Field guide series

Invertebrates of AlUla

Scorpions, Spiders, Dragonflies and Butterflies

العلا
ALULA

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Field guide series: Invertebrates of AlUla
(Scorpions, Spiders, Dragonflies and Butterflies)

Authors
Yuri Simone, Martina Panisi, Vidak Lakušić, Ahmed Taheri, Pedro Tarroso and José Carlos Brito
Series coordination
Duarte Vasconcelos Gonçalves, Leili Khalatbari, Bárbara Santos, Gholam Hosein Yusefi, José Carlos Brito
Foreword
Lourens van Essen
Translation
Ahmed Taheri
Reviewers
Laszlo Patko, Ayman Abdulkareem, Abdulaziz Alsaeed, Lourens van Essen, Benjamin P. Y-H. Lee
Proof reading
Jayne Wilkinson
Cover and page layout
António José Pedro
Cover and species illustrations
Davina Falcão
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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.

WHERE SCIENCE IS ART

ARTE E CIÊNCIA

Editorial Direction
Nuno Ferrand de Almeida
Pedro Beja
Editorial Consultant
Jorge Reis-Sá
Editorial Coordination
Carla Morais Pires

BIOPOLIS – Program in genomics biodiversity and land planning
CIBIO
Campus de Vairão
4485-661 Vairão
Tel. (+351) 252 660 400

Editorial Direction
Nuno Ferrand de Almeida
Editorial Consultant
Jorge Reis-Sá
Editorial Coordination
Carla Morais Pires
Helena Gonçalves
Maria João Fonseca

Museu de História Natural e da Ciência
Universidade do Porto
Praça Gomes Teixeira
4099-002 Porto
Tel. (+351) 220 408 050

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Field guide series

Invertebrates of AlUla

Scorpions, Spiders, Dragonflies and Butterflies

Yuri Simone, Martina Panisi, Vidak Lakušić, Ahmed Taheri, Pedro Tarroso 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 Invertebrates 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 invertebrate assessment for AlUla county and neighbouring areas. It provides original information on the diversity, distribution and richness of invertebrates in the AlUla region. In total, 97 species of invertebrates are depicted and described in the field guide, some resulting from taxonomic reassessment and others from new occurrences. For scorpions, butterflies and dragonflies, all species encountered and collected in the field have been included in this guide. The guide provides comprehensive coverage of spider diversity at the family level, featuring 20 out of the 26 families recorded in Saudi Arabia. However, there is an underrepresentation at the species level. The criteria for spider species selection in this guide were as follows: i) inclusion of at least one species from the most representative families in AlUla county; ii) likelihood of field detection (i.e., high abundance and detectability) or of rare or scarce species; and iii) easy recognition without the need for microscopy or inaccessible equipment. Data for the field guide was obtained from a thorough bibliographical revision and more than six months of intensive field and laboratory work by the authors. Its primary purpose is to provide the tools for the identification of the invertebrates of the AlUla region, and it may be used both by the novice and the experienced arachnologist and entomologist.

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, high diversity of flora and fauna is expected to occur, particularly in arid-adapted species. For scorpions, 36 species have been reported for Saudi Arabia. From Al-Madinah region, only seven species have been reported distributed across three families: Buthidae, Diplocentridae, and Scorpionidae. However, more species can occur in this region because scorpion fauna of Saudi Arabia is considered poorly known. Data on spiders of Saudi Arabia is also very preliminary and it is common for specimen identification to end at the genus level, rendering AlUla spider fauna

mostly an untapped mystery. At least 12 species of dragonflies are known to occur near AlUla but a catalogue of regional dragonflies is unavailable. Butterflies seem to be better investigated within arthropods but no recent checklist is available for Saudi Arabia. Generally, the available knowledge about invertebrate diversity and distribution in the AlUla region is limited, but richness is expected to be relatively high because this group represents a major component of fauna. For these reasons, RCU supported the development of an inventory of invertebrates.

AlUla is an extraordinary example of human and natural heritage co-existence. 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 and integrating the natural and cultural heritage as one living environment. Within the framework of the 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, André Vicente Liz, Bárbara Santos, Diogo Ferreira, Duarte Gonçalves, Francisco Álvares, Fulvio Licata, G. Hosein Yusefi, Hugo Rebelo, Jaime Sousa, László Patkó, Leili Khalatbari, Margareta Lakušić, Mohammad Darwish, Nuno Ferrand, Sophia Rosa, Zbyszek Boratyński, and the rangers of the conservation areas for collecting invertebrate 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; and Alaaeldin I Soultan, Ayman A Abdulkareem, Ingrid Stirnemann, László Patkó, and RCU, 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 its invertebrates, followed by a brief description and illustration of all 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 a list of abbreviations that will help navigate the guide (Ch. 5).

Then, the guide is structured according to each of the four taxonomic groups addressed. For each species, it provides:

- an overview of the biology and diversity of scorpions (Ch. 6), spiders (Ch. 9), dragonflies (Ch. 12) and butterflies (Ch. 15), with a focus on the families and species inhabiting the AlUla region;
- an illustrated section that will guide readers in the first steps in the identification of scorpions (Ch. 7), spiders (Ch. 10), dragonflies (Ch. 13) and butterflies (Ch. 16) at the family and genus levels through the use of relevant diagnostic morphological traits;
- a detailed section with information accompanied by line-art illustrations for the scorpions (Ch. 8), spiders (Ch. 11), dragonflies (Ch. 14) and butterflies (Ch. 17), present in the AlUla region. Species are listed according to the phylogenetic order provided in Chapters 6, 9, 12 and 15. Given the remarkable morphological variability across sexes and ontogenetic states in invertebrates, only adult female spiders have been illustrated in this guide, while in butterflies and dragonflies only adult males have been shown. For these last two taxonomic groups, no larval stages have been considered in either species description and illustrations. No sex preference has been chosen to illustrate scorpions. For each species, the guide 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 (NDVI) 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;
- according to each group, different measurements representing animal body size are reported. For scorpions, the total body length (TBL) is considered as the distance from the tip of the Prosoma to the tip of the telson. In spiders the TBL is considered as the distance from the tip of the cephalothorax to the tip of the abdomen, without considering appendages (such as pedipalps, chelicerae or spinnerets). For dragonflies the TBL is considered as the distance from the tip of the head to the tip of the abdomen without including posterior appendages. Finally, for butterflies the wingspan (WS) is used as a proxy of body size;
- other most relevant identification traits, such as body colouration, prosoma carenation, pincer and telson shape (scorpions), body shape and size, eye arrangement, spinnerets, pedipalps and epigynes (spiders), colouration of dorsal and ventral side of the wings (butterflies), position and size of the eyes, venation of the wings, body and wing colouration, genital structures (dragonflies). Moreover, specific traits that are useful to differentiate sexes and age groups have been reported;
- 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 International Union for Conservation of Nature (IUCN) criteria evaluated at the global level.

Chapter 18 identifies the important areas for invertebrate conservation in the AlUla region based on the distribution of invertebrate 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 Chapters 8, 11, 14 and 17.

Chapter 19 provides information about the toxicity of venoms of scorpions, measures to prevent scorpion sting and spider bites and recommendations in case of envenomation.

Chapter 20 provides a synthetic checklist of the invertebrate of AlUla.

Lastly, the book concludes with the bibliographical references suggested for further reading (Ch. 21) and an Index (Ch. 22).

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 invertebrates 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 due to the different activity patterns of the taxonomic groups presented. Butterflies and dragonflies are active during the daytime. On the other hand, scorpions are active at night while hidden under rocks or burrows during daytime. Spiders have a wide range of different activity patterns depending on the specific families. For instance, Salticidae are generally diurnal, some Sparassidae are strictly nocturnal, and Lycosidae includes both diurnal and nocturnal 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 the analysis of taxonomic traits and for meristic measurements. In addition, distribution data were collected from available literature, from online databases (e.g., Global Biodiversity Information Facility data portal) and from local collaborators.

3. Map of AlUla

The region of AlUla is located in north-western Saudi Arabia, 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**).

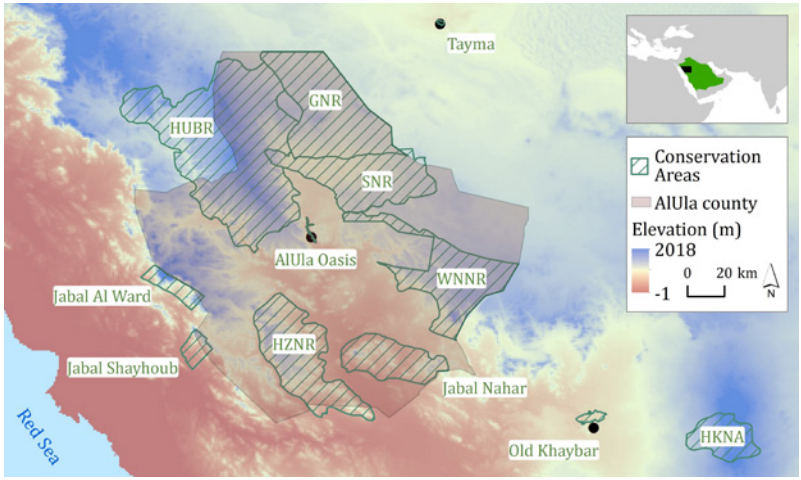
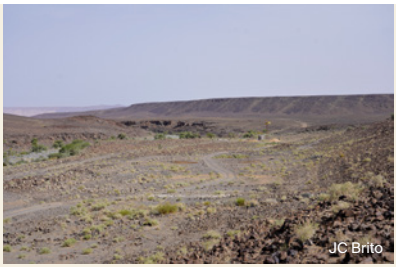


Figure 1 Location of AlUla, major urban areas, and conservation areas for the protection of natural values and ecological heritage in the county.

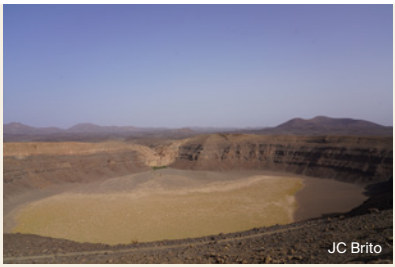
Table 1 Conservation areas within the AlUla region.

Acronym	Name	Category	Area (km²)
HUBR	Harrat Uwayrid	Biosphere Reserve	4,680
WNNR	Wadi Nakhlah	Nature Reserve	1,602
GNR	AlGharameel	Nature Reserve	2,115
HZNR	Harrat AlZabin	Nature Reserve	1,677
SNR	Sharaan	Nature Reserve	1,550
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 Photographs of the main landscapes found in the conservation areas of the AlUla region and examples of associated invertebrates that can be found at each site.



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

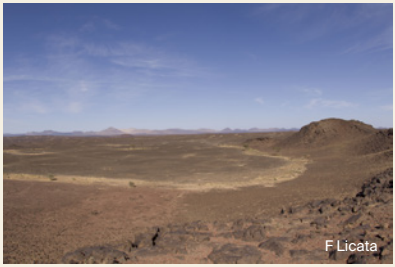
Sharaan: sandy valley and sandstone outcrops – Site 059

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:	*F. trochylus* (butterfly), *O. innesi* (scorpion), *P. dalmasi* (spider), *T. arteriosa* (dragonfly);
	S023:	*B. exilis* (butterfly), *H. misippus* (butterfly), *L. piochardi* (spider), *S. fuscus* (scorpion), *T. arteriosa* (dragonfly).
Wadi Nakhlah	S075:	*B. lepida* (spider), *C. chrysonome* (butterfly), *T. arteriosa* (dragonfly), *T. buettikeri* (scorpion);
	S080:	*J. orithya* (butterfly), *L. nigellus* (scorpion).
AlGharameel	S044:	*P. glauconome* (butterfly), *S. lineatus* (spider);
	S057:	*B. yotvatensis* (scorpion), *C. danae* (butterfly), *C. longipalpis* (scorpion), *L. revivensis* (spider).
Harrat AlZabin	S095:	*B. pseudorectilineus* (spider), *C. liagore* (butterfly), *S. kruglovi* (scorpion);
	S097:	*C. fausta* (butterfly), *L. haenggii* (scorpion).
Sharaan	S059:	*A. ephippiger* (dragonfly), *B. villosus* (scorpion), *E. arabicus* (spider), *L. boeticus* (butterfly);
	S070:	*A. nephilit* (spider), *C. cf setosus* (scorpion), *L. boeticus* (butterfly).

Jabal Nahar	S128:	*A. amarah* (butterfly), *A. crassicauda* (scorpion), *P. arabica* (spider), *P. flavescens* (dragonfly);
	AH060:	*A. crassicauda* (scorpion).
Harrat Khaybar	S143:	*E. charlonia* (butterfly), *O. innesi* (scorpion), *T.* cf. *setiger* (spider);
	S144:	*E. charlonia* (butterfly), *H.* cf. *macullulata* (spider), *S. kruglovi* (scorpion).
Jabal Al Ward	S118:	*C. fausta* (butterfly), *D. chrysippus* (butterfly), *Pardosa* sp. (spider);
	S198:	*A. glaucus* (butterfly), *O. innesi* (scorpion), *U.* cf. *thaleri* (spider).
Jabal Shayhoub	S119:	*C.* cf. *mildei* (spider), *C. halimede* (butterfly), *L. haenggii* (scorpion);
	S122:	*E. praelongipes* (spider), *F. trochylus* (butterfly), *N. hierichonticus* (scorpion), *T. arteriosa* (dragonfly).
Old Khaybar	S140:	*A. imperator* (dragonfly), *D. chrysippus* (butterfly), *C. manzonii* (scorpion), *H. pluchei* (spider), *I. evansi* (dragonfly).
AlUla Oasis	S150 and S153:	*B. exilis* (butterfly), *C.* cf. *khaybari* (scorpion), *J. hierta* (butterfly), *L. chloris* (spider).
Tayma	S136:	*L. boeticus* (butterfly), *P. rapae* (butterfly), *S. radiatus* (spider), *P. flavescens* (dragonfly), *Uloborus* sp. (spider).

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 50% 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 1,000 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.

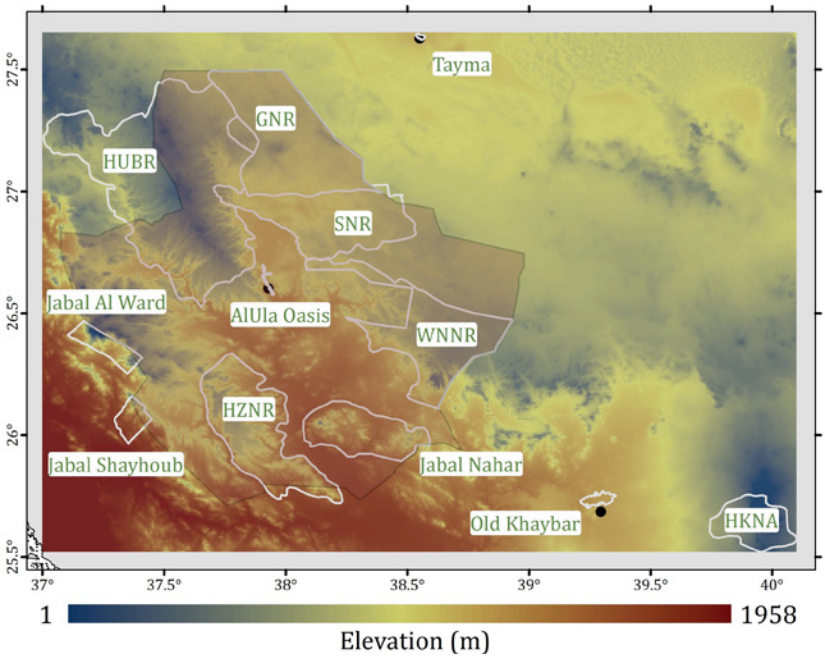


Figure 3 Elevation in the AlUla region. AlUla county (grey polygon), major urban areas (black dot), and conservation areas (white polygons) are identified.

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.

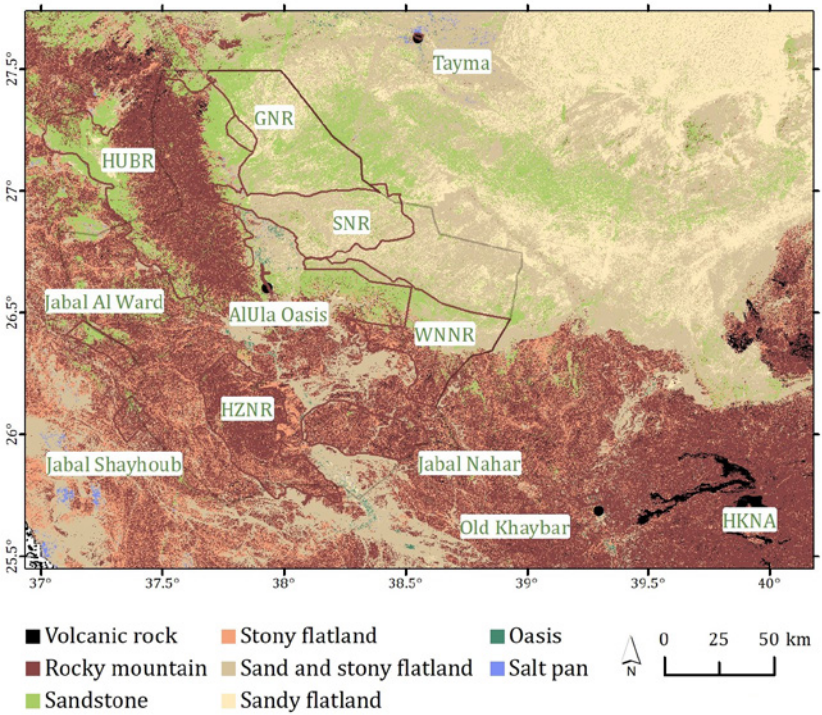


Figure 4 Main land-cover categories found in the AlUla region. AlUla county (grey polygon), major urban areas (black dots) and conservation areas (brown polygons) are identified.

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).

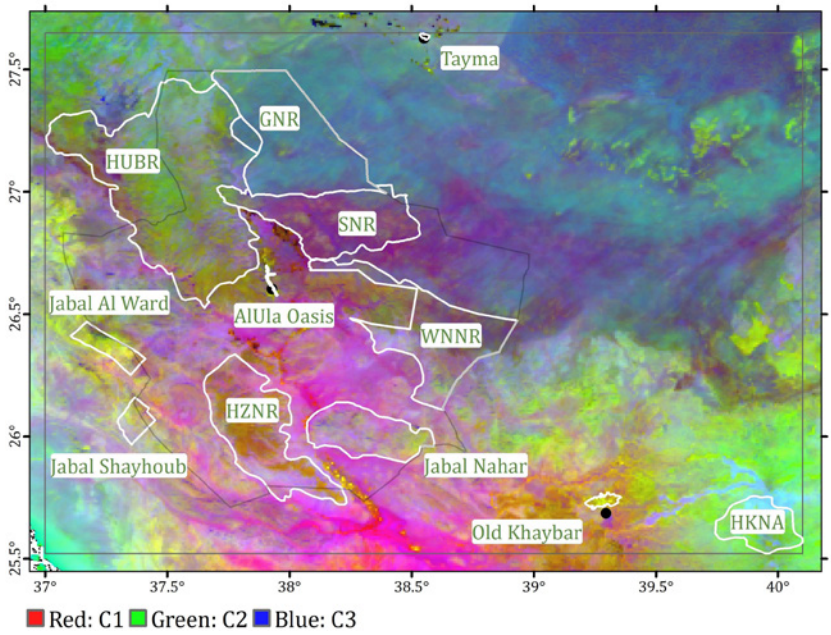


Figure 5 Environmental variability in AlUla county depicted by Harmonic Regression. Scaled coefficients (depicted in RGB colour palette) represent variation in the Normalised Difference Vegetation Index (NDVI; 250m resolution; MODIS satellite) along 2011-2020. AlUla county (grey polygon), major urban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

Abdomen: Posterior part of the body of spiders and insects; in spiders also called 'opisthosoma'.

Aculeus: Structure similar to a hypodermic needle from which venom is injected.

Anal tubercle: Small tubercle situated above the spinnerets of a spider through which the anus opens.

Antennae: Sensory organs in insects positioned on top of the head.

Anterior: Near the front of the body.

Appendages: Structures at the tip of the abdomen of a dragonfly, used in the mating process.

Carapace: Hard cuticular plate covering the cephalothorax.

Carinae: Darkened or granular raised linear ridges.

Cephalothorax: Anterior part of the body of a spider covered by the carapace, also called 'prosoma', where eyes, legs and mouthparts are found.

Chela (p = chelae): Last two tweezer-shaped segments of the scorpion's pedipalps.

Chelicera (p = chelicerae): located on the very front of the cephalothorax of a spider, these are tipped with fangs, and are used to hold the prey and inject venom. In scorpions, chelicerae are located anteriorly to the prosoma and are not associated with venom glands. Mainly used for chewing prey.

Congeneric species: Species belonging to the same genus.

Conspecific: Belonging to the same species.

Cosmopolitan: Distributed in most parts of the world.

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

Diurnal: Active during the day.

Dorsal: Upper or back side of the body.

Endemic: Native or confined to a particular region.

Epigyne: A chitinous plate in which the genital openings are located on the ventral side of the abdomen of female spiders.

Fang: distal part of the chelicerae in spiders.

Fossorial: Burrowing, living partially underground.

Genital operculum: A sclerotised plate covering the reproductive organs of the scorpion located between the sternum and the pectines.

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.

Halophilic: Organisms that inhabit soils with high salt concentration.

Harrat: Volcanic lava field.

Invasive: Species that was introduced and established a population outside its natural range.

Membranule: Triangular opaque membrane in the base of anisoptera wing

Mesosoma: The body part between the prosoma and the metasoma.

Metasoma: The tail-like structure at the rear of the scorpion body carrying the venomous stinger.

Opisthosoma: The section of the scorpion body including the mesosoma and metasoma.

Pectines: Comb-like sensorial organs used in scorpion navigation.

Pedipalp: The second appendage departing from the prosoma in scorpions.In spiders it consists in the second appendage of the cephalothorax, modified into a copulatory organ in male spiders.

Penultimate: Next to the last.

Posterior: Near the back of the body.

Prosoma: Body part including the mouthparts and the eye from which the pedipalps and ambulatory legs depart.

Psammophilous (or Psammophilic): Inhabiting sandy habitats.

