gekkota

The families and genera occurring in the AlUla region can be distinguished by the presence of adhesive toe pads and their shape (**Figure 8**).

Figure 8 Ventral views of digits of the main group of Gekkota in AlUla. *Bunopus*, *Cyrtopodion*, *Pristurus*, *Stenodactylus*, *Tropiocolotes*, *Cyrtopodion* (left), *Hemidactylus* (mid) and *Ptyodactylus* (right).

The genus *Pristurus* can be easily distinguished from the other groups of geckos by the round/ovoid pupils (**Figure 9**).

Figure 9 Lateral view of the head of Gekkota with a round pupil in *Pristurus* (left) and all other species (right).

Further general morphological features can also help in geckos' identification. For instance, preanal pores are absent in the genera *Ptyodactylus* and *Pristurus*, which also lack cloacal sacs and tubercles, while the postmental glands are absent in the genera *Bunopus* and *Stenodactylus* (**Figure 10**).

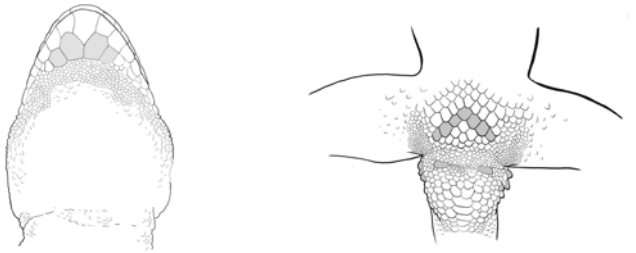


Figure 10 Ventral view of the head of Gekkota showing the postmental scales (absent in *Bunopus* and *Stenodactylus*) (left), and ventral view of the cloacal region of Gekkota showing the preanal pores, cloacal sacs and tubercles (absent in *Ptyodactylus* and *Pristurus*) (right).

Iguania

Iguanian lizards in AlUla can be easily distinguished by external morphological features, such as feet and tail shapes (**Figure 11**).

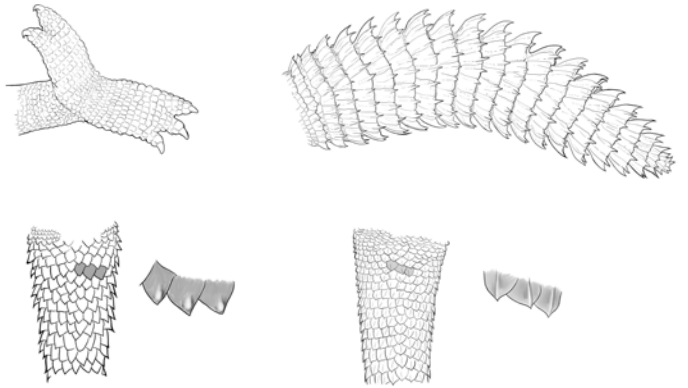


Figure 11 Relevant diagnostic traits to identify Iguanian lizards in AlUla. Chameleon foot with fused, opposable toes (top left), spiny tail in *Uromastyx* (top right), tail scales arranged in whorls in *Laudakia* (bottom right), and tail scales not arranged in whorls in *Pseudotrapelus*, *Trapelus* and *Phrynocephalus* (bottom left).

The presence and shape of the ear opening can also help in distinguishing three common genera (*Pseudotrapelus*, *Trapelus* and *Phrynocephalus*) (**Figure 12**).

Figure 12 Lateral view of the head of Iguanian lizards. Large and oval ear opening in Pseudotrapelus (left), small ear opening, partially covered by scales above in Trapelus (middle), and no external visible ear opening in Phrynocephalus (right).

The patterns and numbers of preanal pores can be used to identify the two species of *Pseudotrapelus* (**Figure 13**).

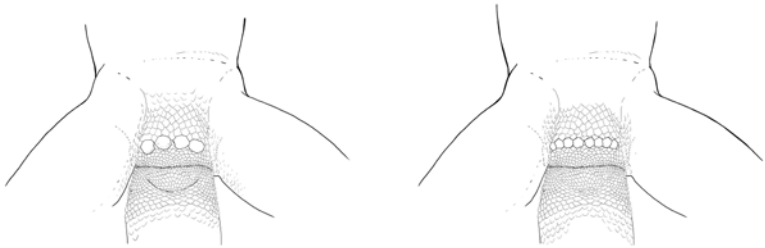


Figure 13 Ventral view of the cloacal region in *Pseudotrapelus*. *Pseudotrapelus aqabensis* (left) with 4 separated preanal pores, and *P. sinaitus* (right) with 6–8 preanal pores in contact with each other.

Lacertoidea

Lacertid lizards have rounded pupils, ventral scales bigger than dorsal scales, and developed femoral pores (**Figure 14**).

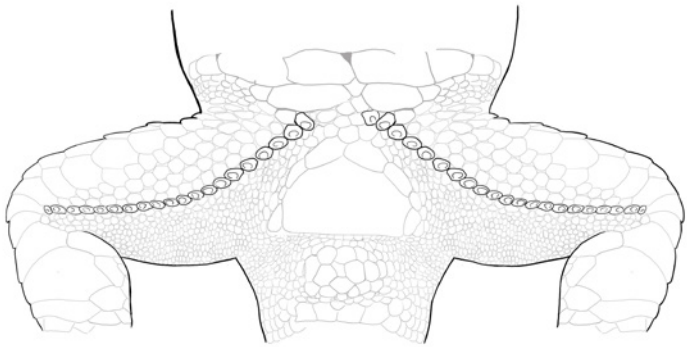


Figure 14 Ventral view of the cloacal region of Lacertoidea with detail of femoral pores.

Most species occurring in the AlUla region can be distinguished by their colouration, head scale patterns, or general body shape, as it is in the case of the only trogonophid limbless lizards (*Diplometopon zarudnyi*). This species can be easily distinguished from snakes because it has body scales arranged in rings and no enlarged ventral scales (**Figure 15**).

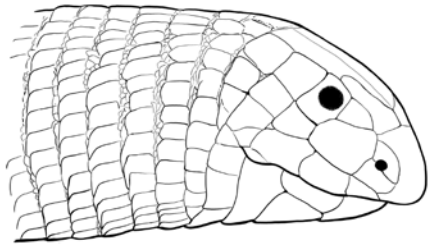


Figure 15 Lateral view of the head of *Diplometopon zarudnyi* with detail of scales arranged in rings.

The position of the nostril with respect to the supralabial scales allows distinguishing between the genera *Mesalina* and *Acanthodactylus* (**Figure 16**).

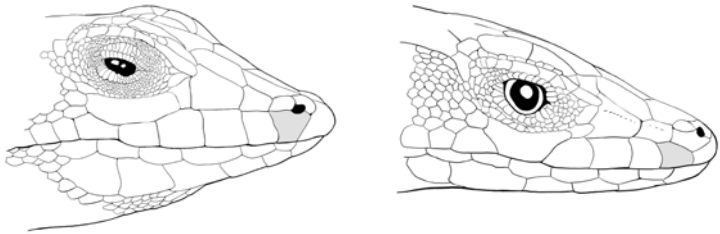


Figure 16 Lateral view of the head of the general *Acanthodactylus* (left) and *Mesalina* (right), with detail of nostril position with respect to the supralabial scales.

Little details in the dorsal pattern can help to tell apart similar species. For instance, *Acanthodactylus boskianus* and *A. opheodurus* have similar colouration, but can be easily distinguished by their unique dorsal pattern (**Figure 17**).

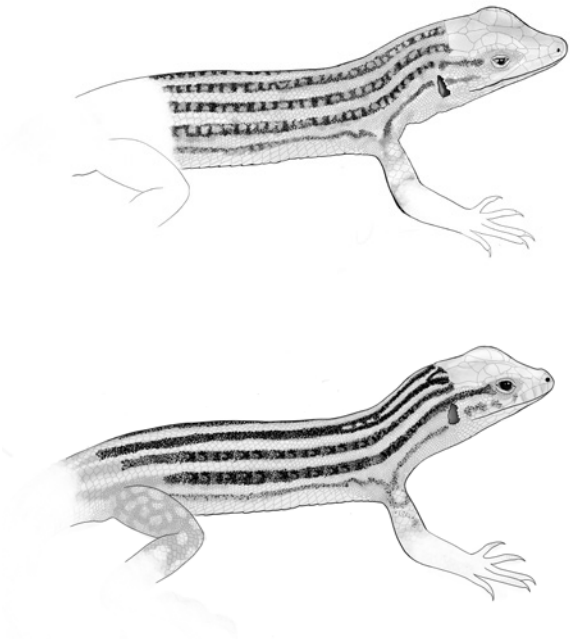


Figure 17 Dorsal view of juveniles of *Acanthodactylus opheodurus* (top) and *A. boskianus* (bottom) with detail of dorsal pattern 'Y-shaped' in this latter species.

Similarly, *A. schmidti* and *A. tilburyi* can be distinguished by the number of loreal scales and the size of the frontonasal scale, which in the latter one, touches the supralabials (**Figure 18**).

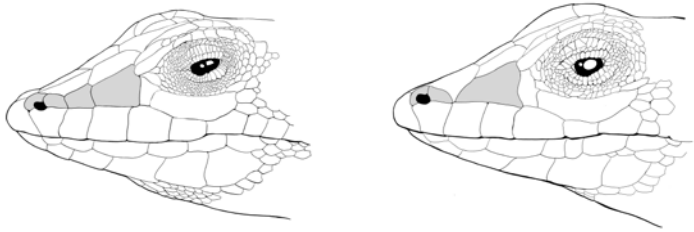


Figure 18 Lateral view of the head of *Acanthodactylus schmidti* (left) and *A. tilburyi* (right) with detail of loreal scales, only one in this latter species.

Scincoidea

Skinks have back and ventral scales about the same size, and shiny. They have round pupils, and do not have femoral or preanal pores.

The skinks occurring in AlUla can be easily distinguished by their colouration, toes and ear openings. The genus *Scincus* has flattened, fringed toes adapted to sandy habitats (**Figure 19**).

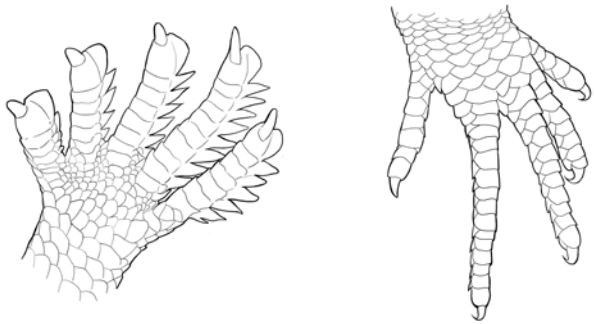


Figure 19 Detail of flattened, fringed toes in the genus *Scincus* (left) and cylindrical toes in the genus *Eumeces* (right).

Chalcides ocellatus and *Ablepharus pannonicus* have round ear openings, not covered by serrated scales, in contrast to *Eumeces schneiderii*, *Eurylepis taeniolata* and the genus *Scincus* (**Figure 20**).

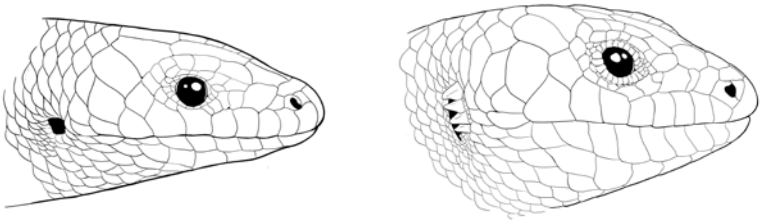


Figure 20 Lateral view of the head of Scincoidea with detail of round, visible ear opening not covered by serrated scales in *Chalcides ocellatus* and *Ablepharus pannonicus* (left), and ear opening covered by serrated scales in all other skinks occurring in the AlUla region (right).

The ear opening position concerning the mouth is relevant to distinguish *Scincus conirostris* from *S. mitranus* (**Figure 21**).

Figure 21 Lateral view of the head of *Scincus conirostris* (left) and *S. mitranus* (right) with detail of ear opening position concerning the mouth.

Serpentes

Snakes have a head scalation pattern similar to lizards (**Figure 22**).

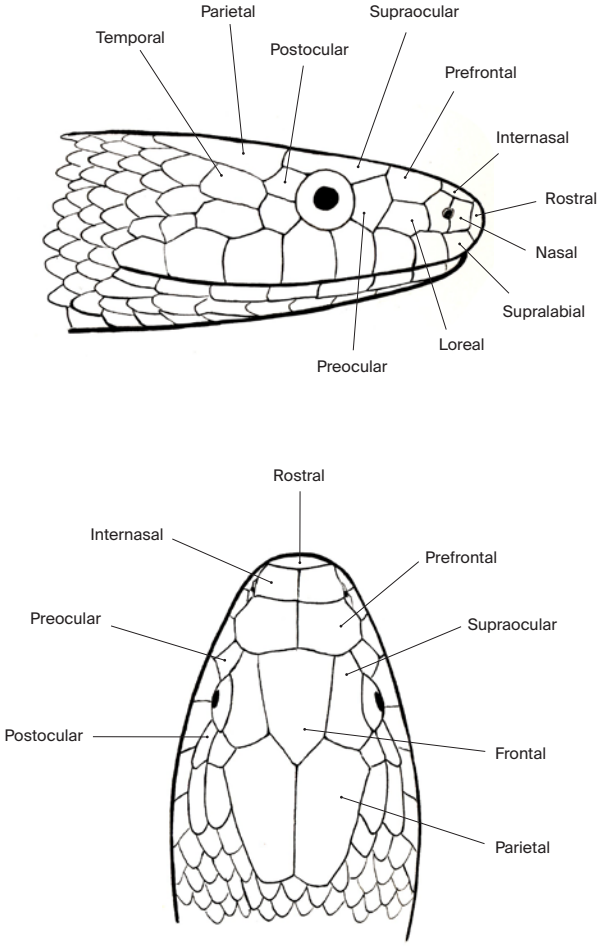


Figure 22 Lateral (left) and dorsal (right) views of the head of Serpentes, with names of the main scales used for identification purposes in the species accounts.

A relevant trait, although not conspicuous, to differentiate snakes, is the presence and position of maxillary teeth in the upper jaws. Venomous snakes possess specialised teeth (fangs) to deliver the venom. Snake fangs can be arranged at the back of the maxilla (rear-fanged snakes or opisthoglyphs), in front, fixed (front-fanged snakes or proteroglyphs) or moveable, with long fangs folded back into the mouth and in most species erected when biting (solenoglyphs). Snakes lacking fangs are called aglyphs (**Figure 23**).

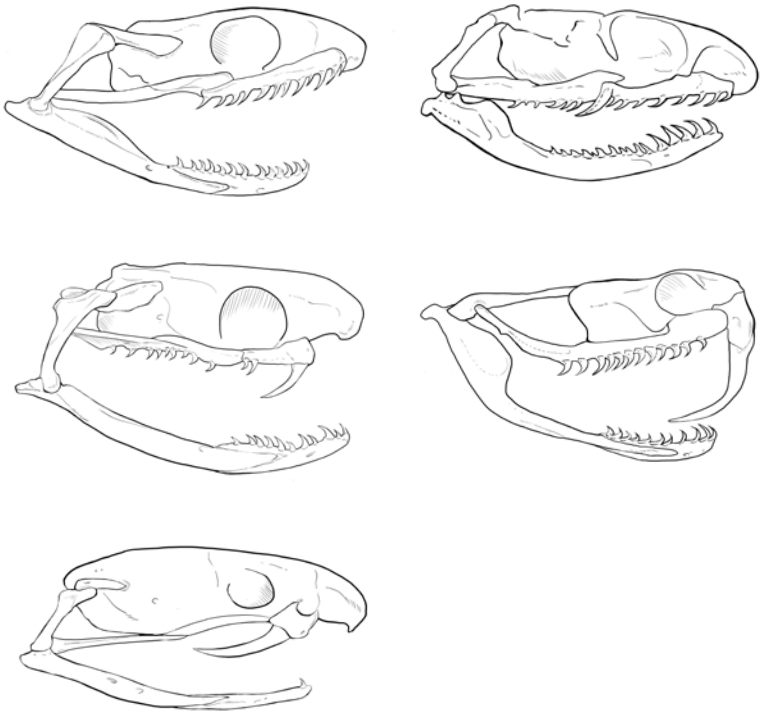


Figure 23 Snake dentition types. Aglyph (top left), opisthoglyph (top right), proteroglyph (mid left), solenoglyph (mid right), and particular solenoglyph dentition found in the genus *Atractaspis* (bottom left).

The snakes in the AlUla region can be distinguished by general external features (body shape, head scales, pupil shape and colouration).

The venomous vipers (*Echis coloratus* and *Cerastes gasperettii*) have keeled scales (**Figure 7**), a stout appearance, vertical pupils, and do not have enlarged scales on top of the head and snout (**Figure 24**). While this latter trait is only found in viperids, vertical pupils are also present in other non-venomous snakes in the AlUla region (*Eryx jaculus* and *Telescopus dhara*). The absence of loreal scales is another trait that allows the identification of venomous snakes (*Atractaspis engaddensis*, *Naja arabica*, and *Walterinnesia aegyptia*; **Figure 24**).

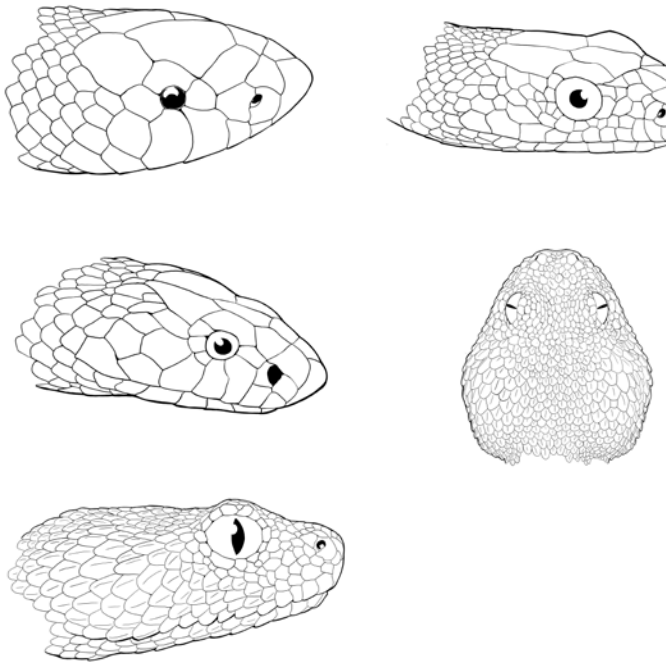
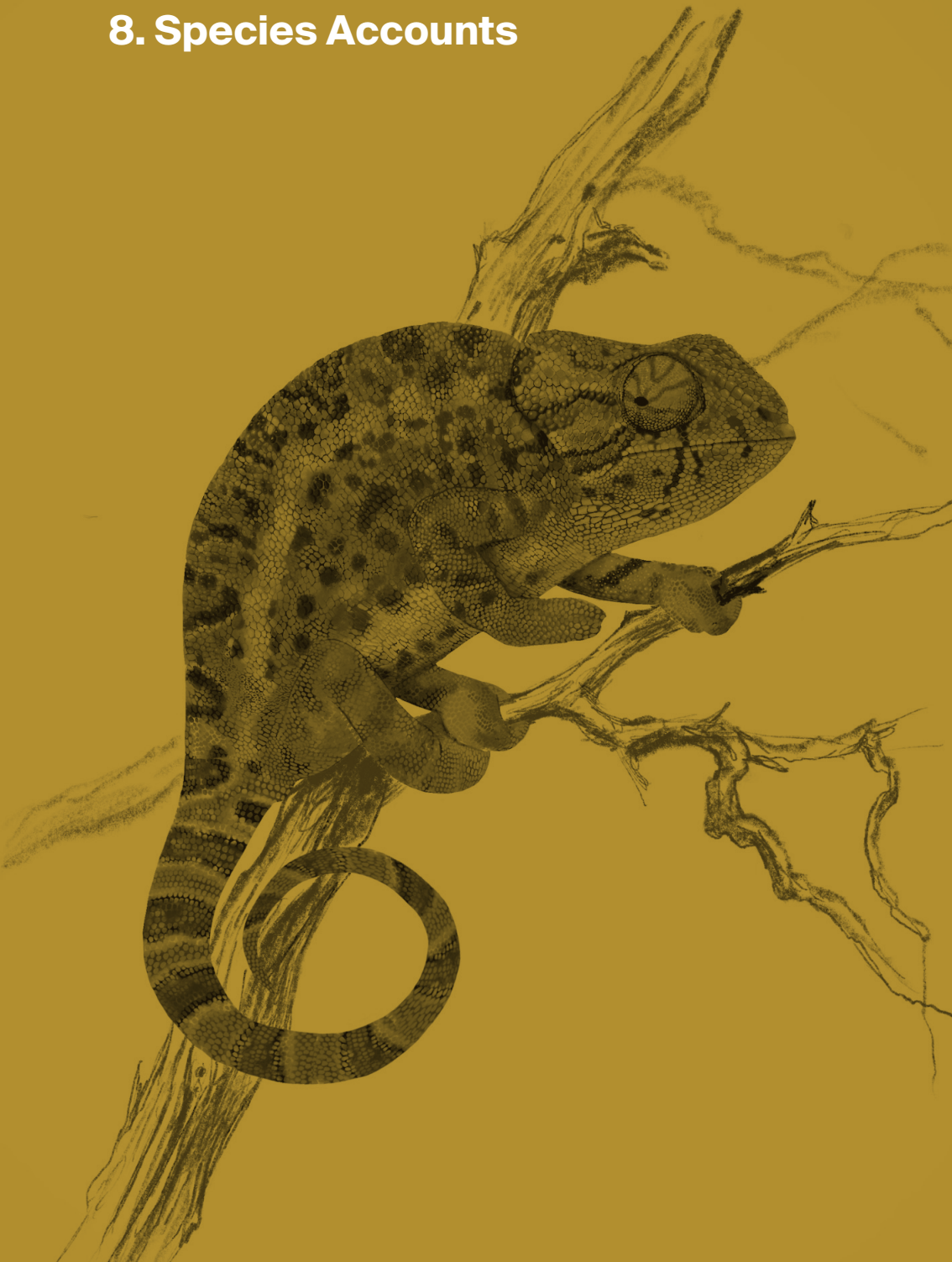
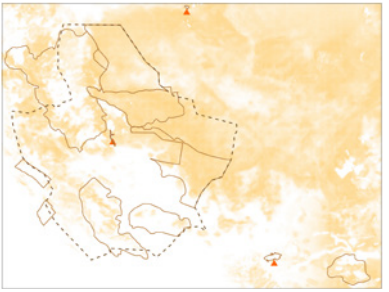


Figure 24 Lateral view of the head of snakes with different types and arrangements of scales. Enlarged head scales with loreal scale absent in the genus *Atractaspis* (top left), enlarged head scales with small loreal scales in the colubrid *Spalerosophis diadema* (top right), enlarged head scales with loreal scale absent in the elapid genus *Walterinnesia* (mid left), small head scales in the viperid genus *Echis* in dorsal (mid right) and lateral view (bottom right).