Pterostigma: Thickened and coloured area on the anterior edge of dragonfly wings.

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.

Sexual dimorphism: Difference between the sexes.

Sinuate: Having a curved margin.

Specimen: A single collected individual.

Spinnerets: appendages of the abdomen of spiders, arranged in several pairs and provided with small excrescences from which the silk emerges.

Sternum: Part of the exoskeleton located under the prosoma between the coxae of the hind pairs of legs.

Sub-aculear tubercule: Spiny structure located in the distal portion of the venom vesicle posteriorly to the aculeus.

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

Telson: The final structure of the metasoma that consists of a bulbous vesicle,containing the venom gland and the aculeus.

Terrestrial: Living on the ground.

Thorax: Middle part of the insect body.

Veins: Sclerotised tubular structures visible on the surface of the insect wings.

Ventral: Under or front side of the body.

Wadi: River valley or ephemeral riverbed.

Xeric: Very dry.

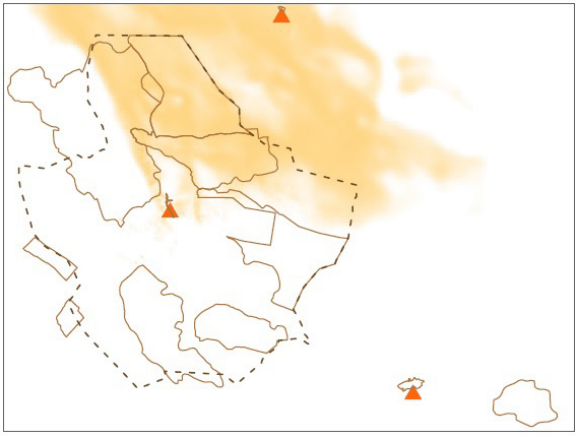
Abbreviations

Ax	antenodal cross-veins
a.s.l.	above sea level
c.	circa
cm	centimetres
cmc	central-median carina
ec	eyebrow carina
e.g.	for example
elc	external lateral carina
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
omc	ocular median carina
plc	posterior lateral carina
pmc	posterior median carina
TBL	total body length
vs	versus
WHO	World Health Organization
WS	wingspan
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.



Order Scorpiones

6. Scorpion Taxonomy

Taxonomic names are given through a process that hinges on phylogeny – the history of the evolution of a species or group. Therefore, species' names are subject to changes over time because of new molecular or morphological phylogenetic evidence. Scorpion taxonomy is undergoing changes all the time and not all researchers agree on what is considered the valid status for families, genera and species. In this guide, we based our identification on the 'The Scorpion Files'' database, https://www.ntnu.no/ub/scorpion-files/intro.php. This database is easily accessible and the published species list reflects the current taxonomic status based on published materials according to international taxonomical rules.

Scorpion order

Order Scorpiones is one of the 11 (or 12 if Xiphosura is included) orders within the class Arachnida. There are about 2,700 species of scorpions currently described and distributed within 22 families.

Scorpions colonised all the continents except Antarctica having as the upper limit of distribution range the 51st parallel North and the lower limit at the 52nd parallel South. Their extreme adaptability to different environments made scorpions able to survive in the most extreme biomes of the planet. They are iconic animals of the deserts. Nevertheless they successfully colonised tropical rainforests, Mediterranean forests, steppes and even alpine environments (scorpions were found above 5,000m on the Andean and Himalayan mountain chain).

The Arabian Peninsula is a hotspot of scorpion diversity. More than 100 species are currently described across Bahrain, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates and Yemen.

Saudi Arabia accounts for 34 species of scorpions (other authors list 36 species for the country) distributed across four different families Buthidae, Diplocentridae, Hemiscorpiidae, and Scorpionidae.

Buthidae. The largest family worldwide accounting for 100 genera and 1,357 species. In Saudi Arabia, this family accounts for 12 genera and a total of 28 species currently described. Buthid scorpions are typically recognised by having almost always a triangular sternum, even if newborn scorpions present a rather pentagonal-shaped sternum. Buthids generally bear slender and elongated pedipalps, ending almost always

with very elongated fingers (even if exceptions exist like males in the genus *Vachoniolus*). The prosoma is trapezoidal and bears characteristic constellations of carenae that can be used to recognise different genera within the family. The venom in these species is highly toxic with mainly neurotoxic effects and excruciating pain. Members of this family are sadly responsible for many fatal accidents worldwide.

Diplocentridae. Consists of 10 genera and accounts for 139 species. It is represented by only 10 species in the whole Middle East belonging to one single genus. In Saudi Arabia, this family includes three different species: *Nebo hierichonticus*, *Nebo yemenensis* and *Nebo jazanensis*. This genus includes large scorpions up to 115 mm in total length. Differently from buthid scorpions, members of this family present robust chelae with strong sexual dimorphism. The most important diagnostic trait of this family that separates this family from others bearing robust chelae is the presence of a sub-aculear tubercle. Venom in this species is potent with mainly hemolytic and necrotic effects. Nevertheless, stings from members of this genus appear to be harmless to humans requiring only mild medical attention.

Hemiscorpiidae. Monotypic family accounting for only one genus *Hemiscorpius* and 17 species. In Saudi Arabia there is only one described species belonging to this family *Hemiscorpius arabicus*. Members of these species generally present a yellowish colouration and robust chelae with quite elongated fingers. One diagnostic trait in this family is a narrow-elongated metasoma carrying a quite short aculeus and elongated venom vesicle. Moreover, the sexual dimorphism of the metasoma is remarkable with males having much longer segments than females. Although scorpions with robust chelae are generally harmless to humans, these species represent the only real exception to this rule. Venom in these species is extremely toxic with cytolytic and hemolytic effects.

Scorpionidae. Consists of 18 genera and 191 species. In Saudi Arabia, three species are currently described belonging to the single genus *Scorpio*. However, in this guide, only two species are considered: – *Scorpio kruglovi* and *Scorpio fuscus* – while waiting for more taxonomic assessments of the genus accounting for more material from Saudi Arabia. The members of this family have rounded, robust and short fingered chelae short metasoma that, contrarily to the members belonging to the genus *Nebo*, lack the subaculear tubercle on the venom vesicle. The most distinctive trait however is the pentagonal shape of the

sternum. Venom is not particularly toxic resulting in only harmless stings to humans.

In this guide, the 14 species of scorpions found in the AlUla region are reported. The taxonomical placements of many of the reported taxa are still under debate. For this guide, some taxonomic positions have been taken, as follows:

- The scorpions belonging to the genus *Butheolus* have been recognised as *Butheolus villosus* the only nominal species occurring in Saudi Arabia for which no genetic sequences are available and whose formal description is based on a single adult female specimen (see Hendrixson 2006).
- The scorpions belonging to the genus *Buthacus* have been recognised as *Buthacus yotvatensis* following the key in Cain et al. (2021).
- The scorpions belonging to the Genus *Orthochirus* have been recognised as *Orthochirus innesi* following the opinions of Vachon (1979) and Hendrixson (2006), although other authors refer to the Asian *Orthochirus* population as *Orthochirus scorbiculatus* limiting the distribution of *Orthochirus innesi* to the African continent (Levy & Amitai 1980).
- Many authors (e.g. Al-Asmari 2013; Alqahtani & Badry, 2021) listed *Scorpio palmatus* for Saudi Arabia in the Medinah Province. Nevertheless all the specimens collected belonging to the genus *Scorpio* were lacking the toothed pectinal plate typical of this species. The occurrence of this species for the region is thus debated and more comparative material should be analysed to confirm more accurately the absence of this species from the northern territories of Saudi Arabia.

7. Scorpion Topography

Scorpions are easy to identify due to their characteristic pair of pincers in the front and the 'tail-like' metasoma carrying the venomous stinger. Both dorsal and ventral sides of the body have important taxonomic traits that are helpful in the recognition of the several species occurring in the AlUla region. Important anatomical traits for scorpion recognition are present in both the dorsal and the ventral side of the animal **(Figure 6)**.

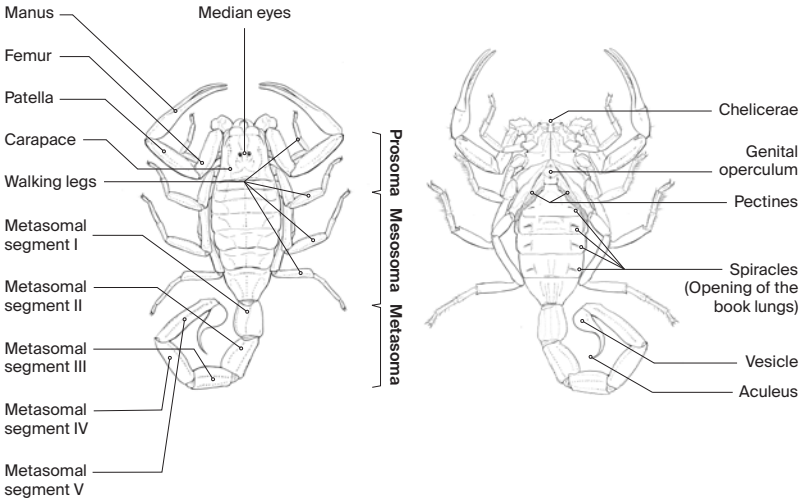


Figure 6 Scorpion overall anatomy, in dorsal (left) and ventral (right) views.

Dorsally, one of the most important traits for species recognition is the prosoma. The shape of the prosoma and the pattern of the spatial distribution of the carenae are diagnostic within and across genera. Each series of carenae has a specific nomenclature **(Figure 7).** Within Buthidae, *Compsobuthus* has the typical fusion of the central and posterior carinae forming a continuous linear series of granules. *Leiurus* has centro-lateral and posterior carinae forming a typical lyre shape. *Buthacus* on the other hand, has a quite smooth prosoma **(Figure 8)**.

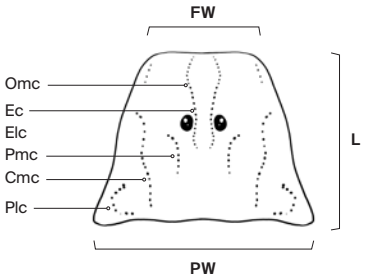


Figure 7 Nomenclature of prosoma granulation.

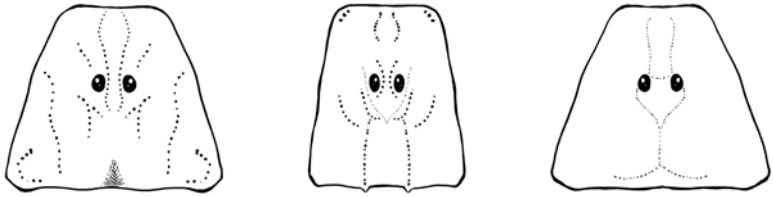


Figure 8 Patterns of prosoma carenae in buthids: *Androctonus crassicauda* (left), *Compsobuthus* spp. (mid), and *Buthacus yotvatensis* (right).

Another extremely important taxonomic trait is the shape of the chelae. Buthids have generally fine and long-fingered chelae while members of the other families have more robust and short-fingered chelae **(Figure 9)**.

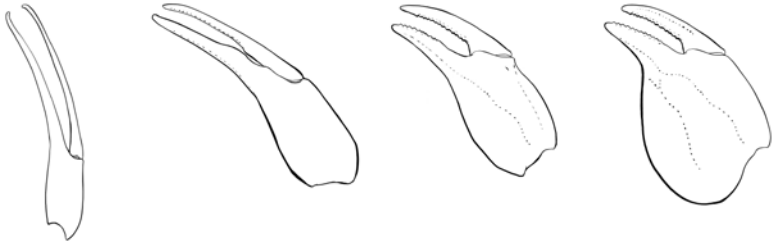


Figure 9 Morphological diversity of pincers in *Compsobuthus longipalpis* (left), *Androctonus crassicauda* (mid-left), *Nebo hierichonticus* (mid-right), and *Scorpio kruglovi* (right).

At the rear of the body plan, scorpions present two very important diagnostic traits: the metasoma and the stinger. The metasoma can vary in length, width and ornamentation. The morphological range

of variation includes very muscular and wide metasomal segments as in the case of the Arabian fat-tailed scorpion to very thin and short metasoma in scorpionids. In Hemiscorpiidae the length of the metasomal segments is different across sexes with males bearing a longer metasoma than females. *Orthochirus* and *Butheolus* also have very distinct ornamentation of their metasoma that makes them extremely easy to recognise. In addition to the metasoma the shape of the stinger is extremely important. Diplocentridae present the subaculear tubercle while all the other families in the AlUla region are lacking it **(Figure 10)**. Finally, the length and curvature of the aculeus is also variable and this is extremely important in recognising similar genera like *Buthacus* and *Tryphanotacus*.

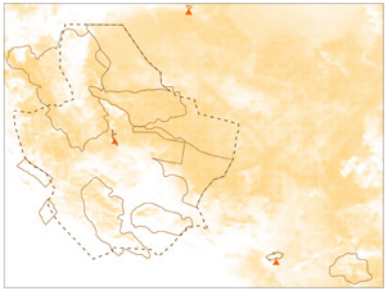
Figure 10 Morphological diversity of the metasoma in *Androctonus crassicauda* (left), *Orthochirus innesi* with punctuation (mid) and *Nebo hierichonticus* with sub-aculear tubercle (right).

On the ventral side of scorpions, the sternum is the most important taxonomic trait at family level. Buthids have mainly triangular-shaped sternum while the other family in the AlUla region have pentagonal sternums (**Figure 11)**. Scorpionidae and Diplocentridae have very similar sternum shapes so this trait is not the best to separate them (instead the presence/absence of the sub-aculear tubercle instead works perfectly). Nevertheless the Hemiscorpiidae have amore rounded sternum than Scorpionidae and Diplocentridae. Observing the ventral side of a scorpion requires the manipulation of the animal and therefore an enhanced risk of accident. The easiest way to observe a scorpion ventrally is to gently push the animal with a stick or a long object into a transparent container and then look beneath it.

Figure 11 Morphological diversity of the sternum in the four families of Arabian scorpions: Buthidae (top), Scorpionidae and Diplocentridae (mid), and Hemiscorpiidae (bottom).

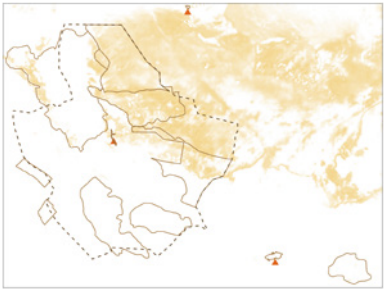
8. Scorpion Species Accounts

Arabian fat-tailed scorpion
Androctonus crassicauda
(Olivier, 1807)



Global distribution: The Sinai Peninsula (Egypt), the Middle East, the Arabian Peninsula, Armenia, Azerbaijan, and Iran.
Distribution in AlUla: Observed between 670 and 1,710 m a.s.l. in the AlUla Oasis, AlGharameel, Harrat Khaybar, Harrat Uwayrid, Jabal Al Ward, Jabal Nahar, Old Khaybar, Sharaan and Wadi Nakhlah.
Measurements: TBL; up to 100 cm.
Identification: large black scorpion with thick and heavily carenated metasoma. Pincers have long fingers but rounded manus. Black-reddish pincers, occasionally yellowish in some populations. No remarked sexual dimorphism; females generally bigger than males and with fewer pectines (females 23–27; males 27–32).
Habitat and habits: Dry/arid areas particularly rich in rocks. Frequent also in oases where encounters may turn into dangerous and even fatal stings.
Abundance: Abundant.
Toxicity: Highly venomous.
Conservation status: NE.

Yotvata sand scorpion
Buthacus yotvatensis
Levy, Amitai & Shulov, 1973

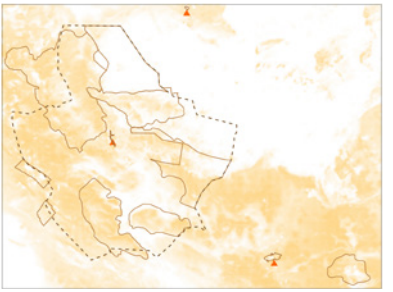


Global distribution: Palestine, southern Arava Valley (Jordan) and Arabian peninsula.
Distribution in AlUla: Observed between 860 and 1,270 m a.s.l. in AlGharameel, Sharaan and Wadi Nakhlah.
Measurements: TBL; up to 70 cm.
Identification: large yellow scorpion characterised by a fairly smooth cuticle, big pair of medial eyes in the middle of the prosoma, long aculeus (longer than the vesicle height) and abundant setosity on the telson, ventral side of metasomal segments and legs. Pincers in this species are slender with fingers being only 1.5 times longer than the manus length. No remarked sexual dimorphism; females are generally bigger than males and with less pectines (females 25–28; males 32–37).
Habitat and habits: Typical psammophilous species encountered in sandy areas where they build their burrow.
Abundance: Abundant.
Toxicity: Highly venomous.
Conservation status: NE.

Hairy tailed scorpion
Butheolus villosus
Hendrixson, 2006

Global distribution: Saudi Arabia.
Distribution in AlUla: Observed between 1,010 and 1,270 m a.s.l. in the AlUla Oasis, Sharaan and Wadi Nakhlah.
Measurements: TBL; up to 35 mm.
Identification: Small scorpion characterised by having the metasomal segments granulated and particularly hairy, bent similarly to the members of the genus *Orthochirus*. The metasoma is dark-brown coloured, while the mesosoma and prosoma are light brown. The pedipalps and the very hairy legs are yellow. Venom toxicity has not been assessed although it should be similar to that of *Orthochirus*.
Habitat and habits: Sandy/desert areas; the villosity and the very elongated claws are characteristic of psammophilous species.
Abundance: Common.
Toxicity: NE.
Conservation status: NE.

Khaybari striped scorpion
Compsobuthus* cf. *khaybari
Abu Afifeh, Aloufi & Al-Saraireh, 2021

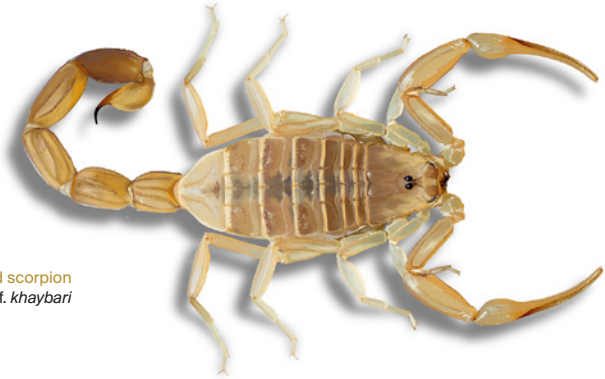


Global distribution: Saudi Arabia.
Distribution in AlUla: Observed between 380 and 1,700 m a.s.l. in the AlUla Oasis, Jabal Al Ward and Jabal Shayhoub.
Measurements: TBL; up to 35 cm
Identification: Small scorpion, generally less than 35 mm in length; body colour ranging from generally yellowish to brown. The prosoma bears the typical carenation of the genus. The mesosoma is yellow-brownish and bears three lines of carenae along the whole body. Pincers are particularly elongated, ending with a sort of hook at the end of both movable and immovable fingers. The dentate margin of the movable finger has 9–10 rows of denticles and outer accessory granules. No remarked sexual dimorphism; females are generally bigger than males and with less pectines (females 17–17; males 20–22).
Habitat and habits: Oasis and rocky wadis.
Abundance: Abundant.
Toxicity: Highly venomous.
Conservation status: NE.

Arabian fat-tailed scorpion
Androctonus crassicauda

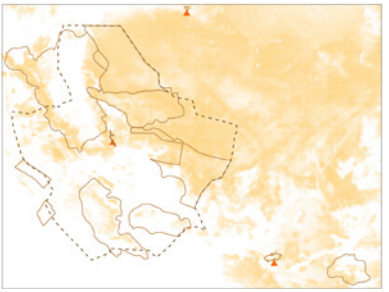
Yotvata sand scorpion
Buthacus yotvatensis

Hairy tailed scorpion
Butheolus villosus



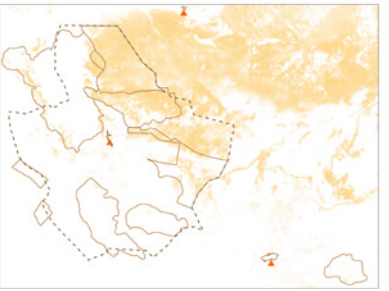
Khaybari striped scorpion
Compsobuthus cf. *khaybari*

Sandy striped scorpion *Compsobuthus* aff. *longipalpis* Levy, Amitai & Shulov, 1973



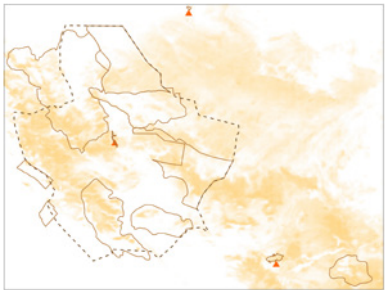
Global distribution: Egypt, Palestine and Saudi Arabia.
Distribution in AlUla: Observed between 720 and 1,260 m a.s.l. in AlGharameel, Harrat Khaybar, Harrat Uwayrid and Sharaan.
Measurements: TBL; up to 50 mm.
Identification: Small scorpion uniformly yellowish except for the fifth segment of the metasoma, which is black for about two-thirds. The prosoma bears the typical carenation of the genus. The mesosoma is quite smooth and carenation is barely visible. Pincers are particularly elongated, ending with a sort of hook at the end of both movable and immovable fingers. The dentate margin of the movable finger presents 14 rows of denticles and outer accessory granules. No remarked sexual dimorphism; females are generally bigger than males. pectinal count: females unknown; males 25-29).
Habitat and habits: Stone cliffs surrounded by flat sand fields with small sand dunes and xeric vegetation.
Abundance: Scarce.
Toxicity: Highly venomous.
Conservation status: NE.

Pale striped scorpion *Compsobuthus* cf. *setosus* Hendrixson, 2006



Global distribution: Saudi Arabia.
Distribution in AlUla: Observed between 930 and 1,360 m a.s.l. in AlGharameel, Sharaan and Wadi Nakhlah.
Measurements: TBL; up to 40 mm.
Identification: Uniformly yellowish with legs being paler than the rest of the body.The prosoma bears the typical carenation of the genus. The mesosoma is yellow-brownish and bears three lines of carenae along the whole body. Pincers are particularly elongated, ending with a sort of hook at the end of both movable and immovable fingers. The dentate margin of the movable finger has 9-10 rows of denticles and lacks outer accessory granules. No remarked sexual dimorphism; females are generally bigger than males and with fewer pectines (females 16–17; males 19–22).
Habitat and habits: Stone cliffs surrounded by flat sand fields
Abundance: Abundant.
Toxicity: Highly venomous.
Conservation status: NE.

Dark striped scorpion
Compsobuthus manzonii
(Borelli, 1915)



Global distribution: Saudi Arabia and Yemen.
Distribution in AlUla: Observed between 720 and 1,710 m a.s.l. in Harrat Khaybar, Wadi Nakhlah and Old Khaybar.
Measurements: TBL; up to 45 cm.
Identification: Small scorpion, generally less than 35 mm in length; body colour ranging from dark to light brown. The prosoma bears the typical carenation of the genus. The mesosoma is yellow-brownish and bears three lines of carenae along the whole body. Pincers are particularly elongated ending with a sort of hook at the end of both movable and immovable fingers. The dentate margin of the movable finger with 9–11 rows of denticles and with outer accessory granules. No remarked sexual dimorphism; females are generally bigger than males and with less pectines (females 17–19; males 19–23).
Habitat and habits: Oasis and rocky volcanic areas.
Abundance: Abundant.
Toxicity: Highly venomous.
Conservation status: NE.

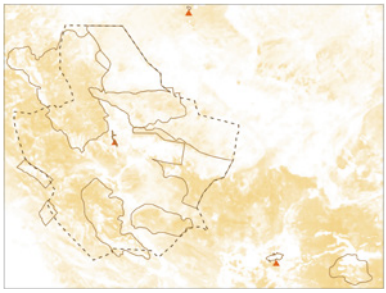
Sandy striped scorpion
Compsobuthus aff. *longipalpis*

Pale striped scorpion
Compsobuthus cf. *setosus*

Dark striped scorpion
Compsobuthus manzonii

Eclipse deathstalker

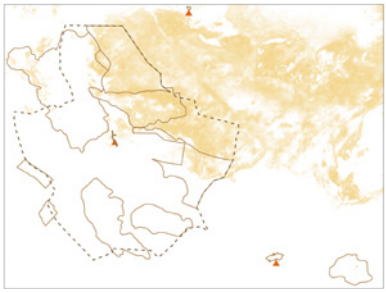
Leiurus haenggii Lowe, Yagmur & Kovařík, 2014



Global distribution: Arabian Peninsula: Saudi Arabia, Yemen and Oman.
Distribution in AlUla: Observed between 280 and 1,720 m a.s.l. in AlGharameel, Harrat AlZabin, Harrat Khaybar, Harrat Uwayrid, Jabal Al Ward, Jabal Nahar, Jabal Shayhoub and Wadi Nakhlah.
Measurements: TBL; up to 120 mm.
Identification: Large scorpion characterised by a darker continuous colouration of the mesosoma and prosoma, yellow legs and pedipalps. The metasoma is slender and elongated with the fifth segment generally black. Pincers are slender and with extremely long fingers. No remarked sexual dimorphism; females are generally bigger than males. The pectine count has large variation and overlaps between sexes (females 24–32; males 28–39).
Habitat and habits: Occurs in dry/arid areas particularly rich in rocks. It can be detected on rock and gravel substrates in densely vegetated wadis, from coastal plains to mountains.
Abundance: Abundant.
Toxicity: Highly venomous.
Conservation status: NE.

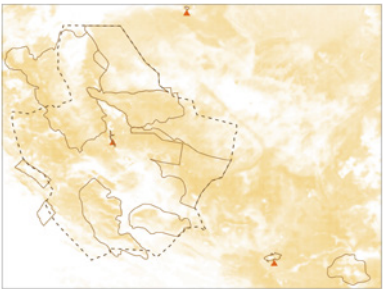
Black deathstalker

Leiurus nigellus Abu Afifeh, Aloufi, Al-Saraireh, Badry, Al-Qahtni & Amr 2023



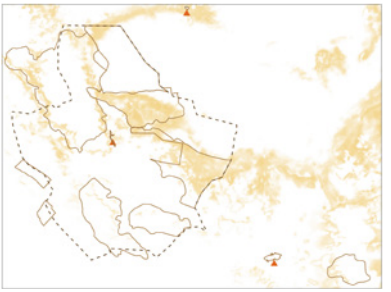
Global distribution: Saudi Arabia.
Distribution in AlUla: Observed between 930 and 1,371 m a.s.l. in AlGharameel and Wadi Nakhlah.
Measurements: TBL; up to 115 mm.
Identification: Large scorpion characterised by black coloration of the whole body excluding in some cases the chelicerae, the tip of legs and movable finger which are coloured in yellow. The metasoma is slender and elongated, carrying the venom vesicle that can also assume yellow colouration but tends to be uniformly black. Chelae are slender and have extremely long fingers with tips coloured in yellow. No remarked sexual dimorphism; females are generally bigger than males with fewer pectines (females 27–31; males 33–37).
Habitat and habits: Sandstone cliffs surrounded by flat sand fields with small sand dunes and xeric vegetation.
Abundance: Abundant.
Toxicity: Highly venomous.
Conservation status: NE.

Pillared-tail scorpion
Orthochirus innesi Simon, 1910



Global distribution: Bahrain, Jordan, Iraq and Saudi Arabia.
Distribution in AlUla: Observed between 480 and 1,710 m a.s.l. in all conservation areas except for Tayma and Jabal Nahar.
Measurements: TBL; up to 30 mm.
Identification: Small scorpion characterised by black colouration of the whole body excluding legs and pincers which are coloured in yellow. Metasoma is short and wide, often bent in a characteristic position and heavily punctuated. Chelae are slender with relatively long fingers. No remarked sexual dimorphism; females are generally bigger than males with fewer pectines (females 15–19; males 17–21).
Habitat and habits: From sandy areas with bushes to areas with rocky/gravel substrate; It can also be found in Oasis. The metasoma of *Orthochirus* is bent in a typical position and often it is moved in a way like as if it is scanning the environment.
Abundance: Abundant.
Toxicity: Highly venomous.
Conservation status: NE.

Arabian burrowing scorpion
Trypanothacus buettikeri (Hendrixson, 2006)



Global distribution: Jordan and Saudi Arabia.
Distribution in AlUla: Observed between 1,040 and 1,320 m a.s.l. in AlGharameel, Harrat Khaybar, Harrat Uwayrid and Wadi Nakhlah.
Measurements: TBL; up to 70 mm.
Identification: Large yellow scorpion characterised by a fairly smooth cuticle, a big pair of medial eyes in the middle of the prosoma, an aculeus shorter than or equal to the vesicle height and strong carenation on the ventral side of the fifth metasomal segment. Chelae in this species are slender with rounded manus and relatively short fingers being only as long as the manus. No remarked sexual dimorphism; females are generally bigger than males and with fewer pectines (females 15–22; males 24–25) with more robust metasomal segments and more slender pedipalp chelae.
Habitat and habits: sandy areas mixed with gravel substrate.
Abundance: Abundant.
Toxicity: Highly venomous.
Conservation status: NE.

Eclipse deathstalker
Leiurus haenggii

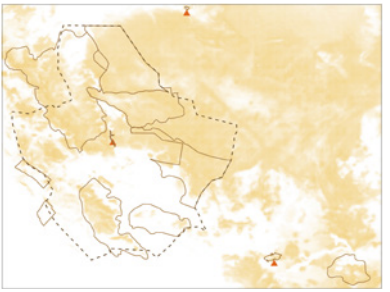
Black deathstalker
Leiurus nigellus

Pillared-tail scorpion
Orthochirus innesi

Arabian burrowing scorpion
Trypanothacus buettikeri

Jericho scorpion

Nebo hierichonticus (Simon, 1872)



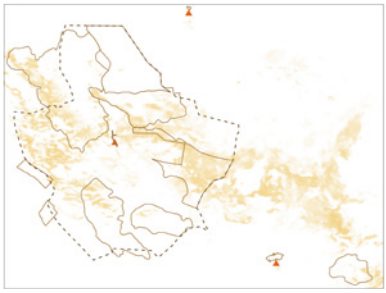
Global distribution: Palestine, Jordan and Saudi Arabia.
Distribution in AlUla: Observed between 650 and 1,700 m a.s.l. in AlGharameel, Harrat Khaybar, Harrat Uwayrid, Jabal Al Ward, Old Khaybar, Sharaan and Wadi Nakhlah.
Measurements: TBL; up to 120 mm.
Identification: Large scorpion characterised by dark colouration of the whole body, with a robust pair of pincers and sub-aculear tubercle. The metasoma is slender and elongated, and the venom vesicle presents typical sub-aculear tubercle and short aculeus. Legs can be yellowish. Pincers are big and robust, being overall longer than higher. Marked sexual dimorphism especially in the pincers andthe pectinal count. Chelae in males have larger proximal tooth and corresponding knob than females. Males present generally more elongated pectines and their number is generally larger even if there is a small degree of overlapping (females 14–15; males 15–18).

Habitat and habits: Under the rocks,in self-dug deep caves in the deserts and in arid to semiarid mountainous regions.
Abundance: Abundant.
Toxicity: Highly venomous.
Conservation status: NE.

Dark large-clawed scorpion
Scorpio fuscus (Ehrenberg, 1829)

Global distribution: Palestine, Jordan and Saudi Arabia.
Distribution in AlUla: Observed between 840 and 1,710 m a.s.l. in Harrat Uwayrid.
Measurements: TBL; up to 100 mm.
Identification: Large scorpion characterised by dark colouration of the whole body, with a robust pair of pincers. The metasoma is slender and quite short and the venom vesicle does not present the typical sub-aculear tubercle. Pincers are big and robust, with the manus being higher than longer. There is no marked sexual dimorphism. Generally males present more elongated pectines and their number is usually larger even if there is a remarkable overlap (females 8–10; males 9–11).
Habitat and habits: Under the rocks, in self-dug deep burrows in the volcanic mountainous regions.
Abundance: Common.
Toxicity: Mildly venomous.
Conservation status: NE.

Kruglovi's large-clawed scorpion
Scorpio kruglovi (Simon, 1872)



Global distribution: Kuwait, Jordan, Iran, Iraq, Qatar, Saudi Arabia, Syria and Turkey.
Distribution in AlUla: Observed between 740 and 1,700 m a.s.l. in Harrat AlZabin, Harrat Khaybar and Jabal Al Ward.
Measurements: TBL; up to 100 mm.
Identification: Large scorpion characterised by dark colouration of the prosoma and mesosoma while the rest of the body is yellow with dark granularity. This species bears a pair of very robust and strong pincers. The metasoma is slender and quite short, and the venom vesicle does not present the typical sub-aculear tubercle. Pincers are big and robust, with the manus being higher than longer. There is no marked sexual dimorphism. Males present generally more elongated pectines and their number is generally larger even if there is a remarkable overlap (females 9–10; males 9–11).
Habitat and habits: Under the rocks, in self-dug deep burrows in sandy/rocky areas and in arid to semiarid mountainous regions or more typically in *wadi*.
Abundance: Abundant.
Toxicity: Mildly venomous.
Conservation status: NE.

Jericho scorpion
Nebo hierichonticus

Dark
large-clawed
scorpion
Scorpio fuscus

Kruglovi's
large-clawed scorpion
Scorpio kruglovi

Order Aranea

9. Spider Taxonomy

Similar to scorpions, spider taxonomy progressively changes over time, with a continuous review of families, genera and species and the discovery of new species around the globe. In this guide, we based our identification on the 'World Spider Catalogue' database: https://wsc.nmbe.ch/. This database is freely accessible and considers all the taxonomically useful published work on spiders up to date.

Spider order

Spiders (Order Araneae) are one of the 11 (or 12 if Xiphosura is included) orders within the class Arachnida. Currently (January 2024), there are about 51,900 species of spiders described, distributed in 138 families.

Spiders are distributed worldwide, occurring on all continents except Antarctica, and adapting to every conceivable terrestrial habitat, such as caves, alpine areas, tropical forests, deserts, and even, in some cases, aquatic zones. Their lifestyles and morphology vary greatly, and as generalist predators, they play a key component in most terrestrial ecosystems, having an impact on the density of insect populations, including controlling arthropod pests in agricultural environments.

In the Arabian Peninsula, spiders are among the most common and ubiquitous animals. However, despite recent progress, knowledge of the diversity of spiders that occur in this area of the world is still far from comprehensive and the inventory of the species is a work in progress.

Saudi Arabia accounts for 25 different families of spiders: Agelenidae, Araneidae, Cheiracanthiidae, Corinnidae, Eresidae, Gnaphosidae, Linyphiidae, Lycosidae, Mimetidae, Oecobiidae, Oonopidae, Oxyopidae, Palpimanidae, Philodromidae, Pholcidae, Salticidae, Scytodidae, Selenopidae, Sicariidae, Sparassidae, Theraphosidae, Theridiidae, Thomisidae, Uloboridae and Zodariidae.

In addition, a new record is the family Hersiliidae Thorell, 1869, which is found in neighbouring countries but has not been previously documented in Saudi Arabia, thereby contributing to a cumulative count of 26 spider families.

Seventy-five spider species are documented in Saudi Arabia. This work adds 17 newly recorded species, bringing the current number of identified spiders at the species level to 92. It is noteworthy that the true

diversity of spider species in Saudi Arabia is likely to be higher, because additional species have been identified only up to the genus level.

Among these, the below-mentioned families are particularly common or distinguishable.

Salticidae (jumping spiders) is the family with the highest number of species recorded in Saudi Arabia up to date (27). They are represented by 6,664 species worldwide and are small to large-sized (3–17 mm) diurnal active hunters, characterised by large anterior median eyes with very well-developed vision. In Saudi Arabia, their colouration is very variable, from bright colours to cream, brownish or black and white colours holding diverse patterns. They are found in a wide variety of habitats, especially on vegetation or under stones, where they build different types of retreats. Due to their high species richness, identifying these spiders at the species level in the field is challenging. Therefore, for this guide, we have selected species that exhibit distinctive coloration, making them easily recognisable.

Thomisidae (crab spiders, 2,171 species worldwide and 12 in Saudi Arabia) and **Philodromidae** (running crab spiders, 530 species worldwide and 4 in Saudi Arabia) are also typically found under stone or on vegetation where they mimic trunks or spines.

Besides the above-mentioned families, species from the family **Araneidae** (orb-weaver spiders, 3,042 species worldwide and 3 in Saudi Arabia) and **Uloboridae** (hackled-orb web spiders, 285 species worldwide and no record at the species level in Saudi Arabia) prevail on vegetation. Araneids are small to large-sized spiders (3–30 mm) with a wide diversity of shapes and colours, and a very marked dimorphism in most species, where the female is much bigger than the male. They predominantly occupy bushes and acacia trees, where they build orb webs with a sticky spiral. Uloborids are small to medium-sized spiders (3–10 mm) characterised by a slender, narrow and elongated abdomen with one or two humps. They are typically found on vegetation where they camouflage and spin their webs horizontally. Unlike most spiders, uloborids do not have venom glands.

Oxyopidae (lynx spiders, 446 species worldwide and 2 species in Saudi Arabia) are commonly found on bushes or dry vegetation among rocks, where females guard their egg sacs. They are small to large-sized spiders (5–23 mm) that can jump to ambush flying prey.

On the ground, small to medium-sized (6–12 mm) long and slender spiders from the family **Gnaphosidae** and **Agelenidae** can typically be found. Agelenids (funnel web spiders) are represented by about 1,400 species worldwide, and 1 species is recorded in Saudi Arabia. With a brown and grey colouration, they are characterised by eight eyes in two

rows equal in size, and a narrow oval abdomen clothed in often feathery setae. They can be easily misidentified with the flat-bellied ground spider (Gnaphosidae family), represented by 2,470 species worldwide and seven species are recorded in Saudi Arabia. However, unlike gnaphosids, agelenids can normally be found in flat, slightly concave brushed sheet webs with a funnel-shaped retreat, usually in grass, low vegetation, or near stones. Gnaphosids are free-living spiders found mainly on the soil surface, or under rocks in sac retreats. Egg sacs are deposited underground and under rocks.

Species from the family **Lycosidae** (wolf spiders) and **Sparassidae** (huntsman spiders) are especially active at night when they hunt and can be spotted easily because their larger eyes shine brightly (especially lycosids). Lycosids (2,476 species worldwide and six species in Saudi Arabia) are small to very large-sized spiders (3–45 mm) characterised by eight eyes in three rows unequal in size, an anterior row with four small eyes, and a second row with two large eyes. Their colouration is cryptic and varies between grey to yellowish, brown, and dark brown, with black bands. They live in burrows or make sheet webs provided with a funnel. Females carry egg-sac attached to spinnerets and spiderlings spend the first days to weeks on the abdomen of the mother. Some species are associated with water sources. Sparassids (1,472 species worldwide and 4 species in Saudi Arabia) are medium-sized to very large spiders (6–40 mm) characterised by a broadly oval carapace and round to oval abdomen covered by dense thin setae and eight eyes arranged in two rows. They are agile, wandering spiders found especially on the soil surface, or in retreat under stones or in sand burrows.

Pholcidae (daddy-long-legs spiders, 1,946 species worldwide, and two species in Saudi Arabia) are easily distinguishable by a circular carapace, a globose, circular or elongated abdomen, and very long legs. They are commonly found in dark places, such as caves, cavities and under big stones or rocks where they construct sheet or space webs.

Theridiidae (cob-web spiders, 2,549 species worldwide and eight species in Saudi Arabia) are particularly relevant to humans because the bite of some species belonging to the genus *Latrodectus* (true widows) is dangerous. They are small to medium-sized spiders (6–15 mm) characterised by an oval to round abdomen, sometimes with a glossy appearance, eight eyes in two rows usually encircled by a brownish ring, and long legs with no or few spines. Their colouration varies from black to bright colours or markings, such as red and yellow. They can be found in caves, under stones or on vegetation where they build irregular webs with threads that radiate in different directions.

10. Spider Topography

Important anatomical traits for spider recognition are present in both the dorsal and the ventral sides of the animal.

Two body parts in spiders can be recognised easily when observing the animal on both sides; the cephalothorax (or prosoma) and abdomen (or opisthosoma), which are joined by a narrow stalk called 'pedicel'. The cephalothorax carries six pairs of appendages: the chelicerae (jaws used for feeding and venom injection), the pedipalps (appendages that in adult males are modified into copulatory organs) and four pairs of walking legs (**Figure 12**).

Dorsally, some important key diagnostic traits for taxonomic identification are the shape and setation of the cuticular plate covering the cephalothorax (carapace), and the size, configuration, and marking patterns of the abdomen.

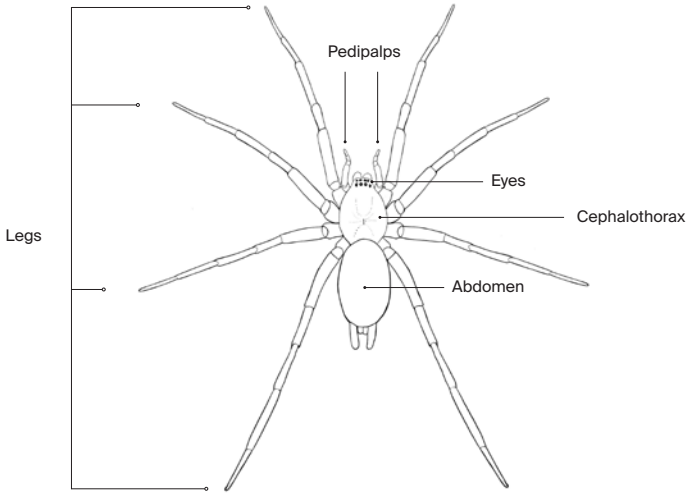


Figure 12 Spider dorsal anatomy.

Ventrally, a sclerotised structure variable in shape called ‘epigyne’ is found in adult females butis absent in males. This is the single most important structure for identifying female spiders to a species level and requires careful observation at the stereoscope. The number, position and thickness of spinneret segments are also useful diagnostic characters at the generic level (**Figure 13**).

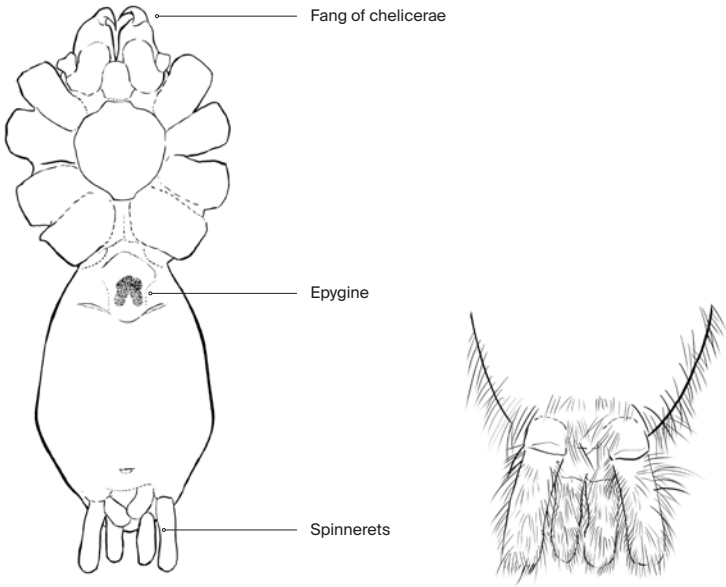


Figure 13 Spider ventral anatomy (left) and a close-up of the spinnerets (right).

When observing the animal frontally, the chelicerae and pedipalps are clearly visible. The fangs are found at the tip of the chelicerae. They Are movable distal sections that are used in feeding and in defence, and they contain the venom glands (when present). Near the chelicerae, the pedipalps represent the single most important structure for identifying male spiders to the species level in adult males and are used as secondary sexual organs (**Figure 14**).

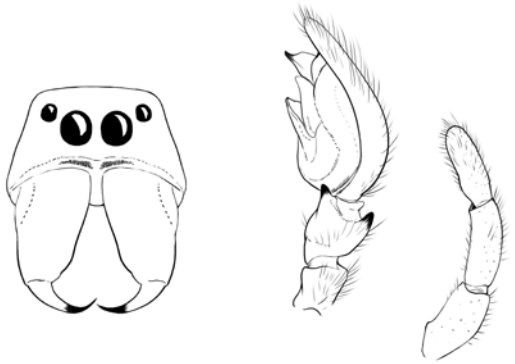


Figure 14 Frontal view of eyes and chelicerae (left), and lateral view of the pedipalps: swollen at their extremities in adult males (centre) and lacking the swollen end in females (right).