8. Species Accounts



Egyptian rock agama
Laudakia vulgaris (Sonnini & Latreille, 1801)



Global distribution: West of the Middle East.

Distribution in AlUla: Observed between 520 and 1,770 m a.s.l., can be found in all conservation areas except Jabal Nahar, Old Khaybar, and Tayma.

Measurements: TBL – 35 cm; SVL – 17 cm.

Identification: Medium size. Slightly depressed head. Typical yellowish-brown colouration, stained with 5–7 irregular, broken yellow blotches in adults. The tail has a banded pattern. Juveniles are more patterned and mottled than adults. 10–12 infralabial scales. Wide band of enlarged, heterogeneous vertebral scales. Irregular, smooth, transverse rows of enlarged, diffuse scales. Prominent claws. Tail segmented into 2 anterior ventral rings, often 3 in the distal half. Males with 3–5 rows of callous precloacal glands and an abdominal stripe.

Habitat and habits: Occurs in rocky arid and semi-arid environments, from lowlands up to 1,900 m, associated with large steep rocky outcrops where it climbs on for basking and territory control. Also found around buildings and cultivated areas. Diurnal, ambush predator, feeds on small arthropods and occasionally on plants. Body colour shifts according to mood and temperature (darker with cold, lighter and brighter with warmth). Shy temperament, it rapidly shelters in cracks if spotted. Males bob heads up and down when threatened.

Abundance: Abundant.

Conservation status: Global – LC; Regional – LC.

Arabian toadhead agama
Phrynocephalus arabicus Anderson, 1894

Global distribution: Arabian Peninsula.

Distribution in AlUla: Observed at 980 m a.s.l., north of Old Khaybar.

Measurements: TBL – 9.5 cm; SVL – 5 cm.

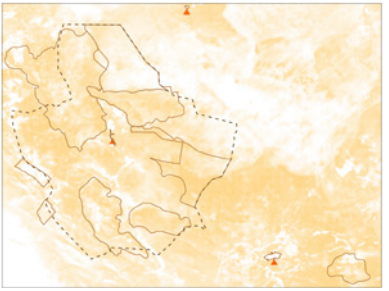
Identification: Large, flattened body, rounded head and shortened tail. Uniform yellowish colouration with dark-brown transverse bands. Dorsum lacks bright colour marks. Very short snout. Nasals in contact and directed upwards. Scales surrounding nostrils in contact on the midline. Usually 3–4 rows of scales between the eye and lip. Scales enlarged on the upper cheek. Covered tympanic opening, hidden under skin or absent. Gular sac absent. Sides of head and neck without projecting fringe-like scales. Dorsal scales are smooth to slightly keeled and homogenous. Femoral/preanal pores absent. Tail rounded and depressed at the base, presenting white colouration on the underside with a black tip and up to 7 black transverse bands. Toes with strong sharp-scaled fringes. Scales on the ventral side of the fourth toe, each with a single keel. Males larger than females.

Habitat and habits: Found on soft, wind-blown sandy areas like *wadi* beds, with scattered vegetation and boulders. Also present on hard, dry, slightly vegetated substrates. Diurnal, ambush predator, mainly insectivorous. When threatened, it stands on fully erected limbs with an open mouth, with the tail rolled up, or quickly buries itself into the loose sand. Darker tail colouration on the upper side when threatened, in contrast with whitish tones when in safe conditions. Shelters into small holes at the base of shrubs. Tail displays have a role in the territory and predator defence and courtship. Dominant males curl-uncurl their tails tightly up over their backs several times.

Abundance: Rare.

Conservation status: Global – LC; Regional – LC.

Aqaba agama
Pseudotrapelus aqabensis Melnikov, Nazarov, Ananjeva & Disi, 2012



Global distribution: West of the Middle East.

Distribution in AlUla: Observed between 720 and 1,700 m a.s.l., can be found in Harrat Khaybar, Harrat Uwayrid, Jabal Nahar and Wadi Nakhlah.

Measurements: TBL – 25 cm; SVL – 9 cm.

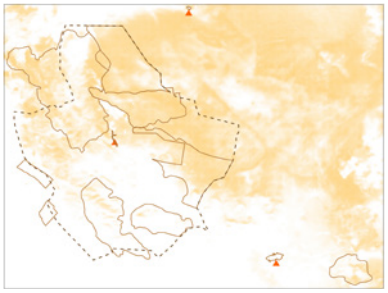
Identification: Slender, depressed body and head. Recognisable by a much longer third toe than the fourth and by large dorsal scales. Tympanic opening smaller than the eye, with one single conical scale at the front of the lower opening. Between 17–18 infralabial scales. Absence of gular sac. Smooth gular and ventral scales. Heterogeneous, weakly keeled dorsals with a longitudinal row of enlarged scales. Elongated limbs, hinds reaching the eye or snout when folded forward. The 3rd toe is much longer than the 4th toe. Greyish body colouration, except for grey-bluish head and arms. Pale vertebral band from just behind the back of the head along the body. Small dark oval patch in both lateral neck folds. Males present 4 well-separated, depressed preanal pores and no enlarged occipital scales. The 4 preanal pores are less developed in females.

Habitat and habits: Occurs in plain and mountain arid environments like canyons, foothills and *wadis*, often on stony slopes and large boulder conglomerations, with some level of vegetation cover. Most of its ecology remains unknown. Diurnal, likely omnivorous diet. When threatened, displays bluish colouration on the head, neck and shoulders.

Abundance: Scarce.

Conservation status: Global – NE; Regional – NE.

Sinai agama
Pseudotrapelus sinaitus (Heyden, 1827)



Global distribution: Northwest of Arabian Peninsula.

Distribution in AlUla: Observed between 820 and 1,240 m a.s.l., can be found in AlGharameel, Sharaan and Tayma.

Measurements: TBL – 26 cm; SVL – 9 cm.

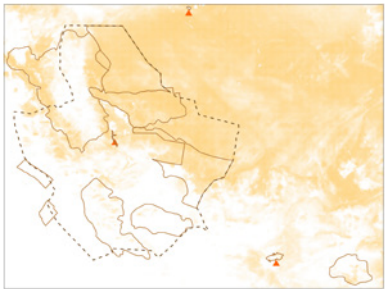
Identification: Large, slender head and body covered in small scales. Absence of thorn tufts on the sides of the head and neck and around the tympanum opening. Large tympanic opening, diameter twice the separation distance from the eye. Usually 15–18 infralabial scales. Nuchal crest absent. Small, evenly overlapping, weakly keeled spine scales. Elongated limbs, hinds reaching the eye or snout when folded forward. Equally-sized third and fourth toes. Between 15 and 17 lamellae under the fourth toe. Variable colouration, often vivid. Males with 6–8 unseparated, prominent precloacal pores, and females with 4 separated ones.

Habitat and habits: Occurs in hyper-arid environments, typically mountainous and hilly areas, often associated with bare rocky outcrops close to shelters in cracks and crevices. Absent from cultivated areas and non-vegetated stony plains, where it is exposed to predators, like birds of prey, snakes and canids. Diurnal, climbs on rocks for basking and territory control. Also present in loamy-gravel *hammadas*, dry grassland, black lava deserts and limestone slopes of *wadis* close to water sources. Omnivorous, with a substantial intake of plants. Also an ambush predator, feeding on insects. Distinctive head bobbing motion. Its colour becomes lighter at midday due to basking. Male colouration changes during mating from brown to turquoise blue. Threatened individuals may also display blue colouration. Females can present brown-reddish spots.

Abundance: Common.

Conservation status: Global – LC; Regional – LC.

Agnes' agama
Trapelus agnetae (Werner, 1929)



Global distribution: West of the Middle East.

Distribution in AlUla: Observed between 510 and 1,500 m a.s.l., can be found in all conservation areas except AlUla Oasis, Harrat Khaybar, Jabal Al Ward, Jabal Nahar, Jabal Shayhoub and Tayma.

Measurements: TBL – 19 cm; SVL – 8.8 cm.

Identification: Medium-size, depressed body. Light grey colour, with dorsal rhomboidal strikes and dark rings on the tail. Unlike *Trapelus mutabilis,* has 1–2 rows of 3–4 distinct spines on the ear's upper edge opening, and small, irregular, imbricate, indistinctly keeled scales on the dorsal body and hind limbs, intermixed with irregular scattered much larger ones, each of which bears a short keel or spine. Triangular head, longer than broad, very convex, short and thick. Upper head scales nearly smooth, some enlarged, occasionally with weakened keels on temporal and supratemporal, and few occipitals. Small tympanic opening, twice as long as high. Flat nasal shield. Nostril slightly above the canthus rostralis. Between 17–19 supralabials and infralabials. No gular sac. Usually smooth ventrals. Relatively long limbs ending in long, sharp-clawed fingers. Variable scales in upper lower leg parts and tail base. Much shorter third toe than the fourth. Males possess 1–3 rows of anal pores, with 9–13 total pores per row. No anal pores in females.

Habitat and habits: Rock-dwelling, occurs in open flat arid environments, typically in dry compact soils such as gravel and stony plains, lava deserts and *hammadas*, associated with stones, dry grasslands and bushes. Also present in sandy vegetated areas such as *wadis* and depressions. Diurnal, likely feeds on small insects like ants. Predated by owls and other birds. Defensive behaviour includes body flattering to the ground, staying motionless, or warning signals, such as opening the mouth.

Abundance: Common.

Conservation status: Global – LC; Regional – LC.

Yellow-spotted agama
Trapelus flavimaculatus Rüppel, 1835

Global distribution: Arabian Peninsula.

Distribution in AlUla: Observed at the sea level, southwest of Jabal Shayhoub.

Measurements: TBL – 30 cm; SVL – 10 cm.

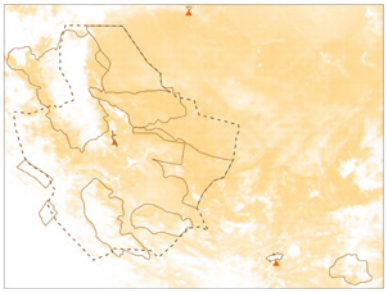
Identification: Medium size. Light-coloured spots spread over the entire body. Distinguishable from other congeneric species by its large, regular, strongly keeled and pointed scales, and strongly keeled caudal scales. Small tympanic opening. Presence of gular sac. Heterogeneous dorsal scales. Spinose scales on the back of the head. Absence of preanal pores and callose scales. Fourth hind toe longer than the third. Males are blue on the ventral surface of the neck during the breeding season, with a red-orange tail. Females are grey or brown, with dark crossbars across the back and tail.

Habitat and habits: Occurs in open areas from sea level to 1,200 m elevation, on stable sand, gravel surfaces and even *sabkhas*, typically associated with low vegetation, including bushes, shrubs and trees. Can be found sun-basking on the branches of small acacia, and on the ground in sandy areas. Present in artificial habitats such as palm plantations and around buildings, where it is found basking on stones and earth. Diurnal, ambush predator, feeds mostly on ants and other insects, and occasionally on larger animals. Displays warning behaviour when approached, opening mouth and hissing, and gular sac becomes darkened and inflated. Males exhibit conspicuous mating colouration, sometimes displayed from prominent locations on bushes or gravel mounds.

Abundance: Rare.

Conservation status: Global – LC; Regional – LC.

Egyptian mastigure
Uromastyx aegyptia (Forskål, 1775)



Global distribution: Egypt and Arabian Peninsula.

Distribution in AlUla: Observed between 330 and 1,490 m a.s.l., can be found in AlGharameel, Sharaan, Harrat Khaybar, Tayma and Wadi Nakhlah.

Measurements: TBL – 60 cm; SVL – 35 cm.

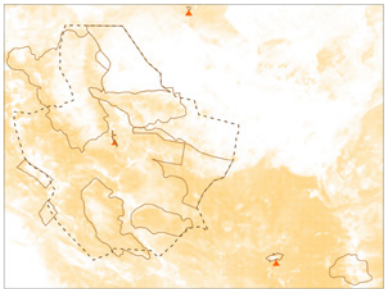
Identification: Largest species in the genus. Flat body covered by small, smooth scales. Olive-grey colour with small dorsal dark spots. Lighter tail and abdomen. Triangular head with strong jaws and small teeth. Enlarged rostral, larger than mental. Small spinous tubercles on flanks. Several scales at mid-body (usually 247–311). Between 149 and 193 ventrals. Possesses 13–21 femoral/preanal pores on each side. Limbs end with five clawed fingers. Cone-shaped spiny tail, covered by zigzag sharp thorns. Absence of intercalary scales between the annuli of the tail, where only the last 2–8 whorls (from a total of 20–24) present a continuous scale row each. Juveniles present 5–6 crossed yellow bands.

Habitat and habits: Found in open, flat hyper-arid areas, including alluvial fans, gravel plains and *wadis*, on rocky substrates with sparse vegetation. Absent from dunes, dry water courses and loose saline soil. Diurnal, solitary, but forms loose colonies occupying extensive territories. Burrows are usually between 80–120 cm deep but up to 180 cm, with a single entrance, vegetation protection and a perimeter wall for thermoregulation and protection. Opportunistic herbivorous, feeding primarily on plant material like leaves, buds, fruits, seeds, and flowers of shrubs and acacias. Occasional predation on insects like grasshoppers, crickets and worms, and scavenger behaviour of vertebrate-origin food. Juveniles hunted by canids, monitor lizards, snakes and birds (raptors and shrikes). Spiny tail used for defence. It can climb on acacias.

Abundance: Abundant.

Conservation status: Global – VU A2abcd+4abcd; Regional – VU A2abcd+4abcd.

Ornate mastigure
Uromastyx ornata Heiden, 1827



Global distribution: West of Arabian Peninsula and Sinai.

Distribution in AlUla: Observed between 700 and 1,190 m a.s.l., can be found in Wadi Nakhlah, Jabal Nahar, Harrat AlZabin, Harrat Uwayrid and AlUla Oasis.

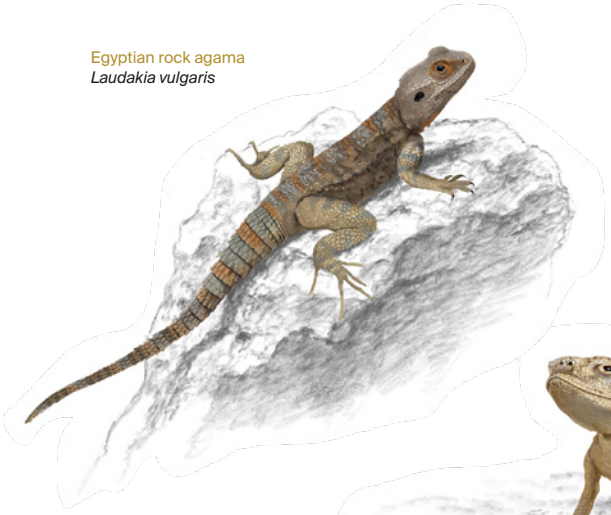
Measurements: TBL – 35 cm; SVL – 18 cm.

Identification: Smaller size and highly variable morphology in comparison to *U. aegyptia*. Large, triangular scales cover the anterior margin of the ear. Between 149–185 large dorsal scales around the mid-body. Presence of 7–14 femoral/preanal pores, clearly marked in males. Short, narrow, flatted tail, with tail length ratio to SVL around 0–7. Between 20 and 30 whorls in the tail, with annuli arranged in a continuous scale row in the last 8–21 whorls. Males are more colourful than females. Male coloration is green, blue or red, with an irregularly reddish-brown net-like pattern, yellow spots on the back, and sometimes also yellow cross-bands. Dark ventral pattern. Females are light brown with dark brown spots, sometimes light yellow or light red spots, and a yellowish or white belly without pattern.

Habitat and habits: Occupies arid and hyper-arid environments up to 1,000 m elevation, typically *wadis* and their surrounding slopes, on firm soil covered with granite rocks, scattered stones or gravel, with sparse acacia and shrubby vegetation. Absent from sandy dunes. Diurnal, solitary or in small groups. It shelters preferably in cracks and crevices. Females dig nesting burrows 100 cm deep, usually on *wadi* beds. Opportunistic herbivorous, feeding primarily on plant material like flowers, fruits and leaves. Hunted by large mammals, reptiles and raptors. It can climb on acacias. Curious mating behaviour, where males flip females onto their backs and walk in circles on their bellies.

Abundance: Common.

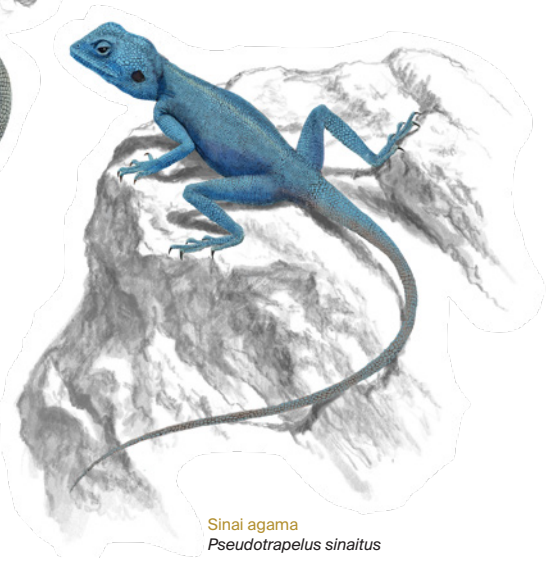
Conservation status: Global – LC; Regional – LC.



Egyptian rock agama
Laudakia vulgaris

Arabian toadhead agama
Phrynocephalus arabicus

Aqaba agama
Pseudotrapelus aqabensis



Sinai agama
Pseudotrapelus sinaitus

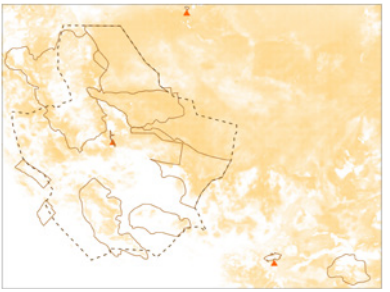
Yellow-spotted agama
Trapelus flavimaculatus

Agnes' agama
Trapelus agnetae

Egyptian mastigure
Uromastyx aegyptia

Ornate mastigure
Uromastyx ornata

Common chameleon
Chamaeleo chamaeleon (Linnaeus, 1758)



Global distribution: North Africa, South Europe, Near East and Arabian Peninsula.

Distribution in AlUla: Observed between 800 and 1,470 m a.s.l., can be found in Harrat Uwayrid and Jabal Al Ward.

Measurements: TBL – 30 cm; SVL – 15 cm.

Identification: Medium- to large-sized lizard with a distinctive pyramid-shaped head and pronounced lateral and parietal crests forming a pointed helmet towards the back. Conical eyes, laterally protruding and protected by fused lids of granular scales. Body laterally compressed; limbs highly mobile with characteristic pincer-like fused fingers. The tail is prehensile and about the same size as SVL.

Colouration and patterns are highly variable according to season and disposition of the animal, typically greenish or grey with two lateral whitish bands, small dark spots and a ventral white line from throat to vent.

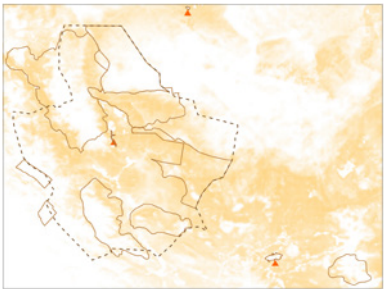
Habitat and habits: Diurnal and arboreal. Inhabits regions with more or less dense vegetation. It is usually found on low vegetation but often on the ground. The specialised tongue apparatus allows chameleons to catch prey from a distance. As a result, chameleons are principally sit-and-wait predators, generally feeding on insects and other arthropods, but exceptionally feeding on small reptiles or fruits, leaves and flowers. Females may lay up to 66 relatively small eggs.

Abundance: Scarce.

Conservation status: Global – LC; Regional – LC.

Common chameleon
Chamaeleo chamaeleon

Baluch rock gecko
Bunopus tuberculatus Blanford, 1874 **complex**



Global distribution: Arabic Peninsula, south-west Asia.

Distribution in AlUla: Observed between 430 and 1,410 m a.s.l., can be found in all conservation areas except AlGharameel, Jabal Shayhoub, Old Khaybar and Tayma.

Measurements: TBL – 13 cm; SVL – 5.7 cm.

Identification: Medium-sized, terrestrial gecko with a moderately depressed body. Eyes with vertical pupils with irregular borders. Body covered in the dorsal part with small flat scales and about 14 longitudinal rows of large, strongly protruding trihedral tubercles. Ventral scales are small and smooth. Males with 8–21 preanal pores and hemipenial pouches on the side of the tail, ventrally. Tail slightly flattened, about the same size or slightly longer than the body size, with rings of enlarged keeled tubercles. Toes slender, not strongly kinked, without toe pads. Dorsum from light brown to greyish, with irregular, darker blotches or crossbars. A dark band extends from the nostril through the eye, prolonging to the back of the head.

Habitat and habits: Ground-dwelling, nocturnal gecko occurring in the sandy, rocky or stony desert, and semi-desert habitats with some vegetation. Generalist predator of small insects and other arthropods. Females lay 1 or 2 hard-shelled eggs under rocks or in burrows.

Abundance: Abundant.

Conservation status: Global – LC; Regional – LC.

Rough bent-toed gecko
Cyrtopodion scabrum (Heyden, 1827)

Global distribution: East Africa along the Red Sea, Arabian Peninsula, and south-west Asia.

Distribution in AlUla: Observed at 150 m a.s.l., south-west of Jabal Shayhoub.

Measurements: TBL – 10 cm; SVL – 5.5 cm.

Identification: Relatively slender gecko with numerous dorsal tubercles. Head elongated, oval, and moderately flattened. Two pairs of enlarged postmental scales. Large eyes, vertical pupils with irregular borders. Body dorsally covered with small flat scales and 12–16 longitudinal rows of strongly keeled, trihedral tubercles. Ventral scales large, hexagonal and imbricate. Males with 4–7 preanal pores under each thigh and ventral hemipenial pouches on the side of the tail. Long, slender toes, strongly kinked, without toe pads, and with smooth transverse subdigital lamellae. Colouration variable, but usually cream greyish, brownish or pinkish with longitudinal rows of brown irregular spots. Tail with a series of transverse dark bars above.

Habitat and habits: Nocturnal, semi-terrestrial gecko associated with human settlements, where it can be found on walls, rock piles, gardens and rubbish dumps, and also on rocky outcrops. Generalist predator of small insects and other arthropods. Females may lay multiple clutches of 1 or 2 hard-shelled eggs, often in communal nesting.

Abundance: Rare.

Conservation status: Global – LC; Regional – LC.

Sub-order Gekkota

Yellow-belly gecko
Hemidactylus flaviviridis Rüppel, 1835

Global distribution: South-west Asia, Arabian Peninsula and East Africa.

Distribution in AlUla: Observed between 0 and 150 m a.s.l., southwest of Jabal Shayhoub.

Measurements: TBL – 20 cm; SVL – 9.5 cm.

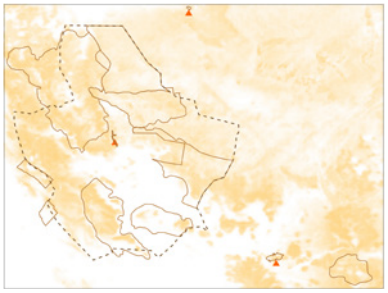
Identification: Medium-sized gecko with depressed body and wide head. Eyes with vertical pupils. Body dorsally covered with small flat scales and no enlarged tubercles. Tail about the same size or 1.2 times the SVL. Two or three pairs of postmental scales. Males with 4–14 femoral pores under each thigh. Digital pads are strongly expanded. 7–10 lamellae under the first toe, and 11–14 lamellae under the fourth toe. Variable dorsal colouration, from yellowish-white to darker brown or grey, with five wavy transverse bands during the day. Ventral colouration is more uniform, whitish or yellow.

Habitat and habits: Mainly nocturnal gecko, commonly observed in urban areas, both inside and outside houses, where it can be found on walls while preying upon moths and other arthropods. An agile climber, it can move quickly even on smooth walls and ceilings. Females lay clutches of 2 hard-shelled eggs.

Abundance: Scarce.

Conservation status: Global – LC; Regional – LC.

Grainy house gecko
Hemidactylus granosus Heiden, 1827 **complex**



Global distribution: Arabian and Sinai Peninsulas.

Distribution in AlUla: Observed between 0 and 1,400 m a.s.l., can be found in Harrat Uwayrid, Old Khaybar, Harrat Khaybar, Jabal Al Ward, Jabal Shayhoub and AlUla Oasis.

Measurements: TBL – 12 cm; SVL – 5.3 cm.

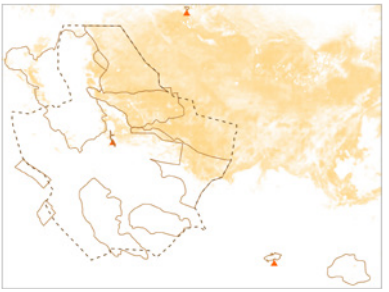
Identification: Small- to medium-sized gecko with a rather elongated head. Eyes with vertical pupils with irregular borders. Body dorsally covered by 14–15 longitudinal rows of enlarged, ovoidal/trihedral, keeled dorsal tubercles. Cloacal sacs sometimes present. Males with 4–7 preanal pores. Large anterior postmental scales in contact with the first and second lower labials. Tail about the same size or 1.3 times the SVL, with 6-8 pointed tubercles in the anterior part, and with alternating dark and light transverse bands more or less contrasted. Dorsal colouration is pale brown with dark brown spots forming transverse bands or crosses, and dark stripes in prefrontal and temporal regions. Tail with 10–13 dark brown transverse bands. Ventral colouration white. In AlUla, at least 2 more species closely related to *H. granosus* also occur; however, they are morphologically highly similar to the nominal species of the group.

Habitat and habits: Nocturnal gecko occurring in rocky cliffs, boulders, ruins and building walls. It is often associated with human settlements, often entering houses and inhabiting crop fields. It is occasionally also found on trees. Generalist predator of small insects and other arthropods.

Abundance: Common.

Conservation status: Global – LC; Regional – NE.

Dune sand gecko
Stenodactylus doriae (Blanford, 1874)



Global distribution: Arabian Peninsula and Middle East.

Distribution in AlUla: Observed between 780 and 1,270 m a.s.l., can be found in AlGharameel, Harrat Uwayrid, Sharaan and Wadi Nakhlah.

Measurements: TBL – 17 cm; SVL – 8.3 cm.

Identification: Medium- to large-sized, robust terrestrial gecko with a large head and moderately protruding nostrils in contact with the rostral scale and usually also with the supralabials. Large eyes with vertical pupils. Relatively small ear opening. Two preanal pores usually present in both sexes, and cloacal tubercles usually disposed in two rows. Digits without toe pads. Toes strongly depressed on the forefeet with a distinct lateral fringe of pointed scales, and 5–13 rows of scales beneath. Dorsal colouration variable, slightly translucent, with pinkish, light, grey, brown and yellow spots and blotches. These latter, sometimes fuse into darker longitudinal streaks. Tail with dorsal bars.

Habitat and habits: Terrestrial, strictly nocturnal gecko found in desert regions, on soft sandy areas with dunes and scattered vegetation. Activity starts normally one hour after dusk. It normally preys on insects and other arthropods, but large individuals may also feed on small geckos. If threatened, adopt a raised, stiff-legged posture. Males vocalise (call: 3–6 clicks). Females lay 1 or 2 eggs in several clutches per year.

Abundance: Common.

Conservation status: Global – LC; Regional – LC.

Slevin's short-fingered gecko
Stenodactylus slevini Haas, 1957

Global distribution: Arabian Peninsula.

Distribution in AlUla: Observed between 790 and 1,640 m a.s.l., can be found in Sharaan, Harrat AlZabin, Harrat Khaybar, Harrat Uwayrid and Wadi Nakhlah.

Measurements: TBL – 10 cm; SVL – 6.5 cm.

Identification: Medium-sized, with small head and body. The head presents two small 'V' shaped lines. Rostral, but not the first supralabial, reaches the nostril. Strong prefrontal projection. Hourglass-shape in eyes. Body limbs ending with small fingernails. Cloacal tubercles, typically in a single row. Toes not depressed, without a distinct lateral fringe, and with three rows of scales beneath. Medium-length tail with dark rings, usually with 7–12 regular and conspicuous dark bands extending to the tip.

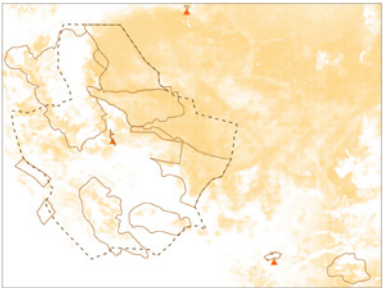
Habitat and habits: Inhabits desert and semi-desert environments from sea level to 1,000 m altitude. Typically found on compact and hard substrates with scattered shrubs, but also in the transition between the sandy and the gravel, or stony deserts, in open plains. Nocturnal. Feeds mainly on insects and other arthropods. Autotomy is restricted to the tail base.

Abundance: Common.

Conservation status: Global – LC; Regional – LC.

Yom-Tov's sand gecko

Tropiocolotes yomtovi Ribeiro-Junior, Tamar, Maza, Flecks, Wagner, Shacham, Calvo, Geniez, Crochet, Koch, & Meiri, 2022 **complex**



Global distribution: North-west Arabian Peninsula and Sinai Peninsula.

Distribution in AlUla: Observed between 560 and 1,460 m a.s.l., can be found in all conservation areas except AlUla Oasis, Jabal Nahar, Tayma and Old Khaybar.

Measurements: TBL – 6 cm; SVL – 2.8 cm.

Identification: Slender and tiny gecko with a more or less oval head and a short, pointed snout. Tail longer than SVL. Tiny, clawed digits with no adhesive pads and keeled subdigital lamellae. Dorsal scales are small and homogeneous. Males with 1 or 2 preanal pores. Dorsal colouration is pale yellow, sandy yellow or yellowish-grey with 4 or 5 dark and light undulating bands. The tail has 8–10 dark brown bars. Colouration changes abruptly during the day, with faded patterns during the night. In AlUla, at least 1 more species closely related to *T. yomtovi* also occurs; however, it is morphologically highly similar to the nominal species of the group.

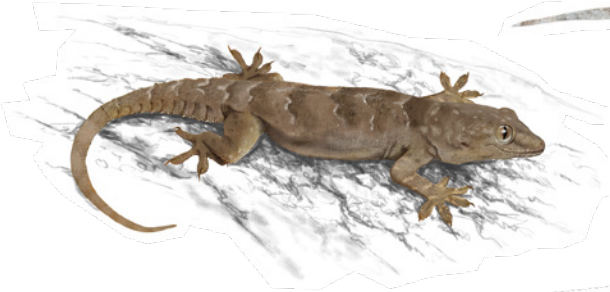
Habitat and habits: Nocturnal, terrestrial gecko found in desert and semi-desert regions, usually in rocky or stony habitats. Females lay a single, relatively large egg per clutch. It feeds on small insects and other arthropods. If threatened, it produces a typical distress call.

Abundance: Common.

Conservation status: Global – NE; Regional – NE.

Baluch rock gecko
Bunopus tuberculatus

Rough bent-toed gecko
Cyrtopodion scabrum

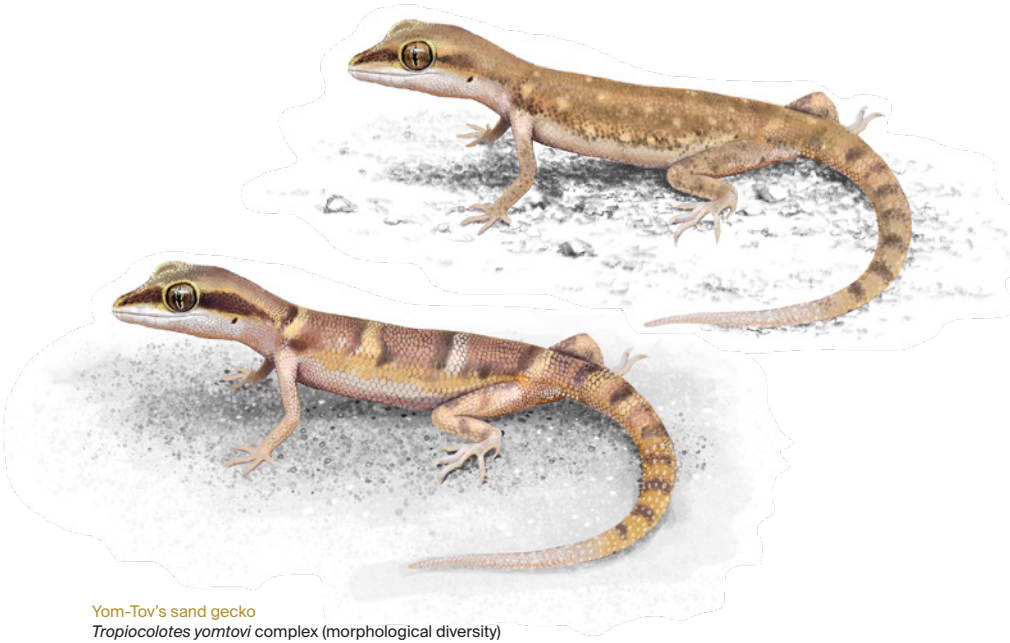


Yellow-belly gecko
Hemidactylus flaviviridis

Grainy house gecko
Hemidactylus granosus complex
(morphological diversity)

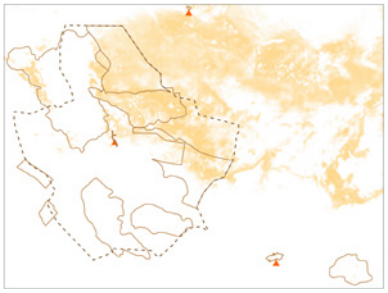
Dune sand gecko
Stenodactylus doriae

Slevin's short-fingered gecko
Stenodactylus slevini



Yom-Tov's sand gecko
Tropiocolotes yomtovi complex (morphological diversity)

Ananjeva's fan-fingered gecko
Ptyodactylus ananjevae Nazarov, Melnikov & Melnikova, 2013



Global distribution: North-west Arabian Peninsula.

Distribution in AlUla: Observed between 800 and 1,190 m a.s.l., can be found in AlGharameel, Sharaan, Tayma and Harrat Uwayrid.

Measurements: TBL – 13.5 cm; SVL – 8 cm.

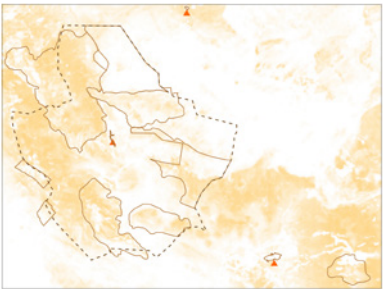
Identification: Medium-sized gecko, with tail slightly longer or equal to the body. Differs from congeneric species by a pattern of small dark reddish-brownish and light patches of irregular shape, a conspicuous contrast head pattern formed by small dark brick-red and light dots, relatively narrow head with elongated rostrum, lack of developed tail segments, and smaller ventral scales (203-207 in *P. ananjevae*, 118-151 in *P. guttatus*, and 110-170 in *P. hasselquistii*). Dorsal colour overall ground, beige and reddish. Dorsal tubercles are rounded, triangle-shaped, and usually enlarged 4–6 times more than the surrounding scales, with developed keels. Enlarged, rounded tubercles cover the sides of the head in the occipital area. No tubercles in the parietal head area. Enlarged tubercles well-developed on the dorsal parts of proximities. Larger, rounded light patches are distinguished along the vertebra. Tail presents between 10–12 transversal dark wide bands, where the width of bands is bigger than the spaces between them. Whitish ventral part of the tail.

Habitat and habits: Barely known species. Mostly nocturnal habits. Distributed in arid and semi-arid areas, sometimes found close to human settlements and inside houses. Both sexes vocalise. It feeds on insects and other arthropods.

Abundance: Common.

Conservation status: Global – NE; Regional – NE.

Sinai fan-fingered gecko
Ptyodactylus guttatus Heyden, 1827



Global distribution: North-west Arabian Peninsula and Sinai Peninsula.

Distribution in AlUla: Observed between 360 and 1,710 m a.s.l., can be found in Jabal Al Ward, Jabal Shayhoub, Harrat AlZabin, Harrat Khaybar and Harrat Uwayrid.

Measurements: TBL – 17.4 cm; SVL – 9.1 cm.

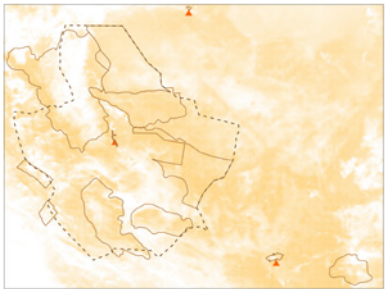
Identification: Medium-sized slender gecko with a triangular head and long extremities. All digits are clawed and with adhesive fan-arranged pads, typical of the genus, each having an average of 20 lamellae below (18 in *P. hasselquistii*). Dorsal scales are small and granular, with interspersed single-keeled tubercles. Tail slender, shorter than SVL, with 31–35 caudal rings that are well-developed (but not in *P. ananjevae*). Males are slenderer than females, have larger heads, more contrasted colouration, and distinctly swollen hemipenial pouches. Dorsal colouration varies depending on the substrate, but generally is light sand grey or pale grey, with light and dark spots forming more or less evident transverse rows and bands.

Habitat and habits: Both nocturnal and diurnal habits, with individuals commonly observed basking during the early morning hours, and later found close to crevice entrances, in the shade. It is found on vertical rocky surfaces, boulders, under ledges, and in caves, and it normally avoids urban areas. Both sexes vocalise. Females lay multiple clutches of 2 hard-shelled, nearly spherical eggs, attached to the rock surface. Communal nesting is common. It feeds on insects and other arthropods.

Abundance: Common.

Conservation status: Global – LC; Regional – NE.

Yellow fan-fingered gecko
Ptyodactylus hasselquistii (Donndorff, 1798) complex



Global distribution: North-west Arabian Peninsula, south-west Asia, North Africa.

Distribution in AlUla: Observed between 560 and 1,400 m a.s.l., can be found in all conservation areas.

Measurements: TBL – 17 cm; SVL – 8.7 cm.

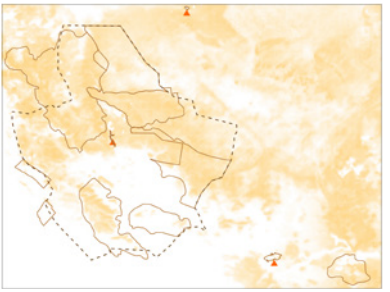
Identification: Medium-sized slender gecko with a triangular head and long extremities. Large eyes with vertical pupils and yellowish or brownish iris. All digits are clawed and with adhesive fan-arranged pads, typical of the genus, each having an average of 18 lamellae below. Dorsal scales are small and granular, with interspersed single-keeled tubercles. Tail slender, about the same size as SVL, with 31–35 caudal whorls that are well-developed (but not in *P. ananjevae*). Males are slenderer than females, have larger heads, more contrasted colouration, and distinctly swollen hemipenial pouches. Dorsal colouration varies depending on the substrate, but generally is light brown and grey, with orange or pinkish shade. Dorsal pattern consists of irregular spots and dots or transverse brownish to orange-brown cross-bands, giving a marbled appearance. In AlUla, at least 1 more species closely related to *P. hasselquistii* also occurs; however, it is morphologically highly similar to the nominal species of the group.

Habitat and habits: Both nocturnal and diurnal habits, with individuals commonly observed basking during the early morning hours, and later found close to crevice entrances, in the shade. It is commonly found in association with human settlements, and it often enters houses. It also inhabits rocky cliffs, caves, deep dry rocky *wadi* surfaces, and groups of big boulders. Both sexes vocalise. Females lay multiple clutches of 2 hard-shelled, nearly spherical eggs, attached to the rock surface. Communal nesting is common. It feeds on insects and other arthropods.

Abundance: Abundant.

Conservation status: Global – LC; Regional – LC.

Haas' semaphore gecko
Pristurus guweirensis Haas, 1943



Global distribution: Oman, Yemen, Saudi Arabia and southern Jordan.

Distribution in AlUla: Observed between 720 and 1,710 m a.s.l., can be found in all conservation areas except Jabal Nahar, Jabal Shayhoub, Sharaan and Tayma.

Measurements: TBL – 5.3 cm; SVL – 2.4 cm.