Finally, the number, arrangement, shape, and size of the eyes are also important key diagnostic traits for spider recognition at the family level (**Figure 15**).

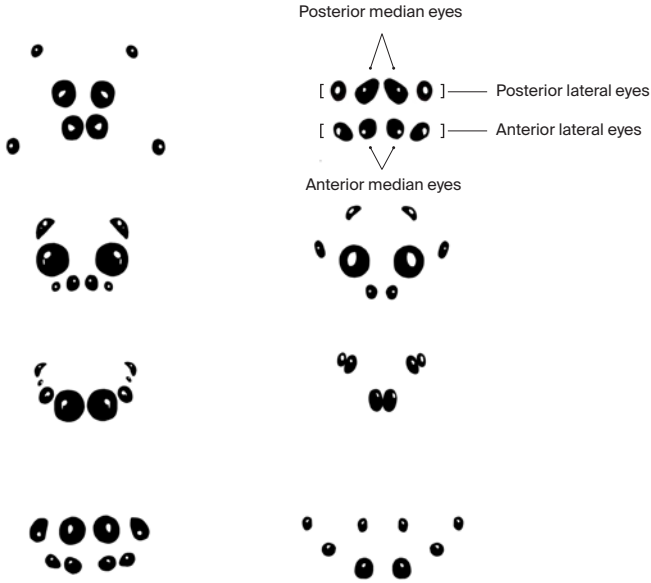
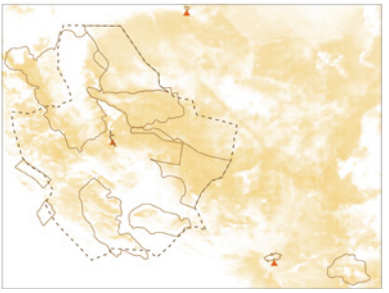


Figure 15 Example of the diversity of eye patterns (frontal view) in eight spider families occurring in the AlUla region: *Stegodyphus lineatus* (family Eresidae) (first line, left), *Lycosa piochardi* (family Lycosidae) (second line, left), *Thyene imperialis* (family Salticidae) (third line, left), *Eusparassus arabicus* (family Sparassidae) (fourth line, left), *Pterotricha dalmasi* (family Gnaphosidae) (first line, right), *Oxyopes* aff. *lineatus* (family Oxyopidae) (second line, right), *Scytodes* cf. *univittata* (family Scytodidae) (third line, right), *Thomisus zyuzini* (family Thomisidae) (fourth line, right).

11. Spider Species Accounts

Desert funnel weaver spider
Benoitia lepida (O. Pickard-Cambridge, 1876)



Global distribution: Southern Europe (Spain) to North Africa and the Middle East.
Distribution in AlUla: AlUla Oasis, Harrat AlZabin, Harrat Khaybar, Harrat Uwayrid, Jabal al Ward, Jabal Nahar, Shaaran, Tayma and Wadi Nakhlah.
Measurements: TBL – up to 9 mm.
Identification: Medium-sized long and slender spiders with eight eyes in two rows and equal in size, legs with numerous spines, a typical pattern on the abdomen and well-separated spinnerets narrowing towards the tips.
Habitat and habits: These spiders can be found in typical funnel-shaped flat and concave sheet webs with narrow retreats. Their sheets are usually built in grass, low vegetation or among rock in a wide variety of habitats from stony slopes to sandy areas. Females are generally bigger than males (females 5–9 mm; males 4–7.8 mm) and hang typical egg sacs from a silken string over the web sheets.
Abundance: Abundant.
Toxicity: Low.
Conservation status: NE.

Banded orb-weaving spider
Argiope trifasciata (Forsskål, 1775)

Global distribution: America, introduced elsewhere.
Distribution in AlUla: AlUla Oasis.
Measurements: TBL – up to 23.5 mm.
Identification: Large-sized spider with silvery cephalothorax and brownish markings. Flattened and wide abdomen, with a characteristic pattern of alternating yellow and silver-white bands separated by thin black lines. Brownish-yellow banded legs. Females can grow up to four times larger than males (females – up to 23 mm, males up to 5 mm).
Habitat and habits: These spiders can be found in large orbicular and decorated webs on vegetation. They generally remain in the centre of their web waiting for prey. Females often have their legs arranged in pairs, making a cross shape.
Abundance: Rare.
Toxicity: Low.
Conservation status: NE.

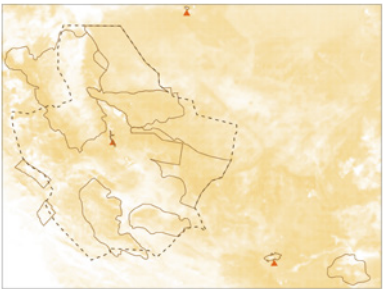
Tent orb-weaver spider
Cyrtophora citricola
(Forsskål, 1775)

Global distribution: Southern Europe, Africa, the Middle East, South and Central Asia, introduced elsewhere.
Distribution in AlUla: AlUla Oasis and Sharaan.
Measurements: TBL – up to 13.3 mm.
Identification: This spider exhibits marked sexual dimorphism; with females being significantly larger and easily distinguished by two pairs of protuberances on the dorsal abdomen, usually absent in males. Female specimens feature a bluish cephalothorax densely covered with white hairs, a darker abdomen, and legs adorned with dark markings.
Habitat and habits: This species is found on trees. In AlUla, it is observed in plantations or sandy desert areas on lemon and acacia trees, with multiple individuals co-occurring on the same tree. They construct conspicuous tent-shaped webs, where females resemble dry leaves, blending in seamlessly with their shape and colour.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Slender orb-weaver spider
Larinia chloris (Audouin, 1826)

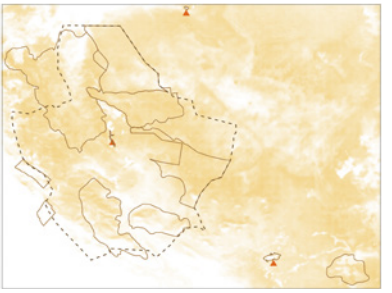
Global distribution: North and East Africa to the Middle East, South Asia, introduced elsewhere.
Distribution in AlUla: AlUla Oasis.
Measurements: TBL – up to 8.5 mm.
Identification: Small to medium size spider with elongated body and oval shape. The cephalothorax is brownish-yellow and the yellowish abdomen is twice as long as it is wide, with brown longitudinal stripes. This species has eight eyes, with the lateral eyes widely separated from the median eyes.
Habitat and habits: This nocturnal spider can be found especially in oases and orchards, where they build orb webs on bushes or trees.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Yellow sac spider
Cheiracanthium cf. *mildei*
L. Koch, 1864



Global distribution: Europe, North Africa, the Middle East, Central Asia, introduced elsewhere.
Distribution in AlUla: AlUla Oasis, Harrat AlZabin, Harrat Khaybar, Harrat Uwayrid, Jabal Nakhlah, Jabal Shayhoub, Old Khaybar, Sharaan and Wadi Nakhlah.
Measurements: TBL – up to 10.7 mm.
Identification: Small to medium-sized pale yellowish or greenish spider, with front legs longer than the others. Males have conspicuous darker brown palpi and chelicerae.
Habitat and habits: These spiders are very active at night when they can be found especially on bushes and low trees, chasing prey. If disturbed, they swiftly descend on draglines and scurry away. During the day, they rest in retreats between leaves. Females generally lay egg sacs inside the retreats and guard them.
Abundance: Common.
Toxicity: Low.
Conservation status: NE.

Desert velvet spider
Stegodyphus lineatus
(Latreille, 1817)



Global distribution: Southern Europe, North Africa to the Middle East and Central Asia.
Distribution in AlUla: AlGharameel, Harrat. AlZabin, Harrat Khaybar, Harrat Uwayrid, Jabal Al Ward, Jabal Nahar, Sharaan, Tayma and Wadi Nakhlah.
Measurements: TBL – up to 23 mm.
Identification: Typical abdomen covered with white hairs and two longitudinal black stripes. This species belongs to the velvet spiders (Eresidae) and has a very distinctive eye arrangement, with the four median eyes close together in a square shape and the 4 lateral eyes widely spaced. Females are bigger and have narrower black stripes compared to males (body length that ranges between 8–15 mm for males and 10–23 mm for females).
Habitat and habits: Its hackle webs can be easily recognised as they are stretched between two points and are usually built on Acacia trees. A small ball-shaped nest is usually attached to the vegetation at the end of one of the points, where the spider retreats during the day. Multiple spiders can be found on the same tree. Occasionally, their webs can also be found stretched between rocks or stones.
Abundance: Abundant.
Toxicity: Low.
Conservation status: NE.

Desert funnel weaver spider
Benoitia lepida

Banded orb-weaving spider
Argiope trifasciata

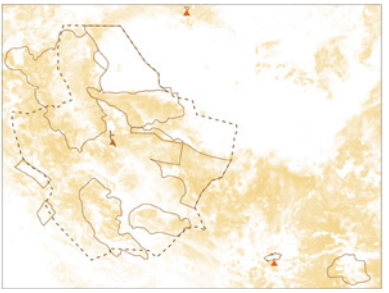
Slender orb-weaver spider
Larinia chloris

Tent orb-weaver spider
Cyrtophora citricola

Yellow sac spider
Cheiracanthium cf. *mildei*

Desert velvet spider
Stegodyphus lineatus

Desert ground spider
Pterotricha dalmasi Fage, 1929

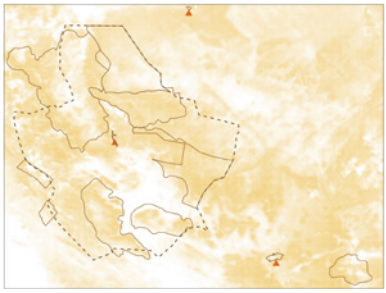


Global distribution: North Africa and the Middle East.
Distribution in AlUla: AlUla Oasis, Harrat AlZabin, Harrat Khaybar, Harrat Uwayrid, Jabal Al Ward, Jabal Nahar, Jabal Shayhoub, Sharaan and Wadi Nakhlah.
Measurements: TBL – up to 11 mm.
Identification: Medium-sized spider with an elongated pale abdomen decorated with brownish markings, eight eyes with posterior median eyes flattened, long and large cylindrical spinnerets well separated from each other.
Habitat and habits: They are found in rocky and sandy environments, on the soil surface. These spiders do not build webs and are mainly found under rocks where they often hide in sac retreats or deposit their egg sacs.
Abundance: Abundant.
Toxicity: Low.
Conservation status: NE.

Banded star-shaped spider
Hersiliola* cf. *macullulata (Dufour, 1831)

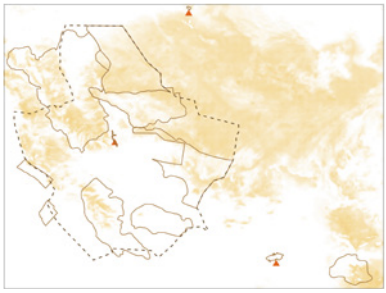
Global distribution: Southwestern Europe (Spain), North and West Africa and the Middle East.
Distribution in AlUla: Harrat Uwayrid, Harrat Khaybar and Jabal Nahar.
Measurements: TBL – up to 5.8 mm
Identification: Small-sized spider with a cream colouration and black, brown and orange markings on cephalothorax and abdomen. Cream long banded legs. Eight eyes on a large tubercle arranged in two strongly recurved rows, and anterior median eyes larger than the others.
Habitat and habits: Despite the common name given to the family they belong to (long-spinnered spiders or tree trunk spiders), the spiders belonging to this genus do not have very conspicuous spinnerets and are ground-dwelling. They are typically found in rocky habitats, often under stones.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Long-legged desert wolf spider
Evippa praelongipes
(O. Pickard-Cambridge, 1871)



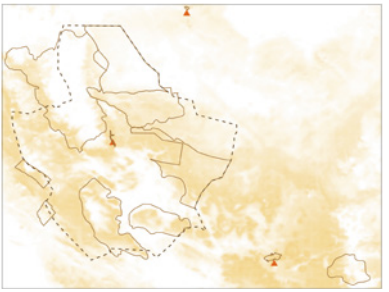
Global distribution: North Africa, the Middle East to Central Asia
Distribution in AlUla: AlUla Oasis, Harrat AlZabin, Harrat Khaybar, Harrat Uwayrid, Jabal Al Ward, Jabal Nahar, Jabal Shayhoub, Old Khaybar, Sharaan, Wadi Nakhlah.
Measurements: TBL – up to 10 mm.
Identification: Medium-sized brown spider with brownish cephalothorax and lateral dark brown bands, pale yellowish abdomen decorated with brown and orange markings, banded legs with numerous spines.
Habitat and habits: Occurs in dry and arid areas, particularly in rocky wadis. They can easily be found near or under shrubs during the night, where they occur abundantly, or hidden under rocks and vegetation during the day. Females carry the egg sac attached to their spinnerets, and the juveniles on their bodies for some time after hatching.
Abundance: Abundant.
Toxicity: Low.
Conservation status: NE.

Tarantula wolf spider
Lycosa piochardi Simon, 1876



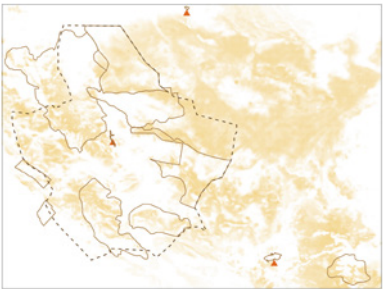
Global distribution: The Middle East.
Distribution in AlUla: Harrat Uwayrid, Jabal Al Ward and Wadi Nakhlah.
Measurements: TBL – up to 21.7 mm.
Identification: Large-sized spider with a light brown cephalothorax with dark brown median bands, connecting to the dark ocular area. Pale and yellowish abdomen with brown patterns. Ventrally black and orange. Body covered with dense setae.
Habitat and habits: Free-living ground-dwelling hunters that hunt typically at night, when they can be easily spotted because their larger (posterior median) eyes shine brightly when illuminated, similar to other Lycosids. These spiders inhabit rocky slopes and wadis, where they reside in burrows, with a short turret, occasionally decorated with twigs and debris, possibly serving as an anti-predatory strategy.
Abundance: Common.
Toxicity: Low.
Conservation status: NE.

Thin-legged wolf spider
***Pardosa* sp.**



Global distribution: Cosmopolitan.
Distribution in AlUla: AlUla Oasis, Harrat AlZabin, Jabal AlWard, Jabal Nahar, Jabal Shayhoub, Old Khaybar, Sharaan and Tayma.
Measurements: TBL – up to 10.5 mm.
Identification: Medium-sized spider with light brown cephalothorax and clear median and lateral dark-brown bands. Brown abdomen decorated with black markings and white spots. Banded legs with numerous spines. The genus *Pardosa* is very large and differentiating between species in this genus in the field is difficult.
Habitat and habits: These spiders are commonly found in the correspondence of wet grounds, such as temporary or permanent ponds, in rocky slopes and wadis. Although wolf spiders are normally active at night, *Pardosa* spiders are often active during the day, near or on the surface of the water.
Abundance: Common.
Toxicity: Low.
Conservation status: NE.

Black disc web spider
Uroctea grossa Roewer, 1960



Global distribution: The Middle East to Central Asia.
Distribution in AlUla: Harrat Khaybar, Jabal Al Ward and Jabal Nahar.
Measurements: TBL – up to 30 mm.
Identification: Medium to large-sized black spider, with abdomen lacking a colourful pattern but with small rounded depressions. Legs are arranged around the body in a star-like shape, eyes are arranged in a compact group, chelicerae are conspicuous and the anal tubercle is large.
Habitat and habits: This species is found in rocky and sandy wadis, where they hide under stones in big tent-like webs.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Desert
ground spider
Pterotricha dalmasi

Banded
star-shaped spider
Hersiliola cf. *macullulata*

Long-legged desert
wolf spider
Evippa praelongipes

Tarantula wolf spider
Lycosa piochardi

Thin-legged
wolf spider
Pardosa sp.

Black disc web
spider
Uroctea grossa

Bordered disc web spider
Uroctea* cf. *thaleri Rheims, Santos & van Harten, 2007

Global distribution: The Middle East to South Asia.
Distribution in AlUla: AlGharameel, Harrat Uwayrid, Jabal Al Ward and Sharaan.
Measurements: TBL – up to 18.3 mm.
Identification: Medium-sized spider with a subcircular yellow to dark brown cephalothorax, oval black abdomen with two longitudinal white bands and, similarly to *U. grossa*, legs arranged around the body in a star-like shape. Eyes arranged in a compact group. Large anal tubercle. This species can be misidentified as *Uroctea limbata* (C. L. Koch, 1843), and it is plausible that both species exist in Saudi Arabia.
Habitat and habits: This species is found in rocky and sandy deserts. They hide under stones in retreat sacs and are fast runners if disturbed.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Striped lynx spider
Oxyopes* aff. *lineatus
Latreille, 1806

Global distribution: The Middle East.
Distribution in AlUla: AlGharameel, Harrat AlZabin and Harrat Khaybar.
Measurements: TBL – up to 8 mm.
Identification: Small to medium-sized spider with pale colouration and brown markings. These spiders belong to the Oxyopidae family (lynx spiders) and are easily recognisable by the longer than wider convex cephalothorax and pointed abdomen. Their eyes are arranged hexagonally on top of the cephalothorax, with the posterior row slightly procurved and the anterior row strongly recurved. Legs are long with prominent spines.
Habitat and habits: They are commonly found on low trees, and bushes or dry vegetation among rocks in wadis or slopes. When disturbed, they jump and use this ability to ambush their prey.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

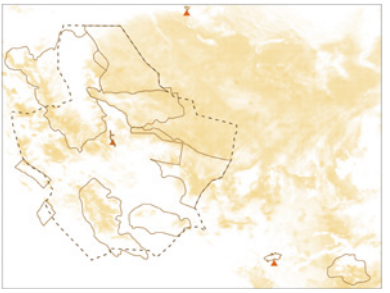
Green lynx spider
Peucetia arabica Simon, 1882

Global distribution: Southeast Europe, Northeast Africa and the Middle East.
Distribution in AlUla: Harrat Uwayrid, Jabal Al Ward and Jabal Nahar
Measurements: TBL – up to 13 mm.
Identification: Medium to large-sized spider with pale yellow-greenish cephalothorax and bright green to yellowish abdomen, in iridescent scale, with white lines and black and yellow markings. Long and slender legs with numerous spines. Males are smaller and more slender than females.
Habitat and habits: These spiders are generally found in shrubs and bushes in rocky habitats, where females lay their egg sacs and guard them continuously. When jumping they trail a dragline but they do not use webs to capture their prey.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Common palp-footed spider
Palpimanus gibbulus Dufour, 1820

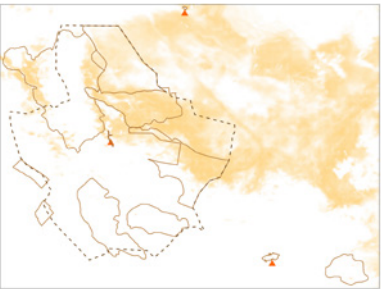
Global distribution: Mediterranean, the Middle East to Central Asia.
Distribution in AlUla: Harrat Uwayrid, Sharaan and Wadi Nakhlah.
Measurements: TBL – up to 6 mm.
Identification: This small-sized species has distinctive sclerotised forelegs used to immobilise their prey when hunting. The cephalothorax is reddish and the abdomen is oval greyish and clothed with setae. Anterior median eyes are larger than the others.
Habitat and habits: This ground dweller can be mostly found on the ground under stones in sandy dry areas. Although it can feed on other arthropods, these spiders are specialists in hunting other spider species.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

False crab spider
Thanatus* cf. *setiger
(O. Pickard-Cambridge, 1872)



Global distribution: The Middle East.
Distribution in AlUla: Harrat AlZabin, Harrat Khaybar, Harrat Uwayrid, Jabal Al Ward and Sharaan.
Measurements: TBL – up to 7.1 mm.
Identification: Middle-sized spider with oval bodies, yellowish cephalothorax with lateral dark brown bands. Yellow to pale brown abdomen decorated with leaf-shaped cardiac dark markings. Long and slender legs. Small eyes arranged in two rows and approximately of the same size, with posterior eyes equally spaced.
Habitat and habits: These spiders are found on bare ground, under stones, in low vegetation, or on trees' bark. They are swift runners and chase prey, making little use of silk.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Giant daddy long-legs spider
Artema nephilit Aharon, Huber & Gavish-Regev, 2017



Global distribution: Southern Europe to the Middle East.
Distribution in AlUla: AlGharameel, Sharaan and Tayma.
Measurements: TBL – up to 9.5 mm.
Identification: Medium to large-sized spider characterised by very long legs, circular yellowish cephalothorax with dark brown markings and slightly elevated ocular area. Globose cream abdomen decorated with greyish and brown markings.
Habitat and habits: These spiders are active at night when they are observed hunting large invertebrates, such as cockroaches and tenebrionid beetles. They are commonly found in dark places (caves and cavities) or in man-made habitats such as buildings or walls.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Bordered disc web spider
Uroctea cf. *thaleri*

Striped lynx spider
Oxyopes aff. *lineatus*

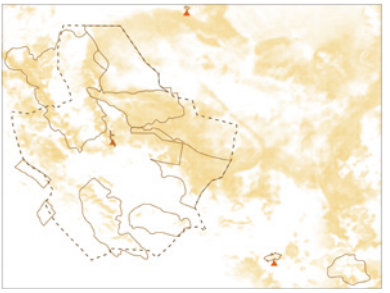
Green lynx spider
Peucetia arabica

Common palp-footed spider
Palpimanus gibbulus

False crab spider
Thanatus cf. *setiger*

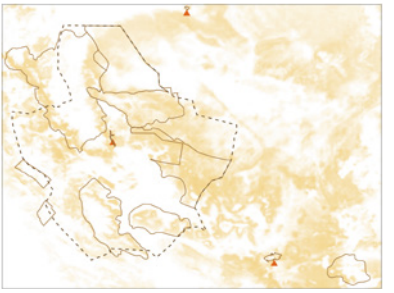
Giant daddy
long-legs spider
Artema nephilit

Marbled daddy long-legs spider
Holocnemus pluchei (Scopoli, 1763)



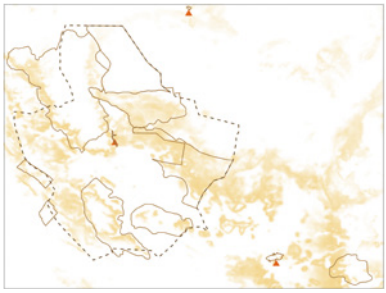
Global distribution: Europe, North Africa, Caucasus, the Middle East, introduced elsewhere.
Distribution in AlUla: AlGharameel, AlUla Oasis, Harrat AlZabin, Harrat Khaybar, Harrat Uwayrid, Jabal Al Ward, Old Khaybar, Sharaan and Wadi Nakhlah.
Measurements: TBL – up to 7.5 mm.
Identification: Medium-sized spider with long legs, whitish cephalothorax with a dark longitudinal band, whitish abdomen with spots and black longitudinal bands.
Habitat and habits: While primarily nocturnal, this species can also be encountered during daylight hours, inhabiting networks of irregular threads within cavities amid rocks, stone walls, bushes, and shrubs, as well as man-made structures like buildings and walls. When disturbed, these spiders swiftly and rapidly retreat into nearby cavities for refuge.
Abundance: Common.
Toxicity: Low.
Conservation status: NE.

Pantropical jumping spider
Plexippus paykulli (Audouin, 1826)



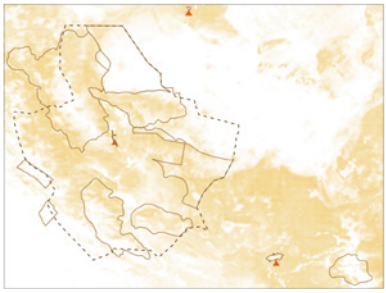
Global distribution: Africa, introduced elsewhere.
Distribution in AlUla: AlUla Oasis, Harrat Uwayrid and Jabal Nahar.
Measurements: TBL – up to 11.9 mm.
Identification: Small to medium-sized jumping spider. The females are brown and feature a light brown band across the middle of the cephalothorax, continuing on the dorsal abdomen. The males can be identified easily by distinct dorsal darker bands and a white median stripe, with front legs that are thicker and darker. Since males are more easily distinguishable than females, this guide includes an illustration specifically featuring a male rather than a female for clarity.
Habitat and habits: These spiders were introduced in Saudi Arabia and are commonly found in plantations and near human settlements. They are particularly prevalent in foliage, tree bark, and bushes.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Imperial jumping spider
Thyene imperialis (Rossi, 1846)



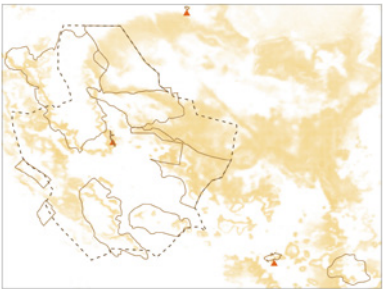
Global distribution: Southern Europe, North and East Africa, the Middle East to Central Asia, South and Southeast Asia.
Distribution in AlUla: AlUla Oasis, Harrat Uwayrid and Wadi Nakhlah
Measurements: TBL – up to 8.5 mm.
Identification: This species displays typical colour and marking patterns with a remarked sexual dimorphism. Females have a bigger yellow-reddish abdomen with a pale area containing dark red and black markings, and black tufts of hair curved upwards next to the lateral eyes. Males have a slender red abdomen with white and black markings, a white band around the lateral eyes, and thickened and enlarged legs compared to females.
Habitat and habits: This species occurs especially on plants or trees, such as in oases, and has been observed on large leaves of fig and banana plants.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Spitting spider
Scytodes* cf. *univittata
Simon, 1882



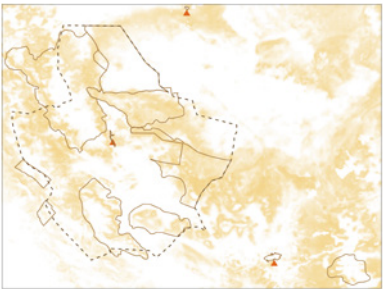
Global distribution: Southern Europe, Northern Africa, Middle to East to Central Asia.
Distribution in AlUla: AlUla Oasis, Harrat Uwayrid, Sharaan and Wadi Nakhlah.
Measurements: TBL – up to 11.7 mm.
Identification: Small to medium-sized yellowish spider with symmetrical dark patterns, such as dots and bands. The carapace is arched in the thoracic region to provide space for the large glands that produce gluey silk. The abdomen is broad and oval. Besides their generally larger carapace than abdomen, they can be easily recognised by their eye arrangements, with six eyes arranged in three pairs and organised in a triangular shape.
Habitat and habits: Nocturnal spider generally found in rocky areas, in crevices. These spiders immobilise their prey by spurting on them a spray composed of glue, silk and venom.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Palm wall crab spider
Selenops radiatus Latreille, 1819



Global distribution: The Mediterranean, Africa, the Middle East, Central and Southeast Asia.
Distribution in AlUla: Harrat Uwayrid, Old Khaybar and Tayma.
Measurements: TBL – up to 16.5 mm.
Identification: Large-sized spider characterised by a flattened body, round brown to yellowish cephalothorax and oval abdomen clothed in dense setae with black markings. Laterigrade banded legs and eight eyes with the four median eyes organised in a straight row.
Habitat and habits: Nocturnal fast-wandering spiders occurring in plantations and near human settlements, on walls and vegetation. Their flattened bodies allow them to retreat into small crevices and under palm tree leaves and barks.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Mediterranean recluse spider
Loxosceles rufescens (Dufour, 1820)



Global distribution: Southern Europe, Northern Africa to the Middle East, introduced elsewhere.
Distribution in AlUla: Harrat AlZabin, Harrat Uwayrid, Jabal Nahar and Wadi Nakhlah.
Measurements: TBL – up to 7.5 mm.
Identification: These spiders can be recognised by having six eyes arranged in three pairs organised in a similar way to *S.* cf. *univittata*. Their cephalothorax is pale with distinctive darker markings; their abdomen is greyish and elongated.
Habitat and habits: This species was found in rocky desert areas and near human settlements. Its bites can cause itchiness, redness and necrotic lesions in humans.
Abundance: Scarce.
Toxicity: Highly venomous.
Conservation status: NE.

Marbled daddy
long-legs spider
Holocnemus pluchei

Pantropical jumping spider
Plexippus paykulli

Imperial jumping spider
Thyene imperialis

Spitting spider
Scytodes cf. *univittata*

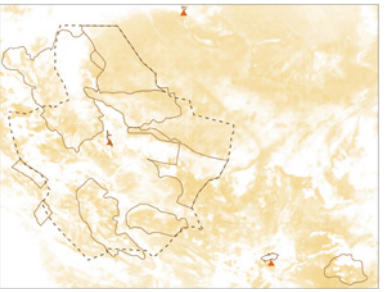
Palm wall crab spider
Selenops radiatus

Mediterranean recluse spider
Loxosceles rufescens

Sand huntsman spider
Cebrennus aethiopicus
Simon, 1880

Global distribution: The Middle East and East Africa.
Distribution in AlUla: Harrat Uwayrid.
Measurements: TBL – up to 17.5 mm.
Identification: Large-sized pale yellowish brown spider, without distinct patterns, but with darker dots on the dorsal abdomen, dark brown distal appendages and large reddish-brown chelicerae. Eight eyes distributed in two forward-facing rows, with the posterior eyes more distanced from each other, similar to other sparassids.
Habitat and habits: These nocturnal spiders hide in burrows, making them particularly difficult to spot during the day. Individuals from the same genus were also found in sandy environments (Sharaan).
Abundance: Rare.
Toxicity: Low.
Conservation status: NE.

Arabian stone huntsman spider
Eusparassus arabicus
Moradmand, 2013



Global distribution: The Middle East.
Distribution in AlUla: AlGharameel, Harrat AlZabin, Harrat Khaybar, Harrat Uwayrid, Jabal Nahar, Jabal Shayhoub and Sharaan.
Measurements: TBL – up to 21.3 mm.
Identification: Very large spider with a yellow-brownish colouration and distinctive markings on the cephalothorax and abdomen, such as two longitudinal black stripes on the latter. Banded long legs with spines. Eight eyes arranged in two rows, the anterior row slightly procurved composed of smaller-sized eyes, and the posterior row straight.
Habitat and habits: These nocturnal predators occur in a wide array of habitats, such as rocky deserts, sandy dunes, and *wadis* beds with scattered vegetation. They are often found wandering on the ground, but juveniles occur occasionally on vegetation such as shrubs and small trees. During the day, they hide in silken papery retreats attached under stones or in crevices where they also moult.
Abundance: Common.
Toxicity: Low.
Conservation status: NE.

Brown widow spider
Latrodectus geometricus
Koch, 1841

Global distribution: Africa, introduced elsewhere.
Distribution in AlUla: Harrat Uwayrid and Sharaan.
Measurements: TBL – up to 13 mm.
Identification: Medium-sized spider ranging from pale to dark brown,characterised by an hourglass-shaped pale streak on the underside of the abdomen. The dorsal side of the abdomen exhibits a variegated pattern with cream longitudinal stripes adorned with black markings and conspicuous spots at the apex of each stripe. Additionally, there are darker areas at the joints of the legs.
Habitat and habits: Typically found in dry rocky or sand deserts, in retreat between stones where they construct irregular webs with threats radiating in different directions. The females guard spiky spherical egg sacs and their common name 'widows' derives from the prevalence of sexual cannibalism, whereby they eat males after mating.
Abundance: Scarce.
Toxicity: Highly venomous.
Conservation status: NE.

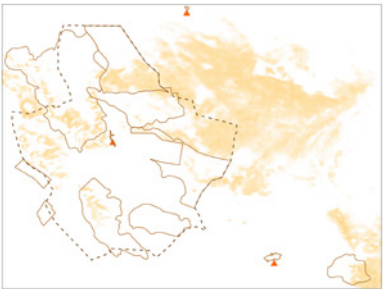
Desert widow spider
Latrodectus revivensis
Shulow, 1948

Global distribution: The Middle East.
Distribution in AlUla: AlGharameel.
Measurements: TBL – up to 11.6 mm.
Identification: Medium-sized spider larger than *L. geometricus*, with both body and legs exhibiting dark colouration. Females are larger than males and have lighter, indistinct markings on the dorsal abdomen. Unlike other *Latrodectus* species found in AlUla, they lack a glossy black appearance.
Habitat and habits: These spiders exhibit nocturnal habits, emerging from their retreats, typically under stones, in holes dug by other animals, or on small bushes, to wait for prey on irregular webs with threads made of sticky silk radiating in different directions. Outside Saudi Arabia this species has been recorded feeding on a *Cerastes* viper. Egg sacs are large, spherical and guarded by females, usually in dark protected retreats.
Abundance: Scarce.
Toxicity: Highly venomous.
Conservation status: NE.

False widow spider *Steatoda* sp.

Global distribution: Cosmopolitan.
Distribution in AlUla: Harrat Uwayrid and Sharaan.
Measurements: TBL – up to 13 mm.
Identification: Medium-sized spider exhibiting a dark purplish-brown colouration and often featuring a lighter band around the frontal part of the abdomen. Females are larger, with a glossy and globular to oval abdomen, while males are smaller and slender. The only species of *Steatoda* documented for Saudi Arabia is *S. paykulliana* (Walckenaer, 1806). However, additional research on mature individuals is necessary to precisely determine the species present in AlUla.
Habitat and habits: Typically, these spiders are found in rocky environments, residing under large stones and constructing irregular, dense webs made of sticky silken threads. They are commonly referred to as 'false widows' due to their potential to be mistaken for true widows (*Latrodectus* sp.), although they are not as harmful to humans.
Abundance: Scarce.
Toxicity: Mildly venomous.
Conservation status: NE.

Ground crab spider *Bassaniodes pseudorectilineus* (Wunderlich, 1995)



Global distribution: Southeast Europe and the Middle East.
Distribution in AlUla: Harrat Khaybar, Harrat Uwayrid and Jabal Al Ward
Measurements: TBL – up to 6 mm.
Identification: Small-sized brown spider with dark brown cephalothorax and lighter abdomen with dark bands and markings.
Habitat and habits: This species is nocturnal and inhabits rocky *wadis* where it can be found wandering under stones or on the ground in the proximity of bushes or small trees. These spiders belong to the Thomisidae family and are commonly referred to as crab spiders because, when they extend their laterigrade legs and move sideways, they resemble the movement of crabs.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Sand huntsman spider
Cebrennus aethiopicus

Arabian stone
huntsman spider
Eusparassus arabicus

Brown widow spider
Latrodectus geometricus

Desert widow spider
Latrodectus revivensis

False widow spider
Steatoda sp.

Ground crab spider
Bassaniodes pseudorectilineus

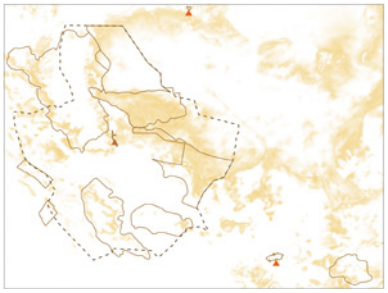
Yellow crab spider
Thomisus citrinellus Simon, 1875

Global distribution: Mediterranean, Africa and the Middle East.
Distribution in AlUla: Old Khaybar and Wadi Nakhlah.
Measurements: TBL – up to 7.3 mm.
Identification: Small-sized yellow and whitish spider with a triangular abdomen. Eyes arranged on a white and brown tubercle. Laterigrade legs. In females, the abdomen may sometimes display circular black spots on the conical protrusions of the abdomen, although individuals in AlUla did not exhibit such markings.
Habitat and habits: These spiders were found on trees in plantations or in rocky desert areas. They camouflage themselves among yellow flowers, such as acacia tree flowers, where they wait to ambush their prey.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Flower crab spider
Thomisus zyuzini Marusik & Logunov, 1990

Global distribution: East Europe, the Middle East to Central Asia.
Distribution in AlUla: Harrat Khaybar.
Measurements: TBL – up to 11 mm.
Identification: Medium-sized white spider with pink and yellowish dorsal markings on the triangular abdomen. Eight eyes arranged in two rows with lateral eyes on tubercles. Laterigrade legs. Females are much bigger than males, and have a dark brown cephalothorax and cream abdomen. This species is morphologically similar to *Thomisus onustus* Walckenaer, 1805, and they can be distinguished from each other only through a careful analysis of mature individuals under the stereoscope.
Habitat and habits: These diurnal spiders inhabit rocky deserts and appear primarily on spiny herbaceous plants growing on slopes. They are typically found on flowerheads, where they ambush their prey. To camouflage themselves, they can gradually change colour.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Spine-shaped crab spider *Tmarus* aff. *piochardi* (Simon, 1866)

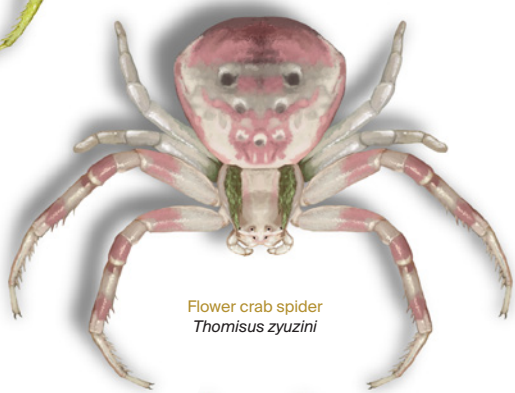


Global distribution: The Mediterranean and the Middle East.
Distribution in AlUla: Harrat Uwayrid, Jabal Al Ward, Sharaan and Wadi Nakhlah.
Measurements: TBL – up to 7 mm.
Identification: Small-sized spider with a characteristic prominent caudo-dorsal tubercle. Yellowish brown body, abdomen with darker brown and white mottles, and a light brown longitudinal band. Two anterior pairs of legs considerably longer than the back pairs and stretched out in front while resting. The ocular area is much elevated.
Habitat and habits: These spiders are especially found on tree bark, branches and twigs of acacia trees, where they camouflage with spines. They do not make use of webs but ambush their prey.
Abundance: Scarce.
Toxicity: Low.
Conservation status: NE.

Hackled orb weavers spider *Uloborus* sp.

Global distribution: Cosmopolitan.
Distribution in AlUla: Sharaan.
Measurements: TBL – up to 7 mm.
Identification: Small to medium-sized spider characterised by a slender, narrow, and elongated abdomen. The abdomen has two larger anterior humps and smaller posterior humps. The spider has eight eyes arranged in two rows. Several species are likely to occur in the AlUla county, including the species illustrated in this guide which is characterised by a cream cephalothorax and a yellow abdomen with white and orange patches and a paler longitudinal stripe.
Habitat and habits: They are typically found on vegetation, where they camouflage and spin their webs horizontally. Unlike most spiders, uloborids do not have venom glands.
Abundance: Scarce.
Toxicity: Non venomous.
Conservation status: NE.

Yellow crab spider
Thomisus citrinellus



Flower crab spider
Thomisus zyuzini

Spine-shaped crab spider
Tmarus aff. *piochardi*

Hackled orb weavers spider
Uloborus sp.

Order Odonata

12. Dragonfly Taxonomy

Dragonflies are insects within the order of Odonata. They represent one of the oldest groups of insects present today. Dragonflies are among the best predators among insects. What makes them so successful is the fact that they are occupying both freshwater and terrestrial habitats, being fearsome predators in both of them.

Larvae of dragonflies represent their aquatic stage. Their development can last from a few months up to five years. They have gills allowing them to spend their whole larval life under water. Dragonfly larvae feed upon freshwater invertebrates, tadpoles, fish eggs or even smaller fish. When the larvae have grown enough, they leave the water colonising the surrounding area where they moult into an adult dragonfly, also known as 'imago'. On the contrary, adult dragonflies spend their life in terrestrial habitats. Strongly developed wings enable them to fly with high speed over vast surfaces, which allow them to cover wide ranges. Big eyes, fast flying and strong mandibles allow them to prey on different groups of invertebrates. Adults are active during the day and most often can be seen around different kinds of water bodies, although they can also be seen far away from water during the dispersion.

Around 6,500 species of dragonflies are described until now, 42 of which are present in Saudi Arabia. The order Odonata is divided into two groups: damselflies (Zygoptera) and true dragonflies (Anisoptera). Damselflies are smaller in comparison to true dragonflies, have smaller eyes located on sides of the head that are not touching at the top of it and they hold their wings vertically above their body while being still. True dragonflies are more robust, eyes are touching or almost touching on the top of the head and they hold their wings horizontally while being still.

13. Dragonfly Topography

The body of the dragonfly is divided into three parts – head, thorax and abdomen (**Figure 16**). The head has one pair of very short antennae, one pair of eyes that can be separated or in contact, depending on the group, and a mouth apparatus known as 'the mask'.

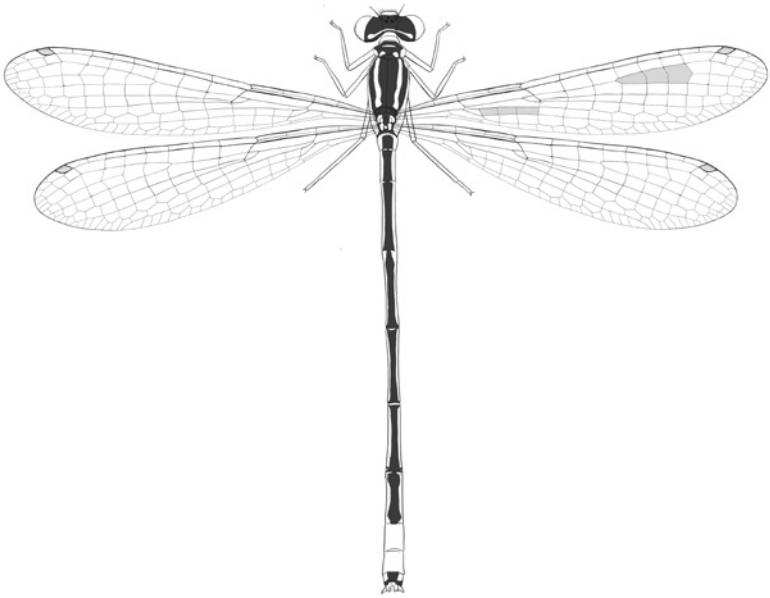


Figure 16 Zygopteran morphology

The thorax is the part that bears three pairs of legs and two pairs of wings. The venation of the wings is among the most important identifying features of dragonflies, especially at the family level. The families Aeshnidae and Gomphidae have an acute corner of the forewing triangle that points outwards (**Figure 17**), while in the family Libellulidae it points backwards (**Figure 18**). Among genera of family Libellulidae that occur in the AlUla region, only *Sympetrum* has 6–8 antenodal cross-veins (Ax), while others have 8–20 Ax. Other genera of this family can be discerned by some other features of the wings such as: the last Ax in forewings is complete (*Orthetrum*), pterostigma in forewings is significantly larger than in hindwings (*Pantala*), the last Ax in forewings is incomplete and pterostigmas are of the same size (*Trithemis*). Beside wings, legs can be used as identifying features, like in *Crocothemis* which is the only Libelullidae dragonfly in this region that doesn't have black on them.

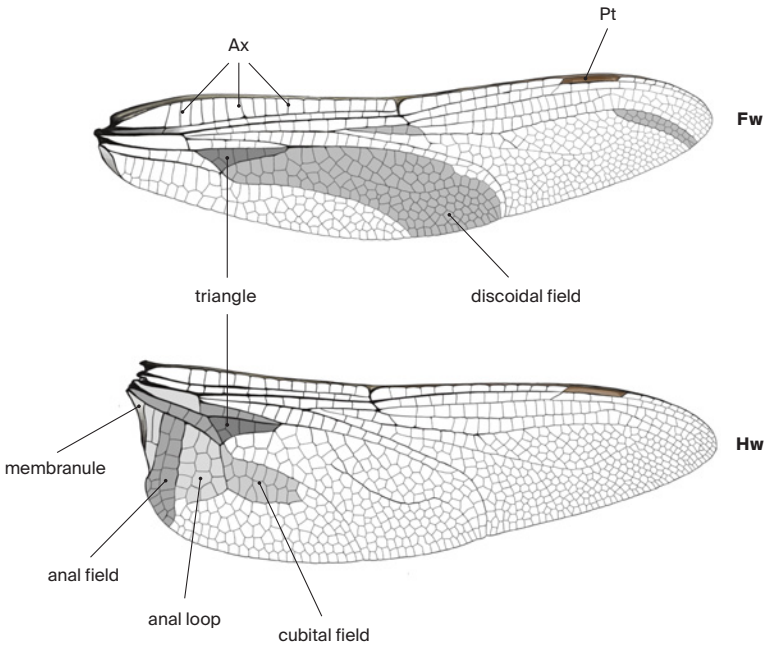


Figure 17 Aeshnidae and Gomphidae wing morphology

The abdomen is the last part of the body and consists of ten segments that bear important identifying traits like genital structures and appendages. The secondary genitalia of males are located on the second segment of the abdomen, while females genitalia are on the ninth segment. The last segment has appendages whose shape and size can be important for discerning similar species.