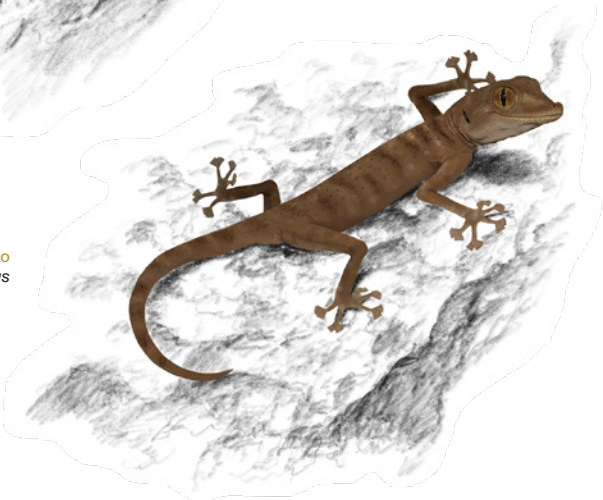
Identification: Tiny, rock-dwelling gecko with short and high head, moderately pointed snout. Eyes moderately large, with rounded pupils and orange-grey iris. Large mental scale, and postmental scales absent. Body and limbs covered with granular scales, with polygonal convex scales present only on the snout. Slender, clawed digits. The tail is laterally compressed, keeled medially above and beneath, and it is longer than SVL. Males with dorsal denticulate tail keels are more distinct, forming a crest of enlarged conical scales, never extending to the body. Dorsal colouration varies between pale grey and brown, with a pattern of more or less distinct longitudinal rows of light and brown to red spots. Dark band on the side of the head, passing through the eye, and oblique dark stripes on the throat.

Habitat and habits: Diurnal, territorial gecko inhabiting rocky cliffs and steep slopes of rocky *wadis*. It is often found on boulders, tree trunks, walls, houses and gardens. This species uses vertical and horizontal tail waving and curling for communicating with conspecifics. It is active all year round, in the late morning hours and in the afternoon. Females lay single oval eggs. Sit-and-wait predator, feeds on ants and a variety of other small arthropods.

Abundance: Abundant.

Conservation status: Global – NE; Regional – NE.

Ananjeva's fan-fingered gecko
Ptyodactylus ananjevae



Sinai fan-fingered gecko
Ptyodactylus guttatus

Yellow fan-fingered gecko
Ptyodactylus hasselquistii

Haas' semaphore gecko
Pristurus guweirensis

Sub-order Scincoidea

Asian snake-eyed skink
Ablepharus pannonicus (Lichtenstein, 1823)

Global distribution: Southwest of Asia.

Distribution in AlUla: Observed at 760 m a.s.l., can be found in AlUla Oasis.

Measurements: TBL – 14 cm; SVL – 6 cm.

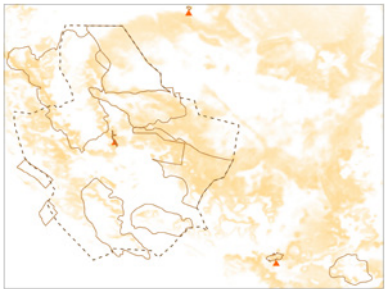
Identification: Small size. Differentiated from congeneric species by smaller tympanic opening and the number of dorsal scales around mid-body (20–22). Single frontoparietal scale. Prefrontals in contact. Absence of supraciliary granules. Long thin post-orbital bone. Obvious tympanum. Females larger than males. Dorsal colouration is olive-brown in females and olive-metallic in males.

Habitat and habits: Variable habitat, including lowland clay, limestone or grassy semi-desert and rocky hillsides at high elevations. Also found in sparsely wooded environments, rocky steppes, fluvial plains and palm groves. Absent from truly desert areas. Diurnal. It hides under rocks or leaves, or among sparse grasses and thorny bushes. Likely a generalist predator of small, mainly flightless arthropod prey.

Abundance: Common.

Conservation status: Global – LC; Regional – LC.

Ocellated bronze skink
Chalcides ocellatus (Forskål, 1775)



Global distribution: North Africa and West of Eurasia.

Distribution in AlUla: Observed between 700 and 1,670 m a.s.l., can be found in AlUla Oasis, Harrat Uwayrid and Old Khaybar.

Measurements: TBL – 28 cm; SVL – 14 cm.

Identification: Elongated medium-size body. Variable colouration, dorsum pale sand with small ocelli. Blunt snout, projecting beyond labial margin. Nostril opening contacts rostral. Postnasal are in contact with the first and second labials. Fifth labial enters the orbit. Lower eyelid with transparent disc. Absence of prefrontals and frontoparietals. Visible tympanic opening. Smooth dorsal scales, usually 28–34 at mid-body. Rounded belly sides. Short limbs with five fingers each. Digits not fringed laterally. Tail shorter than head and body. Females larger than males.

Habitat and habits: Infrequent species occurring in a wide variety of arid and semi-arid environments, from sea level up to 1,700 m elevation, typically on damp ground associated with humid conditions and dense vegetation, often shrubby. Present in *wadi* margins, plantations and cultivated areas. Also found in altered areas such as buildings and gardens, hiding under leaves. Crepuscular, with variable diurnal or nocturnal activity, depending on seasonality and environmental conditions. Mainly insectivorous, feeding on larvae and a variety of adult forms including locusts, crickets, ants, beetles, isopods, spiders or centipedes. Occasional intake of small lizards. Relatively slow, hides within vegetation to avoid predators. Not fossorial, but able to swim in loose sand or soil.

Abundance: Common.

Conservation status: Global – LC; Regional – LC.

Schneider's skink
Eumeces schneiderii (Daudin, 1802)

Global distribution: West of Asia.

Distribution in AlUla: Observed between 740 and 1,620 m a.s.l., can be found in Harrat AlZabin, Harrat Khaybar and Jabal Al Ward.

Measurements: TBL – 40 cm; SVL – 16.5 cm.

Identification: Large, stout skink with robust, triangular head and elongated, well-developed body. Limbs well-developed, with 5 digits not pectinated. Relatively large eyes with movable eyelids, and ear opening partly covered by 3–4 enlarged scales. Nasals in contact with the anterior supralabials. Smooth dorsal scales (22–28 rows at mid-body). Brownish-greyish or olive-grey dorsal colouration, with yellow to orange lateral strip starting from the posterior supralabials and running to the sides of the tail. Dorsal pattern characterised by bright orange scales which can fuse, forming complete crossbars. Orange scales are also found, scattered, on limbs and tail. Belly whitish to yellowish. Juveniles are brownish, with longitudinal rows of dark orange and white spots, and with an orange to reddish lateral stripe. This species is oviparous, laying 4–15 eggs.

Habitat and habits: Inhabits various habitats from dry rocky *wadis* and dry steppes to more vegetated areas. It is often found around settlements and sometimes also in crop fields. It feeds on a variety of prey, mostly large invertebrates, but small lizards are also included in its diet.

Abundance: Scarce.

Conservation status: Global – LC; Regional – LC.

Ribbon-sided skink
Eurylepis taeniolata Blyth, 1854

Global distribution: West of Asia.

Distribution in AlUla: Observed between 720 and 760 m a.s.l., can be found in Old Khaybar.

Measurements: TBL – 23 cm; SVL – 9.5 cm.

Identification: Elongated body and slightly conical head. Single, large postnasal and 2 loreals. Usually 7 supralabials, with the fifth and sixth forming the lower border of the eye, the seventh the largest. Between 6–7 infralabials. Parietal bone with clear lateral indentations. Supratemporal fontanelle open. Heterogeneous dorsal scalation, dorsal in lateral view composed of smaller cycloid, imbricate scales laterally and a vertebral series of 75 enlarged, greatly elongated scales including nuchals. Usually, 21 rows of scales at mid-body. Limbs relatively slender, lamellae not expanded. Third toe shorter than 4th, with 9–11 lamellae under the third toe and 8–9 under the fourth. Tail longer than body and head. Unknown sexual dimorphism or ontogenetic differences.

Habitat and habits: Lives on loose sand, loamy and clay substrates in arid and semi-arid environments with shrubby or grassy vegetation, close to a water source. It spends most of the time under stones, in litter and roots of bushes, or burrowed in the substrate. It feeds on different arthropods and worms.

Abundance: Scarce.

Conservation status: Global – LC; Regional – LC.

Sandfish skink
Scincus conirostris Blanford, 1881

Global distribution: Arabian Peninsula (Saudi Arabia, Oman, United Arab Emirates) and Iran.

Distribution in AlUla: Observed between 780 and 1,170 m a.s.l., can be found in AlGharameel, Sharaan and Wadi Nakhlah.

Measurements: TBL – 22 cm; SVL – 14 cm.

Identification: Sand-adapted, robust cylindrical body, indistinct neck and short conical tail, covered with highly polished scales. Sandy colouration, with 8 to 9 narrow dark dorsal stripes alternating with broad yellow ones. Rarely with dark bands on body sides. Light abdomen. Pointed, wedge-shaped snout, flattened above and below. Nostril opening in a narrow slit behind the rostral. Rostral contacts the frontonasal, separating the supranasals. Small, but visible tympanic opening, with upper margin situated just above, or almost level with, a continuation of the line made by the free edges of the supralabials. Smooth dorsal scales. Usually 26–30 scale rows around mid-body. Vent covered by two large, flat shields. Developed limbs. Five fingers in each limb, each with protruding flattened scales. Juveniles are plain sandy without dorsal banding. Males possess larger bodies and heads than females.

Habitat and habits: Psammophilous, occurs in sandy desert on lowland mobile and stabilised sand dunes, from barren areas to slightly vegetated cover. Also found in oases and areas of fairly hard, compacted sand, close to patches of soft sand. Diurnal, feeds on insects, arachnids and plants. Hibernates between the roots of plants. Singular sand-swimming behaviour, it burrows in sand up to 40 cm deep, with the sand closing immediately behind it. When buried, it detects the vibration produced by its prey on the sand surface.

Abundance: Common.

Conservation status: Global –NE; Regional – NE

Arabian sand skink
Scincus mitranus Anderson, 1871

Global distribution: Arabian Peninsula.

Distribution in AlUla: Observed at 1,000 m a.s.l., northeast of Sharaan.

Measurements: TBL – 20 cm; SVL – 12 cm.

Identification: Sand-adapted, robust cylindrical body, indistinct neck and short tail, covered with highly polished scales. Absence of bold dorsal pattern, being uniform or with fine, lighter and darker spots. Small head. Oval or crescentic nostrils, in contact with rostral shield. Rostral scale in contact with the frontonasal. Often 3 loreals on each side, the first usually separated from the frontonasal. Typically, 8 supralabial on each side. Eye with relatively small cornea and rounded pupil. Small but visible tympanic opening situated well below the level of a line made by the lower edges of the supralabials and covered by two scales, the hind edges of which are usually serrated over the orifice. Smooth dorsal scales. Between 26–30 scales around mid-body. Dark bars or spots present on flanks only on adults.

Habitat and habits: Psammophilous, distributed from sea level up to around 1,000 m elevation, occupying loose sand dune habitats. Diurnal, rather selective diet, feeding on different arthropods, especially centipedes and beetles. Its behaviour is adapted to soft sand environments, including a singular sand-swimming behaviour. It hides under the sand during the warm hours of the day.

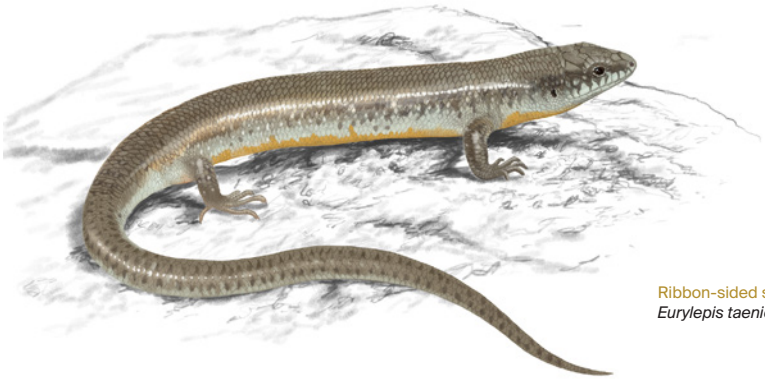
Abundance: Rare.

Conservation status: Global – LC; Regional – LC.

Asian snake-eyed skink
Ablepharus pannonicus

Ocellated bronze skink
Chalcides ocellatus

Schneider's skink
Eumeces schneiderii



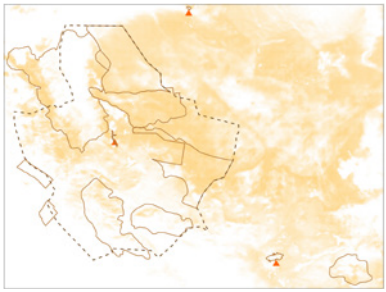
Ribbon-sided skink
Eurylepis taeniolata

Sandfish skink
Scincus conirostris

Arabian sand skink
Scincus mitranus

Sub-order Lacertoidea

Bosk's fringe-fingered lizard
Acanthodactylus boskianus (Daudin, 1802)



Global distribution: North Africa and the Middle East.

Distribution in AlUla: Observed between 500 and 1,730 m a.s.l., can be found in all conservation areas except AlUla Oasis, Harrat AlZabin, Jabal Al Ward, Jabal Shayhoub and Tayma.

Measurements: TBL – 26 cm; SVL – 10 cm.

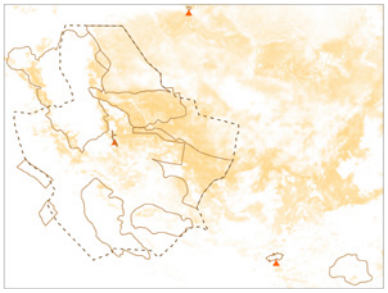
Identification: Larger than most congeneric species. Long-snouted head and flat-topped snout. The mid-dorsal stripe forks before the head in Y-shape. Four supraocular scales and 4 supralabials preceding the subocular. Keeled temporal scales. Slightly denticulated eyelids. Conspicuous gular sac. Necklace present. Usually 19–25 bands of large, keeled, imbricate dorsal scales across the mid-body. Ventrals in 8–12 longitudinal bands. Between 15 and 26 femoral pores. Large, overlapping, and sharply keeled scales on the upper surface of the tail. Long slender toes with lateral fringes. Three rows of scales around fingers. Males have larger body, head and appendages, and also more femoral pores and caudal vertebrae. Females have more ventral plates along the body. Female tail suffused with red colouration during the breeding season. Blue tail in juveniles.

Habitat and habits: Large habitat plasticity, occurs in arid and semi-arid areas from lowlands up to 2000 m, typically associated with densely vegetated *wadis* or open grounds with scattered shrubs and acacias, on gravel to sand. Present in eroded landscapes, like route edges or palm groves. Absent from grasslands and hyper-arid areas. Diurnal, mostly active hunter, feeds in open areas mostly on ants, with anecdotal intake of beetles and spiders. Burrows are 30-40 cm deep, usually in bushes. Tail swishing or shelter in shrubs when threatened.

Abundance: Abundant.

Conservation status: Global – LC; Regional – LC.

Snake-tailed fringe-toed lizard
Acanthodactylus opheodurus Arnold, 1980



Global distribution: Arabian Peninsula.

Distribution in AlUla: Observed between 20 and 1,270 m a.s.l., can be found in all conservation areas except AlUla Oasis, Harrat Khaybar, Jabal Al Ward, Jabal Shayhoub, Old Khaybar and Tayma.

Measurements: TBL – 16 cm; SVL – 5.5 cm.

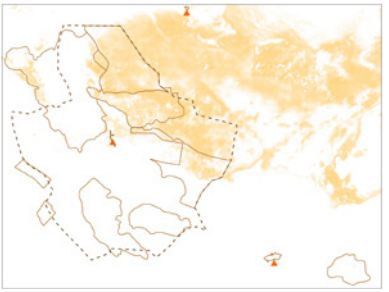
Identification: Small size, short wide head and short conical snout, unlike the syntopic sibling species *Acanthodactylus boskianus*. Rounded and protruding nasals. Reduced colour pattern, with three conspicuous dorsal bands and one reticulate band along the sides. The mid-dorsal stripe reaches the back of the head. Four supraocular scales and 4 supralabials preceding the subocular. Conspicuous subocular keel. Keeled temporals. Strongly pectinated eyelids. Necklace present. Between 29–36 flat, keeled dorsal scales across the mid-body. Ventrals in 10 longitudinal bands. Between 17–22 femoral pores. Large, keeled scales on the upper surface of the tail. Only slight pectination of fringed toes. Three rows of scales around fingers. Unknown sexual dimorphism or ontogenetic differences.

Habitat and habits: Habitat generalist, typically found in *wadi* beds of compact soil and gravel covered with sparse shrubs, reaching low densely-vegetated hills. Also present in sandy environments including plains and riverbeds, but absent from truly hyper-arid and soft sand areas. Diurnal, it feeds on ants and occasionally on larger arthropods such as beetles, exhibiting active or ambush foraging strategies. Ground-dwelling, burrows located at the base of bushes. Defensive behaviour includes tail swishing and shelter within vegetation.

Abundance: Common.

Conservation status: Global – LC; Regional – LC.

Schmidt's fringe-fingered lizard
Acanthodactylus schmidti Haas, 1957



Global distribution: Middle East.

Distribution in AlUla: Observed between 780 and 1,550 m a.s.l., can be found in AlGharameel, Sharaan, Tayma and Wadi Nakhlah.

Measurements: TBL – 20 cm; SVL – 9 cm.

Identification: Distinguishable from other congeneric species by the presence of scales on the sides of the posterior dorsum with double the size of those in the centre and those on the sides of the body. Large and markedly variable size. Sandy dark colouration, with white dots on the entire back, and dark rings on the tail. Elongated head and pointed snout. With 4 supraocular scales and 5 supralabials preceding the subocular. Subocular separated from the lip. Sharply keeled temporal scales and 2 keeled supratemporals. Tympanic opening with distinct anterior pectination. Between 32–54 dorsal scales across the mid-body. Ventrals in 14–16 oblique longitudinal bands, with pointed scales in the outer rows. Between 17–23 femoral pores. Relatively short front and long hind legs. Remarkably pectinate fringed toes. Four rows of scales around fingers. Unknown sexual dimorphism or ontogenetic differences.

Habitat and habits: Largely psammophilous, it is widespread across soft-sand environments up to 1,000 m elevation, typically on open dunes with little vegetation, rocky areas with loose soil and *sabkhas*. Diurnal and active forager, its body becomes rigid when a prey is spotted and violently shakes the tail prior to the attack. It feeds on ants and other insects. Burrows located close to the dune vegetation, where females place the eggs. When threatened, it rapidly shelters within burrows.

Abundance: Common.

Conservation status: Global – LC; Regional – LC.

Tilbury's fringe-fingered lizard
Acanthodactylus tilburyi Arnold, 1986

Global distribution: Southern Jordan and northern Saudi Arabia.

Distribution in AlUla: Observed at 1,050 m a.s.l., can be found in AlGharameel.

Measurements: TBL – 17 cm; SVL – 6 cm.

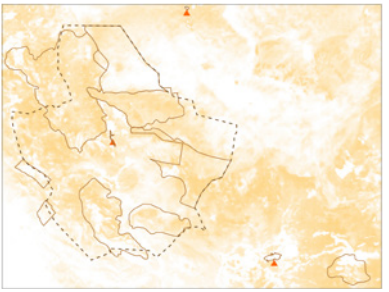
Identification: Small, slender and dorsally-flattened body. Pale-sand colouration. Dorsum dappled, with a darker dorsolateral stripe and white ventral side. Relatively wider head and short, depressed and elongated pointed snout. Supraocular scales more or less intact. Subocular large and with a strong keel, separated from lips. Five supralabial scales from the centre of the eye. Small, keeled dorsal scales in 41–57 longitudinal bands at mid-body. Between 15 and 19 longitudinal bands of ventrals. Spotted hind legs. Four rows of scales around fingers, which are strongly pectinated. 20 femoral pores per each side, extending close to the knee.

Habitat and habits: Psammophilous, typically found where the sand is softer and banked. Diurnal, it feeds on small arthropods. Burrows located in a bush. When threatened, it retreats to the cover of shrubs.

Abundance: Scarce.

Conservation status: Global – LC; Regional – LC.

Baha El Din's small-spotted lizard
Mesalina bahaeldini Segoli, Cohen & Werner, 2002



Global distribution: North-west Arabian Peninsula and Sinai Peninsula.

Distribution in AlUla: Observed between 140 and 1,710 m a.s.l., can be found in all conservation areas except AlUla Oasis, Old Khaybar and Tayma.

Measurements: TBL – 17 cm; SVL – 6 cm.

Identification: Distinguished from other closely related congeners by its consistent striped pattern and brownish colouration, fewer supralabial scales (4–5), dorsals at mid-body (35–40), transverse rows of ventral plates (10) and subdigital lamellae under the fourth toe (21–22), and by longer toes in relation to hindlimb length and subdigital lamellae in relation to body size. Males with distinct femoral pores and a proportionally longer tail than females. Usually with a lateral light stripe extending posteriorly from the middle of the ear, accompanied above by a broader dark band and a dorsolateral chain of black-and-white spots. Prominent occipital, in contact with the interparietal. Moderately curved collar. Transparent disc of lower eyelid comprising two major scales, with black vertical bar.

Habitat and habits: Inhabits mountainous rocky areas, including mountain peaks, canyons and cliffs, on bare fine gravel substrates among rocks, in areas with sparse bushy vegetation. Also present in slightly modified areas. Diurnal, active during a large part of the day, even in the hottest hours. Generalist predator of small arthropods, typically ants.