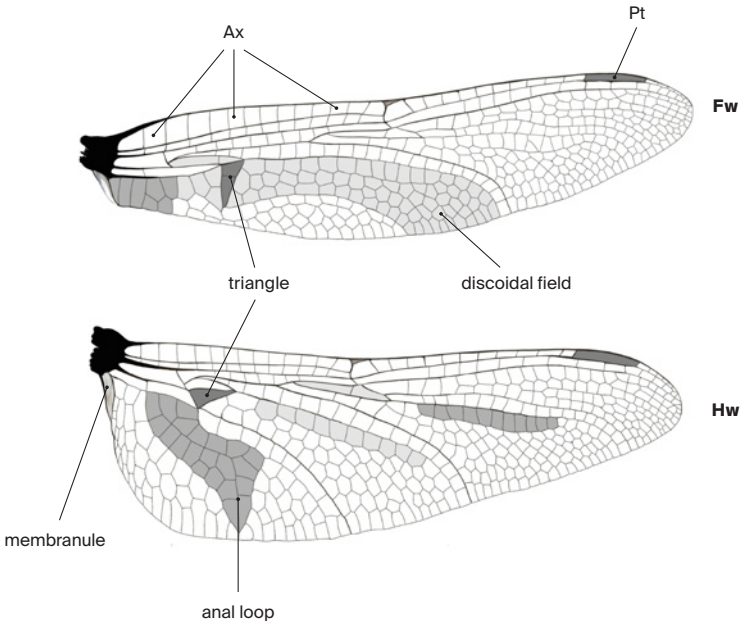


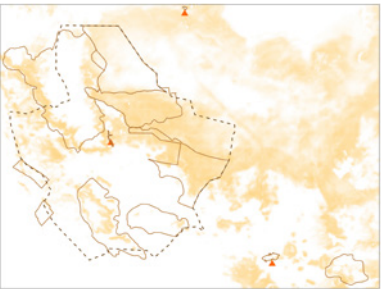
Figure 18 Libellulidae wing morphology

14. Dragonfly Species Accounts

Desert bluetail
Ischnura evansi Morton, 1919

Global distribution: The Arabian Peninsula, Central Asia and the Middle East.
Distribution in AlUla: Observed between 720 and 750 m a.s.l in Old Khaybar.
Measurements: TBL 27 – 31 mm.
Identification: This is the only species of damselfly occurring in the AlUla region. It is easily recognisable by widely separated eyes. Thorax has blue to green colour with a black band on the side. Abdomen is very slender and black, with the completely blue penultimate segment.
Habitat and habits: Inhabits oases with permanent flowing water. Can be observed during flight in vicinity of water or while resting on surrounding vegetation with wings held vertically above the abdomen.
Abundance: Locally abundant.
Conservation status: LC.

Vagrant emperor
Anax ephippiger (Burmeister, 1839)



Global distribution: Africa, the Arabian Peninsula, Central and South Asia, the Middle East and Europe.
Distribution in AlUla: Observed between 730 and 1090 m a.s.l. in Harrat ALZabin, Harrat Uwayrid, Sharaan.
Measurements: TBL 61 – 70 mm.
Identification: One of two Aeshnidae present in the AlUla region. Body is pale brown in both sexes with black medial line on the dorsal side of the abdomen. Males can be discerned by the blue second segment of the abdomen. Unique trait in this species is the presence of three rows of cells in the cubital field. Appendages in females are broad and pointed, while in males they are parallel and pointed.
Habitat and habits: Found in different types of habitat where small, natural or artificial water ponds are present. Usually observed in flight, rarely while resting.
Abundance: Scarce.
Conservation status: LC.

Blue emperor
Anax imperator Leach, 1815

Global distribution: Africa, the Arabian Peninsula, Central and South Asia, Middle East and Europe.
Distribution in AlUla: Observed at 720 m a.s.l. in Old Khaybar.
Measurements: TBL 66 – 84 mm.
Identification: Another Aeshnidae found in the AlUla region and the biggest dragonfly in this area. Males have green thorax with blue colour in front of the wings, while the abdomen is completely blue. Females have both thorax and abdomen completely green. Abdomen in this species is slightly sinuated in the basal part and has a black dorsal line. Cubital field in this species has only two rows of cells.
Habitat and habits: Inhabits oases with permanent flowing water. Observed flying around water body, particularly active at dusk.
Abundance: Rare.
Conservation status: LC.

Sinai hooktail
Paragomphus sinaiticus (Morton, 1929)

Global distribution: The Arabian Peninsula, Chad, Niger, Sinai Peninsula and East Sudan.
Distribution in AlUla: Observed at 760 m a.s.l. near city of Khaybar.
Measurements: TBL 39 – 50 mm.
Identification: The only dragonfly from the family Gomphidae present in the AlUla region. Easily discerned from any other species in this region by separated eyes that are not touching at all and the abdomen appendages that have the shape of a hook and are pale brown coloured. Thorax is greenish with few black straps. Abdomen is black with circular white colouration at the base of each segment.
Habitat and habits: Observed in vicinity of irrigated palm tree plantations.
Abundance: Rare.
Conservation status: LC.

Desert bluetail
Ischnura evansi

Vagrant emperor
Anax ephippiger

Blue emperor
Anax imperator

Sinai hooktail
Paragomphus sinaiticus

Broad scarlet
Crocothemis erythraea
(Brullé, 1832)

Global distribution: Africa, Arabian Peninsula, Central and South Asia, Middle East and Europe.
Distribution in AlUla: Observed at 730 m a.s.l. in Old Khaybar.
Measurements: TBL 36 – 45 mm.
Identification: This is the only species of Libellulidae in the AlUla region that does not have any black markings on the legs, which makes it easily recognisable. Body is a bit bulky, totally red in males, while pale brown in females. Black median line on the dorsal side of the abdomen sometimes can be clearly manifested in females. The base of the hindwings can have orange colouration.
Habitat and habits: Observed in flight in rocky habitat in vicinity of palm tree plantation.
Abundance: Rare.
Conservation status: LC.

Keeled skimmer
Orthetrum coerulescens
(Fabricius, 1798)

Global distribution: North Africa, the Arabian Peninsula, Central Asia, the Middle East and Europe.
Distribution in AlUla: Observed at 730 m a.s.l. in Old Khaybar.
Measurements: TBL 36 – 45 mm.
Identification: This is the smaller species of this genus present in the AlUla region. It can be distinguished from the very similar *O. ransonnetii* for its bulkier and shorter body. Males have almost completely blue bodies, while females are light brown with a black medial line on the dorsal side of the abdomen. The dorsal side of the thorax usually has two pale stripes. They have a brown face and large yellow pterostigma.
Habitat and habits: Observed in flight in rocky habitats in vicinity of palm tree plantation.
Abundance: Rare.
Conservation status: LC.

Desert skimmer
Orthetrum ransonnetii (Brauer, 1865)

Global distribution: North and East Africa, the Arabian Peninsula, Central Asia, the Middle East and Sinai Peninsula.
Distribution in AlUla: Observed between 610 and 1180 m a.s.l. in Harrat Uwayrid, Jabal Nahar.
Measurements: TBL 45 – 59 mm.
Identification: Large true desert dragonfly with slender, almost parallel abdomen that is slightly sinuated near the base. Males are completely blue while females have pale brown colouration. Females have very pale discontinued or even totally missing medial line on the dorsal side of the abdomen. Base of the wings is clear and membranules are pale. Face is usually white while pterostigmas are small and rufous.
Habitat and habits: Inhabits deep wadis in rocky areas, with permanent water ponds. Observed in vicinity of water bodies and also while resting on their edges.
Abundance: Scarce.
Conservation status: LC.

Slender skimmer
Orthetrum sabina (Drury, 1773)

Global distribution: North and East Africa, the Arabian Peninsula, Central, South and South-West Asia, Australia, the Middle East and the Sinai Peninsula.
Distribution in AlUla: Observed between 720 and 750 m a.s.l. in Old Khaybar.
Measurements: TBL 43 – 50 mm.
Identification: Very characteristic species of *Orthetrum* that can be easily confused with species from the Gomphidae family due to the general body shape, but the position of the eyes will remove this doubt. Thorax is greenish with numerous black stripes. Abdomen is black with three white rings on it. Body is particularly slender, base of the abdomen is strongly sinuated and the tip is expanded in height.
Habitat and habits: Inhabits oases with permanent flowing water. Can be observed during flight in vicinity of water or while resting on surrounding vegetation.
Abundance: Rare.
Conservation status: LC.

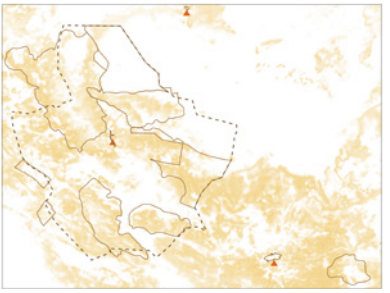
Broad scarlet
Crocothemis erythraea

Keeled skimmer
Orthetrum coerulescens

Desert skimmer
Orthetrum ransonnetii

Slender skimmer
Orthetrum sabina

Wandering glider
Pantala flavescens (Fabricius, 1798)



Global distribution: Cosmopolitan.
Distribution in AlUla: Observed between 440 and 1690 m a.s.l. in Harrat AlZabin, Harrat Khaybar, Harrat Uwayrid, Jabal AlWard, Jabal Nahar, Jabal Shayhoub, Tayma and Wadi Nakhlah.
Measurements: TBL 45 – 55 mm.
Identification: Probably the most widespread species of dragonfly in the world. Body colour is light yellow with orange on the dorsal side of the abdomen. Abdomen also has black medial line on its dorsal side. In males the tip of the wings has brown markings. Pterostigma on hindwings is clearly shorter than pterostigma on forewings. Both male and female have long appendages.
Habitat and habits: Present in all types of habitat. Observed in flight, very often far away from any water body. It's interesting that this species can often be observed in vicinity of people, flying around them.
Abundance: Abundant.
Conservation status: LC.

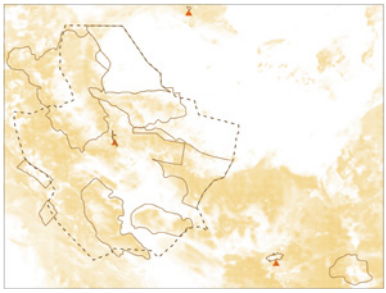
Red-veined darter
Sympetrum fonscolombii (Selys, 1840)

Global distribution: Africa, the Arabian Peninsula, Asia and Europe.
Distribution in AlUla: Observed between 850 and 1610 m a.s.l., found in Harrat Khaybar, Harrat Uwayrid and Sharaan.
Measurements: TBL 33 – 40 mm.
Identification: Single species of this genus present in the AlUla region that can be easily discerned from other genera by 6–7 Ax in forewings. Males are completely red with white band on the side of the thorax and with red veins on the wings. Females are yellow without band on the thorax and yellow veins of the wings. Both sexes have a yellow base of the hindwings and blue underside of the eye. The last three segments on the dorsal side of the abdomen have black lines that are not reaching posterior edge.
Habitat and habits: Inhabits large standing water bodies, both temporary and permanent. Adults observed in flight around those water bodies.
Abundance: Scarce.
Conservation status: LC.

Violet dropwing
Trithemis annulata (Palisot de Beauvois, 1807)

Global distribution: Africa, the Arabian Peninsula, West Asia and Europe.
Distribution in AlUla: Observed between 720 and 750 m a.sl. in Old Khaybar.
Measurements: TBL 32 – 38 mm.
Identification: One of two species of *Trithemis* present in AlUla region. Easily recognisable from other red Libellulidae by 8–20 Ax in forewings and by black on the legs. It has broad abdomen in both sexes and orange in the base of the wings. Males are violet with red veins, while females are yellow. Three last segments of the abdomen have black lines that are reaching the posterior edge.
Habitat and habits: Inhabits oases with permanent flowing water. Can be observed during flight in vicinity of water or while resting on surrounding vegetation.
Abundance: Scarce.
Conservation status: LC.

Red-veined dropwing
Trithemis arteriosa (Burmeister, 1839)



Global distribution: Africa, the Arabian Peninsula and West Asia.
Distribution in AlUla: Observed between 270 and 1,690 m a.s.l., found in the AlUla Oasis and all conservation areas except AlGharameel, Old Khaybar and Sharaan.
Measurements: TBL 32 – 38 mm.
Identification: Another *Trithemis* species and the most common dragonfly in the AlUla region. Particularly slender species with the black markings on the sides of the abdomen, which also reach edges of segments on the dorsal side. Males are completely red with red veins, while females are yellow.
Habitat and habits: Present in all types of habitat with water bodies. Common species in oases.
Abundance: Abundant.
Conservation status: LC.

Wandering glider
Pantala flavescens

Red-veined darter
Sympetrum fonscolombii

Violet dropwing
Trithemis annulata

Red-veined dropwing
Trithemis arteriosa

Order Lepidoptera

15. Butterfly Taxonomy

Butterflies are insects within the Order of Lepidoptera, in which moths are also included. They are probably the most famous insects of all. Presence of scales on their wings make them one of the most colourful and attractive groups of insects.

Larvae are also known as 'caterpillars'. The caterpillar head has strongly developed mandibles, the thorax bears three pairs of legs, while the abdomen usually has five pairs of 'false' legs or prolegs. Larvae are herbivorous in most species and can be recognised as significant agricultural pests. Pupa is a stadium in which metamorphosis occurs, after which a fully developed butterfly emerges. Adults usually feed on nectar of the flowers, but the main role of this stadium is reproduction and dispersion.

Butterflies represent one of the most numerous groups of insects, with around 20,000 species described according to the Global Biodiversity Information Facility (GBIF). According to the available data, about 115 species of butterflies within five families have been registered in the whole of Saudi Arabia.

Hesperiidae (skippers) are easily recognisable due to the wings position that they hold while standing still. Wings can be outspread (Pyrginae) or hindwings are horizontally held and forewings upright (Hesperiinae). Colouration of most of the species is dark, except for some colourful tropical ones. This family contains about 3,500 species with only 13 species currently registered for Saudi Arabia.

Papilionidae (swallowtails) include some of the biggest and most easily recognisable butterflies. Often, apical edges of the second pair of wings are elongated into 'tails'. They are very strong and fast fliers which allows them to travel long distances. Usually they are brightly coloured. There are about 600 species described, four of which are currently recorded in Saudi Arabia.

Pieridae (whites and yellows) are very well described by their name, because most of the species are either white or yellow, although some species can be orange. They are medium sized butterflies, often presenting a remarkable sexual dimorphism in colour patterns. More

than 1,000 species are described in the world, 31 of which are currently registered in Saudi Arabia.

Nymphalidae (brushfoots) has large diversity in species and body size. The dorsal side of the wings is usually very colourful, whereas the ventral side can be very dull. The first pair of legs in males is reduced. This is the most numerous family of butterflies consisting of about 7,000 species, 25 of which are currently registered in Saudi Arabia.

Lycaenidae (hairstreaks, coppers and blues) includes a diverse group of smaller butterflies with remarkably different colour patterns. Some species have developed short filaments on the apical edge of the hindwings. Around 6,000 species worldwide are described. In Saudi Arabia 41 species are currently recorded.

16. Butterfly Topography

The body of the butterfly is divided into three sections – head, thorax and abdomen (**Figure 19**). The head bears one pair of clubbed antennae (thickened at the tip), two compound eyes and a mouth apparatus known as 'proboscis' that is used for sucking nectar. The thorax usually has three pairs of legs, nevertheless in some groups the first pair can be reduced. The thorax also bears two pairs of wings. The butterflies's unique trait is the presence of the scales on their wings. The main identifying features of the butterflies are the colours and patterns of scales on both dorsal and ventral side of the wings. The abdomen is the last part of the body containing genital structures that can be used for discerning morphologically similar species.

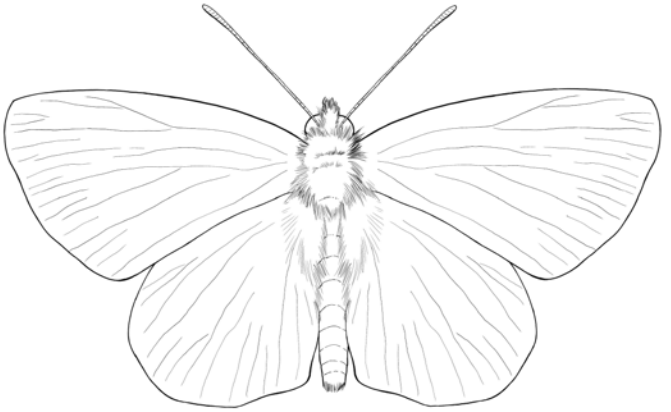


Figure 19 Butterfly morphology

17. Butterfly Species Accounts

False marbled skipper
Carcharodus stauderi
Reverdin, 1913

Global distribution: North Africa, the Arabian Peninsula, Asia Minor, Iran and Transcaucasia.
Distribution in AlUla: Observed at 1,100 m a.s.l. in Jabal Al Ward.
Measurements: WS 25 – 35 mm.
Identification: The background colour of the dorsal side of forewings is grey with dark brown markings in the basal part. The middle part has two white spots, while the third one is positioned near the anterior edge in the apical part. The apical edge is brown, intercepted by grey scales. The posterior edge of the forewings has a continuous light-brown band of scales, while same coloured scales are present also on the veins. The anterior half of the hindwings is dark brown, while the posterior half is light brown and they are both intercepted by a white band in the middle of the wings. The apical edge of the hindwings is white with sporadic greyish peaks. The ventral side of the wings has the same pattern but with a significantly lighter brown colour.
Habitat and habits: Inhabits dry, rocky canyons of mountainous areas.
Abundance: Rare.
Conservation status: LC.

Mediterranean skipper
Gegenes nostrodamus
(Fabricius, 1793)

Global distribution: Afghanistan, North Africa, the Arabian Peninsula, Asia Minor, West China, Iran, Pakistan and South Europe.
Distribution in AlUla: Observed at 670 m a.s.l. in the AlUla Oasis.
Measurements: WS 25 – 32 mm.
Identification: The dorsal side of the wings is completely brown with a slightly darker tone in the basal part. Females have few white spots towards the tip that are not present in males. The ventral side is light-brown with few pale white spots in the middle part of the forewings of males. Females present more defined spots.
Habitat and habits: Inhabits open grassy areas inside palm tree plantations. Flying around flowering vegetation.
Abundance: Rare.
Conservation status: LC.

Green-marbled skipper
Gomalia elma (Trimen, 1862)

Global distribution: Africa, the Arabian Peninsula, India, Pakistan and Sri Lanka.
Distribution in AlUla: Observed at 950 m a.s.l. in Harrat AlZabin.
Measurements: WS 26 – 36 mm.
Identification: The background colouration of the dorsal side of the forewings is brownish-grey with a dark-brown band located at their base. There is a second dark-brown band in the middle part of the wing with black scales on its distal margin which continues into a few grey spots. The background colour of the hindwings is dark-brown with white scales at their base and a white band in the middle of the wings. The apical edge of the hindwings is white. The ventral side has the same colours and patterns.
Habitat and habits: Present in dry rocky habitats with scarce vegetation.
Abundance: Rare.
Conservation status: LC.

Black-branded swift
Pelopidas mathias
(Fabricius, 1798)

Global distribution: Africa, the Arabian Peninsula, South, South-east and East Asia.
Distribution in AlUla: Observed at 750 m a.s.l. in the AlUla Oasis.
Measurements: WS 30 – 36 mm.
Identification: The dorsal side of the wings is brown with greenish colouration at their base. Forewings have eight white spots of different sizes arranged in the semicircle. The underside of the forewings has the same pattern as the dorsal side, while hindwings have seven white spots in a semi-circular arrangement and one white spot at the base of the wings.
Habitat and habits: Inhabits open grassy areas inside palm tree plantations. Flying around flowering vegetation.
Abundance: Scarce.
Conservation status: LC.

False marbled skipper
Carcharodus stauderi

Mediterranean skipper
Gegenes nostrodamus

Green-marbled skipper
Gomalia elma

Black-branded swift
Pelopidas mathias

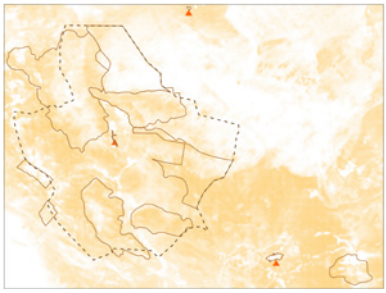
Bushveld sandman
Spialia colotes (Druce, 1875)

Global distribution: Africa and the Arabian Peninsula.
Distribution in AlUla: Observed at 1,370 m a.s.l. in Harrat Uwayrid.
Measurements: WS 21 – 28 mm.
Identification: The dorsal side of the wings is brown with numerous white spots and white apical edges. Forewings have a white spot in their base. The middle of the forewings has five white spots with three more located closer to the anterior edge. Near the apical edge of the wings there is a band of eight white spots, which is curved in an 'S' shape. Hindwings have three white spots in the middle part and a curved band of six white spots next to the apical edge. The apical edge of both fore- and hindwings is white with intercepted brown scales with clear rectangular shape. The ventral side of the wings has the same pattern as the upper side but with lighter colouration.
Habitat and habits: Inhabits riverbeds in dry, rocky mountainous areas.
Abundance: Rare.
Conservation status: LC.