Abundance: Abundant.

Conservation status: Global – LC; Regional – NE.

Bernoulli's short-nosed desert lizard
Mesalina bernoullii (Schenkel, 1901)

Global distribution: Middle East, from the Sinai Peninsula to south-west Iran.

Distribution in AlUla: Observed at 1,070 m a.s.l. in Wadi Nakhlah.

Measurements: TBL – 16 cm; SVL – 5.6 cm.

Identification: Small, slightly depressed lizard. The head is not strongly depressed, with the snout distinctly short. Lower eyelid with a window of two major transparent scales. Occipital scale absent or minute, not in contact with the interparietal scale. Prominent nasal scute, with nostrils distant from supralabial scales. Subocular scale is not in contact with the lip. 36–64 dorsal scales at mid-body. Ventral plates in 12 longitudinal rows. 12–16 femoral pores under each thigh. Fingers always without pectination.

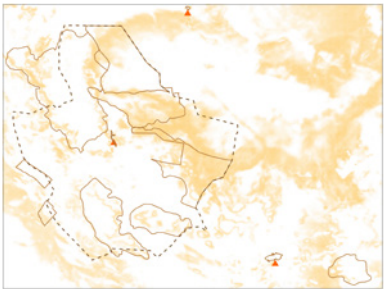
Dorsal colouration and pattern are very variable, usually grey or greyish-brown with dark spots. White ventral colouration.

Habitat and habits: Inhabits desert and semi-desert regions, with sandy soils. Diurnal, active during a large part of the day, even in the hottest hours. Generalist predator of small arthropods.

Abundance: Rare.

Conservation status: Global – NE; Regional – NE.

Blanford's short-nosed desert lizard
Mesalina brevirostris Blanford, 1874



Global distribution: Arabic Peninsula, south-west Asia.

Distribution in AlUla: Observed between 150 and 960 m a.s.l., can be found in Sharaan and Wadi Nakhlah.

Measurements: TBL – 16 cm; SVL – 5.6 cm.

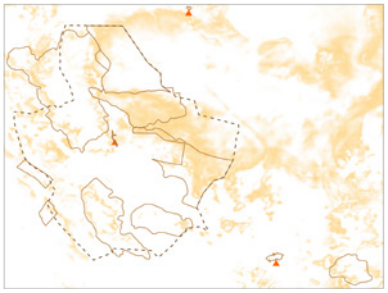
Identification: This species is closely related and largely similar in morphology to *M. bernoullii*, from which can be distinguished by a lower number of dorsal scales at mid-body (31–39). Dorsal colouration and pattern are very variable, grey or greyish-brown, usually with large whitish ocelli edged with black. White ventral colouration.

Habitat and habits: Inhabits desert and semi-desert regions, with rocky, hard soil. Very adaptable, it can be found in sparsely vegetated habitats, as well as in black lava deserts, and is often associated with human habitats. Diurnal, active during a large part of the day, even in the hottest hours. Generalist predator of small arthropods, typically ants.

Abundance: Scarce.

Conservation status: Global – LC; Regional – LC.

Mount Elba snake-eyed lizard
Ophisops cf. elbaensis Schmidt & Marx, 1957



Global distribution: Egypt, Saudi Arabia, Oman, and Yemen.

Distribution in AlUla: Observed between 150 and 1,270 m a.s.l., can be found in Harrat Uwayrid, Jabal Shayhoub and Wadi Nakhlah.

Measurements: TBL – 28 cm; SVL – 3.5 cm.

Identification: Small, slender lizard. Supraoculars in contact with the superciliaries; tympanum exposed, tympanic shield small; supratemporals small, not distinct from other temporals; occipital and interparietal large and in contact. Dorsal scales large (17–19) imbricate, strongly keeled; 6 ventrals; 9–10 femoral pores. Dorsal pattern with black stripes, head and tail olive-brown, limbs pinkish brown with dark marbling and belly greyish white. Males slightly larger than females with more contrasting colours and a small reddish patch under the armpit.

Habitat and habits: Inhabits well-vegetated microhabitats, with boulders and rocks. Climbs readily into vegetation and on rocks. Diurnal, very active species, but secretive.

Abundance: Scarce.

Conservation status: Global – DD; Regional – DD.

Zarudnyi's worm lizard
Diplometopon zarudnyi Nikolsky, 1907

Global distribution: Middle East and Arabian Peninsula.

Distribution in AlUla: Observed at 820 m a.s.l., can be found in Tayma.

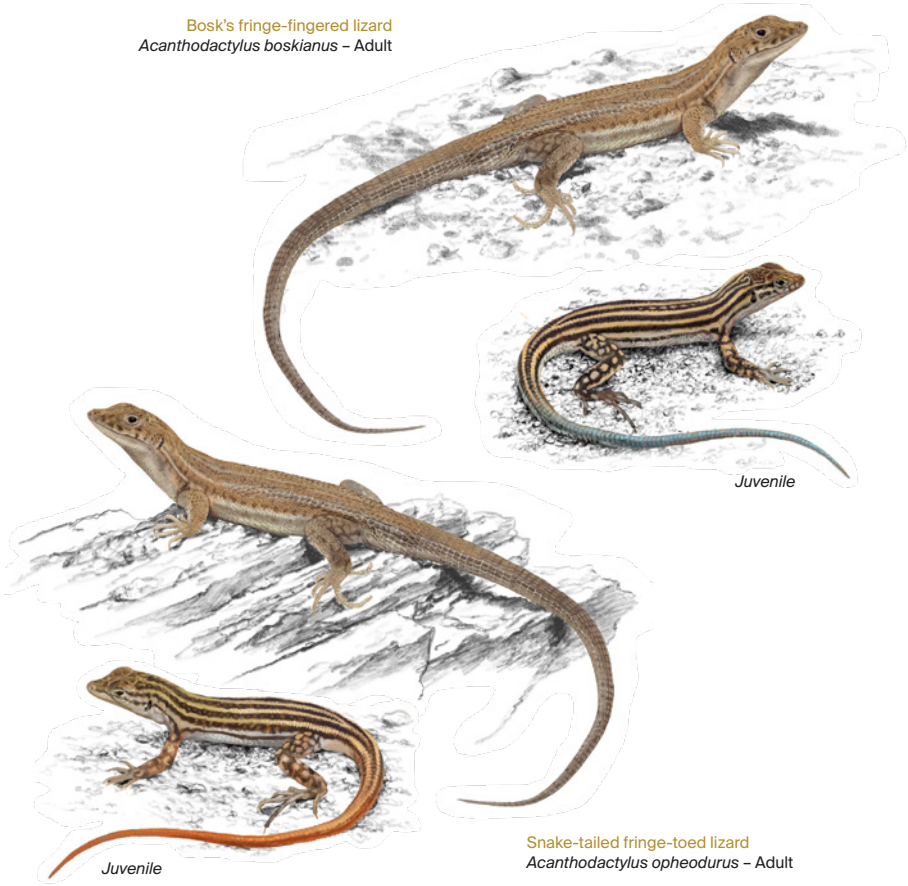
Measurements: TBL – 23.6 cm; SVL – 22.1 cm.

Identification: Elongated, limbless lizard adapted to fossoriality. The head is small, robust, and wedge-shaped, with 4–5 large plates on the top. Rudimentary eyes are conspicuous, and protected by a translucent scale. External ear openings absent. Body scales small and rectangular, arranged in 165–178 rings separated by shallow grooves. Tail short and pointy. With 4–6 precloacal pores in both males and females. Body colour pinkish, with dorsal dark-brown spots.

Habitat and habits: Nocturnal, fossorial lizard inhabiting sandy soils, with extensive sand dunes and sparse vegetation, but also found in grasslands and shrublands. Generalist predator of small insects and other arthropods.

Abundance: Rare.

Conservation status: Global – LC; Regional – LC.



Bosk's fringe-fingered lizard
Acanthodactylus boskianus – Adult

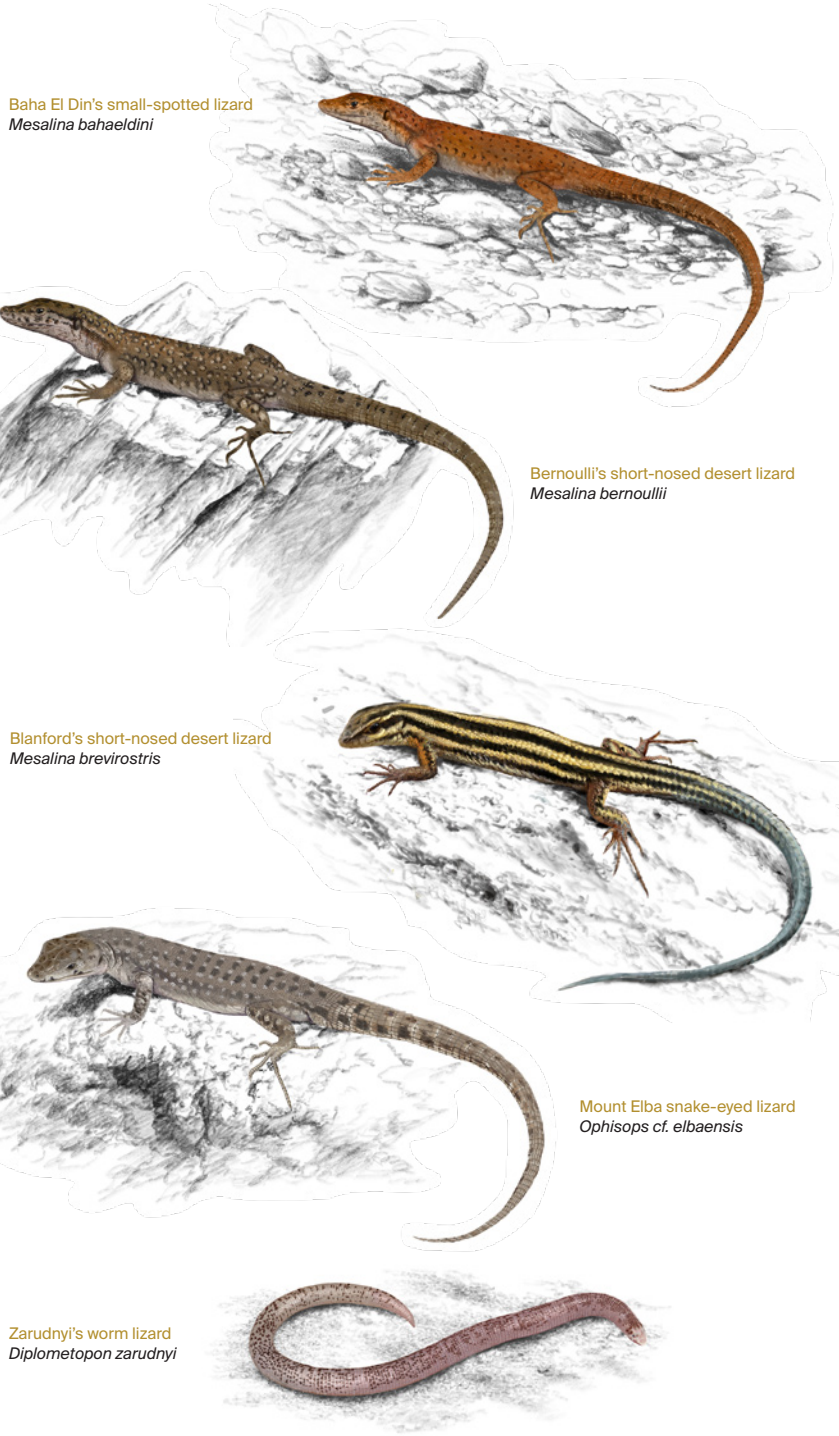
Juvenile

Juvenile

Snake-tailed fringe-toed lizard
Acanthodactylus opheodurus – Adult

Tilbury's fringe-fingered lizard
Acanthodactylus tilburyi

Schmidt's fringe-fingered lizard
Acanthodactylus schmidti



Baha El Din's small-spotted lizard
Mesalina bahaeldini

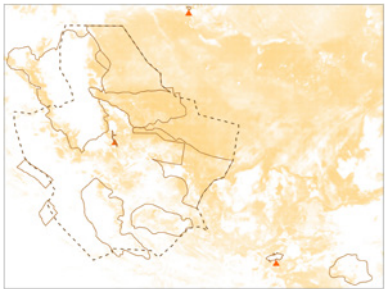
Bernoulli's short-nosed desert lizard
Mesalina bernoullii

Blanford's short-nosed desert lizard
Mesalina brevirostris

Mount Elba snake-eyed lizard
Ophisops cf. elbaensis

Zarudnyi's worm lizard
Diplometopon zarudnyi

Desert monitor
Varanus griseus (Daudin, 1803)



Global distribution: North Africa, Middle East and Arabian Peninsula.

Distribution in AlUla: Observed between 660 and 1,260 m a.s.l., can be found in AlGharameel, Harrat Uwayrid, Sharaan and Wadi Nakhlah.

Measurements: TBL – 150 cm; SVL – 56 cm.

Identification: The largest Arabian lizard, with a slender round body, powerful limbs and strong claws. The neck and the head are very elongated, and it has a pointed snout, with nostrils directed backwards closer to the eye than to the snout. Very long, dark tongue retractile into a sheath. Long tail (1.6 times the SVL) covered in scales arranged in more or less regular whorls. Dorsal scales are granular, becoming larger, keeled and trihedral on the sides of the neck. Dorsal colouration varies with age, with adults usually uniform yellowish, light brown or grey, reddish tail and yellow or reddish head. Two dark streaks extend from the side of the head to the side of the neck. Tail conspicuously barred. Juvenile colouration is more intense reddish or orange, with yellow to orange spots.

Habitat and habits: Active, diurnal lizard. Inhabits desert regions with both sandy and hard soils, dry *wadis*, base and slopes of rocky hills, but also extreme habitats such as basal desert and wind-blown dunes. It can travel long distances (often more than 5 km) while searching for prey. It feeds on a vast variety of prey, including mammals, birds, reptiles and large arthropods. Burrows are dug among rocks and under bushes, but also in open areas. Seasonal activity culminates at the beginning of summer. Females lay large clutches of 5–25 eggs. Hatching can take up to 10 months.

Abundance: Scarce.

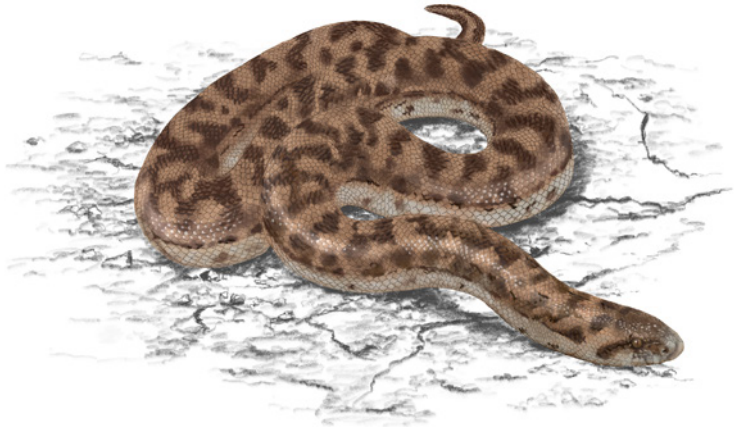
Note: Prolonged bite (chewing) by this species can lead to health complications, such as systemic muscle pain, breath difficulties, dizziness and nausea. Getting medical attention is advisable.

Conservation status: Global – LC; Regional – LC.

Sub-order Anguimorpha

Desert monitor
Varanus griseus

Sub-order Serpentes



Javelin sand boa
Eryx jaculus

Javelin sand boa
Eryx jaculus (Linnaeus, 1758)

Global distribution: North Africa, south Europe, south-west Asia, and Arabian Peninsula.

Distribution in AlUla: Observed between 1,000 and 1,050 m a.s.l., northeast of Sharaan.

Measurements: TBL – 83 cm.

Identification: Stout, medium-sized snake with a small head, indistinct from the neck, and a sharp-edged snout. The upper part of the head is slightly concave. Small eyes, directed sideways, with vertical elliptical pupils. Two (rarely three) internasals, 6–12 scales around the eye, 7–11 supralabials, 2–3 loreals and 4 scales between the eyes. Body scales are smooth, becoming slightly keeled on the caudal part and the tail. 41–57 rows of dorsal scales at mid-body. 161–200 very small ventral scales, and 15–36 subcaudals. Dorsal colouration mostly greyish or light brown, cream, whitish, yellowish or reddish ventrally. Dark stripe running on the side of the head and passing through the eye.

Habitat and habits: Inhabits dry steppes with sparse vegetation and stones. Often found in crop fields. Activity pattern changes during seasons. Diurnal during the colder periods of the year, and active only during early and late day hours during the warmer periods. Predation occurs by constriction of prey in body coils. It feeds on small mammals, lizards and larger insects, and occasionally on small birds and snails. This snake is ovoviviparous. After a gestation of three months, females give birth to 6–20 young.

Abundance: Scarce.

Toxicity: Non-venomous (Aglyph).

Conservation status: Global – LC; Regional – LC.

Crowned dwarf racer
Eirenis cf. coronella (Schlegel, 1837)

Global distribution: Northwestern Arabian Peninsula and Middle East.

Distribution in AlUla: Observed at 1,300 m a.s.l., can be found in Jabal Al Ward.

Measurements: TBL – 35 cm.

Identification: Small, slender snake with narrow head not clearly distinct from the neck. Sandy or greyish dorsal colouration, banded with 32–65 light brownish crossbars. Broad dark grey-brownish collar on the neck. Ventral part white, sometimes spotted on the anterior part. Seven supralabials, 141–162 ventrals, 48–67 subcaudals, 15 scale rows around mid-body; anal scale divided, and paired subcaudals.

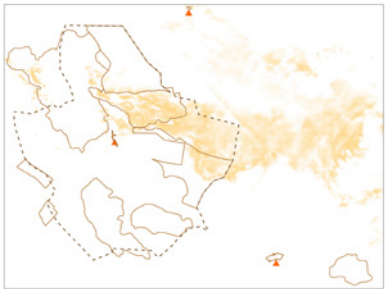
Habitat and habits: Occurs in semi-arid, mountainous areas, where it can be found on sparsely vegetated stony hillsides. Secretive species, its habits are little known. Crepuscular and diurnal, it feeds on insects and other arthropods, such as spiders and scorpions. Oviparous, females lay at least 5 eggs.

Abundance: Rare.

Toxicity: Non-venomous (Aglyph).

Conservation status: Global – LC; Regional – LC.

Crowned leafnose snake
Lytorhynchus diadema (Duméril, Bibrin & Duméril, 1854)



Global distribution: North Africa and Arabian Peninsula.

Distribution in AlUla: Observed between 950 and 1,150 m a.s.l., can be found in Sharaan.

Measurements: TBL – 39 cm.

Identification: Distinguishable by its flat, projecting snout and a large, wedge-shaped rostral, separating partly the internasals. Relatively small size. Pale or cream dorsal pattern, usually with 13–18 large transversely rhomboidal dark spots and a dark median band along the head and neck. White abdomen. Head slightly distinct from neck. Nostril with an oblique slit between two large nasals. Suture between the internasals much shorter than that between the prefrontals. Small, squared loreal. Eyes moderate or small with elliptical pupils. Smooth dorsal scales, with 19 rows around mid-body. Anal divided. Paired subcaudals. Short tail. Males possess longer bodies and tails than females.

Habitat and habits: Psammophilous, occurs on sand and loose soil substrates. It inhabits a wide array of arid habitats, typically sand dunes, but also *sabkhas*, gravel plains interrupted by undulating sand and low hills, and rocky or clay plateaux with slight grass cover. Its singular rostral scale is an adaptation for its burrowing behaviour, although it is not considered strictly fossorial. Nocturnal habits, large above-ground distance coverage within a single night. Active hunter, it feeds mostly on animals inhabiting burrows or holes, mainly nocturnal geckos and other lizards, as well as their eggs, but also on large arthropods and small rodents. Serpentine locomotion, leaving very distinctive rounded sinusoidal tracks.

Abundance: Scarce.

Toxicity: Non-venomous (Aglyph).

Conservation status: Global – LC; Regional – LC.

Elegant racer
Platyceps elegantissimus (Günther, 1878)

Global distribution: West of Arabian Peninsula.

Distribution in AlUla: Observed between 770 and 1,090 m a.s.l., can be found in Sharaan.

Measurements: TBL – 70 cm.

Identification: Slender, medium-size body and cylindrical, smooth tail. Bright yellow or light colouration with characteristic wide, black cross bands, between 21–28 on head and body and 7–13 on tail. Sometimes with an orange dorsal stripe. Hardly distinct head and neck. Projecting, obtusely pointed snout. Slightly broad rostral, deeply hollowed out beneath, the portion visible from above nearly one-third as long as its distance from the frontal. Internasals shorter than prefrontals. With 2 preoculars, 2 postoculars and 1–2 suboculars. Usually 8 supralabials and 10 infralabials, 5 contact the anterior chin-shields. Posterior chin-shields as long as the anterior, separated from each other by two series of scales. Loreal as long as deep. Small eyes with rounded pupils. Smooth body scales, 19 at mid-body. Divided anal plate. Unknown sexual dimorphism or ontogenetic differences.