Desert grizzled skipper
Spialia doris (Walker, 1870)

Global distribution: Africa, the Arabian Peninsula, India, Iran, Iraq and Pakistan.
Distribution in AlUla: Observed at 930 m a.s.l. in Sharaan.
Measurements: WS 22 – 26 mm.
Identification: The dorsal side of the wings is brown with white apical edge. Forewings have two to three white spots in their base. The middle part of the forewings has six white spots with three more located closer to the anterior edge. Near the apical edge of the wings there is a band of eight white spots, which is almost straight. Hindwings have three white spots in the middle part of which one is significantly larger. Next to the apical edge there is a straight band of six white spots. The apical edge of both fore- and hindwings has triangular white markings intercepted with brown scales. The ventral side of the wings has the same pattern as the upper side but with lighter colouration.
Habitat and habits: Inhabits dry sandy areas with sandrocks.
Abundance: Rare.
Conservation status: LC.

Black-striped hairtail
Anthene amarah (Guérin-Méneville, 1847)



Global distribution: Africa and the Arabian Peninsula.
Distribution in AlUla: Observed between 280 and 1,730 m a.s.l., found in the AlUla Oasis and all conservation areas except Old Khaybar and Tayma.
Measurements: WS 21 – 29 mm.
Identification: Small butterfly with brownish dorsal side of the wings, two to three orange markings and two black dots on apical edge of hindwings. Has a characteristic presence of little tufts of hair at the posterior margin of the hindwings that form short tails, although they could be missing due to the state and age of the specimen. The posterior edge of the ventral side of the forewings has a black coloured strip. The ventral side of the hindwings is characterised by four black dots at its base, three black dots on the anterior edge and two orange markings with black dots on its apical edge. Tip of the antenna is orange.
Habitat and habits: Present in all types of arid habitats where acacia species occur. Almost exclusively found in their vicinity actively flying around the trees.
Abundance: Abundant.
Conservation status: LC.

Arabian sapphire
Argiolaus glaucus (Butler, 1885)

Global distribution: West Africa and the Arabian Peninsula.
Distribution in AlUla: Observed between 1,140 and 1,330 m a.s.l., found in Jabal Al Ward and Wadi Nakhlah.
Measurements: WS 16 – 20 mm.
Identification: The dorsal side of the wings in both sexes features a blue colouration. Males typically exhibit an iridescent blue hue, while females often display a brown colouration with a blue scaling in the wing base. The hindwings usually have one black spot and two well developed tails each. The ventral side of the wings is white with linear black markings and blue scaling on the apical edge, next to the tails and two black spots.
Habitat and habits: Found in various habitats where a parasitic plant of acacia species, mistletoe is present, flying around its flowers.
Abundance: Scarce.
Conservation status: NE.

Bushveld sandman
Spialia colotes

Desert grizzled skipper
Spialia doris

Black-striped hairtail
Anthene amarah

Arabian sapphire
Argiolaus glaucus

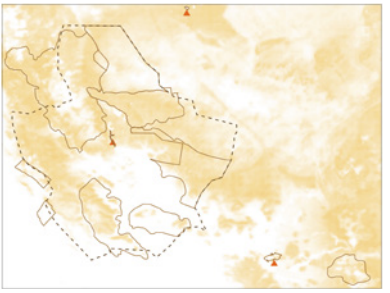
Bright babul blue
Azanus ubaldus (Cramer, 1782)

Global distribution: Africa, the Arabian Peninsula and India.
Distribution in AlUla: Observed between 1,070 and 1,100 m a.s.l., can be found in Harrat Uwayrid and Sharaan.
Measurements: WS 16– 24 mm.
Identification: Colouration of the dorsal side of the wings in males is brown with blue scales in the middle parts of the wings, while females have completely brown wings. The underside of the forewings has a characteristic orange band on the anterior edge, with additional two black dots in the middle of the same edge. Hindwings have five black dots in the basal part and two more on the apical edge but without orange scales as in *A. amarah*, with which this species can easily be confused. The tip of the antennae is not orange.
Habitat and habits: Present in all types of arid habitats where acacia species occur. Almost exclusively found in their vicinity actively flying around the trees.
Abundance: Scarce.
Conservation status: LC.

Western pygmy blue
Brephidium exilis (Boisduval, 1852)

Global distribution: North and Central America, introduced to the Arabian Peninsula.
Distribution in AlUla: Observed between 680 and 1,310 m a.s.l., found in Harrat Uwayrid and the AlUla Oasis.
Measurements: WS 12 – 20 mm.
Identification: One of the smallest butterflies known, whose dorsal side of the wings is brown with bluish scales at the base of the wings. The underside is greyish in its basal part, while being dark orange in the apical part of the forewings. Basal part of the hindwings is also grey, but with four black dots. The apical part in hindwings has orange colouration with a row of black dots near the apical edge.
Habitat and habits: Prefers sandy habitats with halophilic host plants. Found in trenches between the palm plantations inside the oases. Very difficult to notice due to its size, usually observed flying very low, around host plants.
Abundance: Scarce.
Conservation status: NE (Introduced).

Pomegranate butterfly
Deudorix livia (Klug, 1834)



Global distribution: Africa, the Arabian Peninsula, East Mediterranean including Greece.
Distribution in AlUla: Observed between 650 and 1,610 m a.s.l., found in the AlUla Oasis, Harrat AlZabin, Harrat Khaybar, Harrat Uwayrid, Jabal Al Ward, Sharaan and Wadi Nakhlah.
Measurements: WS 30 – 40 mm.
Identification: Colouration of the dorsal side of the wings in females is brown, while in males only the edges of the forewings are brown, while the rest is orange. Apical edge of each hindwing bears two black spots and a well developed tail. The ventral side of the wings is light grey with brownish markings, including two black dots in the apical part of the hindwings.
Habitat and habits: Found in all types of habitat where acacia trees are present and also in oases. Usually observed flying around acacia trees.
Abundance: Abundant.
Conservation status: NE.

Grass jewel
Freyeria trochylus (Freyer, 1845)

Global distribution: Africa, the Arabian Peninsula, South Asia, India and South Europe.
Distribution in AlUla: Observed between 540 and 1,270 m a.s.l., found in Harrat Uwayrid and Jabal Shayhoub.
Measurements: WS 16 – 20 mm.
Identification: Very small, brown butterfly with orange markings and three black dots on the apical edge of hindwings. The ventral side of the wings is grey. Forewings have a row of six encircled black dots and an elongated brownish dot. Hindwings have five black dots in the basal part and one more black dot located in the middle of the anterior edge. The apical part of hindwings is orange with three black dots with a shiny blue arc on them.
Habitat and habits: Arid hot rocky habitats with scarce grassy vegetation. Flying low around vegetation.
Abundance: Scarce.
Conservation status: LC.

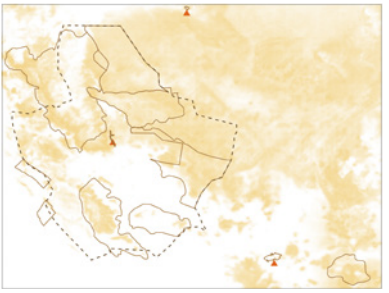
Bright babul blue
Azanus ubaldus

Western pygmy blue
Brephidium exilis

Pomegranate butterfly
Deudorix livia

Grass jewel
Freyeria trochylus

Pea blue
Lampides boeticus (Linnaeus, 1767)



Global distribution: Africa, the Arabian Peninsula, Europe, South and Southeast Asia, Australia.
Distribution in AlUla: Observed between 560 and 1,730 m a.s.l., found in the AlUla Oasis, AlGharameel, Harrat Khaybar, Jabal Al Ward, Sharaan and Tayma.
Measurements: WS 24 – 34 mm.
Identification: The dorsal side of the wings is blue in males, while brown with few bluish scales at the base of the wings in females. In both sexes, two black dots are present in the apical part of hindwings together with one developed tail on each wing. Underside of the wings is ocher with white lines. Distal white line in hindwings is significantly wider than the rest. Apical part bears two black dots with whitish arcs, which are leaning on orange scales.
Habitat and habits: Present in different types of arid habitats, but also very common in palm plantations. Usually observed in flight around *Acacia* trees.
Abundance: Abundant.
Conservation status: LC.

Lang's short-tailed blue
Leptotes pirithous (Linnaeus, 1767)

Global distribution: Africa, the Arabian Peninsula, Asia Minor and Europe.
Distribution in AlUla: Observed between 660 and 1,610 m a.s.l., found in the AlUla Oasis and Harrat Khaybar.
Measurements: WS 21 – 30 mm.
Identification: The dorsal side of the wings is blue in males while blue-brown in females with two black dots and a developed tail on the hind edge of the hindwings. The underside of the wings is similar in males and females, brown with irregular white markings. The apical part of the hindwings has two black dots encircled by shiny white and orange scales.
Habitat and habits: Very common in the palm tree plantations, but also found in wadis.
Abundance: Abundant locally.
Conservation status: LC.

Loew's blue
Plebejidea loewii (Zeller, 1847)

Global distribution: The Arabian Peninsula, Middle East, Greece, India, Iran and Pakistan.
Distribution in AlUla: Observed between 1,610 and 1,730 m a.s.l. in Harrat Khaybar.
Measurements: WS 26 – 36 mm.
Identification: The dorsal side of the wings in females is brown with a few black dots and orange scales in the middle of the apical edge of the hindwings. The dorsal side of the wings in males is glossy blue. The ventral side of the forewings has a black dot in the middle with six black dots distally from it. The apical edge has six brownish dots. Hindwings have four black dots in the base, two more near the posterior edge and one elongated black dot in the middle, which is encircled by six more dots. The apical edge bears seven brownish dots, of which posterior ones are in contact with orange scales.
Habitat and habits: Inhabits wadis with abundant vegetation in the lava fields.
Abundance: Rare.
Conservation status: LC.

Little tiger blue
Tarucus balkanica (Freyer, 1844)

Global distribution: North Africa, the Arabian Peninsula, Asia Minor, India, Iran and Southeast Europe.
Distribution in AlUla: Observed at 1,180 m a.s.l. in Harrat Uwayrid.
Measurements: WS 22 – 27 mm.
Identification: The dorsal side of females wings is brown, while in males blue colour is dominant. Forewings have black markings in the middle part. Hindwings bear black points on their apical edge and a short tail. Ventral side of the wings is white. Forewings have a black line at their base, with two more black lines in the middle part. Additional four black dots are located distally to the lines, after which there are two bands of seven black dots each. The apical edge is black in both pairs of wings. Hindwings have a black line at their base with two elongated and two rounded dots in front of it. The middle part has one elongated dot after which six more black dots are present. Towards the apical edge there is a black semicircled band while the apical edge has six black dots with the posterior one being the biggest and it is encircled by blue scales.
Habitat and habits: Inhabits riverbeds in dry, rocky mountainous areas.
Abundance: Rare.
Conservation status: LC.

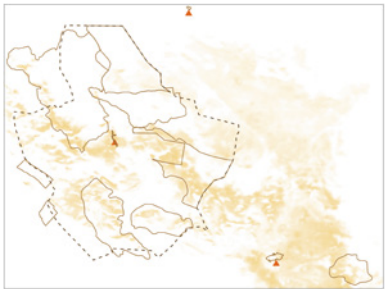
Pea blue
Lampides boeticus

Lang's
short-tailed blue
Leptotes pirithous

Loew's blue
Plebejidea loewii

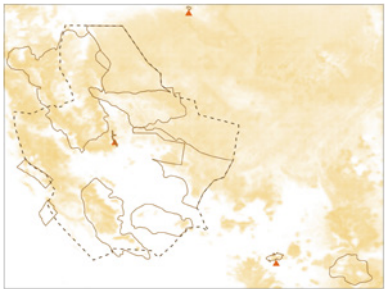
Little tiger blue
Tarucus balkanica

Dark grass blue
Zizeeria karsandra (Moore, 1865)



Global distribution: North Africa, the Arabian peninsula, South and Southeast Asia, Australia, Cyprus, Middle East and Sicily.
Distribution in AlUla: Observed between 700 and 1,130 m a.s.l., found in the AlUla Oasis, Harrat AlZabin, Harrat Khaybar and Tayma.
Measurements: WS 15 – 20 mm.
Identification: Small butterfly with brown dorsal side of the wings in females, while in males it is blue with only apical edges brown. The ventral side of the wings is light grey in both sexes. Forewings have a black dot in their base, an elongated black spot in the middle part and a band of six black dots distally from it. The ventral side of hindwings has four black dots in the base, one elongated greyish spot in the middle and eight more dots in a semicircle around it. The apical edges of all wings have two rows of grey markings.
Habitat and habits: Very common species in the oases and agricultural fields, but can also be found in natural habitats with abundant vegetation.
Abundance: Scarce.
Conservation status: NA.

Plain tiger
Danaus chrysippus (Linnaeus, 1758)



Global distribution: Africa, the Arabian Peninsula, South and Southeast Asia, Australia and South Europe.
Distribution in AlUla: Observed between 660 and 1,610 m a.s.l., found in the AlUla Oasis, Harrat Khaybar, Harrat Uwayrid, Jabal Al Ward, Old Khaybar, Sharaan, Tayma and Wadi Nakhlah.
Measurements: WS 70 – 80 mm.
Identification: The largest butterfly found in the AlUla area. The dorsal side of both wings is light-brown. The apical part of the forewings is dark-brown with an interrupted white band. Hindwings have four black dots in their middle part and a dark-brown apical margin. The underside of the wings is similar as the upper side, except for the apical part of the forewings which is light-brown. The body of this species is black with numerous white dots.
Habitat and habits: Inhabits all types of arid habitats where vegetation is present, but also very common in oases and agricultural areas.
Abundance: Common.
Conservation status: LC.

Diadem
Hypolimnas misippus Linnaeus, 1764

Global distribution: Africa, the Arabian Peninsula, South and Southeast Asia and Australia.
Distribution in AlUla: Observed at 1,370 m a.s.l. in Harrat Uwayrid.
Measurements: WS 60 – 70 mm.
Identification: Species of butterfly with very distinctive sexual dimorphism. The dorsal side of the male wings is black with three white spots encircled by blue iridescent scales. Two elongated spots are in the apical part of the forewing, while the third, the largest one, is positioned in the middle of the hindwing. Underside of the males is brown with white bands positioned in the middle of both fore- and hindwings, with a white spot in the apical part of the forewings. Upperside of the wings in females is similar to that of the Plain tiger butterfly. Colouration of the wings is light brown to orange with black-coloured apical part, a white band in the forewings and only one black spot in hindwings. The underside is pale brown with same pattern as dorsal side of the wings.
Habitat and habits: Inhabits wadis in harrats, with a well-developed vegetation.
Abundance: Rare.
Conservation status: LC.

Yellow pansy
Junonia hierta Fabricius, 1798

Global distribution: Africa, the Arabian Peninsula, South and Southeast Asia.
Distribution in AlUla: Observed between 560 and 1,410 m a.s.l., found in the AlUla Oasis, Harrat Uwayrid, Jabal Al Ward and Jabal Shayhoub.
Measurements: WS 40 – 60 mm.
Identification: The dorsal side of the wings is black with four distinct yellow patches. Forewings in females bear a blue spot encircled by black scales, which is not present in males. Hindwings in both sexes have a blue spot in their base, while in females there are also two additional blue spots encircled by black scales in the yellow part of the wing. Underside of the forewings is yellow with one blue spot encircled by black scales and grey edges. Hindwings are grey with irregular brownish pattern.
Habitat and habits: Inhabits arid rocky mountains with scarce vegetation, while also present in trenches among palm plantations.
Abundance: Scarce.
Conservation status: LC.

Dark grass blue
Zizeeria karsandra

Plain tiger
Danaus chrysippus

Diadem
Hypolimnas misippus

Yellow pansy
Junonia hierta

Blue pansy
Junonia orithya Linnaeus, 1758

Global distribution: Africa, the Arabian Peninsula, South and Southeast Asia and Australia.
Distribution in AlUla: Observed between 660 and 1,530 m a.s.l., found in the AlUla Oasis, Harrat Uwayrid, Tayma and Wadi Nakhlah.
Measurements: WS 45 – 60 mm.
Identification: The dorsal side of the forewings is black at its base, grey in anterior apical part and blue in the posterior apical part. In the grey area there are also two blue spots encircled by black and orange scales. Hindwings are blue with two blue spots with the same markings. Underside of the wings has beige colour and is irregularly patterned with two black spots in both fore- and hindwings.
Habitat and habits: Very common species in oases, but also inhabits different types of arid habitats with abundant vegetation.
Abundance: Common.
Conservation status: LC.

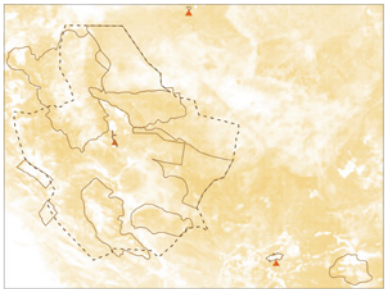
Desert fritillary
Melitaea deserticola Oberthür, 1911

Global distribution: North Africa, the Arabian Peninsula and the Middle East.
Distribution in AlUla: Observed at 1,100 m a.s.l. in Jabal Al Ward.
Measurements: WS 30 – 40 mm.
Identification: The background colour of the dorsal side of the wings is orange with numerous black markings. Forewings have a curved line of seven large black dots in the middle part. Another line with eight smaller black dots is situated near the apical edge. The base of the hindwings has several black markings, while the apical edge has five black dots. The apical margin in all wings is black, while the underside of the antennae is completely orange. The ventral side of the forewings is orange, while in hindwings it is white with sporadic orange markings. Both fore- and hindwings have numerous black dots on their ventral side.
Habitat and habits: Inhabits dryest habitats present in this region.
Abundance: Rare.
Conservation status: NE.

Lesser spotted fritillary
Melitaea trivia (Denis & Schiffermüller, 1775)

Global distribution: The Arabian Peninsula, Central Asia, the Middle East, Europe and Sinai Peninsula.
Distribution in AlUla: Observed at 1,440 m a.s.l. in Harrat Uwayrid.
Measurements: WS 28 – 42 mm.
Identification: Another fritillary present in the AlUla region. The base of the forewings has several black lines, while the middle part of the wings has seven black dots that are smaller than in *M. deserticola*. Near the apical edge of the forewings, eight black dots are situated but they have crescent shape. The middle part of the hindwings has two rows of 4–5 black dots, while five crescent black dots are situated near the apical edge. The apical margin in all wings is black. The ventral side of the forewings is orange with black markings. Hindwings are white with orange markings and numerous black dots on the underside.
Habitat and habits: Observed in high elevated wadis in the harrat area.
Abundance: Rare.
Conservation status: NE.

Painted lady
Vanessa cardui (Linnaeus, 1758)



Global distribution: North America, Europe, Africa, Asia and Australia.
Distribution in AlUla: Observed between 280 and 1,700 m a.s.l., found in all conservation areas except Old Khaybar.
Measurements: WS 50 – 74 mm.
Identification: This is one of the most widespread species of butterflies in the world and also the most abundant species in the AlUla region. The dorsal side of the wings is orange with brown markings. The tip of the forewings is brown with one white band and four white dots. Hindwings have brown markings in three rows by the apical edge of the wing. The ventral side of the forewings has the same pattern as the upper side, while the hindwings have four blue iridescents spots encircled by orange scales in the apical part.
Habitat and habits: Found in all types of habitat. More common in higher elevation, especially in peaks of hills or mountains.
Abundance: Abundant.
Conservation status: LC.

Blue pansy
Junonia orithya

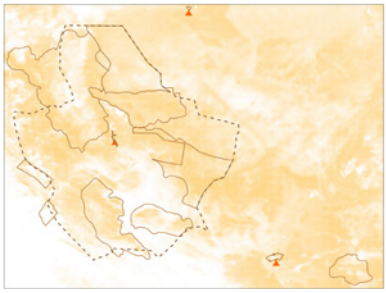
Desert fritillary
Melitaea deserticola

Lesser spotted fritillary
Melitaea trivia

Painted lady
Vanessa cardui

Pioneer white

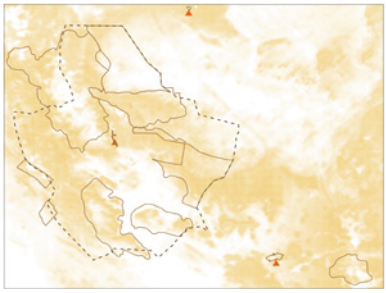
Belenois aurota (Fabricius, 1793)



Global distribution: Africa, the Arabian Peninsula and India.
Distribution in AlUla: Observed between 700 and 1,730 m a.s.l., found in all conservation areas except Jabal Nahar, Old Khaybar and Tayma.
Measurements: WS 50 – 60 mm.
Identification: Relatively large butterfly with white wings and brown area with white spots in their apical parts. Spots in forewings are elongated, while in hindwings they are rounded. The ventral side has a similar pattern but with strongly expressed brown veins, especially in the hindwings.
Habitat and habits: Present in all types of arid habitats. Common in oases and agricultural areas.
Abundance: Abundant.
Conservation status: LC.

African migrant

Catopsilia florella (Fabricius, 1775)

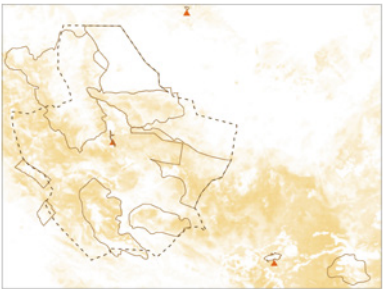


Global distribution: Africa and the Arabian Peninsula.
Distribution in AlUla: Observed between 360 and 1,730 m a.s.l., found in the AlUla Oasis, Harrat AlZabin, Harrat Khaybar, Harrat Uwayrid, Jabal Al Ward, Jabal Shayhoub, Sharaan and Wadi Nakhlah.
Measurements: WS 54 – 66 mm.
Identification: The dorsal side of the wings is light green or white, rarely yellow, with a black spot in the forewings and darkened edge in some individuals. Underside has the same colour as the dorsal side, with one white spot in the forewings and two to three white spots in the middle of the hindwings.
Habitat and habits: Present in all types of habitats. Usually observed in fast flights.
Abundance: Abundant.
Conservation status: LC.