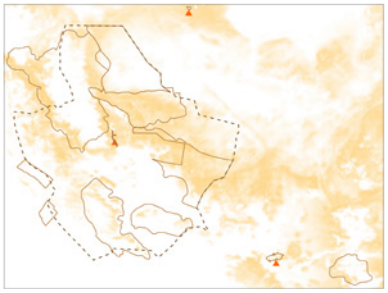
Habitat and habits: Highly cryptic species, rarely observed in the field. Occurs in gravel and hard sandstone arid habitats. Usually absent from rocky and sand dune areas. Seemingly diurnal, yet crepuscular or nocturnal activity may also occur. Excellent eyesight, capable of detecting distant and minor prey and predator movements. It feeds on lizards, mainly geckos, as well as small rodents, which it captures in their burrows. Flattened body reflects basking. When threatened, it rapidly shelters or freezes. Spotted swimming in *wadis*.

Abundance: Scarce.

Toxicity: Non-venomous (Aglyph).

Conservation status: Global – LC; Regional – LC.

Common cliff racer
Platyceps rhodorachis (Jan, 1863)



Global distribution: West of Asia and Horn of Africa.

Distribution in AlUla: Observed between 610 and 780 m a.s.l., can be found in AlUla Oasis and Old Khaybar.

Measurements: TBL – 130 cm.

Identification: Long, slender body. Recognisable by its large number of ventral scales, over 208, usually more in males. Dark grey head with three dark bars on both sides. Anterior body covered with around 80 dark, transverse bars, each one composed of closely spaced spots. Posterior body with uniform, light sand colouration and a pink tail. Hardly distinct head and neck. Narrow and pointed snout. Two postoculars. Usually 9 supralabials, the fifth and sixth entering the eye, and 10 infralabials, the fourth and fifth contact the anterior chin-shields. Small eyes with rounded pupils. Loreal longer than deep. Smooth body scales, 19 at mid-body, and 11–13 ventrally. Cylindrical, smooth tail. Divided anal plate.

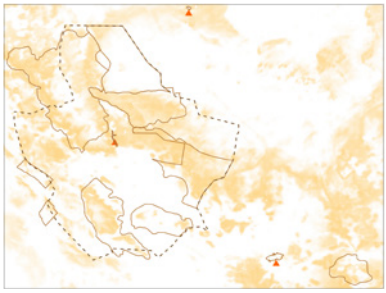
Habitat and habits: Relatively adaptable to different environments. Typical in arid and hyper-arid areas, on gravel, stone or rock substrate, often around hills and cliffs. Also found nearby agricultural irrigation channels and pools. Shelters in rocky crevices, sometimes basking in the open areas. Diurnal or crepuscular. Feeds on lizards, including lacertids, agamids, geckos and skinks, small mammals like shrews, and small birds, with anecdotal reports of blind snake intake. Juveniles may also prey on insects. Rapidly shelters into crevices when threatened. Spotted swimming, likely predating also on amphibians and fishes. Tends to be a calm snake.

Abundance: Scarce.

Toxicity: Non-venomous (Aglyph).

Conservation status: Global – LC; Regional – LC.

Saharan racer
Platyceps saharicus Schätti & McCarthy, 2004



Global distribution: Northeast of Africa and Northwest of Arabian Peninsula.

Distribution in AlUla: Observed between 220 and 1,020 m a.s.l., can be found in AlUla Oasis and Sharaan.

Measurements: TBL – 75 cm; SVL – 55 cm.

Identification: Very slender, medium-size body. Distinguishable by the number of subcaudal scales, over 106 (usually 113-154). Variable colouration, typically grey or pale sand in dorsum, with numerous alternating dark and light transverse crossbars, starting from the nuchal and fading posteriorly. Iridescent, light ventral colouration, with dark spots on the anterior margins. Uniform, pinkish tail. Typically, 9 supralabials, the fifth and sixth entering the eye. Smooth dorsal scales. High count of ventral scales, between 213-262. Typically, 19 rows of scales at mid-body. Relatively long tail. Divided anal plate. Juveniles with more contrasting colouration patterns.

Habitat and habits: Found in arid and hyper-arid environments from sea level up to 2,000 m elevation. Typical in rocky, stony and gravelly habitats in or near wadis and mountains, like cliffs and canyons, sometimes devoid of any vegetation cover. Also present near settlements, in ruins, oases and agricultural fields. Diurnal and crepuscular habits, sometimes night activity. Predates on small vertebrates like lizards and birds, especially *Ptyodactylus* geckos, which inhabit the same rocky habitats. Rapid movements.

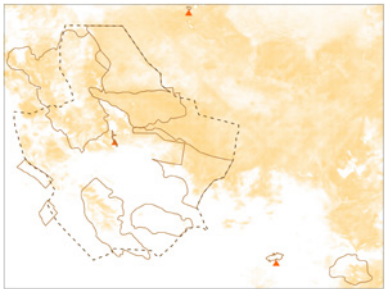
Abundance: Scarce.

Toxicity: Non-venomous (Aglyph).

Conservation status: Global – LC; Regional – LC.

Hejaz black-collared snake

Rhynchocalamus hejazicus Licata, Pola, Šmíd, Ibrahim, Liz, Santos, Patkó, Abdulkarem, Gonçalves, Al-Shammari, Busais, Egan, Ramalho, Smithson & Brito, 2024



Global distribution: AlUla region.

Distribution in AlUla: Observed between 1,030 and 1,410 m a.s.l., can be found in Harrat Uwayrid, Sharaan, AlGharameel and Wadi Nakhlah.

Measurements: TBL – 39.3 cm.

Identification: Thin, cylindrical and slender body, with narrow head not clearly distinct from the neck. Shiny, deep reddish body colouration. Head shiny black from the middle of the supraoculars and the frontal scale to the tip of the snout, which is whitish. A deep reddish band passes behind the eyes, through the middle of the frontal scale, encompassing the large parietals, and fading ventrally to whitish. A black collar extends behind the neck, tapering towards the centre in males. Deep reddish ventral colouration, fading to white towards the upper part of the body. Eyes with round pupils, not distinct from the background body colouration. Large rostral scale, dorsally separating the internasals. Trapezoid-shaped prefrontals. Bell-shaped frontal. Undivided nasal. Small loreal. 6 supralabials, the third and fourth entering the eye. Two postocular scales. Smooth dorsal scales, 15 rows at mid-body, 227-250 ventral scales, 67 subcaudals, and anal plate divided. A melanistic morph of this species can also occur, with a characteristic shiny black colouration.

Habitat and habits: New species, found only in the AlUla region. Natural history is largely unknown. The specimens observed in the AlUla region were observed active at night in rocky, vegetated, steep and dry *wadis*. Tends to be a calm snake.

Abundance: Scarce.

Toxicity: Non-venomous (Aglyph).

Conservation status: Global – NE; Regional – NE.

Palestine kukri snake
Rhynchocalamus melanocephalus (Jan, 1862)

Global distribution: The Middle East.

Distribution in AlUla: Observed between 680 and 970 m a.s.l., can be found in Jabal Al Ward.

Measurements: TBL – 46 cm.

Identification: Thin, cylindrical body. Blackish colouration of head and neck, with light supralabials and rostral shield. Black nuchal band reaching the abdomen. Reddish dorsal and light-yellow abdomen, both without maculation. Small head, indistinct from neck. Large rostral, extending to the upper surface of the snout, separating internasals. Trapezoid-shaped internasal. Undivided nasal. Usually 7 supralabials, the third and fourth entering the eye. Between 3 to 4 infralabials in contact with anterior chin-shields. Small posterior chin-shields. Small or absent loreal. Small eyes with rounded pupils. Smooth dorsals arranged in 15 rows at mid-body. Between 164–235 ventrals. Short tail. Divided anal plate and subcaudal scales. Body characters are larger in males.

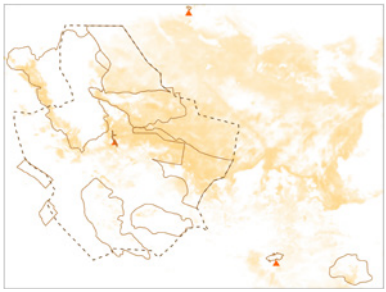
Habitat and habits: Enigmatic species, with few records due to its largely subterranean nature. Typical in humid environments with dense to scarce scrubby vegetation, including open forests, mountain scrublands and *wadis*, on heavy soils. Also present in relatively arid areas, including stony steppes and sparsely vegetated rocky slopes, and in altered landscapes such as olive groves and ruins. Absent from sandy areas. Fossorial, inhabiting the upper layer of soil. Mostly nocturnal habits with occasional daily activity. Mainly insectivorous, it feeds on ants, crickets, locusts, centipedes and perhaps small lizards. When active, it can be found under small stones.

Abundance: Scarce.

Toxicity: Non-venomous (Aglyph).

Conservation status: Global – LC; Regional – NE.

Diadem snake
Spalerosophis diadema (Schlegel, 1837)



Global distribution: North Africa and West of Asia.

Distribution in AlUla: Observed between 20 and 1,610 m a.s.l., can be found in AlGharameel, AlUla Oasis, Harrat Khaybar, Sharaan, Tayma and Wadi Nakhlah.

Measurements: TBL – 130 cm.

Identification: Large, slender, robust body. Unlike other colubrids, subocular scales prevent contact between supralabials (usually 10–13) and eyes. Variable colouration, between greyish, yellowish, sandy-beige or reddish. Large, dark to light brown spots cover the dorsum, white scales around borders. Alternate small spots on flanks. Distinct head and neck. Frontal almost as long as broad, usually shorter than the parietals. Usually 5 infralabials in contact with the anterior chin-shields, which are nearly as long as the posterior. Orbit encircled by 10–13 ocular scales. Usually 2–4 preoculars and 3–4 postoculars. Prefrontals and loreals (3–5) divided into several small scales. Divided temporals. Large eyes with round pupils. Smooth, small dorsals. Between 205–254 ventrals, more numerous in males. Undivided anal plate. Short tail.

Habitat and habits: Occurs throughout a wide array of arid and semi-arid environments from lowlands to up to 1,500 m elevation, in steppe plains, dry river beds with sparse vegetation, slightly wooded hillsides and riverside forests, on sand, clay and stone substrates. Also present nearby human settlements, oases, and dry agricultural lands. Absent from hyper-arid areas. Nocturnal or crepuscular activity, likely with daytime activity during winter. It feeds on lizards and small rodents. When threatened, deploy warning signals as defensive behaviour.

Abundance: Common.

Toxicity: Venomous (Aglyph) Not listed as medically important.

Conservation status: Global – LC; Regional – LC.

Arabian cat snake
Telescopus dhara (Forskål, 1775)

Global distribution: Arabian Peninsula.

Distribution in AlUla: Observed between 610 and 1,270 m a.s.l., can be found in AlGharameel and Jabal Al Ward.

Measurements: TBL – 70 cm.

Identification: Medium-sized, fairly slender body. Recognisable by separated loreal from the eye by one preocular. Typical brown or reddish head with a short, dark, indistinct nuchal streak. Ovoid head, distinct from neck. Short, broad, rounded snout. Light reddish dorsum, with a series of large darker and lighter blotches along the mid-dorsal line. Lighter, markedly iridescent abdomen. Nostril in a partly divided nasal. Usually 9 supralabials, three of them entering the eye. Smooth dorsals, arranged in 19–21 rows at mid-body. Between 240 and 269 ventrals. Between 57–66 paired subcaudals. Entire anal plate. Short tail. Males are darker and noticeably shorter than females.

Habitat and habits: Variable habitat, typically rocky mountains, occurs in *hammadas*, rocky hills and *wadis*, gravel plains and dry savannas, usually associated with trees. Also present in oases, buildings and agricultural areas. Females live on bushes and trees, remaining hanging motionless on shrubs and acacia branches. Males are strictly ground inhabitants. Nocturnal. Feeds primarily on birds and their eggs, but also bats, rodents and reptiles, including chameleons. Young females frequently feed on lizards. Possesses large venom glands and toxic venom, yet venom effects seem to be mild.

Abundance: Scarce.

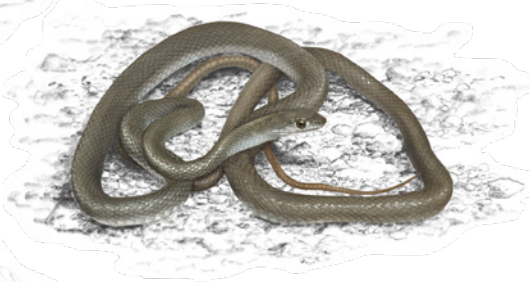
Toxicity: Venomous (Opisthoglyph) Not listed as medically important.

Conservation status: Global – LC; Regional – LC.

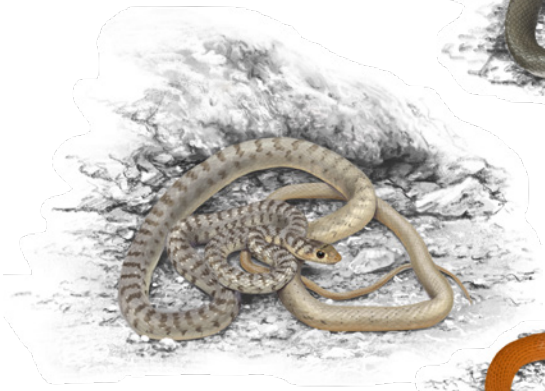
Crowned dwarf racer
Eirenis cf. coronella

Crowned leafnose snake
Lytorhynchus diadema

Elegant racer
Platyceps elegantissimus



Common cliff racer
Platyceps rhodorachis



Saharan racer
Platyceps saharicus

Hejaz black-collared snake
Rhynchocalamus hejazicus

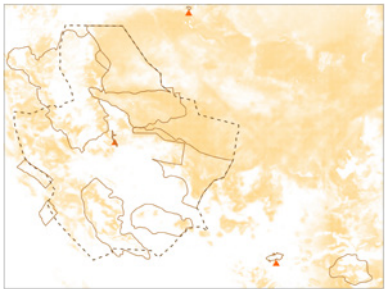
Hejaz black-collared snake
Rhynchocalamus hejazicus (black morph)

Palestine kukri snake
Rhynchocalamus melanocephalus

Diadem snake
Spalerosophis diadema

Arabian cat snake
Telescopus dhara

En-Gedi mole viper
Atractaspis engaddensis Haas, 1950



Global distribution: Sinai Peninsula, South-west Asia, and Arabian Peninsula.

Distribution in AlUla: Observed between 610 and 1,270 m a.s.l., can be found in Harrat Uwayrid, Jabal Al Ward and Wadi Nakhlah.

Measurements: TBL – 80 cm.

Identification: Robust, medium-sized snake with a cylindrical body and head indistinct from the neck, with a very short tail. The head is small and depressed, with a sharply-edged and pointed snout. Very large, hollow fangs attached to the maxillary. Small eyes with rounded pupils. Body covered with smooth scales. 25–29 rows of dorsal scales at mid-body. 263–282 ventral scales, anal plate undivided, and 32–40 subcaudals, with a conical scale at the tail tip. No loreal scale, one preocular, one postocular, a large frontal, nasal scale divided in its lower half, 6–7 supralabials, 10 lower labials. Body colouration is uniformly shiny black or brown (rarely grey), and slightly lighter ventrally.

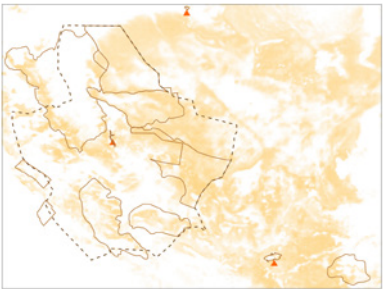
Habitat and habits: Fossorial, nocturnal and slow-moving snake. Rarely encountered due to its secretive lifestyle. It may be found under rocks or at night on roads or in fields in semi-arid to arid habitats with sparse vegetation. It exhibits a peculiar striking behaviour, striking with a nearly closed mouth, with one fang moving sideways, downwards and backwards.

Abundance: Scarce.

Toxicity: Venomous (Solenoglyph) Secondary medical importance.

Conservation status: Global – LC; Regional – LC.

Moila snake
Malpolon moilensis
(Reuss, 1834)



Global distribution: South-west Asia, Arabian Peninsula, North Africa.

Distribution in AlUla: Observed between 610 and 1,130 m a.s.l., can be found in AlGharameel.

Measurements: TBL – 190 cm.

Identification: Medium- to large-sized snake, with the head slightly distinct from the body, a convex profile, an angular canthus rostralis, and prominent supraoculars. Large eyes with rounded pupils and golden iris (darker towards the edges). 7–8 supralabials; loreal scale present; 1 preocular, 2 (or 3) postoculars 4–6 temporals. Body scales are smooth, with 17 scale rows at mid-body; 159–176 ventrals; anal plate divided; 48–73 subcaudals. Dorsal colouration may vary between cream, brownish or yellowish with irregular dark spots. Characteristic dark spot between the eye and the neck. Ventral part is whitish.

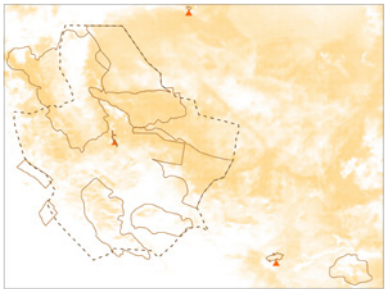
Habitat and habits: Mainly diurnal snake, also found active at dusk with higher temperatures. Very fast and agile, it mostly inhabits arid, sparsely vegetated stony *wadis* with hard soils, but it is also found in sandy areas, stony desert plains and cultivated areas. It feeds mainly on rodents, but also birds, lizards and other snakes. Juveniles may feed on large arthropods. Prey is killed with its venom, which does not seem to be dangerous to humans (i.e., causes localised swelling on the bitten area). Oviparous females lay up to 18 eggs. When threatened, it frequently imitates the defensive behaviour of cobras by spreading its neck into a hood and hissing.

Abundance: Scarce.

Toxicity: Venomous (Opisthoglyph) Not listed as medically important.

Conservation status: Global – LC; Regional – LC.

Schokari sand racer
Psammophis schokari (Forskål, 1775)



Global distribution: South-west Asia, Arabian Peninsula, North Africa.

Distribution in AlUla: Observed between 440 and 1,460 m a.s.l., can be found in AlGharameel, AlUla Oasis, Harrat Uwayrid, Old Khaybar and Sharaan.

Measurements: TBL – 150 cm.

Identification: Medium- to large-sized snake, very slender in comparison to other snakes. With an elongated head distinct from the body, and an angular canthus rostralis. Large eyes with rounded pupils and golden iris (darker towards the edges). Dorsal scales smooth, ordered in 17–19 scale rows at mid-body; 162–194 ventrals; anal plate and subcaudals (95–149) divided. Dorsal colouration may vary from light to olive brown, or reddish to brownish grey, with or without longitudinal light and dark bands. On the sides of the head, a dark stripe usually extends from the nostrils to the neck, crossing the eye. Dark elongated blotches on top of the head, and dark spots on the upper and lower labials. Ventral part is whitish. Greyish to reddish belly, with interrupted fine longitudinal stripes.

Habitat and habits: Diurnal/crepuscular shy and rapid snake, able to climb on small trees and bushes. Habitat generalist, it occupies different habitats, from vegetated *wadis* and rocky highlands, to arid sandy areas and vegetated gravel plains. It feeds on rodents, birds or lizards, which it can either paralyse with venom injected through its fangs with a chewing motion or kill through constriction with its body coils. Venom does not seem to be dangerous to humans (i.e., local swelling in the bitten area). Oviparous females lay up to 8 eggs.

Abundance: Common.

Toxicity: Venomous (Opisthoglyph) Not listed as medically important.

Conservation status: Global – LC; Regional – LC.

Desert cobra
Walterinnesia aegyptia Lataste, 1887

Global distribution: Sinai Peninsula, South-west Asia, and Arabian Peninsula.

Distribution in AlUla: Observed between 610 and 1,060 m a.s.l., can be found in Harrat AlZabin.

Measurements: TBL – 130 cm.

Identification: Medium- to large-sized snake with a robust, cylindrical body. The head is distinct from the neck, and has a sharply-edged snout. Head covered by 9 symmetrically arranged enlarged plates. Small eyes with rounded pupils. The rostral scale is broader than deep, and the nostrils are located between 2–3 nasals and the internasal. The loreal scale is absent. Single, elongated preocular; two postoculars; one subocular; 5 temporals (the lower anterior enlarged); 7 supralabials. Dorsal scales are smooth anteriorly, and keeled posteriorly and on the tail. 21–25 mid-body scale rows; 180–200 ventrals; divided anal plate; 40–53 subcaudals (at least one is entire, the rest are double). Males have relatively longer tails. Colouration mostly uniformly shiny black (rarely dark brown), with iridescent bluish black belly. Juveniles have more or less distinct light crossbars.

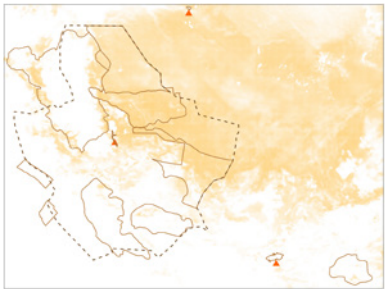
Habitat and habits: Fossorial, nocturnal snake, which is rarely encountered and therefore little is known about its biology. Found in desert and semi-desert habitats, except for sandy areas. Inhabits dry stony *wadis* with scarce vegetation, usually near water bodies, and often associated with human settlements (e.g., crop fields). It feeds on desert vertebrates, such as lizards, other snakes, toads and rodents. Oviparous species.