Clouded yellow
Colias croceus (Geoffroy, 1785)

Global distribution: North Africa, the Arabian Peninsula, West and Central Asia, Caucasus and Europe.
Distribution in AlUla: Observed at 1,700 m a.s.l. in Harrat Khaybar.
Measurements: WS 46 – 62 mm.
Identification: Easily recognisable species by its strong yellow colour on the dorsal side of the wings. Beside yellow there is a black dot near the anterior edge of the forewings, while both pairs of wings have a black band on the apical edge. The ventral side of the wings is completely yellow with different markings. Forewings have a black dot in the middle, near the anterior edge and a band of five to six black dots near the apical edge. In the middle of the hindwings there is a white spot encircled by orange scales. Near the apical edge and continuing to the anterior edge there is a band of seven brownish dots.
Habitat and habits: Inhabits harrat's with particularly abundant vegetation.
Abundance: Rare.
Conservation status: LC.

Golden arab
Colotis chrysonome (Klug, 1829)



Global distribution: Africa and the Arabian Peninsula.
Distribution in AlUla: Observed between 560 and 1,340 m a.s.l., found in Harrat AlZabin, Jabal Al Ward, Jabal Shayhoub and Wadi Nakhlah.
Measurements: WS 33 – 38 mm.
Identification: The basal part of the dorsal side of the forewings is white and continues into yellow colouration towards the tip which is characterised by strong, black venation. The apical edges of the wings are black. Hindwings have the same colours and patterns. The underside of the wings is light orange to yellow with pale markings of dorsal patterns.
Habitat and habits: Inhabits valleys and wadis with abundant vegetation.
Abundance: Scarce.
Conservation status: NE.

Pioneer white
Belenois aurota

African migrant
Catopsilia florella

Clouded yellow
Colias croceus

Golden arab
Colotis chrysonome

Crimson tip
Colotis danae (Fabricius, 1775)

Global distribution: Africa, the Arabian Peninsula and South Asia.
Distribution in AlUla: Observed between 560 and 1,010 m a.s.l. in AlGharameel and Jabal Shayhoub.
Measurements: WS 45 – 52 mm.
Identification: The dorsal side of the wings is white with black edges and a red patch in the apical part of the forewings. Males and females have similar patterns, although females have black dots in the posterior part of the red patch of the forewings and in the middle part of the hindwings. Ventral side of the wings is white with a pale red patch in the apical part of the forewings, and has a small black dot posteriorly to it. Females have a pale line of dots on the underside of the hindwings.
Habitat and habits: Inhabits sandy habitats with sand rocks as well as mountain canyons.
Abundance: Scarce.
Conservation status: NE.

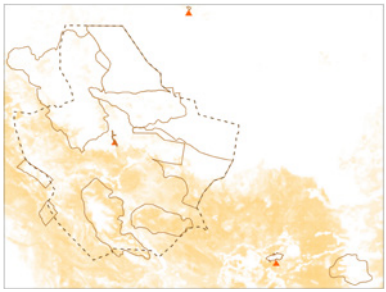
Large salmon arab
Colotis fausta (Olivier, 1804)

Global distribution: The Arabian Peninsula and South Asia.
Distribution in AlUla: Observed between 950 and 1,100 m a.s.l., found in Harrat AlZabin, Harrat Uwayrid and Jabal Al Ward.
Measurements: WS 45 – 60 mm.
Identification: The dorsal side of the wings has salmon colour with black apical edges and a black dot in the middle of the forewings. The underside of the wings has pale yellow colour with pale markings equal to those on the dorsal side and a pale spot in the middle of the hindwings.
Habitat and habits: Inhabits deep valleys with abundant vegetation.
Abundance: Rare.
Conservation status: NE.

Yellow patch white
Colotis halimede (Klug, 1829)

Global distribution: Africa and the Arabian Peninsula.
Distribution in AlUla: Observed around 520 m a.s.l. in Jabal Shayhoub.
Measurements: WS 40 – 50 mm.
Identification: Sexual dimorphism is noticeable in this species. The dorsal side of the wings in both sexes is white with a yellow band on a posterior edge of forewings and an anterior edge of hindwings. Males can be recognised by brown veins in forewings. Females lack the brown veins, but have one dot in the middle of the forewings and a line of seven dots in the apical part of the forewings. Ventral side of the wings has the same patterns.
Habitat and habits: Rocky mountainous areas with abundant vegetation.
Abundance: Rare.
Conservation status: NE.

Desert orange tip
Colotis liagore (Olivier, 1804)



Global distribution: Africa, the Arabian Peninsula, India and Pakistan.
Distribution in AlUla: Observed between 380 and 950 m a.s.l., found in Harrat AlZabin and Jabal Shayhoub.
Measurements: WS 30 – 40 mm.
Identification: Sexual dimorphism is present in this species, but not as expressed as in *C. halimede*. The dorsal side of the wings is white in both sexes with an orange patch in the apical part of the forewings, which is darker in females and with light brown markings. Hindwings have narrow black markings on the wing's apical edge of males, while in females those markings are brown and considerably wider. The ventral side of both sexes is white with a pale orange patch in the apical part of the forewings.
Habitat and habits: Present in arid rocky habitats with scarce vegetation.
Abundance: Scarce.
Conservation status: NE.

Crimson tip
Colotis danae

Large salmon arab
Colotis fausta

Yellow patch white
Colotis halimede

Desert orange tip
Colotis liagore

Greenish black-tip
Elphinstonia charlonia (Donzel, 1842)

Global distribution: North Africa, the Arabian Peninsula and Turkey.
Distribution in AlUla: Observed between 1,100 and 1,720, found in AlGharameel, Harrat Khaybar and Harrat Uwayrid.
Measurements: WS 30 – 40 mm.
Identification: The dorsal side of the wings is light-green with a black spot in the middle of the forewings and with black tip. The underside of the forewings is yellowish with the same black spot present in the dorsal side and darkened tip. Hindwings are greenish with several small white spots in the middle and anterior parts.
Habitat and habits: Inhabits rocky dry areas in harrats and the sands of AlGharameel. Occasionally gathering on top of the hills and mountains.
Abundance: Common.
Conservation status: NE.

Green-striped white
Euchloe belemia (Esper, 1800)

Global distribution: North Africa, the Arabian Peninsula and Europe.
Distribution in AlUla: Observed at 1,100 m a.s.l. in Harrat Uwayrid.
Measurements: WS 36 – 44 mm.
Identification: The dorsal side of the forewings is white with a black spot in the middle of the anterior edge and black tip with few white markings. Hindwings are also white but with a transparent underside pattern. The ventral side of the forewings is dominantly white with the same black spot and tip with three to four horizontal green stripes. Hindwings have numerous green horizontal stripes outlined by golden-yellow scales, which can be arranged forming different patterns.
Habitat and habits: Arid rocky mountain peaks.
Abundance: Rare.
Conservation status: NE.

Small white
Pieris rapae (Linnaeus, 1758)

Global distribution: North Africa, North America, the Arabian Peninsula, Asia, Australia, New Zealand and Europe.
Distribution in AlUla: Observed between 730 and 810 m a.s.l., found in the AlUla Oasis and Tayma.
Measurements: WS 32 – 47 mm.
Identification: Medium-sized butterfly that has completely white wings with three black dots in the middle of the forewings closer to apical the edge and one black dot on the anterior edge of the hindwings. The underside of the forewings has the same patterns, while the hindwings do not have any dots.
Habitat and habits: Widespread species, common in oases and agricultural farms.
Abundance: Scarce.
Conservation status: LC.

Bath white
Pontia daplidice (Linnaeus, 1758)

Global distribution: North Africa, the Arabian Peninsula, Asia and Europe.
Distribution in AlUla: Observed at 810 m a.s.l. in Tayma.
Measurements: WS 38 – 50 mm.
Identification: The dorsal side is white with blackish tip and a black spot in the middle not reaching the anterior edge. The hindwings are white with transparent underside patterns. The ventral side of the forewings has the same pattern as the upper side with an additional black spot in the middle of the wings towards the posterior edge. The hindwings are predominantly green, with golden veins and white spots in between.
Habitat and habits: Inhabits open dry habitats where host plants are present as well as oases.
Abundance: Rare.
Conservation status: LC.

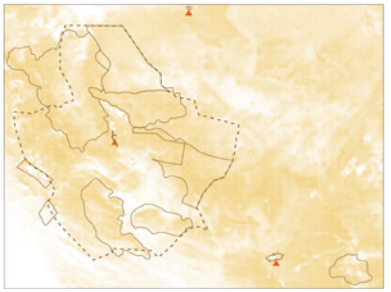
Greenish black-tip
Elphinstonia charlonia

Green-striped white
Euchloe belemia

Small white
Pieris rapae

Bath white
Pontia daplidice

Desert white
Pontia glauconome Klug, 1829



Global distribution: Africa, the Arabian Peninsula, Central Asia and the Middle East.
Distribution in AlUla: Observed between 340 and 1,720 m a.s.l., can be found in all conservation areas.

Measurements: WS 45 – 50 mm.
Identification: The dorsal side of the forewings is white with black tip and a black spot in the middle not reaching the anterior edge. The hindwings are white with transparent underside patterns. This species is very similar to the Bath white butterfly and can be distinguished by the underside pattern of the hindwings that has considerably less green colouration and more highlighted golden veins.
Habitat and habits: Present in all types of habitat with or without vegetation. One of the most common butterflies in this region, which is usually observed in flight.
Abundance: Abundant.
Conservation status: LC.

Desert white
Pontia glauconome

18. Important Invertebrate Areas

The most important areas for invertebrates, according to the distribution of species richness, are located in Sharaan, Wadi Nakhlah, the Western and Eastern slopes of Harrat Uwayrid, and Harrat AlZabin (**Figure 20**).

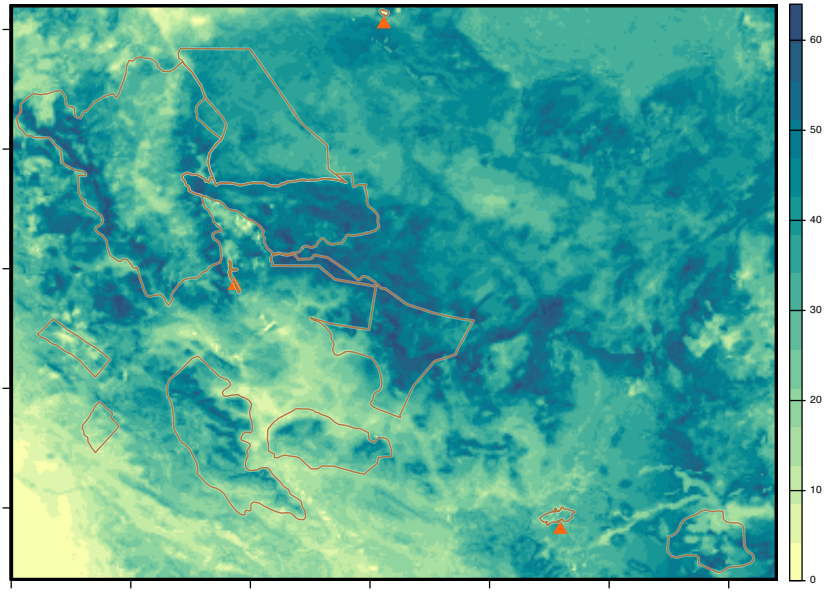


Figure 20 Distribution of invertebrates species richness in the AlUla region; the legend on the right indicates the number of species.

19. Venom, Scorpion Sting and Spider Bite Prevention

Scorpion venom

Scorpion venoms are complex mixtures of toxins adapted to overpower prey or deter potential predators successfully. Envenomation occurs through a sting, including rupture and injection as part of a defence mechanism. There is a general rule of thumb to identify a harmful scorpion from a harmless one. The longer the fingers of the chelae, the more dangerous the species. Buthidae are scorpions with generally very long fingers, are capable of inflicting dangerous stings on humans and are classified as medically important. However, in the Arabian Peninsula and in Iran, differently from elsewhere in the world, scorpions belonging to the families Hemiscorpiidae and Diplocentridae can lead to hospitalisation despite the robust chela design and relatively shorter finger length.

Venom from Buthidae predominantly induces neurotoxic effects at systemic level. Symptoms range from extreme pain diffusing from the stinged body part to the rest of the body to alteration of the neuromuscular junction causing severe spasms and often resulting in respiratory, cardiac and renal failure. Venom from the Arabic Diplocentridae and Hemiscorpiidae is mainly hemotoxic and cytotoxic, acting on the circulatory system and causing bleeding, inflammation, local pain, swelling, and tissue necrosis around the bite site. Interestingly, the venom of *Hemiscorpius* spp. besides being very toxic, is also painless. The lack of pain makes envenomation from this species very perfidious. The envenomated subjects develop symptoms without noticing that they have been stung and seek to medical assistance when it might already be too late. While the Hemiscorpidae family is absent in the AlUla region, members of the families Diplocentridae and Buthidae are very common.

Spider venom

Spider venoms are a complex cocktail of toxins evolved for predatory and defensive purposes. The two frontal fangs contain the venom glands and are the body structures that are responsible for the venom injection. Unlike scorpions, not all spiders are venomous. The family Uloboridae

for instance, lost their venom glands, and subdue their prey only with their silk.

Of the few species considered of medical significance and whose bite may have severe complications, only two genera can be found in the AlUla aerea: *Latrodectus* spp. (known as 'widows') and *Loxosceles* spp. (*L. rufescens*, also known as 'recluse spiders'). These spiders have nocturnal habits and are often synanthropic. The two genera however, present different types of venom with quite different symptoms. The venom of the widows in humans acts on the nervous system (neurotoxic activity), resulting in symptoms such as pain and convulsions, and in the most severe cases even to death. Conversely, the venom of *Loxosceles rufescens* is cytotoxic and hemolytic and more prone to induce bacterial infections which are not carried by the spider itself.

Although with less severe effects compared with the two above-mentioned species, bites from the false widows (*Steatoda* spp.) and the sac spiders (*Cheiracanthium* spp.) occasionally result in hospitalisation. The venom of the false widows has similar effects to that of the true widows while the venom from the sac spiders has similar effects to that of the recluse spiders, although with minor manifestations of the symptoms.

Prevention

Scorpions and spiders are prone to engage in active defence that can lead to stings or bites if disturbed or constrained, without the possibility of safely escaping as a first way of defence. Behaving responsibly contributes to avoiding envenomation and it is generally advisable to remember the following advice:

1. Do not chase or try to capture scorpions.
2. Wear closed shoes and long trousers.
3. Be aware of where you step, sit and put your hands.
4. Scorpions in the AlUla region are almost exclusively active at night. Most species are slow-moving and ground-dwelling. Bring a UV torch for night walks to easily spot them.
5. When sleeping outdoors, use a tent with a mattress.
6. If leaving carpets on the ground overnight, be careful when removing them the next morning.

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 allow more time to reach a hospital.
2. Place a bandage loosely to decrease the local blood flow around the sting or bite.
3. Keep the bitten or stung part in a comfortable position, lower than the level of the heart.
4. Remove all items (e.g. watch, bracelet,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 scorpion 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, AlUla 43543 · +966 14 884 3743
N 26.554787°
E 37.949865°

20. Checklist of the Scorpions, Spiders, Dragonflies and Butterflies of AlUla

Species		Conservation status by IUCN	
Class – Order / Family / Common name	Latin name	Global	Regional
Arachnida – Araneae			
Agelenidae			
Desert funnel weaver spider	*Benoitia lepida*	NE	NE
Araneidae			
Banded orb-weaving spider	*Argiope trifasciata*	NE	NE
Tent orb-weaver spider	*Cyrtophora citricola*	NE	NE
Slender orb-weaver spider	*Larinia chloris*	NE	NE
Cheiracanthiidae			
Yellow sac spider	*Cheiracanthium* cf. *mildei*	NE	NE
Eresidae			
Velvet desert spider	*Stegodyphus lineatus*	NE	NE
Gnaphosidae			
Desert ground spider	*Pterotricha dalmasi*	NE	NE
Hersiliidae			
Banded star-shaped spider	*Hersiliola* cf. *macullulata*	NE	NE
Lycosidae			
Common desert wolf spider	*Evippa praelongipes*	NE	NE
Tarantula wolf spider	*Lycosa piochardi*	NE	NE
Thin-legged wolf spider	*Pardosa* sp.	NE	NE
Oecobiidae			
Bordered disc web spider	*Uroctea* cf. *thaleri*	NE	NE
Black disc web spider	*Uroctea grossa*	NE	NE
Oxyopidae			
Striped lynx spider	*Oxyopes* aff. *lineatus*	NE	NE
Green lynx spider	*Peucetia arabica*	NE	NE
Palpimanidae			
Common palp-footed spider	*Palpimanus gibbulus*	NE	NE

Philodromidae			
False crab spider	*Thanatus* cf. *setiger*	NE	NE
Pholcidae			
Giant daddy-long-legs spider	*Artema nephilit*	NE	NE
Marbled daddy-long-legs spider	*Holocnemus pluchei*	NE	NE
Salticidae			
Pantropical jumping spider	*Plexippus paykulli*	NE	NE
Imperial jumping spider	*Thyene imperialis*	NE	NE
Scytodidae			
Spitting spider	*Scytodes* cf. *univittata*	NE	NE
Selenopidae			
Palm wall crab spider	*Selenops radiatus*	NE	NE
Sicariidae			
Mediterranean recluse spider	*Loxosceles rufescens*	NE	NE
Sparassidae			
Sand huntsman spider	*Cebrennus aethiopicus*	NE	NE
Arabian stone huntsman spider	*Eusparassus arabicus*	NE	NE
Theridiidae			
Brown widow spider	*Latrodectus geometricus*	NE	NE
Desert widow spider	*Latrodectus revivensis*	NE	NE
False widow spider	*Steatoda* sp.	NE	NE
Thomisidae			
Ground crab spider	*Bassaniodes pseudorectilineus*	NE	NE
Yellow flower crab spider	*Thomisus citrinellus*	NE	NE
Flower crab spider	*Thomisus zyuzini*	NE	NE
Spine-shaped crab spider	*Tmarus* aff. *piochardi*	NE	NE
Uloboridae			
Hackled orb weavers spider	*Uloborus* sp.	NE	NE
Arachnida – Scorpiones			
Buthidae			
Arabian fat-tailed scorpion	*Androctonus crassicauda*	NE	NE
Yotvata sand scorpion	*Buthacus yotvatensis*	NE	NE
Hairy tailed scorpion	*Butheolus villosus*	NE	NE
Khaybari striped scorpion	*Compsobuthus* cf. *khaybari*	NE	NE
Sandy striped scorpion	*Compsobuthus* aff. *longipalpis*	NE	NE
Pale striped scorpion	*Compsobuthus* cf. *setosus*	NE	NE

Dark striped scorpion	*Compsobuthus manzonii*	NE	NE
Eclipse deathstalker	*Leiurus haenggii*	NE	NE
Black deathstalker	*Leiurus nigellus*	NE	NE
Pillar-tailed scorpion	*Orthochirus innesi*	NE	NE
Arabian burrowing scorpion	*Trypanothacus buettikeri*	NE	NE
Diplocentridae			
Jericho scorpion	*Nebo hierichonticus*	NE	NE
Scorpionidae			
Dark large-clawed scorpion	*Scorpio fuscus*	NE	NE
Kruglovi's large-clawed scorpion	*Scorpio kruglovi*	NE	NE
Insecta – Lepidoptera			
Hesperiidae			
False marbled skipper	*Carcharodus stauderi*	LC	NE
Mediterranean skipper	*Gegenes nostrodamus*	LC	NE
Green-marbled skipper	*Gomalia elma*	LC	NE
Black-branded swift	*Pelopidas mathias*	LC	NE
Bushveld sandman	*Spialia colotes*	LC	NE
Desert grizzled skipper	*Spialia doris*	LC	NE
Lycaenidae			
Black-striped hairtail	*Anthene amarah*	LC	NE
Arabian sapphire	*Argiolaus glaucus*	NE	NE
Bright babul blue	*Azanus ubaldus*	LC	NE
Western pygmy blue	*Brephidium exilis*	*NE	*NE
Pomegranate butterfly	*Deudorix livia*	NE	NE
Grass jewel	*Freyeria trochylus*	LC	NE
Pea blue	*Lampides boeticus*	LC	NE
Lang's short-tailed blue	*Leptotes pirithous*	LC	NE
Loew's blue	*Plebejidea loewii*	LC	NE
Little tiger blue	*Tarucus balkanica*	LC	NE
Dark grass blue	*Zizeeria karsandra*	LC	NE
Nymphalidae			
Plain tiger	*Danaus chrysippus*	LC	NE
Diadem	*Hypolimnas misippus*	LC	NE
Yellow pansy	*Junonia hierta*	LC	NE
Blue pansy	*Junonia orithya*	LC	NE
Desert fritillary	*Melitaea deserticola*	NE	NE

Lesser spotted fritillary	*Melitaea trivia*	NE	NE
Painted lady	*Vanessa cardui*	LC	NE
Pieridae			
Pioneer white	*Belenois aurota*	LC	NE
African migrant	*Catopsilia florella*	LC	NE
Clouded yellow	*Colias croceus*	LC	NE
Golden arab	*Colotis chrysonome*	NE	NE
Crimson tip	*Colotis danae*	NE	NE
Large salmon arab	*Colotis fausta*	LC	NE
Yellow patch white	*Colotis halimede*	NE	NE
Desert orange tip	*Colotis liagore*	NE	NE
Greenish black-tip	*Elphinstonia charlonia*	LC	NE
Green-striped white	*Euchloe belemia*	LC	NE
Small white	*Pieris rapae*	LC	NE
Bath white	*Pontia daplidice*	LC	NE
Desert white	*Pontia glauconome*	NE	NE
Insecta - Odonata			
Coenagrionidae			
Desert bluetail	*Ischnura evansi*	LC	NE
Aeshnidae			
Vagrant emperor	*Anax ephippiger*	LC	NE
Blue emperor	*Anax imperator*	LC	NE
Gomphidae			
Sinai hooktail	*Paragomphus sinaiticus*	LC	NE
Libellulidae			
Broad scarlet	*Crocothemis erythraea*	LC	NE
Keeled skimmer	*Orthetrum coerulescens*	LC	NE
Desert skimmer	*Orthetrum ransonnetii*	LC	NE
Slender skimmer	*Orthetrum sabina*	LC	NE
Wandering glider	*Pantala flavescens*	LC	NE
Red-veined darter	*Sympetrum fonscolombii*	LC	NE
Violet dropwing	*Trithemis annulata*	LC	NE
Red-veined dropwing	*Trithemis arteriosa*	LC	NE

IUCN threat status: species of conservation concern globally and regionally.
Status: LC – Least Concern; NE – Not Evaluated; * – introduced species.

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22. Index


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