Abundance: Rare.

Toxicity: Venomous (Proteroglyph) Secondary medical importance.

Conservation status: Global – LC; Regional – LC.

Gasperetti's viper
Cerastes gasperettii Leviton & Anderson, 1967



Global distribution: South-west Asia, and Arabian Peninsula.

Distribution in AlUla: Observed between 10 and 1,270 m a.s.l., can be found in AlGharameel, Sharaan and Wadi Nakhlah.

Measurements: TBL – 84 cm.

Identification: Medium-sized, stout snake with a large head, well-distinct from the body, and a short and broad snout with nostrils directed upwards and outwards. Eyes with vertical pupils and yellow iris. Head covered with keeled or imbricate scales. 4–5 small scale rows between the eye and the supralabials (which are 12–15). Above the eyes, a large horn-like scale can be present. Body covered with keeled scales with apical pits (30–37 scale rows at mid-body). Males are slender and have larger heads and a swollen basis of the (relatively) longer tail. Furthermore, males have 146–159 ventral scales (152–167 in females), and 22–41 subcaudals (22–38 in females). Colouration can vary depending on the environment, ranging from pale cream to reddish, brown and greyish, with a more or less distinct pattern of longitudinal rows of round darker spots, lighter on the sides. An oblique dark band extends on the side of the head, starting from the eye and directed caudally. The tip of the tail may be black.

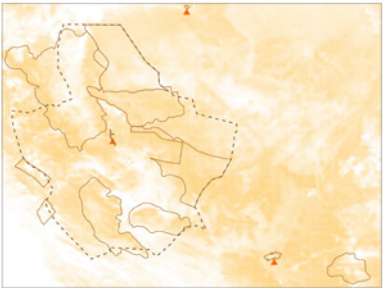
Habitat and habits: Nocturnal snake, during the day it is burrowed in the sand or hidden in burrows or under stones. Typically, it inhabits sandy areas with loose sand and sand dunes. When threatened, it rubs its coils, producing loud hissing- or crackling-like sounds, and is able to strike quickly and repeatedly. It leaves unique traces on the sand, due to its typical sidewinding locomotion. It is able to travel long distances overnight searching for prey, which usually consists of reptiles, mammals and, sporadically, birds.

Abundance: Common.

Toxicity: Venomous (Solenoglyph) Highest medical importance.

Conservation status: Global – LC; Regional – LC.

Burton's carpet viper
Echis coloratus Günther, 1878



Global distribution: South-west Asia, Arabian Peninsula, Sinai Peninsula, eastern North Africa.

Distribution in AlUla: Observed between 310 and 1,550 m a.s.l., can be found in all conservation areas except AlGharameel, Harrat AlZabin, Jabal Nahar, Sharaan and Tayma.

Measurements: TBL – 83 cm.

Identification: Medium-sized, relatively slender in comparison to other vipers, with large triangular to bell-shaped head well distinct from the body. Eyes with vertical elliptical pupil and yellow-golden iris, situated closer to the snout. Head covered with small convex scales, body scales are strongly keeled and with apical pits. With 31–37 scale rows at mid-body; 175–210 rounded ventrals; anal plate and 40–57 subcaudals undivided. Males have a longer tail than females. Dorsal colouration is brownish or yellowish grey, paler on the sides. White to cream belly, sometimes with little spots. A row of greyish-white, transversally elongated rhomboid blotches with narrow dark edges extends along the dorsum. Less distinct, similar blotches on the sides, with a row of small dark brown blotches along the ventrals. Head with dark band on the sides, extending from the nostril to the corner of the mouth, passing through the eyes.

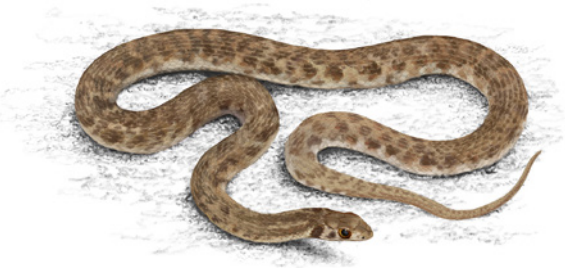
Habitat and habits: Nearly strictly nocturnal snake, active after sunset, although it can also be found during daylight. It inhabits dry and warm slopes in rocky *wadis*, preferring hard soils covered by rocks and with scattered vegetation, sometimes also found near human settlements. If threatened, it coils and rubs its lateral scale to produce a warning hiss. It feeds on rodents, birds, lizards and occasionally frogs and other snakes, while juveniles may also feed on arthropods. Oviparous females lay between 4 and 10 eggs per clutch.

Abundance: Abundant.

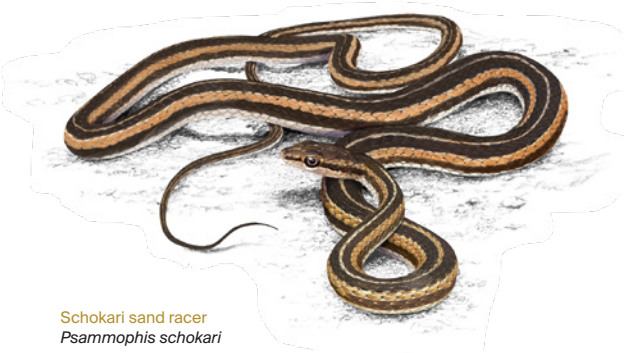
Toxicity: Venomous (Solenoglyph) Highest medical importance.

Conservation status: Global – LC; Regional – LC.

En-Gedi mole viper
Atractaspis engaddensis



Moila snake
Malpolon moilensis

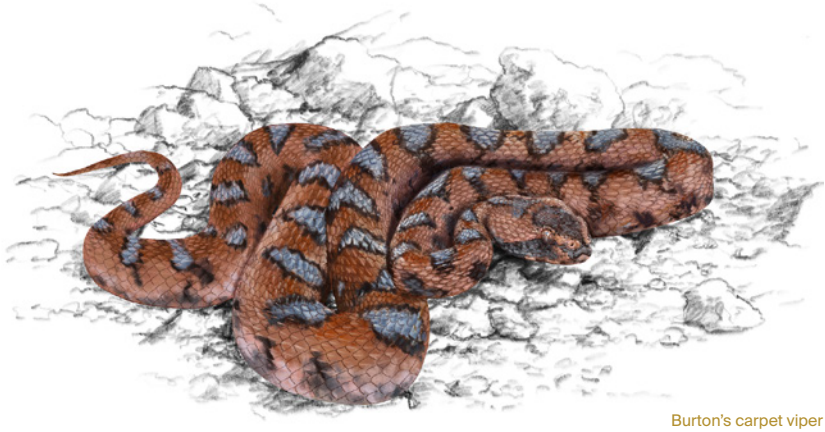


Schokari sand racer
Psammophis schokari

Desert cobra
Walterinnesia aegyptia

Gasperetti's viper
Cerastes gasperettii

Gasperetti's viper
Cerastes gasperettii – detail
of Horned viper head



Burton's carpet viper
Echis coloratus

Sindh thread snake
Myriopholis cf. blanfordi (Boulenger, 1890)

Global distribution: Central and south-west Asia, Arabian Peninsula.

Distribution in AlUla: Observed at 820 m a.s.l., can be found in Harrat Uwayrid.

Measurements: TBL – 24 cm.

Identification: Small-sized, burrowing snake. Head with a rounded snout, not distinct from the body. Cycloid body scales, smooth and shiny. Small, rudimentary eyes located dorsally. Large rostral scale (approx. 1/3 of the head width), not reaching the level of the eyes. 268–375 dorsal scales, and 18–48 subcaudals. 14 scale rows at mid-body, and 12 scale rows at mid-tail. Tail short and stout, ending in a sharp spine. Dorsal colouration pale brownish or dark pinkish, lighter ventrally.

Habitat and habits: Nocturnal, fossorial snake. Secretive habits, little is known of its natural history. In AlUla, it has been observed in rocky habitats of a river valley. Can be found under stones, and occasionally on the surface. It feeds on small insects and other arthropods. This species is oviparous, but the clutch size is unknown.

Abundance: Rare.

Toxicity: Non-venomous (Aglyph).

Conservation status: Global – DD; Regional – NE.

Brahminy blind snake
Indotyphlops braminus (Daudin, 1803)

Global distribution: Native from India, introduced to all continents except Antarctica and South America.

Distribution in AlUla: Observed in AlUla Oasis.

Measurements: TBL – 15 cm.

Identification: Small-sized, burrowing snake with round body. Head with rounded snout, not distinct from the body. Small, rudimentary eyes located dorsally, next to the supraocular scale. Body scales are smooth, shiny and cycloid, with dorsal and ventral scales identical. 20 scale rows at mid-body; 306–348 dorsal scales. Tail as long as it is wide, ending with a conic, pointed scale. Variable dorsal colouration, typically dark brown or black, but pinkish individuals can also be observed. Snout tip and ventral part of the body with a paler shade.

Habitat and habits: Nocturnal snake, active after sunset. It is commonly found in urban and agricultural areas. It feeds on ants and termites. This species is composed only of females, being the only known obligate parthenogenetic species of snake, and lay on average between 3 and 8 eggs throughout the year.

Abundance: Not Evaluated.

Toxicity: Non-venomous (Aglyph).

Conservation status: Global – LC; Regional – Not Applicable.

Brahminy blind snake
Indotyphlops braminus

Sindh thread snake
Myriopholis cf. blanfordi

9. Important Reptile Areas

The most important areas for reptiles, according to the distribution of species richness, are located in Sharaan, Wadi Nakhlah, AlGharameel, the western and eastern slopes of Harrat Uwayrid, and Harrat AlZabin (**Figure 25**).

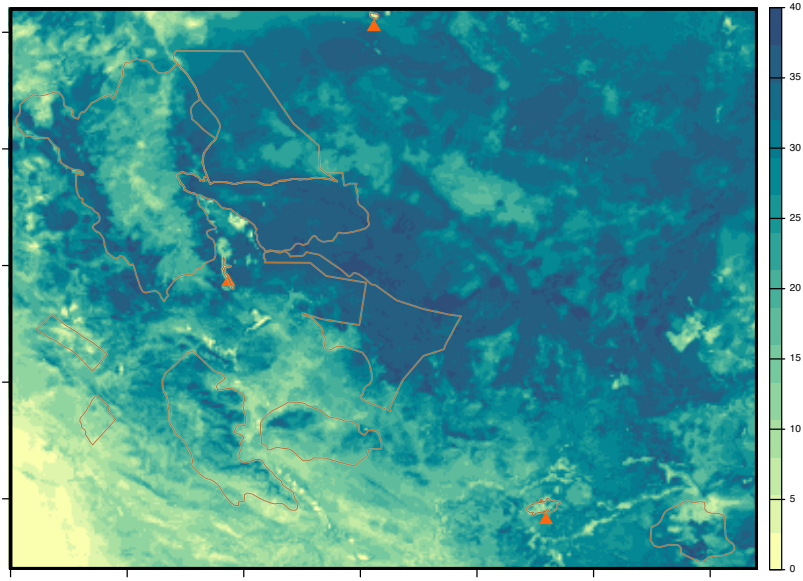


Figure 25 Distribution of reptile species richness in the AlUla region. The legend on the right indicates the number of species.

10. Venom and Snakebite Prevention

Types of venom

Snake venoms are complex mixtures of toxins adapted to overpower prey or deter potential predators successfully. Envenomation occurs through a bite, including rupture and injection, or when venom is sprayed into the eyes (not present in any of the snakes found in AlUla) as part of a defence mechanism. Snake species capable of causing harm to humans, consequently classified as medically important, belong to Atractaspididae, Elapidae and Viperidae.

Venom from Elapidae predominantly induces neurotoxic effects on the neuromuscular junction, causing neuromuscular paralysis and often resulting in respiratory failure. Viperidae venom is mainly hemotoxic and cytotoxic, acting on the circulatory system and causing bleeding, inflammation, local pain, swelling and tissue necrosis around the bite site. Atractaspididae venom displays neurotoxic, hemotoxic and cytotoxic effects.

Medically important venomous snakes in the AlUla region and their predominant venom type:

1. En-Gedi mole viper, *Atractaspis engaddensis* (Atractaspididae): hemotoxic venom.
2. Desert cobra, *Walterinnesia aegyptia* (Elapidae): neurotoxic venom.
3. Gasperetti's viper, *Cerastes gasperettii* (Viperidae): hemotoxic venom.
4. Burton's carpet viper, *Echis coloratus* (Viperidae): hemotoxic venom.

Prevention

Snakes, if disturbed or constrained, without the possibility of safely escaping as a first means of defence, are prone to engage in active defence that can lead to biting. Behaving responsibly contributes to avoiding envenomation, and it is generally advisable to:

1. Not chase or try to kill or capture snakes.
2. Wear closed shoes and long pants.
3. Pay attention to where you step, sit and put your hands.
4. Remember that venomous snakes in the AlUla region are almost

exclusively active at night. The majority of species are slow-moving, ground-dwelling species. Bring a torch for night walks.
5. Use a tent with a mattress, when sleeping outdoors.
6. Not alter potential snake microhabitats (logs and rocks).

In case of envenomation

DO:

1. Stay calm and immobile as much as possible; this will slow down the spreading of the venom through the body and give time until reaching a hospital.
2. Place a bandage loosely to decrease the local blood flow around the bite.
3. Lay or sit down with the bite in a neutral position of comfort.
4. Remove all items (e.g. rings, watches, bracelets or clothes) that can put pressure around the affected area.
5. Go to the nearest medical centre for professional medical treatment.

DON'T:

1. Panic, run or engage in activities that will increase blood flow and accelerate the circulation of venom through the blood system.
2. Try to capture and/or kill the snake for identification purposes; if possible, take a photo of the animal.
3. Apply a tourniquet. Decreasing the oxygen flow to the limb can cause more damage than the envenomation itself.
4. Cut and/or suck out the venom from the wound.
5. Use oxidising substances, potassium permanganate or stun guns.

Hospital in AlUla:
Prince Abdulmuhsin Hospital
70, Al Ula 43543 · +966 14 884 3743
N 26.554787°
E 37.949865°

11. Checklist of the Reptiles of AlUla

Reptile Species		Conservation Status by IUCN	
Family / Common name	**Latin name**	**Global**	**Regional**
Agamidae			
Egyptian rock agama	*Laudakia vulgaris*	LC	LC
Arabian toadhead agama	*Phrynocephalus arabicus*	LC	LC
Aqaba agama	*Pseudotrapelus aqabensis*	NE	NE
Sinai agama	*Pseudotrapelus sinaitus*	LC	LC
Agnes' agama	*Trapelus agnetae*	LC	LC
Yellow-spotted agama	*Trapelus flavimaculatus*	LC	LC
Egyptian mastigure	*Uromastyx aegyptia*	VU	VU
Ornate mastigure	*Uromastyx ornata*	LC	LC
Chamaeleonidae			
Common chameleon	*Chamaeleo chamaeleon*	LC	LC
Gekkonidae			
Baluch rock gecko	*Bunopus tuberculatus*	LC	LC
Rough bent-toed gecko	*Cyrtopodion scabrum*	LC	LC
Yellow-belly gecko	*Hemidactylus flaviviridis*	LC	LC
Grainy house gecko	*Hemidactylus granosus*	LC	NE
Dune sand gecko	*Stenodactylus doriae*	LC	LC
Slevin's short-fingered gecko	*Stenodactylus slevini*	LC	LC
Yom-Tov's sand gecko	*Tropiocolotes yomtovi*	NE	NE
Phyllodactylidae			
Ananjeva's fan-fingered gecko	*Ptyodactylus ananjevae*	NE	NE
Sinai fan-fingered gecko	*Ptyodactylus guttatus*	LC	NE
Yellow fan-fingered gecko	*Ptyodactylus hasselquistii*	LC	LC
Sphaerodactylidae			
Haas' semaphore gecko	*Pristurus guweirensis*	NE	NE

Scincidae			
Asian snake-eyed skink	*Ablepharus pannonicus*	LC	LC
Ocellated bronze skink	*Chalcides ocellatus*	LC	LC
Schneider's skink	*Eumeces schneiderii*	LC	LC
Ribbon-sided skink	*Eurylepis taeniolata*	LC	LC
Sandfish skink	*Scincus conirostris*	NE	NE
Arabian sand skink	*Scincus mitranus*	LC	LC
Lacertidae			
Bosk's fringe-fingered lizard	*Acanthodactylus boskianus*	LC	LC
Snake-tailed fringe-toed lizard	*Acanthodactylus opheodurus*	LC	LC
Schmidt's fringe-fingered lizard	*Acanthodactylus schmidti*	LC	LC
Tilbury's fringe-fingered lizard	*Acanthodactylus tilburyi*	LC	LC
Baha El Din's small-spotted lizard	*Mesalina bahaeldini*	LC	NE
Bernoulli's short-nosed desert lizard	*Mesalina bernoullii*	NE	NE
Blanford's short-nosed desert lizard	*Mesalina brevirostris*	LC	LC
Mount Elba snake-eyed lizard	*Ophisops cf. elbaensis*	DD	DD
Trogonophidae			
Zarudnyi's worm lizard	*Diplometopon zarudnyi*	LC	LC
Varanidae			
Desert monitor	*Varanus griseus*	LC	LC
Boidae			
Javelin sand boa	*Eryx jaculus*	LC	LC
Colubridae			
Crowned dwarf racer	*Eirenis cf. coronella*	LC	LC
Crowned leafnose snake	*Lytorhynchus diadema*	LC	LC
Elegant racer	*Platyceps elegantissimus*	LC	LC
Common cliff racer	*Platyceps rhodorachis*	LC	LC
Saharan racer	*Platyceps saharicus*	LC	LC
Hejaz black-collared snake	*Rhynchocalamus hejazicus*	NE	NE
Palestine kukri snake	*Rhynchocalamus melanocephalus*	LC	NE
Diadem snake	*Spalerosophis diadema*	LC	LC
Arabian cat snake	*Telescopus dhara*	LC	LC

Atractaspididae			
En-Gedi mole viper	*Atractaspis engaddensis*	LC	LC
Psammophiidae			
Moila snake	*Malpolon moilensis*	LC	LC
Schokari sand racer	*Psammophis schokari*	LC	LC
Elapidae			
Desert cobra	*Walterinnesia aegyptia*	LC	LC
Viperidae			
Gasperetti's viper	*Cerastes gasperettii*	LC	LC
Burton's carpet viper	*Echis coloratus*	LC	LC
Leptotyphlopidae			
Sindh thread snake	*Myriopholis cf. blanfordi*	DD	NE
Typhlopidae			
Brahminy blind snake	*Indotyphlops braminus*	LC	NA

IUCN threat status: species of conservation concern globally and regionally.
Status: VU – Vulnerable; LC – Least Concern; DD – Data Deficient; NE – Not Evaluated; NA – Not Applicable.

12. References

Al-Johany, A.M. & Spellerberg, I.F. (1988). Reproductive biology of the lizard *Acanthodactylus schmidti*, Weigmann in Central Arabia. *Journal of Arid Environments* 15: 197-207.

Al-Melhim, W.N., Amr, Z.S., Disi, A.M. & Katbeh-Bader, A. (1997). On the diet of the little owl, *Athene noctua*, in the Safawi area, eastern Jordan. *Zoology in the Middle East* 15: 19-28.

Al-Oran, R.M. (2000). Notable herpetological records from central and southern Jordan. *Zoology in the Middle East* 21: 31-36.

Aloufi, A., Amr, Z. & Baker, M.A. (2022). Reptiles from 'Uruq Bani Ma'arid and Harat al Harrah protected areas in Saudi Arabia: Reptiles from two protected areas in Saudi Arabia. *Herpetology Notes* 15: 483-491.

Aloufi, A.A. & Amr, Z.S. (2015). On the herpetofauna of the Province of Tabuk, northwest Saudi Arabia. *Herpetozoa* 27: 147-158.

Aloufi, A.A., Amr, Z.S. & Abu Baker, M.A. (2021). Reptiles and amphibians of Al Madinah Al Munawwarah Province, Saudi Arabia. *Russian Journal of Herpetology* 28: 123-137.

Alqahtani, A.R. (2018). Lizard community in Tathleeth District of southwestern Saudi Arabia. *Egyptian Academic Journal of Biological Sciences, B. Zoology* 10: 29-34.

Al-Sadoon, M.K., Paray, B.A. & Al-Otaibi, H.S. (2016). Survey of the reptilian fauna of the Kingdom of Saudi Arabia. V. The lizard fauna of Turaif region. *Saudi Journal of Biological Sciences* 23: 642-648.

Al-Shammari, A., Badry, A., Aloufi, B. & El-Abd E. (2022). Molecular phylogeny of *Walterinnesia aegyptia* (Reptilia, Elapidae) isolated from Ha'il Province, Saudi Arabia. *Open Journal of Applied Sciences* 12: 1661-1672.

Al-Shammari, A.M. & Busais, S.M. (2020). Distribution of snakes in Ha'il province, Saudi Arabia, with an identification key to the species. *Russian Journal of Herpetology* 27: 5-10.

Al-Shammari, A.M. (2012). Additional records of lizards in Ha'il Province, Saudi Arabia. *Russian Journal of Herpetology* 19: 287-291.

Al-Shammari, A.M., Busais, S.M. & Ibrahim, A.A. (2017). Snakes in the Province of Ha'il, Kingdom of Saudi Arabia, including two new records. *Herpetozoa* 30: 59-63.

Amr, Z.S., Alenezi, A.A.S., Al-Sayegh, M.T. & Baker, M.A.A. (2022). *Reptiles and Amphibians of the State of Kuwait*. Gland, IUCN; Kuwait, Environment Public Authority.

Amr, Z.S., Shehab, A. & Baker, M.A. (2007). Recent observations on the herpetofauna of Syria with notes on trade in reptiles. *Herpetozoa* 20: 21-26.

Arnold, E.N. (1983). Osteology, genitalia and the relationships of *Acanthodactylus* (Reptilia: Lacertidae). *Bulletin of the British Museum of Natural History* 44: 291–339.

Arnold, E.N. (1984). Ecology of lowland lizards in the eastern United Arab Emirates. *Journal of Zoology* 204: 329-354.

Babelhadj, B., Thorin, C., Benaissa, A., & Guintard, C. (2021). Biometrical study of the Common Skink or Common Sandfish *Scincus scincus* (Linnaeus, 1758): analysis of the sexual dimorphism of the subspecies *S. s. scincus* (Linnaeus, 1758) from the region of El Oued Souf (Algeria). *Revue Suisse de Zoologie* 128: 85-92.

Babocsay, G., Talbi, R., Shacham, B. & Seligmann, H. (2009). Nocturnal or diurnal? Notes on the daily activity pattern and life history of the Middle Eastern Elegant racer *Coluber elegantissimus* (GÜNTHER, 1878). *Herpetozoa* 55: 173-180.

Baig, K., Wagner, P., Ananjeva, N. & Böhme, W. (2012). A morphology-based taxonomic revision of *Laudakia* Gray, 1845 (Squamata: Agamidae). *Vertebrate Zoology* 62: 213-260.

Böhm, M., Collen, B., Baillie, J.E.M., Bowles, P., Chanson, J., et al. (2013). The conservation status of the world's reptiles. *Biological Conservation* 157: 372–385.

Böhm, M., Williams, R., Bramhall, H.R., McMillan, K.M., Davidson, A.D., et al. (2016). Correlates of extinction risk in squamate reptiles: the relative importance of biology, geography, threat and range size. *Global Ecology and Biogeography* 25: 391-405.

Boulenger, G.A. (1917). On the lizards of the genus *Philochortus* Matschie. *Proceedings of the Zoological Society of London* 1917: 145-157.

Brito, J.C. & Pleguezuelos, J.M. (2020). Desert Biodiversity–World's Hot Spots/ Globally Outstanding Biodiverse Deserts. In: Goldstein MI, DellaSala DA (Eds.), *Encyclopedia of the World's Biomes*, vol. 2. Elsevier, pp. 10–22.

Brito, J.C., del Barrio, G., Stellmes, M., Pleguezuelos, J.M. & Saarinen, J. (2021). Drivers of change and conservation needs for vertebrates in drylands: an assessment from global scale to Sahara-Sahel wetlands. *European Zoological Journal* 88: 1103-1129.

Brito, J.C., Godinho, R., Martínez-Freiría, F., Pleguezuelos, J.M., Rebelo, H., et al. (2014). Unravelling biodiversity, evolution and threats to conservation in the Sahara-Sahel. *Biological Reviews* 89: 215-231.

Burbrink, F.T., Crother, B.I., Murray, C.M., Smith, B.T., Ruane, S., et al. (2022). Empirical and philosophical problems with the subspecies rank. *Ecology and Evolution*, 12(7), e9069.

Burriel-Carranza, B., Mazuch, T., Estarellas, M., Talavera, A., Riaño, G., et al. (2023). *Pristurus guweirensis* Haas, 1943 (Gekkota: Sphaerodactylidae): the most abundant and widely distributed species of *Pristurus* previously referred to as *Pristurus sp. 1*. *Zootaxa* 5297: 594-599.

Carranza, S., Els, J. & Burriel-Carranza, B. (2021). *A Field Guide to the Reptiles of Oman*. Madrid: Digital CSIC. ISBN: 978-84-00-10876-2.

Castilla, A.M., Richer, R., Herrel, A., Conkey, A.A.T., Tribuna, J. & Al-Thani, M. (2011). First evidence of scavenging behaviour in the herbivorous lizard *Uromastyx aegyptia microlepis*. *Journal of Arid Environments* 75: 671-673.

Cox, N., Young, B.E., Bowles, P., Fernandez, M., Marin, J., et al. (2022). A global reptile assessment highlights shared conservation needs of tetrapods. *Nature* 605: 285-290.

Cox, N.A., Mallon, D., Bowles, P., Els, J. & Tognelli, M.F. (compilers) (2012). *The Conservation Status and Distribution of Reptiles of the Arabian Peninsula*. Cambridge, UK and Gland, Switzerland: IUCN, and Sharjah, UAE: Environment and Protected Areas Authority.

Cunningham, P.L. (2001). Notes on some aspects of the ecology of *Acanthodactylus opheodurus* Arnold, 1980, from the United Arab Emirates. *Herpetozoa* 14: 15-20.

Datta-Roy, A., Deepak, V., Chaitanya, R., Murthy, C., Bhosale, H., et al. (2017). On the taxonomic status of *Eurylepis poonaensis* (Squamata: Scincidae): resolving a long-standing conundrum. *Salamandra* 53: 389-397.

Dinerstein, E., Olson, D., Joshi, A., Vynne, C., Burgess, N.D., et al. (2017). An ecoregion-based approach to protecting half the terrestrial realm. *BioScience* 67: 534-545.

El Din, S.B. (2006). *A Guide to the Reptiles and Amphibians of Egypt*. Oxford University Press.

Feldman, A. & Meiri, S. (2013). Length–mass allometry in snakes. *Biological Journal of the Linnean Society* 108: 161-172.

GBIF.org (2022). *GBIF Occurrence* Download. https://doi.org/10.15468/dl.csm5ua [downloaded on 13 October 2022].

Grigg, G. & Kirshner, D. (2015). *Biology and Evolution of Crocodylians*. CSIRO. 671 pp.

Gutiérrez, J.M., Calvete, J.J., Habib, A.G., Harrison, R.A., Williams D.J. & Warrell, D.A. (2017). Snakebite envenoming. *Nature Reviews Disease Primers* 3: 17063.

Heikkinen, R.K., Luoto, M.L., Araújo, M.B., Virkkala R., Thuiller, W. & Sykes, M.T. (2006). Methods and uncertainties in bioclimatic envelope modelling under climate change. *Progress in Physical Geography: Earth and Environment* 30: 751-777.

Hetherington, T.E. (1992). Behavioural use of seismic cues by the sandswimming lizard *Scincus scincus*. *Ethology Ecology & Evolution* 4: 5-14.

Hussain, S., Shah, A.A. & Ahmad, K. (2022). A contribution to taxonomy and biology of *Spalerosophis diadema diadema* Schlegel, 1837 along with new record of *Spalerosophis atriceps* Fisher, 1885 from district Poonch of Jammu and Kashmir, India (Reptilia, Squamata, Colubridae). *ARPHA Preprints* 3: e94479.

Karamiani, R., Rastegar-Pouyani, N. & Rastegar Pouyani, E. (2021). Systematics and distribution of the genus *Ablepharus* Fitzinger, 1823 (Sauria, Scincidae): A review. *Iranian Journal of Animal Biosystematics* 17: 115-129.

Karamiani, R., Rastegar-Pouyani, N. & Rastegar-Pouyani, E. (2018). Sexual dimorphism in the Asian snake-eyed skink, *Ablepharus pannonicus* (Fitzinger, 1823 (Sauria): Scincidae) from Iran. *Russian Journal of Herpetology* 25: 1-5.

Karamiani, R., Rastegar-Pouyani, N. & Rastegarpouyani, E. (2018). Modeling the past and current distribution and habitat suitability for *Ablepharus grayanus* and *A. pannonicus* (Sauria: Scincidae). *Asian Herpetological Research* 9: 56-64.

Karger, D.N., Conrad, O., Böhner, J., Kawohl, T., Kreft, H. et al. (2017). Climatologies at high resolution for the Earth land surface areas. *Scientific Data* 4: 170122.

Khan, M.A.R. (1998). *The Reptiles of Jebel Hafeet*. The Natural History, Geology and Archaeology of Jebel Hafeet.

KSA-Kingdom of Saudi Arabia (2020). *Vision 2030*. Kingdom of Saudi Arabia.

Lagerqvist, M. (2022). *Trip report: Saudi Arabia April 22nd to 29th, 2022*. Cloud Birders. https://www.cloudbirders.com/be4/download?filename=LAGERQVIST_SaudiArabia_04_2022.pdf

Liz, A. V., Rödder, D., Gonçalves, D.V., Velo-Antón, G., Tarroso, P., et al. (2023). Overlooked species diversity in the hyper-arid Sahara Desert unveiled by dryland-adapted lizards. *Journal of Biogeography* 50: 101-115.

Liz, A.V., Rödder, D., Gonçalves, D.V., Velo-Antón, G., Fonseca, et al. (2021). The role of Sahara highlands in the diversification and desert colonization of the Bosc's fringe-toed lizard. *Journal of Biogeography* 48: 2891-2906.

Malik, S., Javid, A., Iqbal, M.A., Hussain, A., Bukhari, S.M., et al. (2021). Phylogeography of cliff racer (*Platyceps rhodorachis* Jan, 1865) from Punjab, Pakistan. *Brazilian Journal of Biology* 83: e246243.

Masood, M.F. (2012). Ecological distribution of snakes' fauna of Jazan region of Saudi Arabia. *Egyptian Academic Journal of Biological Sciences, B. Zoology* 4: 183-197.

Mbogga, M.S., Wang, X. & Hamann, A. (2010). Bioclimate envelope model predictions for natural resource management: dealing with uncertainty. *Journal of Applied Ecology* 47: 731-740.

Melnikov, D., Melnikova, E., Bondarenko, D. & Amr, Z. S. (2013). Taxonomy and distribution of *Pseudotrapelus* (Agamidae, Sauria) in Jordan. *Russian Journal of Herpetology*, 20: 213-216.

Melnikov, D., Melnikova, E., Nazarov, R., Rajabizadeh, M., Al-Johany, A., et al. (2014). Taxonomic revision of *Phrynocephalus arabicus* anderson, 1984 complex with description of a new species from Ahvaz, south-western Iran. *Russian Journal of Herpetology*, 21: 149-159.

Melnikov, D., Nazarov, R., Ananjeva, N.B. & Disi, A. (2012). A new species of *Pseudotrapelus* (Agamidae, Sauria) from Aqaba, southern Jordan. *Russian Journal of Herpetology* 19: 143-154.

Modrý, P., Rifai, L., Abu Baker, M. & Amr, Z. (2004). Amphibians and reptiles of the Hashemite Kingdom of Jordan. *Denisia* 14: 407-420.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858.

Nemtzov, S.C. (2008). *Uromastyx* lizards in Israel. In *NDF Workshop Case Studies*, WG (pp. 1-22).

Pola, L., Hejduk, V., Winkelhöfer, T., Zíka, A., Baker, M.A.A., & Amr, Z.S. (2020). Recent observations on amphibians and reptiles in the Hashemite Kingdom of Jordan. *Jordan Journal of Natural History* 7: 11-29.

Pola, L., Crochet, P.-A., Geniez, P., Shobrak, M., Busais, S., et al. (2024). Some like it hot: Past and present phylogeography of a desert dwelling gecko across the Arabian Peninsula. Journal of Biogeography, in press. https://doi.org/10.1111/jbi.14823

Rhodin, A.G., Stanford, C.B., Van Dijk, P.P., Eisemberg, C., Luiselli, L., et al. (2018). Global conservation status of turtles and tortoises (order Testudines). *Chelonian Conservation and Biology*, 17(2), 135-161.

Roll, U., Feldman, A., Novosolov, M., Allison, A., Bauer, A.M., et al. (2017). The global distribution of tetrapods reveals a need for targeted reptile conservation. *Nature Ecology and Evolution* 1: 1677-1682.

Roobas, B. & Feulner, G.R. (2013). A population of Bosk's fringe-toed lizard *Acanthodactylus boskianus* (Daudin, 1802) in the Hajar Mountain foothills of the UAE. *Tribulus* 21: 24-37.

Salvador, A. (1982). A revision of the lizards of the genus *Acanthodactylus* (Sauria: Lacertidae). *Bonner Zoologische Monographien*, 16.

Schätti, B., Kucharzewski, C. & Tillack, F. (2014). *Platyceps rhodorachis* (Jan, 1863) - a study of the racer genus *Platyceps* Blyth, 1860 east of the Tigris (Reptilia: Squamata: Colubridae). *Vertebrate Zoology* 64: 297-405.

Segoli, M., Cohen, T. & Werner, Y.L. (2002). A new lizard of the genus *Mesalina* from Mt. Sinai, Egypt (Reptilia: Squamata: Sauria: Lacertidae). *Faunistische Abhandlungen* 23: 157-176

Seifan, M., Gilad, A., Klass, K. & Werner, Y.L. (2009). Ontogenetically stable dimorphism in a lacertid lizard (*Acanthodactylus boskianus*) with tests of methodology and comments on life-history. *Biological Journal of the Linnean Society* 97: 275-288.

Sindaco, R. & Jeremčenko, V.K. (2008). *The Reptiles of the Western Palearctic*: Annotated checklist and distributional atlas of the turtles, crocodiles, amphisbaenians and lizards of Europe, North Africa, Middle East and Central Asia. Latina: Edizioni Belvedere.

Sivan, J., Kam, M., Hadad, S., Degen, A.A., Rozenboim, I. & Rosenstrauch, A. (2013). Temporal activity and dietary selection in two coexisting desert snakes, the Saharan sand viper (*Cerastes vipera*) and the crowned leafnose (*Lytorhynchus diadema*). *Zoology* 116: 113-117.

Šmíd, J., Carranza, S., Kratochvíl, L., Gvoždík, V., Nasher, A.K. & Moravec, J. (2013). Out of Arabia: A complex biogeographic history of multiple vicariance and dispersal events in the gecko genus *Hemidactylus* (Reptilia: Gekkonidae). *PLoS One* 8: e64018.

Šmíd, J., Moravec, J., Kratochvíl, L., Gvoždík, V., Nasher, A.K., et al. (2013). Two newly recognized species of *Hemidactylus* (Squamata, Gekkonidae) from the Arabian Peninsula and Sinai, Egypt. *ZooKeys* 355: 79–107.

Šmíd, J., Moravec, J., Gvoždík, V., Štundl, J., Frynta, D., et al. (2017). Cutting the Gordian Knot: Phylogenetic and ecological diversification of the *Mesalina brevirostris* species complex (Squamata, Lacertidae). *Zoologica Scripta* 46: 649-664.

Šmíd, J., Sindaco, R., Shobrak, M., Busais, S., Tamar, K., et al. (2021). Diversity patterns and evolutionary history of Arabian squamates. *Journal of Biogeography* 48: 1183-1199.

Šmíd, J., Uvizl, M., Shobrak, M., AlGethami, R. H. M., Algethami, A. R., et al. (2021). Swimming through the sands of the Sahara and Arabian deserts: Phylogeny of sandfish skinks (Scincidae, *Scincus*) reveals a recent and rapid diversification. Molecular *Phylogenetics and Evolution* 155: 107012.

Šmíd, J., Uvizl, M., Shobrak, M., Busais, S., Ali Salim, A.F., et al. (2023). Diversification of *Hemidactylus* geckos (Squamata: Gekkonidae) in coastal plains and islands of southwestern Arabia with descriptions and complete mitochondrial genomes of two endemic species to Saudi Arabia. *Organisms Diversity & Evolution* 23: 185-207.

Tamar, K., Chirio, L., Shobrak, M., Busais, S. & Carranza, S. (2019). Using multilocus approach to uncover cryptic diversity within *Pseudotrapelus* lizards from Saudi Arabia. *Saudi Journal of Biological Sciences* 26: 1442-1449.

Tamar, K., Scholz, S., Crochet, P. A., Geniez, P., Meiri, S., et al. (2016). Evolution around the Red Sea: Systematics and biogeography of the agamid genus *Pseudotrapelus* (Squamata: Agamidae) from North Africa and Arabia.

Molecular Phylogenetics and Evolution 97: 55-68.
Tamar, K., Šmíd, J., Göçmen, B., Meiri, S. & Carranza, S. (2016). An integrative systematic revision and biogeography of *Rhynchocalamus* snakes (Reptilia, Colubridae) with a description of a new species from Israel. *PeerJ* 4: e2769.
Trape, J.F., Chirio, L. & Trape, S. (2012). *Lézards, Crocodiles et Tortues d'Afrique Occidentale et du Sahara*. IRD éditions.
Uetz, P., Freed, P, Aguilar, R., Reyes, F. & Hošek, J. (eds.) (2023) *The Reptile Database*, http://www.reptile-database.org [accessed 31 July 2023].
Van der Kooij, J. (2001). The herpetofauna of the Sultanate of Oman. Part 3: the true lizards, skinks and monitor lizards. *Podarcis* 2: 15-26.
Wagner, P., Melville, J., Wilms, T.M. & Schmitz, A. (2011). Opening a box of cryptic taxa-the first review of the North African desert lizards in the *Trapelus mutabilis* Merrem, 1820 complex (Squamata: Agamidae) with descriptions of new taxa. *Zoological Journal of the Linnean Society* 163: 884-912.
Weather Spark (2023). *Climate and Average Weather Year Round in Al-`Ula, Saudi Arabia*. https://weatherspark.com/y/100173/Average-Weather-in-Al-%60Ula-Saudi-Arabia-Year-Round
Werner, Y.L. & Sivan, N. (1996). Systematics and zoogeography of *Ptyodactylus* (Reptilia: Sauria: Gekkonidae) in the Levant: 3, experimental and natural hybrids of *P. guttatus* and *P. puiseuxi*. *Israel Journal of Ecology and Evolution* 42(2), 185-202.
Werner, Y.L., Gajst, O., Talbi, R. & Bouskila, A. (2012). *Acanthodactylus opheodurus* Arnold, 1980 in the Levant revisited, and the striped patterns of Levantine *Acanthodactylus*: (Reptilia: Lacertidae). *Zoology in the Middle East* 56: 31-38.
WHO-World Health Organization (2023). *Expert Derived Snake Distributions*. WHO. https://snbdatainfo.who.int
Willis, R.E. (2009). Transthyretin gene (TTR) intron 1 elucidates crocodylian phylogenetic relationships. *Molecular Phylogenetics and Evolution* 53(3), 1049-1054.
Wilms, T. & Bohme, W. (2000). A new *Uromastyx* species from south-eastern Arabia, with comments on the taxonomy of *Uromastyx aegyptia* (Forskal, 1775). *Herpetozoa* 13: 133-148.
Wilms, T. & Böhme, W. (2007). Review of the taxonomy of the spiny-tailed lizards of Arabia (Reptilia: Agamidae: Leiolepidinae: *Uromastyx*). *Fauna of Arabia* 23: 435-468.
Wilms, T. M., Wagner, P., Shobrak, M., Lutzmann, N. & Böhme, W. (2010). Aspects of the ecology of the Arabian spiny-tailed lizard (*Uromastyx aegyptia microlepis* Blanford, 1875) at Mahazat as-Sayd protected area, Saudi Arabia. *Salamandra* 46: 131-140.

Wilms, T.M., Shobrak, M. & Wagner, P. (2010). A new species of the genus *Tropiocolotes* from Central Saudi Arabia (Reptilia: Sauria: Gekkonidae). *Bonner Zoological Bulletin* 57: 275-290.

Wilms, T.M., Wagner, P., Shobrak, M. & Böhme, W. (2009). Activity profiles, habitat selection and seasonality of body weight in a population of Arabian Spiny-tailed Lizards (*Uromastyx aegyptia microlepis* Blanford, 1875; Sauria: Agamidae) in Saudi Arabia. *Bonner Zoologische Beiträge* 56: 259-272.

WTO-World Tourism Organization (2020). *AlUla Framework for Inclusive Community Development through Tourism*. UNWTO, Madrid.

Yousefkhani, S.S.H., Marin, G.M.M., Rastegar-Pouyani, N. & Rastegar-Pouyani, E. (2015). A bibliographic recompilation of the genus *Mesalina* Gray, 1838 (Sauria: Lacertidae) with a key to the species. *Russian Journal of Herpetology* 22: 23-34.

Zhang, X., Liu, L., Chen, X., Gao, Y., Xie S, & Mi, J. (2021). GLC_FCS30: global land-cover product with fine classification system at 30 m using time-series Landsat imagery. *Earth System Science Data* 13: 2753-2776.

Zheng, Y. & Wiens, J.J. (2016). Combining phylogenomic and supermatrix approaches, and a time-calibrated phylogeny for squamate reptiles (lizards and snakes) based on 52 genes and 4162 species. *Molecular Phylogenetics and Evolution* 94: 537-547.

Zinner, H. (1985). On behavioral and sexual dimorphism of *Telescopus dhara* Forskal 1776 (Reptilia: Serpentes, Colubridae). *Journal of the Herpetological Association of Africa* 31: 5-6.

13. Index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